

# AI & the Metaverse: AR and VR in sci-fi

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## Aspirations & Nightmares of VR

The aspiration of VR is to be real, but without limits. VR dreams of being a dream manifest. Cinema doesn't aspire to such immersions. Though Andre Bazin, in the late 50s, famously imagined cinema art as ever approaching "a recreation of the world in its own image," this has surely been disappointed (Bazin 2005, p. 21). Over the past century, huge amounts of wealth have been spent on film productions and presentations yet most films are still 2D color rectangles with sound; immersive iMax and 3D hold relatively small market shares.<sup>1</sup> Instead, cinema (and television) have pursued, for over 100 years, the form first posited by early kino enthusiasts: a language of montage to immerse viewer in stories (Vertov 1984, p. 5; Eisenstein 1949, p. 72). VR is different; its *raison d'être* is complete immersion in an image with the fidelity of the real. But the sci-fi genre in popular film, television, and literature is an ideal arena in which to see society's changing aspirations and anxieties connected with a technological phenomenon like VR. In the film, *Ready Player One* (released in 2018, based on the novel by Ernest Cline, also titled *Ready Player One*, published in 2011), the metaverse called OASIS seems more popular and attractive than reality; characters log in to the VR experience with special headsets, gloves, suits, and treadmills to be completely immersed in a video game-like environment. In this metaverse, only the players' senses and physical activity remain real: everything else—their entire surroundings and their own bodies—is replaced with virtual content; players are unconscious of their real environments, which are often dismal. It is like an active dream—though a dream created by another person (this is a central plot element). The metaverse is full of colorful fantasies; their bodies are replaced by colorful avatars; the limits superseded in the metaverse are the limits superseded in fantasy... that is, that which is desired can become manifest because it is desired. One can become taller, or prettier, or move faster and have special powers; though these things can only be achieved through a certain game economy, the limits of reality are no longer present: all things are achievable.

VR in the *Star Trek* television series, beginning with the depiction of the 'holodeck' in the 1987 first episode of *Star Trek the Next Generation*, is more reproductive of reality than the metaverse in *Ready Player One* ("Encounter at Farpoint" 0:51:00-0:56:00). In *Star Trek*, VR is used to create real-seeming natural environments—natural, but outside of achievable space or time: lush nature created on board a deep space cruiser, as in the holodeck debut in S1.E1; worlds only depicted in genre and popular fiction as in S1.E12 "The Big Goodbye" or S2.E3 "Elementary, Dear Data," in which the holodeck re-creates the worlds that Raymond Chandler and Arthur Conan Doyle imagined in their famous novels; as well as alternate roleplaying versions of the shared space ship reality, such as S3.E21 "Hollow Pursuits". Perhaps because *Star Trek* already presents a sci-fi world of elaborate technologies, the VR worlds depicted seem to reproduce reality with the characters remaining largely the same in appearance and abilities but surrounded by worlds that escape the limits of their time or space (or, at a meta-narrative level, escape their genre). The fictional holodeck technology incorporates projections, treadmills, forcefields, and

<sup>1</sup> An article in the *Hollywood Reporter* notes that iMax's global gross receipts for 2023 are almost equivalent to the record setting year of 2019, when they reached \$1.1 billion (Vlessing 2023). In 2019, 3D film receipts were \$6.5 billion globally, and this amount accounted for only a 15% share of the global box office (Newbould 2021).

some fanciful technology of matter creation and beam technologies, all taking place in a square black room aboard the ship (Murray 1997, p. 24). We, the audience, just like the TV characters, cannot differentiate the different methods of illusion; it all looks ‘real’ in the show, but it is supposed to provide harmless entertainment for the crew of the starship.



**Fig. 1** The holodeck as it appears in *Star Trek: The Next Generation*. Left & middle: the entrance to the holodeck running a nature program as depicted in S1.E1 “Encounter at Farpoint.” Right: the holodeck ‘in real life’ when no program is running, as depicted in S3.E21 “Hollow Pursuits.” (Paramount Television)

