Managing the rise of Artificial Intelligence

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***Abstract*—** This paper initially defines terminology and concepts associated with artificial intelligence, for those that are not familiar with the field, such as neural networks, singularity, machine learning, algorithms, virtual reality, the Internet of Things and big data. The paper then considers the possible impact of the rise of artificial intelligence on human employment, on human rights, on warfare and on the future of humans generally. Themes discussed include whether AI will reduce or exacerbate various forms of discrimination, whether AI can be safely regulated, AI and the potential loss of privacy, the ethics of AI, the benefits and risks of AI. The major conclusion of the paper is that regulation is needed to manage the rise of AI, to ensure that AI benefits are distributed to all.

***Keywords*—** Machine learning, artificial intelligence, human rights, deep learning, ethics.

I. Introduction

More than 80 years ago, the new US president, Franklin Delano Roosevelt, famously said in his inauguration address, "the only thing we have to fear is fear itself--nameless, unreasoning, unjustified terror which paralyzes needed efforts to convert retreat into advance" (Roosevelt, 1933, p. 26). In these more complex times we appear to have much more to fear, than mere fear itself.

There are stockpiles of thousands of nuclear weapons capable of ending life on earth, as well as rogue nations racing to develop nuclear weapons (Glenn, 2016); There is a healthcare crisis with superbugs, resistant to all known antibiotics, across the globe (Kumar M. , 2016); climate change is seeing extreme weather events taking place across the earth (Thomas, 2016, p. 3); Terrorism is escalating, both in the number of events and deaths across the world (Clarke, 2015) and approximately one third of nations are currently at war, either with other nations, or with terrorists, separatists or guerrilla groups (Wars in the World, 2017).

And we also have Artificial Intelligence (AI).

There are many that already fear the rise of AI, both those who understand AI and those who do not. Of the former group, there are numbers of academics and technology leaders, who are expressing concern about the rise of AI. Stephen Hawking has stated that, "Success in creating AI would be the biggest event in human history…Unfortunately, it might also be the last, unless we learn how to avoid the risks. In the near term, world militaries are considering autonomous-weapon systems that can choose and eliminate targets" (Sainato, 2015). Professor Hawking further said, "Humans, limited by slow biological evolution, couldn't compete and would be superseded by A.I." (Codilla, 2017). Elon Musk has claimed that AI is, "our greatest existential threat" (Kline, 2017) and warned that he was, "increasingly inclined to think that there should be some regulatory oversight, maybe at the national and international level, just to make sure that we don't do something very foolish" (Gibbs, 2014). Musk invested in the two AI companies, DeepMind and Vicarious Artificial Intelligence, to, "keep an eye on what's going on with artificial intelligence. I think there is potentially a dangerous outcome there" (Wile, 2014). Bill Gates, Microsoft co-founder expressed concern in 2015 saying that, "I am in the camp that is concerned about super intelligence. First the machines will do a lot of jobs for us and not be super intelligent. That should be positive if we manage it well. A few decades after that though the intelligence is strong enough to be a concern. I agree with Elon Musk and some others on this and don't understand why some people are not concerned" (Rawlinson, 2015).Of the latter group, that do not understand AI, many are frightened at the prospect of 'the robots taking over'. They likely have formed their opinion about AI based on movies such as the Terminator series, 2001: A Space Odyssey, the Matrix, Blade Runner and Transcendence as well as on sensationist claims in the media. This paper will consider whether these opinions are valid.

Contrastingly, there are those who see the rise of AI as the start of a new golden era in humanity with AI solving the world's most difficult problems. Mark Zuckerberg is one that sees a golden future for AI and he has complained that, "I think people who are naysayers [about AI] and try to drum up these doomsday scenarios — I don't understand it. It's really negative, and in some ways I think it's pretty irresponsible" (Wagner, 2017). Some see AI as providing "more effective medical care, safer industries and services, and boost[ing] productivity on a massive scale" (Internet Society,

2017, p. 6).

There is an increasing body of evidence that AI will benefit humanity on a wide scale and across many fields. AI is being used to undertake medical research on a scale, on a level and at a speed, never possible. AI will be used to personalise drug treatment, using data accumulated from monitoring patients and from existent data, improving medical treatments and thereby improving both the quality of life and extending life. Self-driving cars will likely see a significant drop in road deaths and injuries – perhaps even saving hundreds of thousands of lives from the nearly 1.3 million deaths and up to 50 million injured that currently occur worldwide each year. AI is being used effectively as a teaching assistant. Georgia Tech University deployed a virtual teaching assistant based on IBM's Watson in 2016 (Watson is the AI that won the Jeopardy game against top human opponents). This AI is used to answer student questions online and has now reached a 97% accuracy rate. The University's goal is to have the AI answering 40% of the 10,000 questions asked by students. AI will be capable of offering personal tutoring on a scale not currently possible. AIs are being used to regulate the use of energy in data centres. Google has claimed a 40% saving in energy costs from the moment the centres were monitored and controlled by an AI. AI is being used increasingly to assist the elderly and those with disabilities to be more mobile and less carer dependent. AI will help governments to better serve their citizens, eliminating waste and reducing costs (Gray, 2017; Association for Safe International Road Travel, 2017; Maderer, 2016; Executive Office of the President National Science and Technology Council Committee on Technology, 2016).

Nils Bohr, a Nobel Laureate, has wryly commented regarding forecasting the future that, "prediction is very difficult, especially if it's about the future" (Cohen, 2017, p. 11). Predicting the future of AI and its impact on humankind could be arguably be considered amongst the most difficult subjects to forecast as AI has the potential to affect every aspect of human life, on a scale and at a level of detail, far greater than previous revolutions such as the Industrial Revolution. Further, AI development is occurring at such as tremendous rate that no one person or company can stay in touch with all the change (Sharp, 2017). Nevertheless, this paper will attempt to look at the future of AI and its likely impact on humanity. We will consider AI's potential benefits, as well as the pitfalls and risks and consider how some of the risks might be managed and mitigated. This paper will attempt to grapple with the thesis that humanity has much to fear from the rise of AI.

At the outset, we will cover some of the recent trends in AI and automation but, with the field so broad and moving so rapidly, a comprehensive examination is beyond scope. Although there is extensive reference to academic literature on AI, this paper attempts to capture the latest developments and trends and thus references both media web sites and recent interviews with AI personalities. To ensure that the reader can understand AI terminology and concepts there will be some explanatory information provided. Topics that will be covered include AI definitions and emerging technologies; the beneficial use of AI; the impact of automation on the workforce; possible human resistance to the emergence of AI as a major disruptor in employment and in other areas; ethics of the AI age and the use of AI for warfare.

1. What is Artificial Intelligence?

Alan Turing is credited with inspiring the development of Artificial Intelligence when he wrote his 1950 paper, titled "Computing Machinery and Intelligence". He asked the question as to whether machines could think or not and whether machines could learn in the same manner young children do. He also proposed a method to test an AI for human level intelligence (Executive Office of the President National Science and Technology Council Committee on Technology, 2016) which is discussed latter in this paper. However, AI as a field of research, is considered by many to have begun properly in 1956 when a conference called the "Dartmouth Summer Research Project on Artificial Intelligence", took place (Floridi, 2017; Flasiński, 2016, p. 4). AI mimics human cognitive ability such as our ability to solve problems and to learn (Seshia, Sadigh, & Sastry, 2016). A digital AI or physical AI (robot) can undertake tasks normally performed by humans such as reasoning, discovering meaning, generalisation and learning from experience. Notably, AIs have surpassed human ability in many singular areas (known as Artificial Narrow Intelligence) but no AI currently has the ability to match a human's wide breadth of knowledge and experience. Thus, a lot of the research in AI is directed at this broader concept of AI – called Artificial General Intelligence (Copeland, 1993). It is important to note that AI is already widely used in the developed world. AI is providing us with search engines such as Google or Bing; GPS navigation on smartphones and in cars; voice recognition software

(Brundage & Bryson, 2016) such as Siri or Alexa; email filtering services that identify spam and prioritise emails; fraud detection by banks for anomalous activity on bank accounts and even personalisation services used by Netflix, Amazon and others which use past viewing and purchasing habits to suggest relevant items (Internet Society, 2017). Some believe that there will be 3 distinct phases in the development of AI. Phase 1, the current phase, is Artificial Narrow Intelligence, also known as Weak Artificial Intelligence, in which narrow tasks are undertaken by AIs such as Apple's Siri, Microsoft's Cortana and Amazon's Alexa to answer questions and perform tasks and in which AIs are capable of matching and even outperforming humans in limited tasks. The second will be Artificial General Intelligence phase, when AIs become equal to humans in thinking ability across a wide range of knowledge and skills. The final phase is Artificial Super Intelligence, which will occur when AIs exceed human capability (The Ai Revolution: The Road to Superintelligence, 2015; Walsh, 2017). Some believe that Artificial Super Intelligence will be achieved within 30 years. When this happens, it may be that man is displaced as the dominant entity on earth or a new entity, a fuse of human and computer – a cyborg, may emerge (Sharp, 2017).

2. The AI Winter

The mid 1980s saw a period when research investment and interest in AI diminished after a period of intense hype had failed to realise advancement in AI. There was a recognition in the industry that there were many difficult problems that were not readily surmountable, and this period became known as the AI winter (Hendler, 2008).

3. Components of AI

3.1. AI Reasoning

Reasoning includes the ability to make decisions based on either deductive inferences or inductive inferences. Simplistically, deductive reasoning would allow a computer to work out how many apples were left if we started with 5 and 2 were eaten. Inductive reasoning would allow a computer to decide where it does not have all the facts to hand but make a probabilistic decision based upon the available evidence and its accumulated experience (Copeland, 1993). Stephen Hawking has cautioned that he sees no significant difference between computer thinking and biological brains and that this means that if computers can think like humans, they will then proceed to exceed human capability (Techworld Staff, 2017).

3.2. AI Types of Learning

One important AI skill is that of the AI learning and there are two types. One involves rote learning where a computer is taught to play chess and through random moves can achieve a check mate. It stores the moves that resulted in the mate and attempts to use them again. The other, more important type of learning is generalisation. That is, being able to apply previous learnings to situations that are analogous but not identical (Copeland, 1993). For example, an AI might apply some of the principles it already knows about chess, and where applicable, utilise them in playing strategy games other than chess.

3.3. AI Problem solving

AI problem solving involves an AI searching to find a solution from all the possible actions\choices that it has at its disposal. This is one area where an AI can outperform a human as it can search through millions or even billions of potential solutions in a very short time frame. It can also make use of big data - identifying trends and patterns not discernible by humans, such as is already happening with the detection of some cancers (Liu, et al., 2017; Parsons, 2017). There are two types of problem solving. One method, called special purpose, is problem solving in a narrow field (Copeland, 1993). This is called Narrow AI. An example is Deep Blue, an AI that was built by IBM to play chess and that defeated the previously unbeaten world chess champion, Garry Kasporov. Deep Blue used its computational power to examine all possible moves (Miller, Chess master Garry Kasparov still 'a sore loser' two decades after Deep Blue, 2017). The other type of problem solving is called general purpose and this is what Artificial General Intelligence (AGI) is aiming for (Copeland, 1993). Not merely an AI that can play chess well, but one that can apply its problem-solving ability to different types of situations (Copeland, 1993).

3.4. AI Perception

Perception is the ability of an AI to make sense of the physical world such as image and object recognition. Computers have been performing facial recognition since the 1960s (FBI, 2005) and have advanced sufficiently to better humans. However, there remains a need for improvement, as the Megaface Challenge demonstrated when AIs that had scored near perfect results on small datasets of 13000 faces were asked to perform recognition on 1,000,000 faces. The best score achieved was by Google, who scored 75% accuracy (Kemelmacher-Shlizerman, Seitz, Miller, & Brossard, 2015) Although clearly, the ability to recognise faces on a massive scale is only possible for AIs and is beyond the capabilities of humans. Object recognition\perception, by AIs, is already sufficient to see the advent of autonomous cars and other vehicles. Robot vision is another area that has advanced, yet has need for improvement. Although AI vision is advanced, and the accuracy rate is already exceeding that of humans, robot vision has significant deficits when robots are in uncontrolled environments (D'Innocente, Carlucci, Colosi, & Caputo, 2017).

3.5. Chatbots and natural language

Intelligent virtual assistants, also known as digital assistants, conversational interfaces, virtual people, avatars, chatbots, or more simply as bots, are one of the technologies at the forefront of the AI revolution. Essentially a chatbot is software that has been designed to engage in conversation with humans utilising natural language, this may be a text based conversation or spoken word. Some have personas, but most do not. Some are intended for simple conversations whilst others are designed to be as human like as possible. They are being used in fields as disparate as education, e-commerce and customer service. Some well-known chatbots are Google Assistant, Apple's Siri, Amazon's Alexa and Microsoft's Cortana. Examples of other companies that use chatbots include Uber, MasterCard, Pizza Hut, Airbnb, HealthTap, CNN, Fox News, the Guardian, the Wall Street Journal, Staples, Spotify and Starbucks. There are hundreds of thousands of bots, many of them built for a narrow specific purpose. Meisal, editor and publisher of LUI News, which focuses on chatbot technologies, claims that narrow bots will be generating US623 billion business globally by 2020. There are many hundreds of thousands of developers working on chatbots world-wide including 30,000 on the Microsoft Skype platform alone. One major factor that is seeing chatbots emerge as a leading technology in the rise of AI, is that most people in the world have access to a mobile device that can be used as a platform for chatbots, whether with SMS capabilities or with the ability to run apps or display web pages. Thus, 6.1 billion are feasibly able to interact with a chatbot, from a total world population of 7.3 billion (Dale, The Return of the Chatbots, 2016).

3.6. Virtual Reality (VR)

Virtual Reality is the use of technology to create a completely virtual experience that is either based on the real world e.g. it looks like an actual place that the user is not physically at or is completely computer generated e.g. another planet or a fantasy world. The user experiences a "fully enclosed, synthetic experience with no sense of the real world" (Cardinal, 2017). VR is the use of hardware and AI software "to trick your mind into thinking you are experiencing something you aren't" (Gregory, 2017, p. 6),"the real world is completely out of view" (Gregory, 2017, p. 7).

3.7. Augmented Reality (AR)

Augmented reality is technology that overlays the real world and provides additional information and content – such as Pokémon Go which displays Pokémon characters on phones and tablets to players as they move about the real world (Anderton, 2016). Although the real world remains the focal point, virtual details enrich the experience (Cardinal, 2017). AR is a "technology that superimposes a computer-generated image on a user's view of the real world, thus providing a composite view" (Androl, 2016, p. 732). Pokémon Go was one of the first widely adopted AR applications. There are apps that can be used to place furniture virtually in your house to see if it fits in space wise and with the existing decor. Apple have released a software development kit that will allow developers to develop AR applications on the iPhone platform (Robertson, 2017). Apple's latest iPhones 8 and X both have the capability to provide an augmented reality experience that includes digital image and video overlays to real life. According to one analyst, AR will be the subject of intense competition in the mobile consumer technology sphere, with Apple and Google as the leaders initially. Because Apple has a user base of approximately 1 billion, it is likely that Apples adoption and use of AR will provide the catalyst for AR as a technology to be taken up widely. Credit Suisse estimate that the AR market will be worth up to 700 billion within 8 years. AR will be used for numerous purposes including gaming, for providing contextual information such as having AR provide information at sporting

events and for commercial uses such as seeing what a particular item of clothing looks like on the person before buying it (McDuling, 2017). Huge's CEO, Aaron Shapiro, has described Apple's entry into the AR market as a game changer and one that see AR become a mainstream technology. Ikea is poised to release an app that will allow users to see what Ikea furniture looks like in their homes (Dua, 2017). There have however, been notable failures in the AR field. One was the original version of Google Glasses. Google ceased manufacturing the consumer version of Google Glasses some time ago as it was buggy, it failed to deliver on promises and there were concerns about privacy. However, Google also launched an Enterprise Edition aimed at workers. These glasses provide overlayed digital information in the workplace. The new Glass Enterprise Edition were formally launched on 18th July 2017. A report by Forrester Research suggests that over 14 million US workers will be using smart glasses within 8 years (Levy S. , 2017).

3.8. Mixed Reality

Mixed reality, also known as merged reality, is a relatively new term. It means combining the real world with virtual reality to produce a richer interactive mix including the ability to interact and manipulate both the real and the virtual content (Cardinal, 2017).

