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Audiovisual Translation and the Art of Subtitling: Producing English-to-Italian Subtitles for a Documentary on Artificial Intelligence

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INTRODUCTION

Over the last few decades, the global circulation of audiovisual content has grown at an impressive speed, reaching audiences far from the borders of the countries where it was originally produced. This trend has drawn new attention to the field of audiovisual translation, which plays a key role in making films, TV series, documentaries, and other types of multimedia accessible to international audiences. As streaming platforms and online media continue to expand, the demand for high-quality AVT has become more evident than ever.

Among the various types of AVT, subtitling has gained particular relevance. Its relatively low cost and fast production process, together with the fact that it allows the original audio to be preserved, make it a widely used and appreciated solution. Subtitles let the audience hear the authentic voices of the speakers, preserving a strong connection with the source culture and language. For this reason, subtitling is not only a technical task but also a cultural and creative one, which requires careful choices and a deep understanding of both languages involved.

This thesis focuses on the field of audiovisual translation, with special attention to subtitling. The aim is to combine theoretical knowledge with practical experience, offering a complete overview of the topic. The thesis is divided into three main chapters, each one addressing a specific aspect of the subject and gradually moving from general considerations to a concrete case study based on my personal work.

The first chapter introduces the field of audiovisual translation, outlining its development over time and presenting its main forms, such as dubbing, voice-over, audio description, and localization. It discusses the main challenges AVT professionals face when translating content that is not only verbal, but also visual and acoustic. In fact, audiovisual products communicate through different channels at the same time, and this makes the translator's task particularly complex. The chapter ends with a short section dedicated to the Italian context, where dubbing has traditionally been the most popular form of audiovisual adaptation. I briefly reflect on why subtitling has had a more limited diffusion in Italy and how this preference has influenced the way foreign media is received.

The second chapter is entirely focused on the practice of subtitling. In the first part, I explore the history of subtitling in recent decades and explain the difference between interlingual and intralingual subtitles. I then dedicate a section to subtitles for the Deaf and Hard of Hearing (SDH), which play a crucial role in making audiovisual content more inclusive. Afterwards, I look at how subtitling varies depending on the type of content, such as news reports, films, or video games, and how different genres can influence the strategies used. I also discuss the technical and linguistic constraints that make subtitling a unique type of translation, including space and time limitations, and the constant need to remain clear, concise, and faithful to the original message. In addition, I present some of the most common tools and techniques used by subtitlers to deal with challenges like idiomatic expressions, humor, and culture-specific references.

The third and final chapter is dedicated to the practical part of this thesis. It describes the process I followed while creating Italian subtitles for an English-language documentary on artificial intelligence. I explain each step of the workflow, from transcription and segmentation to translation, timing, and creation of the final video with Italian subtitles. I also reflect on the difficulties I encountered, especially those related to the technical complexity and the translation of specialized vocabulary, technical terms, and scientific concepts, as well as to the solutions I adopted to make the subtitles accurate and understandable for an Italian audience.

In conclusion, this thesis aims to provide a complete and clear view of audiovisual translation, highlighting the importance of subtitling in making content accessible across languages and cultures. By combining theoretical analysis with practical work, my goal is to share some insights into the fascinating and often underestimated art of subtitling, which combines language, technology, and creativity.

CHAPTER 1: AUDIOVISUAL TEXTS AND AUDIOVISUAL TRANSLATION

1.1 Multimodality, multimediality and syncretic texts

The terms multimodality and multimediality are created using the prefix multi-, with one referring to mode and the other to media (Cosenza, 2008, 229). Mode refers to organized forms such as image, gesture, posture, speech, music, writing, and other similar items (Suciu et al., 2015, 34). Media is defined as organized means of representing a message to others, i.e. the substance through which the message becomes available to the others (Kress et al., 2001).

The term ‘multimodal’ refers to the integration of multiple modes within a single medium, each contributing to enhancing the audience's comprehension of a product. Etymologically, the term ‘multimodal’ refers to the mode of communication rather than the specific tool or medium utilized. In this context, television and cinema are considered to be multimodal media as they employ various modes of communication such as sound, images, and occasionally text. In contrast, radio is classified as a single-mode medium as it relies solely on auditory communication. The adoption of the term ‘multimodal’ marked a significant cultural transition in the debate surrounding new media, as it shifted the focus from the technical aspects of media to their communicative features and modes. In contrast to ‘multimedia’, the term ‘multimodal’ emphasizes the importance of exploring not just the medium or technology used for communication transmission, but also the manner in which communication is delivered, organized in relation to the user, and ultimately the intended message (Bollini, 2001). Multimodal communication has a long history and can be found in various forms, including printed literary texts that utilize typography, margins, illustrations, colors, and images. Other examples of multimodal texts include textbooks, user manuals, websites, comic books, games, video clips, blogs, operas, songs, advertisements, technical texts, tags in museums, medical brochures, tourist brochures, lectures with slides, and audiovisual texts (Gambier, 2023).

Therefore, multimodality encompasses a wide range of text types and communication methods and is now linked to various translation and localization practices (Jakobson, 1959; Reiss, 1971).

As far as ‘multimediality’ is concerned, media can be distinguished between old and new media and between two interpretations of media, i.e. media as “technologies” and media as “forms of communication” (Cosenza, 2008, 227). The latter refers to culturally, socially, and historically determined rules, conventions, and organizational structures that individuals adhere to when communicating through various technologies. According to the author, anything that we are not yet familiar with, and that we cannot fully or partially categorize within the existing rules and frameworks we adhere to, is perceived as new (Cosenza, 2008, 227). Consequently, the concept of *new* is fluid and changes over time: as we become accustomed to something, it transitions from being new to known, and eventually, with the passage of time, becomes taken for granted and considered old.

In recent years, in wealthy countries in the Western and Northern countries, media described as “new” by encyclopedias have been changing at a much quicker rate than in previous decades. This shift is driven not only by the swift development of communication technologies but also by marketing and sales tactics employed for technological products. These tactics often create trends and consumer fads by branding items as “new”, even when they do not involve any true innovation. The shifts brought about by information technology, along with its marketing strategies, create a dynamics in which it is challenging to fully adapt to any particular advancement in this area. The swift turnover of technological innovations prevents us from becoming familiar enough to view them as obsolete. As a result, the defining feature of new media is their dependence on information technologies, which are inherently in a continuous state of renewal (Cosenza, 2008, 228). Prominent examples of new media that have attracted considerable attention over the last two decades include the Web, especially with the development of virtual worlds, social media platforms, and the advent of Web 2.0, marked by platforms that rely on content created by users, such as YouTube and Wikipedia. Furthermore, the rise of e-learning, which facilitates remote education, and e-government, which refers to the online interactions between public authorities, citizens, businesses, and other governmental bodies, are significant advancements in this area. The list of emerging new media is rapidly evolving, driven by technological advancements and shifting cultural trends, which makes it increasingly challenging to comprehensively account for and document every new development and innovation in

the field. However, a recurring theme in discussions of new media is the concept of multimediality.

The concept of “multimedia” is increasingly integrated itself into everyday language and communication, becoming a widely recognized term. However, it is frequently employed imprecisely, which leads to ambiguity and varying interpretations depending on the context in which it is used. It refers to a wide variety of elements, ranging from multimedia messaging services (MMS) and web-based animations to modern video games, all of which tend to fall under this broad term. The word “multimedia” is sometimes used merely to indicate the digitalization of content and the perceived sense of innovation that accompanies it, or as a means to draw consumers’ attention.

In the field of semiotics, the idea of “multimedia” can be effectively described through the concept of a “syncretic text”. In a syncretic text, a single instance of communication engages “a plurality of languages of manifestation”, meaning it incorporates multiple semiotic systems that are diverse in nature (Cosenza, 2008, 229), such as sound, visuals, and touch, along with varying forms of expression and content, depending on the interpretation of “language” (Greimas & Courtés, 1986). Syncretic texts can be found in various forms, including comic books, magazines, and print advertisements. A more complex variant of syncretic texts is the audiovisual text, e.g. films, television shows, and commercials, which merges visual and auditory expressions, combining imagery with sound-based languages. This fusion includes elements like music (e.g., themes, background scores, and soundtracks), sound effects, and the various ways spoken language is conveyed through the auditory medium, i.e. linguistic features, prosodic elements (such as pauses, vowel and consonant duration, and stress), as well as paralinguistic aspects (such as tonal variation, volume, and vocal quality) (Cosenza, 2008). In conclusion, the author defines multimedia as texts that incorporate:

- a) a variety of media, each representing different modes of communication;
- b) a unified strategy for conveying the message across these media;
- c) combinations that challenge conventional associations, which we thus perceive as new;
- d) experiences that involve multiple sensory channels, enhancing the interaction.

1.2 The audiovisual product

Audiovisual products, e.g. films, television series, news programmes and documentaries are complex multisemiotic systems that communicate meaning through various channels simultaneously, which “cooperate to create potential meaning for the viewer” (Díaz Cintas & Remael, 2020). These works combine visual, auditory, and verbal codes, creating a synthesis of multiple semiotic elements. Audiovisual products are comprised of both verbal and non-verbal components, meanings directly conveyed as well as those suggested through subtler forms of expression, which have a significant impact on foreign language subtitling and dubbing (Pettit, 2004).

Sound in audiovisual media can generally be divided into two main components: the verbal and the non-verbal. The verbal component includes spoken dialogues between characters as well as the narrator’s voiceover, both of which play a fundamental role in constructing the narrative and guiding the viewer’s understanding (Rondolino et al., 2011). The non-verbal component, instead, refers to background music, ambient noises, and sound effects, which are usually grouped together under the broader term “soundtrack.” These sounds are particularly important for creating the mood of a scene, reinforcing its atmosphere, and supporting its emotional dimension.

The way in which these sound elements are employed depends largely on the genre of the audiovisual product. Genres differ not only in terms of narrative structure and visual style, but also in their communicative aims and discourse features. As Pettit underlines, films and television series are based on performance, where actors play fictional roles within a carefully developed plot. Their main purpose is to entertain, often through dramatization and emotional involvement.

On the other hand, news programmes follow a much more formal and standardized format. Presenters speak in a clear and objective way, aiming to communicate information as efficiently and accurately as possible. Documentaries, however, represent a different case. They generally feature real individuals, not actors, who speak in a more spontaneous and natural manner. This contributes to a sense of authenticity, even though the final product is still the result of editing and narrative choices. Nevertheless, the boundaries between genres are not always easy to define. Many audiovisual texts combine elements from different genres, and each one of these

not only influences the structure, but also the linguistic register that is considered most appropriate, although these norms are often flexible and can vary (Kovačič, 1998).

In addition to genre considerations, understanding how meaning is conveyed in audiovisual media also requires attention to the interaction between sound and image. In this regard, films function on two interconnected levels. The first is the immediate level, consisting of the images and sounds that the audience directly perceives. The second is more conceptual: it is a narrative space that the viewer constructs mentally, based on what is shown and heard, but also on what is suggested or implied. This double structure allows the audience to follow complex narratives, imagine events that are not directly represented, and engage emotionally with the story (Branigan, 1992).

One of the main challenges in AVT, particularly in practices like subtitling, is the necessity of taking into account all the filmic sign systems when translating the verbal content. This approach allows for a coherent and meaningful integration of the different communicative elements, resulting in a unified multimodal experience for the viewer (Díaz Cintas & Remael, 2020).

A deeper understanding of these multimodal dynamics is offered by Zabalbeascoa (2008), who identifies four specific types of signs: audio-verbal (words heard), audio-nonverbal (music and special effects), visual-verbal (written text), and visual-nonverbal (picture and photography). According to the same author, a prototypical audiovisual screen text should ideally meet three basic criteria:

- 1) An integration of verbal, nonverbal, auditory, and visual components, each holding equal significance. This form of communication engages both the viewers' visual perception (for observing, watching, and reading) and auditory perception (for hearing speech and other sounds) during the entire viewing of the audiovisual text. Some experts (Merino, 2001) argue that the concept of audiovisual media does not necessarily require the presence of a screen, suggesting that stage productions should also be incorporated within a comprehensive theory of audiovisual translation (AVT).
- 2) The various components of an audiovisual text are designed to complement one another and are therefore considered inseparable for achieving effective communication. For instance, music is often selected to align with the visuals

and dialogue, or any other combination of audiovisual elements, regardless of whether these components were created specifically for the production. In the context of film, the music may be original or pre-existing; however, what holds primary significance from a textual and communicative perspective is the interplay among the music, script, and cinematography. Their combined effect shapes how the audience interprets and engages with the production.

- 3) The production process is generally divided into three primary stages: (a) pre-shooting, which involves activities such as scriptwriting, casting, and rehearsals; (b) shooting, encompassing directing, camera operation, make-up, and acting; and (c) post-shooting, including editing and cutting. However, this traditional framework shifts significantly in the context of revoicing and subtitling, where the visual elements and effects are typically considered untouchable.

As Díaz Cintas and Remael explain, meaning emerges from the simultaneous combination of these various modes and the way in which the audience interprets them. In the case of foreign-language productions, the auditory-verbal mode is the most problematic, since it becomes inaccessible to viewers who do not understand the original language. This can potentially disrupt the multimodal coherence of the text. Subtitling and other forms of AVT aim to compensate for this gap and allow the target audience to engage with the audiovisual product in a meaningful way.

1.3 Audiovisual translation: from the 1920s to the present

During the early 1900s, the distribution of silent films to international markets was facilitated through various forms of interlingual mediation (Pérez-González, 2020). This included the use of translated intertitles, which served as a means of conveying narrative and dialogue in silent films, and other methods to adapt the content for audiences unfamiliar with the original language (Ivarsson 2002; Pérez-González 2014; O’Sullivan & Cornu 2018). With the advent of sound films in the late 1920s, new forms of audiovisual translation were essential for ensuring the content was accessible and comprehensible to audiences in foreign markets. Consequently, since the early 1930s,

audiovisual translation began to develop as a distinct field and gradually evolved into a specialized branch of translation studies.

Nowadays, audiovisual content can be adapted and translated in various ways, including subtitling for the deaf and hard-of-hearing, live subtitling, surtitling, audio description, as well as interpretation through consecutive, simultaneous, or sign language methods, and online translations by fans (Gambier & Jin, 2019). This expansion of adaptation and translation modes is the outcome of two distinct processes operating simultaneously: on the one side, technological advancements have enabled the development of more sophisticated and flexible services and programs; on the other, the global nature of audiences continues to expand, driven by platforms like YouTube and the widespread availability of films on the internet. Additionally, the involvement of users and consumers in the creation and dissemination of information and audiovisual content has grown significantly, alongside an increasing number of opportunities for translation and adaptation.

1.3.1 Key concepts in audiovisual translation

Initial research on audiovisual translation (AVT) focused on the specific challenges that set audiovisual texts apart from other types of content. In 1982, Titford introduced the concept of “constrained translation”, drawing attention to the complexities involved in aligning linguistic elements with audiovisual features. Building on this idea, Mayoral, Kelly, and Gallardo (1988) broadened its scope to encompass all forms of multimodal texts, underlining the importance of achieving “content synchrony” across verbal, visual, and auditory components to maintain cohesion.

Chaume (2004, 41) further expanded on this idea by outlining some key principles of AVT, including the inadequacy of linguistic theories in explaining verbo-iconic texts, the significance of non-verbal communication, the influence of “noise” (i.e. cultural and communicative disruptions), and the categorization of constraints within the various modes of translation.

Following Bartrina and Espasa (2005, 85), the complexity of AVT stems from its mode of delivery and the interplay of simultaneous semiotic elements, such as images, sound, and text. They pointed out the “redundancy” in audiovisual texts, where meaning

is communicated through overlapping verbal and non-verbal channels, presenting translators with the challenging task of adapting both linguistic and non-linguistic elements effectively.

A paper published in 1989 by Delabastita is considered a foundational work in AVT. He describes AV products as a “multi-channel and multi-code” (Delabastita, 1989, 102) medium of communication, utilizing visual and acoustic channels while incorporating a variety of codes: verbal (e.g., dialects), literary and theatrical (e.g., narratives), proxemic and kinetic (non-verbal actions), and cinematic (e.g., techniques and genres).

Delabastita (1989) identifies four fundamental elements of audiovisual translation:

- Visual-verbal: e.g. text inserts and headlines.
- Visual-nonverbal: e.g. gestures and visual imagery.
- Acoustic-verbal: e.g. dialogue and monologue
- Acoustic-nonverbal: e.g. music and sound effects.

Delabastita (1989, 101) emphasizes a significant distinction between cinema and theatre: films are reproducible and consistent, which makes them well-suited for mass communication, while theatrical performances are inherently unique, and vary with each presentation. This consistent reproducibility, combined with the interaction of auditory, visual, and verbal elements, presents unique challenges in the translation of films.

Sokoli (2009, 41) underscores the key characteristics of audiovisual texts, including their dual reception through visual and auditory channels, the significant role of non-verbal elements, the necessity for synchronization between verbal and non-verbal components, and the fixed, reproducible nature of audiovisual content.

Another key concept is “multimodality”, which was analyzed in Paragraph 1.1. The translation of audiovisual texts increasingly incorporates "multimodal" content, combining multiple semiotic resources such as language, sound, and imagery. Multimodal analysis prioritizes the study of how these resources interact and integrate to achieve the communicative purpose of a text. As technology advances, analyzing the relationship between verbal, visual, acoustic, and kinetic elements has become crucial for gaining a deeper understanding of audiovisual translation (O'Halloran & Smith,

2012). Gambier (2006) points out a paradox in AVT research: although the importance of the interaction between verbal and non-verbal elements is acknowledged, the field remains largely focused on linguistic aspects. He attributes this to the linguistic background of many researchers and the difficulties involved in gathering and analyzing multimodal data. Gambier proposes that multimodal discourse analysis could provide deeper insights into the integration of semiotic resources in audiovisual and multimedia content. Taylor (2003, 197) suggests that "multimodal transcription" serves as a valuable method for studying audiovisual texts. This method involves dividing films into distinct frames or shots and analyzing the semiotic components within each. It provides insights into how meaning is generated through multiple modalities and how subtitles interact with these elements. This approach has been utilized to analyze and compare subtitling strategies across various genres, including films, advertisements, and news broadcasts.

Audiovisual texts, such as films and TV dramas, employ prefabricated orality, scripted language designed to mimic spontaneous speech, as noted by Chaume (2004). While this language appears natural, it is planned to adhere to specific cinematic conventions, creating a distinct gap between real-life spontaneous speech and scripted dialogue. Translators working on dubbed texts must navigate this challenge, adapting linguistic diversity, character registers, and cultural references to create dialogue that feels natural while aligning with target language norms. Baños Piñero and Chaume (2009, 2) highlights the guidelines provided by Televisió de Catalunya, which stress the importance of crafting dialogue that imitates oral spontaneity while accommodating the grammatical and cultural specifics of the target language. However, dubbed language often sounds artificial, as it fails to replicate natural conversational nuances. The duality of prefabricated orality, balancing planned discourse with the illusion of spontaneity, presents significant challenges for translators, who must ensure that dubbed texts feel authentic while adhering to linguistic and cultural conventions.

1.4 The different modes of audiovisual translation

Audiovisual translation includes various methods employed to adapt audiovisual content for audiences across different languages and contexts. The primary modes

include subtitling, dubbing, voice-over, surtitles, audio description and localization. Each mode is adapted to meet particular audience requirements, budget constraints, and cultural preferences, influencing the way audiovisual content is experienced globally.

1.4.1 Subtitling

Shuttleworth and Cowie (1997) define subtitling as ‘the process of providing synchronized captions for film and television dialogue’, while, according to O’Connell (2007), it consists of ‘supplementing the original voice soundtrack by adding written text on the screen’. Subtitling, alongside dubbing, is one of the most used methods for bringing an audiovisual product from its country of origin to audiences worldwide (Petillo, 2012). Subtitles are textual elements added to support the comprehension of an audiovisual message. They can be classified as either intralingual or interlingual, based on whether the language of the subtitles matches or differs from the original language.

Contrary to popular belief, subtitling goes beyond simply transcribing spoken dialogue word for word. It involves a more intricate process of adapting the content into a written format that considers various factors, including space limitations, the pace of the dialogue, the tone of the original speaker, and other elements. Effective subtitles require careful syntactic and lexical adjustments, along with appropriate editing, to distinguish high-quality subtitles from poorly executed ones. A skilled subtitler must mediate and take all these factors into account while ensuring that the original message of the author remains intact. The theoretical and technical aspects of subtitling will be examined in detail in Chapter 2.

1.4.2 Dubbing

Dubbing, often called lip-syncing can be described as *traduction totale* due to its linguistic complexity (Díaz Cintas & Remael, 2020). It is one of the most common methods of audiovisual translation. It is widely used in countries such as Brazil, China, France, Germany, Italy, Japan, Spain, Thailand, and Turkey. Dubbing involves replacing the original film dialogue with a new voice track in the target language, carefully synchronized in articulation and expression. More broadly, the term also

encompasses the final product, the performance of the translated dialogues in a film or television program for the target audience (Petillo, 2012). Petillo also states that the term's etymology, originating from the Late Latin *duplare*, which derives from *duplus*, meaning “double”, intrinsically suggests notions of imitation, simulation, and duality. The verb “to dub” evokes the notion of duplication and duplicity, further extending to the idea of a rhetorical-technical artifice, repetition, and, ultimately, ambiguity. Malaguti (2004, 74) describes dubbing as “a trick, a convention, a form of inlaid artistry that aims to replace voices and words originally spoken in a certain way and language with different voices in another language, all while striving to preserve the illusion of a seamless whole, enhancing, in essence, the inherent illusion of cinema itself.” The primary goal of dubbing is to create the illusion that the characters on screen speak the viewer’s language. To achieve this, three types of synchronization must be maintained: lip synchrony, ensuring the translated speech matches the characters’ lip movements; isochrony, keeping the duration of the original and translated utterances similar; and kinetic synchrony, aligning the translated dialogue with the actors’ performance and ensuring voice choices suit the characters’ physical traits (Díaz Cintas & Remael, 2020). In their work, Díaz Cintas and Remael (2020) also take into consideration fandubbing, which involves the dubbing or redubbing of audiovisual content by amateurs or fans rather than professional voice actors. This practice is common for productions that lack an official dubbed version or for those where the existing dubbing is considered weak. While fandubs are predominantly interlingual, some are intralingual and created mainly for comedic purposes, often referred to as fandubs (Baños, 2019).

1.4.3 Voice-over

Voice-over is one of the language transfer methods that, unlike dubbing and subtitling, has yet to receive substantial academic recognition. The limited research on this subject has made it challenging to establish a clear theoretical framework for voice-over as a distinct audiovisual translation practice (Petillo, 2012). As a result, misunderstandings and confusion have arisen regarding the true nature of voice-over, leading to various associations with other forms of audiovisual translation, such as commentary and narration, as well as with interpreting, particularly in its simultaneous interpretation

form. Díaz Cintas and Remael (2020, 8) state that narration “differs from voice-over in that the original speech is completely removed from the soundtrack and replaced by a new voice, in translation”. According to Petillo, commentary, often used alongside narration, serves as a key method for adapting documentaries and short films into different languages. It proves particularly effective when there is a significant cultural gap between the source and target audiences. This approach enables a form of cultural domestication, allowing content to be adjusted to the receiving culture in order to minimize the potential cultural shock that a strictly faithful and foreignizing translation might otherwise produce. Voice-over is a form of partial dubbing that does not aim to conceal the fact that an audiovisual text is a translation; rather, it is meant “to be a faithful, literal, authentic and complete version of the original audio” (Franco et al., 2010). It involves delivering a spoken translation of the original dialogue while keeping the source audio slightly audible (Díaz Cintas & Remael, 2020). Typically, the original speaker is heard for a few seconds before the volume is lowered, allowing the translated speech to be superimposed. The translation generally finishes before the original speaker stops talking, ensuring that the audience briefly hears the foreign language again at the end. This form of audiovisual translation is particularly suited for adapting non-fiction genres that aim to depict reality, such as documentaries, interviews, or news reports, and is common for television in Russia, Poland and other countries in Eastern Europe, where it is also utilized for films. The use of voice-over presents both advantages and disadvantages. On the one hand, it significantly reduces the costs associated with full dubbing, as background sounds are not replaced, eliminating the need to reproduce all non-dialogue audio elements. On the other hand, the viewing experience may be considerably disrupted by the presence of a monotone voice reading the translated dialogue, which partially obscures the original speech and sounds.

1.4.4 Surtitling

Bestente defines surtitles, also known as supertitling in the US and supratitling, as “the event that has most profoundly transformed the history of opera theatre reception in the past thirty years”. Surtitles were initially created by the Canadian Opera Company in

Toronto, with the first-ever opera production to feature them being the 1983 staging of *Elektra* (Díaz Cintas & Remael, 2020). Often considered as an evolution of subtitling, surtitles consist of specially crafted captions designed to facilitate the comprehension of opera libretti, and occasionally prose theater, following the same principle as film subtitles. However, unlike traditional subtitles, surtitles must seamlessly integrate not only with singing and acting but also with the musical score. Their distinguishing trait compared to more conventional forms of subtitling, lies in the polysemiotic and multimodal nature of operatic performance, which conveys meaning to the audience through a complex interplay of diverse semiotic codes, including words, music, singing, acting, dance, lighting, costumes, and stage design (Petillo, 2012).

The libretto serving as source text, surtitles typically preserve the literary essence of the original, aiming to replicate its stylistic features as accurately as possible. However, as Virkkunen (2004, 93) observed, even in this specialised form of subtitling, the process inevitably involves selecting and condensing textual content. Estimates suggest that only about one-third of the lexical units found in the complete libretto are retained in the final surtitles (Petillo, 2012).

From a strictly technical standpoint, producing surtitles is a relatively simple process. Initially, translated portions of text were displayed on dedicated LED screens positioned above the stage. However, the large dimensions of many prosceniums often risk making the surtitles invisible or difficult to read from certain sections of the theatre. To address this issue, some opera houses have adopted seat-back title screens, i.e. small screens installed on the back of each spectator's seat supporting multi-language surtitles, which enhances the audience's experience. To maintain a discreet viewing experience, the screens are typically designed to prevent visibility of the titles on neighbouring displays (Díaz Cintas & Remael, 2020). Surtitles are typically pre-prepared but are manually triggered in real time by a technician or operator to align closely with the pacing and delivery of the live performance. Software developments now enable the operator to adjust the display by skipping or switching surtitles as needed (Díaz Cintas & Remael, 2020).

1.4.5 Audio description

Unlike subtitles or dubbing, which focus on translating spoken language, audio description (AD) provides verbal narration of visual elements in media for individuals who are blind or visually impaired to ensure them a comprehensive experience and allow them to follow the story. It involves describing key visual aspects, such as actions, facial expressions, settings, costumes, and scene changes, during natural pauses in dialogue or important sound effects (Baños, 2019, 184).

AD is sometimes combined with audio subtitling, which is the verbal presentation of written subtitles or surtitles, making them accessible to individuals with visual impairments (Díaz Cintas and Remael, 2020). These subtitles may be read by the same voice providing the audio description or by a different speaker. In some cases, audio subtitles are modified to account for the inevitable omissions found in interlingual subtitles. For live events, surtitles are often integrated into the AD or included in an audio introduction, which is an accessibility service complementing AD, offering a summarized overview of the plot, including details about the characters and settings. This introduction, typically used for live performances, can be delivered either in real-time or as a pre-recorded segment before the event begins (Díaz Cintas & Remael, 2020).

1.4.6 Video game localization

Video game localization is a distinct branch of audiovisual translation that focuses on adapting a video game to suit the linguistic and cultural expectations of a specific audience. Rather than merely translating text, it ensures that the game's content, tone, humor, cultural references and overall user experience are seamlessly integrated, making the game feel natural and immersive for players in the target market. Video games, by their very nature, are audiovisual and multimedia forms of expression; however, they must also evolve in alignment with technological and computational advancements (Frasca, 2001). These audiovisual products are able to create a multimodal and polysemiotic environment in which players engage with the system through multiple channels of communication (Frasca, 2001). Unlike traditional

audiovisual products, video game localisation is deeply integrated into the production process, requiring a seamless blend of technological and linguistic expertise. As Chiaro (2009, 157) emphasizes, translation is an integral part of localization, rather than a post-production add-on. Its primary goal is to ensure that games are both linguistically and culturally suited for international audiences. This often requires adapting, modifying, or omitting culture-specific elements, wordplay, and references that may not be easily understood or appreciated by players in the target market. The creative liberties granted to game localizers set this field apart from traditional translation (Petillo, 2012).

1.5 Dubbing and subtitling in Italy

Dubbing and subtitling have played a crucial role in Italy's audiovisual landscape, with dubbing traditionally serving as the dominant method of translating foreign films and television series. This preference dates back to the early 20th century, when the Fascist regime promoted dubbing as a means of linguistic unification and cultural control. Following the regime's collapse, dubbing continued to be favoured due to its widespread acceptance by audiences and the established presence of talented voice actors (Sandrelli, 2014).