The nightmare of VR is the scenario in which the VR escapes its imagined limits and affects the real. In *Ready Player One*, this occurs in a direct way: the hero’s actions in the OASIS VR result in his family being murdered in reality (*Ready Player One* 0:57:00 – 1:00:00). Starting in S1.E12 of *Star Trek: The Next Generation*, a malfunctioning holodeck that suddenly becomes deadly in real life is a frequent narrative trope: if one dies in the VR world, one dies in reality (“The Big” 0:17:30-0:41:00). In 1950, Ray Bradbury authored an early depiction of VR in his short story “The Veldt” (first titled, “The World the Children Made” in the September 23 issue of *The Saturday Evening Post*). The VR is depicted as an immersive TV room within a futuristic house. The depiction doesn’t concern itself with special technological interfaces such as headsets or gloves, instead the multi-sensory room reflects the thoughts of the children that use it. As the children become troubled, and then murderous, the VR becomes an African grassland inhabited by all-too-real lions that eventually eat the parents (Bradbury 1951). This crossing of boundaries—the virtual becoming real not just to the senses, but also to the body—is almost always portrayed as insidious: VR breaching its boundaries is, necessarily, imperceptible. In “The Veldt,” the parents suspect some sinister malfunction in the VR room: the lions cause them real fear. But they have no way of perceiving the trouble until it is too late; after all, the room is supposed to appear real to the senses. In S1.E12 “The Big Goodbye,” though the crew outside the holodeck know it is malfunctioning, the participants don’t know until one of their members is shot and wounded, because everything is supposed to appear as real (0:26:30). The humans are shocked by this breach of contract between them and the VR: it should only affect their senses, not their lives outside the virtual experience. The 1999 film, *The Matrix* depicts this betrayal with VR technology at an extreme: the participants perceive the virtual as entirely real, completely suppressing their own true reality. The creator of the metaverse is alien and betrays the basis of the VR contract: the boundaries between real and virtual are completely

unknown to the participants.<sup>2</sup> A VR that achieves a *complete* simulation of reality—so that even the fact of virtuality itself is given the illusion of real—is monstrous. The contract of the VR experience is the knowledge that one's senses are real (that you are still real), but what is being sensed is virtual.



**Fig. 2** Two stills from *Ready Player One* showing the VR experience. Top: the protagonist with his visor, gloves, and universal treadmill setup; bottom: the same protagonist (on the left) as he appears in the game world next to another player who also dons an alternate avatar body inside the game. (Warner Bros.)

A wonderfully monstrous portrayal of VR is found in a special 2014 Christmas episode of the TV series *Black Mirror* (“White Christmas”). The main character, played by Jon Hamm, works as a trainer of virtual assistants. These assistants are exact copies of humans; the virtual humans are tortured until they will comply to a life of slavery, serving the same wealthy humans from which they have been copied (0:31:00-0:38:00). The virtual entities are presented as perfect sentient copies of humans, but are

<sup>2</sup> In the film, the aliens' nefarious purpose is to somehow harvest energy from the virtual living of the unwilling participants.

treated as objects without moral value; throughout the episode, humans show not the slightest qualm about inflicting hell upon the virtual entities, yet the scenic direction makes no distinctions between the real humans and their virtual copies (0:31:00-0:38:00, 1:10:00-1:12:00). It is a dystopia of VR: the virtual reality is controlled by a malevolent other and it cannot be escaped; but here the controlling other is not alien, instead it is humans that are the monsters. And the suffering entities are not real participants, as in *The Matrix*, but are virtual sentient entities. There is something essentially postmodern about this moral quandary. This is not a narrative of people being tricked into thinking the virtual is real, or the virtual escaping its boundaries and affecting people in the real—here a fresh question is asked: what of the virtual projections? If we doubt the Platonic dichotomy of true and false, then the images projected can have moral value (Plato 2000, pp. 220-223). At what point does the virtual become morally real—or more exactly, what differentiates humans from the virtual? *Star Trek*, in a number of episodes, tries to deal sensitively with this question, but in the end, there is no way to resolve the contradiction that the crew perceives the holodeck entities as both sentient/real and virtual/disposable; the narrative must escape this moral dilemma. “When you’re gone, will this world still exist? Will my wife and kids still be waiting for me at home?” asks the AI entity within the holodeck; “I honestly don’t know,” responds the captain (“The Big Goodbye” 0:40:00). And then the captain quickly exits the VR scenario so the starship (and the story) can return to normal; it is an example of what the film theorist, Robin Wood, might term “the happy ending: often a mere ‘emergency exit’ (Sirk’s phrase) for the spectator, a barely plausible pretense that the problems the film has raised are now resolved” (Wood 1989, pp. 290-291).