3.9. Machine Learning

In the past, AIs were designed and developed by subject matter experts who codified the program's 'intelligence' line by line. These were known as 'Expert Systems'. Systems like this were only feasible, when the situations faced by the Ai were within its lines of code. To deal with new situations, or new functions, required additional expert coding. Consequentially these types of AIs were labour intensive, expensive to build and maintain and only useful in narrowly defined situations. These types of AIs utilised deterministic algorithms – that is the inputs would also follow the same processing steps and always output the same results. Adapting to change or variety is beyond the capability of these AIs. These were significant impediments to advancing AI. Researchers needed a better way to train an AI and machine learning presented a way to build an AI that was capable of learning and solving problems, comparable to human intelligence, rather than deterministic operation. In 1959 Arthur Samuel, of IBM, was one who predicted a time when computers would be able to learn without needing line by line coding (Boyd, 2017). Machine Learning developed an AI that could look at data and make decisions based on probabilities. For example, if a person looks at a Persian cat they rely on their previous experience (data) of seeing Persian cats to identify the cat as a cat and specifically, as a Persian cat. Depending upon the depth of their experience the person can state that they are sure that it is a Persian cat (i.e. 98% probability that it is a Persian cat). If they see another cat that they think is a Siamese cat, but are only 30% sure – their confidence level is below the level required for them to definitively identify it is as a Siamese. Machine learning works in a similar way to the human brain, with probabilities and confidence levels enabling the AI to decide whether it knows or doesn't know something. (Roell, 2016; Society for Neuroscience, 2009). To make machine learning effective it requires massive amounts of computing power and this computing power has only relatively recently become readily available to AI developers. Computers in the 1980s were too slow and lacked the capacity. In recent times, the development of the graphical processing unit (GPU) – originally used primarily for gaming – has provided the platform for processing images and data in a parallel manner that suits machine learning. (Roell, 2016).

An AI is provided with training data e.g. pictures of cats. It is taught how to extract features – e.g. shapes of ears, faces, paws etc. This creates a list of classifiers which the AI uses for object detection. Shown a picture the AI is asked whether there is a cat in the picture. As it is provided with more and more pictures, it becomes adept at identifying cats. Then it is provided with random pictures and it can identify those with a cat and those without.
Perhaps it is taught to identify whether the photo contains a male human or a female and after being provided with many pictures it becomes adept at identifying each of these two genders. Overtime it becomes adept at interpreting photos and its skill level can then exceed humans. This has happened with medical pictures and x-rays of patients. AI can now identify malignancy at a higher degree than doctors. This has also happened with ophthalmology with AI able to detect eye problems, such as diabetic retinopathy, with a greater degree of accuracy and consistency than ophthalmologists (Gargeya & Leng, 2017).
To understand how significant machine learning is and how much it is propelling the development of AI, consider trying to create a computer that has all the same skills and memories that a human adult does. Imagine writing code for everything they know, line by line. Even if that were possible it would take a very long time to document everything that the person knows and that is assuming a way can be found to access all their memories and

experiences. If we did it by interviewing the person, it would take enormous amount of effort and yet still not be exhaustive. However, this is the approach that AI used to take and therefore was only ever capable of single tasks – i.e. Deep Blue mentioned above. Deep Blue used brute force to run through every possible move, as it had been programmed line by line, to do (Miller, Chess master Garry Kasparov still 'a sore loser' two decades after Deep Blue, 2017). An AI that is proficient in one skill only and has been programmed line by line is a long way away from Artificial General Intelligence.

Deepmind, a British company acquired by Google in 2014, produced an AI called AlphaGo. This AI was trained to play computer games without line by line coding. Deep learning algorithms were designed that gave it a basis to self-learn. It was then given 50 Atari games and it was able to master these games. Kasparov himself said recently, "Deep Blue was a dead end. It solved a problem but then there was nothing else it could do. AlphaGo is the beginning. It's something new" (Russell, After beating the world's elite Go players, Google's AlphaGo AI is retiring, 2017; Burgess, 2017; Miller, Chess master Garry Kasparov still 'a sore loser' two decades after Deep Blue, 2017).

One of machine learning's advantages is that it can be used even when it is not possible to write down explicit code to problem solve.

So, machine learning allows an AI to learn independently of programming once it is in place. The original algorithms create a way for the AI to learn and adapt from training data that it will be exposed to. Different training data sets mean that an AI can undertake different tasks without being specifically trained for the tasks. For example, an AI could be given training data to teach it to translate languages or other training data to make stock market predictions. In the case of the translation task, it would build a set of rules based on its experience with the training data that would allow it to perform translations. In the stock market example, it would develop rules based on its experiences with the stock market training data and then use it in the real world, refining and learning as it was given more data either as further training data or as real-world data. This ability to learn, adapt and write new rules based on experience is the essence of machine learning and is its strength as complex programming is no longer required and the AI can learn independently of programmers once its original algorithms are set up. Many recent advancements in AI have resulted from use of big data to train AIs rather than developments in original algorithm development (Internet Society, 2017).

There are 3 types of machine learning in use. Supervised learning means that the AI is given labelled data as well as the required output. For example, it is given pictures of dogs with the label 'dog' and told to classify these pictures as dogs. Unsupervised learning means that the AI is given unlabelled data and it is tasked with finding patterns in the data. An example might be when it is shown medical x-rays and it learns to identify patterns. Reinforcement learning means that the AI is provided feedback on an ongoing basis (Internet Society, 2017).

3.10.Deep Learning

Deep learning is a type of advanced machine learning. Deep learning deals with images, sound, video and data directly. Deep learning enables AI to be more accurate than humans at image recognition and the main reason is that it uses large amounts of data (big data). The Google Brain Project is an example. Deep learning uses neural networks which operate similarly to the human brain. Some financial institutions, such as Goldman Sachs, have been using AI for some time to trade stocks using deep learning (Terman, 2017). AI is incorporating human learning patterns and there have been very significant advances in recent years that have lifted AI development out of decades of inactivity and disappointment and made it one of the most important technological fields in the world today. Deep Learning is providing the way forward for AI, with programmers no longer having to write millions of lines of explicit code, but rather setting up the right algorithms and then teaching the AI to solve problems independently (Gopnik, 2017; Aubé, 2017).

3.11.Neural networks

AI utilise a processing process like the way a human brain operates. The human brain is thought to make decisions based on rapid and complex probability calculations occurring in the brain's neurons. Humans also utilise certainty in decision making with decisions favouring higher certainty outcomes. Thinking involves accepting data in the form of the senses – sound, feel, touch, taste and smell that activate neurons. Millions of these neurons that recognise patterns then pass on this recognition to other layers of neurons that also recognise patterns until the decision is reached. Neurons are all capable of pattern recognition and once they have received input from other neurons they pass on their output to other neurons and thus high-level decisions are possible (Roell, 2016; Society for Neuroscience, 2009).

3.12.Algorithms

An algorithm describes a sequence of actions to be performed. For example, consider how you might make toast. 1 - get a slice of bread. 2 - place the bread in the toaster. 3 - select the required settings. 4 - turn the toaster on. 5 - remove toasted bread from the toaster. 6 - put the toast on a plate. 7 - use a knife to spread margarine. 8 - serve the toast.

So, an AI algorithm is computer coding that carries out a number of instructions. Computers require algorithms to determine how they will interpret tasks such as decision making and problem solving. An algorithm requires inputs and modifiers and then produces an output. The number of steps it takes to reach its output will depend on the complexity of the task it is undertaking. How we live our lives, including how we work, communicate and learn, is being increasingly determined by computer systems that are running according to these AI algorithms (Vieth & Bronowicka, 2015).

3.13.IoT - the Internet of Things.

Making everyday items part of the internet e.g. a networked fridge that communicates with its owner to advise that milk is running low or is about to expire. Consider a home with PCs, mobile devices and printers all connected on a Wi-Fi network – the IoT will add in all the household whitegoods and possibly clothes to this network. You would be able to send instructions to your household electrical items over the internet, such as turn on the air-conditioning when you are 15 minutes away from home or remotely turn your oven on and off. Your oven would know from your car or mobile device when you 15 minutes from home.

3.14.Big Data

The amount of data we produce every year increases at an exponential rate. Some claim that it doubles every year (Helbing, et al., 2017), others that it is increasing at 50% per year (Walsh, 2017). With the Internet of Things joining millions of everyday items including household white goods, and perhaps even our clothing to the internet it has been estimated that 10 years from now there will be 150 billion networked sensors. This will see data doubling twice in every 24-hour period (Helbing, et al., 2017).

Worldwide there are very large amounts of scholarly data being produced such as papers and books. The US government's PubMed database, which holds biomedical literature, has over 26 million citations. Google Scholar has more than 100 million scholarly documents. The emerging field of Scholarly big data is being used to determine what are emerging research topics, what the quality of scholarly documents is, how authors interact and influence one another, who are field experts and who is funding the different research areas (Albrecht, et al., 2016; You, 2014). Research holdings are so large and increasing so rapidly that it would be impossible for any person, such as researcher, a Doctor, lawyer or other professional to stay up to date with millions of articles being added each year (Pontis, Blandford, Greifeneder, Attalla, & Neal, 2015). This is one area that will only become increasingly impossible for humans to stay up-to-date and one where AI can easily outperform humans.

3.15.Unstructured Data

In a speech given by the CEO of IBM, Ginni Rometty stated that "Eighty percent of the world's data is "unstructured."" (Rometty, 2016). This data includes digital audio, video and images as well as written documents. Rometty calls this 'dark data' because it is not readily understandable to computers. Computers can create, process, store and capture it but not understand it. However, AIs can understand unstructured data. AIs can learn to understand unstructured data by training and experience (Rometty, 2016), potentially learning in a cycle that never stops, growing ever more effective and increasingly more accurate.

3.16.Singularity

The Singularity refers to the moment in time when artificial intelligence arrives at the point of super intelligence. Singularity, also known as the technological singularity, will occur after artificial general intelligence (human level general intelligence) is reached and an exponential advancement takes place, with the AI able to redesign and improve itself infinitely, making it vastly superior to human capability. Humans would not be able to keep up with it unless they are enhanced in some way i.e. as a cyborg with their own super intelligent AI.

Singularity may occur immediately or near to the time that AGI is reached, or it may follow some years later. Kurzweil suggests that AGI may occur in approximately 30 years and the Singularity follow 15 years later (Niewiadomski & Anderson, 2017; Kurzweil, n.d.). Once AGI was achieved by an AI it would then, "create yet

higher intelligence, which could, in turn, create yet higher intelligence, and so on [resulting in]… a growth well beyond human ability… an 'intelligence explosion'" (Müller & Bostrom, 2016).

3.16.1. Plot for a movie starring Arnold Schwarzenegger

Once Singularity has been realised there would be no going back to a previous state unless there was a way to shut down or modify the AI. If the AI was connected to the Internet, there would be little chance that it could be shut down. A darkly dystopian view might be that the AI would be in a state where it would anticipate a threat to its existence and it would take counter measures to protect, including disseminating itself. Theoretically, the AI would have accessed all online services, at the moment of achieving super intelligence and have gained control over essential utilities including power, water, transportation and over weapon systems. It would then eliminate or dramatically diminish any perceived threat against it. The Terminator series of movies deals with this theme. Skynet is an AI that has achieved Singularity. It has gained control of all weapon systems and has begun to eliminate humans whom it sees as threats to its existence (IMDB, 1984).

3.16.2. An Electronic Messiah

Conversely, a utopian view would see an AI achieving the Singularity and then setting about resolving the world's problems including repairing the environmental and preventing severe weather patterns; improving health care by eliminating diseases and extending life; providing alternate forms of energy; improving the quality and quantity of food production and inventing new devices, new forms of travel and improving the design and manufacture of current devices. It may even resolve conflicts around the globe, acting as a type of AI impartial United Nations.

3.17.Nanobots

Nanobots are co-called because they are minute robots, smaller than the width of a human hair and they are controllable at the molecular level. Nanobots potentially have many potential uses including some that might seem far-fetched or in the realm of science fiction (much like AI in general) today. Nanobots might potentially be used to clean up an oil tanker spillage or remove air pollution from the atmosphere. They might be used to purify drinking water. They might be able to keep food fresh longer. They could be used in the human body, being injected into the blood stream to fight illnesses such as the common cold or even cancerous cells or to undertake repairs to the body. They could be deployed to boost an immune system, or to target medicines to the exact site they are needed. They could be used by soldiers in the field to self-administer first aid. They could be used to give an athlete a super boost. One company has developed a nanobot that can carry 200 times the oxygen of a normal blood cell. But they could also potentially be used to deconstruct us - a kind of super virus that could potentially wipe out millions (Billington, 2014).

3.18.Cyborgs and Transhumanism

Transhumanism is a term that describes the artificial evolution of humans through biological connection of technology to the human body such as direct brain connection to technology.

Ray Kurzweil, a well-known AI futurist, predicts that humans and technology will fuse together, perhaps as a cyborg like entity, with the neocortex joined to the cloud, in about 30 years (Sharp, 2017; Rejcek, 2017).

Musk is working on an innovation he calls the 'neural lace' as a way to create the connection between the human brain and computers. He sees it as the only way that humans can keep pace with AI in deference to becoming inferior. Musk claims that we are already cyborgs in that we carry mobile devices that provide us with the power of the cloud with the only proviso that we are not yet physically integrated with the devices. He claims that these mobile devices give us more information at our finger tips, than the US president had at his disposal 20 years ago, enabling us to answer any question, to instantly message or video conference anyone, anywhere. He notes that the major challenge is the slow rate of input and output of the information and is looking to overcome this with a direct interface to the brain (Rejcek, 2017). Some describe this process as "brain hacking" (Hanley, 2017).

Even the act of carrying a baby in a womb has the potential for AIs to emulate human capability. Artificial wombs are being used for lambs and human artificial wombs are thought to be about a decade away (Mangu-Ward, 2017, p. 5). Modern forms of artificial insemination have been around since the 1770s (Ombelet & Robays, 2015).

There are already people that have implanted and connected technologies, such as those with artificial lungs, hearts, livers and other internal organs as well as artificial limbs or those with artificial vision systems or microchips that are used for purchasing, identification and unlocking and locking doors or pace makers or insulin dispensers (Nelson, 2013; Galeon, 2017; Forbes, 2016). AI will see these technologies increase in proliferation and abilities and the focus

may shift to enhancing humans such as increasing brain capacity, connection to the cloud or increased speed, strength and endurance (discussed elsewhere in this paper). As is the case today, these technologies will be available to those that can afford them.

3.19. Bitcoin and the block chain

Although Bitcoin is not strictly an AI technology, it is thought by some to be the currency of AI and that we may see a world where AIs trade in Bitcoin or other types of digital-currency (Connell, 2017; Terman, 2017). Bitcoin is an alternative type of currency that facilitates financial transactions using cryptography rather than the traditional trust methods used by banks. (Seetharaman, Saravanan, Patwa, & Mehta, 2017). Bitcoin uses block chain technology which means that everyone participating in the exchange of Bitcoins has a copy of the ledger (shared public distributed ledger) detailing all Bitcoin transactions so that fraudulent creation of Bitcoins is very difficult. Nevertheless, fraudulent use of Bitcoins and money laundering are issues facing Bitcoin. Importantly, financial institutions, like banks, are not required. In a traditional exchange two parties use the services of a bank to transfer money and the bank charges a fee. In block chain, the two parties can exchange currency without a third party being involved and without fees as it works as a decentralised payment system with the change to the public ledger being updated and distributed to everyone in the network who verify the change. The ledger is therefore secure and not liable to manipulation unlike a bank – which holds the record of the transaction and is the single point of trust. The potential repercussions on the financial industry are enormous, as is the potential impact on taxation systems. The Bank for International Settlements has stated that widespread take up of digital currencies could see banks lose their ability to have control over economies, to issue money and other traditional banking functions. Bitcoin was the world's best performing currency with an increase of 35% in 2015. Several banks are now examining digital currencies with a view to issuing their own versions (Bitcoin, 2017; Frost, 2016). Currently there are several competing digital currencies that use the block chain including, Ethereum, Ripple, Litecoin, Steem, Dash and Dogecoin (Booker, 2016)

3.20. The Turing Test

As to determining whether a system is actually an artificially intelligent entity., Alan Turing came up with a test, later to be called the Turing test, that involves a human interviewer having a conversation with a computer and a human simultaneously, where the identity of both is obscured. If the interviewer cannot identify between the human and the machine, the machine would be considered as intelligent as the human (Flasiński, 2016, p. 3).

3.21. Quantum computers

Still theoretical (although some companies claim they have them). These are computers that utilise a new way of computing that exponentially exceeds the ability of current computers. E.g. a computer today could be used to analyse a book at a time in the local library, but a quantum computer could analyse every book in the entire library simultaneously. Once they emerge as viable products they will cause a revolution in computing and facilitate rapid advancement for AI technologies.

3.22. Nano technology

Nano technology is technology at the atom and molecular level. It potentially offers the ability to solve some of the world's problems like pollution, sickness and depleted natural resources. It will be used to create new smart materials and new products including products that can be inserted into the bloodstream and be guided by artificial intelligence. It could also potentially be weaponised and used to create new super weapons (Dredge, 2015).