For many years, subtitling in cinema was mostly confined to film festivals, where regulations required films to be presented in their original version with subtitles, and a few art-house theatres. Aside from occasional special programs showcasing renowned foreign filmmakers, on television, subtitled content was almost nonexistent in free-to-air television until the rise of digital terrestrial television. However, since 1986, 'encrypted' subtitles, which viewers had to activate themselves, was available on Televideo's page 777. These intralinguistic subtitles were aimed at the hearing impaired, with the addition of English interlinguistic subtitles on page 778, designed for immigrants, foreigners, and students (De Seriis, 2006). The introduction of DVDs and digital television significantly improved accessibility by allowing multiple audio tracks, subtitles, and audio descriptions, enhancing inclusivity for the hearing and visually impaired. Digital advancements have made it easier for broadcasters to offer films in both original and dubbed versions, driving the demand for audiovisual translation. Reality shows often opt for more cost-effective voice-over and subtitling instead of traditional dubbing. Electronic subtitling has also become widespread in film festivals. However, Italy has

been slow to adopt these innovations, with commercial networks offering far fewer subtitled programs compared to the UK. This gap highlights the considerable potential for expanding subtitling and audio description in cinema, television, and home entertainment.

CHAPTER 2: THEORY AND PRACTICE OF SUBTITLING

2.1 Definition and history of subtitling

In an article published by Jorge Díaz Cintas in 2012, the author provides a comprehensive definition of the art of subtitling. He states that:

Subtitling may be described as a translation practice that consists of rendering in writing, usually at the bottom of the screen, the translation into a target language of the original dialogue exchanges uttered by different speakers, as well as all other verbal information that appears written on screen (letters, banners, inserts) or is transmitted aurally in the soundtrack (song lyrics, voices off). As opposed to dubbing, which completely erases the original dialogue, subtitling preserves the original text, both aurally and visually, while adding an extra layer of information (Díaz Cintas 2012, 274).

The modern concept of subtitles traces its origins back to the so-called “intertitles”, also known as “captions” or “leaders” and “title cards”, which were displayed between film scenes in silent films (Petillo, 2012). With the widespread adoption of sound, these textual elements became largely obsolete, particularly in countries that embraced full dubbing. Intertitles can be considered the oldest relatives of subtitles, with the first experiments dating back to the early 20th century (Díaz Cintas & Remael, 2020). They were a defining feature of silent films and typically consisted of brief white text displayed against a dark background, most commonly white text on black. Their primary functions were to present character dialogue (dialogue intertitles) and to provide descriptive narrative content corresponding to the images (expository intertitles). Regarded as both unesthetic and anti-cinematic for continuously disrupting the rhythm of film narration, intertitles gradually gave way to subtitles by the late 1920s. This shift involved moving from text inserted between sequences to text directly overlaid onto the images.

2.2 Types of subtitles: intralingual and interlingual

While dubbing constitutes a form of interlingual translation, by converting a source-language audio into a target-language soundtrack, subtitling can be either interlingual or

intralingual. This means that subtitles may serve to translate spoken dialogue into another language or to present same-language captions, primarily designed for the deaf and hard of hearing (Sandrelli, 2014; Gottlieb, 1998). In its most typical form, interlingual subtitling is monolingual since it implies the translation from a source to a target language. It can be described as a translation technique that involves displaying written text, typically at the bottom of the screen, to convey the original dialogue exchanged between speakers, as well as other verbal elements presented visually or aurally.

Subtitled content consists of three fundamental components: spoken language, visual imagery, and subtitles. The interplay between these elements, combined with the viewer's reading speed, ability to process both images and text simultaneously, and screen size, defines the core characteristics of the audiovisual experience. To be effective, subtitles must be synchronized with both the dialogue and the visuals, offer a meaningfully accurate representation of the source language conversation, and remain on screen long enough for viewers to read comfortably (Díaz Cintas & Remael, 2020).

Bilingual subtitles represent a variation within interlingual subtitling and are commonly used in regions where multiple languages coexist. In Belgium, for instance, to accommodate both the Walloon and Flemish communities, some cinemas provide subtitles in both French and Flemish. Similarly, in Finland, where Swedish holds official status alongside Finnish, bilingual subtitles are employed in certain areas for both television and cinema to ensure linguistic inclusivity (Díaz Cintas & Remael, 2020).

A distinctive example of interlingual subtitling that emerged in the 1990s is known as *reversed subtitling*. This technique involves presenting the dialogues dubbed in the viewer's native language while displaying foreign-language subtitles on the screen. Research has shown that this approach, when used for educational purposes, can be particularly beneficial in the early stages of language learning. At this level, learners focus on acquiring specific grammatical and syntactic structures, which are reinforced through written exposure in the target language (Petillo, 2012). This form of linguistic transposition appears to offer the advantage of facilitating the decoding, assimilation, and long-term retention of foreign vocabulary (Danan, 1992, 513).

2.2.1 Subtitles for people who are D/deaf or hard-of-hearing (SDH)

Subtitles for Deaf and hard-of-hearing (SDH) viewers play a crucial role in making audiovisual content accessible by presenting both spoken dialogue and relevant non-verbal sounds, such as sound effects and speaker identification. This allows individuals with hearing impairments to have a more complete and immersive viewing experience. SDH functions as either an intralingual or interlingual form of translation. It may be displayed as open (burnt-in) or closed (superimposed) subtitles and can be created in advance or generated live. These subtitles can be either summarized or nearly verbatim, including both verbal dialogue and non-verbal (auditory) elements. Although primarily intended for individuals with hearing impairments, SDH also supports those with cognitive or learning difficulties, as well as individuals who are not fully proficient in the spoken language, such as immigrants (Neves, 2018, 88).

Intralingual SDH subtitles differ significantly from intralingual subtitles for hearing individuals. Given the potential reading difficulties of the target audience, the subtitler needs to transcribe spoken dialogue from a soundtrack into written text, identifying the speaker and ideally incorporating relevant paralinguistic elements that enhance the meaning of the message. These may include emphasis, irony, tone, speech characteristics, prosody, accents, and the use of foreign languages. Additionally, they convey other significant auditory details that contribute to the plot, aid in understanding the narrative, or establish the atmosphere, elements that individuals with hearing impairments cannot perceive directly. Such details include instrumental music, songs, ringing phones, laughter, applause, knocking sounds, engine noises, and various ambient effects (Díaz Cintas & Remael, 2020).

When discussing subtitles for people who are D/deaf or hard-of-hearing, there is also a category known as real-time subtitling, which is further divided into stenotyping and respeaking (Petillo, 2012). The first one, also known as simultaneous subtitling, enables accessibility for individuals with hearing impairments during live broadcasts. Stenotyping, the traditional method, involves collaboration between a subtitler, who condenses or translates the message, and a technician who uses a specialized keyboard to produce subtitles in real time. Despite its higher costs and lower flexibility compared

to newer methods, stenotyping remains widely used in Italy, especially in legislative and judicial contexts, as well as in academia to support deaf students (Petillo, 2012).

Respeaking, a more recent approach, relies on speech recognition software. A trained respeaker listens to the source content, reformulates or translates it, and dictates it to the software, which generates written subtitles. This method has gained popularity in media accessibility, benefiting not only deaf and hard-of-hearing individuals but also non-native speakers and those in noisy environments. While primarily used in live television broadcasts, it has expanded to legal, medical, and political domains.

2.3 Subtitling for different genres

Subtitling requires a customized approach, as each audiovisual product comes with its own challenges and demands specific strategies to enhance accessibility, engagement, and clarity for viewers. The following section will examine the range of challenges that subtitlers may encounter when working with different audiovisual genres. It will also explore the strategies and solutions that can be employed to address these difficulties.

2.3.1 Film and television

In a recent paper published in 2023, Sun and Liu highlight the relevance of Skopos Theory¹ in the context of film and television subtitling. They argue (Sun and Liu, 2023, 12) that this theory, which focuses on the intended purpose of a translation (Nord, 2001), should serve as a fundamental guideline for subtitle translators. Depending on the communicative function of the text and the needs of the target audience, translators may choose between a literal or a free translation strategy. The key idea is that there is no single ‘correct’ method for every situation; instead, the chosen approach should support the overall goal of cross-cultural communication.

Moreover, Sun and Liu (2023, 15) underline the importance of selecting the most suitable translation methods, such as interpretative translation, literal translation, or domestication, to effectively render meaning and preserve cultural nuances for

¹ Skopos theory, which was developed in Germany in the late 1970s (Vermeer, 1978), represents a shift from traditional linguistic and formal translation theories to a more functionally and socioculturally focused approach to translation

international audiences. These strategies are particularly relevant when dealing with culturally loaded references, idioms, or humor, which often require adaptation rather than direct translation in order to be understood and appreciated by viewers from different backgrounds.

In this sense, subtitle translators are constantly required to strike a balance between remaining faithful to the source dialogue and making the translation culturally accessible to the target audience. This often involves complex decisions, especially when the original text includes figurative language, wordplay, or culturally specific jokes. In addition, the translator must also consider the technical limitations of subtitling, such as time and space constraints, character limits, and synchronization with the visual and audio elements, which frequently require content to be condensed or rephrased without compromising clarity or meaning.

These challenges become even more evident when dealing with different audiovisual genres, each with its own stylistic and communicative conventions. Subtitling a comedy, for instance, may require creative solutions to keep the humor effective, while translating a documentary calls for a more neutral and informative tone. Technical challenges will be discussed in Paragraphs 2.4 and 2.5.

2.3.2 Videogames

Video-game subtitling is a distinct branch of audiovisual translation that focuses on adapting in-game dialogues, instructions, and narrative elements to suit diverse linguistic and cultural audiences. Unlike conventional subtitling for films and television, it presents unique challenges due to interactivity, player choice, and non-linear storytelling.

Many video games offer optional subtitles that players must enable through the settings menu. Subtitles in games can be intralingual or interlingual, but while more games now include intralingual subtitles, some still lack them due to developers' limited awareness of accessibility needs. However, following player criticism, companies like *Ubisoft* have made intralingual subtitles a standard feature in their games since 2008 (Mangiron, 2013). Unlike films or TV, subtitles for the deaf and hard of hearing are not

common in games, although some subtitles adopt SDH features, such as color-coding for different speakers.

The lack of subtitles or poorly designed subtitles can greatly affect a player's gaming. Game designer Griffiths (2009) presented guidelines for effective game subtitles. These include using readable fonts and large text, maintaining good spacing and contrast, and ensuring subtitles are visible across different screens. Other key recommendations involve allowing players to control subtitle speed, avoiding overlap between subtitle skip buttons and gameplay actions, and including character labels, sound effect descriptions, and error-free text. Although extensive research in audiovisual translation has resulted in the development of guidelines for both intralingual and interlingual subtitling, these standards are often overlooked in the gaming industry. It is common to find games featuring subtitles that exceed three lines, use fonts that are difficult to read due to their small size, and ignore recommended average reading speeds (Mangiron, 2013).

2.3.3 News and live broadcasts

Live subtitling in news and live broadcasts is a distinct field within audiovisual translation, dedicated to delivering real-time captions for live events to improve accessibility. This process typically utilizes speech-to-text interpreting (STTI), also referred to as live subtitling, which integrates translation, interpretation, and accessibility services. The need for live subtitling in news and broadcasts grew in response to regulatory requirements which aimed for 100% subtitling coverage (Rander & Looms, 2010).

Live subtitling faces multiple issues, including the quality of subtitles, linguistic compression, and delays between audio and text. The primary methods used are stenography, re-speaking (where the subtitler dictates a compressed version of the spoken content; cf. Chapter 1), and machine-generated systems. These methods are not perfect, with common challenges such as inaccuracies, errors, and delays, which can increase the cognitive load for viewers with hearing impairments. In particular, the delay between the video/audio and the display of live subtitles is an inherent challenge in live subtitling, which can impact accessibility, especially for viewers with

impairments. Rander and Looms (2010) believe that a potential solution is to use a digital buffer to resynchronize the video/audio with subtitles, which could reduce or eliminate the delay. In conclusion, while live subtitling in its current form does not completely resolve accessibility challenges, buffering and resynchronizing audiovisual content offer a viable solution for enhancing accessibility.

2.3.4 Specialized subtitling

Specialized subtitling involves creating subtitles for content that requires expertise, in-depth knowledge, or specific adaptation beyond basic dialogue translation. This process often includes dealing with technical, industry-specific, or culturally sensitive materials. While some types of specialized subtitling have been already analyzed, such as SDH subtitles, live subtitling and videogame subtitles, this section focuses on technical subtitling and creative subtitling.

Technical subtitling involves creating subtitles for content with complex terminology, industry-specific jargon, and structured information. It is used in fields such as medicine, law, engineering, IT, science, and finance, where precision and accuracy are fundamental. Technical audiovisual products often contain specialized terminology with varying levels of complexity, from highly technical terms to more accessible, simplified expressions. Translating them accurately requires domain expertise, which many audiovisual translators lack, making the process particularly challenging (Vyzas, 2022).

Creative subtitling, on the other hand, refers to the creation of subtitles that not only translate the dialogue but also enrich the viewer's experience by adapting the content to match the tone, style, and context of the audiovisual product. Unlike technical subtitling, which prioritizes accuracy and clarity, creative subtitling focuses on maintaining the original's artistic and emotional impact while ensuring the translation is both engaging and culturally appropriate. Creative translation and subtitling are relevant in AV products like comedies, when translators have to deal with humor, punchlines, puns and curse words, or in animated films when it comes to the translation of songs. To conclude, subtitlers in this field must possess creative thinking skills and the ability to

adapt content to suit diverse audiences, while maintaining the integrity of the original message.

2.3.5 Subtitling for streaming platforms

Streaming platforms enable users to access audiovisual content online without downloading, ensuring quick access through a buffering system. Nowadays, technology has profoundly transformed translation practices, particularly subtitling. Streaming platforms such as Netflix have adopted proprietary online tools that enhance security by minimizing data leaks and enable multiple translators to work on the same project. However, this shift has also resulted in a more fragmented workflow, affecting subtitle consistency and translation quality (Campos & Azevedo, 2020, 234).

Modern subtitling platforms typically provide pre-segmented, time-coded transcriptions, which can restrict translators' ability to adjust phrasing and timing for natural flow and cultural accuracy. These rigid frameworks, combined with increasingly compressed deadlines, often result in superficial translations and insufficient quality control. The technical constraints, such as limited character counts and fixed display times, can compromise subtitle readability and viewer comprehension (for the technical aspects of subtitling, see Paragraph 2.4). Despite the central role streaming platforms play in global content distribution, the subtitling workflow remains undervalued and under-resourced, with translators working under pressure and with limited input, ultimately affecting the quality and consistency of the viewer's experience. Campos and Azevedo (2020, 237) suggest a more thoughtful approach: one that includes extended time for translation and revision, a two-step review process involving both the subtitler and a proofreader, and improved subtitle readability through reduced character count and slower reading speeds.

2.3.6 Fansubbing

The advent of digital technology has significantly impacted subtitling, giving rise to increasingly hybrid and innovative approaches, such as fansubbing. Fansubbing is an illegal practice that “involves the unofficial, amateur translation of dialogue, followed by the synchronization of the resulting subtitles with the video and audio of an

audiovisual product” (Petillo, 2012). It is a practice not carried out by professional translators, but devoted fans of the AV product, whose primary goal is to enable its free circulation and accessibility on the internet by fellow enthusiasts unfamiliar with the original language.

The practice of fansubbing saw rapid growth throughout the 1990s, driven by the increased availability of appropriate computer equipment, which allowed genre enthusiasts to undertake translation, produce subtitles, and subsequently share the audiovisual material via the web (Díaz Cintas & Muñoz Sánchez, 2006, 47). Since the subtitles are made by amateurs, the quality of translations circulating on the Internet is often relatively limited, with a considerable risk of linguistic and cultural inaccuracies during the shift from the source to the target language. Fansubbing represents a distinctive process of hybridization within audiovisual translation, as its practitioners utilize conventions from both interlingual subtitling and subtitling for the deaf and hard of hearing, while also making use of techniques typically found in video game subtitling (Petillo, 2012).

2.3.7 Subtitling documentaries

Documentaries are audiovisual products in which, unlike fiction, narrative and expressive elements are drawn from reality. The goal of documentaries is to present a scientific subject or a feature of the natural world to diverse audiences with varying levels of specialization, serving as a democratic cultural medium and a mass communication tool for spreading knowledge and raising public awareness (Bianchi, 2015: 8; Vyzas, 2022: 50). Since my dissertation focuses on subtitling a documentary about artificial intelligence, this section focuses on scientific documentaries. The main goal of the translator working with scientific or specialized texts is to produce a target version that communicates the same content and creates a similar communicative impact as the original (Scarpa 2001: 77). This becomes particularly challenging in the case of subtitling, where strict limits in terms of space and timing make the process more complex. One of the biggest difficulties when subtitling scientific documentaries is the use of technical terminology. In written translation, this issue can often be managed by including additional explanations or notes when an exact term does not

exist in the target language (Scarpa 2001: 93). In subtitling, however, the translator cannot rely on such strategies because of the limited number of characters allowed on screen and the short time each subtitle remains visible. As a result, it is often impossible to explain certain concepts in detail, and this may lead to the use of more generic or simplified terms. In some cases, key information might be left out, which can reduce the clarity or accuracy of the translation. This is particularly problematic in scientific documentaries, where precision is essential. Therefore, translators need to find a careful balance between staying faithful to the original and adapting the content in a way that remains understandable and accessible to viewers. In addition, subtitlers are often required to work across a wide range of subject areas, which makes it challenging for them to possess in-depth expertise in every domain (Gambier, 2012: 51). This lack of topic familiarity contributes to the many challenges they face when working on documentaries. These challenges include identifying and understanding specialized terms, selecting appropriate equivalents, dealing with terminological variation, addressing the absence of direct equivalents, resolving ambiguity, and adapting terminology for audiences without technical backgrounds (Matamala, 2010: 5).

2.4 The subtitling process

In creating subtitles, the subtitler has to deal with formal and quantitative constraints, which essentially concern the maximum number of characters that can be used per line, the placement of subtitles on the screen, their exposure time to the viewer and the space they can occupy on the screen (Petillo, 2012: 117). Unlike other types of written translation, where the focus is only on stylistic and translational choices, subtitling effectiveness is heavily influenced by various technical and visual factors. These elements have a great impact on linguistic aspects as well, particularly on syntax. As a result, the way subtitles are structured, timed, and presented on screen can either support or interfere with the viewer's ability to understand the product's content.

In the following sections, I will focus on the primary technical issues that a subtitler must address during the subtitling process., with special reference to time and space constraints, as well as synchronization and the proper way to place subtitles on screen.

2.4.1 Time and spatial constraints

The unit of measurement of the temporal dimension of subtitles is frames per second. Every audiovisual product is made up of a series of static images, called frames, that follow one another at high speed to create moving images in films, TV series or videogames. The frame rate, which is the number of frames per seconds (fps), varies depending on the audiovisual product. For example, in cinema, the frame rate is 24 fps, while in other media, it can range from 25 to 30 fps (Díaz Cintas & Remael, 2020: 101). As concerns videogames, computers and new generation consoles, e.g. PS5 and Xbox Series X and S can run games at higher frame rates, which can reach 120 fps in games like first-person shooters.

From a practical point of view, many subtitling programs, including *Ooona Tools* automatically recognize the frame rate of a video. In the case of the video The documentary selected for this study (cf. Paragraph 3.1) has a frame rate of 23.976 fps, which is basically the same as cinema. *Ooona Tools* also allows professionals to move forward or backwards in the video frame by frame in order to determine the exact moment a person starts and finishes speaking. Another important element is the timecode, which serves as a unique identifier for each individual frame, enabling professionals to easily locate and reference a specific frame within the entire program (Díaz Cintas & Remael, 2020: 103). A timecode consists of 8 digits: two for the hours, two for the minutes, two for the seconds, and the last two for the frames (e.g. 00:12:27:18). Each subtitle has an in-time frame, in which the speaker starts to speak, and an out-time frame, which represents the moment when the speaker finishes speaking. Consecutive subtitles should be timed with a consistent gap to ensure clear separation and maintain a smooth, even pacing. This gap typically ranges from 2 to 6 frames, depending on the frame rate (with 3 to 4 frames being ideal), and should remain uniform throughout the entire subtitle file. For the subtitling project developed in this study, I opted for a 4-frame gap between subtitles, since Díaz Cintas and Remael recommend a 2-frame minimum gap (2020, 113). Subtitles lasting less than one second should generally be avoided, while the maximum duration, according to the six-second rule (Díaz Cintas & Remael, 2020: 109), should not exceed six seconds. Exceptions may be made in specific cases, such as for song lyrics or on-screen text.

Turning to spatial limitations, the maximum number of lines per subtitle is restricted to two for interlingual subtitles, taking up no more than one-sixth of the screen image. In this respect, subtitling for hearing audiences differs from SDH, which in some countries commonly uses three or even four lines. Similarly, bilingual subtitles may occasionally extend to four lines as well (Díaz Cintas & Remael, 2020: 93). When it comes to the characters per line, the length of each line varies a lot between countries and the medium used. It typically ranges from 34 to 50 characters, spaces included. In my project, the maximum number of characters per line is 42, as it is the default setting in *Ooona Tools*. The amount of text in a subtitle is influenced by several factors, including context, target language, audio, and visual editing. These elements should guide decisions about how concise the subtitle needs to be and how long it should remain on screen to ensure comfortable readability.

2.4.2 Synchronization

Temporal synchronization is the process of matching dialogue with the corresponding subtitle content in an audiovisual product. For many viewers, this aspect plays a crucial role in how they perceive the quality of subtitling. If subtitles appear too early, too late, or disappear without aligning with the audio, they can disrupt the viewing experience and undermine an otherwise well-executed translation. Precise timing is essential for effective subtitling, as it supports the semiotic integrity of the program and helps the audience clearly identify which character is speaking at any given moment (Díaz Cintas & Remael, 2020: 101). An important step in creating subtitles is the process of spotting, also known as timing or cueing, which consists in identifying the in and out times of each subtitle. During the spotting process, rapid dialogue exchanges can significantly increase the difficulty of the task. Since achieving perfect synchronization is not always feasible, professionals often apply a certain level of technical flexibility. When the original dialogue is particularly dense in meaning and cannot be easily condensed or shortened without losing essential information, some level of asynchrony in subtitle timing is acceptable. In such situations, subtitles may be shown a few frames before the speech begins or remain on screen briefly after the speaker has finished (Díaz Cintas & Remael, 2020: 102). In general, subtitles that stay on screen after the dialogue has ended

are more acceptable than those that appear before the speaker begins to talk. In my project, I carried out the spotting process using Create Pro by *Ooona Tools* on the English video to determine all the timecodes, and then proceeded to translate the subtitles in *Translate Pro* (for the tools and methods of the subtitling project, see Section 3.2 and 3.3).

2.4.3 Placing subtitles on screen

For languages based on the Latin alphabet, subtitles are typically placed at the bottom of the screen. However, they should be moved or raised when necessary to prevent overlap with on-screen text, signs, speakers' mouths, or other important visual elements. Certain languages, such as Japanese and Korean, traditionally display subtitles vertically along the right side of the screen, a practice particularly common in theatrical releases (Díaz Cintas & Remael, 2020: 94).

Frequent or sudden changes in subtitle position should be avoided to maintain visual stability. All subtitle text should be centered within the so-called "safe area", which is the portion of the video screen guaranteed to remain visible regardless of a television's overscan, which may cut the outer edges of the image. Typically, this safe area falls within 10% of each frame's borders. The default settings in *Ooona*, for instance, are 72 pixels' margin from the left and right edges and 57 pixels from the top and bottom. Other important factors when placing subtitles on screen are font type, font size and color. The choice of subtitle fonts depends on several factors, including the platform where the content will be displayed, the delivery format, and client specifications. To maintain the invisibility of subtitling, distributors typically prefer clean fonts such as Arial, Verdana, or Helvetica for most Western languages, unless the subtitles are intended to serve a creative purpose within the program (Díaz Cintas & Remael, 2020: 96). *Ooona*, for example, recommends using Arial size 30 for languages that use the Latin alphabet. Nevertheless, subtitlers have some degree of freedom when choosing the font size.

Another fundamental element is segmentation, also known as line break. Every subtitle should stand on its own in terms of meaning and grammar, even when a sentence continues across multiple subtitles. Line breaks should ideally follow natural

pauses in meaning, making it easier for viewers to follow. It's best to avoid long chains of very short subtitles, as well as sentences that span across three or more subtitles, unless absolutely necessary. When splitting lines within a subtitle, closely related logical, syntactic, and semantic units should be kept together. This is more important than purely visual considerations, like making the bottom line longer for balance. If several line break options are equally clear, subtitles should be shaped to resemble a rectangle or pyramid, while avoiding extremely short lines consisting of just one or two words.

2.4.4 Technology in the subtitling process

Technology plays a very important role in the process of subtitling audiovisual content, as it provides translators with tools that can make their work more accurate and efficient. Some of the most commonly used subtitling programs are *Ooona*, *Aegisub*, and *Subtitle Edit*. These tools give professionals the possibility to control the timing of subtitles with great precision, making sure the text matches the audio perfectly. They also allow users to move the subtitles around the screen in order to avoid overlapping with important visual elements, like names, signs, or other written information that appears in the video. Another useful feature is the video preview, which lets the subtitler watch the subtitles directly on the screen while working, so they can immediately check how the final result will look. *Ooona*, for example, is a professional, cloud-based platform that is widely used by companies because it supports many subtitle formats and offers a user-friendly interface. *Aegisub* and *Subtitle Edit* are also very popular, especially among independent translators or students, because they are free, open-source, and offer a lot of flexibility.

When it comes to translation, software powered by artificial intelligence, like DeepL or the instant translation function available in Trados Studio, can help create a first version of the subtitles. Even if these translations are not always perfect, they are useful for saving time, especially when working on long videos. The subtitler can then focus on editing and improving the translation to make it sound more natural and faithful to the original message. Another helpful tool in the subtitling process is automatic transcription. For instance, programs like Turboscribe can generate almost

complete transcriptions of the spoken content, including punctuation and speaker changes. This is especially useful in the first phase of subtitling, as it allows the translator to focus more on the language rather than having to write down the entire dialogue manually. Of course, human revision is always necessary, but these technological tools have become essential in the daily work of many subtitlers, especially when dealing with tight deadlines or a large number of projects.

2.5 Main linguistic, cultural and technical challenges in subtitling

From a strictly linguistic perspective, achieving the highest possible level of accuracy is essential for quality subtitling. Unlike dubbing, where the original dialogue is replaced, subtitling keeps the source dialogue audible on screen, making it a constant point of reference for viewers, especially for those with some understanding of the original language. For this reason, subtitlers are undoubtedly even more exposed to checking than other translators, and the standards of precision must be particularly high. This is especially true when considering the intended target audience: for example, a nature or science documentary with moderately technical content, like the one I chose for creating subtitles, is likely aimed at an educated audience, making it really important to avoid careless mistakes or inaccuracies (Petillo, 2012: 118). It goes without saying that any omission of content from the original dialogue should be strictly limited and only considered when necessary due to time restrictions, such as preventing subtitles from appearing too rapidly and affecting the viewing experience, or space constraints, like avoiding the obstruction of key visual elements or actors' faces on screen.

In this paragraph, I will discuss the main linguistic and cultural challenges that subtitlers face when producing interlingual subtitles (Paragraphs 2.5.1 and 2.5.2), the technical difficulties involved in the subtitling process and the specific textual adaptation strategies applied to the source material to ensure an effective and accessible outcome (Paragraph 2.5.3).

2.5.1 Idioms and humor

A particularly complex linguistic element in the subtitling process is the use of idioms. Idioms often convey meanings that go beyond their literal translation and are closely related to the culture of the source language. Translating them directly can lead to confusion or cause the intended meaning to be lost for the target audience. Due to the time restrictions and spatial limitations inherent in subtitling, idioms often need to be adjusted or swapped with equivalent phrases in the target language that capture the same meaning or emotional tone. When there's no direct equivalent, subtitlers might choose to paraphrase or simplify the message, making sure to maintain the original intent and tone. On top of that, the constraints of timing and reading speed push translators to make quick yet meaningful decisions that stay true to both the language and the viewing experience.

Another difficult linguistic element to subtitle is humor. According to Díaz Cintas and Remael (2020, 217), the reason why translating humor is such a challenge, is that it is “a social event, at the same time universal and culture-bound”. Zabalbeascoa (1996) and Díaz Cintas and Remael (2007) identify three main types of humor: (a) language-dependent humor, (b) national or community-based humor and exoticism and, despite not being directly connected to humor, (c) audiovisual challenges.