**Fig.3** A VR entity training session in *Black Mirror*, S2.E4 “White Christmas.” Left: the view from inside the VR entity’s world—they see Jon Hamm, the trainer, explaining their new state of slavery. Right: the VR entity after a torture session (100s of days of boredom in a blank white room), sitting demoralized on the floor, ready to surrender.

## Aspirations & Nightmares of AR

AR aspires to be seamless: reality like a smooth surface upon which the virtual can flow.<sup>3</sup> The borders between real and virtual should be finely crafted, without aliasing.<sup>4</sup> In this sense, AR does not seek immersion, instead it seeks integration: the virtual and real to be made whole. But, all the same, there must be a perceived border; as in VR, the contract of the AR experience is that the user knows the virtual to be virtual.<sup>5</sup> So there is an ontological and epistemological tension: the real and fake must be perceptively different, but also experienced as a seamless whole.

AR is featured in sci-fi romance stories in which these tensions are made dramatic. In *Bladerunner 2049* (released in 2017), the protagonist has a holographic girlfriend who is beautiful and intelligent and seems in all ways sentient (0:18:00-0:23:00).<sup>6</sup> They seem to be in love with each other, but frustrated ontologically—they cannot have sex—and epistemologically: the protagonist cannot know that the hologram's love is real and true; when she says "I'm so happy when I'm with you," he replies, "You don't have to say that" (0:22:30). The first scene in which we meet the hologram, its system is upgraded so it is no longer limited in where it can be projected: she can travel to the roof of the building, or out into the city to join the protagonist on his adventures.<sup>7</sup> This romance narrative within the *Bladerunner* movie is quite similar to the romance between an audio-based AI and a human, told in the 2013 film, *Her*. In *Her*, an AI virtual assistant that is part of a new operating system becomes the virtual girlfriend of the protagonist; she is strictly limited to an audio experience which can be transported anywhere through earbuds. As in *Bladerunner 2049*, the AR entity appears completely (humanly) sentient and intelligent. The human and AI also seem to fall in love. In both films, the virtual girlfriends obtain physical surrogates in an attempt to bridge the ontological gap and have sex with their humans (a simulant prostitute in *Bladerunner*, and a volunteer human surrogate in *Her*), with mixed results: in *Her*, the human ultimately rejects the experience as fake, in *Bladerunner 2049* the human consummates their

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<sup>3</sup> Here thinking of the terminology used by Michael Hardt, who in "Withering of Civil Society" (Social Text 45; Winter 1995) uses 'smooth' to describe cyberspace: "The metaphorical space of the societies of control is perhaps best characterized by the shifting desert sands, where positions are continually swept away; or, better, the smooth surfaces of cyberspace, with its infinitely programmable flows of codes and information" (Hardt, p. 37).

<sup>4</sup> Aliasing refers to rendered artifacts which occur when electronic sampling is unable to distinguish between one value and another (thus one and its 'alias'). In computer graphics this typically looks like 'jaggies', where gradients or curves rasterize as jagged lines (see "What is aliasing?" PhysLink.com).

<sup>5</sup> It is hard to delineate what types of virtual media can constitute AR, because our pedestrian realities include frequent contact with media of all sorts: broadcast sound, pictures, telecommunications, sensors, etc. Of AR, we typically think like Supreme Court Justice Potter Stewart: "I know it when I see it" (Jacobellis 1964, p. 197). But, to go beyond that and list a discrete set of required technologies is difficult. Certainly, an intelligent hologram home-companion is AR, but is a typical TV screen AR because it augments an interior with virtual content? What about a gaming device, which is more intelligent and interactive? What about a sentient android? And must AR be visual, or can it be auditory, like Alexa and Siri? Must it speak and appear, or can it only watch and listen?

<sup>6</sup> *Bladerunner 2049*, similar to *Black Mirror* "White Christmas", also has a narrative of enslaved AI entities: synthetic humans ('simulants') are clearly sentient, but humans treat them as a slave race, to be used for services and as disposable labor for dangerous activities, such as off-world colonization (*Bladerunner* 0:40:00-0:42:00).