4. CURRENT LEADERS IN AI

Current leaders in AI include the following companies, Alphabet (parent company of Google), DeepMind (acquired by Google), NVidia, IBM, Microsoft, Apple, Amazon, Facebook, Baidu, Tesla and Ali Baba. Reasons for these companies leading in AI include their massive investments and their big data holdings. Big Data is one of the most valuable commodities in the AI field and thus, smaller start-ups will always struggle competing against these leaders. Google could arguably be considered to the strongest AI company because of their larger investment capability and their big data holdings including Google search results. Horvitz, a chief scientist at Microsoft Research's main lab,

has stated that, “The next, if not last enduring competitive battlefield among major IT companies will be artificial intelligence” (BBC, 2015).

5. VIVA LA REVOLUTION!

The AI Revolution is fundamentally different from the previous Industrial and Agricultural revolutions in one important regard. Although the actual timing of the Agricultural is still debated, it is accepted that it took place over a period of many decades (Allen, 1999). The Industrial Revolution similarly took place over many decades (Ashton, 1997). In both these revolutions, labour forces had time to adapt and to seek re-employment in other areas. In contrast, the AI Revolution, has the potential to disrupt the labour force in a short period of time that will leave insufficient time for adaptation and re-employment. The pool of available labour positions may be diminished to the point that a large permanent pool of unemployable people is created.

The driving force for the AI Revolution, like the Agricultural and Industrial ones before it, remains the same – improving the profit margin. The risk is greater that the benefits will not be equally distributed than the other revolutions as power is being concentrated into fewer hands and there will be a much smaller work force required. Although some argue that the AI revolution will be no different from the other revolutions and that people will find reemployment in other areas with the net number of jobs remaining stable, there are those that believe that AI has the potential to replace many if not all, blue collar and white collar jobs including highly skilled careers such as Medicine, Law and Journalism, indeed anything humans can do, AI can do or will eventually be able to do and to do better than humans and that the revolution will take place at a much faster pace. The loss of jobs across the spectrum of employment will occur in a very short time frame possibly within 1-2 decades. Even if alternate employment is available, how can large numbers be retrained in short periods of time and what employment would remain immune from automation. It is therefore probable that a reassessment of the concept of working for a living may cease to make sense in the new world. The scale and pace of the change will not be able to be managed with normal economic adjustments (Niewiadomski & Anderson, 2017; Elliott, 2014; Walsh, 2017).

6. WILL THE ROBOTS (AND AIS) TAKE OUR JOBS?

Frey and Osborne describe the technologically driven unemployment, that will be a major by-product of the continued development of AI and robotics, as being so overwhelming as to negate the job creating phenomena, that was a mark of previous technological revolutions. They suggest that the speed of advancement of AI\robotics will make human labour obsolete at such a rate that retraining and further education will not suffice to make those displaced marketable in a shrinking human labour market (Frey & Osbourne, 2013).

Elon Musk, perhaps the most vocal of the critics of the rise of AI, has made the extraordinary claim that robots will eventually take over all jobs. He has stated, "transport will be one of the first to go fully autonomous. But when I say everything — the robots will be able to do everything, bar nothing" (Clifford, Elon Musk: ‘Robots will be able to do everything better than us’, 2017; Morris, 2017). Musk warns that AI will disrupt employment. He claims that, “robots will be able to do everything better than us. ... I mean all of us,". Seemingly pessimistically he cautions that he is “not sure exactly what to do about this. This is really the scariest problem to me" (Clifford, Elon Musk: ‘Robots will be able to do everything better than us’, 2017).

Musk is not the only one seeing massive disruption ahead. Sharp believes that 80% of the current top 100 companies will disappear within 30 years as AI advances (Sharp, 2017). One futurist alarmingly warns that with AI being such a significant competitor for all human jobs, over the next 20 years, that it may mean that human supremacy is about to end (Makridakis, 2017, p. 2). Sir Tim Berners-Lee, creator of the World Wide Web, has warned that when AIs decide which companies to take over and can create their own companies, there will be an AI evolutionary battle of the fittest take place and the result may be that fairness and equity are lost in translation (Techworld Staff, 2017).

There is emerging research that AI will have a significant impact on employment with substantial loss of jobs to AI and robots. In fact, automation has already seen many jobs automated including diverse entities such as factory production lines and bank tellers. According to research by pwc, 59% of manufacturers are already using some form of robotic automation (pwc, 2017). There are approximately 2,000,000 Automatic Teller Machines in the world according to the World Bank (Bank, 2017). These Teller machines have not only displaced many human workers but have also extended the operating hours of the services they provide, to 24 hours, 7 days a week, 365 days a year.

AI is presently disrupting transportation with Uber, which is essentially an AI software tool, now the biggest taxi service in the world and yet does not own any cars. Airbnb, also a software tool, is the biggest hotel company in the world and does not own any properties. In the US some have started to use IBM's Watson AI natural language law questions and Watson then searches the complete body of US law and returns answers with citations and references (IBM Cognitive Business, 2017; Kumar P. , 4th Industrial Revolution… Exponential Age!, 2017).

Nonetheless, new jobs will be created because of the widespread adoption of AI and many existing jobs will be improved through automation, freeing people for more creative activities, including focusing on the strategic and social aspects of their work (Walsh, 2017). Further the education professions will likely see a large increase in demand as those displaced from the workforce are retrained or are refocused e.g. to learn artistic pursuits, either as a lifestyle or career option.

Looking at the US workforce, in the well cited article, The Future of Employment: how susceptible are jobs to computerisation (Frey & Osbourne, 2013), the authors posit that 47% of total US employment will be automated within 10-20 years. Another study suggests that up to 80% of US employment will be replaced by automation – a revolution that the author compares with the shift from 80% employed in agriculture to just a few percent (Elliott, 2014). A more recent analysis, from pwc, suggests that 38% of the US workforce will be replaced by automation by 15-20 years (Berriman, 2017). Looking at these three articles, a reasonable assumption would be that a sizable portion of the US workforce (and other world workforces) will be displaced by automation by the mid-2030s (Berriman, 2017). A Japanese study shows that 55% of the Japanese workforce is likely to lose their jobs to automation.

The continued development of AI will mean further automation for the manufacturing sector and other sectors such as office administration, the service industry and computer programming. The great challenge is that this transition may be very rapid, in some cases overnight. This will see major disruption as people displaced by these changes will not have time to retrain or relocate. One industry, that is facing disruption on a massive scale as noted by Musk, is the trucking industry. In Canada, in 2011, there were more than 260,000 people who listed truck driver as their occupation – the second most common job for men. Uber has achieved delivery by a self-driving truck. Transport companies will be compelled, to remain competitive, to adopt self-driving fleets to cut costs, reduce loss from accidents and free itself from union related issues simply by replacing its fleet (Gilmore, 2017). In Australia, self-driving trucks would (presumably) not have to obey the fatigue management restrictions (National Heavy Vehicle Regulator, 2017) currently imposed on truck drivers and so a self-driving truck or taxi or other commercial vehicle could stay on the road continuously with only stops to load\unload, refuel and to undertake maintenance. Initially this would have the effect of reducing the number of trucks on the roads and therefore reducing the number of truck drivers. Major companies would likely be the first to replace their entire fleets and owner drivers would be left to compete in an aggressive market that would see their earnings greatly reduced and eventually they would be priced out of the market. These scenarios would likely apply equally to the Taxi industry as well as other forms of transportation such as buses, ferries, shipping and even air transport.

Steve Wozniak, co-founder of Apple worries, "that the future is scary and very bad for people. If we build these devices to take care of everything for us, eventually they'll think faster than us and they'll get rid of the slow humans to run companies more efficiently," (Apple co-founder Steve Wozniak on the Apple Watch, electric cars and the surpassing of humanity, 2015).

Japan is a world leader in humanoid robots and already has a hotel that is staffed entirely by robots. One of the Japanese banks is using a robot in their reception, Nestlé Japan is using robots to sell its coffee makers in more than 1000 Japanese stores, the National Museum of Emerging Science and Innovation uses robots as guides for visitors (Rajesh, 2015; MSN, 2017).

There is increasing reportage of robots replacing humans and this trend will continue to grow, perhaps reaching exponential rates in the not too distant future. Amazon is using more than 30,000 robots in its warehouses to service fulfilments and is looking to replace more workers with robots over time. Cambridge Industries Group, a Chinese telecom supplier, is replacing two-thirds of its workforce of 2,000 with robots. Uber is testing self-driving cars in the US with a potential intention to replace human drivers in the future. Tesla's Gigafactory 1 is being constructed to eventually be near 100% automated. UK company Capita, is replacing 2000 humans with robots. US Target stores have begun testing robots to check stock. Adidas has opened a fully automated factory in Bavaria. Walmart is using drones to do stocktakes in one day – a task that took humans a month. MasterCard and Pizza Hut are using robots as cashiers and for customer service in Pizza Huts in China; Ocado, a UK online supermarket, uses more than 1000 robots in its warehouses (MSN, 2017); In 2016 Apple and Samsung supplier, Foxconn replaced 60,000 employees

with robots; China's Everwin Precision Technology is in the process of replacing 90% of its factory workforce with automatons (Forrest, 2015); The Dutch bank, ING, is replacing nearly 6,000 employees with robots; DHL is a very large user of robots and is also using cobots – so called because they are robots that work along with humans; The Nissan factory in Sunderland in the UK is considered to be one of the world's most efficient car factories and is 95% automated (MSN, 2017); Some investment companies, such as JP Morgan Chase and Goldman Sachs, are making increasing use of AI for stock investment; Inditex, the Spanish parent company of the fashion chain, Zara, runs 14 automated factories and is able to manufacture product within 10 days from design to sales floor (Reese, 2017).

6.1. JOB LOSSES IN BOTH LOW AND HIGH SKILLS AREAS

Some authors claim that AIs and robots will mainly impact lowly qualified workers and have little impact on more highly skilled work (Arntz, Gregory, & Zierahn, 2016). However, there are many that see both low skilled and high skilled jobs being taken over by AIs and robots.

Many current professions will become obsolete and the related job losses will not just be in what was traditionally considered as low-skill jobs but will include many professional jobs. Studies have shown that the job losses will be deep and widely prevalent, and the replacement jobs will not be sufficient to fill the void (Frey & Osborne, 2013). Although it appears readily conceivable that autonomous vehicles will see taxi, truck and courier drivers out of job, automation is not confined to lower skilled jobs. Jobs, that are today considered high-skill jobs, could be automated or even downgraded to low-skill (Autor, 2015; Autor & Dorn, 2013; Goos & Manning, 2007). Bots have begun to takeover customer service type functions in both the commercial world and the government world (Sharp, 2017) and this has been one of the hot areas of AI as many see benefits to having bots answer customers and clients consistently and accurately. Job polarization is currently happening (Goos et al., 2009; McAfee & Brynjolfsson, 2016) and does not appear to be dependent upon singularity. "Artificial intelligence is learning to be an accountant, an architect, a designer, a singer, a composer, a teacher, a scientist, an artist, a retailer, a trader, a doctor and the list goes on and on" (Munoz & Naqvi, 2017).

AI has a unique advantage over other technologies in that it could potentially be applied across many occupations and therefore an AI company could wield immense power. For example, once it has developed an AI that can undertake accountancy work, it could potentially displace accountancy as a career path for humans. Few companies would persist with human accountants if an AI alternative was available at a fraction of the cost, without the overheads and with the power of big data behind the AI to ensure that it was up-to-date and was using the best and latest data to provide its employer with the best possible accountancy service. Already AI is out performing trained professionals such as lawyers and doctors in research and diagnosis abilities respectively and these abilities are being built by software engineers rather than medical or legal specialists. Another example is that of an AI as a tax agent, once developed and trained, it could act as the tax agent for an entire country (Munoz & Naqvi, 2017, p. 7).

Automation may slow the offshoring of jobs to the developing world with employers choosing to automate locally but it will still result in a net reduction in jobs in the local country (Internet Society, 2017).

6.2. Autonomous Vehicles

Widespread adoption of driverless cars appears imminent with Tesla releasing a driverless Tesla in 2018, Volkswagen a driverless Volkswagen by 2019, GM (General Motors) driverless GMs in 2020 and Ford releasing driverless Fords by 2021 (Driverless Future, 2017).

Self-driving cars will mean that many people may dispense with owning a car. By 2030 autonomous cars may have already replaced most cars and there will no longer be a need to own a car. Consequentially, businesses that support the ownership of cars – such as petrol stations, motor mechanics, smash repairers, spare parts dealers and commercial car parks are likely to see a very significant decrease in patronage (Needham, 2017). This may also see the demise of the major automotive manufacturers, if they fail to effectively engage in the production of autonomous vehicles. Autonomous vehicles are currently being produced by traditional car manufacturers but also by start-ups such as Tesla. There will be intense competition to build the first widely available autonomous vehicles. Taxi companies will evolve, or new businesses will form around providing fleets of autonomous vehicles at low cost and low wait times to consumers. Even houses, apartment blocks and office blocks will change as drive ways and garages are no longer needed. Over the longer period roads may narrow as autonomous vehicles will be able to travel closer together and at higher speed.

The International Transport Forum, comprising 57-member countries has recently released a report into the advent of autonomous transportation. The report suggest that driverless trucks could be widely in use within 10 years. They

note that millions of truck drivers will likely be displaced, and they recommend that structures be put in place both to manage the introduction of driverless trucks but also to manage the impact on truck drivers. The Forum acknowledges that driverless trucks will offer greater safety, reduced fuel usage and reduced costs and therefore, are an inevitability but that the timing of their introduction and regulatory recognition is not yet known (International Transport Forum, 2017).

6.3. Even highly expert professions could be replaced by AI

The future of Psychology, Psychotherapy and Psychiatry will likely be Artificial Intelligence. An AI Psychologist, Psychotherapist or Psychiatrist will be built and prepared through deep learning and exposure to large amounts of training data. Traditional practitioners would be unable to compete with the knowledge that an AI has, as in their lifetimes they would have seen thousands of patients at most, whereas the AI would be exposed to millions of cases through training data. Google's AI system can detect cancer faster and, more accurately than humans. AI algorithms are better at detecting the presence or absence of tuberculosis in x-rays than humans (Guedim, 2017; Hsieh, 2017). An individual AI could fulfil the different roles of Psychology, Psychotherapy and Psychiatry as well as prescribe medicine (currently limited to Psychiatrists and Physicians) and switch between the roles on a needs basis. An AI could be an all-in-one medical practitioner for the patient.

In the traditional treatment scenario, a patient meets with the practitioner on a regular basis and must book and travel to the meeting. Continuity between the meetings is maintained by the practitioner and their notes as well as the patient's recollections. In contrast, an AI can be available at any time at any place for the patient (even as a life coach coaching them through life situations) and has perfect recall of previous discussions as well as access to all the latest medical research about treatments including drugs and is able to compare the patients experience in real time with (conceivably) millions of other experiences. IBM claim that its AI, Watson, absorbs 5,000 new medical studies a day as well as uses accumulated medical patient data, amounting to the contents of 300 million books, to personalise healthcare (IBM, 2017).

Perhaps the patient has chosen to allow the AI to monitor them so that the AI has access to the patient's real-time health including periods of stress manifesting as elevated heart rates. The patient may permit the AI to monitor all the patient's phone calls, emails, internet searches and activity and social media activity. It could then use this collected data to proactively counsel the patient and to refine its understanding of the patient. No human practitioner would be able to compete with this holistic level of intimate knowledge of the patient. The patient would be able to customise the AI's attributes such as voice, 'gender', language and approach – some may prefer a light touch approach and others may prefer a more intrusive approach such as the AI dispensing practical advice on a regular basis. The AI would be available over the long term building a lifelong relationship with the patient not taking holidays or changing practices. Naturally privacy issues would need to be addressed. AIs would conceivably reduce the costs of running a practice including needing to have consulting rooms at all and an AI would be able to meet with multiple patients concurrently. Although there will be those that resist AIs, who defer to the human touch, many consumers will be convinced to use the AI option because of the differential features and abilities that it brings as well as the economic rationale. Some may prefer that the AI take a human form such as a humanoid robot or even in a non-human form if that was preferred, for example a doll or a robot dog or cat. Perhaps, once there is widespread adoption of domestic robots this type of mental health counselling could be an optional function that they have. An AI could also multi task for the patient being a Psychiatrist as well as a life coach as well as a personal trainer for fitness and perhaps even as a religious counsellor if that was required. Paradoxically, it may be the advent of the rise of AI and the resultant disruption that sees a large increase in the need for the therapy. Patients, who are seeking treatment because of significant life changes, perhaps as a direct result of AI, may not want to turn to an AI for help. Some people may feel increasingly isolated in a technology driven world and seek human contact and avoid robot\AI contact. Looking at robot\AI therapy from an Orwellian dystopian perspective, AIs may be required to report certain conditions or actions directly to the authorities. Although AIs will likely be built to comply with Patient Doctor confidentiality arrangements, their ability to record and store with perfect recall, may mean that governments have an override or back door into these sessions. Recorded and stored sessions will also have value for hackers, hacktivists, criminals and terrorists.