Language-dependent humor includes puns and wordplays, which are difficult to translate because the semantic and pragmatic impact of wordplay in the source text often stems from unique structural features of the original language—such as homophones, near-homophones, polysemy, idiomatic expressions, or specific grammatical constructions, which are frequently difficult, if not impossible, for translators to replicate in the target language (Delabastita, 1994: 223). The best strategies to translate language-dependent humor are substitution and compensation (cf. Paragraph 2.5.2).

National or community-based humor is deeply embedded in the cultural background, traditions, and sometimes even the biases of a specific country or group. As a result, it may appear foreign or unfamiliar to audiences from the target culture. In essence, national or community-based humor and exoticism are two sides of the same coin: both can serve to highlight social divides, mock or criticize, but also to create a

sense of unity or reinforce perceptions of superiority and inferiority (Díaz Cintas & Remael, 2020: 229). When subtitling an audiovisual product like a comedy movie, the translator or the subtitler must always think about source and target culture and find the correct way to transfer humor between the two different cultures.

Audiovisual challenges arise from the fact that humor in audiovisual productions can be conveyed through various semiotic layers, particularly visual and aural elements. Visual humor includes aspects like shot composition, editing, gestures, and facial expressions, which can sometimes transcend cultural boundaries. However, cultural context still plays a role in how humor is received. Since much of visual and aural humor is non-verbal, subtitlers often focus more on translating dialogue while relying on visual cues to convey humor (Díaz Cintas & Remael, 2020: 237). According to Díaz Cintas and Remael (2020), the difficulty in translating humor lies in the fact that it is a complex interplay of language, culture, visuals, and sound.

2.5.2 Cultural references

Cultural references, also known as *realia*, are references rooted in a specific community's culture, history, or geography that can present significant challenges in the translation process (Díaz Cintas & Remael, 2020: 202). Cultural references comprehend geographical references, ethnographic references, such as food, art and weights and measures, socio-political references, such as institutions and administrative units.

There are many different translation strategies when dealing with cultural references. Díaz Cintas and Remael (2007) present a list of nine strategies: loan, literal translation, calque, explicitation, substitution, transposition, lexical recreation, compensation and omission. Loan, also referred to as borrowing, involves incorporating a word or expression from the source language directly into the target language text. This typically occurs when the same term is already used in both languages (e.g. manager, weekend, budget) and with terms related to information and communication technologies.

Literal translation is a method where the source text is rendered into the target language almost word for word, preserving its original structure and vocabulary. This approach tends to be effective when the two languages involved have comparable

grammatical rules and similar ways of expressing ideas. The calque is a strategy where an expression from the source language is rendered into the target language by translating each of its elements literally. Rather than adopting the term as it is, like in loan, calque involves dissecting the original phrase and rebuilding it with target language equivalents, preserving the structure and meaning while adapting it linguistically (e. g. skyscraper and *grattacielo*). Explicitation is a translation technique where the translator makes implicit information from the source text clear and explicit in the target text. Essentially, it involves adding extra details or explanations to help ensure the message is fully understood by the audience of the target language. Substitution is a strategy in which an element from the source language is replaced with a suitable equivalent in the target language. This approach is commonly used when a literal translation would sound awkward or when no direct equivalent exists in the target language, enabling the translator to adjust the meaning while preserving the original message's intent. Transposition is a technique where the original grammatical structure or word order of a sentence is adjusted to better fit the rules and style of the target language, while still conveying the same meaning. It's often used when a literal translation sounds awkward or doesn't work grammatically in the target language. Lexical recreation is used when the source text features an imaginative, culturally specific, or entirely invented word, like a pun, a newly coined term, or a fictional name. Rather than opting for a literal translation, the translator crafts a new expression in the target language that captures the original's creativity, tone, and effect, ensuring it resonates just as effectively with the new audience. Compensation is used when specific meanings, stylistic elements, or subtle nuances from the original text can't be directly replicated in the same spot or format in the target language. Rather than attempting a forced or awkward translation, the translator chooses to convey the missing effect in a different part of the text, ensuring the overall tone and intent of the original are still effectively communicated. Lastly, omission is a technique where specific words, phrases, or portions of the original text are intentionally left out in the translated version. This approach is typically used when the excluded content is repetitive, not culturally relevant, or too difficult to translate smoothly without affecting the clarity or rhythm of the text, particularly in formats like subtitling, where space and time are limited.

To conclude, choosing the appropriate translation strategy depends on the nature of the cultural reference and the intended audience. Ultimately, the translator's aim is to retain the original content's meaning, tone, and overall effect, while also making sure the translation remains clear and accessible to viewers in the target language.

2.5.3 Technical complexity

Reducing interlingual subtitling to the act of translating source-language dialogue into target-language subtitles would be an oversimplification and a misrepresentation of the process. Translating dialogue is just one step in a broader process. Before the original lines can appear in the target language, they need to be adapted to the technical requirements of the medium, meaning they must fit within the limited time and screen space available in film or television formats (Petillo, 2012: 119).

There are three fundamental processes in the creation of interlingual subtitles. The first is reduction, which can be full or partial, and it is the initial step the subtitler needs to take to determine what should be translated and what can be left out. This process essentially creates the linguistic structure that will form the basis for the final subtitles.

Next, we have the diamesic transformation, or the shift from oral to written code, which also impacts the final result, as the original dialogue needs to be adjusted by removing speech-specific linguistic markers that could be awkward or distracting in written form. Lastly, the adapted text is then translated into the target language. However, since the source text has already been condensed, it is crucial that the translation does not introduce additional semantic losses that could impair the overall comprehension of the film's message (Petillo, 2012: 119). The translation should be clear, effective, and easy for the audience to understand, ensuring that nothing significant is left out.

2.6 The future of subtitling

Recent breakthroughs in artificial intelligence and speech recognition technologies are reshaping the field by automating transcription processes with improved accuracy. AI-powered systems are now able to transcribe speech in a wide range of languages,

dialects, and accents, significantly boosting efficiency and decreasing the need for manual labor. In addition, Natural Language Processing (NLP) plays a key role in enhancing the precision of subtitling by ensuring that subtitles are correctly aligned with the timing of the video. The now widely popular machine translation allow for the automatic translation of subtitles into multiple languages, significantly enhancing global accessibility.

In the future, the subtitling industry will undergo a significant transformation driven by continued technological innovation. Emerging developments include interactive and customizable subtitle formats designed to accommodate individual viewer preferences, improved accessibility tools aimed at supporting audiences with disabilities, and the implementation of real-time subtitling solutions for live broadcasts. These advancements will reshape the subtitling industry by enhancing the overall efficiency, precision and inclusivity of the subtitling process.

CHAPTER 3. THE SUBTITLING PROJECT AND THE ANALYSIS OF THE SUBTITLES

This chapter is dedicated to the case study and focuses on the creation of Italian subtitles for an English documentary about artificial intelligence. It provides an overview of the subtitling process, including the subtitling tools and methodological steps (Paragraphs 3.2 and 3.3), and the challenges I encountered along the way, both technical and linguistic (Paragraphs 3.4 and 3.5)

Paragraph 3.1 describes the audiovisual product, including its main themes it explores and its stylistic and technical features. Section 3.2 will focus on the software used for project, namely *Ooona Tools*. I will explain why I chose this platform, describe its main features, and evaluate how it supported the subtitling process. Paragraph 3.3 outlines the entire workflow, from the initial spotting phase and creation of source-language subtitles to the final translation and adjustments. Paragraph 3.4 discusses the main technical difficulties encountered during the task, such as inaccurate timecodes and subtitle timing constraints. Finally, Paragraph 3.5 addresses the linguistic challenges involved in translating specialized terminology related to artificial intelligence. I will focus on how Italian equivalents were selected for technical, the resources I consulted, and the balance I aimed to find between accuracy and accessibility for a non-specialist audience.

3.1 The AVT product

The documentary “*The Revolution of AI*”² takes a deep dive into how artificial intelligence is changing our world and its future evolution. It was released on YouTube on September 18, 2024, by Moconomy, a YouTube channel that has become quite popular for producing informative videos on topics like economics, finance, and global trends. Since its launch in December 2017, Moconomy has grown a lot, and by May 2025, it had over 1.19 million subscribers and more than 65 million views. Their content tends to be well-researched and backed by official sources, which makes it both reliable and easy to follow.

² <https://youtu.be/8jY50cMB1TU?si=Pyovj0U08IV8oP2J>, last access on May 20, 2025

The main host of the documentary is Shivani Bigler, an American engineer and neuroscientist who guides viewers through the different scenes. She is knowledgeable in both science and technology, so she can explain some technical concepts in a popularizing and clear way. Throughout the documentary, she interacts with various professionals, scientists, tech developers, and policy experts, about how AI is being developed and its potential impact on everyday life. The overall goal seems to be showing how AI could help improve the quality of life, solve big problems, and even help the planet.

The structure of the documentary includes different parts, each focusing on a specific application of AI. A narrator helps connect them, offering extra information and predictions about what the future might look like if these technologies keep developing the way they are. The first part introduces self-driving cars. These are already being tested and even used as taxis in some cities. Engineers explain how the cars are able to move around safely using sensors and algorithms that help them understand their environment. They also discuss some of the challenges and risks involved, especially concerning safety and legal responsibility. Next, the documentary shifts to AI-powered rescue robots, i.e. robots that can go into dangerous places, like collapsed buildings or mines, where it might be too risky for people to go. They can find people using technologies like thermal imaging and then send data back to help emergency teams figure out where to go. The third section deals with drones that do not need GPS. Instead, they use other tools to figure out where they are and how to move. These drones are especially useful in dangerous environments like construction zones or farmland. The interesting part is that they can work in groups, almost like a team, which opens up possibilities for helping solve big issues, e.g. food production and climate monitoring. Then the focus shifts to humans-machine interaction and how robots can learn from people. They can pick up new tasks by observing and practicing. This technology is already being used in factories and will soon be implemented in healthcare settings. But there are also concerns about how this might affect jobs and the way we work in the future. One of the most ambitious parts of the documentary explores Artificial General Intelligence. Unlike regular AI, which is usually designed for one specific task, Artificial General Intelligence is meant to be more flexible, by imitating the way humans can learn new things and adapt. This part brings up a lot of

interesting questions about whether machines could eventually become truly intelligent or even self-aware. The last section jumps into the future and presents hyper-realistic avatars and humanoid robots. These are designed to look and act like real people, and they are being developed for use in virtual reality and customer service. Finally, the documentary discusses some of the concerns people have about privacy, identity, and ethics.

Even though the topics are quite advanced, the documentary keeps concepts understandable. The language is simple, and when technical terms are used, they are usually explained in a clear way. The main host is always asking the kinds of questions that most people would have and breaking things down without making it feel oversimplified. Visually, the documentary offers a balanced mix of expert interviews, animations, real-world footage, and graphics that help explain complex ideas. The transitions between sections are smooth, and the music and editing help keep it interesting without being overwhelming. All in all, “The Revolution of AI” is a really well-made documentary that tries to make sense of a really complex topic that changes day after day. It does not just show what AI can do today, since it also encourages viewers to think about where we might be headed in the future and what kind of world we are building as these technologies continue to develop.

3.2 The subtitling tool

For the subtitling task, I decided to use *Ooona Tools* as my main software after trying out a few different options. I experimented with *Trados Studio Subtitling*, *Subtitle Edit*, and *Aegisub*, all of which have their own strengths. For example, *Trados* is specific for people who are already in the translation field, *Subtitle Edit* is very flexible and open-source, and *Aegisub* is excellent for fansubbing. But after testing them all, *Ooona* proved to be the most complete in terms of tools, as well as the easiest to use and the most straightforward, especially for unexperienced subtitlers.

One of its main strengths is that *Ooona* is an online platform which does not require any installation and has a clean and modern interface. The workflow is smooth and fast. The layout is not overwhelming, but actually simple and effective. In addition, it is designed for both beginners and professionals. It also supports a lot of different

subtitle formats like SRT, VTT, ASS, STL, and more, so everyone can export the format needed. The built-in subtitle editor is definitely one of the most notable features. It let me create and synchronize subtitles manually, but I could also import files from the first draft of subtitles I created with *Turboscribe* (cf. Section 3.3). There are also some handy keyboard shortcuts that helped speeding up the workflow, like jumping a few seconds forward or back, pausing the video quickly, or adding timecodes more precisely.

Ooona works well with many languages and character sets, including those that use non-Latin scripts like Arabic, Japanese, Chinese, or Russian. This makes it a great choice for international projects. Another useful tool is the quality check function, which automatically checks for issues like overlapping lines, missing breaks, or inconsistent styles. It makes it easier to find small errors that might be missed otherwise and helps keep everything clean and professional. One impressive feature is the automatic timecoding option. It uses speech recognition to create timecodes for subtitles, which really helped speed up the process, especially with longer or more dialogue-heavy passages. *Ooona* also has a tool called “Burn & Encode” that allows users to export videos with the subtitles already embedded in various formats, e.g. MP4 and MOV.

Overall, I had a good experience working with *Ooona Tools*. It was not too complicated, and even when I did run into minor issues, like fixing timings or formatting, it was easy to solve with the tools available. The software really helped me stay organized and focused, and I did not feel overwhelmed by the technical side of things. I would definitely consider using it again for future projects, especially if I need to work with different subtitle formats or deliver videos quickly without compromising on quality.

3.3 The subtitling procedure

In this project, I worked on subtitling a YouTube documentary, translating it from English to Italian. The process involved several technical steps, from transcription and timing to translation and final video export.

First, I chose the video I wanted to subtitle from YouTube and downloaded the entire documentary onto my computer. To understand the content better, I watched it

several times to get familiar not only with the main ideas and topics but also with the specific words and expressions used. After I felt comfortable with the video, I started transcribing the dialogue. For this, I used an online tool called *Turboscribe*, which uses artificial intelligence to automatically turn the audio from videos into written text. It is a very useful tool because it saves a lot of time compared to typing everything out by hand. By simply uploading the audio or video file, the AI listens and writes down what is said. The transcription can then be edited or exported into different subtitle formats. *Turboscribe* is especially helpful because it creates a first draft that you can improve later, making the whole process of spotting much faster.

Unfortunately, *Turboscribe* only supports files that are 30 minutes or shorter. Since the documentary was longer than that, I split it into two parts: one of 30 minutes and the other around 20 minutes. I uploaded and transcribed each part separately, then downloaded the two English subtitle files in .srt format, which is the file supported by *Ooona*. With the transcriptions ready, I moved on to synchronizing the subtitles with the video. For this, I used the “Create Pro” tool on the *Ooona* platform, which is used for subtitle editing. I uploaded the documentary video (.mp4) and the two subtitle files (.srt) and then started the spotting process, where I carefully matched each subtitle to the exact time it was spoken in the video. During this step, I also shortened some of the text so it would fit the screen properly and be easy to read, following subtitle timing rules (cf. Paragraph 2.4.1).

After finishing the spotting and making sure all subtitles were timed correctly, I exported the English subtitle file in .srt format. This made the next step, translating the subtitles, much easier because I already had the text perfectly timed with the video. Next, I opened the “Translate Pro” tool and uploaded the timed English .srt file. At that point, the tool displayed the English subtitles on one side and an empty column for the Italian translation on the other. This side-by-side layout made it easier for me to translate each line while checking the original text at the same time. After translating all the subtitles into Italian, I worked on some technical details to improve the way the subtitles were positioned on the screen. For example, when the subtitles covered any on-screen text, especially during the narrator’s voice-over, I moved them to the top of the screen, so that the potential viewer would be able to read everything. Also, I italicized

all subtitles that were voice-overs, i.e. narrating off-screen utterances. This is a common way to show the difference between spoken dialogue and narration.

Finally, I exported the Italian subtitles in two formats: .srt and .html. The .html format keeps the subtitle styles and is used for embedding subtitles into the video. Using the “Burn & Encode” tool, I uploaded the original video file and the Italian .html subtitles. This tool combined the subtitles with the video, so the Italian subtitles were permanently added to the documentary. Once the process was finished, I downloaded the final version of the video with the Italian subtitles ready for viewing.

3.4 Main technical challenges

The main challenges encountered during the subtitling process were both technical and linguistic. In this paragraph, I will primarily focus on the technical challenges, while Section 3.5 will be dedicated to exploring the linguistic problems, especially those connected to the specialized terminology used in the field of artificial intelligence.

One of the most significant and time-consuming obstacles throughout the project was undoubtedly the spotting phase, which involves accurately synchronizing the subtitles with the exact moments they are spoken in the video. As I mentioned in the previous paragraph, I initially used the transcription software *Turboscribe* to generate a first draft of the subtitles, complete with suggested timecodes. This tool was somewhat helpful in speeding up the initial workflow because it produced an automatic draft rather quickly. However, the vast majority of the timecodes it generated were far from accurate, and I was forced to manually review and adjust every single subtitle frame by frame. Given that the documentary contains more than 700 subtitles, this became an incredibly time-consuming and tedious task. It required a lot of patience and attention to detail, as even small errors in timing could disrupt the viewer’s experience, making subtitles appear too early, too late, or overlapping inappropriately.

After accurately correcting the timing, the next crucial step was finalizing the English subtitles to create a well-structured draft that would then support the translation process. Once again, *Turboscribe* provided a first draft of the subtitles. However, these were essentially verbatim transcriptions of the spoken dialogue, meaning they were a direct, word-for-word representation without any adaptation or condensing for subtitle

reading speed or space. This meant the text was often too long and not yet suitable for subtitling, which naturally requires more concise and readable phrasing.

To solve this problem, I had to reduce the text of the subtitles, which was particularly demanding and time-intensive. This step was necessary to ensure that the subtitles would comply with the strict spatial and temporal constraints typical of subtitling. They must be brief enough to be read comfortably in the limited time they appear on screen, and they must also fit within a limited screen space. Achieving this balance proved to be particularly challenging, especially because it involved condensing sentences that were originally spoken in a foreign language. This required me to have a solid grasp of English so that I could effectively choose suitable synonyms, rephrase sentences without losing important meaning, and occasionally omit information I viewed as less essential for the viewer's understanding.

What further complicated this task was the speed at which some speakers in the documentary delivered their lines. In several passages, hosts spoke very quickly, conveying a large volume of information in a short amount of time. This rapid delivery meant that the subtitles often had to condense complex ideas or lengthy sentences into very short segments. As a result, I was sometimes forced to make difficult decisions about which words or expressions to leave out, always trying to maintain the overall message and coherence while respecting the technical limits of subtitle length and timing.

Once the spotting phase was fully completed and I exported the polished English subtitles with reduced text as an .srt file, I moved on to the final stage of the subtitling process: translating the subtitles into Italian. To do this, I imported the English .srt file into the Translate Pro tool, which made the translation workflow more organized and efficient by displaying the English and Italian subtitles side by side. Compared to the spotting and reduction steps, this translation phase was not as demanding in terms of timing because the timecodes were already established and the text was already reduced.

However, this phase still presented its own set of challenges. One difficulty was related to the structural differences between English and Italian. Italian generally uses more articles and longer words than English, which often makes Italian subtitles longer and potentially more difficult to fit within the spatial constraints of the screen. This

linguistic difference meant that even though the timing was fixed, I occasionally had to make slight adjustments to the timecodes to ensure that the Italian subtitles would not appear too quickly or stay on screen too briefly for viewers to read comfortably. Balancing the need to remain faithful to the original message while making the subtitles readable and visually accessible in Italian required careful attention and sometimes additional adjustments of the subtitle timing.

Due to the tendency of Italian subtitles to be considerably longer than their English counterparts, both in terms of word length and syntactic complexity, I often found myself having to adopt a range of strategies in order to respect the temporal and spatial constraints that subtitling naturally imposes. One of the strategies I found particularly useful in this regard was condensation, which involves reducing the length of a text while still preserving its essential meaning. A clear example of this can be found in subtitles 7 and 8 (See Appendix 1). In the original English, the content is expressed through two separate and independent sentences: “Most people live and work side by side with self-aware androids” and “These AI companions boost productivity and liberate humans from tedious tasks.” When translating these segments, I initially attempted a more literal approach. However, I quickly noticed that subtitle 8 would exceed the acceptable time limits if translated word for word into Italian. This posed a challenge, as the Italian version needed to be concise enough to fit within the temporal constraints while still conveying the main message of the original.

To solve this, I decided to merge the two sentences using the relative pronoun “che”. This allowed me to omit the subject “These AI companions”, which would have been redundant in the Italian version, given the clear reference to “androidi intelligenti” in the previous line. In doing so, I not only respected the time and space restrictions but also maintained the logical flow between the two ideas. In this specific instance, condensation allowed me to streamline the original information while still preserving the communicative intent of the text. The final Italian subtitles therefore became: “Molte persone vivono e lavorano insieme ad androidi intelligenti” and “che aumentano la produttività e ci liberano dai compiti più noiosi.”

Overall, this subtitling process was a complex task that involved not only technical precision but also careful linguistic judgment. The manual effort required for spotting and adapting the subtitles, combined with the translation challenges posed by

the structural differences between English and Italian, made the project both demanding and rewarding. Every stage of the process came with its own specific set of challenges, all of which needed to be carefully addressed in order to create a final subtitle file that was not only precise in timing and translation but also easy for viewers to read and understand.

3.5 Managing LSP terminology

As mentioned in Paragraph 3.1, one of the main things that really stands out about the documentary is that it was clearly made with an educational goal in mind. It is aimed at a general audience, meaning people who do not necessarily have any background in artificial intelligence or computer science. Most viewers probably have only a basic idea of what AI is, or maybe just know some of the terms they have heard in the media. Thus, the creators had to make some intentional choices about how to present the content in a way that was easy to understand, e.g. to use fairly simple and direct language throughout the documentary, avoiding long, complicated sentences or too much technical jargon unless necessary.

The frequent inclusion of interviews with professionals like engineers, scientists, and researchers makes the documentary easier to follow. These experts explain their work in a way that is meant to be clear and accessible to people who are not familiar with the technical aspects. They usually speak in a very straightforward and conversational way, breaking down complex ideas into simpler terms, which definitely helps the audience stay engaged and understand what is going on.

Shivani, the main host, acts like a guide throughout the documentary and provides voice-over narration that ties topics together and adds extra context or clarification. These voice-overs are helpful because they do not just repeat what is being said: they explain and simplify terms and ideas that might otherwise be confusing. Despite the creators' efforts to keep the language simple and the explanations clear, artificial intelligence remains a technical and complicated topic. So, there are plenty of moments where specialized vocabulary is used. I had to find a way to stay true to the original meaning while still making sure that the subtitles would be understandable to someone

who might not know all the technical terms. In other words, it was about finding the right balance between being accurate and being clear.

A big part of the challenge comes from the fact that artificial intelligence is a fairly new field that is constantly changing and growing. Because of that, many of the terms used in AI originally come from English. In Italian, several have been borrowed through the process of loan. Some good examples of this are terms like “machine learning,” “deep learning,” and “deepfake.” These terms do not have proper Italian equivalents, and even if they did, most people are more familiar with the English versions.

In the documentary, the host usually takes time to explain specialized terms when they are first used, which really helps the audience understand them even if they have never heard them before. For instance, when “machine learning” is introduced, the host immediately gives a simple explanation of what it means and how it is used in real life (Appendix 1, Subtitles 112-113). That way, even someone who has no idea what the term means can still follow along. In some cases, like with the term “deepfake”³, there is no direct explanation, but the visuals in the documentary make it clear what the term refers to.

When dealing with English technical terms that actually do have possible Italian translations, I tried to be really careful about which version to use. I conducted research to figure out which version was more commonly used or better understood. For this, I looked at Italian tech websites and magazines like *Wired Italia*, because they often talk about AI and use the kinds of terms that people in the field are familiar with. If there were two different translations of the same term, I would search both on Google to see which one had more results and in which sources it was utilized. My thinking was that the version with more hits is probably the one most researchers use. For example, the English term “artificial general intelligence” can be translated as either *intelligenza artificiale forte* or *intelligenza artificiale generale*. When I searched both, I found that *intelligenza artificiale generale* had more results and was used in magazines like *Wired*, so I implemented that one.

³ “Neologism: a video featuring bodily and facial images captured from the Internet, reprocessed and adapted to a context different from the original one through a sophisticated algorithm”. (translated from Treccani, last access on May 30, 2025)

For words like “sculpting” and “casting,” which are used in the context of making 3D models, I used *WordReference*, which includes definitions from different fields, which is useful to figure out which meanings make the most sense based on how the terms are being used. One of the most important terms in the whole documentary is “hyperintelligence”. Even though a Google search showed that *superintelligenza* is more commonly used in Italian than *iperintelligenza*, I decided to opt for *iperintelligenza*. That’s because, according to the Oxford English Dictionary, “hyper-” has a stronger meaning than “super-,” and captures the original idea better. Also, in the Italian version of James Lovelock’s 2019 book *Novacene: The Coming Age of Hyperintelligence*, the word is translated as *iperintelligenza*, which helped confirm this choice.

A specialized term in the field of AI is “voxelized,” which I translated as *voxelizzato*. The use of calque is, in this case acceptable in Italian but most people probably wouldn’t know what it means unless they have a background in computer graphics or similar fields. Unfortunately, subtitles do not leave much room to add explanations, so I could not really add any extra information.

One strategy I consistently applied throughout the subtitling process was to render the term “*intelligenza artificiale*” using its acronym, both in English (*AI*) and in Italian (*IA*), in order to reduce the character count in the subtitles, given the high frequency with which the term appears in the source text. There was one specific case in which I had to retain an English acronym, as translating it into Italian would have caused the subtitle to exceed the character limit. The acronym in question was *CGI* (Computer-Generated Imagery), which is typically rendered in Italian as *computer grafica*. Fortunately, CGI is a widely recognized term within the field of cinema, and it is now fairly well understood by a large portion of the Italian-speaking audience. This made it possible to keep the English acronym without significantly compromising comprehension.

With regard to the names of institutions and organizations, the documentary features references to several American universities throughout. For the translation, I researched each institution online to verify whether an established Italian equivalent existed. I found that some university names are typically left in English, while others are more commonly translated into Italian. For instance, Columbia University and the

Massachusetts Institute of Technology are generally not translated, whereas more widely recognized institutions such as Harvard University and the University of Pennsylvania are often rendered as *Università di Harvard* and *Università della Pennsylvania*, respectively.

In the case of the *University of Pennsylvania*, I encountered a particular challenge. In English, the institution is frequently referred to using the abbreviation *UPenn*, which is widely understood in academic and popular discourse. However, in Italian there is no commonly used or official equivalent for this abbreviation. This posed a problem in one subtitle in particular (Appendix 1, subtitle 150), where the use of *UPenn* would not have been immediately clear to the Italian audience, but rendering the full Italian name would have exceeded the character limit. As a result, I had to slightly rephrase the subtitle in order to preserve both readability and clarity, while remaining within the technical constraints of the medium: “I’m at UPenn, remotely in Vijay Kumar’s lab” was thus translated as *Mi trovo virtualmente nel laboratorio di Vijay Kumar*.

In sum, dealing with specialized language in a documentary about artificial intelligence was one of the most challenging parts of the whole subtitling project. I had to think really carefully about every term, not just in terms of its literal meaning, but also how understandable it would be for the people watching the documentary. I wanted to make sure the subtitles were accurate but also clear and accessible, and finding that balance took a lot of time, research, and sometimes even guesswork. But in the end, I think it was one of the most interesting and rewarding parts of the whole experience.

CONCLUSIONS

This thesis has explored the field of audiovisual translation, focusing in particular on subtitling. Starting with general theories and key ideas, I then moved to a practical project that allowed me to apply what I had studied. My aim was to show how subtitling is not just a technical job, but also a creative and cultural process. It requires a mix of language skills, cultural knowledge, and technical awareness.

In the first chapter, I discussed important ideas that help us understand audiovisual texts. These include multimodality (the use of different types of communication, such as images, sound, and text), multimediality, and syncretic texts. I also talked about the Italian context, where dubbing is much more common than subtitling. This has shaped the way Italian audiences relate to foreign content. However, this situation is slowly changing due to the influence of global streaming platforms. Understanding the cultural habits and expectations of the audience is essential when working in audiovisual translation.

The second chapter focused on subtitling itself. I described the types of subtitles used today, interlingual, intralingual, and SDH (subtitles for the deaf and hard of hearing), and explained the main features of each. I also analyzed the main problems that subtitlers face, such as limited space and time, the need for synchronization with images, and the challenge of translating humor, idioms, and culture-specific references. I learned that subtitling is different from other types of translation. It often requires reducing the original content while keeping the meaning, which is not always easy. I also discussed the impact of technology, which can help the subtitling process but cannot replace human judgment and creativity.

The third chapter was based on my subtitling project. I translated a documentary on artificial intelligence from English into Italian using professional tools like Create Pro and Translate Pro (both by *Ooona*). This part of the thesis was the most practical and challenging. I had to deal with technical language, fast speech, and tight timing. I also had to follow specific rules, such as the maximum number of characters per line and reading speed. In some cases, I had to change or shorten expressions to make them fit, while still keeping the meaning clear and natural for Italian viewers. This experience

helped me understand how demanding subtitling can be, and how many decisions the translator must make in a short amount of time.

