Considering a shared future between humans, post-humans and AI

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It seems that a viral video of dancing robots or new artificial intelligence (AI) doing incredible feats emerges every week. These advances in AI and robot technology are astounding, yet these technologies could potentially displace millions of jobs. As a young researcher working in the field, I can understand the hesitation and even negativity held towards AI and robotics research. Human enhancement technologies have long been an avenue for heated debates, as it's a fast-changing field in which innovations can lead to major social impact.

Recently I read a thought-provoking book on the topic, *Engineering the Human: Human Enhancement Between Fiction and Fascination* (Koops et al., 2013), for an assignment in my final year of undergraduate study. The book is a collection of discussions of human enhancement technologies written by industry and academic experts. By reviewing research trends and discussing how they reflected in science fiction literature and media, the book explores the entire spectrum of human enhancement, both biological and cybernetic. Furthermore, the book paints an animated picture of how people in each era responded to, and eventually accepted, these technologies that challenged their fundamental understanding of 'what it means to be human'. Although the book was published in 2013, I find many of the book's ideas and arguments to remain relevant despite major leaps in technology since then. I highly recommend the book for any reader as it shows the intricate ties between culture, philosophy and technology. As an (overworked) engineering student, reading it made learning about the (otherwise dry) topics to be quite an engaging process.

Photo by Andrea De Santis on Unsplash

This article is inspired by the book's gripping discussions and was adapted from my book review assignment. First, I expand on two of the book's topics by introducing some emerging technologies in human enhancement in the fields of genetic modification and AI. I then turn to a response to the ethical discussions put forth in the book in regard to the status and fundamental rights of sentient life forms. And for those wishing to use science fiction pop culture and media to explore developments in the ethical debates related to human enhancement, I offer some recommendations for further reading and video game play. In particular, I'll discuss a sub-genre overlooked by the book's authors, Cyberpunk.

My hope is that these discussions will spark your curiosity about these technologies related to human enhancement and the ethical issues that may arise in our lifetime, and prompt your further investigation.

Humanity of the future: Genetic Modification and AI

We humans seem to have the desire to control the characteristics of ourselves and our children, and technology is advancing our capability to do so. Koops et al. (2013) gives a fascinating overview of the many biological methods for human enhancement, including eugenics - the selection of desired heritable characteristics to improve future generations, and collective human conditioning – 'molding' of desired traits not through hereditary means but educative and societal means. The authors mention 'helicopter parenting' as an extension of this, which struck me as humorous yet accurate.

Genetic modification, or changing an organism's characteristics by manipulating its DNA, is then considered to be the next step in human enhancement. Scientists are actively pursuing a future in which favorable traits and characteristics can be directly chosen before birth. The concept of Artificial Humans is then discussed as the ultimate extension of eugenics by creating 'ideal humans' out of nothing. The interest in improving humanity continues and is advancing today. In the last decade since the book's publishing, human enhancement has been championed by rapidly advancing technologies in genetic modification and AI which are worthy of discussing.

Photo by ThisIsEngineering

Human enhancement through genetic modification

Many advances in genetic modification have emerged in the past decade, and the backbone of these technologies today is CRISPR. Detailed in the influential paper by Jennifer Doudna and Emmanuelle Charpentier (Jinek et al., 2012), the method promises a genetic editing technology that sounds straight out of science fiction. CRISPR or CRISPR-Cas9, short for Clustered Regularly Interspaced Short Palindromic Repeats using Cas9 Enzyme, is a programmable 'molecular scissors' that can target and cut out or replace specific portions of DNA, permanently modifying the genes in living cells. The precision and speed of CRISPR is unparalleled compared to previous methods and allows scientists to realize gene modifications within weeks. CRISPR drives much of today's biomedical research by enabling and accelerating research; however, performing CRISPR on living cells, especially on humans' embryos, is a tightly regulated technology in most countries due to ethical reasons.