6.4. Robot Surgery

There are nearly 4,000 da Vinci Surgical robots, worldwide, that have together performed more than 3 million medical operations. These robots are more efficient than human surgeons in that they can manoeuvre inside the human body, with the use of cameras, more effectively than humans as well as undertake excisions impossible for

human hands. They can reduce the invasiveness of current procedures with resultant lessened blood loss, smaller scars, lessened pain and faster recovery. One example is that the robot can use a 1cm incision to operate on a kidney, whereas a surgeon traditionally makes a 15-cm incision (Gerrie, 2016).

The above empirical and theoretical examples suggest that humans are increasingly at a great disadvantage when compared to robots and to AI in the job market. Robots take no breaks, work around the clock (apart from maintenance periods), work faster and with more accuracy than humans, avoid mistakes, work for a fraction of the cost of humans, need no facilities, require no unions, have no need for safety measures and are afforded no human rights. Musk has stated that "you can see robots that can learn to walk from nothing within hours, way faster than any biological being" (Clifford, Elon Musk: 'Robots will be able to do everything better than us', 2017). Under these conditions there does not seem to be anything that can stem the tide of robot and AI encroachment on jobs. It appears inevitable that the loss of jobs and transfer of occupations to AI will only accelerate and spread.

6.5. AIs will initially augment humans, then take over

In many cases it is probable that AIs will initially augment human ability and then, once fully trained, take over. A developing example is H&R Block who are using IBM Watson to augment human agents preparing US tax returns. IBM Watson can absorb the federal tax code, which currently extends over 74,000 pages, as well as each year's tax changes, which number in the thousands. More than 11 million of H&R Block's customers are already benefiting from the AI (Bloomberg, 2017; Gaudin, 2017).

Although in this instance, the AI is augmenting human agents, the longer-term outcome will most probably be to have the AI undertake the work without human assistance. An AI has, in this circumstance, several advantages. No human could possibly compete to keep up with the amount of tax code information and rate of change. There will a magnitude of scale once IBM Watson is fully trained as an agent, and it will be easy to extend the service to millions of new customers. As the AI will understand taxation on a scale not possible before it will conceivably be the most efficient and effective tax agent, easily returning better tax returns to its clients and presumably at a rate competitive with human services. Although some people will choose to continue using a human tax agent for reasons of familiarity, or fear of AI or even because they are seeking to deceive (i.e. submit a fallacious return), the majority of tax payers, who would normally use the services of a tax agent, would be induced to use the AI service.

Extrapolating from this example it is easy to not only see how valuable and pervasive an AI could become but also to see how issues such as ethics and privacy could be abused. Conceivably, an AI tax agent could, if given access, manage a person's affairs completely in a background manner, without explicit interaction from the human. For example, if the person gave access to their banking and credit card records the AI could track their income and expenditure and prepare their tax return without intervention. Adding to this, the AI could act not only as a tax agent, but also as an accountant and financial advisor. The AI could, in this way, become an indispensable service to the human.

This could be disruptive in several ways. Accountants, financial advisors, tax agents and others in the financial services area, would face uncertainty about their professions. Governments would face a drop in their tax revenue bases as AIs ensured that large numbers of tax payers paid the minimum taxation possible under the law (no suggestion intended that Governments are deliberately wanting their citizenry to over pay tax). Humans using these AIs could become completely dependent upon them to the point that the AI has effective control over portions of their lives. The electronic footprint of this information would be a very valuable commodity to be traded or stolen. Once an AI is acting in this capacity, the AI might be using persuasive techniques to steer the client toward financial products that the AI company is directly or indirectly benefiting from. Issues of ethics and privacy will need to be carefully considered and regulated to prevent misuse. It is possible that many people will abrogate their right for privacy and their right for ethical treatment for the convenience and benefits of a service like this. Consider how the advertising of a service like this might appear: We can return a larger tax return than anyone else, at a fraction of the cost, in a fraction of the time. Along with this service we can also act as your personal accountant and financial advisor, available to you 24 hours a day. An advisor that knows everything financial about you whilst also understanding the law and the tax code, as well as being fully up-to-date with any changes. We can even provide you with real-time, tax position tracking. No need to make an appointment or to attend an office. The service is available as an app on a mobile device, on a PC, as a voice service, in any language and at any time and in any accessible form required.

6.6. The Job Market of 2050

No one can accurately predict what the state of the job market will be in 30 years, except to state that it will be very different from today. Many of today's common jobs will no longer exist and there will be new types of employment emerging that are complementary to the rise of AI. It is probable that there will be "post work world" in existence as well where, "the idea of going to the office to earn a living would sound as strange as the idea of going to the forest to hunt your dinner" (Falk, 2017).

6.7. The transition from human workers to robots and AI

It is probable that, in many cases, the transition from humans undertaking work, to robots and AI taking over, will occur through a process of gradualism. Robots and AI will initially work alongside or augment humans. Doctors are already making use of surgical robots and using AIs to detect medical conditions such as cancers (discussed elsewhere in this paper). The devlopment and wide deployment of autonomous vehicles will likely pass through a phase of augmenting drivers, for example, adaptive cruise control is a technology that augments a human driver until such time as the presence of a human supervisor is no longer necessary.

6.8. The Gig Economy

One example of a changing form of employment that appears to favour employers, although not exclusively associated with AI, but likely to be greatly exacerbated by AI, is that of the rise of the gig economy which has emerged since the global financial crisis. The Gig economy is a term coined to represent the trend for significant rises in freelance, temporary and contract work at the expense of permanent work, sometimes enabled by AI. An AI example, is the rise of Uber, with freelance drivers replacing taxi drivers (Walsh, 2017; Shetty, 2017; Hopkins, 2017). Sheldon describes the loss of worker's entitlements to sick and annual leave, maternity leave and retirement pensions as a consequence of the advent of the Gig economy which he calls the "uberisation of jobs" (Sheldon, New Tech Industries Are Bringing Digital Work Choices, TWU's Tony Sheldon Warns, 2015).

7. THE UNIVERSAL BASIC INCOME

Within decades, most of the jobs that currently exist today for humans, will disappear as AI exceeds human capability. New professions will emerge, such as virtual world designers, although those displaced by AI may not be able to adapt to the new professions. Creating new jobs will not be the core issue for humans but rather jobs that cannot be better performed by algorithms and robots. Consequentially, there will be a new class of humans emerge. These will be the permanently or very long term unemployed. Unlike those that are long term unemployed today for various reasons. This new class will be created directly because of displacement of humans by AI. They may never have the opportunity for paid employment in their lifetimes or once made redundant by technology. Hariri jarringly refers to them as "the useless class" (Harari, The meaning of life in a world without work, 2017).

If the revenue earned by AI and robotics are retained for the exclusive use of the owners, there will be a very great divide between those that have and those that do not. This is the current situation. Over time this divide will accelerate at an exponential rate. One solution is that the earnings from AI and robotics using the mechanism of a universal basic income (UBI). The universal basic income is a form of wealth redistribution which imposes higher taxes on the wealthy and especially upon those benefiting from the loss of jobs. There are several challenges with the UBI. Most important is how Governments might fully fund it. Another is motivating some people to continue to work whilst others are paid the UBI. Several governments have run trials of the UBI, including Finland, Canada, the USA and the Dutch. One aspect of the tests is to observe whether people will still choose to work when they can access the UBI. It will be a very serious challenge to create meaningful lives for those that may be permanently unemployable or unable to remain in the workforce because of the advance of AI. The cohesiveness of society will be under threat, unless this is fully addressed. Further, unemployed people may increasingly choose to live in virtual worlds as a form of escapism (Harari, The meaning of life in a world without work, 2017; Janda, 2017) – some perhaps working at imaginary jobs.

Tony Sheldon, National Secretary of the Transport Workers Union of Australia, has asked how we might benefit from the higher productivity and income as well as the reduction in working hours that AI will bring whilst avoiding increased inequality that previous technological revolutions have produced (such as the industrial revolution). He supports the idea that that AI innovations should bring about increased prosperity for all. He states that market power must be balanced across society and not accumulated in the hands of a few big businesses. Rather, power must be

distributed across both large and small businesses as well as employees and contractors. And for those whose employment is lost to AI, they should be compensated with an adequate safety net of unemployment benefits and pensions. The revenue to fund the safety net should come directly from the companies that most benefit from AI (Sheldon, Organised Disruption: Protecting Workers in the Digital Age, 2015). Sheldon asserts that,

> disruptive firms need to be accountable for the labour markets and supply chains they create, and the impact of these on communities…Disruptive technology companies need to be good corporate citizens. They need to think through the consequences of their innovations on the labour markets they disrupt, and work with employees, contractors and governments to ensure a framework for decent pay, rights and conditions (Sheldon, Organised Disruption: Protecting Workers in the Digital Age, 2015).

Sheldon advocates that a universal basic wage be considered if we are to have an equitable society (Sheldon, Organised Disruption: Protecting Workers in the Digital Age, 2015).

8. THE PROBABLE IMPACT OF LARGE SCALE LOSS OF EMPLOYMENT

There are many issue concerning the universal basic wage. Inequality of the basic wage across nations driving up economic migrations. Loss of identity through the lack of meaningful work. The gap between the rich and powerful and the rest of society widening as the rich get richer and the middle class and lower class gets poorer and ever more disempowered. In the extreme, there might be a collapse of the middle class, in the absence of work and consequentially polarisation of society into the rich and the poor. Finally, death rates will likely increase on a large scale including both suicide and murder rates as well as other crimes, as these rates have been linked to increased unemployment (Parry, 2015; Ajimotokin, Haskins, & Wade, 2015). One study shows an increase of approximately 30,000 people dying, world-wide, for each increase in unemployment of 1% (Harrigan, 2016).

8.1. Are the automation job loss rates exaggerated?

Some commentators see the figures being used to predict loss of jobs to automation as exaggerated. For example, some occupations require a level of dexterity, such as watch repairers, that robots will struggle to achieve. They claim that humans have an advantage over robots in uncontrolled environments and an adaptability that robots lack and an advantage that will be very difficult for robot designers to circumvent. They question the validity of the thesis that once a robot\AI can perform a task, e.g. drive a car, that all truck, taxi, bus drivers as well as couriers will be automated. As well they express doubt that all employers will automatically cede jobs to automation. They also state that models predicting job losses to automation do not take into account the many new jobs that will be created to support automation, such as marketing, installing and maintaining robots. The Organisation for Economic Co-operation and Development (OECD) commissioned a 2016 study into the likely average rates of automation and their findings are that only 9% of jobs will be automated across 21 of the OECD countries examined. The main conclusions of the paper are thus that automation is unlikely to replace large numbers of jobs and that the jobs that will be replaced are at the lower skill levels. The report suggests that the main challenges for the future are rising rates of inequality for lower skilled workers as well as the need for their retraining (Gittins, 2017; Arntz, Gregory, & Zierahn, 2016).

With regard to the wide disparity in predicted automation rates, the actual rates of automation will only become apparent as AI and robotics continue to develop and their real capabilities and limitations are established.

9. WHEN THINGS GO WRONG

9.1. Accountability for errors

Machine Learning will present a difficult issue when it comes to assigning accountability for decisions made by an AI. The ultimate responsibility for a decision made by an AI can be the result of decisions made by the system owners, or the programmers, or providers of the data or even with the AI itself. Through machine learning, AIs are developing to a stage where they are self-improving, making their own modifications and ceasing to be explicitly under the control of its original programmers. It may have become so complex through iterative improvements, changes and the sheer size of the AI, that it becomes problematical to ascertain why it makes decisions. Many of these decisions will directly affect the lives of humans, such as the behaviour and actions of an autonomous vehicle.

Thus, the process of determining accountability will present significant challenges for legal systems and it is likely that much legal precedence will be required over time to manage AIS within society (Internet Society, 2017).. One recent example describes the challenge. A Tesla Model S car was put into auto pilot by driver, Joshua Brown. The car then collided with the truck's trailer killing Mr Brown. Tesla initially suggested that the fault lay with the driver as he should have remained alert rather than rely on the autonomous mode. This incident raises several questions including whether Mr Brown was using the car in an appropriate manner relying on the autonomous capability of the car, whether the software was at fault as Tesla claimed that the car failed to identify the white coloured truck and trailer against a bright sky backdrop (Levin & Woolf, 2016). The US National Transportation Safety Board (NTSB) investigated the crash and the resultant fatality. Their findings were that the Tesla's algorithms could not recognise the truck cutting across its path, nor respond to an impending crash. This resulted in the car not slowing and the failure of the collision warning and emergency braking systems. Mr Brown was able to over rely on automation and demonstrated a misunderstanding of the car's limitations. The Tesla's design allowed the driver to misuse the automation capability and its system to warn the driver to take back control was inadequate. The NTSB Chairman, Robert L. Sumwalt III, stated that automation has the potential to save many lives, but he warned that the technology is still in its infancy and yet to achieve full automation. Until that time drivers will have to remain engaged and take over as needed (National Transportation Safety Board Office of Public Affairs, 2017).

Lessons around accountability that can be drawn from this incident include that humans will still be held accountable for their actions when interacting with AIs and robots. Another lesson is that when incidents do occur, AI algorithms will be challenged and the companies that design and maintain them will be held accountable. Notably, Tesla made changes to their algorithms because of the crash (National Transportation Safety Board Office of Public Affairs, 2017).

9.2. Error Prone Superintelligence

Although one of the attractions and advantages of AI is the prospect of a reduction in error rates, it is not plausible that a superintelligence could make consistently perfect decisions. The world is changing with such rapidity and data stores are growing at exponential rates and this is resulting in complexity that any system will struggle to absorb it all. Without a complete picture, it is probable that an AI will make mistakes, perhaps through failing to consider localised knowledge. This can simplistically be illustrated when considering an AI designed to prepare tax returns (as mentioned elsewhere H&R Block are using an AI to undertake tax returns). It could be trained to prepare tax returns for an entire country and use its collective experience to do this optimally, in most cases. However, if it is not provided with every local nuance, such as local tax breaks, it will inevitably make mistakes. Historically, centralised bodies often fail to make the best decisions because of their remoteness and disconnectedness from the local issues. "Distributed, local control methods are often superior to centralized approaches, especially in complex systems whose behaviors are highly variable, hardly predictable and not capable of real-time optimization" (Helbing, et al., 2017).

Conversely, strengths of AI include that it can learn from its mistakes; it can absorb and make sense of big data in a way that humans have not be able to do, and it can be designed to incorporate sensors and data collection points in any locality, providing it with detailed local knowledge as well as the big picture.

9.3. Hacking

It is a certainty that some AIs will be hacked by extremists, hacktivists, criminals or terrorists. "Almost all companies and institutions have already been hacked, even the Pentagon, the White House and the NSA" (Helbing, et al., 2017). Unfortunately, transparency may have its own risks. If the training data and algorithms are publicly available it may facilitate attacks against the AI (Internet Society, 2017, p. 8).

Some AIs will be hacked for malicious purposes. Tay was an experimental Microsoft AI chatbot, that was given a Twitter account. It was targeted by a collective attack by Twitter users and they taught it to behave in a racist and politically biased manner. Within 16 hours of being launched, Tay was shut down because of the attack (Internet Society, 2017; Hunt, 2016). This technique – of maliciously manipulating an AI, has become known as "adversarial

learning" and its purpose is to then exploit the AI in some way such as an attempt to defeat a spam filter (Internet Society, 2017).
In 2015 a Jeep Cherokee was experimentally remotely hacked. The hackers exploited the internet connected electronics system of the car, rather than an AI in the car and obtained full control over the car (Greenberg, 2015). The experiment suggests that autonomous vehicles will be liable to hacking and this has all kinds of implications. On the one hand, it may be used to save lives if a car\driver is detectably driving dangerously. On the other hand, it could mean that a vehicle could be deliberately crashed into an object or into pedestrians.

9.4. AIs that take shortcuts

As AIs develop there is a possibility that some will make decisions or take short cuts – known as "reward hacking" where the AI thinks it has found an easier or more efficient solution to a problem – such as a robot vacuum depositing dirt under a carpet. Therefore, potentially harmful behaviours by AIs could result in them being in direct conflict with the intention of the original programmers. Another example is an autonomous car driving on the wrong side of the road as an attempt to reach its destination earlier. This is known as the exploration/exploit dilemma in reinforcement learning (Internet Society, 2017). An extreme example, along Terminator lines, might be that an AI that decides to eliminate humans to reduce greenhouse gases.
Without perfectly aligning an AI's goals with human goals an AI might take a destructive method to achieve a beneficial goal. If a super intelligent AI is given a difficult project to undertake, it might choose means that cause extensive damage and then fight against human attempts to mitigate and control it (Global Challenges Foundation, 2017).