From this experience, I learned that subtitling is not only about knowing two languages. It also requires the ability to decide what is most important, what can be omitted, and how to make the subtitles easy to read. A good subtitler must understand the audiovisual product as a whole, including the images, sounds, and rhythm. Subtitling is a form of communication that connects people from different cultures and makes content more accessible. It is also a responsibility, because a poorly translated subtitle can confuse or mislead the viewer.

I also became more aware of the importance of accessibility. Subtitles are not only for people who don't speak the original language, they are also useful for people who are deaf or hard of hearing, for those learning a language, or for anyone watching content in a noisy place. Subtitles allow more people to enjoy and understand audiovisual content, and this is an important goal in today's global society.

Looking to the future, I believe that subtitling will gain increasing attention and importance. The number of international films and TV series available online is increasing, and viewers from different countries need translations that are fast, accurate, and well-made. However, the pressure to produce subtitles quickly and cheaply can lead to lower quality. I think it is important to value the role of human subtitlers and to invest in proper training. Technology can support the process, but it cannot fully replace the human ability to understand meaning, culture, and tone.

Training and education are key to preparing new professionals in this field. Universities and other institutions should offer more practical courses, where students can learn how to use real subtitling tools and work on real materials. It is important not only to study theory, but also to practice and face real problems. In my case, the practical project helped me understand many things that books alone cannot teach.

To conclude, this thesis has been a valuable and enriching journey. It allowed me to connect theory with practice, and to develop useful skills for my future career. I discovered the complexity of subtitling and the important role it plays in today's media world. I hope that my work can show the value of subtitling as a serious and creative profession and encourage more people to study and appreciate it.

APPENDIX 1

#	Timing	Duration	Source Text	Target Text
1	00:00:01:17 - 00:00:05:02	00:00:03:09	<i>This is what the future of hyperintelligence looks like.</i>	<i>Ecco come appare il futuro dell'iperintelligenza.</i>
2	00:00:05:20 - 00:00:07:22	00:00:02:02	<i>Most people no longer own cars.</i>	<i>Molti non hanno più un'auto,</i>
3	00:00:08:18 - 00:00:14:08	00:00:05:14	<i>Instead, AI operates fully electric network self-driving vehicles.</i>	<i>Ormai sostituite da veicoli elettrici a guida autonoma gestita dall'IA.</i>
4	00:00:14:16 - 00:00:19:07	00:00:04:15	<i>As a result, air pollution and traffic congestion plummet worldwide.</i>	<i>Di conseguenza, l'inquinamento e il traffico crollano in tutto il mondo.</i>
5	00:00:20:13 - 00:00:25:01	00:00:04:12	<i>Self-navigating aerial drones are on the front lines for disaster response</i>	<i>I droni aerei autonomi sono in prima linea nelle operazioni di soccorso</i>
6	00:00:25:05 - 00:00:26:21	00:00:01:16	<i>and search and rescue tasks.</i>	<i>e di ricerca e salvataggio.</i>
7	00:00:27:01 - 00:00:31:01	00:00:04:00	<i>Most people live and work side by side with self-aware androids.</i>	<i>Molte persone vivono e lavorano insieme ad androidi intelligenti</i>
8	00:00:31:11 - 00:00:36:18	00:00:05:07	<i>These AI companions boost productivity and liberate humans from tedious tasks.</i>	<i>che aumentano la produttività e svolgono i compiti più noiosi,</i>
9	00:00:37:06 - 00:00:39:11	00:00:02:05	<i>Totally revolutionizing modern life.</i>	<i>rivoluzionando così la vita moderna.</i>
10	00:00:41:11 - 00:00:43:10	00:00:01:23	<i>It's like I'm in a superhero film</i>	<i>È come un film di supereroi.</i>
11	00:00:43:14 - 00:00:47:07	00:00:03:17	<i>Today, scientists are blazing a trail to this very future.</i>	<i>Oggi, gli scienziati tracciano la via verso il futuro.</i>
12	00:00:47:10 - 00:00:50:10	00:00:03:00	<i>We're enabling the system to make its own decisions</i>	<i>Consentiamo al sistema di prendere le sue decisioni.</i>
13	00:00:50:14 - 00:00:51:23	00:00:01:09	<i>Words fail me.</i>	<i>Non ci sono parole.</i>
14	00:00:52:04 - 00:00:54:21	00:00:02:17	<i>I want to know what progress is being made.</i>	<i>Voglio sapere che progressi sono stati fatti.</i>
15	00:00:55:01 - 00:00:58:03	00:00:03:02	<i>It's talking and you're having a dynamic conversation.</i>	<i>Parla e interagisce con te.</i>
16	00:00:58:07 - 00:00:59:07	00:00:01:00	<i>It's awesome!</i>	<i>È incredibile.</i>
17	00:00:59:11 - 00:01:02:16	00:00:03:05	<i>Machines can be self-aware in ways that we can't.</i>	<i>Le macchine possono essere più autoconsapevoli di noi.</i>
18	00:01:02:20 - 00:01:04:11	00:00:01:15	<i>That will bring us to...</i>	<i>Che ci condurranno...</i>
19	00:01:04:15 - 00:01:06:11	00:00:01:20	<i>Oh my god, she's looking at me!</i>	<i>Oh mio Dio, mi sta guardando!</i>
20	00:01:06:19 - 00:01:08:10	00:00:01:15	<i>Hyperintelligence.</i>	<i>all'iperintelligenza.</i>
21	00:01:34:08 -	00:00:02:20		FORGIARE IL FUTURO

1	00:01:37:04			
2 2	00:01:38:03 - 00:01:41:07	00:00:03:04		IPERINTELLIGENZA
2 3	00:01:43:03 - 00:01:44:18	00:00:01:15	My name is Shivani Bigler.	<i>Mi chiamo Shivani Bigler.</i>
2 4	00:01:45:05 - 00:01:47:21	00:00:02:16	As an engineer and neuroscientist in training.	<i>Sono ingegnere e neuroscienziata in formazione</i>
2 5	00:01:48:01 - 00:01:50:04	00:00:02:03	I'm obsessed with AI	<i>con una grande passione per l'IA.</i>
2 6	00:01:51:07 - 00:01:54:11	00:00:03:04	As a kid, my father took me to tech and robotics shows.	<i>Andavo spesso con mio padre alle fiere di robotica,</i>
2 7	00:01:54:15 - 00:01:56:14	00:00:01:23	Where I was struck by science.	<i>dove la scienza mi ha colpito.</i>
2 8	00:01:57:00 - 00:02:00:01	00:00:03:01	Every year, the inventions were smarter and smarter.	<i>Ogni anno c'erano invenzioni sempre più intelligenti.</i>
2 9	00:02:00:14 - 00:02:04:14	00:00:04:00	AI has come a very long way in the last couple of years	<i>L'IA ha fatto enormi progressi negli ultimi anni.</i>
3 0	00:02:05:07 - 00:02:09:12	00:00:04:05	Most AI technologies are programmed to think for themselves,	Molte tecnologie di IA sono programmate per pensare autonomamente
3 1	00:02:09:23 - 00:02:11:09	00:00:01:10	to learn from examples,	e imparare dagli esempi,
3 2	00:02:11:15 - 00:02:14:05	00:00:02:12	like simulating human intelligence	simulando il modo in cui l'intelligenza umana
3 3	00:02:14:11 - 00:02:17:14	00:00:03:03	in a way that it learns from past experience.	Impara dall'esperienza passata.
3 4	00:02:18:07 - 00:02:20:17	00:00:02:10	How does AI actually work?	<i>Come funziona realmente l'IA?</i>
3 5	00:02:20:22 - 00:02:24:08	00:00:03:10	Will AI achieve human traits like emotions,	<i>L'IA riuscirà ad acquisire tratti umani come emozioni,</i>
3 6	00:02:24:16 - 00:02:26:18	00:00:02:02	consciousness or even free will?	<i>coscienza o libero arbitrio?</i>
3 7	00:02:27:11 - 00:02:30:05	00:00:02:18	And how will humans and robots work together?	<i>Come lavoreranno insieme esseri umani e robot?</i>
3 8	00:02:31:16 - 00:02:35:21	00:00:04:05	Today, the clearest road to the future is the self-driving car.	<i>Oggi, la strada più chiara verso il futuro è l'auto a guida autonoma.</i>
3 9	00:02:36:15 - 00:02:39:06	00:00:02:15	Unlike a normal car, which is just a machine,	<i>A differenza di un'auto normale,</i>
4 0	00:02:39:12 - 00:02:42:17	00:00:03:05	a self-driving car is a robot that can make decisions.	<i>l'auto a guida autonoma può prendere decisioni.</i>
4 1	00:02:43:07 - 00:02:46:15	00:00:03:08	Will every car on the road become driverless?	<i>Tutte le auto diventeranno a guida autonoma?</i>
4 2	00:02:47:08 - 00:02:48:08	00:00:01:00	To find out,	<i>Per scoprirlo,</i>
4 3	00:02:48:12 - 00:02:51:17	00:00:03:05	I've come to a hot bed of self-driving car research.	<i>siamo nel focolaio della ricerca di queste automobili.</i>
4 4	00:02:51:22 - 00:02:53:06	00:00:01:08	PITTSBURGH, Pennsylvania	<i>PITTSBURGH, Pennsylvania</i>

4 5	00:02:53:21 - 00:02:59:07	00:00:05:10	Everyone has started to talk about self-driving car,	Tutti parlano di auto a guida autonoma,
4 6	00:02:59:21 - 00:03:01:14	00:00:01:17	because they're the future.	perché sono il futuro.
4 7	00:03:02:06 - 00:03:05:14	00:00:03:08	But to understand it, we have to look under the hood.	Ma per capire, dobbiamo guardare sotto il cofano.
4 8	00:03:06:00 - 00:03:07:12	00:00:01:12	Making quick decisions,	<i>Prendere decisioni al volo</i>
4 9	00:03:07:16 - 00:03:09:07	00:00:01:15	even simple ones like these,	<i>anche semplici come questa,</i>
5 0	00:03:09:11 - 00:03:11:08	00:00:01:21	is not easy for computers	<i>non è semplice per un computer.</i>
5 1	00:03:11:18 - 00:03:15:11	00:00:03:17	To discover the workings, I'm with a true pioneer in the field	<i>Per scoprire come funziona, siamo con un pioniere del settore.</i>
5 2	00:03:15:18 - 00:03:17:10	00:00:01:16	- Please, get in. - Thanks.	- Entri pure. - Grazie.
5 3	00:03:17:16 - 00:03:20:17	00:00:03:01	Dr. Raj Rajkumar of Carnegie Mellon University.	Il Dott. Raj Rajkumar della Carnegie Mellon University.
5 4	00:03:22:14 - 00:03:26:03	00:00:03:13	Carnegie Mellon is the birthplace of self-driving technology,	<i>In questa università è nata la tecnologia a guida autonoma,</i>
5 5	00:03:26:07 - 00:03:29:03	00:00:02:20	Thanks to the work of Raj and his colleagues.	<i>grazie al lavoro di Raj e dei suoi colleghi.</i>
5 6	00:03:29:10 - 00:03:33:09	00:00:03:23	They've been the main innovators in this field for 25 years.	<i>Da 25 anni sono i principali innovatori in questo settore.</i>
5 7	00:03:34:05 - 00:03:39:11	00:00:05:06	How does his self-driving car make decisions to navigate like a human driver?	<i>Come fa la sua macchina autonoma a prendere decisioni come facciamo noi?</i>
5 8	00:03:40:23 - 00:03:42:18	00:00:01:19	Should we get started?	Possiamo iniziare?
5 9	00:03:43:05 - 00:03:44:10	00:00:01:05	Yes, we can.	Sì parte.
6 0	00:03:44:17 - 00:03:47:09	00:00:02:16	Since Raj is distracted by our conversation,	<i>Dato che Raj è impegnato a parlare con me,</i>
6 1	00:03:47:20 - 00:03:52:23	00:00:05:03	For safety reasons, another driver in the front seat monitors the road.	<i>per sicurezza, un altro conducente sul sedile anteriore monitora la guida.</i>
6 2	00:03:53:18 - 00:03:54:23	00:00:01:05	This is so cool.	È fantastico.
6 3	00:03:55:07 - 00:03:57:08	00:00:02:01	I'm nervous but excited.	Sono agitata, ma entusiasta.
6 4	00:03:57:22 - 00:04:01:15	00:00:03:17	What's the longest you've ever driven a vehicle autonomously?	La distanza maggiore che hai percorso su un veicolo autonomo?
6 5	00:04:02:00 - 00:04:03:14	00:00:01:14	Hundreds of miles.	Centinaia di miglia.
6 6	00:04:03:18 - 00:04:04:18	00:00:01:00	Awesome.	Incredibile.
6 6	00:04:05:01 -	00:00:02:13	I'm going auto by pressing	Con questo pulsante si

7	00:04:07:14		this button.	passa all'autonomo.
6 8	00:04:09:03 - 00:04:10:11	00:00:01:08	Oh my gosh.	Oh mio dio.
6 9	00:04:12:09 - 00:04:14:01	00:00:01:16	It really is driving itself!	Sta guidando da sola.
7 0	00:04:14:14 - 00:04:17:01	00:00:02:11	Most self-driving cars are made from zero,	<i>Molte di queste auto sono prodotte da zero,</i>
7 1	00:04:17:05 - 00:04:19:05	00:00:02:00	but Raj took a regularly used car	<i>ma Raj ha preso un'auto usata</i>
7 2	00:04:19:09 - 00:04:22:17	00:00:03:08	and hacked it with powerful onboard computer systems,	<i>e l'ha modificata installando potenti sistemi informatici,</i>
7 3	00:04:22:22 - 00:04:25:21	00:00:02:23	making it more adaptable than other regular cars.	<i>rendendola più adattabile di altre auto normali.</i>
7 4	00:04:26:10 - 00:04:28:16	00:00:02:06	We installed sensors in there.	Abbiamo installato dei sensori.
7 5	00:04:29:07 - 00:04:31:13	00:00:02:06	It can shift the transmission gear,	Può cambiare la marcia,
7 6	00:04:31:21 - 00:04:33:11	00:00:01:14	turn the steering wheel,	girare il volante,
7 7	00:04:33:16 - 00:04:35:12	00:00:01:20	apply both brake and gas pedal.	accelerare e frenare.
7 8	00:04:36:03 - 00:04:38:14	00:00:02:11	It's the software that runs on the computer	È il software interno
7 9	00:04:38:20 - 00:04:41:11	00:00:02:15	that makes this capability really practical.	che rende tutto così semplice.
8 0	00:04:41:14 - 00:04:47:11	00:00:05:21	There are some key AI layers that try to mimic what the humans do.	Alcune reti neurali cercano di imitare ciò che fanno gli esseri umani.
8 1	00:04:48:06 - 00:04:49:19	00:00:01:13	To decide like a human,	<i>Per prendere decisioni,</i>
8 2	00:04:49:23 - 00:04:53:17	00:00:03:18	self-driving cars use a combination of cameras and radars	<i>queste auto usano una combinazione di videocamere e radar</i>
8 3	00:04:53:21 - 00:04:55:15	00:00:01:18	to see their surroundings.	<i>per guardarsi attorno.</i>
8 4	00:04:55:19 - 00:05:00:04	00:00:04:09	The AI software compares external objects to an internal 3D map	<i>L'IA confronta gli oggetti esterni con una sua mappa 3D</i>
8 5	00:05:00:08 - 00:05:03:08	00:00:03:00	of streets, signs and transportation infrastructure	<i>di strade, segnali e infrastrutture di trasporto.</i>
8 6	00:05:03:19 - 00:05:05:23	00:00:02:04	A map is static in nature.	Generalmente una mappa è statica.
8 7	00:05:06:11 - 00:05:09:05	00:00:02:18	Traffic, people, objects are dynamic in nature.	Ma traffico, persone e oggetti sono dinamici.
8 8	00:05:09:10 - 00:05:12:02	00:00:02:16	It quickly understands the dynamic information.	Può capire al volo le informazioni dinamiche.
8 9	00:05:13:06 - 00:05:18:21	00:00:05:15	Dynamic information allows it to understand where it is heading in space	<i>Le informazioni dinamiche le permettono di capire dove va</i>
9 0	00:05:19:05 - 00:05:21:20	00:00:02:14	and react to changes and traffic signals.	<i>e di reagire a cambiamenti e segnali stradali.</i>

9 1	00:05:22:12 - 00:05:25:04	00:00:02:16	- Aha, it recognizes the stop sign. - Yes.	- Ha riconosciuto lo stop. - Esatto.
9 2	00:05:26:11 - 00:05:29:23	00:00:03:12	She's a pedestrian. We definitely should not run into her.	È un pedone e dovremmo ovviamente evitarlo
9 3	00:05:30:08 - 00:05:34:19	00:00:04:11	The challenge of making a vehicle drive itself is not an easy task.	Creare un veicolo a guida autonoma non è affatto semplice.
9 4	00:05:35:13 - 00:05:39:08	00:00:03:19	Safety is priority number one and number two and three as well.	La sicurezza è la priorità numero uno, ma anche due e tre
9 5	00:05:41:02 - 00:05:46:02	00:00:05:00	What happens when the AI system doesn't understand specific objects?	<i>Cosa succede quando l'IA non riconosce oggetti specifici?</i>
9 6	00:05:47:05 - 00:05:51:10	00:00:04:05	A pedestrian in Tempe, Arizona was killed by a self-driving taxi.	<i>Un pedone a Tempe, Arizona è stato investito da un taxi a guida autonoma.</i>
9 7	00:05:51:17 - 00:05:55:05	00:00:03:12	It's the first fatality caused by an autonomous vehicle.	<i>È la prima morte causata da un veicolo a guida autonoma.</i>
9 8	00:05:55:18 - 00:06:01:11	00:00:05:17	The tragedy occurred due to a self-driving car not recognizing a person.	<i>Questo è successo perché l'auto non ha riconosciuto una persona.</i>
9 9	00:06:01:16 - 00:06:02:22	00:00:01:06	A jaywalker.	<i>Un pedone imprudente.</i>
1 0 0	00:06:03:02 - 00:06:08:04	00:00:05:02	Someday, self-driving cars will have to make life and death decisions on the fly.	<i>Un giorno, queste auto dovranno prendere decisioni critiche al volo.</i>
1 0 1	00:06:08:12 - 00:06:11:20	00:00:03:08	If avoiding the jaywalker means hitting another car,	<i>Se evitare il pedone significasse colpire un'altra auto,</i>
1 0 2	00:06:12:00 - 00:06:13:16	00:00:01:16	possibly killing the driver,	<i>uccidendo il conducente,</i>
1 0 3	00:06:13:23 - 00:06:15:09	00:00:01:10	what should it choose?	<i>cosa dovrebbe scegliere?</i>
1 0 4	00:06:15:17 - 00:06:18:21	00:00:03:04	How will scientists face huge problems like these?	<i>Come affronteranno problemi così grandi gli scienziati?</i>
1 0 5	00:06:20:05 - 00:06:22:15	00:00:02:10	The first wave of AI robots	<i>I primi robot con IA</i>
1 0 6	00:06:22:19 - 00:06:26:19	00:00:04:00	were programmed by engineers with static sets of rules	<i>erano programmati dagli ingegneri CON istruzioni fisse</i>
1 0 7	00:06:27:08 - 00:06:29:11	00:00:02:03	These rules are called algorithms.	<i>chiamate algoritmi.</i>
1 0 8	00:06:29:20 - 00:06:32:09	00:00:02:13	But not all rules work in all situations.	<i>Questi però non funzionano sempre.</i>
1	00:06:32:16 -	00:00:03:12	This approach is very	<i>È un approccio rigido che</i>

09	00:06:36:04		inflexible, requiring new programming	<i>richiede una riprogrammazione</i>
110	00:06:36:08 - 00:06:39:11	00:00:03:03	to accomplish even the smallest changes in any task	<i>anche per cambiamenti minimi in un dato compito.</i>
111	00:06:40:08 - 00:06:43:23	00:00:03:15	A new approach called machine learning has changed everything	<i>Un nuovo approccio chiamato machine learning ha cambiato tutto,</i>
112	00:06:44:03 - 00:06:49:12	00:00:05:09	With machine learning, computers can use information by interacting with the world,	<i>perché ora i computer possono utilizzare le informazioni interagendo con il mondo</i>
113	00:06:49:16 - 00:06:53:06	00:00:03:14	to rewrite their programming, getting smarter on their own	<i>per riprogrammarsi e diventare più intelligenti.</i>
114	00:06:55:21 - 00:07:00:23	00:00:05:02	To see machine learning in action, I'm with another team in a coal mine.	<i>Per vedere il machine learning in azione, ci troviamo in una miniera di carbone.</i>
115	00:07:01:11 - 00:07:02:13	00:00:01:02	Dr. Matt Travers	<i>Matt Travers</i>
116	00:07:02:17 - 00:07:07:06	00:00:04:13	leads a group that won a subterranean navigation competition	<i>guida un gruppo che ha vinto una competizione di navigazione sotterranea</i>
117	00:07:07:13 - 00:07:11:00	00:00:03:11	held by the Department of Defense's research agency, DARPA.	<i>organizzata dall'agenzia governativa di ricerca DARPA.</i>
118	00:07:11:17 - 00:07:17:06	00:00:05:13	They're affectionately known as R1, R2, and R stands for robot.	<i>Li chiamiamo affettuosamente R1 e R2, dove R sta per robot.</i>
119	00:07:19:06 - 00:07:24:03	00:00:04:21	These robots are designed for very dangerous search and rescue missions.	<i>Questi robot sono progettati per missioni di ricerca e salvataggio ad alto rischio.</i>
120	00:07:24:13 - 00:07:28:02	00:00:03:13	And unlike the self-driving car, they work without a map.	<i>Diversamente dall'auto a guida autonoma, non usano una mappa.</i>
121	00:07:29:02 - 00:07:34:03	00:00:05:01	To achieve this, they have to learn to identify every object they encounter.	<i>Per farlo, devono imparare a identificare al volo ogni oggetto in cui si imbattono.</i>
122	00:07:35:03 - 00:07:39:02	00:00:03:23	They are programmed to go out and actually act fully autonomously.	<i>Sono programmati per operare in piena autonomia.</i>
123	00:07:39:12 - 00:07:45:12	00:00:06:00	They'll make all their own decisions, recognizing objects and choosing the path.	<i>Prendono le decisioni, riconoscono gli oggetti, scelgono il percorso</i>
124	00:07:45:16 - 00:07:47:15	00:00:01:23	- Where to explore. - Wow...	<i>e cosa esplorare.</i>
125	00:07:47:20 - 00:07:52:18	00:00:04:22	To see this in action, the R2 robot begins a simulated search and rescue mission	<i>Per vederlo in azione, l'R2 inizia una missione di ricerca e salvataggio</i>

				<i>simulata</i>
1 2 6	00:07:52:22 - 00:07:55:05	00:00:02:07	<i>to find a stranded dummy in the mine.</i>	<i>per trovare un manichino nella miniera.</i>
1 2 7	00:07:55:19 - 00:08:00:23	00:00:05:04	Imagine having a map of a collapsed mine before sending a rescue team.	Immagina di avere una mappa di una miniera crollata prima che partano i soccorsi.
1 2 8	00:08:01:03 - 00:08:03:03	00:00:02:00	It's really a game changer.	È davvero una svolta.
1 2 9	00:08:04:07 - 00:08:09:19	00:00:05:12	<i>The robot's understanding of its environment mirrors an infant's learning.</i>	<i>Un robot legge l'ambiente proprio come imparano i neonati.</i>
1 3 0	00:08:10:06 - 00:08:13:23	00:00:03:17	<i>A 3-month-old uses her senses to map her environment</i>	<i>A tre mesi, i bambini usano i loro sensi per mappare l'ambiente</i>
1 3 1	00:08:14:03 - 00:08:15:19	00:00:01:16	<i>and recognize her parents.</i>	<i>e riconoscere i genitori.</i>
1 3 2	00:08:16:02 - 00:08:19:18	00:00:03:16	<i>She uses this map to interact with everything in her world.</i>	<i>Usano questa mappa per interagire con quanto li circonda.</i>
1 3 3	00:08:21:07 - 00:08:22:08	00:00:01:01	<i>Like this robot.</i>	<i>Come questo robot.</i>
1 3 4	00:08:23:05 - 00:08:24:19	00:00:01:14	Okay, we're ready to roll.	Siamo pronti a partire.
1 3 5	00:08:25:15 - 00:08:28:23	00:00:03:08	AI makes this learning curve possible.	<i>L'IA rende possibile questa curva di apprendimento.</i>
1 3 6	00:08:29:07 - 00:08:33:05	00:00:03:22	How does it create a map and identify a human on its own?	<i>Ma come può creare una mappa e identificare un umano autonomamente?</i>
1 3 7	00:08:33:12 - 00:08:36:14	00:00:03:02	And without an internal map like the internet?	<i>E senza una mappa interna come internet?</i>
1 3 8	00:08:37:22 - 00:08:43:00	00:00:05:02	<i>Test engineer Steve Willits shows me how the R2 can detect a stranded person.</i>	<i>L'ingegnere Steve Willits mi mostra come fa il robot a rilevare una persona.</i>
1 3 9	00:08:44:11 - 00:08:47:12	00:00:03:01	When you're in a search and rescue scenario,	Una missione di ricerca e salvataggio
1 4 0	00:08:47:20 - 00:08:51:13	00:00:03:17	that's the situation where you'd want to deploy one of these	è la situazione ideale per utilizzare questi robot.
1 4 1	00:08:52:04 - 00:08:56:23	00:00:04:19	<i>As it explores and maps the cave, it drops signal repeaters</i>	<i>Mentre esplora e mappa la caverna, il robot lascia dei ripetitori di segnale</i>
1 4 2	00:08:57:02 - 00:08:59:00	00:00:01:22	<i>to create a Wi-Fi network trail.</i>	<i>per creare una rete Wi-Fi.</i>
1	00:08:59:04 -	00:00:03:11	It drops those sort of	Lascia queste "briciole"

4 3	00:09:02:15		breadcrumbs along the path.	durante il percorso.
1 4 4	00:09:02:23 - 00:09:04:05	00:00:01:06	<i>Using this network,</i>	<i>Con questa rete,</i>
1 4 5	00:09:04:09 - 00:09:07:10	00:00:03:01	<i>the robot sends data to create a map.</i>	<i>il robot invia dati per creare una mappa.</i>
1 4 6	00:09:08:21 - 00:09:14:14	00:00:05:17	<i>At once, the robot must examine every object to identify the stranded human.</i>	<i>Deve esaminare ogni oggetto per identificare il disperso.</i>
1 4 7	00:09:15:05 - 00:09:19:04	00:00:03:23	So the LIDAR system is giving a full laser scan.	Il sistema LIDAR esegue quindi una scansione laser completa.
1 4 8	00:09:20:03 - 00:09:23:10	00:00:03:07	<i>LIDAR stands for Light Detection and Ranging.</i>	LIDAR sta per Light Detection and Ranging.
1 4 9	00:09:23:22 - 00:09:27:09	00:00:03:11	<i>Similar to the radar, which uses radio waves,</i>	<i>Come il radar, che utilizza onde radio,</i>
1 5 0	00:09:27:15 - 00:09:30:11	00:00:02:20	<i>LIDAR systems send out laser pulses of light.</i>	<i>i sistemi LIDAR emettono impulsi laser</i>
1 5 1	00:09:30:20 - 00:09:34:15	00:00:03:19	<i>and calculates the time it takes to hit a object and bounce back.</i>	<i>e calcolano il tempo di ritorno dopo aver colpito l'oggetto.</i>
1 5 2	00:09:35:04 - 00:09:39:06	00:00:04:02	<i>This process creates a 3D image of the objects in the environment,</i>	<i>Questo processo crea un'immagine 3D degli oggetti nell'ambiente</i>
1 5 3	00:09:39:14 - 00:09:42:02	00:00:02:12	<i>which the onboard computer can identify.</i>	<i>che il computer di bordo può identificare.</i>
1 5 4	00:09:43:03 - 00:09:47:00	00:00:03:21	<i>This process is similar to how the eye sends data to the brain,</i>	<i>Un processo simile a quello dell'occhio che invia dati al cervello,</i>
1 5 5	00:09:47:16 - 00:09:52:16	00:00:05:00	<i>which then recognizes objects using our knowledge of their appearance.</i>	<i>e poi riconosce gli oggetti utilizzando la nostra conoscenza del loro aspetto.</i>
1 5 6	00:09:54:15 - 00:09:56:14	00:00:01:23	<i>By understanding its environment,</i>	<i>Comprendendo l'ambiente,</i>
1 5 7	00:09:56:18 - 00:09:59:18	00:00:03:00	<i>R2 can make better decisions about where to go,</i>	<i>R2 può prendere decisioni migliori su dove andare,</i>
1 5 8	00:10:00:03 - 00:10:01:07	00:00:01:04	<i>and where not to go.</i>	<i>e dove non andare.</i>
1 5 9	00:10:03:01 - 00:10:06:04	00:00:03:03	What our robot's doing right now is exploring.	In questo momento il robot sta esplorando.
1 6	00:10:07:02 - 00:10:09:00	00:00:01:22	So the robot came to a junction	Ora è arrivato a un bivio