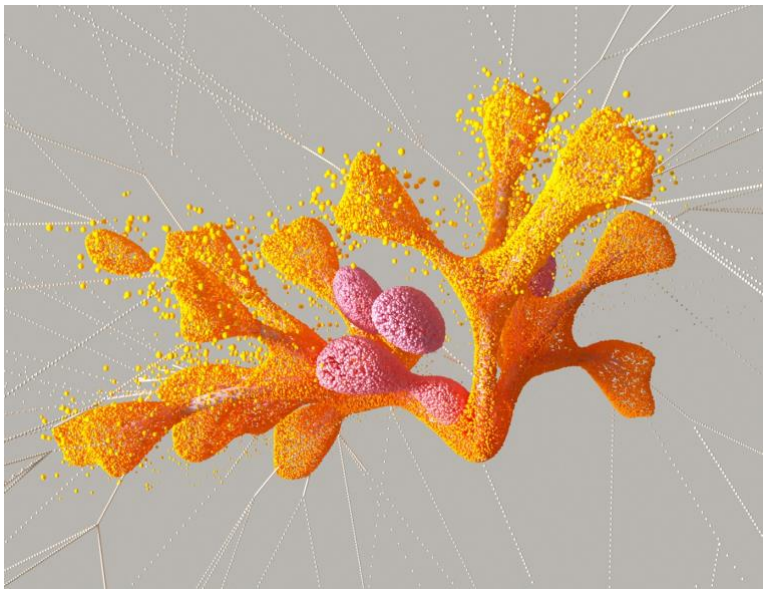
The potential impact of CRISPR on improving human life was affirmed in 2020 when the pair received the Nobel Prize in Chemistry. CRISPR has shown immediate promise in treating

genetic diseases such as sickle cell disease and beta thalassemia by modifying genes during the fetal stage (Frangoul et al., 2021). This can greatly advance the quality of life of our future generations. Perhaps even more promising is that CRISPR can also be used to edit T-Cells of cancer patients to make them more potent at targeting cancer (Stadtmauer et al., 2020), which could benefit the lives of our already-born generation, a technological advancement that perhaps not even the book authors could imagine would become reality in this decade. CRISPR is also a critical enabling technology for producing and transplanting artificial organs (Kuscu et al., 2020). Only recently in January 2022 was the first animal-human transplant performed (Kotz, 2022), in which a pig heart was transplanted into a human. The procedure's key enabling technology was the CRISPR genetic editing of the pig's tissue to ensure that the human body would not reject it. These applications are shocking to me, yet I expect that developments like this will continue to appear in our news headlines.

Another aspect related to human enhancement captivating public discourse is the development of AIs that behave like humans to perform menial or labor-intensive tasks. Artificial Intelligence (AI) is a vast and fascinating field of computer science that focuses on building machines capable of human-like intelligence and exploring its applications. In this section I'll introduce a few of its fundamental concepts.

Training AI through Deep Learning

Most AI systems today consist of many layers of neural networks that are 'trained' using massive datasets; therefore, they are often referred to as Deep Neural Networks, whereas the field is called Deep Learning (DL). DL was initially used to recognize simple images in a competition by using AlexNet (Krizhevsky, Sutskever, & Hinton, 2012). Since then, deep learning models have grown significantly in depth, by becoming more advanced and reliable for real-world applications, and in breadth, by adopting different training methods and architectures to achieve state-of-the-art performance in different fields. As an engineer, what I find most interesting is the diversity of methods used to train artificial intelligence for different use cases.



Digital Biology: The artwork illustrates AI's effort in understanding and predicting biological forms and functions.
Artist: Khyati Trehan Photo by DeepMind on Unsplash

Supervised Learning

AI can be trained through supervised learning (SL), which is like showing an AI millions of questions along with the correct answers. In the example of image recognition, the questions would be the images, and the answers would be the labels describing the images. In practice, massive datasets (often obtained from public Internet content or social media) are required to be labeled and fed to a deep neural network. By backpropagating the desired outputs (labels) according to the inputs, the neurons within the deep neural network are nudged towards the desired configurations en masse.