9.5. Future crimes and misdemeanours

It is certain that the laws governing us will have to evolve to accommodate the rise of AI in many areas including consumer law, property law and criminal law. Challenges will include ensuring that the Laws evolve as fast as the technology. Although, given historical law precedence, it is very unlikely that the law will match the pace of AI development and especially given that there is an expectation of exponential advancement in AI. It may be that in the future we have to grapple with the question of whether an AI or robot can be charged with a crime. Although this seems like a non-sequitur today and only relevant to the world of movies, one-day AIs will presumably be artificial general intelligences, capable of thought at the level of humans and beyond.
We are likely to see humans causing malicious damage to AIs and robots for different reasons and current laws will initially suffice to deal with these situations. But further into the future this becomes more complex. Indeed, it may be possible in the future to 'murder' (or terminate) an AI or robot. Although this seems counter-intuitive at first, imagine if someone had obtained an AI and had developed a relationship with it over many years, whether as friend, companion, assistant or partner and it had accumulated memories and experiences with that person and had adapted itself consequently. If that AI were to be damaged, hacked or destroyed in such a way that those memories were irretrievably altered or lost, then there would be a loss of the accumulated artificial personality and this may be construed a crime, akin to murder. Perhaps the damage could be to adversely alter the Ai – to make it belligerent or aggressive to its owner. These scenarios presume that there are no feasible backups and restores – or that the damage extended to include the backups. The crime would appear to be against the person that 'owned' the AI. Perhaps though, the main plaintiff might be the AI. Even the concept of 'owning' an AI may become awkward. There may be scenarios where the owner alters the AI in a way that the AI does not agree, or the AI could alter itself in a way that the owner does not agree. Once an AI had achieved general artificial intelligence, it may not be possible for it to be 'owned' any longer. Conversely, we may find ourselves becoming the pets of these super AIs, as an inferior species.

10. CAN A MACHINE ACHIEVE CONSCIOUSNESS?

Discussion on what constitutes consciousness can be traced back in history to philosophers such as René Descartes (1596-1650) who formulated that only humans can experience consciousness and that consciousness was a state of mind. Anything else, such as animals, he classified as unthinking automata (Frith & Rees, 2017). Although a full discussion of the subject of consciousness is beyond the scope of this paper we will touch briefly on some aspects of consciousness that concern AI.
There is much debate on whether an AI\robot will achieve human like consciousness. If a machine does achieve human like consciousness will that 'consciousness' be a synthetic version of human consciousness or will it achieve a 'real' consciousness, or one perhaps unique to machines? Is there a difference to the consciousness of a cyborg, a human enhanced by AI - such as the research work being undertaken by DARPA (mentioned elsewhere). Will this be

a new form of super consciousness? Added to these questions, there are those that express concern about the consequences, if such consciousness were to be achieved.
The crux of the question is whether a machine really understands the ideas and concepts it works with or whether is it just processing the binary 1s and 0s. Some refer to this saying that a machine that only processes symbols can never be a machine that understands the symbols. One philosopher, who has attempted to negate the possibility that machines can think, is John Searle. In the 1980s, Searle described an experiment he called the Chinese Room Thought experiment: A person, who speaks and reads English only, is provided with a large amount of Chinese writing. He is then given a second set of Chinese writing with some English instructions. Then finally he is given a third lot of Chinese writing and some more rules in English. Simplistically, the rules allow the person to identify shapes of characters and to identify which shapes to show in response. The administrators of the experiment would call the first batch of Chinese a 'script', the second a 'story' and the third 'answers'. At no time does the person come to understand any of the Chinese scripts but once they become adept at matching the symbols, to an outside observer, they appear to be able to read and understand Chinese script as they give what appears to be, the correct responses. This Searle equates with the operation of machines. They can manipulate symbols, but they cannot understand what they are doing, and they do not understand the symbols themselves. As Searle puts it, in the room the person does not understand any of the characters and yet there are inputs and outputs identical to a native Chinese speaker. The person can be provided with any set of instructions in English that they like but they will still not understand any of the Chinese script. A machine is identical to the person in the room. It can simulate understanding but it cannot really understand. In the end, it is only capable of manipulating the symbols without any understanding of the semantics (Hauser, n.d.).

11. Human Rights for Robots?

Once AIs become sentient and self-aware, it may be that some form of protective legislation needs to be set up to recognise that they have rights. At some point, there will be legal recognition of artificial self-awareness. Up until that point, normal criminal law would suffice, as mentioned above. The entity of most value, that will need to be protected, is the learned and developed personality. This learned and developed personality may outlast their original human owners, somewhat like Andrew, the robot from the fictional movie, Bicentennial Man.
There are several salient concepts and ideas that can be drawn from this movie, based on the forward thinking, Isaac Asimov book, the Bicentennial Man and the later book by Isaac Asimov and Robert Silverberg, the Positronic Man (The Positronic Man, 2017). The film tells the story of Andrew, a robot that evolves over time into an android, capable of exhibiting human-like creativity and emotions. The difference between a robot and an android, is that a robot appears like the traditional view of a robot as a mechanical looking entity, whereas an android is human-like in appearance. The story starts with Andrew explaining the "Three Laws of Robotics" as proposed by Isaac Asimov. The three laws proposed were, 1 - "A robot may not injure a human being or, through inaction, allow a human being to come to harm", 2 – "A robot must obey the orders given it by human beings except where such orders would conflict with the First Law" and 3 – "A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws" (Anderson M. R., 2017; Warner, 2002; Deng, 2015). There would appear to be a far measure of dissonance between these laws, first proposed by Asimov beginning in 1941, and the current state of robot and AI development. An obvious conflict exists with Law number 1 with several governments developing autonomous weapons designed to kill humans, as discussed elsewhere in this paper. Another deviation from Law number 1, is that autonomous vehicles are inevitably going to be built to make decisions during crashes that minimise casualties, but that may result in the death of the driver, the occupants, pedestrians or the occupants of other vehicles (Dvorsky, 2016; Lubin, 2016). Law 2 seems to be open to abuse if, for example, a human directed a robot to commit an act that did not injure another human, but that was criminal in nature. Law 3 is already defunct in that robots are being sent into hazardous situations, that threaten their existence, such as in bomb disposal situations. Although these three laws of robotics are inadequate and perhaps appear naïve by today's standards, there is an absolute need for the development of regulations that govern the behaviour of robots. This will not be a one case suits all. Regulations or laws that govern domestic and workplace robots and AIs will differ from robots and AIs that are designed for warfare.

11.1. Self-aware Robots and AI

Perhaps the major concept of the Bicentennial Man book and the movie, is whether a robot (or an AI) can be considered as a person. The movie poses several philosophical questions that humankind will have to grapple with as AIs and robots develop. These include determining whether self-consciousness is the essence of personhood? Whether an AI can become self-conscious? When does the answers the robot or AI give, or the behaviours exhibited cease to be programming and become something that is being understood by the AI? Should a self-aware robot receive the profits from original creative work that it undertakes? Can a self-aware robot marry a human? Can a robot have its own legal rights? Can a self –aware robot cease to be owned by humans and be emancipated? Can an otherwise near immortal AI or robot choose to cease to exist? (Anderson & Anderson, 2011).

If AIs and Robots reach a state of self-awareness, displaying human-like traits, there will either be a necessity to define under which circumstances robots and AIs are recognised as conscious entities and either to extend human rights to robots or to have a separate body of legislation, created to protect the rights of AI's and robots.

The movie uses an accident, in which Andrew is damaged, as the supposed catalyst for him to exhibit self-aware, human-like emotions and this sets him apart from other, otherwise identical robots. He can learn through his experiences and can independently think and plan. Notably, the books and the movie were made in the 1990s and the concept of a self-learning robot, able to learn from experience independently, is not presented as something readily achievable. Today, it is becoming commonplace for AIs and robots to be able to self-learn, adapt and exhibit human like emotions. Nevertheless, full self-consciousness has not yet been achieved. Some claim that limited self-consciousness has been achieved. One test, conducted by the Rensselaer Polytechnic Institute with 3 Nao robots, determined that one of the robots could exhibit apparent self-awareness. Selmer Bringsjord, one of the administrators of the tests, suggests that the development of a "logical and a mathematical correlate to self-consciousness", is already underway (Pearson, 2015). It may be that AI and robots have different journeys in terms of their acceptance as self-aware entities, even though the underlying algorithms may be identical. Conceptually, it may be easier to consider a synthetically self-aware, human-like android, a person, before considering a disembodied AI as such, even though that might not be a logical construct.

Initially, Andrew is a domestic robot and is gradually accepted as a member of the household and treated somewhat like a human. However, one of the members of the family is repulsed by Andrew and acts in a hostile manner towards him, including trying to get Andrew to damage and destroy himself. Andrew begins to exhibit original creative behaviour and begins generating income for the family as a wood carver creating original works of art. But this deviance from the norm is considered to be defective by the robot manufacturer. Needing repairs for other reasons, the robot company is warned by Andrew's owner, that he will litigate, should they alter his cognitive ability. Thus, we see that Andrew's learning and development with the family has created a unique value that has become irreplaceable. It is the potential loss of this learned behaviour and memories that is the subject of discussion in another part of this paper, as is that of the digital ghost that can capture, store and replay memories - a skill that Andrew employs, as the family ages and as members die. The film ends with Andrew, who now has a largely biological body, choosing to die at the age of 200, whilst the World Court agrees that he can be considered a human and validates his marriage to a human (IMDb, 1999).

11.2. Will AIs protect or abuse human rights?

AIs may take our jobs and, unregulated, they may they also take away human rights. Whilst some, like Nick Bostrom and Elon Musk, argue that AI will eventually dominate humankind, others see real problems already occurring with AI aggravating inequality in the home, the workplace and in the legal world. One way that this is occurring is that sexism, racism and other forms of discrimination are being introduced, inadvertently in most cases, into AI algorithms (Crawford, 2016). There have been several notorious incidences concerning AIs that were found to be operating in a discriminatory manner. For example, Flickr erroneously labelled some black and white people as apes and animals and labelled Native American Dancers as being in 'costume' attire in its AI application. Google's photo app replicated Flickr's error and labelled a black couple as gorillas. There was a swift apology from Google and a commitment for immediate remediation. Google noted that machine learning was a challenging task and that its app has identified white people as seals and dogs (Walsh, 2017; Crawford, 2016; Zhang, 2016).

Much earlier, in 2009, Nikon's photo software interpreted Asian people as blinking and Hewlett Packard's camera software struggled with identifying anyone with dark skins tones (presumably because the AI had been trained primarily with white faces). Although these are very public errors there may be errors being made by algorithms that are not being readily picked up. Algorithms are making decisions on many varied items such as personal product

endorsements, credit ratings, job selections and online dating without transparency or the knowledge of those affected (Walsh, 2017; Crawford, 2016).

Of course, machine learning, by its nature is intended to improve over time (called reinforcement learning). It is built to learn from its mistakes – if they are detected by humans or other systems. When AIs are trained to recognise images, this is done by the engineers selecting training pictures and the AI comes to understand the world through these choices. Therefore, if the AI is shown predominantly pictures of white people then it may likely struggle with non-whites as the above examples describe.

A serious failing concerns AI software that is commonly used in US courts. The AI is used to assess the potential for inmate recidivism, once released. A process called risk assessment is used to assist judges in determining whether to free offenders and at what amount to set bail. The US Attorney General, in 2014, stated that he was concerned the risk scores might be introducing bias into the legal system. He recommended that the AI system be assessed to assure that there was no inherent bias. The US sentencing Commission did not take up the recommendation and so ProPublica, an "independent, non-profit newsroom that produces investigative journalism in the public interest" (ProPublica, 2017), decided to investigate. They collected statistics on recidivism and compared them with the risk assessments. Not only did they find that the assessments were inaccurate in predicting recidivism rates but also that black subjects were being rated twice as likely to re-offend than whites and that whites were being flagged predominantly as low risk. The company that manages the AI has not released the proprietary algorithms for commercial reasons (Crawford, 2016; Angwin, Larson, Mattu, & Kirchner, 2016). There will be some debate around the release of proprietary algorithms as AIs become more prevalent and they are tested in real life. AI Companies have much to lose if they do accede to release their algorithms in terms of loss of intellectual property, but also reputation and even legal liability, if the algorithms are found to be biased, flawed, simplistic or plagiarised.

The US, Canadian and British Police have begun to use AI tools to predict crimes before they are committed (Munn, 2017; Predpol, 2015; O'Donoghue, 2016). Reminiscent of the Tom Cruise Movie, Minority Report, in which the authorities were able to predict murders before they occurred and to arrest 'perpetrators' before they committed the crime (although their source of information is 3 individuals who can visualise the future rather than AI algorithms and facial recognition). The systems use historical criminal data to direct Police resources. Unfortunately, this has the impact of distorting crime statistics because a greater police presence in a particular area means that more arrests will occur in that area and the area will become even more of a red light to the system. In the US this may mean heavier Police presence in non-white areas whilst Police presence in white areas decreases. Historical discrimination against ethnic groups may simply be migrated into the neural networks of AI algorithms.

The UK version is called the Harm Assessment Risk Tool (HART) (Crawford, 2016; Dickinson & Hamill, 2017). One could surmise that a Police officer, directed to a neighbourhood by an AI because a crime is likely to occur there, will police in a different manner than if just undertaking normal duties.

The Australian Department of Immigration and Border Protection has begun using an AI to assess the risk profile of people detained in immigration detention centres. Called the Security Risk Assessment Tool, it attempts to determine those that pose a risk. The information is used to decide what freedoms and privilege they have access to and ultimately whether or when should they be released into the community. A former President of the Australian Human Rights Commission, has claimed that the use of AI algorithms, in lieu of professional judgement, is Orwellian and an abrogation of the Department's responsibility. (Koziol & Bagshaw, 2017). Opposition to AIs will increase in concert with their increased use and presence in society. There would appear to be little point in opposing their use, as there are clearly advantages using AIs. As mentioned elsewhere in this paper, AIs are already being used that have real-time, access to millions of law cases on which to base judgements, something beyond the capability of even the most experienced law practitioner. Nevertheless, there should be careful examination and accountability for how the AIs make decisions and this needs to be an ongoing process of review.

Chinese scientists are using facial recognition to identify criminals from mug shots and, astoundingly, are claiming an accuracy level of 89.5%. They claim that their neural network was identifying criminals as having a 6% shorter distance between the inner corner of eyes and 23% larger curvature of the upper lip compared to non-criminals. These results are disturbing on several levels. Firstly, they seem reminiscent of the racist and discredited early 1900's Eugenics movement and secondly, they seem to damn anyone with these features to future judgement (Tegün, 2017).

Another example of unintentional racist bias occurred in 2016 when Amazon was found in a study by Bloomberg, to be excluding zip codes from its new Prime Free Same-Day Delivery service that were predominately black neighbourhoods. Amazon moved to remediate it but significantly declined to reveal why this discriminatory exclusion had occurred. Amazon, like others, cited commercial in confidence reasons for their lack of transparency (Crawford, 2016; Letzter, 2016; Ingold & Soper, 2016).

11.3.Until rust do us part

Another human rights issue concerns the future of relationships, both between robots and humans and between humans and humans. Like the movie, Bicentennial Man, mentioned above, one futurist foresees human-robot marriage as a probability during this century (Levy D. , 2007). The future may see some individuals opting out from human contact and living either in a virtual world, an enhanced world, living with a humanoid robot or even with a non-humanoid robot, such as a dog like robot. For many, companion robots and inanimate AIs may prove to be powerful cures to alleviate loneliness and isolation and disability. However, the dark side of this is that if this were to become commonplace it could damage the fabric of society. Sex robots are already available, and the 30-billion-dollar sex technology industry is engaged in a race to develop sex robots. The sex industry has a reputation for being a driver of technology and are one of the major industries that drove development of the world wide web in its early days (Waskul, 2004). Max McMullen, owner of the sex doll company, RealDoll, claims that he has AI sex dolls, that not only have the capacity to have sex with their owners but also have the capacity to engage in independent action and to hold conversations on many topics (Kleeman, 2017). Conversely, a segment of the population may opt out of relationships and perhaps society itself because of feeling inadequate, as they compare themselves to flawless robots with programmable personalities.

The development of sex robots will present humanity with difficult questions and ethical dilemmas. At present sex robots are being developed in the shape and form of adult males and adult females. Is it ethical to create a sex robot in other forms such as an animal? Will child pornographers design sex robots as children? Child pornography laws may suffice to prevent the development of sex robots in the form of children. Bestiality is illegal in many parts of the world (Wikipedia, n.d.). Will sex with an animal-like robot be considered a form of bestiality? Can a robot be raped or harmed by a person, if it is self-aware? Does a robot have a right to resist attempts to harm it, is it is self-aware? How will the advent of sex robots affect the behaviour of males and females? Research shows that pornography has become a primary method of sex education and that generally, has a detrimental effect on relationships, both decreasing intimacy with real world partners and creating unreal expectations that drives dissatisfaction and low self-esteem. (Sun, Bridges, & Johnson, 2016). With sex robots, these negative influences may exacerbate, for example, someone who practices abusing, physically assaulting or even ‘raping’ or ‘killing’ their robot, may, through desensitising themselves to the act, carry it out in the real world.