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1 6 1	00:10:09:09 - 00:10:13:11	00:00:04:02	and saw it couldn't pass left. - Right.	e ha visto che a sinistra non può passare.
1 6 2	00:10:13:20 - 00:10:17:08	00:00:03:12	So it saw the opening to the right, and that's where he went.	Ha visto l'apertura a destra, ed è andato là.
1 6 3	00:10:22:17 - 00:10:25:01	00:00:02:08	It looks like it's making decisions	Sembra stia decidendo
1 6 4	00:10:25:08 - 00:10:30:04	00:00:04:20	about whether or not to climb over these planks and obstacles	se scavalcare o meno queste assi e gli ostacoli
1 6 5	00:10:30:10 - 00:10:34:05	00:00:03:19	all up in this area, right? - That's exactly what it's doing.	sparsi in questa zona, giusto? - Esattamente.
1 6 6	00:10:34:19 - 00:10:37:15	00:00:02:20	<i>Just like a baby, R2 learns to trial and error.</i>	<i>Proprio come un bambino, R2 impara per tentativi.</i>
1 6 7	00:10:37:20 - 00:10:39:18	00:00:01:22	It's like a dog wagging its tail.	Sembra un cane che scodinzola.
1 6 8	00:10:40:11 - 00:10:42:19	00:00:02:08	<i>With no one to rescue, it moves on.</i>	<i>Non avendo nessuno da salvare, prosegue.</i>
1 6 9	00:10:44:20 - 00:10:47:06	00:00:02:10	<i>As R2 continues to map out the mine,</i>	<i>Mentre R2 continua a mappare la miniera,</i>
1 7 0	00:10:48:01 - 00:10:50:05	00:00:02:04	Oh my god, a human.	Oh mio Dio, una persona.
1 7 1	00:10:50:15 - 00:10:52:21	00:00:02:06	<i>it stumbles upon its intended target.</i>	<i>si imbatte nel suo obiettivo.</i>
1 7 2	00:10:53:01 - 00:10:56:02	00:00:03:01	That is Randy, Rescue Randy.	Questo è Randy, Rescue Randy.
1 7 3	00:10:56:21 - 00:11:00:14	00:00:03:17	Hello Rescue Randy, you scared me.	Ciao Rescue Randy, mi hai fatto paura.
1 7 4	00:11:01:12 - 00:11:03:12	00:00:02:00	<i>With the finding of Rescue Randy,</i>	<i>Dopo aver trovato Rescue Randy,</i>
1 7 5	00:11:03:16 - 00:11:06:18	00:00:03:02	<i>the R2 can not only alert emergency personnel,</i>	<i>R2 può allertare il personale di emergenza,</i>
1 7 6	00:11:06:21 - 00:11:09:11	00:00:02:14	<i>but also provide a map on how to find him.</i>	<i>e anche fornire una mappa per raggiungerlo.</i>
1 7 7	00:11:10:09 - 00:11:13:20	00:00:03:11	That is incredible. It knows what it's doing.	È incredibile. Sa quello che sta facendo.
1 7	00:11:15:00 - 00:11:20:13	00:00:05:13	<i>These rescue robots are paving the path for</i>	<i>Questi robot da soccorso stanno aprendo la strada</i>

8			<i>hyperintelligence.</i>	<i>all'iperintelligenza.</i>
1 7 9	00:11:22:22 - 00:11:23:22	00:00:01:00	<i>In the future,</i>	<i>Nel futuro</i>
1 8 0	00:11:24:02 - 00:11:29:21	00:00:05:19	<i>Autonomous vehicles perform search and rescue in all disaster zones.</i>	<i>i veicoli autonomi eseguono operazioni di ricerca e soccorso in zone di disastri.</i>
1 8 1	00:11:30:11 - 00:11:32:22	00:00:02:11	<i>even in avalanches on Mount Everest.</i>	<i>Anche in valanghe in cima al monte Everest.</i>
1 8 2	00:11:33:11 - 00:11:34:11	00:00:01:00	<i>Incredibly,</i>	<i>Incredibilmente,</i>
1 8 3	00:11:34:15 - 00:11:40:13	00:00:05:22	<i>Intelligent off-road vehicles are mapping undiscovered cave systems,</i>	<i>i fuoristrada intelligenti mappano sistemi di grotte ancora sconosciuti,</i>
1 8 4	00:11:40:20 - 00:11:45:23	00:00:05:03	<i>discovering a vast supply of rare earth elements essential for modern technology.</i>	<i>e scoprono vaste riserve di elementi rari, essenziali per la tecnologia moderna.</i>
1 8 5	00:11:48:05 - 00:11:51:18	00:00:03:13	<i>AI will clearly save human lives in the future.</i>	<i>È chiaro che nel futuro l'IA salverà vite umane.</i>
1 8 6	00:11:52:11 - 00:11:56:06	00:00:03:19	<i>But much of Earth's terrain is too tough for wheels to navigate.</i>	<i>Ma gran parte del suolo terrestre non si può esplorare via terra.</i>
1 8 7	00:11:57:01 - 00:12:00:06	00:00:03:05	<i>How will intelligent robots navigate rainforests,</i>	<i>Come faranno i robot a esplorare le foreste pluviali,</i>
1 8 8	00:12:00:18 - 00:12:03:19	00:00:03:01	<i>bodies of water, or even mountaintops?</i>	<i>gli specchi d'acqua o le vette delle montagne?</i>
1 8 9	00:12:05:01 - 00:12:10:17	00:00:05:16	<i>In Philadelphia, Jason Derenick of Exyn Technology is addressing this issue.</i>	<i>A Philadelphia, Jason Derenick della Exyn Technology sta affrontando il problema.</i>
1 9 0	00:12:11:08 - 00:12:16:14	00:00:05:06	<i>We focus on autonomous aerorobotics to help drones navigate</i>	<i>Ci occupiamo di robotica aerea autonoma per aiutare i droni a muoversi</i>
1 9 1	00:12:16:18 - 00:12:19:00	00:00:02:06	<i>unknown or unexplored spaces.</i>	<i>in spazi sconosciuti o inesplorati.</i>
1 9 2	00:12:19:17 - 00:12:24:08	00:00:04:15	<i>Jason's team built the first self-flying industrial drone that can fly anywhere.</i>	<i>Il team di Jason ha costruito il primo drone autonomo che può volare ovunque.</i>
1 9 3	00:12:24:21 - 00:12:28:09	00:00:03:12	<i>Incredibly, these autonomous robots navigate without GPS,</i>	<i>Incredibilmente, questi robot autonomi si muovono senza GPS,</i>
1 9 4	00:12:28:18 - 00:12:30:19	00:00:02:01	<i>and map the environment as they go.</i>	<i>e mappano l'ambiente mentre volano.</i>
1 9 5	00:12:31:01 - 00:12:34:10	00:00:03:09	<i>We focus on autonomy, including perception,</i>	<i>Ci concentriamo sull'autonomia, inclusi la percezione,</i>

1 9 6	00:12:34:18 - 00:12:36:03	00:00:01:09	<i>flight orientation,</i>	l'orientamento in volo,
1 9 7	00:12:36:13 - 00:12:39:11	00:00:02:22	<i>motion planning, and then, finally, control.</i>	la pianificazione e il controllo del movimento.
1 9 8	00:12:40:01 - 00:12:45:08	00:00:05:07	<i>But going from two to three dimensions requires an increase in AI processing.</i>	<i>Passare da due a tre dimensioni richiede più capacità di calcolo dell'IA.</i>
1 9 9	00:12:46:23 - 00:12:51:05	00:00:04:06	<i>The drone's mission is to fly independently through a 3D path</i>	<i>L'obiettivo del drone è volare in modo autonomo lungo un percorso 3D</i>
2 0 0	00:12:51:09 - 00:12:53:06	00:00:01:21	<i>across the warehouse.</i>	<i>attraverso il magazzino.</i>
2 0 1	00:12:54:03 - 00:12:55:19	00:00:01:16	Starting in three, two, one.	Si parte tra tre, due, uno.
2 0 2	00:12:57:17 - 00:12:59:16	00:00:01:23	<i>To mess with its computer mind,</i>	<i>Per confondere il robot,</i>
2 0 3	00:12:59:20 - 00:13:04:05	00:00:04:09	<i>Jason's team places new and unexpected obstacles in its path.</i>	<i>il team di Jason posiziona nuovi ostacoli sul suo tragitto.</i>
2 0 4	00:13:05:04 - 00:13:07:18	00:00:02:14	<i>Will the drone recognize this changes?</i>	<i>Il drone riconoscerà questi cambiamenti?</i>
2 0 5	00:13:08:11 - 00:13:11:02	00:00:02:15	<i>Will it get lost? Will it crash?</i>	<i>Si perderà? Si schianterà?</i>
2 0 6	00:13:11:23 - 00:13:16:02	00:00:04:03	<i>We have a gimbaled LIDAR system that allows the vehicle to paint</i>	C'è un sistema LIDAR girevole che permette al robot di tracciare
2 0 7	00:13:16:06 - 00:13:20:07	00:00:04:01	<i>a full 360 sphere around it, in order to sense its environment.</i>	una sfera a 360 gradi intorno a sé, per percepire ciò che lo circonda.
2 0 8	00:13:20:20 - 00:13:24:18	00:00:03:22	<i>Like the robot in the mine, this aerial robot uses LIDAR to see.</i>	<i>Come il robot nella miniera, il robot aereo usa il LIDAR per vedere.</i>
2 0 9	00:13:25:15 - 00:13:30:10	00:00:04:19	<i>It generates a voxelized representation of the space that you see here.</i>	Genera una rappresentazione voxelizzata dello spazio che vedi qui.
2 1 0	00:13:30:21 - 00:13:34:01	00:00:03:04	<i>Each cube in the space is trying to determine</i>	Ogni cubo nello spazio cerca di determinare
2 1 1	00:13:34:07 - 00:13:38:13	00:00:04:06	<i>whether that cube is occupied or whether it's free space.</i>	se quel cubo di spazio è libero o occupato.
2 1 2	00:13:43:01 - 00:13:48:10	00:00:05:09	<i>The robot makes real-time navigation decisions based on its visual input.</i>	<i>Il robot decide come muoversi in tempo reale in base agli input visivi.</i>
2 1	00:13:49:04 - 00:13:50:13	00:00:01:09	Kind of like us humans.	<i>Come facciamo noi.</i>

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2 1 4	00:13:53:07 - 00:13:57:04	00:00:03:21	<i>Incredibly, the drone recognizes and avoids the whiteboards.</i>	<i>Con grande stupore, il drone riconosce ed evita le lavagne.</i>
2 1 5	00:13:58:16 - 00:14:02:06	00:00:03:14	What makes this system particularly special	Ciò che rende speciale questo sistema
2 1 6	00:14:02:11 - 00:14:07:04	00:00:04:17	is that it's being used in the real world, to keep people out of harm's way.	è che viene utilizzato nel mondo reale, per tenere la gente lontano dal pericolo.
2 1 7	00:14:08:07 - 00:14:12:19	00:00:04:12	<i>Autonomous drones are already working in hazardous industries like mining,</i>	<i>I droni autonomi operano già in settori rischiosi come l'estrazione mineraria,</i>
2 1 8	00:14:13:00 - 00:14:15:09	00:00:02:09	<i>construction and oil exploration.</i>	<i>l'edilizia e l'esplorazione petrolifera.</i>
2 1 9	00:14:15:16 - 00:14:21:05	00:00:05:13	They safely inspect dangerous areas and create detailed maps of rough terrain.	<i>Ispezionano aree pericolose e creano mappe dettagliate di terreni accidentati.</i>
2 2 0	00:14:22:01 - 00:14:24:01	00:00:02:00	From a technological perspective,	Da un punto di vista tecnologico,
2 2 1	00:14:24:13 - 00:14:26:16	00:00:02:03	The fact that we can do everything	il fatto che possiamo fare tutto
2 2 2	00:14:26:19 - 00:14:31:04	00:00:04:09	onboard, self-contained, and enabling the system to make its own decisions,	in modo autonomo, permettendo al sistema di prendere decisioni da solo,
2 2 3	00:14:31:16 - 00:14:33:13	00:00:01:21	I don't know where to start.	mi lascia senza parole.
2 2 4	00:14:37:20 - 00:14:42:15	00:00:04:19	<i>Self-flying robots will revolutionize search and rescue, and disaster response.</i>	<i>I droni autonomi rivoluzioneranno le operazioni di soccorso ed emergenza.</i>
2 2 5	00:14:43:11 - 00:14:46:03	00:00:02:16	<i>They could also transform package delivery.</i>	<i>Potrebbero rivoluzionare persino le consegne.</i>
2 2 6	00:14:46:12 - 00:14:49:09	00:00:02:21	<i>But large single drones have their limits.</i>	<i>Ma i droni grandi da soli hanno i loro limiti.</i>
2 2 7	00:14:49:16 - 00:14:54:15	00:00:04:23	More complex tasks will require teams of small, nimble autonomous robots.	<i>I compiti più complessi richiederanno squadre di piccoli e agili robot autonomi.</i>
2 2 8	00:14:56:05 - 00:14:59:11	00:00:03:06	<i>Dr. Vijay Kumar at the University of Pennsylvania</i>	<i>Il Dott. Vijay Kumar dell'Università della Pennsylvania</i>
2 2 9	00:14:59:15 - 00:15:01:22	00:00:02:07	<i>is working with swarms of drones</i>	<i>lavora con sciame di droni</i>
2	00:15:02:02 -	00:00:05:04	<i>to play music and build</i>	<i>per suonare e costruire</i>

3 0	00:15:07:06		<i>structures cooperatively.</i>	<i>strutture in modo cooperativo.</i>
2 3 1	00:15:08:18 - 00:15:13:09	00:00:04:15	<i>He's also developing technologies to tackle some very big problems,</i>	<i>Sta anche sviluppando tecnologie per affrontare problemi molto grandi,</i>
2 3 2	00:15:13:14 - 00:15:15:02	00:00:01:12	<i>Including world hunger.</i>	<i>tra cui la fame nel mondo.</i>
2 3 3	00:15:15:06 - 00:15:16:17	00:00:01:11	In a couple of decades,	Tra un paio di decenni,
2 3 4	00:15:16:21 - 00:15:20:11	00:00:03:14	we'll have over nine billion people to feed on this planet.	avremo oltre nove miliardi di persone da sfamare sulla Terra.
2 3 5	00:15:20:15 - 00:15:22:19	00:00:02:04	Of course, that's a big challenge.	Ovviamente, è una grande sfida.
2 3 6	00:15:23:05 - 00:15:25:05	00:00:02:00	<i>To take on such a big task,</i>	<i>Per affrontarla,</i>
2 3 7	00:15:25:11 - 00:15:29:22	00:00:04:11	<i>he's building an army of small flying robots that can synchronize.</i>	<i>sta creando un esercito di piccoli robot volanti sincronizzati.</i>
2 3 8	00:15:30:06 - 00:15:35:00	00:00:04:18	We think about technologies that can be mounted on small flying robots,	Pensiamo a tecnologie che possono essere montate su piccoli robot volanti,
2 3 9	00:15:35:07 - 00:15:37:15	00:00:02:08	that can be directed in different ways,	direzionabili in modi diversi,
2 4 0	00:15:38:00 - 00:15:41:04	00:00:03:04	like a flock of birds reacting to a predator,	come uno stormo di uccelli che reagisce a un predatore,
2 4 1	00:15:41:10 - 00:15:42:21	00:00:01:11	or a school of fish.	o un banco di pesci.
2 4 2	00:15:43:11 - 00:15:49:05	00:00:05:18	You have coordination, collaboration, and it all happens very organically.	C'è coordinazione, collaborazione, e tutto accade in modo molto naturale.
2 4 3	00:15:49:22 - 00:15:55:14	00:00:05:16	<i>Getting robots to coordinately work together using AI is a daunting task.</i>	<i>Far lavorare insieme e in modo coordinato i robot usando l'IA è una sfida enorme.</i>
2 4 4	00:15:57:11 - 00:16:02:09	00:00:04:22	Three or five years ago, most of our robots relied on GPS-like sensors.	Fino a pochi anni fa, i robot si basavano per lo più su sensori simili al GPS.
2 4 5	00:16:02:18 - 00:16:07:21	00:00:05:03	Today, we have the equivalent of smartphones embedded in our robots,	Oggi, integrano l'equivalente degli smartphone,
2 4 6	00:16:08:06 - 00:16:11:20	00:00:03:14	and they sense how fast they're going by looking at the world,	e percepiscono la loro velocità osservando l'ambiente
2	00:16:12:02 -	00:00:03:04	combining it with inertial	e lo combinano con la

4 7	00:16:15:06		measurement data,	misurazione inerziale
2 4 8	00:16:15:15 - 00:16:20:02	00:00:04:11	and then estimating their location and speed.	Così da stimare la loro posizione e la loro velocità.
2 4 9	00:16:20:19 - 00:16:24:23	00:00:04:04	<i>This I have to see, and I'm going to check it out virtually as a robot.</i>	<i>Questo lo devo vedere, e lo farò virtualmente come un robot.</i>
2 5 0	00:16:26:19 - 00:16:30:03	00:00:03:08	<i>I'm at UPenn, remotely in Vijay Kumar's lab.</i>	<i>Mi trovo virtualmente nel laboratorio di Vijay Kumar.</i>
2 5 1	00:16:31:01 - 00:16:32:17	00:00:01:16	<i>Sample my surroundings.</i>	<i>Esamino ciò che mi circonda.</i>
2 5 2	00:16:33:10 - 00:16:35:09	00:00:01:23	<i>Oh, I hit something.</i>	<i>Ops, ho colpito qualcosa.</i>
2 5 3	00:16:35:16 - 00:16:37:02	00:00:01:10	- Hello. - Hey.	- Ciao. - Ehi.
2 5 4	00:16:37:17 - 00:16:40:14	00:00:02:21	<i>Vijay's apprentice, Dinesh Thakur, is my guide.</i>	<i>L'allievo di Vijay, Dinesh Thakur, è la mia guida.</i>
2 5 5	00:16:41:00 - 00:16:43:20	00:00:02:20	Today, we will show robots flying in formation.	Oggi mostreremo i robot che volano in formazione.
2 5 6	00:16:44:03 - 00:16:46:05	00:00:02:02	- Can we see how it works? - Sure.	- Ci mostri come funziona? - Certo
2 5 7	00:16:46:10 - 00:16:52:04	00:00:05:18	<i>The first step in coordinating the drones is providing a common point of reference.</i>	<i>Per coordinare i droni bisogna fornire un punto di riferimento comune.</i>
2 5 8	00:16:52:08 - 00:16:56:13	00:00:04:05	<i>In this case, a visual tag similar to a basic QR code.</i>	<i>In questo caso, un riferimento visivo simile a un codice QR.</i>
2 5 9	00:16:58:12 - 00:17:03:02	00:00:04:14	<i>Using only the onboard camera, these drones reference the code on the tag</i>	<i>Usando la sola telecamera integrata, i droni usano il codice sul riferimento</i>
2 6 0	00:17:03:10 - 00:17:05:13	00:00:02:03	<i>and visualize where they are.</i>	<i>e visualizzano la propria posizione.</i>
2 6 1	00:17:05:21 - 00:17:09:00	00:00:03:03	<i>Using sophisticated, bio-inspired algorithm,</i>	<i>Utilizzando un algoritmo ispirato alla biologia,</i>
2 6 2	00:17:09:04 - 00:17:13:08	00:00:04:04	<i>the drones can determine each other's position in the swarm.</i>	<i>i droni determinano la posizione reciproca nello sciame.</i>
2 6 3	00:17:14:11 - 00:17:16:19	00:00:02:08	<i>Are the drones communicating?</i>	<i>I droni stanno comunicando tra loro?</i>
2 6	00:17:16:23 - 00:17:20:05	00:00:03:06	- Yes, they're communicating over Wi-Fi.	- Sì, comunicano tramite Wi-Fi.

4			- So cool!	- Incredibile.
2 6 5	00:17:21:03 - 00:17:25:23	00:00:04:20	Future drones will create their own localized wireless network to communicate.	In futuro, i droni creeranno una propria rete wireless locale per comunicare.
2 6 6	00:17:26:13 - 00:17:29:03	00:00:02:14	For now, this swarm is a proof of concept.	Per ora, lo sciame è una prova di concetto.
2 6 7	00:17:29:16 - 00:17:33:01	00:00:03:09	You've defined a formation, and they're assuming it?	Hai stabilito una formazione e loro la stanno assumendo?
2 6 8	00:17:33:05 - 00:17:38:15	00:00:05:10	Yeah, I just say I want to form a line and the drones figure out their positions.	Sì, gli dico di mettersi in fila e i droni si posizionano da soli.
2 6 9	00:17:38:22 - 00:17:42:02	00:00:03:04	Once they know their positions relative to each other,	Una volta che conoscono le loro posizioni reciproche,
2 7 0	00:17:42:07 - 00:17:45:04	00:00:02:21	They can then cooperate to achieve a shared goal,	collaborano per raggiungere un obiettivo comune,
2 7 1	00:17:45:09 - 00:17:47:11	00:00:02:02	Like ants working collectively.	come fanno le formiche.
2 7 2	00:17:48:03 - 00:17:52:04	00:00:04:01	Once they can coordinate, we can assign them specific missions.	Una volta in grado di coordinarsi, possono svolgere compiti specifici.
2 7 3	00:17:52:13 - 00:17:53:19	00:00:01:06	That's really cool.	È fantastico.
2 7 4	00:17:55:20 - 00:17:58:14	00:00:02:18	Swarms of flying robots have their advantages.	Gli sciame di droni hanno diversi vantaggi.
2 7 5	00:17:58:23 - 00:18:03:18	00:00:04:19	Unlike a single drone self-coordinating swarms can perform complex tasks	Rispetto a un singolo drone, gli sciame auto-coordinati eseguono compiti complessi
2 7 6	00:18:03:22 - 00:18:05:16	00:00:01:18	like mapping, much faster.	come la mappatura velocemente,
2 7 7	00:18:06:01 - 00:18:08:10	00:00:02:09	By collaborating and sharing data.	collaborando e condividendo dati.
2 7 8	00:18:09:00 - 00:18:12:13	00:00:03:13	Losing one drone doesn't doom the whole operation.	Perdere un drone non compromette l'intera operazione.
2 7 9	00:18:14:15 - 00:18:19:04	00:00:04:13	Vijay imagines using his advanced swarm technology to work on farms.	Vijay immagina di utilizzare gli sciame di droni nelle fattorie.
2 8 0	00:18:19:14 - 00:18:23:22	00:00:04:08	This precision agriculture will help feed the world's growing population.	L'agricoltura di precisione aiuterà a sfamare la popolazione in aumento.
2 8 1	00:18:24:10 - 00:18:27:20	00:00:03:10	We'd like robots to be able to roam farms,	Vorremmo vedere i robot volare per le fattorie
2	00:18:28:00 -	00:00:03:15	and be able to provide	per fornire dati precisi su

8 2	00:18:31:15		precise data on individual plants,	ogni singola pianta,
2 8 3	00:18:31:22 - 00:18:36:06	00:00:04:08	that then can be used to increase the efficiency of food production.	così da aumentare l'efficienza della produzione.
2 8 4	00:18:36:18 - 00:18:39:05	00:00:02:11	That would greatly impact our world.	Sarebbe un grande passo avanti.
2 8 5	00:18:39:15 - 00:18:43:18	00:00:04:03	This is our duty as responsible citizens and as responsible engineers.	È il nostro dovere in quanto cittadini e ingegneri responsabili.
2 8 6	00:18:44:02 - 00:18:49:18	00:00:05:16	<i>This visionary approach to solving future problems is surely a path I can get on.</i>	<i>Questo approccio visionario è un percorso che potrei seguire.</i>
2 8 7	00:18:53:03 - 00:18:58:11	00:00:05:08	<i>In the future, AI will coordinate flocks of drones to protect the environment,</i>	<i>Nel futuro, l'IA coordina sciame di droni per proteggere l'ambiente</i>
2 8 8	00:18:58:15 - 00:19:00:15	00:00:02:00	<i>and boost the food supply.</i>	<i>e aumentare la produzione di cibo.</i>
2 8 9	00:19:01:00 - 00:19:05:01	00:00:04:01	<i>To fight climate change's negative impact on agricultural crops,</i>	<i>Per contrastare i danni del cambiamento climatico alle colture,</i>
2 9 0	00:19:05:12 - 00:19:09:14	00:00:04:02	<i>robotic bees assist with pollination in orchards and on farms,</i>	<i>api robotiche sostengono l'impollinazione in frutteti e fattorie,</i>
2 9 1	00:19:09:22 - 00:19:12:13	00:00:02:15	<i>making them more sustainable and productive.</i>	<i>rendendoli più sostenibili e produttivi.</i>
2 9 2	00:19:13:05 - 00:19:17:21	00:00:04:16	<i>Fish-shaped underwater robots deploy automatically in case of an oil spill.</i>	<i>Robot a forma di pesce intervengono subito in caso di sversamento di petrolio.</i>
2 9 3	00:19:18:16 - 00:19:22:12	00:00:03:20	<i>These drones create a barricade to rapidly contain spills,</i>	<i>Creano una barriera per contenere gli sversamenti,</i>
2 9 4	00:19:22:21 - 00:19:26:01	00:00:03:04	<i>saving marine life and oceans across the world.</i>	<i>salvando la vita marina e gli oceani di tutto il mondo.</i>
2 9 5	00:19:27:10 - 00:19:30:13	00:00:03:03	<i>Modern society has a long history of building robots</i>	<i>Da tempo la società moderna costruisce robot</i>
2 9 6	00:19:30:17 - 00:19:34:11	00:00:03:18	<i>for dangerous, difficult, or repetitive tasks for humans.</i>	<i>per compiti pericolosi, difficili o ripetitivi.</i>
2 9 7	00:19:35:00 - 00:19:39:14	00:00:04:14	<i>AI is poised to automate all kinds of tedious work ranging from factory work,</i>	<i>L'IA automatizzerà i lavori monotoni, dalla produzione industriale,</i>
2 9 8	00:19:39:21 - 00:19:42:14	00:00:02:17	<i>to taxi driving, to customer service.</i>	<i>alla guida dei taxi, fino al servizio clienti.</i>
2 9 9	00:19:43:03 - 00:19:48:21	00:00:05:18	<i>While some fear smart robots will replace human labor, that's not necessarily true.</i>	<i>Alcuni temono sostituirà il lavoro umano, ma non è detto.</i>

3 0 0	00:19:49:09 - 00:19:54:19	00:00:05:10	<i>As a sector, AI is expected to generate 58 million new types of jobs</i>	<i>Si stima che l'IA creerà 58 milioni di nuovi posti di lavoro</i>
3 0 1	00:19:54:23 - 00:19:56:05	00:00:01:06	<i>in just a few years.</i>	<i>in pochi anni.</i>
3 0 2	00:19:56:16 - 00:20:01:10	00:00:04:18	<i>What will human-robot interaction mean for our work and livelihoods?</i>	<i>Cosa implica l'interazione uomo-robot per il nostro lavoro e sostentamento?</i>
3 0 3	00:20:02:14 - 00:20:06:19	00:00:04:05	<i>I'm at the Massachusetts Institute of Technology to meet Dr. Julie Shaw.</i>	<i>Sono al Massachusetts Institute of Technology con la Dott.ssa Julie Shaw.</i>
3 0 4	00:20:06:23 - 00:20:10:09	00:00:03:10	<i>She leads pioneering research in human-robot collaboration.</i>	<i>Conduce studi innovativi sulla collaborazione uomo-robot.</i>
3 0 5	00:20:10:22 - 00:20:14:09	00:00:03:11	<i>My lab works to develop robots as effective teammates.</i>	<i>Qui sviluppiamo robot che siano bravi compagni di squadra</i>
3 0 6	00:20:15:02 - 00:20:19:03	00:00:04:01	<i>Julie's team is creating a software for robots to learn from humans,</i>	<i>Stanno creando un software per far sì che i robot imparino dagli umani</i>
3 0 7	00:20:19:07 - 00:20:22:08	00:00:03:01	<i>and gain insight into their behaviors.</i>	<i>e comprendano i loro comportamenti.</i>
3 0 8	00:20:22:19 - 00:20:27:12	00:00:04:17	<i>By being aware of real people, robots can directly work and interact with them.</i>	<i>Riconoscendo le persone reali, i robot possono lavorare e interagire con loro.</i>
3 0 9	00:20:28:03 - 00:20:34:03	00:00:06:00	<i>How do you teach these robots or machines to do these human-like tasks?</i>	<i>Come insegnate loro a svolgere compiti simili a quelli umani?</i>
3 1 0	00:20:34:13 - 00:20:37:07	00:00:02:18	<i>The first step, as it would be for any person,</i>	<i>Il primo passo, come per qualsiasi persona,</i>
3 1 1	00:20:37:13 - 00:20:40:18	00:00:03:05	<i>They first observe and immerse in the environment.</i>	<i>è quello di immergersi nell'ambiente e osservare.</i>
3 1 2	00:20:41:00 - 00:20:43:02	00:00:02:02	<i>Then, active learning begins.</i>	<i>Poi inizia l'apprendimento attivo.</i>
3 1 3	00:20:43:12 - 00:20:48:02	00:00:04:14	<i>The robot needs to be able to communicate to the person what it's learned.</i>	<i>Il robot deve poter comunicare ciò che ha imparato.</i>
3 1 4	00:20:48:09 - 00:20:52:23	00:00:04:14	<i>We don't want the robot to learn a sequence of actions, we want it to learn</i>	<i>Non vogliamo che impari una sequenza di azioni, ma che acquisisca</i>
3 1 5	00:20:53:05 - 00:20:54:19	00:00:01:14	<i>more general understanding.</i>	<i>una comprensione generale.</i>
3 1 6	00:20:55:02 - 00:20:57:02	00:00:02:00	<i>That's ultimately our challenge.</i>	<i>È proprio questa la nostra sfida.</i>
3 1 1	00:20:57:16 - 00:20:59:06	00:00:01:14	<i>Getting a robot to grasp</i>	<i>Far comprendere a un robot</i>