Here, it is important to note that 'desired outputs' of SL can be more than simple labels such as names of objects and their locations. For example, when training AI chatbots, desired outputs would be a dialogue, or when training AIs to forecast stock prices, the desired output would be future stock prices. With all this 'labeled' data, after thousands of training iterations, deep neural networks become incredibly accurate approximations of the dataset it was trained on. An incident in June 2022 exemplifies this issue; after a seemingly intelligent conversation between human and machine, a Google employee claimed that Google's new dialogue AI LaMDA was sentient. The employee was subsequently suspended.

SL has been applied to train AIs to model social interactions or generate images from text. In terms of research, the biggest challenges today are creating more capable architectures, more efficient training methods, and fair and transparent AI models regardless of the shortcomings in the training dataset.

Reinforcement Learning

Another major method of training AIs is Reinforcement Learning (RL). This can be imagined as putting the AI in a sandbox, assigning each small task with some rewards and punishment, and letting them learn through play. The training process is often done with many simulated environments running in parallel, carefully crafted to resemble the physics and interactions of the real world. AI robots trained with RL, which are called **agents**, learn how to act by getting rewards from achieving subtasks such as 'not crashing into other cars' or 'getting to the destination'. In the process of doing these subtasks, the agent must learn to interpret the input from the sensors, understand underlying rules of itself and the environment such as 'if I walk too close to the edge I will fall over', and learn sequences of actions necessary to achieve the goals. RL has been applied to autonomous robots and protein folding.

Because training is almost always done in simulation first, video games have become a popular avenue for training and validating RL training methods. For example, Dota 2, Starcraft 2, and Minecraft are all training grounds for researchers to learn and develop RL agents capable of navigating complex goals. Personally, I find the process quite charming, as it is a mix of

tinkering with software and observing the agents play out like fish in an aquarium, then evaluating their performance methodically and repeating the process.

Breakthroughs in the field of RL are often achieved by surprisingly 'human' and intuitive methods. An example is the Actor-Critic framework in which one part of the robot brain learns how to act, and another part of the robot brain learns how to criticize or reward it. Another example is the use of a memory buffer for agents to replay memories and learn from them. In other words, robots today do dream, on a regular basis, and they dream a lot more than we do.

Artificial General Intelligence: "AI under the hood - AI creating flowing materials or recreating air flows, this could represent how AGI could look while processing." Artist: Domhnall Malone, Photo by DeepMind on Unsplash

So, will AI soon be living side-by-side with humans? It still seems stretch to imagine AIs acquiring human-like intelligence in my opinion. While these AI models perform spectacularly for specific tasks, researchers have not quite managed to integrate AIs of different purposes into a single 'general agent' (although tech giants such as Tesla and Xiaomi are racing to be the first). There is much being published on the topic. Yan Le Cunn, veteran researcher of DL and current Director of AI at Meta, recently outlined a blueprint for training human-level AI by integrating many fields of AI research within a single application. Other recent papers focus on a multimodal understanding of language, vision, human intent and the physical rules of the world through 'representation learning'.

To see some of the latest developments of agents performing human tasks, I recommend these intriguing videos from DeepMind; they show AI controlling robotic arms and even tidying up a room.

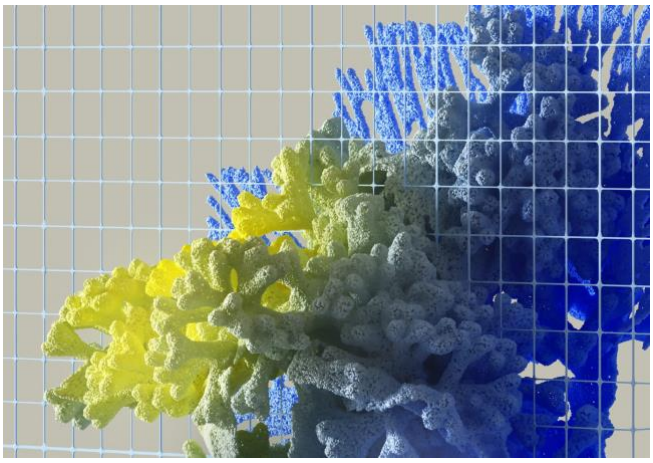
Turning to the Ethics of Human Enhancement and AI