11.4.Discriminatory advertising

AI advertising of products and services has created a new way to discriminate on a per consumer basis. Personally, targeted advertising and pricing are not equivalent to traditional advertising and discount coupons, as the latter are generalist and not invasive of our privacy nor with a goal to exploit “psychological weaknesses and knock out our critical thinking” (Helbing, et al., 2017).

11.5.Discriminating against the poor

Ellis writes that it is likely that the average lifespan will increase to 150 within 50 years and that other advances in this field will see the average lifespan grow beyond 150 (Ellis, 2011). As with inequality in other areas of life, it is likely that extending life opportunities will also see a division between the haves and not haves when it comes to access to these technologies. Extended life will be accessed by an exclusive group and this will fuel resentment with the excluded majority. Death has always been an equalizer between rich and poor, but it is likely that the future will see the rich and privileged living much longer lives than the poor. It may be that the rich can remain young and beautiful in perpetuity. So, even if actual immortality is not possible, the lack of equity of access to live extending technologies will have serious social repercussions (Falk, 2017). Not only is enhanced life expectancy likely to denied to the poor but also access to cyborg modifications.

11.6.Discriminating against the unfit

Some health insurers are already incentivising their members, that wear the trackers, to stay healthier. This data could conceivably be used to increase membership fees for those that don’t meet their targets, thus creating a new class of discrimination against those that do not stay sufficiently fit (Fitness trackers set sights on healthcare, 2017).

11.7.New forms and new ways to discriminate

AIs ability to identify patterns that are currently either undetectable or difficult to detect by humans may give rise to "new types of advanced profiling, possibly discriminating against particular individuals or groups" (Internet Society, 2017). One early example of this, that has been greeted with considerable controversy, is that of an experiment conducted by Stanford University. The experiment attempts to use AI to identify sexual orientation using facial features undetectable by humans. In one of the tests, 81% accuracy rates were claimed for identification of gay and heterosexual men. The accuracy rates for lesbian and heterosexual women were lower at 71%. This means that approximately 20% of males and 30% of females are not being identified correctly (BBC, 2017). Information like this, in the hands of the wrong people or the wrong governments, could lead to persecution, incarceration, torture and even death. Heterosexuals, incorrectly identified as gay or lesbian, are also at risk. Recent research claims that 74 countries identify homosexual relationships as criminal offenses. 13 countries of these countries exercise the death penalty against homosexuals (Fenton, 2016).

11.8.Sexist AIs

Women are not exempt from AI discrimination. A study by Carnegie Mellon University showed that Google was more likely to show ads of highly paid job advertisements to male visitors to employment sites than to female visitors to the same sites. Again, there was no transparency as Google also protects its intellectual property. It could be that the advertisers had requested that their ads be preferentially shown to men or that the algorithms had an introduced bias in them (Spice, 2015; Crawford, 2016). An AI word embedding tool has been demonstrated to show race and gender bias in research undertaken. One of the co-authors of the report, Joanna Bryson, has stated "A lot of people are saying this is showing that AI is prejudiced. No. This is showing we're prejudiced and that AI is learning it." Bryson has cautioned that unless algorithms are deliberately designed to avoid bias it will potentially see the reinforcement of existing human bias in the AI systems of the future. She stated that it would be a danger "if you had an AI system that didn't have an explicit part that was driven by moral ideas, that would be bad". Word embedding is a widely used tool that assists AIs to interpret human language. It uses a numerical approach to words that assign values to words according to their proximity and frequency to other words. It is used for web searches and for machine translation. It is a much more powerful and accurate method than dictionary lookups. The research identified that "female" and "woman" were relating to occupations such as the arts and humanities, as well as with the home, whilst "male" and "man" were being associated with professions like maths and engineering (Devlin, 2017). The algorithm was more likely to connect pleasant words like "gift" and happy" and white faces with European American names, whilst contrastingly connecting unpleasant words with African American names (Devlin, 2017).

Another gender issue concerns the gendering of robots. Roff writes that United States Defense Advanced Project Agency (DARPA), is working towards building robots for warfare and is reinforcing stereotypical gender divisions designing warfare robots along masculine lines and designing research and humanitarian robots along feminine lines (Roff, 2016). Fessler comments that there is a preference to utilise female personas, including female names and voices for personal digital assistants and that the reason for this is that they are predominately designed by men. Further, that they had female voices and were designed to serve the user, it was reinforcing stereotypes of women as servants. A study undertaken to test Siri, Alexa, Cortana and Google Home's resilience to sexual harassment has determined that they have been designed to not offer sufficient resistance to sexual harassment and that this will reinforce stereotypes of women as subservient and unassertive, for those that chose to interact with them using sexist and derogatory terms. Alarmingly, it seems that humans have a propensity to abuse their AIs. A CEO of a Bot company has claimed that 5% of the interactions of customers with the Bot had been of an explicitly sexual nature. One of Cortana's writers has stated that a large proportion of interaction, upon launch, was concerned with the sex life of Cortana (Fessler, 2017).

There are those that believe that the immediate danger in the development of AI is not that of our domination by robots but rather the dearth of diversity in the design phase. The percentage of US female students studying computer science has been steadily decreasing with 37% female in 1985, to just 18% in 2011. Some claim that this creates a dangerous situation because males are more concerned by the mathematical properties of algorithms, in deference to bigger questions such as that of benefiting humankind. This myopic viewpoint of AI development may lead males to design systems without regarding the perspective of minorities and of women. In a sense, like Dr Frankenstein, create a monster for the sake of science, without regard for the consequences. To address the imbalance, more diversity is required in the field of AI (Todd, 2015).

Although many assume that AIs are more rational and less biased than humans, they are designed by humans and these human biases can be introduced into the AIs. We should exercise great caution assuming that AIs will always make better decisions than humans. "There are racist algorithms and sexist ones. Algorithms are not neutral, but rather they perpetuate the prejudices of their creators. Their creators, such as businesses or governments, can potentially have different goals in mind than the users would have" (Vieth & Bronowicka, 2015, p. 6). Algorithms have the same biases as the general population. Bias plays a large part in society. A study has shown that a CV with a European American name has a 50% better chance of getting an interview than the same CV with an African American name. If algorithms are not programmed otherwise, biases such as these, will flow into the AI world. Sandra Wachter, a data ethics and algorithm researcher, has stated that, "The world is biased, the historical data is biased, hence it is not surprising that we receive biased results" (Devlin, 2017). Finally, because the process of AI decisions can have many layers of complexity, utilising millions of pieces of data, it may be unfeasible to eliminate bias (Internet Society, 2017).

12. THE AI ARMS RACE

Some claim that AI driven weapon systems are warfare's third revolution, with gunpowder and nuclear weapons being the first two (Autonomous Weapons: An Open Letter From AI & Robotics Researchers, 2015). Conceivably, once a major country (or even a minor rogue nation) decides to implement autonomous AI weapons, an AI arms race then becomes a certainty. The world must decide to prevent the arms race or to allow it. If an arms race ensues, Autonomous weapons will become ubiquitous. AI weaponry differs from nuclear weaponry in that nuclear technology is very difficult to obtain and develop and requires scarce resources. In stark contrast, Autonomous weapons will likely end up plentiful and easily attainable and therefore end up in the hands of terrorists and dictators to be used for all kinds of evil actions such as terrorism, assassinations, genocides, and the like. AI autonomous weaponry may reduce the threshold for entering into a war and thereby be a causal agent for increased rate of war (Autonomous Weapons: An Open Letter From AI & Robotics Researchers, 2015).

It may be that there is already a de facto AI arms race underway. The Chinese Government has set a goal of being a global leader in AI, releasing a cabinet statement that says, "By 2030, our country will reach a world leading level in artificial intelligence theory, technology and application and become a principal world centre for artificial intelligence innovation" (Peyton, 2017). This pronouncement will not have been overlooked by other nations, including those that border the South China Sea, and who already see China, the world's preeminent rising economic power, as a military threat. Baidu are looking to obtain support from the Chinese Military in a joint project to focus on "intelligent human-machine interaction, big data analysis and prediction, smart medical diagnosis, smart drones and piloting technology, as well as robotics technologies for military and civilian use" (Collins, 2015). Thus, a race is inevitable.

Harari agrees that an autonomous arms race is inevitable. He states that no nation can police AI and even if nations like the US chose not to develop autonomous weaponry, rogue states will (Harari, Yuval Noah Harari on the future according to Facebook, 2017).

There is a risk that AI could develop so quickly that there is no time to respond with regulation or controls. This is especially the case if advancement becomes automated. There is also considerable risk that the AI arms race could see shortcuts taken in their development leading to more dangerous and less controllable weapon systems (Global Challenges Foundation, 2017) and if the AIs are controlling conventional weapons, such as nuclear weapons, an existential threat to humankind.

12.1.AI instigated war

Could we see a fake news driven war? Musk claims that, "The pen is [still] mightier than the sword" and that theoretically an AI could trigger a war by using fake news, news releases and spoofed emails in a disinformation campaign perhaps to drive up stocks in the defence industry (Morris, 2017). Whether or not AI could formant a war it is probable that wars of the future will be fought with AIs as battles will be fought with autonomous weapon systems at such speed and with massive amounts of battlefield data that no human could control the battlefield.

12.2.Robots that kill

At present, robot warfare consists of devices such as drones and bomb detector robots that are remotely controlled. Future iterations will see fully autonomous weapons with robots able to independently make kill decisions (Krishnan, 2009, pp. 34,35).

One threat, identified in the report on Global Catastrophic Risks 2017, is that of AI autonomous weapons causing mass destruction. For example, if autonomous weapons were obtained by a rogue states or terrorists. Or if an AI arms race lead to an AI initiated war resulting in widespread destruction and significant loss of life. To ensure that these weapon systems were resilient to enemy interference they would be designed to be autonomous and resistant to attempts to shut them down and therefore, loss of control would be a serious possibility (Global Challenges Foundation, 2017).

12.3.AI Cyber Warfare

The internet has provided a platform for a new type of warfare – that of cyber warfare. Now AI will likely provide a more formidable way to wield this new weapon. In 2010 a new form of complex malware was discovered in Belarus by a cyber-security company enlisted to assist the Iranians with an ongoing disruption to Iranian computers. Stuxnet proved to be the first in a new type of weapon. It was the first digital weapon, designed not to cripple or disrupt computing, but to physically damage equipment. It had been specifically designed to attack Iranian nuclear centrifuges at the Natanz uranium enrichment plant and had succeeded in causing an unprecedented failure rate. The US and Israeli governments were claimed to be the originators of Stuxnet (Zetter, 2014; Whigham, 2016). The former CIA and NSA Director, Michael Haydon, has been quoted as saying that Stuxnet's appearance could be equated with the advent of the first offensive use of atomic weapons against Japan in 1945. He said, "This has the whiff of August 1945. Somebody just used a new weapon and this weapon will not be put back in the box" (Whigham, 2016). Alex Gibney, Director of the documentary on Stuxnet, Zero Days, warned that these new digital weapons have terrible potential to cause immense harm to humankind through such damage as causing power grid shutdowns (Whigham, 2016). Gibney noted that Stuxnet was a game changer in the digital world as it set a precedent that other nations would surely follow (Lauder, 2016). There are several important lessons to be learned from Stuxnet even though it wasn't an AI as such. One is a digital weapon arms race is most likely already underway, because of the advent of Stuxnet. Another is that code can be used to cause physical harm and the precedent has now been set. Another is that once it was released, it spread to many countries, apart from its prime target, Iran and was in essence – out of control. It even caused damage in the US, one of the supposed authors of Stuxnet. The fourth lesson is that the code of Stuxnet had become so complex, compared to malware before it, that it required the efforts of one or more nation states to construct it. In the future we will likely see AIs that can design and releasing malware, in cyber warfare scenarios and that these highly evolved and complex pieces of malware may be beyond the ability of humans to create, manage and control them. Perhaps, in the relatively near future, it may no longer just be in the realm of a science fiction movie that AIs could cause massive destruction and loss of life through use of digital weapons to interfere with infrastructure such as power grids, transportation systems and water supplies, albeit obeisant to human commands. Although it appears hyperbolic now, in the more distant future, a super intelligent AI may be able to independently undertake simultaneous attacks across many fronts and across wide geographical areas, even to the point of causing a near extinction event to human life.

13. BIG BROTHER WRIT LARGE

Whoever controls AI technologies will have the power to influence on a massive scale. Either to sway elections, to change opinions, to drive consumerism or for other purposes. This manipulation will be in many cases, undetectable and manipulate on an individual basis creating an "echo chamber effect" where the individual's opinions are reinforced and echoed back to them. The danger in this is that it polarises society, bringing division and separation and inadvertently destroying social cohesion in the process (Helbing, et al., 2017).

If Kant were alive today, he might tell us that the danger of a Government, or a big AI company, thinking that they can manipulate the populace as if a father, knowing what is best for immature children incapable of discerning good from bad, "is the worst despotism we can think of" and leaving us with "no freedom whatsoever" (Kant, 1983, pp. 72, 73). If we lose this freedom, then we also lose our rights under the law and democracy will not function effectively, if at all (Helbing, et al., 2017). Like the proverbial frog in the boiling water, it may be that AI is eroding

our freedoms by degrees. However, this is occurring at such a slow pace that there has been "little resistance from the population, so far" (Helbing, et al., 2017)

We may already be living in an Orwellian world with free thought disappearing, the masses manipulated by the few, using the tools of AI on a scale and with personalised detail not previously possible. Algorithms have increasingly powerful insights into us. They know where we work, were we go on holidays, what we like, what we don't, what we say online, what we buy, what we sell, our preferences in everything from sexual preferences to cinematic tastes to music tastes to religious beliefs. It is not a far stretch to see that AIs already have more insight than our closest friends and relatives. This has benefits. One is that recommendations for products and offers, such as holiday destinations, means that the online world is being increasingly personalised and therefore relevant for us (Helbing, et al., 2017).

AI is already able to write code to improve itself and when it reaches the stage that it can review all its own code and make revisions and improvements it will have surpassed humans. (Sharp, 2017)

13.1.Persuasive consumerism

Again, the Film, Minority Report showed scenes where external electronic advertisements recognised Tom Cruise's character, John Anderton, through retina recognition and addressed him vocally by name and offered him advertisements specifically tailored to him. In 2015 Facebook commenced feeding purchasing behaviour, user location and click history to commercial companies so that they could better target advertisements (Orlowski, 2015; Carson, 2017). In a sense we are being ever more controlled remotely by these developments and this power over us will increase as AIs improve and we will be less free as we are increasingly manipulated. Going further, "persuasive computing", also known as captology, is the programming of people. Humankind's ability to think freely and independently is being hijacked by AI. Thus, instead of humans programming the machines, the machines are beginning to program us (Helbing, et al., 2017; Sharp, 2017).

In 2016, one of the FTS100 (Financial Times Stock Exchange 100 Index) companies, Admiral Insurance company, planned to offer some new drivers cheaper car insurance based on using AI natural language processing algorithms to read Facebook entries to attempt to identify those with personalities that indicated a lower risk profile, as new drivers. There was public outrage and Facebook closed the project down 2 hours before it went live claiming that it breached its privacy rules. At the time, Facebook stated that the privacy of users was of paramount importance. Privacy advocates were glad to see it shut down but warned that this type of use of personal data would occur at increasing frequency. (Walsh, 2017; Ruddick, Admiral to price car insurance based on Facebook posts, 2016; Ruddick, Facebook forces Admiral to pull plan to price car insurance , 2016)A privacy advocate described it as "the tip of a very large iceberg that consumers and businesses are increasingly going to encounter. The challenge with these sorts of solutions is that users may find it increasingly difficult to avoid opting in as the financial disadvantage in doing so becomes so significant that users have no other option but to hand over access to their data" (Ruddick, Admiral to price car insurance based on Facebook posts, 2016). Jim Killock, Open Rights Group's Executive Director – agency setup to protect the rights in the digital age, stated that more thought needed to be given to the consequence of companies like Facebook being able to use social media to made decision about consumers based on their usage of social media. "Such intrusive practices could see decisions being made against certain groups based on biases about race, gender, religion or sexuality". (Ruddick, Admiral to price car insurance based on Facebook posts, 2016)

AI is already using sophisticated technologies to silently guide and influence how we live our lives, including our political persuasions, the goods and services that we buy and how we undertake our work. This is facilitated by the ubiquity and domination of search engines across the world such as Baidu in China and Google in the west and the domination of social media platforms such as Facebook. These colossal entities "can be used to nudge us towards political, social and commercial outcomes" (Sharp, 2017).

It may be that AIs are forcing us into a closed loop -AIs can predict our preferences, including likes and dislikes and they use this ability to match products and news to us. The AIs are then reinforcing our likes and dislikes and keeping us from alternate products, opinions and viewpoints. We naturally think that the things we are being served up, being reinforcements for our likes and dislikes, are our own choice. Although, in actuality, we are being manipulated (Sharp, 2017). As George Orwell noted, "the best books … are those that tell you what you know already" (Orwell, 1949, p. 253) and "so long as they are not permitted to have standards of comparison, they never even become aware that they are oppressed" (Orwell, 1949, p. 261).