<sup>7</sup> In this way, the hologram takes on the role performed by the android replicant love interest in the first *Bladerunner* film, released in 1982—in the second chapter, released in 2017, the human protagonist is replaced with a synthetic human, and the love interest, who was a synthetic human in the first film, is replaced with a hologram. It raises the question, how is an android (or synthetic human) essentially different from a sentient AR hologram?

relationship via the surrogate/prostitute, but in the end is betrayed by this synthetic woman who has her own ulterior motives (*Her* 1:15:00 – 1:20:00; *Bladerunner* 1:26:00 – 1:32:00). In both films, the romance begs the question, to what extent can one perceive the virtual as real through AR... Are there perceptual, emotional, or moral limits? The romantic love seems testament to the fact of the AR integration, the failing of the romance (through the AI's evolution in *Her*, and through its violent deletion in *Blade Runner 2049*) testifies to the insurmountable difference between virtual and real (*Her* 1:51:00, *Bladerunner* 2:00:30).<sup>8</sup>

In these depictions of AR, the virtual is AI sentient and the AR entities' virtuality is evidenced by their diegetic impotency: the audio or audio-visual holograms cannot touch the world in which they appear. This is in tension with their high fidelity to reality: they manifest as real to their limits, but by these limits they are perceived as virtual.<sup>9</sup> In this light, one could say that AR is an unbounded VR: where the boundary between real and virtual in VR is always the same—the users' senses and will to action are real, all other perceptions are simulated—the boundary in AR is malleable and changing with the device, the AR entity, and the situation; reality a smooth surface on which the virtual flows.

The nightmare of AR is to lose control of one's senses. In these romance stories, the tragic ending is when these AR entities are turned off against the protagonists' wishes. Some dystopian portrayals of AR, including other holograms in *Bladerunner*, focus on advertising: corporations controlling our senses as an expansion of our current advertising media technologies. So, for example, in the 2002 film, *Minority Report*, AR is used by luxury brands to personally appear to people in the train station; Tom Cruise, playing a stressed-out fugitive, has no choice but to suffer the distractions (0:46:00-0:47:00). This narrative is taken to an extreme in the television series, *Black Mirror*.

In the *Black Mirror* "White Christmas" episode, the society depicted has adopted an AR technology that is built in to their perceptions—perhaps through the same neuro-linked "cookie" technology that is used for the virtual clones of people. The built-in AR is presented as technology familiar to us; it's able to live video link groups of people, and take photos like contemporary smartphones (0:46:00). The AR feature central to the story is that people can be "blocked" (0:26:00, 0:49:00, 1:10:00). Clearly a reference to being 'blocked' on contemporary social media, in this sci-fi AR it means one can no longer hear or see the person who blocks you, and they cannot hear or see you—like a virtual restraining order of the senses. At its most extreme, someone can be blocked by everyone.<sup>10</sup> Similar to the VR entities who are callously tortured, this AR punishment is presented as horrific: a person's reality is altered, against their will, and isolates them completely. As with the VR entities, our impression is that humans, given godlike powers to control realities, show their true monstrous natures; AR and VR technologies allow for the abuse and suffering of both human and AI participants: abuse at the hands of humans through machines.

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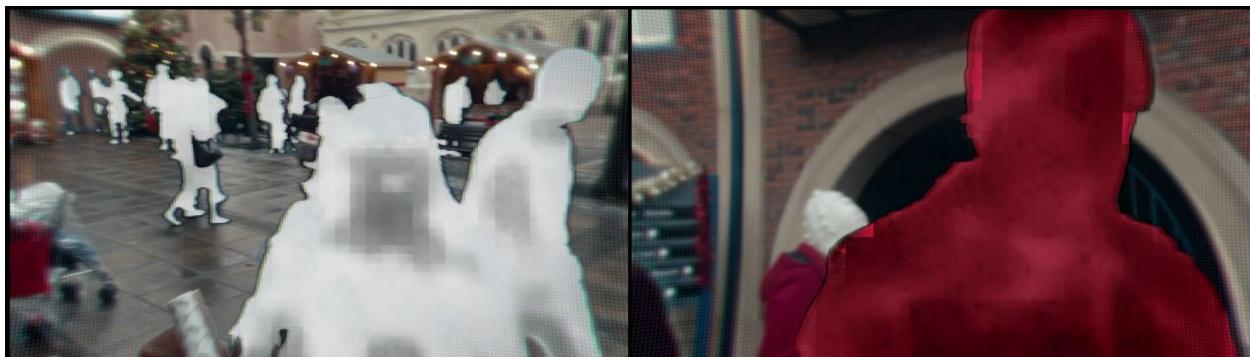
<sup>8</sup> But this question is not posed reciprocally. Both films seem to evade the question of the AR entity's own experiential senses—they are able to deliver experiences of sight and sound, but what are they able to experience themselves? What would be the AR entity's experience of sex? How can something that has never experienced touch, want touch?