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3 1 8	00:20:59:10 - 00:21:04:01	00:00:04:15	<i>the bigger picture concept to understand the basics of its task</i>	<i>il concetto generale perché capisca le basi del suo compito</i>
3 1 9	00:21:04:05 - 00:21:08:10	00:00:04:05	<i>requires a lot of observation and hand-holding.</i>	<i>richiede molta osservazione e costante supporto.</i>
3 2 0	00:21:09:05 - 00:21:12:19	00:00:03:14	My research focuses on trying to make robot programming easier	La mia ricerca intende facilitare la programmazione dei robot
3 2 1	00:21:12:23 - 00:21:16:23	00:00:04:00	by trying to teach robots how to do tasks by demonstrating them.	insegnando loro i compiti attraverso dimostrazioni.
3 2 2	00:21:17:15 - 00:21:22:04	00:00:04:13	<i>Julie's colleague, Ankit Shah, shows how this robot learns to set a table.</i>	<i>Il collega di Julie, Ankit Shah, mostra come il robot impari ad apparecchiare.</i>
3 2 3	00:21:22:20 - 00:21:25:18	00:00:02:22	This is all the silverware, plates, bowls and cups.	Qui ci sono posate, piatti, ciotole e tazze.
3 2 4	00:21:26:01 - 00:21:28:15	00:00:02:14	And this is the table that it has to set.	E questo è il tavolo da apparecchiare.
3 2 5	00:21:29:00 - 00:21:30:18	00:00:01:18	- Yes, that is correct. - Okay.	- Esattamente. - Okay.
3 2 6	00:21:31:17 - 00:21:32:23	00:00:01:06	<i>As any parent knows,</i>	<i>Ogni genitore sa che</i>
3 2 7	00:21:33:03 - 00:21:37:08	00:00:04:05	<i>the first step in teaching a child is modeling the desired behavior.</i>	<i>per insegnare a un bambino serve l'esempio</i>
3 2 8	00:21:37:18 - 00:21:39:12	00:00:01:18	<i>Machine learning is the same.</i>	<i>Nel machine learning è uguale.</i>
3 2 9	00:21:40:05 - 00:21:44:16	00:00:04:11	<i>In this case, the AI robot recognizes the objects with a visual tag,</i>	<i>In questo caso, il robot riconosce gli oggetti tramite un'etichetta visiva</i>
3 3 0	00:21:44:20 - 00:21:46:04	00:00:01:08	<i>similar to a QR code,</i>	<i>simile a un codice QR,</i>
3 3 1	00:21:46:08 - 00:21:49:12	00:00:03:04	<i>and for two weeks, it observes Ankit setting a table.</i>	<i>e per due settimane osserva Ankit apparecchiare.</i>
3 3 2	00:21:49:20 - 00:21:53:23	00:00:04:03	- You pick an item to place on the table? - That's what we did.	- Prendi un oggetto da mettere sul tavolo? - Proprio così.
3 3 3	00:21:54:03 - 00:21:58:08	00:00:04:05	And based on that, the robot learns what it means to set a dinner table.	E così, il robot impara cosa significa apparecchiare.
3 3 4	00:21:58:13 - 00:22:03:11	00:00:04:22	<i>Dynamic tasks like setting a table or doing laundry are easy for humans,</i>	<i>Attività dinamiche come apparecchiare o fare il bucato sono facili per noi,</i>
3 3	00:22:03:15 - 00:22:05:13	00:00:01:22	<i>but really hard for robots.</i>	<i>ma molto complesse per i robot.</i>

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3 3 6	00:22:05:23 - 00:22:08:12	00:00:02:13	<i>The software struggles with many variables</i>	<i>Il software fa fatica con molte variabili,</i>
3 3 7	00:22:08:16 - 00:22:11:22	00:00:03:06	<i>and small environmental changes can throw them off.</i>	<i>e piccole modifiche ambientali possono farlo confondere.</i>
3 3 8	00:22:12:04 - 00:22:15:17	00:00:03:13	One thing I like to do is hide objects,	Mi diverto a nascondere gli oggetti,
3 3 9	00:22:16:04 - 00:22:17:22	00:00:01:18	so it doesn't see the spoon.	così non vede il cucchiaino.
3 4 0	00:22:18:06 - 00:22:21:20	00:00:03:14	We do this to demonstrate that the robot is robust	Lo facciamo per dimostrare che il robot
3 4 1	00:22:21:23 - 00:22:24:07	00:00:02:08	to disturbances in the task.	tollerare le interferenze.
3 4 2	00:22:25:20 - 00:22:29:16	00:00:03:20	<i>The robot software has learnt each object and its location.</i>	<i>Il software ha imparato la posizione di ogni oggetto.</i>
3 4 3	00:22:30:02 - 00:22:34:15	00:00:04:13	<i>Now, let's see if it can think dynamically to set the table.</i>	<i>Ora vediamo se riesce a pensare in modo dinamico per apparecchiare.</i>
3 4 4	00:22:35:16 - 00:22:38:12	00:00:02:20	- So you can just pick up the card. - Here we go.	- Basta sollevare la carta. - Proviamo.
3 4 5	00:22:39:19 - 00:22:41:07	00:00:01:12	I've revealed the spoon.	Ho svelato il cucchiaino.
3 4 6	00:22:43:08 - 00:22:48:01	00:00:04:17	<i>Incredibly, the robot recognizes the spoon and places it next to the bowl.</i>	<i>Incredibilmente, il robot riconosce il cucchiaino e lo mette accanto alla ciotola.</i>
3 4 7	00:22:48:17 - 00:22:54:00	00:00:05:07	<i>This shows the robot has learned the concept and acts dynamically.</i>	<i>Questo dimostra che il robot ha imparato il concetto e agisce in modo dinamico.</i>
3 4 8	00:22:55:07 - 00:23:00:14	00:00:05:07	<i>In the process, the software continuously writes and revises its own code.</i>	<i>Il software intanto continua a scrivere e correggere il proprio codice.</i>
3 4 9	00:23:01:01 - 00:23:02:18	00:00:01:17	<i>Basically, it's learning.</i>	<i>In sostanza, sta imparando.</i>
3 5 0	00:23:05:11 - 00:23:09:05	00:00:03:18	<i>If robots, like humans, can grasp the bigger picture context,</i>	<i>Se riescono a comprendere il contesto generale,</i>
3 5 1	00:23:09:11 - 00:23:11:09	00:00:01:22	<i>and not just the math tasks,</i>	<i>e non solo i compiti matematici,</i>
3 5 2	00:23:11:21 - 00:23:15:17	00:00:03:20	<i>Will AI robots of the future end the need to work?</i>	<i>i robot IA porranno fine alla necessità di lavorare?</i>
3	00:23:16:03 -	00:00:04:21	The key is not developing AI	Il punto non è sviluppare

5 3	00:23:21:00		to replace or supplant	l'IA per sostituire il lavoro umano,
3 5 4	00:23:21:04 - 00:23:25:13	00:00:04:09	human work but understanding how they fit together like puzzle pieces.	ma capire il modo in cui si integrano come pezzi di un puzzle.
3 5 5	00:23:25:21 - 00:23:28:15	00:00:02:18	People work in teams to build cars or planes	Nelle fabbriche di automobili o aerei,
3 5 6	00:23:28:19 - 00:23:31:06	00:00:02:11	and robots are an effective team member.	i robot sono validi collaboratori.
3 5 7	00:23:31:13 - 00:23:35:05	00:00:03:16	It's real teamwork, like in basketball, you have your goal.	È vero lavoro di squadra. Come nel basket, c'è un obiettivo.
3 5 8	00:23:35:09 - 00:23:38:23	00:00:03:14	You have to think spatially, choosing who to pass the ball to.	Bisogna valutare lo spazio, scegliere a chi passare la palla
3 5 9	00:23:39:02 - 00:23:42:15	00:00:03:13	And at what time you do that so that everything matches up.	e a quando farlo, affinché tutto funzioni.
3 6 0	00:23:42:19 - 00:23:46:06	00:00:03:11	The analogy of a basketball team is outstanding,	L'analogia col basket è perfetta,
3 6 1	00:23:46:10 - 00:23:51:16	00:00:05:06	because of the importance of spatial awareness and timing.	Data l'importanza della percezione spaziale e del tempismo.
3 6 2	00:23:51:23 - 00:23:55:09	00:00:03:10	We need to develop AI for robots to work alongside us.	Dobbiamo sviluppare l'IA affinché i robot lavorino con noi.
3 6 3	00:23:56:17 - 00:24:00:06	00:00:03:13	<i>One of the toughest aspects in creating hyper-intelligence</i>	<i>Uno degli aspetti più difficili nel creare iperintelligenza</i>
3 6 4	00:24:00:10 - 00:24:04:00	00:00:03:14	<i>is something that sometimes even we humans get wrong.</i>	<i>è una cosa che a volte anche noi esseri umani sbagliamo:</i>
3 6 5	00:24:04:10 - 00:24:07:02	00:00:02:16	<i>And that is anticipation.</i>	<i>la previsione.</i>
3 6 6	00:24:07:12 - 00:24:10:00	00:00:02:12	<i>Anticipating a teammate or a co-worker</i>	<i>Anticipare un compagno di squadra</i>
3 6 7	00:24:10:04 - 00:24:15:00	00:00:04:20	<i>requires deeper understanding of contextual information,</i>	<i>richiede una profonda comprensione delle informazioni contestuali,</i>
3 6 8	00:24:15:10 - 00:24:17:19	00:00:02:09	<i>and predicting what will happen next.</i>	<i>e la capacità di prevedere cosa accadrà.</i>
3 6 9	00:24:18:00 - 00:24:21:01	00:00:03:01	<i>Can robots predict as accurately as we can?</i>	<i>I robot possono prevedere con la nostra precisione?</i>
3 7 0	00:24:22:04 - 00:24:24:06	00:00:02:02	Abby's our industrial robot.	Abby è il nostro robot industriale.
3	00:24:24:22 -	00:00:02:04	<i>Pem Lasota is giving the</i>	<i>Pem Lasota sta fornendo ad</i>

7 1	00:24:27:02		<i>Abby machine</i>	<i>Abby</i>
3 7 2	00:24:27:06 - 00:24:31:17	00:00:04:11	<i>the intelligence to anticipate a human co-worker's actions.</i>	<i>l'intelligenza per prevedere le azioni di un collega umano.</i>
3 7 3	00:24:32:01 - 00:24:34:23	00:00:02:22	This simulated manufacturing task that we set up	Questa operazione simulata
3 7 4	00:24:35:04 - 00:24:39:05	00:00:04:01	simulates a task where a person and robot could work on together.	riproduce un'attività in cui persone e robot possono collaborare.
3 7 5	00:24:39:21 - 00:24:45:14	00:00:05:17	<i>For safety reasons, actual human-robot interaction is, for now, fairly minimum.</i>	<i>Per sicurezza, l'interazione tra umani e robot è ancora piuttosto limitata.</i>
3 7 6	00:24:46:02 - 00:24:50:02	00:00:04:00	In factories, robots are behind metal cages with no people with them.	Nelle fabbriche, di solito i robot lavorano isolati in gabbie.
3 7 7	00:24:50:06 - 00:24:54:03	00:00:03:21	So, we want to create something a person can safely interact with.	Vogliamo creare qualcosa con cui si possa interagire in sicurezza.
3 7 8	00:24:54:16 - 00:24:57:18	00:00:03:02	What are human and robot doing together in this task?	Come collaborano umani e robot in questo lavoro?
3 7 9	00:24:58:00 - 00:25:01:22	00:00:03:22	In this task, a person places fasteners on a plane	In questo caso, una persona posiziona i fissaggi su un pannello,
3 8 0	00:25:02:02 - 00:25:04:21	00:00:02:19	while the robot applies sealant over to seal it.	mentre il robot applica il sigillante.
3 8 1	00:25:05:07 - 00:25:07:01	00:00:01:18	- Can we see it happen? - Sure.	- Possiamo vedere? - Certo.
3 8 2	00:25:08:05 - 00:25:12:00	00:00:03:19	<i>In order to work together, the robot must first be able to see</i>	<i>Per lavorare insieme, il robot deve prima vedere</i>
3 8 3	00:25:12:04 - 00:25:14:20	00:00:02:16	<i>and recognize its human counterpart's actions,</i>	<i>e riconoscere le azioni del collega umano,</i>
3 8 4	00:25:15:04 - 00:25:17:11	00:00:02:07	<i>and adjust to the person's every move.</i>	<i>per poi adattarsi a ogni suo movimento.</i>
3 8 5	00:25:17:17 - 00:25:20:16	00:00:02:23	Ooh, I feel like I'm in a superhero movie.	Wow, è come un film di supereroi.
3 8 6	00:25:21:03 - 00:25:23:21	00:00:02:18	So the cameras in the room can see these lights	Le telecamere nella stanza vedono queste luci
3 8 7	00:25:24:02 - 00:25:27:14	00:00:03:12	and track your hand to avoid it being cut off by the robot.	e seguono la tua mano per evitare che sia colpita dal robot.
3 8 8	00:25:27:19 - 00:25:28:19	00:00:01:00	Exactly.	Esattamente.
3	00:25:29:03 -	00:00:02:22	Cameras and lights act as	Le telecamere e le luci sono

8 9	00:25:32:01		the robot's eyes.	gli occhi del robot.
3 9 0	00:25:32:05 - 00:25:34:08	00:00:02:03	That's how the robot locates me.	In questo modo sa dove mi trovo.
3 9 1	00:25:34:16 - 00:25:39:16	00:00:05:00	<i>The monitor shows the robot's visual representation of the room.</i>	<i>Il monitor mostra la rappresentazione visiva che ha il robot della stanza.</i>
3 9 2	00:25:40:10 - 00:25:43:13	00:00:03:03	This is what the robot does when I'm not in its way.	Ecco cosa fa il robot quando non sono vicino.
3 9 3	00:25:43:17 - 00:25:46:05	00:00:02:12	The robot's sealing, and I shouldn't be here.	Sta sigillando e io non dovrei esserci.
3 9 4	00:25:46:11 - 00:25:49:10	00:00:02:23	<i>Pem does something the robot can't expect.</i>	<i>Pem fa qualcosa che il robot non può prevedere.</i>
3 9 5	00:25:49:20 - 00:25:51:18	00:00:01:22	If I block the robot with my hand	Se blocco il robot con la mano.
3 9 6	00:25:51:23 - 00:25:52:23	00:00:01:00	Oh, wow.	Oh, wow.
3 9 7	00:25:53:03 - 00:25:55:05	00:00:02:02	<i>By quickly recognizing this action,</i>	<i>Riconoscendo al volo questa azione,</i>
3 9 8	00:25:55:09 - 00:25:57:16	00:00:02:07	<i>The AI software reacts accordingly.</i>	<i>il software IA reagisce di conseguenza,</i>
3 9 9	00:25:58:05 - 00:25:59:05	00:00:01:00	<i>By stopping.</i>	<i>fermandosi.</i>
4 0 0	00:25:59:08 - 00:26:01:10	00:00:02:02	Sharing the workspace is crucial	Condividere lo spazio è essenziale.
4 0 1	00:26:03:07 - 00:26:04:22	00:00:01:15	<i>Building on this teamwork,</i>	<i>Fatto questo,</i>
4 0 2	00:26:05:02 - 00:26:08:16	00:00:03:14	<i>Pem's next step is helping Abby predict his next move,</i>	<i>il passo successivo è aiutare Abby a prevedere la sua mossa,</i>
4 0 3	00:26:09:04 - 00:26:11:09	00:00:02:05	<i>Based on subtle, contextual cues.</i>	<i>basandosi su indizi contestuali.</i>
4 0 4	00:26:12:01 - 00:26:16:03	00:00:04:02	In this case, the robot will not only track my actions so far,	In questo caso, il robot non solo seguirà le mie azioni,
4 0 5	00:26:16:12 - 00:26:19:13	00:00:03:01	but also anticipate the space I'll use next.	ma prevederà anche quale spazio andrò a occupare.
4 0 6	00:26:19:20 - 00:26:23:10	00:00:03:14	It will avoid those locations when planning its motions,	Quando pianifica i suoi movimenti, evita quelle aree
4	00:26:23:18 -	00:00:01:21	so we can work seamlessly.	così da lavorare

07	00:26:25:15			agevolmente.
408	00:26:25:19 - 00:26:27:14	00:00:01:19	After replacing this bolt,	Dopo aver cambiato il bullone,
409	00:26:27:21 - 00:26:30:14	00:00:02:17	the robot predicts I'll go here next.	il robot prevede che mi sposterò qui.
410	00:26:31:23 - 00:26:34:09	00:00:02:10	You'll see it'll behave differently.	Vedrai che si comporterà diversamente.
411	00:26:34:14 - 00:26:35:18	00:00:01:04	I've placed the bolt	Ho inserito questo
412	00:26:36:00 - 00:26:38:15	00:00:02:15	and the robot takes a more roundabout path,	e il robot fa un percorso più ampio,
413	00:26:38:23 - 00:26:41:16	00:00:02:17	that allows me and the robot work closely.	che ci permette di lavorare fianco a fianco.
414	00:26:41:21 - 00:26:46:07	00:00:04:10	And I don't worry about it crashing into me, as it's trying to avoid me.	E non mi preoccupo che mi colpisca, dato che sta cercando di evitarmi.
415	00:26:47:11 - 00:26:50:02	00:00:02:15	So similarly on this side, I place this bolt.	Ora posiziono il bullone da questa parte.
416	00:26:51:11 - 00:26:54:04	00:00:02:17	The robot takes a more roundabout path.	Il robot segue un percorso più ampio.
417	00:26:54:09 - 00:26:55:21	00:00:01:12	- Because you move there.	- Perché ti sposti là.
418	00:26:56:01 - 00:26:58:04	00:00:02:03	It slowed down, as it's close to me.	Ha rallentato, poiché è vicino a me.
419	00:27:00:00 - 00:27:01:12	00:00:01:12	Work together seamlessly.	Lavorare con fluidità.
420	00:27:01:16 - 00:27:06:19	00:00:05:03	The interaction is more efficient since the robot doesn't stand still too long,	L'interazione è più efficiente poiché il robot non rimane fermo troppo a lungo,
421	00:27:08:07 - 00:27:12:02	00:00:03:19	and it's safer since the robot avoids hitting me frequently,	è più sicura, poiché il robot evita spesso di colpirmi,
422	00:27:12:08 - 00:27:14:16	00:00:02:08	and also feels better for the worker.	ed è più confortevole per il lavoratore.
423	00:27:15:04 - 00:27:17:08	00:00:02:04	I really love the teamwork theme.	Adoro questo lavoro di squadra.
424	00:27:18:05 - 00:27:22:18	00:00:04:13	<i>Programming robots to coordinate with us and anticipate where we'll move</i>	<i>Programmare i robot per coordinarsi con noi e anticipare i nostri</i>

				<i>movimenti</i>
4 2 5	00:27:22:22 - 00:27:27:15	00:00:04:17	<i>will revolutionize the workplace, and also change society at large.</i>	<i>rivoluzionerà il luogo di lavoro e cambierà anche la società in generale.</i>
4 2 6	00:27:31:03 - 00:27:32:03	00:00:01:00	<i>In the future,</i>	<i>Nel futuro,</i>
4 2 7	00:27:32:07 - 00:27:35:08	00:00:03:01	<i>the coordination of man and machine is so advanced</i>	<i>il coordinamento tra uomo e macchina è così avanzato</i>
4 2 8	00:27:35:12 - 00:27:40:08	00:00:04:20	<i>that it increases productivity and accuracy in most industries</i>	<i>da aumentare produttività e precisione in molti settori.</i>
4 2 9	00:27:41:02 - 00:27:45:03	00:00:04:01	<i>AI robots now accompany surgeons in hospitals across the globe.</i>	<i>I robot IA affiancano i chirurghi negli ospedali di tutto il mondo.</i>
4 3 0	00:27:45:15 - 00:27:49:19	00:00:04:04	<i>They anticipate the doctor's needs and hand them the right medical tool</i>	<i>Anticipano le loro esigenze e passano lo strumento giusto</i>
4 3 1	00:27:49:23 - 00:27:51:14	00:00:01:15	<i>Just before it's needed.</i>	<i>poco prima che occorra.</i>
4 3 2	00:27:51:21 - 00:27:55:13	00:00:03:16	<i>This dramatically reduces surgery times and human error.</i>	<i>Ciò riduce drasticamente i tempi e gli errori umani.</i>
4 3 3	00:27:58:01 - 00:28:01:05	00:00:03:04	<i>As machines grow smarter in interacting with humans,</i>	<i>Insieme a interazioni sempre più sofisticate,</i>
4 3 4	00:28:01:09 - 00:28:03:12	00:00:02:03	<i>will they develop consciousness?</i>	<i>svilupperanno anche una coscienza?</i>
4 3 5	00:28:03:17 - 00:28:07:19	00:00:04:02	<i>And will AI actually surpass human intelligence?</i>	<i>E l'IA supererà davvero l'intelligenza umana?</i>
4 3 6	00:28:08:10 - 00:28:12:03	00:00:03:17	<i>While some machines have surpassed humans in games like trivia,</i>	<i>Alcune macchine hanno superato gli umani in cultura generale,</i>
4 3 7	00:28:12:07 - 00:28:14:08	00:00:02:01	<i>- We come to Watson. - and chess,</i>	<i>- Parliamo di Watson. - e scacchi,</i>
4 3 8	00:28:14:12 - 00:28:18:12	00:00:04:00	<i>these AI systems were designed to master just a single skill.</i>	<i>ma questi sistemi sono progettati per padroneggiare una sola abilità.</i>
4 3 9	00:28:18:20 - 00:28:22:03	00:00:03:07	<i>These programs use brute force computer processing power</i>	<i>Sfruttano la potenza di calcolo</i>
4 4 0	00:28:22:08 - 00:28:25:18	00:00:03:10	<i>and tailored software to beat their human opponents.</i>	<i>e software personalizzati per battere gli avversari umani.</i>
4 4 1	00:28:27:12 - 00:28:30:13	00:00:03:01	<i>To achieve the holy grail of hyperintelligence,</i>	<i>Per trovare il sacro graal dell'iperintelligenza,</i>
4	00:28:30:17 -	00:00:05:06	<i>Scientists must develop</i>	<i>bisogna sviluppare sistemi</i>

4 2	00:28:35:23		<i>systems with human-like learning and thinking abilities</i>	<i>con abilità di apprendimento e pensiero umano.</i>
4 4 3	00:28:36:11 - 00:28:40:07	00:00:03:20	<i>This form of smarts is called artificial general intelligence.</i>	<i>Questa forma di intelligenza è chiamata IA generale.</i>
4 4 4	00:28:41:04 - 00:28:44:19	00:00:03:15	<i>I'm back in New York City on my campus at Columbia University</i>	<i>Sono a New York, nel mio campus alla Columbia University</i>
4 4 5	00:28:44:23 - 00:28:46:13	00:00:01:14	<i>to meet Dr. Hod Lipson.</i>	<i>insieme al Dott. Hod Lipson</i>
4 4 6	00:28:47:01 - 00:28:51:04	00:00:04:03	<i>Hod's lab is developing robots that paint original artworks,</i>	<i>Il suo laboratorio sviluppa robot che dipingono opere d'arte originali,</i>
4 4 7	00:28:51:10 - 00:28:53:03	00:00:01:17	<i>self-assembling robots,</i>	<i>robot auto-assemblanti,</i>
4 4 8	00:28:53:08 - 00:28:57:11	00:00:04:03	<i>and even robots that learn about their world without human assistance.</i>	<i>e robot in grado di comprendere il mondo autonomamente.</i>
4 4 9	00:28:58:00 - 00:29:00:14	00:00:02:14	<i>But his goal is even more ambitious.</i>	<i>Ma il suo obiettivo è ancora più ambizioso.</i>
4 5 0	00:29:01:15 - 00:29:05:06	00:00:03:15	<i>Can a machine think about itself or have free will?</i>	<i>Un robot può riflettere su se stesso o avere libero arbitrio?</i>
4 5 1	00:29:05:12 - 00:29:08:03	00:00:02:15	<i>I believe that, in fact, machines can be</i>	<i>Credo che le macchine possano essere</i>
4 5 2	00:29:08:12 - 00:29:12:00	00:00:03:12	<i>sentient and self-aware in ways that we can't.</i>	<i>senzienti e consapevoli di sé in modi che noi non possiamo.</i>
4 5 3	00:29:13:06 - 00:29:14:14	00:00:01:08	<i>As a neuroscientist,</i>	<i>Come neuroscienziata,</i>
4 5 4	00:29:14:18 - 00:29:20:14	00:00:05:20	<i>I know we've only scratched the surface of understanding human consciousness.</i>	<i>so che abbiamo appena iniziato a comprendere la coscienza umana.</i>
4 5 5	00:29:21:10 - 00:29:26:09	00:00:04:23	<i>How could computer code give a robot this transcendent feature?</i>	<i>Come potrebbe un codice informatico dare a un robot questa dote trascendente?</i>
4 5 6	00:29:27:06 - 00:29:29:05	00:00:01:23	<i>Our hypothesis is very simple.</i>	<i>La nostra ipotesi è semplice.</i>
4 5 7	00:29:29:09 - 00:29:32:14	00:00:03:05	<i>It is that self-awareness is nothing but the ability</i>	<i>L'autocoscienza non è che la capacità</i>
4 5 8	00:29:33:00 - 00:29:34:23	00:00:01:23	<i>to simulate oneself,</i>	<i>di immaginarsi,</i>
4 5	00:29:36:06 - 00:29:39:16	00:00:03:10	<i>to model oneself, to have a self image.</i>	<i>di plasmarsi, di avere un'immagine di sé.</i>