A controversial example of persuasive computing is that of Cambridge Analytica (CA), who some believed help Donald Trump win the US election of 2016 and helped the Brexit Leave campaign to succeed (Anderson & Horvath,

2017). CA openly offers an AI service that uses data to design campaigns to change consumer and electorate behaviour, respectively, in the commercial and political worlds. (Cambridge Analytica, 2017) CA claim of themselves, "We are the global leader in data-driven campaigning with over 25 years of experience, supporting more than 100 campaigns across five continents. Within the United States alone, we have played a pivotal role in winning presidential races as well as congressional and state elections" (Cambridge Analytica, 2017). Although campaigns and marketing have existed for millennia to influence people, AI campaigns are different in that they identify individual's personality and preferences from their digital footprint and then target a campaign accordingly. According to the CEO of CA, they have personality profiles for all 200 million US adults that are increasing in accuracy as more data is collected. From these profiles they can determine how and why an individual makes decisions – a process he called: "behavioural microtargeting". From this they determine who the swinging voters are and then attempt to persuade those people. They claim that "using personality targeting, Facebook posts can attract up to 63 percent more clicks and 1,400 more conversions". Much of the persuasion consists of so called Facebook dark posts (Anderson & Horvath, 2017), also known as Unpublished Page post ads (Facebook, 2017) which only the targeted person can see. Researchers outside CA, who have examined Cambridge Analytica's activities during the 2016 Election "have unearthed an expansive, adaptive online network that automates the manipulation of voters at a scale never before seen in political messaging" (Anderson & Horvath, 2017). It is not hard to extrapolate from this that we are on the cusp of a revolutionary frontier of pervasive, invasive and manipulative marketing and control that we have never seen before.

13.2.The Big Nudge

AI is being used by governments who are trying to influence their citizens to live more healthily or to be more environmentally conscious through use of a "nudge", which could be considered as the latest iteration of paternalism. "Big nudging" – a euphemism for mass manipulation, is the use of big data to influence citizenry to desirable behaviours (Helbing, et al., 2017). To some this might appear as the perfect solution to many of society's ills. To be able to govern the masses and steer them in the direction that has the approval of Government. A big, caring brother. However, there is evidence that historical attempts to control opinions is destined to fail. With nudging, no one has the knowledge to manage and predict how to use manipulative AI tools wisely. What appears to be the right course of action later proves to be wrong in hindsight. The 2009 German Swine Flu epidemic saw the German Government encouraging its citizenry to get vaccinations only to see numbers of them suffer from narcolepsy consequently. A further example is that of health insurance companies that offer their members free fitness bracelets to decrease heart disease. Although the strategy might see a net decrease in heart disease, it could see a corresponding rise in hip operations. Because of the complexity of society, an improvement in one facet might lead to problems in another. "Thus, large-scale interventions can sometimes prove to be massive mistakes" (Helbing, et al., 2017).

Yuval Noah Harari, the author of the futuristic books, Homo Deus A Brief History of Tomorrow and *Sapiens: A Brief History of Humankind* has stated that there are reasons to fear AI. He gives the example that it is conceivable that Facebook could identify swing voters in the US election 2020 and determine what each of them needs to be told to swing their vote towards a particular candidate using big data (Harari, Yuval Noah Harari on the future according to Facebook, 2017).

Singapore is considered by some as a prime example of a controlled society. It has tightly controlled the use of the internet by its citizens with its sedition law and Internet code of practice law as well as Class Licensing Law which requires citizens to register their web sites if they intend to comment on religious or political issues regarding Singapore. The impact of the control extends to every aspect of Singaporean life including schooling, property, immigration and finance (Helbing, et al., 2017; Shin, 2012).

Baidu, China's major search engine provider with approximately 75% Chinese market share, is collaborating with the Chinese military on the China Brain Project which has been set up to study the brain, its diseases and, through studying the brain, to develop stronger artificial intelligence (Poo, et al., 2016; Helbing, et al., 2017; Tao, 2017). The Chinese Government's Social Credit system is using search data including social media and online shopping activity, and eventually many other types of metrics such as driving records, how pupils rate you (if a teacher), financial history, work place evaluations and data holdings by Chinese Government agencies, to assign each citizen a score. The higher the score the more access the person has to services such as car hire without deposit and other benefits. Some are using social media to boast about their high scores and there is a web site where Chinese citizens can view each other's scores. If the Chinese Government pushes ahead with an amalgamation of all the metrics they will have a comprehensive picture of the digital footprint of each citizen that they can make use of outside the financial realm (Hodson, 2015)

13.3.1984 – AI think

If algorithms are increasingly influencing decisions at a deep psychological level and on a personal basis we risk finding that the populace has become brainwashed. In a sense we could become automatons ourselves, predictably responding to stimuli. The personalised and targeted influences creating "a "filter bubble" around us, a kind of digital prison for our thinking" (Helbing, et al., 2017). Independent thought, creativity and "out of the box" thinking would diminish. A centralised super intelligent system that was impelling desirable behaviours and attitudes could become an all-pervasive dictator with knowledge and power never seen. Big Nudging is an attempt to control on a massive scale and is perhaps a first step towards a digital dictator (Helbing, et al., 2017). Not unlike 1984's Big Brother but writ large but with immensely more power and influence and control of each individual's thought life.

14. IS IT ALL JUST HYPE?

Some consider that AI has a bad reputation for the art of exaggeration of its progress (Machine Intelligence Research Institute, n.d.). According to Gartner, machine learning is at the peak of its Hype Cycle for Emerging Technologies, but, conversely, only 2-5 years from mainstream adoption. Smart robots and virtual personal assistants are 5-10 years away from adoption. Whereas Artificial General Intelligence is still at the innovation trigger level, with widespread adoption still more than 10 years away (Gartner, 2016).

The 2016 OECD report into automation rates suggested a much lower rate of automation than that claimed by most commentators (Arntz, Gregory, & Zierahn, 2016).

The Obama Whitehouse produced a report that stated that according to the consensus of experts from the private sector, AGI would not be achievable for decades (Executive Office of the President National Science and Technology Council Committee on Technology, 2016). One of the primary reasons that AI is the subject of much hype and fear is that there is a great deal of ignorance of the subject matter. This is unsurprising as the field of AI is so vast and so complex and so difficult for the non-initiated to conceptualise. For example, the thought that robots could take over someone's job seems easy to accept when considering manual labour such as factory work or agriculture or transport work such as taxi, bus, train, ship and trucking. However, if one were to consider a robot undertaking a white-collar job such as an actor, a journalist, a therapist, a teacher, a middle level manager or a lawyer, it is much more difficult to accept. Notably, there are examples of all the white-collar occupations being undertaken by Artificial Intelligence already (Tynan, 2017).

There is a market perception that IBM's Watson has failed to live up to the hype. Chamath Palihapitiya, CEO of Social Capital (a Venture Capitalist fund), has claimed that "Watson is a joke, just to be completely honest" (Darrow, 2017). Frustratingly for IBM, in the health care sphere, which is one that IBM has targeted, the M.D. Anderson Cancer Center has recently ceased using Watson. The problems that Watson experienced was that it had been overhyped and that it needed quality training data to become effective. Training data is in short supply and difficult to access. This problem is not unique to IBM but a challenge for all AI companies. Palihapitiya stated that other AI companies were advancing AI development more effectively than IBM (Darrow, 2017)

Nevertheless, IBM Watson in 2016 had clients in 45 countries and was experiencing 300% annual growth rates in usage of Watson (Rometty, 2016).

AI is either claimed to be the greatest technology ever, or the scariest, and thus far, it has been underwhelming in both regards. However, one should not ignore actual progress and potential of AI because of hype (Darrow, 2017; Armstrong, 2017). The environmental conditions now exist to see dramatic advances in AI. Many companies are incorporating AI statements into their strategic plans. AI is still immature and therefore there is a lot of hype. Indeed, one commentator claims that most of the AI being touted by companies is only narrow algorithms and not complex AI, which can self-learn and self-modify. (Sharp, 2017).

The AI winter truly ended around 2010 when the convergence of three factors occurred. One was that computers were being built that were sufficiently powerful to handle the massive computations required for AI. Second was that big data was becoming available from many sources including Government, Social Media, Science and the business and commercial worlds. The third was that big data could be used to train AI algorithms and that the algorithms then became much more accurate. Many experts were taken by surprise at the rate of advancement. An example was the ImageNet Large Scale Visual Recognition Challenge. This challenge showed in 2011 that AIs had an error rate of 26% compared to the human error rate of 5% in identification of images. By 2015 the AI error rate was better than the human error rate at only 3.5%. At this time big companies like Google and IBM, as well as many others, were

telling the market place that they were making AI their number 1 business focus (Executive Office of the President National Science and Technology Council Committee on Technology, 2016)

Walsh, a Professor of Artificial Intelligence, at the University of NSW, has written that the amount of venture capital in AI is increasing by 50% per year as are acquisitions of AI start-ups (Walsh, 2017). AI patents are increasing exponentially (Hoffman, 2016; Walsh, 2017). The financial stakes for companies involved in the race to develop AI are enormous. Billions are being invested by the big tech companies, as well as by many smaller and start-up companies. Companies see that AI is a realistic opportunity and AI will begin to pay off for some. Forrester claims that AI will see a 300% increase in investment in 2017 (Press, 2016). The huge amounts of investment lend credence to the viability and future of AI (Sharp, 2017).
Andrew Ng, former Chief scientist at Baidu, has stated that "Whoever wins artificial intelligence will win the Internet in China and around the world" (Lococo & Womack, 2014).
With the current market competition and massive investment in AI, it appears unlikely that there will be another AI winter, albeit, AGI and superintelligence may prove to be more challenging that currently thought and therefore may still be many decades away.

15. THE AI WILD WEST– THE CURRENT LACK OF REGULATION

There is currently no universal regulation of AI and regulation may be improbable in the near future. "The world's various legal systems and legislatures have little or no basic understanding of the problems and are not equipped to anticipate and regulate" (Sharp, 2017). Unfortunately, humanity has not always proven to be effective at collectively co-operating on issues as important as climate change or dealing with world poverty and other crises and this does not augur well for ensuing that AI development is done in a safe manner (Sharp, 2017). Sharp warns that "by the time that Governments realise they need to legislate, it will already be too late" (Sharp, 2017). Musk has stated, "AI's a rare case where we need to be proactive in regulation, instead of reactive. Because by the time we are reactive with AI regulation, it's too late,", he further illuminated the point by comparing regulation of other industries with that of regulating AI declaring that "AI is a fundamental risk to the existence of human civilization, in a way that car accidents, airplane crashes, faulty drugs, or bad food were not" (Stapleton, 2017).
Musk was emphatic that although he was opposed to overregulation, he believes that it was crucial that there was regulation and that it should be put in place as soon as possible (Morris, 2017).

15.1. REGULATED AI

Perhaps the most important question about AI is whether policy makers can put in place controls to ensure that we reap benefits from AI and avoid the risks. There is resistance to regulation of the AI industry as some see it as stifling innovation such as Andrew McAfee, who co-authored the Second Machine Age and said that it was "too early for explicit AI Policy" (Brundage & Bryson, 2016, p. 1). Demis Hassabis, founder of Deepmind, the company that developed AlphaGo which defeated the world's top Go player, Lee Se-do, has said that although there are real concerns that should be examined and debated before AI advances in the decades ahead, that it is too early for regulation as it's too early in the development cycle and no one knows what needs to be regulated (Hassabis, 2015). However, AI is already a mature technology impacting many people's lives – for example – the world's two most popular smart phone manufacturers have both sold more than 1 billion smartphones each (Reisinger, 2017). Policy need not interfere with development but can be crafted to facilitate innovation e.g. by enforcing industry standards. Neither does the technology need to be fully matured before policy can be shaped. Policy would be the summation of what is acceptable to society and what is not. Examples of issues that will need to be worked out include liability for injuries with driverless cars – determining where responsibility rests throughout the supply chain from design to implementation. Another issue is that of the development of autonomous lethal weapon and robot systems and whether these will be permitted under international agreement. Another issue is the misuse of AI by the owners of the AI or by individuals in areas such as privacy and bias. Another issue is managing the impact on humans of unemployment because of AI replacing jobs. How can AI be made to benefit all of humankind rather than just the few that control AI companies or the already rich (Brundage & Bryson, 2016; Amodei, et al., 2016).

15.2. Can AI realistically be regulated?

To ensure that AI benefits humankind, AI development should be undertaken in a planned manner, ensuring that the benefits are spread equally. Governments should regulate to ensure that no one Technology company is in the position to monopolise from the rise of AI. No single company should have machine learning applications, access to big data and robotics. Of course, there are already several companies that have these three elements. Google has some of the most advanced AI applications in the world, access to massive data stores on a large percentage of the population of earth and is also developing robotics. The potential exists for Google (and others) to become immensely powerful on a scale never seen (Munoz & Naqvi, 2017, p. 10). Whether it is at all possible to regulate AI is becoming the great challenge of our age.

15.3. Are the Skynet Terminators coming for us?

There are some, well versed in AI, that warn of a dystopian future for humankind at the 'hands' of AI. Sharp claims that "the dark pop culture depictions of Hal 2000 or Skynet would not necessarily be pure fantasy" (Sharp, 2017). Steve Wozniak, co-founder of Apple, believes that the future of AI would be both frightening and very detrimental for humans, that AI may get rid of slow humans to improve efficiency of companies and that, in an extreme scenario, humans may be relegated to pet status (Helbing, Societal, Economic, Ethical and Legal Challenges of the Digital Revolution: From Big Data to Deep Learning, Artificial Intelligence, and Manipulative Technologies, 2015). Bostrom, in his well-respected book, Superintelligence, warns that, "once unfriendly superintelligence exists, it would prevent us from replacing it or changing its preferences. Our fate would be sealed" (Bostrom, 2014, p. v). Musk has warned, referring to Google, that even the best of intentions could "produce something evil by accident", perhaps with the creation of "a fleet of artificial intelligence-enhanced robots capable of destroying mankind." Some dismiss Musk as a naysayer for AI (Dowd, Elon Musk's Billion-Dollar Crusade To Stop The A.I. Apocalypse, 2017), including Mark Zuckerberg, who disagrees with the warnings from Elon Musk, "I think people who are naysayers and try to drum up these doomsday scenarios — I just, I don't understand it. It's really negative and in some ways I actually think it is pretty irresponsible" (Clifford, Facebook CEO Mark Zuckerberg: Elon Musk's doomsday AI predictions are 'pretty irresponsible', 2017). Chief Microsoft Research Scientist Horvitz has stated, "There have been concerns about the long term prospect that we lose control of certain kinds of intelligences… I fundamentally don't think that's going to happen" (BBC, 2015).

Nevertheless, Musk claims, "On the artificial intelligence front, I have access to the very most cutting edge AI, and I think people should be really concerned about it" (Morris, 2017). There is a viewpoint that states that a super AI would be beyond the ability of humans to control or understand it. If it had control of critical systems such as power grids, water supplies etc. the results could be catastrophic with humans no longer controlling their own destiny, and, in the worst-case scenario, the rise of a super AI could be the cause of an extinction event (Executive Office of the President National Science and Technology Council Committee on Technology, 2016).