<sup>9</sup> In *Bladerunner 2049*, when the AR entity first travels outside to the roof, she experiences rain for the first time. The rain drops pass through her incarnate form, but they also render as holographic raindrops on her hand (we assume this is through sensitive and intelligent AR coding) (0:21:00).

<sup>10</sup> This is the fate of the character played by Jon Hamm. In punishment for his crime, he is put "on the register" and cannot see anyone, or be seen by them (1:08:00-1:10:00).



**Fig.4** *Bladerunner 2049*: three stills showing the protagonist's holographic AR girlfriend. Top-left: the hologram experiences rain for the first time, it both passes through her incorporeal hand, and is also rendered as virtual raindrops; top-right: the protagonist mimes the gesture of caressing the holographic entity (unable to actually touch); bottom: the AR girlfriend, having enlisted a prostitute as corporeal surrogate, attempts to sync her holographic form with the actual body to have tactile interactions with the protagonist.



**Fig.5** *Black Mirror* "White Christmas," the protagonist, portrayed by Jon Hamm is "blocked." Left: his view, being unable to see or hear others in the world; right: others' view of him... he appears as an indecipherable, and unintelligible, red blur.

## A Sentient Metaverse

The metaverse is a content: a virtual world that is persistent and changeable through interactions. The metaverse aspires to be sentient: a discrete, persistent entity that reacts, learns, and grows. For it to be a universe ready for navigation, it must be larger than what can be perceived at any moment. Only a small part of the metaverse is rendered; the rest lies in wait within the algorithms, data, AI of the system. VR allows one to enter a metaverse which waits to be navigated. AR allows a metaverse (a discrete sentience) to enter into reality and interface with people. In these sci-fi narratives discussed, VR is a metaverse spreading out beyond one's perceptions, AR is a 'metaverse within' that is a sentient AI entity.

In our current non-fiction realities, we don't have holographic giants roaming the streets, as in *Bladerunner*, but we do have AI metaverses rendered for our interactions. When one hails a car that is supported by an app-based networked system such as Uber, Didi, Lyft, or Grab, the journey one takes is designed based on an intelligent analysis of an ever-updated map of the city, its current traffic patterns, GPS sensors, weather, and more. Both you and the driver are given your need-to-know information based on this intelligent universe of data: small pieces of this vast metaverse rendered to each of your phones, but the entire metaverse—the internal data, calculations, and algorithms of the ride hailing system—is beyond comprehension.<sup>11</sup> One participates in the rendering of this metaverse: we find the car at a GPS location matching a communicated license number and car color; the driver follows transmitted directions, live updated based on the car's GPS location; finally financial transactions are completed and we are prompted to give a review. People perform their roles, entering and exiting the metaverse of these intelligent maps. This is similar to our performance with ChatGPT. In ChatGPT, it's internal universe of data, coding, algorithms, and training are inconceivable; but we interact with a rendered prompt, designed to simulate a human assistant: "How can I help you today?"<sup>12</sup> This human-like chat is not a trick, but an interface to the AI world designed to sound human. ChatGPT-3 claimed roughly 175 billion parameters for analyzing and intelligently producing text, trained on a dataset of trillions of words from the internet (Brown 2020; Farseev 2023). These are numbers at a size hard to humanly conceive. But our new technologies interface with humans through intelligible renders like iceberg tips floating above massive oceans of calculations and data. In pieces, the metaverse is made human and legible for us, and as a totality it exists somewhere else beyond comprehension. This seems to be the current popular experience of the metaverse.<sup>13</sup>

This collaboration between the human and massive apparatus of technical algorithms and information is key to what Vilém Flusser terms an age of "technological images" (Flusser 2011, p. 7). Flusser has been

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<sup>11</sup> The most popular map program, Google Maps, is comprised of many petabytes of geographic data: a quantity of information (each petabyte equivalent to one-million gigabytes) that is hard to imagine (Nahar 2017).

<sup>12</sup> "How can I help you?" is the initial prompt given at <https://chat.openai.com/> as of January 2024.