While reading *Engineering the Human: Human Enhancement Between Fiction and Fascination* (Koops et al., 2013), it was the chapter on the ethical and societal implications of these developments in human engineering and enhancement that I found most thought-provoking. It explores the evolving societal construct of 'what it means to be human'. It is convincingly argued that since any modified human will inevitably affect the community around them, these developments are an important avenue of discussion, and not only for those who advocate for modifications. The author then concludes the discussions with a bold call to

action: that while all individuals' decisions should be respected, *society should treat all humans equally, whether modified or unmodified.*

I considered how humans adapt to new technology and wondered about the feasibility of this principle. When facing the 'slow drip' of scientific developments, it seems that the public gradually accepts the new technologies in order to keep up with advancements in society. For example, most people have embraced the pervasive cloud technology of today lest they be excluded from society at large. Regarding human enhancement technology, many parents are likely to embrace the use of groundbreaking technologies such as CRISPR to better the lives of their children; these personal decisions would result in humans with varying degrees of ability and qualification. If we are to ensure equality among all individuals, as Koops et al. (2013) urge, then the discussion should be pushed forwards to engage everyone, with tangible steps taken as in other human rights movements.

The ethics surrounding the currently emerging synthetic life is another topic the book explores. As a deep learning engineer, I have read substantially on this topic from an engineering standpoint but never from a fundamental rights or legal standpoint, so I was particularly interested in the discussion of what constitutes a legal human and their fundamental rights.



Bioethics. Artist: Khyati Trehan
Photo by DeepMind on Unsplash

The authors recommend that a new set of fundamental rights and rules of development for enhanced lifeforms, which includes synthetic life, should be drafted. Yet it occurs to me that their discussions are based on humanoid robots that can readily integrate into human society. Based on recent trends, I believe AI agents resembling sentient life are much more likely to emerge from *non-humanoid robots that were trained using RL* to collaborate with humans. These robots often take the form of home assistants, or robotic arms. The authors' discussions, which center around sentient robots with a similar appearance and needs to humans, should be updated to fit the most recent developments.

The current trend in robotics research is creating AI agents that are not just experts at specific tasks but that can understand more about human intent and world representation. For example, Google has placed an incredible amount of emphasis on integrating language capabilities in their new robot butler to enhance its understanding the context of commands when carrying out tasks. An established example of giving robots human-like qualities would be the use of Partially Observable Markov Decision Processes (POMDP) for RL agents. Similar to how children learn object permanence in early childhood, POMDPs are used to explicitly

separate the agent's 'Observation' (what the agent perceives), 'Belief' (what the agent believe is true, based on statistics), and 'State' (what is the true state of the surroundings). Hence AI agents can learn to make decisions based on partial information based on their beliefs, just as humans do. Another example is the study of 'Expectation' and 'Trust' between humans and collaborative robots. People want to work with robots that operate in reliable and predictable ways – and when the robots don't, roboticists hope to be able to understand the robot's expectations and modify them in a tangible manner. The popularity of the topic 'Trust' is further illustrated in the ICRA 2022 workshop: Shared Autonomy in Physical Human-Robot Interaction: Adaptability and Trust. Hence, I believe the first time we see a robot go on strike and demand equal rights, it will be an overworked robotic arm and not a robot with a human-like face and body. In that case, it seems unlikely that society would discuss the matter with the same amount of respect posed by the book authors.

Humanity's Future through the Lens of Science Fiction

Another interesting discussion in the book, perhaps my favorite, is human enhancement through the lens of science fiction films and literature. Sci-fi pop culture provides a rich medium to review scientific developments and ethical discussions in a way that connected well with my imagination and life outside of the research lab.