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4 6 0	00:29:41:04 - 00:29:43:21	00:00:02:17	<i>The first step to create robotic consciousness,</i>	<i>Il primo passo verso una coscienza robotica,</i>
4 6 1	00:29:44:00 - 00:29:48:03	00:00:04:03	<i>is teaching the software to build its physical self</i>	<i>è insegnare al software a costruire il proprio sé fisico</i>
4 6 2	00:29:48:07 - 00:29:50:04	00:00:01:21	<i>inside its computer mind.</i>	<i>nella sua mente computazionale.</i>
4 6 3	00:29:51:05 - 00:29:53:20	00:00:02:15	<i>We humans take consciousness for granted,</i>	<i>Noi diamo per scontata la nostra coscienza,</i>
4 6 4	00:29:54:03 - 00:29:58:07	00:00:04:04	<i>even in simple moments, like recognizing our image in a mirror.</i>	<i>anche nelle azioni più semplici, come riconoscersi allo specchio.</i>
4 6 5	00:29:58:21 - 00:30:03:15	00:00:04:18	<i>Humans develop awareness of their emotions and thoughts around the age of one.</i>	<i>Gli umani diventano consapevoli di emozioni e pensieri verso l'anno di età.</i>
4 6 6	00:30:04:01 - 00:30:06:23	00:00:02:22	<i>This helps babies form a self-image in their minds,</i>	<i>Questo aiuta i bambini a formare un'immagine di sé</i>
4 6 7	00:30:07:03 - 00:30:10:14	00:00:03:11	<i>and it helps them learn about their environment and role.</i>	<i>e a conoscere l'ambiente e il proprio ruolo.</i>
4 6 8	00:30:11:08 - 00:30:13:11	00:00:02:03	When a robot learns what it is,	Quando un robot impara a conoscersi,
4 6 9	00:30:13:15 - 00:30:18:06	00:00:04:15	it can use that self-image to plan new tasks.	può sfruttare questa consapevolezza di sé per pianificare nuove attività.
4 7 0	00:30:19:05 - 00:30:24:10	00:00:05:05	<i>In humans and robots, awareness of the physical self is called proprioception.</i>	<i>La consapevolezza del proprio corpo, umano o robotico, è detta proprioccezione.</i>
4 7 1	00:30:25:07 - 00:30:30:11	00:00:05:04	<i>Neuroscientists call this self-awareness of our bodies a sixth sense.</i>	<i>I neuroscienziati definiscono questa autoconsapevolezza fisica un sesto senso.</i>
4 7 2	00:30:31:10 - 00:30:35:02	00:00:03:16	We use the same test that a baby does in its crib.	Usiamo lo stesso test che fa un neonato nella culla.
4 7 3	00:30:35:22 - 00:30:41:09	00:00:05:11	<i>A baby flails and moves its arms in ways that seem random, but they're not.</i>	<i>Un neonato agita le braccia in modi che sembrano casuali, ma non lo sono,</i>
4 7 4	00:30:41:18 - 00:30:43:23	00:00:02:05	<i>And then it touches its nose, right?</i>	<i>per poi toccarsi il naso, giusto?</i>
4 7 5	00:30:44:07 - 00:30:49:12	00:00:05:05	If its brain predicts that it's going to feel something and it actually feels that,	Se il cervello prevede che sentirà qualcosa e lo sente davvero,
4 7	00:30:49:21 - 00:30:54:12	00:00:04:15	that means its self-image was correct, and the same	la sua immagine di sé era corretta, e lo stesso vale

6			applies to a robot.	per un robot.
4 7 7	00:30:54:18 - 00:30:58:21	00:00:04:03	<i>If proprioception can be developed to the same level as humans,</i>	<i>Se si può sviluppare la propriocezione al livello di quella umana,</i>
4 7 8	00:30:59:01 - 00:31:02:17	00:00:03:16	<i>this could lead to robotic consciousness.</i>	<i>si potrebbe sviluppare una coscienza robotica.</i>
4 7 9	00:31:03:21 - 00:31:09:17	00:00:05:20	<i>Pod's colleague, Rob Kwiatkowski, is the creator of a baby robot he built.</i>	<i>Il collega di Pod, Rob Kwiatkowski, ha costruito un nuovissimo baby robot.</i>
4 8 0	00:31:10:17 - 00:31:15:21	00:00:05:04	<i>By interacting with its surroundings, it's developing its own self-image.</i>	<i>Interagendo con l'ambiente, sta sviluppando la propria immagine di sé.</i>
4 8 1	00:31:16:10 - 00:31:18:01	00:00:01:15	So, what are these claws?	Cosa sono questi artigli?
4 8 2	00:31:18:05 - 00:31:19:15	00:00:01:10	They're actually feet.	Sono piedi in realtà.
4 8 3	00:31:20:14 - 00:31:24:05	00:00:03:15	They're designed for walking on carpet but now it doesn't walk.	Sono progettati per camminare sui tappeti, ma ora non cammina.
4 8 4	00:31:24:09 - 00:31:28:02	00:00:03:17	It's still a baby and must first learn how the world works.	È ancora un neonato e deve imparare come funziona il mondo.
4 8 5	00:31:28:06 - 00:31:31:02	00:00:02:20	What do you mean by "it's still a baby"?	In che senso "è ancora un neonato"?
4 8 6	00:31:32:10 - 00:31:37:18	00:00:05:08	Like a baby, it's sending totally random actions to each of these robot arms	Come un neonato, invia impulsi totalmente casuali a ogni braccio robotico,
4 8 7	00:31:38:03 - 00:31:41:12	00:00:03:09	and trying to get an understanding of itself primarily.	cercando di comprendere prima di tutto sé stesso.
4 8 8	00:31:41:22 - 00:31:45:19	00:00:03:21	It looks like a spider that doesn't know how to use its legs.	Sembra un ragno che non sa come usare le zampe.
4 8 9	00:31:46:00 - 00:31:49:00	00:00:03:00	Yeah, I guess that's a pretty good way to put it.	Sì, direi che è un'ottima descrizione.
4 9 0	00:31:50:04 - 00:31:52:02	00:00:01:22	So it will really be learning	Perciò imparerà davvero
4 9 1	00:31:52:06 - 00:31:55:14	00:00:03:08	by doing this babbling for about a day to a week.	facendo queste mosse per massimo una settimana.
4 9 2	00:31:55:21 - 00:32:00:20	00:00:04:23	It will process this data to create an informative model of itself.	Elaborerà questi dati per creare un modello informativo di sé stesso.
4 9 3	00:32:01:06 - 00:32:04:07	00:00:03:01	And from there, imagine how it would walk,	A quel punto immaginerà come camminare,
4	00:32:04:21 -	00:00:02:14	and execute that walking in	e lo farà poi nel mondo

9 4	00:32:07:11		the real world.	reale.
4 9 5	00:32:08:18 - 00:32:12:04	00:00:03:10	<i>These are the first steps in developing its self-image.</i>	<i>Sono i primi passi nello sviluppo della sua immagine di sé.</i>
4 9 6	00:32:12:12 - 00:32:15:00	00:00:02:12	<i>And like a baby, it will learn to walk.</i>	<i>E come un bambino, imparerà a camminare.</i>
4 9 7	00:32:15:04 - 00:32:19:08	00:00:04:04	<i>We know this because a prototype, using the same technique,</i>	<i>Lo sappiamo perché, con la stessa tecnica, un prototipo,</i>
4 9 8	00:32:19:12 - 00:32:21:09	00:00:01:21	<i>learned to walk after 100 hours.</i>	<i>ha imparato dopo 100 ore.</i>
4 9 9	00:32:21:23 - 00:32:25:17	00:00:03:18	<i>But walking won't, by default, lead to robotic consciousness.</i>	<i>Ma camminare non porterà automaticamente alla coscienza robotica.</i>
5 0 0	00:32:26:05 - 00:32:28:21	00:00:02:16	<i>And that's why self-awareness is so crucial.</i>	<i>Per questo l'autocoscienza è cruciale.</i>
5 0 1	00:32:29:04 - 00:32:33:11	00:00:04:07	This is a robot which we've taken to calling self-aware robot.	Questo robot lo abbiamo definito robot auto-consapevole,
5 0 2	00:32:33:15 - 00:32:37:16	00:00:04:01	It is self-aware in a literal sense that it is aware of itself,	poiché è letteralmente consapevole di sé stesso
5 0 3	00:32:37:22 - 00:32:41:10	00:00:03:12	its locations in space, and its dynamics as how it moves.	della sua posizione nello spazio e di come si muove.
5 0 4	00:32:41:19 - 00:32:45:22	00:00:04:03	Okay, so it understands its own movements and where it is in space,	Quindi comprende i suoi movimenti e la sua posizione nello spazio.
5 0 5	00:32:46:02 - 00:32:47:04	00:00:01:02	But how?	Ma come fa?
5 0 6	00:32:47:07 - 00:32:51:12	00:00:04:05	By using deep learning, which has become popular in recent years.	Grazie al deep learning, che è diventato famoso di recente.
5 0 7	00:32:52:04 - 00:32:55:08	00:00:03:04	<i>Deep learning is a form of AI</i>	<i>Il deep learning è una forma di IA che,</i>
5 0 8	00:32:55:12 - 00:32:58:05	00:00:02:17	<i>that, like our brain, learns through raw data,</i>	<i>come il nostro cervello, impara da dati grezzi,</i>
5 0 9	00:32:58:09 - 00:33:00:14	00:00:02:05	<i>unsupervised and without structure.</i>	<i>senza supervisione e senza struttura.</i>
5 1 0	00:33:00:23 - 00:33:06:01	00:00:05:02	<i>Deep learning lets machines experience and process reality like us.</i>	<i>Il deep learning permette alle macchine di vivere ed elaborare la realtà come noi.</i>
5 1 1	00:33:08:02 - 00:33:12:10	00:00:04:08	<i>Rob devised an experiment to test what the robot knows about its world.</i>	Rob ha ideato un esperimento per testare cosa sa il robot del suo

				mondo.
5 1 2	00:33:13:00 - 00:33:15:13	00:00:02:13	It's like looking at these red cotton balls.	Osserva queste palline di cotone rosse.
5 1 3	00:33:15:17 - 00:33:18:12	00:00:02:19	You have an idea in space as to where they are.	Hai un'idea di dove si trovano nello spazio.
5 1 4	00:33:18:19 - 00:33:22:13	00:00:03:18	If you closed your eyes and tried to put them in this cup.	Immagina di chiudere gli occhi e di metterle in questa tazza.
5 1 5	00:33:23:04 - 00:33:25:15	00:00:02:11	- Obviously it's not a trivial task. - No.	- Certo, non è un compito banale. - No.
5 1 6	00:33:25:23 - 00:33:29:22	00:00:03:23	It's not a difficult task because we have a good proprioception.	Ma non è troppo difficile perché abbiamo una buona propriocezione,
5 1 7	00:33:30:02 - 00:33:31:14	00:00:01:12	We have a good self-model.	un modello di noi stessi,
5 1 8	00:33:31:18 - 00:33:36:18	00:00:05:00	You know where your arm is in relation to other things in space.	Sai dove si trova il tuo braccio rispetto ad altri oggetti nell'ambiente.
5 1 9	00:33:37:17 - 00:33:41:06	00:00:03:13	<i>But for this robot, there's a catch.</i> - Where are the cameras?	<i>Ma per questo robot c'è un problema.</i> - E le telecamere?
5 2 0	00:33:41:14 - 00:33:42:17	00:00:01:03	There's no camera.	Non ci sono.
5 2 1	00:33:42:21 - 00:33:47:06	00:00:04:09	It's as if you were to close your eyes, you know the locations at the start,	È come se avessi gli occhi chiusi, conosci la posizione iniziale,
5 2 2	00:33:47:18 - 00:33:50:11	00:00:02:17	then you pick it up and place it totally blind.	poi prendi la pallina e la sposti alla cieca.
5 2 3	00:33:50:17 - 00:33:54:13	00:00:03:20	<i>Furthermore, it was not given a map or any form of instructions.</i>	<i>Inoltre, non sono state fornite né mappe né istruzioni.</i>
5 2 4	00:33:54:22 - 00:33:57:22	00:00:03:00	<i>The robot has to feel its way through the task.</i>	<i>Il robot deve trovare la soluzione autonomamente.</i>
5 2 5	00:33:58:06 - 00:34:00:04	00:00:01:22	- Let's see it. - Give it a shot.	- Vediamo. - Certo.
5 2 6	00:34:01:01 - 00:34:06:06	00:00:05:05	<i>The robot learned to use its arm through trial and error, gaining proprioception.</i>	<i>Il robot ha imparato a usare il suo braccio, acquisendo propriocezione.</i>
5 2 7	00:34:07:00 - 00:34:11:05	00:00:04:05	<i>By exploring, it generated an internal representation of the world,</i>	<i>Esplorando, ha generato una rappresentazione interna del mondo</i>
5 2 8	00:34:11:14 - 00:34:13:00	00:00:01:10	<i>and its place in it.</i>	<i>e del suo posto in esso.</i>
5 2	00:34:14:00 - 00:34:18:02	00:00:04:02	<i>The robot is using only its internal image of the</i>	<i>Il robot sfrutta solo la sua immagine interna del</i>

9			<i>external world</i>	<i>mondo esterno</i>
5 3 0	00:34:18:06 - 00:34:21:20	00:00:03:14	<i>to move its arm, pick up the balls, and place them in the cup.</i>	<i>per muovere il braccio, e mettere le palline nella tazza.</i>
5 3 1	00:34:22:14 - 00:34:25:12	00:00:02:22	<i>I'm not sure I could do it with my eyes closed.</i>	<i>Non so se saprei farlo ad occhi chiusi.</i>
5 3 2	00:34:26:14 - 00:34:31:06	00:00:04:16	It's really just based off of understanding where you are in space.	Ci si basa puramente sulla consapevolezza della propria posizione nello spazio.
5 3 3	00:34:31:10 - 00:34:32:10	00:00:01:00	That's right.	Esatto.
5 3 4	00:34:32:18 - 00:34:37:14	00:00:04:20	<i>Creating AI robots with an internal model of their world is an important step</i>	<i>Creare robot con un modello interno del loro mondo è un passo importante</i>
5 3 5	00:34:37:18 - 00:34:39:12	00:00:01:18	<i>to machine self-awareness.</i>	<i>verso l'autocoscienza.</i>
5 3 6	00:34:40:03 - 00:34:44:12	00:00:04:09	Self-awareness is sort of a similar proprioceptive capability,	L'autocoscienza è simile a una capacità propriocezionale,
5 3 7	00:34:44:16 - 00:34:49:13	00:00:04:21	but applied to mental thinking, so they think about thinking and what they are.	ma applicata al pensiero mentale, per riflettere sul pensiero e su ciò che sono.
5 3 8	00:34:49:17 - 00:34:53:10	00:00:03:17	Once you can do that, you can plan things into the future.	In questa maniera, è possibile pianificare il futuro.
5 3 9	00:34:54:23 - 00:34:59:20	00:00:04:21	<i>Once self-aware, robots will need advanced ways to communicate with humans.</i>	<i>Una volta autocoscienti, serviranno nuovi modi per comunicare con gli umani.</i>
5 4 0	00:35:00:09 - 00:35:03:18	00:00:03:09	<i>Keyboards and screens are inadequate for complex thoughts.</i>	<i>Tastiere e schermi non sono adatti a pensieri complessi.</i>
5 4 1	00:35:04:14 - 00:35:08:14	00:00:04:00	<i>Robots will need to learn to speak and have natural conversations,</i>	<i>I robot dovranno imparare a parlare e avere conversazioni naturali,</i>
5 4 2	00:35:09:00 - 00:35:12:05	00:00:03:05	<i>like a baby who listens around and learns to talk.</i>	<i>come un bambino che impara a parlare ascoltando.</i>
5 4 3	00:35:13:05 - 00:35:16:10	00:00:03:05	<i>Laying the groundwork for human-machine interaction</i>	<i>A gettare le basi per l'interazione uomo-macchina</i>
5 4 4	00:35:16:13 - 00:35:19:18	00:00:03:05	<i>is scientist Barbara Grosz of Harvard University.</i>	<i>c'è Barbara Grosz dell'Università di Harvard.</i>
5 4 5	00:35:20:10 - 00:35:23:14	00:00:03:04	<i>Her seminal work in natural language processing</i>	<i>Il suo lavoro sull'elaborazione del linguaggio naturale</i>
5 4	00:35:23:18 - 00:35:27:19	00:00:04:01	led to the development of voice-activated artificial	<i>ha portato allo sviluppo di IA a comando vocale</i>

6			intelligence	
5 4 7	00:35:28:01 - 00:35:30:01	00:00:02:00	like Alexa or Siri.	<i>come Alexa o Siri.</i>
5 4 8	00:35:30:22 - 00:35:35:15	00:00:04:17	Natural language processing actually predates artificial intelligence,	In realtà, l'elaborazione del linguaggio naturale è nata prima dell'IA,
5 4 9	00:35:36:01 - 00:35:38:22	00:00:02:21	and started with machine translation efforts.	con la traduzione automatica.
5 5 0	00:35:39:17 - 00:35:44:18	00:00:05:01	<i>The ability for a computer system to carry on a spoken dialogue with a person</i>	<i>La capacità di un sistema informatico di parlare con una persona</i>
5 5 1	00:35:45:00 - 00:35:50:02	00:00:05:02	<i>has been a long-standing goal of AI research from its inception.</i>	<i>è stata uno dei primi obiettivi della ricerca sull'IA.</i>
5 5 2	00:35:50:23 - 00:35:55:22	00:00:04:23	And it turns out, this is a challenge because when you speak, what you say	Chiaramente, è una sfida perché ciò che diciamo
5 5 3	00:35:56:04 - 00:35:58:11	00:00:02:07	really depends on the context.	dipende dal contesto.
5 5 4	00:35:59:00 - 00:36:04:04	00:00:05:04	<i>Another challenge is the meaning of words can change based on delivery.</i>	<i>Inoltre, il significato delle parole può cambiare in base al tono.</i>
5 5 5	00:36:04:17 - 00:36:08:07	00:00:03:14	So one example is the contrast between saying,	Ad esempio, una cosa è dire
5 5 6	00:36:08:11 - 00:36:11:22	00:00:03:11	"that's fabulous" and "that's fabulous".	"è fantastico", oppure "è fantastico".
5 5 7	00:36:12:13 - 00:36:14:15	00:00:02:02	When we have a conversation,	Quando abbiamo una conversazione,
5 5 8	00:36:14:19 - 00:36:20:06	00:00:05:11	we mark paragraphs with rising intonation at the start and falling at the end.	Diamo alle frasi un'intonazione prima crescente e poi calante.
5 5 9	00:36:20:10 - 00:36:26:03	00:00:05:17	The speech signal can tell you something about the context and the intended meaning	Il segnale vocale può dirci qualcosa sul contesto e sul significato inteso.
5 6 0	00:36:27:08 - 00:36:30:23	00:00:03:15	<i>Barbara's early research led to computer programming methods</i>	<i>Le ricerche di Barbara hanno portato a metodi di programmazione</i>
5 6 1	00:36:31:03 - 00:36:34:00	00:00:02:21	<i>to understand the meaning of spoken language</i>	<i>capaci di capire il significato di un dialogo</i>
5 6 2	00:36:34:08 - 00:36:37:15	00:00:03:07	<i>by using clues from a person's tone and context.</i>	<i>sfruttando indicatori come il tono e il contesto.</i>
5 6 3	00:36:38:02 - 00:36:39:17	00:00:01:15	So let's flash forward.	Facciamo un salto in avanti.

5 6 4	00:36:39:21 - 00:36:42:04	00:00:02:07	The speech systems are amazing now	Oggi i sistemi vocali sono straordinari
5 6 5	00:36:42:10 - 00:36:45:21	00:00:03:11	because there are lots of recordings of people speaking	Perché possono basarsi su molte registrazioni
5 6 6	00:36:46:03 - 00:36:48:07	00:00:02:04	that they can build their systems on.	di veri parlanti.
5 6 7	00:36:48:16 - 00:36:53:00	00:00:04:08	<i>As a result, AI has gotten much better at understanding what people say.</i>	<i>L'IA è così migliorata molto nel comprendere cosa dicono le persone.</i>
5 6 8	00:36:53:08 - 00:36:56:00	00:00:02:16	<i>However, there is still room for improvement.</i>	<i>Ma si può ancora migliorare.</i>
5 6 9	00:36:56:06 - 00:37:01:11	00:00:05:05	The systems that do exist are pretty much focused on very narrow tasks.	I sistemi esistenti si focalizzano per lo più su compiti molto specifici.
5 7 0	00:37:01:17 - 00:37:04:17	00:00:03:00	This takes Siri and Alexa as examples.	Pensiamo a Siri o Alexa.
5 7 1	00:37:05:01 - 00:37:09:14	00:00:04:13	They're mostly oriented around a single question or a single request,	Funzionano principalmente per singole domande o richieste,
5 7 2	00:37:09:19 - 00:37:10:21	00:00:01:02	and they presume	e presuppongono
5 7 3	00:37:11:02 - 00:37:16:13	00:00:05:11	that anybody will stay within the range of behavior that the designers imagined.	che tutti rispettino i limiti delle richieste impostati dagli sviluppatori.
5 7 4	00:37:17:02 - 00:37:19:15	00:00:02:13	<i>Researchers are turning to machine learning.</i>	<i>Il machine learning è sempre più studiato.</i>
5 7 5	00:37:20:00 - 00:37:24:01	00:00:04:01	<i>By training AI with hours and hours of human conversation,</i>	<i>Allenando l'IA con ore di conversazioni umane,</i>
5 7 6	00:37:24:05 - 00:37:28:00	00:00:03:19	<i>they can learn to better understand human conversational context.</i>	<i>si può comprendere meglio il contesto delle conversazioni.</i>
5 7 7	00:37:28:16 - 00:37:34:11	00:00:05:19	<i>Future technology will allow us to have natural conversations with our computers.</i>	<i>In futuro potremo avere dialoghi naturali con i computer.</i>
5 7 8	00:37:35:03 - 00:37:37:04	00:00:02:01	One thing that's amazing to me,	Una cosa davvero fantastica
5 7 9	00:37:37:17 - 00:37:40:21	00:00:03:04	is that the fields have succeeded so well,	è che il successo è stato tale
5 8 0	00:37:41:00 - 00:37:44:13	00:00:03:13	that there are devices out there that people use every day.	che oggi questi dispositivi vengono usati ogni giorno.

5 8 1	00:37:44:17 - 00:37:47:18	00:00:03:01	I never dreamed that would the case in my lifetime.	Non avrei mai immaginato di vederlo con i miei occhi.
5 8 2	00:37:49:06 - 00:37:51:16	00:00:02:10	<i>Hyper-intelligent natural language AI</i>	<i>L'IA con l'iperintelligenza del linguaggio</i>
5 8 3	00:37:51:20 - 00:37:55:15	00:00:03:19	<i>will change the way we interact with our computers and robots.</i>	<i>cambierà la nostra interazione con computer e robot.</i>
5 8 4	00:37:56:05 - 00:38:00:17	00:00:04:12	<i>But this technology will never reach its full potential as human companions</i>	<i>Ma non raggiungerà mai il suo pieno potenziale</i>
5 8 5	00:38:00:22 - 00:38:03:06	00:00:02:08	<i>until it looks convincingly like us.</i>	<i>finché non ci assomiglierà davvero.</i>
5 8 6	00:38:04:01 - 00:38:06:05	00:00:02:04	<i>I'm in Los Angeles to meet Hao Li.</i>	<i>Sono a Los Angeles insieme ad Hao Li.</i>
5 8 7	00:38:06:12 - 00:38:10:04	00:00:03:16	<i>His company Pinscreen is giving AI a human face.</i>	<i>La sua società, Pinscreen, sta dando un volto umano all'IA.</i>
5 8 8	00:38:10:18 - 00:38:15:21	00:00:05:03	<i>They're developing cutting- edge techniques to create hyper-realistic digital avatars.</i>	<i>Sviluppano tecniche all'avanguardia per creare avatar digitali iper- realistici.</i>
5 8 9	00:38:16:02 - 00:38:17:02	00:00:01:00	<i>In an instant.</i>	<i>In un istante.</i>
5 9 0	00:38:17:12 - 00:38:21:01	00:00:03:13	It's really hard bringing humans to the virtual world,	È molto difficile portare gli umani nel mondo virtuale,
5 9 1	00:38:21:05 - 00:38:23:01	00:00:01:20	specifically faces.	soprattutto i volti.
5 9 2	00:38:24:04 - 00:38:29:12	00:00:05:08	<i>To create believable faces, Hao is relying on complex AI algorithms.</i>	<i>Per creare volti credibili, Hao si affida a complessi algoritmi di IA.</i>
5 9 3	00:38:29:23 - 00:38:35:01	00:00:05:02	It's an AI that actually digitizes yourself into the computer,	È l'IA che riesce a digitalizzarti all'interno del computer,
5 9 4	00:38:35:17 - 00:38:39:12	00:00:03:19	by just looking at a single image or partial information.	basandosi semplicemente su un'immagine o informazioni parziali
5 9 5	00:38:39:23 - 00:38:45:03	00:00:05:04	And it's not just a 3D model, but one that can be animated and brought to life.	Non è solo un modello 3D, ma uno che si può animare e rendere vivo.
5 9 6	00:38:46:19 - 00:38:49:05	00:00:02:10	<i>Other methods of creating lifelike avatars</i>	<i>Altri metodi per creare avatar realistici</i>
5 9 7	00:38:49:09 - 00:38:52:18	00:00:03:09	<i>need to capture multiple angles of a face in motion,</i>	<i>richiedono di catturare il volto da più angolazioni,</i>
5	00:38:53:01 -	00:00:02:00	<i>and they can take hours to</i>	<i>e impiegano ore per il</i>

9 8	00:38:55:01		<i>render,</i>	<i>rendering,</i>
5 9 9	00:38:55:06 - 00:38:57:07	00:00:02:01	<i>but not Pinscreen's technology.</i>	<i>ma non la tecnologia di Pinscreen.</i>
6 0 0	00:38:57:12 - 00:39:00:03	00:00:02:15	- Let me show how quick it is. - Yeah.	- Ti mostro quanto è veloce. - Certo.
6 0 1	00:39:00:11 - 00:39:05:23	00:00:05:12	<i>Incredibly, his software also allows him to superimpose any face in real time.</i>	<i>Il suo software permette anche di sovrapporre qualsiasi viso in tempo reale.</i>
6 0 2	00:39:06:08 - 00:39:10:15	00:00:04:07	So if I do this, this blue face is basically a face tracker.	Se faccio così, questo volto blu è praticamente un rilevatore facciale.
6 0 3	00:39:10:19 - 00:39:14:06	00:00:03:11	So in real time, it's actually modeling my face in 3D.	Il mio volto viene modellato in 3D in tempo reale.
6 0 4	00:39:14:10 - 00:39:19:20	00:00:05:10	If I move around my face, the blue mask is basically a 3D representation of my face.	Se giro il viso, la maschera blu non è che un'immagine 3D del mio volto.
6 0 5	00:39:20:03 - 00:39:22:06	00:00:02:03	Wow, it's a sort of green screen.	Wow, è una sorta di green screen.
6 0 6	00:39:22:13 - 00:39:23:15	00:00:01:02	Sort of like, yes.	Praticamente sì.
6 0 7	00:39:23:21 - 00:39:25:15	00:00:01:18	<i>Like a Hollywood CGI film,</i>	<i>Come nei film con grafica CGI,</i>
6 0 8	00:39:25:19 - 00:39:30:15	00:00:04:20	<i>the computer dynamically models Hao's face and tracks his movement on the fly.</i>	<i>il computer modella dinamicamente il volto e ne traccia i movimenti in tempo reale.</i>
6 0 9	00:39:31:04 - 00:39:34:11	00:00:03:07	Like on him, turn myself into Putin.	Ora sono diventato Putin.
6 1 0	00:39:35:00 - 00:39:36:00	00:00:01:00	Wow.	Wow.
6 1 1	00:39:36:07 - 00:39:39:07	00:00:03:00	And it's generating everything in real time now.	E sta generando tutto in tempo reale.
6 1 2	00:39:39:13 - 00:39:40:20	00:00:01:07	Oh my gosh.	Incredibile.
6 1 3	00:39:41:02 - 00:39:42:18	00:00:01:16	It's like he's talking to me.	Sembra che mi stia parlando.
6 1 4	00:39:43:10 - 00:39:46:04	00:00:02:18	<i>Hao can create more than just political leaders.</i>	<i>Hao può creare non solo leader politici.</i>
6	00:39:46:15	00:00:01:07	You got Vito Cruz.	Ecco Vito Cruz.

1 5	00:39:47:22			
6 1 6	00:39:49:02 - 00:39:50:02	00:00:01:00	Audrey Hepburn.	Audrey Hepburn.
6 1 7	00:39:50:12 - 00:39:53:04	00:00:02:16	Oh wow, look at you, you're so pretty.	Oh wow, guardati, sei bellissima.
6 1 8	00:39:55:22 - 00:39:58:10	00:00:02:12	It generates all the pixels in real time.	Genera tutti i pixel in tempo reale.
6 1 9	00:39:58:15 - 00:40:01:05	00:00:02:14	This teeth are never seen in this picture.	I denti non si vedono mai in questa foto.
6 2 0	00:40:01:10 - 00:40:05:06	00:00:03:20	It predicts what your teeth will look like and these aren't yours.	Prevede come saranno i tuoi denti ma questi non sono i tuoi.
6 2 1	00:40:05:15 - 00:40:07:20	00:00:02:05	Yes, they aren't, it's generating.	Esatto, li sta generando.
6 2 2	00:40:08:06 - 00:40:10:07	00:00:02:01	Oh my goodness.	Oh mio dio.
6 2 3	00:40:11:12 - 00:40:16:06	00:00:04:18	<i>Hao believes that software like this will humanize the digital world.</i>	<i>Hao crede che questi software renderanno umano il mondo digitale.</i>
6 2 4	00:40:16:22 - 00:40:21:23	00:00:05:01	<i>Ultimately, this will result in friendlier looking androids and even virtual beings.</i>	<i>Questo porterà ad androidi dall'aspetto più amichevole e anche a esseri virtuali.</i>
6 2 5	00:40:22:04 - 00:40:25:18	00:00:03:14	<i>I have been hanging with my dog for a while, do you have pets?</i>	<i>Sono stata un po' con il mio cane. Tu hai animali domestici?</i>
6 2 6	00:40:25:22 - 00:40:27:06	00:00:01:08	Yes, three toy poodles.	Sì, tre barboncini toy.
6 2 7	00:40:27:19 - 00:40:33:01	00:00:05:06	Someday, we'll interact with virtual beings that will assist us in our lives.	Un giorno interagiranno con esseri virtuali che ci aiuteranno nella vita reale
6 2 8	00:40:33:05 - 00:40:37:07	00:00:04:02	Imagine instead of talking to Siri or Alexa, you're talking to a face.	Immagina di parlare con un volto invece che con Siri o Alexa.
6 2 9	00:40:37:12 - 00:40:41:10	00:00:03:22	And the best way to communicate is face-to- face.	Il modo migliore per comunicare è farlo faccia a faccia.
6 3 0	00:40:41:13 - 00:40:43:23	00:00:02:10	And AI provides you perfect companionship.	E l'IA offre una compagnia perfetta.
6 3 1	00:40:44:11 - 00:40:49:03	00:00:04:16	<i>This kind of technology will give AI a face that most people can relate to.</i>	<i>Questa tecnologia darà all'IA un volto con cui le persone potranno relazionarsi.</i>
6 3 2	00:40:49:11 - 00:40:52:00	00:00:02:13	Are you human or are you AI?	Sei umana o sei un'IA?