<sup>13</sup> One can think of one comparably massive dataset that precedes our current age of technological revolution... History: the sum of all archives, museums, and libraries describing the events and objects that have come before now. This idea of history as a metaverse that can be accessed through VR and AR has been explored in both sci-fi and real-world projects. In the opening sequence of the first *Guardians of the Galaxy* (2014), the protagonist uses an AR device to project holograms showing the ancient city as it once was, complete with people and pets (0:05:00-0:6:00). The Chicago History Museum's *Chicago 00 Project* and the Museum of London's *Streetmuseum* have published apps that use AR to project the museums' photo archives on to the places where the history occurred. The exhibition, *Notre-Dame de Paris : the Augmented Exhibition*, by the studio, Histovery created an AR-enabled exhibition in which one could see the entire history of the famous site (see References).

called a writer of “philosophical science fiction” (Flusser 1999, p. 13). He describes our age, writing in the 80s and 90s, as the beginning of a new technological revolution: an age of algorithms and information that supersedes ages of tools and machines, in which the nature of man will be transformed into “robot-man” (1999, p. 12). This is a relationship of production; Flusser describes:

*It becomes more and more apparent that the relationship between human being and robot is reversible and that they can only function together: the human being in effect as a function of the robot, and by the same token the robot as a function of the human being. The robot only does what the human being wants, but the human being can only want what the robot can do.* (1999, pp. 47-48)

I think of the protagonist in *Her*, basing his romance on oral conversations to interface with his AI girlfriend, or the protagonist in *Bladerunner 2049* pantomiming romantic caresses with his holographic lover (*Bladerunner* 0:22:00). The other primary feature of this technological revolution, according to Flusser, is immateriality. In his essay, “Form and Material,” he writes:

*[...] now it is a question of making a world appear that is largely encoded in figures, a world of forms that are multiplying uncontrollably. In the past, it was a matter of formalizing a world taken for granted, but now it is a matter of realizing the forms designed to produce alternative worlds. That means an ‘immaterial culture’, though it should actually be called a ‘materializing culture.* (1999, p. 28)

The technological revolution he describes is one in which ideal mathematical forms have moved from being ideals that are roughly imposed on matter by humans and machines, to information that is materialized through screens and holograms and VR (this can be found throughout his essays, see in particular “On the Word Design,” “Form and Material,” “About Forms and Formulae,” and “The Non-Thing;” 1999, pp. 19, 22, 27, 36, 86, 91). All of these renderings are “in the true sense of the expression, ‘impossible to get hold of’. They are only open to decoding” (1999, p. 86). Our current society, straddling an age of machines and an age of information, is “perhaps the last generation to be able to see the way things are going.” (1999, p. 94)

There is an image that sticks in one’s head a long time. It is an image that arises from thoughtful empathy with the robot, or AI, or metaverse. Watching the dramatic scenarios portrayed on the holodeck in *Star Trek: The Next Generation...* imagine the perspective of the computer. According to the fiction, the holodeck experience comprises a complicated array of illusions: projections, forcefields, treadmills, matter instantly created and destroyed... The reality of the room is portrayed as a medium-sized hanger: black with yellow grid lines across floor, wall, and ceiling (“Hollow Pursuits” 0:42:30). The computer must surveille the crew who are often alone in this dark, bare space, talking to illusions, sitting on forcefields, running on treadmills... An embarrassing performance, which the crew in the show never acknowledge. What does the computer think of this? There is something in this empathy—imagining the view from our robot metaverse companions – that may be fruitful for art. In an immaterial age, it is a link to reality.

## References

Bazin A (2005) *What is Cinema?* (trans: Andrew D). University of California Press, Berkeley.

“The Big Goodbye.” *Star Trek: The Next Generation*, created by Gene Roddenberry, season 1, episode 12, Paramount Television, 9 Jan 1988.

*Bladerunner*. Directed by Ridley Scott, Warner Brothers, 1982.

*Bladerunner 2049*. Directed by Denis Villeneuve, Columbia Pictures, 2017.

Bradbury R (1951) “The Veldt.” In: *The Illustrated Man*. Bantam Books, New York, pp. 7-18.

Brown T, Mann B, Ryder N et al (2020) Language Models are Few-Shot Learners. CoRR abs/2005.14165. <https://arxiv.org/pdf/2005.14165.pdf> Assessed 1 Jan 2024.

*The Chicago 00 Project*. 2016-2021, G.A.Rhodes & Chicago History Museum. See <https://chicago00.org/>. Accessed 1 Jan 2024.