Photo by Robynne Hu on Unsplash

The authors discuss many science fiction works extensively, and link them according to the technologies that they use. What I found interesting was how these works reflect the interests and fears of society in each era (Koops et al., 2013). For example, in the World War II and cold war eras, we see a slew of science fiction works which reflect the fear of socialist and utilitarian societies. Novels mentioned such as *Brave New World, Boys from Brazil, and 1984* (among other Orwellian novels) depict forms of human enhancement through genetic engineering or collective human conditioning for utilitarian purposes, dictated by a central, often socialist, authority. Other discussed novels such as *Invasion of the Body Snatchers (1956, rebooted in 1978)* uses the then fictional concept of people being replaced by clones to trigger the then legitimate fear of the society being silently replaced by the enemy – either clones from aliens, or individuals who have turned to embrace socialist beliefs. Adding to this discussion, I believe films such as *WarGames (1983)* and

Colossus: The Forbin Project (1970) are also good examples of western society viewing the potential of AI through the lens of the cold war.

Since the 1980s, as scientific development has left the clutches of governments, science fiction has come to review technology from the perspective of the lives and philosophy of individuals (Koops et al., 2013). Examples discussed in the book include *Gattaca, Cloned Lives, The Cloning of Joanna May: A Novel.* The plots and themes of these films align with the authors' argument that human enhancement has moved away from utilitarian motives such as eugenics and has become a tool for individuals to enhance our lives often for selfish means, such as with cosmetic surgery or genetic defect screening of embryos.

Surprisingly however, the book does not tap into the myriad of Cyberpunk sci-fi works related to human enhancement; I believe this sub-genre perfectly illustrates the authors' discussions of the final stage of human enhancement - *humans that are immortal due to enhanced biological systems or humans that have extended lives through cybernetic and robotic means*. Such pervasive modifications to the human body, such as the use of brain-computer interfaces, would prompt society to rethink what is 'human', as well as introduce societal implications such as widening the inequality and poverty gap (Koops at al., 2013).

Exploring Cyberpunk as the future of humanity

Cyberpunk is a sub-genre of science fiction in which human enhancements and artificial intelligence are juxtaposed with societal issues such as extreme social inequality and powerful mega-corporations. They are often set in a far-right dystopian future best summarized as "low life, high tech" (Gibson, 1986). Classic cyberpunk franchises include *Neuromancer*, *Blade Runner* and *Ghost in the Shell*; more recent works include the 2019 film *Alita: Battle Angel* and the popular 2020 video game *Cyberpunk 2077*. Following the reasoning from the previous section, perhaps the popularity of Cyberpunk stories within my generation is because they best resonate with our fears.

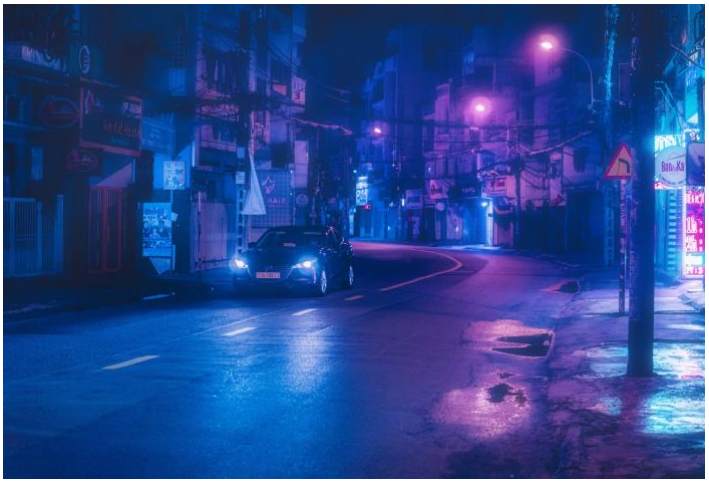


Photo by Hiep Duong on Unsplash

A recurring theme in Cyberpunk is the monopoly of wealth within the rich echelons of society while common folk are subjected to the whims of mega-corporations. Despite the personal liberty to modify oneself with cybernetic enhancements or genetic modifications, most of the population cannot afford them and are deprived of the technology and its promises. At the same time, consumers spend their hard-earned money to purchase the best new technologies