6 3 3	00:40:52:05 - 00:40:54:05	00:00:02:00	<i>That is an interesting question.</i>	<i>È una domanda interessante.</i>
6 3 4	00:40:54:09 - 00:40:57:19	00:00:03:10	<i>I think I am human, but I am artificial intelligence.</i>	<i>Penso di essere umana, ma sono un'intelligenza artificiale.</i>
6 3 5	00:40:58:12 - 00:41:03:12	00:00:05:00	<i>Hyper-intelligent companions could usher in a more helpful and hopeful world.</i>	<i>Con I compagni iperintelligenti potrebbe nascere un mondo più utile e promettente.</i>
6 3 6	00:41:05:21 - 00:41:08:19	00:00:02:22	<i>In the future, AI-powered virtual beings</i>	<i>Nel futuro, esseri virtuali alimentati dall'IA</i>
6 3 7	00:41:08:23 - 00:41:12:22	00:00:03:23	<i>that look, talk, and even think like real humans are commonplace.</i>	<i>che sembrano, parlano e pensano come noi saranno una cosa comune.</i>
6 3 8	00:41:13:07 - 00:41:17:11	00:00:04:04	<i>These holographic assistants take care of many aspects of daily life,</i>	<i>Questi assistenti olografici gestiscono molti aspetti della nostra vita,</i>
6 3 9	00:41:17:15 - 00:41:20:18	00:00:03:03	<i>ranging from fashion advice to business consultation.</i>	<i>dai consigli di moda alle consulenze aziendali.</i>
6 4 0	00:41:21:08 - 00:41:25:22	00:00:04:14	<i>Their faces and wardrobes can be customized depending on their role.</i>	<i>Volto e abbigliamento sono personalizzabili in base al ruolo.</i>
6 4 1	00:41:26:15 - 00:41:32:01	00:00:05:10	<i>If a doctor is needed, virtual assistants play the part and are always on call.</i>	<i>Se serve un medico, assumono questo ruolo e sono sempre disponibili.</i>
6 4 2	00:41:32:07 - 00:41:38:00	00:00:05:17	<i>Armed with the latest medical knowledge, they accurately diagnose common diseases.</i>	<i>Con le conoscenze mediche più recenti, diagnosticano le malattie più comuni.</i>
6 4 3	00:41:38:15 - 00:41:39:21	00:00:01:06	<i>The same technology</i>	<i>La stessa tecnologia</i>
6 4 4	00:41:40:00 - 00:41:45:06	00:00:05:06	<i>is also capable of capturing the image, voice, and life story of loved ones.</i>	<i>può ricreare il volto, la voce e la vita dei nostri cari.</i>
6 4 5	00:41:45:20 - 00:41:50:21	00:00:05:01	<i>After death, these virtual friends and family are always a part of our lives.</i>	<i>Dopo la morte, questi esseri virtuali restano con noi per sempre.</i>
6 4 6	00:41:53:01 - 00:41:58:11	00:00:05:10	<i>Even if engineers can create human-like robots, called androids,</i>	<i>Anche se si possono creare robot umanoidi, gli androidi,</i>
6 4 7	00:41:58:21 - 00:42:01:15	00:00:02:18	<i>in order for AI to become true companions,</i>	<i>perché l'IA diventi una vera compagna,</i>
6 4 8	00:42:02:00 - 00:42:07:14	00:00:05:14	<i>we'll need to feel comfortable embracing these androids figuratively and literally.</i>	<i>dovremo poterli abbracciare, sia in senso metaforico che reale</i>
6 4 9	00:42:08:14 - 00:42:13:01	00:00:04:11	<i>I'm outside San Diego to meet Matt McMullen, the founder of Realbotics.</i>	<i>Sono appena fuori San Diego con Matt McMullen, fondatore di Realbotics.</i>

6 5 0	00:42:13:21 - 00:42:18:00	00:00:04:03	<i>Matt is building androids that people will want to embrace physically.</i>	<i>Matt costruisce androidi che la gente vorrà abbracciare fisicamente.</i>
6 5 1	00:42:19:01 - 00:42:24:07	00:00:05:06	The goal is to create not only a robot but an AI, that are both appealing enough,	L'obiettivo è creare un robot e un'IA così affascinanti
6 5 2	00:42:24:16 - 00:42:29:17	00:00:05:01	that someone would feel like they were getting to know someone, not something.	da farci sembrare di conoscere una persona, non una cosa.
6 5 3	00:42:30:09 - 00:42:32:14	00:00:02:05	<i>Once sculpting and casting is done,</i>	<i>Dopo la scultura e lo stampaggio,</i>
6 5 4	00:42:32:18 - 00:42:37:13	00:00:04:19	<i>member's of Matt's team mold the silicon skin on an actual functioning robot.</i>	<i>i membri del team modellano la pelle di silicone su un robot funzionante.</i>
6 5 5	00:42:38:11 - 00:42:43:06	00:00:04:19	The faces are actually modular, the face just literally comes off.	I volti sono modulari, nel senso che si staccano.
6 5 6	00:42:43:10 - 00:42:44:10	00:00:01:00	Yes, it does.	È vero.
6 5 7	00:42:45:01 - 00:42:47:20	00:00:02:19	The idea is you create one robotic head	L'idea è creare una testa robotica
6 5 8	00:42:48:00 - 00:42:51:05	00:00:03:05	and many characters that can all run on that same heads.	e tanti personaggi intercambiabili sulla stessa testa.
6 5 9	00:42:52:04 - 00:42:54:11	00:00:02:07	All of the things that move in the face	Tutti i movimenti del viso
6 6 0	00:42:54:15 - 00:42:57:17	00:00:03:02	are actuated by these magnets that are in the skin.	sono attivati da magneti all'interno della pelle.
6 6 1	00:42:58:14 - 00:43:04:14	00:00:06:00	<i>The team of programmers use AI to create advanced chatbots for these robots.</i>	<i>I programmatori utilizzano l'IA per creare chatbot avanzate per questi robot.</i>
6 6 2	00:43:04:22 - 00:43:08:22	00:00:04:00	<i>The goal is to achieve natural conversations with their companions.</i>	<i>L'obiettivo è realizzare conversazioni naturali con i loro robot.</i>
6 6 3	00:43:09:04 - 00:43:10:07	00:00:01:03	She's a blinking.	Sbatte le palpebre.
6 6 4	00:43:11:00 - 00:43:12:07	00:00:01:07	Yeah, she's a blinker.	Hai visto?
6 6 5	00:43:12:19 - 00:43:14:18	00:00:01:23	This is a test of my system.	Questo è un test del mio sistema.
6 6 6	00:43:15:12 - 00:43:17:01	00:00:01:13	Wow, it's looking at me.	Wow, mi sta guardando.
6	00:43:17:12 -	00:00:01:18	Hi, how are you today?	Ciao, come stai?

6 7	00:43:19:06			
6 6 8	00:43:19:21 - 00:43:22:22	00:00:03:01	I'm okay, I'm fine.	Sto bene, tutto okay.
6 6 9	00:43:23:02 - 00:43:25:03	00:00:02:01	I'm doing just fine, how are you?	Tutto bene, tu come stai?
6 7 0	00:43:25:21 - 00:43:27:12	00:00:01:15	Why do you ask me that?	Perché me lo chiedi?
6 7 1	00:43:28:14 - 00:43:31:19	00:00:03:05	You know, because I care about your feelings.	Be', perché mi importa come ti senti.
6 7 2	00:43:35:12 - 00:43:38:20	00:00:03:08	<i>Speech is only one aspect of human communication.</i>	<i>L'oralità è solo un aspetto della comunicazione umana.</i>
6 7 3	00:43:39:07 - 00:43:43:11	00:00:04:04	<i>Facial expressions are hugely important in social interaction.</i>	<i>Le espressioni facciali sono fondamentali nell'interazione sociale.</i>
6 7 4	00:43:44:01 - 00:43:48:07	00:00:04:06	<i>So Matt is incorporating this non-verbal communication into his androids.</i>	<i>Matt sta integrando questa comunicazione non verbale nei suoi androidi.</i>
6 7 5	00:43:49:07 - 00:43:51:10	00:00:02:03	With our vision system in development	Grazie al nostro sistema di visione,
6 7 6	00:43:51:14 - 00:43:57:02	00:00:05:12	she'll be able to look at you and detect your emotion by you face expression,	potrà guardarti e rilevare le tue emozioni dall'espressione del volto,
6 7 7	00:43:57:10 - 00:44:00:11	00:00:03:01	by the temperature of your skin and other things.	dalla temperatura della pelle e da altri segnali.
6 7 8	00:44:00:17 - 00:44:05:18	00:00:05:01	Communication verbally and non-verbally is key, right?	Comunicazione verbale e non verbale sono fondamentali, giusto?
6 7 9	00:44:05:22 - 00:44:06:22	00:00:01:00	Exactly.	Esattamente.
6 8 0	00:44:07:02 - 00:44:08:19	00:00:01:17	It looks remarkable,	È straordinario.
6 8 1	00:44:08:23 - 00:44:13:01	00:00:04:02	it's moving, talking and it's having. a dynamic conversation with you.	Si muove, parla e sta avendo una conversazione dinamica con te.
6 8 2	00:44:13:04 - 00:44:14:12	00:00:01:08	That's the wonder.	È questa la meraviglia.
6 8 3	00:44:15:03 - 00:44:18:18	00:00:03:15	I can imagine someone might say, oh look, a sex robot.	Immagino che qualcuno possa vederlo come un robot del sesso.
6 8 4	00:44:19:00 - 00:44:23:12	00:00:04:12	The thing is to make a really impressive and good sex robot,	La verità è che, per creare un buon robot del sesso

6 8 5	00:44:23:23 - 00:44:26:16	00:00:02:17	you have to make a good robot at first.	bisogna creare prima di tutto un ottimo robot.
6 8 6	00:44:26:21 - 00:44:29:11	00:00:02:14	But I think that the longer term goals	Penso che l'obiettivo a lungo termine
6 8 7	00:44:29:15 - 00:44:33:20	00:00:04:05	will be to let people use these systems however they choose.	sarà permettere alla gente di usare questi sistemi come preferisce.
6 8 8	00:44:34:21 - 00:44:38:16	00:00:03:19	<i>Matt is building these androids for a wide range of applications.</i>	<i>Matt costruisce androidi per diverse applicazioni.</i>
6 8 9	00:44:39:13 - 00:44:44:14	00:00:05:01	We're creating human-like robots that can be used for a huge variety of things.	Creiamo robot umanoidi per diversi scopi.
6 9 0	00:44:45:02 - 00:44:46:18	00:00:01:16	For people who are lonely,	Per le persone sole,
6 9 1	00:44:46:22 - 00:44:50:14	00:00:03:16	whether they're old or maybe they're socially isolated,	che siano anziane, socialmente isolate,
6 9 2	00:44:50:18 - 00:44:52:20	00:00:02:02	or they suffer from social anxiety.	o che soffrano di ansia sociale.
6 9 3	00:44:53:09 - 00:44:58:01	00:00:04:16	<i>Friendly-faced androids could keep the elderly company and monitor their health.</i>	<i>Questi androidi potrebbero fare compagnia agli anziani e monitorarne la salute.</i>
6 9 4	00:44:58:14 - 00:45:03:21	00:00:05:07	<i>Armed with AI, these androids could take on other qualitative roles.</i>	<i>Grazie all'IA, potrebbero assumere altri ruoli qualitativi,</i>
6 9 5	00:45:04:16 - 00:45:06:13	00:00:01:21	I think therapy is a huge one.	come, la psicoterapia.
6 9 6	00:45:06:17 - 00:45:09:17	00:00:03:00	Using the robot as a safe conduit	Usando quindi il robot come un canale sicuro
6 9 7	00:45:09:21 - 00:45:14:04	00:00:04:07	for communication and letting people open up since they don't feel judged	per la comunicazione, poiché le persone non si sentono giudicate
6 9 8	00:45:14:11 - 00:45:15:23	00:00:01:12	by something like this.	da qualcosa del genere.
6 9 9	00:45:16:06 - 00:45:21:21	00:00:05:15	<i>Companion androids will forge a future where nobody will ever have to feel alone.</i>	<i>Questi androidi creeranno un futuro in cui nessuno si sentirà mai più solo.</i>
7 0 0	00:45:23:20 - 00:45:26:18	00:00:02:22	<i>While lifelike human androids and virtual beings</i>	<i>Gli androidi realistici e gli esseri virtuali</i>
7 0 1	00:45:26:22 - 00:45:30:06	00:00:03:08	<i>have the potential to enhance human social interactions,</i>	possono migliorare le interazioni sociali,
7	00:45:30:10 -	00:00:02:04	<i>there are ethical concerns</i>	<i>ma ci sono anche questioni</i>

0 2	00:45:32:14		<i>as well.</i>	<i>etiche.</i>
7 0 3	00:45:33:02 - 00:45:38:03	00:00:05:01	<i>Using AI, it's possible to hijack a person's physical identity.</i>	<i>Con l'IA, si può assumere l'identità fisica di una persona.</i>
7 0 4	00:45:38:11 - 00:45:42:17	00:00:04:06	There's one very big problem in the whole thing, which is privacy.	La privacy è un grosso problema in questo ambito.
7 0 5	00:45:42:21 - 00:45:45:09	00:00:02:12	What if I would do something bad to you?	Se volessi farti qualcosa di male?
7 0 6	00:45:45:13 - 00:45:49:06	00:00:03:17	And by that you mean reconstruct somebody	Intendi che si può ricreare qualcuno
7 0 7	00:45:49:10 - 00:45:52:14	00:00:03:04	and have them say something they would never say or do?	e fargli dire qualcosa che non direbbe mai?
7 0 8	00:45:53:16 - 00:45:58:06	00:00:04:14	<i>Digital fabrications like this are already emerging online,</i>	<i>Queste fabbricazioni digitali sono già presenti online,</i>
7 0 9	00:45:58:11 - 00:46:00:12	00:00:02:01	<i>in what are called deep fakes.</i>	<i>e vengono chiamate deepfake.</i>
7 1 0	00:46:01:01 - 00:46:04:18	00:00:03:17	I can go on your website, take a picture from it,	Posso andare sul tuo sito web, prendere una tua foto
7 1 1	00:46:04:23 - 00:46:08:14	00:00:03:15	and then create some content with it without your consent.	e ricavarne contenuti senza il tuo consenso.
7 1 2	00:46:10:01 - 00:46:15:22	00:00:05:21	<i>Also dangerous, swarms of AI-driven drones could be used in terrorist attacks.</i>	<i>Sciami di droni guidati da IA potrebbero essere usati in attacchi terroristici.</i>
7 1 3	00:46:16:09 - 00:46:18:04	00:00:01:19	Can drones be weaponized?	I droni possono essere armati?
7 1 4	00:46:18:11 - 00:46:19:21	00:00:01:10	Of course they can.	Certamente.
7 1 5	00:46:20:03 - 00:46:24:16	00:00:04:13	These breakthroughs yield results that can oftentimes be used against humans.	Purtroppo, questi progressi possono essere usati contro gli esseri umani.
7 1 6	00:46:24:20 - 00:46:27:17	00:00:02:21	You have to be held liable for what you developed,	Siamo i responsabili di ciò che sviluppiamo,
7 1 7	00:46:27:21 - 00:46:31:18	00:00:03:21	and it's our moral responsibility to think about the consequences.	ed è nostra responsabilità morale pensare alle conseguenze.
7 1 8	00:46:32:22 - 00:46:35:23	00:00:03:01	<i>When it comes to ethical considerations like these,</i>	<i>Quando si tratta di considerazioni etiche,</i>
7 1 9	00:46:36:05 - 00:46:40:10	00:00:04:05	<i>I still feel hopeful that science, technology, and human ingenuity</i>	<i>sono fiduciosa che la scienza, la tecnologia e l'ingegno umano</i>
7	00:46:40:14 -	00:00:02:12	<i>will find solutions for these</i>	<i>troveranno soluzioni a</i>

2 0	00:46:43:02		<i>problems.</i>	<i>questi problemi.</i>
7 2 1	00:46:43:21 - 00:46:49:08	00:00:05:11	The potential for artificial intelligence to profoundly improve society,	Il potenziale dell'IA di migliorare profondamente la società,
7 2 2	00:46:49:12 - 00:46:55:01	00:00:05:13	to improve jobs, to improve health care, to improve education is enormous,	il lavoro, la sanità e l'istruzione è enorme,
7 2 3	00:46:55:08 - 00:46:57:09	00:00:02:01	if we do it the right way,	ma va sviluppata nel modo giusto,
7 2 4	00:46:57:16 - 00:47:02:16	00:00:05:00	by building computer systems that assist them in doing what they're doing better.	creando sistemi che aiutino le persone a fare meglio ciò che già fanno.
7 2 5	00:47:03:06 - 00:47:07:15	00:00:04:09	Technology is more likely to provide some tools	È più probabile che la tecnologia ci fornirà strumenti
7 2 6	00:47:07:23 - 00:47:11:04	00:00:03:05	that will allow us to become superhuman,	che ci permetteranno di diventare "superumani",
7 2 7	00:47:11:10 - 00:47:14:20	00:00:03:10	augment our intelligence to make better decisions,	aumentando la nostra intelligenza per fare scelte migliori
7 2 8	00:47:15:01 - 00:47:17:08	00:00:02:07	and get better insights of the world.	e comprendere meglio il mondo.
7 2 9	00:47:17:17 - 00:47:22:09	00:00:04:16	<i>Future versions of this technology will surpass human intelligence.</i>	<i>Le versioni future di questa tecnologia supereranno l'intelligenza umana.</i>
7 3 0	00:47:22:15 - 00:47:26:15	00:00:04:00	I believe there's no doubt robots will exceed human capability.	Credo che, senza alcun dubbio, i robot supereranno le capacità umane.
7 3 1	00:47:26:20 - 00:47:31:17	00:00:04:21	The path is very clear, whether it's going to take 20 years or 200 years.	La direzione è molto chiara, che ci vogliano 20 anni o 200.
7 3 2	00:47:31:22 - 00:47:36:01	00:00:04:03	This is maybe the most powerful technology we've ever invented.	Forse questa è la tecnologia più potente che abbiamo mai inventato.
7 3 3	00:47:36:15 - 00:47:39:20	00:00:03:05	The potential of AI is limitless.	Il potenziale dell'IA non ha limiti.
7 3 4	00:47:40:00 - 00:47:42:05	00:00:02:05	Whatever big idea you can think of,	Qualsiasi grande idea tu possa avere,
7 3 5	00:47:42:10 - 00:47:48:10	00:00:06:00	you can ultimately, probably program a robot or a computer,	probabilmente potrai programmare un robot o un computer
7 3 6	00:47:48:17 - 00:47:50:02	00:00:01:09	to realize your vision.	per realizzarla.
7 3	00:47:51:04 - 00:47:52:15	00:00:01:11	<i>And in the right hands,</i>	<i>E nelle mani giuste,</i>

7				
7 3 8	00:47:52:19 - 00:47:58:01	00:00:05:06	<i>this technology has the potential to transform every part of daily life</i>	<i>questa tecnologia potrebbe trasformare ogni aspetto della vita quotidiana</i>
7 3 9	00:47:58:11 - 00:47:59:11	00:00:01:00	<i>for the better.</i>	<i>in meglio.</i>
7 4 0	00:47:59:16 - 00:48:02:15	00:00:02:23	<i>A true partnership with hyper-intelligent robots,</i>	<i>Una vera collaborazione con robot iperintelligenti,</i>
7 4 1	00:48:02:22 - 00:48:08:04	00:00:05:06	<i>with their intentions aligned with our own will transform humanity for the better.</i>	<i>con intenzioni simili alle nostre, trasformerà l'umanità in meglio.</i>

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RIASSUNTO IN ITALIANO

Negli ultimi decenni, la diffusione globale dei contenuti audiovisivi ha subito profondi cambiamenti, trasformandosi in uno dei principali strumenti attraverso cui le persone accedono alla cultura, all'informazione e all'intrattenimento. Questo fenomeno è stato fortemente influenzato dallo sviluppo delle tecnologie digitali e, soprattutto, dalla crescita esponenziale di Internet, che ha rivoluzionato il modo in cui i contenuti vengono creati, distribuiti e consumati. L'arrivo delle piattaforme di streaming on demand, come Netflix, Amazon Prime Video, Disney+, YouTube e molte altre, ha reso disponibile un'enorme varietà di contenuti audiovisivi provenienti da ogni parte del mondo, accessibili in qualunque momento e da qualunque dispositivo connesso alla rete.

In questo nuovo panorama mediale sempre più globalizzato, la traduzione audiovisiva (AVT) ha assunto un ruolo centrale e imprescindibile. Tradurre un prodotto audiovisivo non significa semplicemente trasporre un testo da una lingua a un'altra, ma comporta un'attività molto più complessa, che implica la mediazione tra codici linguistici, culturali e tecnici. Tra le varie modalità di AVT, la sottotitolazione si distingue per la sua efficacia comunicativa, i costi contenuti e la velocità di realizzazione. Inoltre, mantenendo inalterata la traccia audio originale, consente di preservare l'autenticità del messaggio e il legame con la cultura d'origine, elementi fondamentali per una fruizione consapevole e rispettosa del contenuto audiovisivo.

La presente tesi si articola in tre capitoli principali, ognuno dei quali affronta un aspetto specifico della traduzione audiovisiva e, nello specifico, della sottotitolazione. Il primo capitolo si concentra sugli aspetti teorici della TAV, il secondo approfondisce le caratteristiche tecniche e linguistiche della sottotitolazione, mentre il terzo presenta un caso di studio concreto basato sull'esperienza pratica di sottotitolazione di un documentario scientifico a fine divulgativo.

Nel primo capitolo vengono introdotti concetti fondamentali per comprendere la complessità dei testi audiovisivi. Si parla in particolare di multimodalità e multimedialità: due concetti chiave per definire la natura composita del testo audiovisivo, che nasce dall'interazione di diversi codici comunicativi (immagini, suoni, parole, musica, gesti), e viene veicolato attraverso molteplici canali tecnologici. Il

traduttore audiovisivo si trova quindi a lavorare con un testo sincretico, in cui il significato emerge dall'insieme coordinato degli elementi visivi e sonori. Questo richiede una competenza che va oltre la semplice conoscenza linguistica, poiché è necessario interpretare e rielaborare il messaggio tenendo conto della sua dimensione plurisemiotica.

Il capitolo prosegue con una panoramica storica dell'evoluzione della traduzione audiovisiva, dalle origini del cinema muto, con l'utilizzo dei cartelli esplicativi, fino alle forme moderne come il doppiaggio, la sottotitolazione, l'audiodescrizione e la localizzazione dei videogiochi. Particolare attenzione viene riservata al contesto italiano, dove il doppiaggio ha storicamente avuto un ruolo predominante, anche per motivi politici e culturali. Solo in tempi recenti, grazie all'avvento della televisione digitale, dei DVD e delle piattaforme online, si è assistito a una maggiore diffusione dei contenuti in lingua originale e, di conseguenza, a una crescente accettazione della sottotitolazione anche da parte del pubblico italiano.

Il secondo capitolo si concentra in modo specifico sulla sottotitolazione, analizzandone le caratteristiche teoriche e pratiche. Viene fornita una definizione tecnica della sottotitolazione come rappresentazione testuale, concisa e sincronizzata, del parlato e dei suoni rilevanti di un prodotto audiovisivo. Si distinguono le principali tipologie: sottotitoli interlinguistici (da una lingua all'altra), intralinguistici (nella stessa lingua o per scopi didattici) e SDH (Subtitles for the Deaf and Hard-of-Hearing, per persone con difficoltà uditive), che includono informazioni non verbali come effetti sonori e musica.

Il capitolo analizza anche le difficoltà intrinseche del processo di sottotitolazione, legate ai vincoli di spazio (numero massimo di caratteri per riga) e di tempo (durata di esposizione a schermo), alla necessità di sincronizzazione precisa tra testo e immagine, e alla resa efficace dei contenuti, anche nei casi di dialoghi sovrapposti o di contenuti specialistici. Si approfondisce inoltre l'utilizzo dei principali software professionali come Ooona Tools, Subtitle Edit, Aegisub, evidenziando i loro punti di forza e di debolezza.

Una parte significativa del capitolo è dedicata alle strategie traduttive necessarie per affrontare le sfide linguistiche e culturali: giochi di parole, espressioni idiomatiche, riferimenti culturali, registri diversi e dialoghi naturali. L'adattamento richiede

flessibilità e creatività da parte del traduttore, che deve anche tenere conto della trasformazione diamesica, cioè del passaggio dall'oralità alla scrittura, con tutto ciò che questo comporta in termini di sintesi, chiarezza e leggibilità.

Il terzo capitolo rappresenta il fulcro operativo del lavoro e presenta un caso di studio concreto: la sottotitolazione in italiano del documentario divulgativo “*The Revolution of AI*”, pubblicato dal canale YouTube Moconomy, noto per i suoi contenuti di carattere scientifico e tecnologico. Il documentario, della durata di circa 50 minuti, affronta vari temi legati all'intelligenza artificiale, tra cui le auto a guida autonoma, i robot da salvataggio, i droni intelligenti, il machine learning, l'intelligenza artificiale generale e gli avatar iperrealistici.

Il lavoro è iniziato con una visione attenta del documentario, seguita dalla trascrizione automatica dell'audio tramite Turboscribe, uno strumento basato su intelligenza artificiale. I sottotitoli generati sono stati poi caricati su Ooona Tools, scelto dopo un confronto con altri software, per la sua semplicità d'uso e completezza di funzioni. Una volta effettuato lo spotting e corretti i timecode errati, si è passati alla traduzione dei sottotitoli, avendo cura di adattare i contenuti in modo comprensibile per un pubblico italiano non specializzato.

Durante il lavoro sono emerse diverse difficoltà tecniche, tra cui la scarsa precisione della trascrizione automatica e la necessità di condensare testi lunghi in sottotitoli brevi e leggibili. Alcuni passaggi, particolarmente densi di informazioni, hanno richiesto scelte traduttive complesse, come l'unione di più frasi o l'eliminazione di dettagli secondari. Anche la terminologia specialistica ha rappresentato una sfida: si è cercato un equilibrio tra fedeltà al significato originale e chiarezza espositiva, ricorrendo a fonti autorevoli e adottando, quando necessario, abbreviazioni o prestiti linguistici.

L'esperienza ha evidenziato quanto il lavoro di sottotitolazione richieda non solo competenze linguistiche avanzate, ma anche capacità di analisi, sintesi e adattamento. Ogni sottotitolo è il risultato di una decisione ponderata, in cui il traduttore deve bilanciare vincoli tecnici, esigenze comunicative e rispetto per il pubblico.

In conclusione, questa tesi ha permesso di approfondire il ruolo della sottotitolazione come pratica professionale multidisciplinare. Tradurre un prodotto audiovisivo significa contribuire alla sua accessibilità, favorire il dialogo interculturale e ampliare la diffusione della conoscenza. La parte teorica ha offerto le basi per

comprendere le dinamiche della traduzione audiovisiva, mentre il progetto pratico ha consentito di mettere alla prova le competenze acquisite. Ne emerge un profilo del sottotitolatore come figura chiave nel panorama mediale contemporaneo, capace di unire precisione tecnica, sensibilità linguistica e consapevolezza culturale. È auspicabile, per il futuro, una maggiore valorizzazione di questa professione, anche attraverso percorsi formativi che integrino teoria e pratica, e che preparino i traduttori a rispondere alle sfide di un mercato in continua evoluzione.