Eisenstein S (1949) Film Form: Essays in Film Theory (ed. & trans. Leyda J). Harvest / Harcourt Brace Jovanovich, New York.

“Elementary, Dear Data.” *Star Trek: The Next Generation*, created by Gene Roddenberry, season 2, episode 3, Paramount Television, 5 Dec 1988.

“Encounter at Farpoint.” *Star Trek: The Next Generation*, created by Gene Roddenberry, season 1, episode 1, Paramount Television, 26 Sep 1987.

Farseev A (2023) “Is Bigger Better? Why The ChatGPT Vs. GPT-3 Vs. GPT-4 'Battle' Is Just A Family Chat” In: *Forbes* (17 Feb). <https://www.forbes.com/sites/forbestechcouncil/2023/02/17/is-bigger-better-why-the-chatgpt-vs-gpt-3-vs-gpt-4-battle-is-just-a-family-chat/?sh=400677cc5b65> Assessed 1 Jan 2024.

Flusser V (1999) The Shape of Things: A Philosophy of Design (trans: Mathews A). Reaktion Books, London.

Flusser V (2011) Into the Universe of Technical Images (trans: Roth NA). University of Minnesota Press.

*Guardians of the Galaxy*. Directed by James Gunn, Walt Disney Pictures, 2014.

Hardt M (1995) “Withering of Civil Society” In: *Social text* 45, pp. 27-44.

*Her*. Directed by Spike Jonze, Warner Brothers, 2013.

“Hollow Pursuits.” *Star Trek: The Next Generation*, created by Gene Roddenberry, season 3, episode 21, Paramount Television, 28 Apr 1990.

*The Matrix*. Directed by Lana and Lilly Wachowski, Warner Brothers, 1999.

*Minority Report*. Directed by Steven Spielberg, Dreamworks Pictures, 2002.

Murray JH (1997) *Hamlet on the Holodeck : the Future of Narrative in Cyberspace*. The Free Press, New York.

Nahar A (2017) “Google Maps – the most expansive data machine” (Posted 5 Apr) In: *Harvard Digital Innovation and Transformation: MBA Student Perspectives*. <https://d3.harvard.edu/platform-digit/submission/google-maps-the-most-expansive-data-machine/> Assessed 1 Jan 2024.

Newbould C (2021) “Did Covid-19 kill the 3D cinema or is the format just a con?” In: *The National News* (25 Nov). <https://www.thenationalnews.com/arts-culture/film/2021/11/25/did-covid-19-kill-the-3d-cinema-or-is-the-format-just-a-con/> Assessed 1 Jan 2024.

*Notre-Dame de Paris : the Augmented Exhibition*. 2022, multiple locations. See <https://histovery.com/en/works.html>. Accessed 1 Jan 2024.

Plato (2000) *The Republic* (ed: Ferrari G.R.F, trans: Griffith T). Cambridge University Press.

*Ready Player One*. Directed by Steven Spielberg, Warner Brothers, 2018.

*Streetmuseum*. 2010, DREEm: Digital, Regeneration and Experience Economy modelling (UAL), with Museum of London. See <https://www.dreem.org.uk/experience/streetmuseum-museum-of-london/>. Accessed 1 Jan 2024.

U.S. Supreme Court, *Jacobellis v. Ohio*, 378 U.S. 184 (1964), <https://tile.loc.gov/storage-services/service/ll/usrep/usrep378/usrep378184/usrep378184.pdf> Assessed 1 Jan 2024.

Vertov D (1984) The Writings of Dziga Vertov (ed. Michelson A, trans: O’Brien K). University of California Press, Berkely.

Vlessing E (2023) “Imax Delivered \$1.06B in 2023 Global Box Office, Near 2019’s Record Year” In: Hollywood Reporter (9 Jan). <https://www.hollywoodreporter.com/business/business-news/imax-2023-global-box-office-1235782550/> Assessed 1 Jan 2024.

“What is aliasing” PhysLink.com Physics & Astronomy Online. <https://www.physlink.com/Education/AskExperts/ae490.cfm> Assessed 1 Jan 2024.

“White Christmas.” *Black Mirror*, created by Charlie Brooker, season 2, episode 4, House of Tomorrow, 16 Dec. 2014.

Wood R (1989) *Hitchcock’s Film Revisited*. Columbia University Press, New York.