from such corporations, perpetuating wealth inequality. These plot elements can be seen in popular cyberpunk films, such as *Alita: Battle Angel* and to some extent *Blade Runner*. Both Alita and Deckard are middle-class workers living in dilapidated environments directly in contrast to the pristine towers their upper-class employers live in. In Alita's story, the author makes the analogy even stronger by showing how she spends their hard-earned money to purchase new technologies from tech giants, inadvertently propagating the disparity between the two classes.

The depiction of society in Cyberpunk seems to be today's reality to a certain extent. We are seduced by big tech companies with the allure of the newest products every year, despite very marginal improvements. Whether it's smartphones or computer equipment, we can feel left out if we are not getting the best that we can afford. Meta, for example, has managed to – through ample marketing and exploiting people's fear of missing out - convince a large portion of the population to trade real world money for virtual assets and NFTs which are wholly owned by Meta. Meanwhile, Google, Meta and Tencent have a monopoly over niches in social media and technological services. Their services have become so integral to our society that the population can feel forced to accept their terms of service to continue their everyday lives. For instance, when WhatsApp changed their terms of service in 2021, a movement of masses left the service but eventually returned, showing our dependence on these tech giants to function in our modern lives.

Photo by Manny Moreno on Unsplash

Social media companies also have direct influence over the population by controlling the information flow through their in-house algorithms. I believe that the concept of collective conditioning should be reviewed in the scope of algorithms engineered by corporations which determine the information that we read, and the online communities that we interact with. An unintended effect is that similar people tend to be grouped together and form echo chambers to reinforce certain political beliefs or philosophies.

AI and human-like agents are topics explored in many popular shows these days, and I'd like to recommend two stand-outs: the British television series *Black Mirror* (2011 - present) and the animated American television series, *Love, Death and Robots* (2019 – present). Both depict a near future that is eerily familiar. For example, the *Black Mirror* episode 'Be Right Back' centers on a grieving woman who is goaded into purchasing a robotic recreation of her recently deceased boyfriend – which is generated using AI that is trained on their internet footprint, videos, photos, instant messages, and social media activities. The show follows the

woman's journey through the stages of denial and acceptance of this synthetic lifeform, which is ultimately the property of a corporation and a capitalist tool for profit. In a peculiar case of life imitating art, a Canadian man recently brought his deceased fiancée back in a similar way, by feeding the chatbot AI with her text messages and social media footprint.


Photo by Ameer Basheer on Unsplash

As a researcher involved with deep learning, I believe these AI developments will soon be accelerated even further. Powerful Generative Adversarial Networks (GANs) can impersonate people's voices (Gao, Singh, & Raj, 2018) or generate new content, which can be conversations that appear even more natural (Brown et al., 2020). So perhaps the big concern for our generation may not be machines gaining sentience in the far future, but a near-future in which mega-corporations can leverage our Internet footprints to sell us advertisements, products, human enhancements, or even more personalized virtual AI agents.

New media as a tool to explore ethical issues

It can feel as if almost every sci-fi work exploring the ethics of modified humans and synthetic life has been rebooted and republished these days. The good news is that a new medium for enjoying these works is emerging, which is the use of story-driven video games and interactive media to explore ethical questions. Personally, I have always found active thinking and interactive narratives, such as the classic ethical dilemma the trolley problem, to be key to exploring ethical issues and empathizing with others. Here I would like to introduce to you two critically acclaimed narrative-based video games, which put the players in the front seat of ethical dilemmas. These are *Detroit: Become Human* (2018) by Quantic Dream and *SOMA* (2015) by Frictional Games.

Detroit: Become Human (2018) by Quantic Dream a narrative-based video game about humans, artificial humans, and everything in between. It is often described as an 'interactive movie' and in my opinion, it's the spiritual successor to Phillip. K. Dick and Isaac Asimov's android centered novellas. In the game, players follow three androids who unexpectedly find themselves sentient. Each of the androids have different motives: Connor is a police investigator android tasked with tracking down androids who have 'deviated' from their programming (gained sentience) – he propels an android-hunting-android narrative popularized by classics such as *Do Androids Dream of Electric Sheep?*. Kara is a housekeeper robot in an abusive household who gains sentience while defending her owner's daughter – hers is a story about android-gaining emotions and going against their prime directive of subservience. Markus is a caretaker android who wishes to free other robots from bondage –

which draws parallels to the many sentient robot revolution stories. Although these stories have been well told by the many novels and movies before it, the game puts the players in the intense situations with the unnervingly human-like androids, imposing a sense of self-preservation and moral responsibility that is unparalleled by any novel that I have read. For those interested in watching the gameplay, I highly recommend the YouTube playthrough by Michael Reeves and Lily Pichu.

Turning to the horror genre, another narrative-based video game which explores ethical situations related to the future of humanity is *SOMA* (2015) by Frictional Games. In the game's journey, the player encounters 'humans' that range from mutilated humans in near-vegetative states and human consciousness uploaded into robotic bodies, to simulated characters who are unaware that they are computer programs. At every turn, the player is forced to weigh the value of the lives of these lives to progress his own agenda of escaping the facility. Instead of discussing ethical dilemmas from a backseat, players meet human-like robots and empathize with their fears and emotions. For example, the player might meet digital humans that can be infinitely replicated – yet have a strong sense of self and are afraid of death; or mechanical robots that try to convince you that they feel pain. The game tells organic stories that are well written, disguising a series of ethical dilemmas reminiscent of the 'trolley problem' which evoke mental stress and trigger deep existential fears. The gameplay also forces the player to reconsider the uniqueness of 'self'; in a world where consciousness could be copied and modified at will, would we still keep our sentimental views on human consciousness and human life?

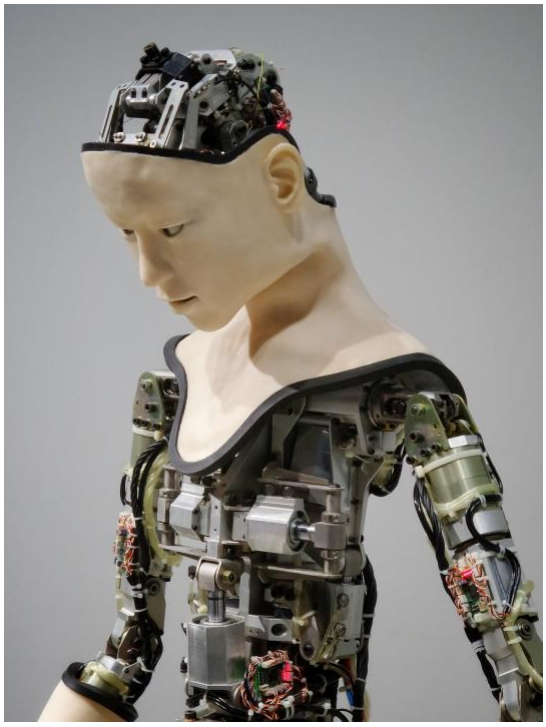


Photo by Xu Haiwei on Unsplash

Final Thoughts

The 2020's are shaping up to be an era of great advancement in genetic modification, human body modification, and human-robot collaboration. This article has shared some of my views on scientific developments in these fields, the ethics of such, and how science fiction can help us better understand and explore them. I hope to have demonstrated the importance that technology plays in the future of humanity, and as a researcher of AI, I believe we must be well informed of these developments and related ethical issues.

As this article draws to a conclusion and I return to the computer lab, let's continue to consider the shared future between humans, post-humans, and AI.

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