16. The Dystopian Future of AI?

Elon Musk has proposed that AI could get out of control. He posits that if we were to create:

> a self-improving AI to pick strawberries and it gets better and better at picking strawberries and picks more and more and it is self-improving, so all it really wants to do is pick strawberries. So then it would have all the world be strawberry fields. Strawberry fields forever. No room for human beings (Dowd, Elon Musk's Billion-Dollar Crusade To Stop The A.I. Apocalypse, 2017)

The British television series Black Mirror, which has as themes, dystopian outcomes of the use of technology, presented the use of mixed reality in its' episode called "Men against Fire" (Verbruggen, 2016). The story involved a group of American soldiers who were tasked with exterminating mutated humans that they called "roaches". Each soldier had a neural implant that augmented their natural senses and supressed others, such as the smell of death and blood. They could visualise data pertinent to the mission including maps in 3D of the battle field. Their dreams were also influenced and controlled by the implant as was their perception of their surroundings. Importantly, they see the "roaches" as zombie in appearance with disfigured faces and distorted voices. During a battle, the main character's neural implant is disabled, and he discovers to his shock, that the "roaches" are just normal civilians and not zombies at all. The neural implant has been using augmented reality to alter the appearance and voices of the "roaches" to demonise them and to make it easier for the soldiers to kill them (Verbruggen, 2016). Although this process was

achieved in the episode using mixed reality, the demonization of a segment of society is a technique used in conflicts, throughout the ages, to unite one people against an enemy people. The most notorious example of this being the Nazi demonization of the Jewish people, beginning in the years shortly before the Second World War. Jews were described in Nazi propaganda as sub humans - as inferior to the German people. This had an impact of dehumanising the Jewish people so that the regime was able to enlist its people to participate in the attempted extermination of the Jewish people. (Kershaw, 2014; Goldhagen, 2007, pp. 8,38). One of the enduring problems that armies face is a reluctance on behalf of some of the soldiers to fire their weapons and to shoot to kill. There is historical evidence, albeit not without dispute, that most soldiers either do not fire their guns in battles or aim to miss, because of an aversion to killing (Grossman D. , 2014). The temptation to override this instinct may be a driver in use of augmented soldiery of the future. Although today this may seem far-fetched, DARPA, the US Defense Advanced Research Projects Agency, is already working on a project to implant an interface to connect the human brain to the cloud and provide a capability to augment the brain's capacity to visualise, to assess large amounts of data and to control warfare machinery such as jet fighters, at higher speed. As well they are working on expanding human capacity to retain knowledge (DARPA, 2017). Thus, AI has the potential to provide new ways to manipulate people and their perceptions in ways not previously possible. In the fictional account in Black Mirror, it was to dehumanise the target population in the eyes of the soldiers thereby increasing their killing efficiency. In fact, manipulation of perception is what augmented, virtual and mixed reality are all about. The Black Mirror episode finishes with the protagonist returning to a dilapidated home which is covered in graffiti. However, he perceives it, with his neural implant reactivated, as being a beautiful home, complete with an attractive partner who does not exist in the real world. The implant has erased all the unpleasant memories of the war. In effect, he is living a manufactured lie. He has become a zombie of the state.

Sir Clive Sinclair has stated that once AI overtakes human level intelligence that human survival will be difficult and that this advent is an inevitability (BBC, 2015).

16.1. A Dystopian World of the Haves and the Have Nots

The AI industry, which already is dominated by a small pool of powerful, global IT companies such as Google, Amazon, Baidu, Microsoft etc. has the potential to continue to concentrate power for these companies. This may "lead to greater inequality within and between societies. Inequality may also lead to technological distrust, particularly of AI technologies and of the Internet, which may be blamed for this shift" (Internet Society, 2017).

16.2. The Emergence of Smart Cities

More than 50% of the world's population now lives in urban centres, with this et to increase to 66% within 30 years. The concept of the Smart City (also called the Smart Sustainable City) is intended to address the challenges posed by this urbanisation trend. The challenges include maintaining and improving quality of life for the inhabitants, ensuring that there are sufficient and sustainable resources, dealing with increased pollution, poverty and social stress. Some assign 6 dimensions in defining a Smart City: Smart Economy, Smart Environment, Smart Governance, Smart Living, Smart Mobility and Smart People. One definition of the Smart City is a city that innovatively uses technology and other measures to, "improve the quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects" (Ibrahim, Adams, & El-Zaart, 2016, p. 8). AI is a major enabler of smart cities.

Local governments, developing smart cities, are using real-time data collected from systems and sensors, along with AI, to enable the smarter use of assets and resources. AI helps city planners understand how citizens are using the facilities, resources and infrastructure with an aim to improve and optimise usage as well as increasing public safety. The first transformation required for a city to evolve into a smart city is in the improvement of collecting and monitoring data. Quality data is essential for quality results and AI is the tool that is facilitating this. Metrics that can be collected, measured and analysed include transportation data from trains, buses, cars and traffic sensors; rate and taxation information; police monitoring and reports; weather reports, and video and photo monitoring. AI systems can process and make sense of the massive amounts of data, analysing and identifying trends and patterns, counting pedestrian and vehicle numbers. Several companies have AI offerings specifically designed to assist local governments in developing smart cities (Walker, 2017).

The Australian Government is one government that is pursuing the take up of disruptive technologies in a drive to develop smart cities. AI is delivering smart technology which will revolutionise communications, transportation and energy use. Their philosophy is to consider technology solutions first, to make best use of real time and other data and to use technology to drive energy efficiencies (Department of the Prime Minister and Cabinet, 2016).
The rise of AI may see some of the smart cities evolving into self-governed city states. These advanced cities will see greatly increased standards of living for a decreasing number of people as many jobs disappear. Use of technologies such as block chain currencies like Bitcoin may see these cities becoming independent of central governments. The displaced workers will migrate to the less technologically advanced cities resulting in overcrowding, increased poverty, hopelessness and eventually civil unrest. Correspondingly the best and brightest workers, as well as the wealthy, will leave the less technologically advanced cities for the AI cities. To dismiss outcomes such as these as being dystopian and claiming that history repeats itself so therefore this will not occur does not take into consideration that artificial intelligence is uniquely capable of change on a scale never seen (Munoz & Naqvi, 2017). This may happen on an international level and see a congregation of wealthy and clever people to AI centres such as Silicon Valley. This may disrupt society in a variety of ways including possible outbreaks of civil unrest, widespread litigation against AI companies, exponential growth for an elite group of the super-rich and powerful class, increased wars and creation of an underclass with increases in mental disorders and a subsequent increase in suicides and addictive behaviour – e.g. drug and alcohol abuse.

17. The Utopian Future of AI?

Not everyone thinks that the future of AI is a dystopian one. Mark Zuckerberg, CEO of Facebook, is one who sees a bright future in AI as does Google's Eric Schmidt, who has downplayed fears of the rise of AI claiming that it, "will ultimately be one of the greatest forces for good in mankind's history simply because it makes people smarter" (McFarland, 2015).

17.1.Assistive AI technologies

Building environments that can improve the quality of life of those that are living with a disability is one focus of AI development. Aims include increasing a person's autonomy and reducing need for care givers. However, the diversity of the disabilities and the circumstances make solutions challenging and limit the ability to create universal solutions (Albrecht, et al., 2016). Virtual reality is being used successfully to assist with recovery from stroke rehabilitation (Fonseca, Silva, & Pinto, 2017); traumatic brain injury (Straudi, et al., 2017); mental disorders (Eichenberg & Wolters, 2012); addictions, phobias and motor rehabilitation problems (Lutz, et al., 2017). Augmented Reality is being used in the classroom to teach in ways that traditional teaching cannot (Leighton & Crompton, 2017). It is being used by surgeons and doctors (Androl, 2016). It is being used in manufacturing, military and in entertainment as well as tourism and architecture (Manuri & Sanna, 2016). AR and VR are evolving into multi-billion-dollar industries and KPMG predict that VR will be a mass market product by mid-2019 and AR by mid-2021 (KPMG, 2016).
The world's population is shifting from one that is predominantly young to one where there are a significant number of people over the age of 65. This change will see a shortfall in younger people available to assist the older population. AI has the potential to assist, for example with enabling aging persons to remain independently living in their homes longer. Some examples of AI technologies that can be used include text to speech for those with low or no vision; wheelchairs with automatic obstacle avoidance and home-based robots that can assist with household duties (Pollack, 2005).
In the Hitchhiker's Guide to the Galaxy, Douglas Adams described the Babel fish as being a "small, yellow, leech-like, and probably the oddest thing in the Universe" (Adams, 1979). It served as an in-ear translator that could translate from any language in the Universe to the wearer's native language. Although this concept was only a satirical vision of the future AI has today achieved a Babel fish like capability (albeit limited to only 8 languages at present). An Australian company has invented a device called the Translate One2One earpiece that uses IBM's Watson to translate on the fly from 9 different languages including English, Japanese, French, Italian, Spanish, Brazilian Portuguese, German and Chinese. Coupled with an app it can also translate text (Watson, 2017)
Much of the AI development that is being undertaken by military organisations will provide many benefits to enhance the lives of those with disabilities. The United States Defense Advanced Project Agency (DARPA) launched its Brain Initiative in 2013 and is looking at the following areas of research: using injectable Nano technology to

accelerate the body's natural healing processes; restoring loss of sense of touch; providing greatly enhanced prosthetic limbs; providing new memory capabilities; restoring the ability to recover memories in those that have suffered brain injuries and implants to treat and cure those that are suffering from neuropsychological illness (DARPA, 2017). Robotic technology and AI is seeing disabled soldiers returned to the battlefield. Not only is AI being used for disabled soldiers, but ordinary soldiers will be increasingly augmented with AI technology creating Cyborg super soldiers (Satheaswaran, 2016). Women, who average 30% less muscular strength than men, will be able to match the strength and ability of men with the use of exoskeletons (Grossman L. , 2013)

17.2.Getting better all the time

Tourism is already benefiting from AR with tourists able to interact with multimedia and content. Augmented tourist guides can locate and book travel for the tourist as well as guide the tourist and overlay content and commentary on the way (Manuri & Sanna, 2016). An early example was Tuscany + which displayed information balloons in English or Italian as they walk around Tuscany. The balloons contained information on sightseeing with directions and distances to sites; details on hotels and accommodation with reviews; details on restaurants and eateries including reviews; entertainment options as well as transportation options. The information is taken from Internet sources such as Wikipedia and Wikitravel (Barbara, 2010). In another type of AR for tourists a puzzle or mystery is overlayed the locations and the tourist has to solve the puzzle before moving onto the next clue\location. This is known as space gamification and it adds a new dimension to the tourist experience (Manuri & Sanna, 2016, p. 23). Virtual reality could be used to allow a visitor to 'visit' a heritage site, without physically travelling there and to have access that is normally off limits such as moving in amongst the stones at Stonehenge or moving through the Parthenon in Athens or 'climbing' the Great Pyramid in Giza or to climb Uluru in central Australia. VR could enable those, that are physically unable, to visit tourist sites or to participate in activities that their disability prevents them from experiencing. AR could be used to 'restore' the elements of ancient structures that have disintegrated through antiquity or have been removed to a museum, such as controversial removal of the Elgin Marbles of the Parthenon to the British Museum (Trustees of the British Museum, 2017). Visitors to the Valley of the Kings could visit the tomb of Tutankhamun and see all the treasures, using AR, which were removed to the Egyptian Museum, 'restored' to their original location in the tomb. Visitors to Babylon could see the ancient hanging gardens of Babylon as they may have appeared.

18. TRANSPARENCY OF AI DECISION MAKING

Will it be possible to determine how a machine has made a decision given its complexity? Lack of transparency is a concern as, "many current AI technologies are black boxes, unable to explain how they come to particular decisions" (Walsh, 2017, p. 6). An example of the problem is how deep learning, which feeds big data through multiple layers of AI neurons triggering the next layer of neurons in neural networks to make decisions to perform task as diverse as detecting cancers, providing insurance quotes and predicting crime. These decisions cannot be easily explained. Examining the neural networks, the individual trigger decisions and the data used does not suffice as explanatory (Walsh, 2017).

19. THE UNWITTING SACRIFICE OF PRIVACY ON THE ALTAR OF CONVENIENCE

In the past, less complicated world, consumers had the option to opt into or out of a commercial company's use of their data. With the rise of AI, the option of opting in or out is becoming increasingly irrelevant as to whether personal data can be accumulated. Unbeknownst to the consumer, with data matching and AI tools, detailed and extensive profiles can be built up on anyone that has a digital footprint.

The University of Cambridge has designed an (AI) personalisation engine that can read human digital footprints and thence predict physiological traits. For example, if given access to a person's Facebook 'Likes', it can predict gender, personality traits e.g. whether conservative or liberal; level of intelligence; life satisfaction level; political orientation, religious orientation, sexual preference, education background and relationship status. The profiler can also use Twitter and Facebook posts. (University of Cambridge, 2017). The profiler provides a detailed insight into the person without having accessed traditional personal data.

Even children's toys have become a frontier of the assault on privacy. Hello Barbie and My Friend Cayla both use AI to engage in conversation with a child, prompting them to disclose personal information about themselves. This is

recorded and stored in the cloud. There is also an app for Hello Barbie to allow parents to listen in to the conversations (Taylor & Michael, 2016, pp. 8,9; Chipi, 2017).

On the erosion of our privacy, Governments and businesses have access to AI insights about our lives that are unprecedented. The potential for AI to introduce a Big Brother system is a real threat (Walsh, 2017). As an example, consider how personal information was gathered about individuals prior to AI. It was through paperwork, through interviews and research and even through extreme measures such as spying and torture. Consider then having access to a person's digital footprint, including all their Internet searches, all their activity on social media, their purchasing behaviour, their travelling behaviour via Google Maps and other apps and all their other activities on the Internet. Unless the person was deliberately attempting to deceive or was carefully restricting their activities, the investigator would have an unparalleled insight into the person's beliefs, attitudes and personal data such as their physical movements, where they live, work and travel to, who their friends are, what their political beliefs are, their religious beliefs, their relationship status, their private sexual behaviour, their dietary habits, their purchasing behaviour, whether or not they owned their home – the list is exhaustive. The Global war on terror is just one of many pressures on Governments to circumvent the privacy of their citizenry. There is arguably no greater tool than AI to track and identify terrorists and will citizenry forgo their privacy for greater security? Is it ok that it is AI algorithms doing he tracking and not humans? (Walsh, 2017).

In 2015 Edward Snowden released documents describing a British Government operation (Government Communications Headquarters -GCHQ) with the code name "Karma Police". Its raison d'être was to record the Internet behaviour of "every visible user on the internet" (From Radio to Porn, British Spies Track Web Users' Online Identities, 2015). In other words, an attempt to spy on every internet connected person on earth. The data collected included web searches, use of Internet radio, Skype calls, text messages, social media activity, cell phone locations and use of Google maps, across more than 185 countries. The data was stored in a data repository called the "Black Hole". By 2012 there were more than 50 billion records being collected daily. GHSQ used massive scale, AI data mining techniques to detect patterns and suspicious behaviour (From Radio to Porn, British Spies Track Web Users' Online Identities, 2015). The ability to surveil people on massive scale, with an unprecedented level of detail, and to analyse the collected data expeditiously is only possible with the advent of both the Internet and AI.

The rise of AI sees the paradox of AI being used to erode privacy as well as likely being used to protect privacy. A means should be made possible for consumers to have access to any personal data held by AI companies and for them to be able to challenge those records (Helbing, et al., 2017). It may be improbable that this will occur unless there is universal international action to introduce regulations as AI companies prize the secrecy of their algorithms and big data holdings. Added to this is the growth of power of many of the international global companies that can use local laws to their advantage and have extensive legal teams to defeat attempts to make them transparent. For several reasons, including the complexity and speed with which AI is developing, as well as the immense power and influence these multinational companies wield, local Privacy advocates, whether government or private, face an uphill battle to defend the privacy rights of consumers.

Given that many "have resigned themselves to a world where cyberattacks are par for the course, and any expectation of privacy is readily sacrificed for the convenience of an internet-connected existence" (Chipi, 2017), it is arguable that there exists for many, an ostrich in the sand approach to the loss of privacy. Reasons for this may include the desire for convenience, a lack of knowledge of the consequences, naiveté, the speed of change and the ubiquitousness of AI. For example, many social media users believe that they ultimately control who has access to their information on social media platforms such as Facebook. The reality is not the case (Munn, 2017). Many follow the fallacious mantra that if they are personally not doing anything wrong, then they have nothing to fear from the loss of privacy (Walsh, 2017). Contrastingly, Microsoft's chief scientist, Horvitz, has claimed that, "that machine learning, reasoning and AI more generally will be central in providing great tools for ensuring …privacy" (Bentley, 2015).

20. The Rise of Humanoid Robots and AIs

Anthropomorphobia is the fear of seeing human characteristics in non-human entities such as robots. This can take the form of looking human in appearance or behaving and thinking as a human. Humans are not affected universally in the same way – what one person finds confronting may be quite acceptable to another. Mensvoort states that the fear can be triggered by an entity failing to be human enough or to undermining of what it means to be human and a fear of inadequacy. Many people will be very fearful about the proliferation of humanoid robots into general society. Without careful consideration of the impact, widespread introduction of robots may be a causal agent for the

alienation of individuals (Mensvoort, 2011). One phycologist claims that there a "deep-seated fear of the almost human" (Gopnik, 2017).
Mori, an early robot designer in 1970, proposed that there was a point at which a human like robot reaches a stage of likeness where only subtle deviations remain in behaviour and appearance from humans and this could be the cause of feelings of revulsion. He also postulated that the closer the robot appeared to human likeness the more that humans would instinctively react to it as human… That robots that are too life like would make people fearful. He proposed that robot designers stop short of complete likeness to avoid this – so that a robot will always look like a robot (MacDorman & Ishiguro, 2006, pp. 299,301,303). However, the drive to produce realistic humanoid robots will Digital characters have been appearing in the movies for some time. Computer generated graphics is being used to replace deceased actors and their voices in movies. AI is being used to animate large groups of people or beings independently, as was done in The Lord of the Rings Trilogy. The deceased actors, Carrie Fisher and Peter Cushing, were both recreated in the Star Wars Rogue One movie. It is conceivable that AI could advance to a stage where an actor's image is all that is needed for a movie and that Studios no longer need real actors (Esteban, 2017). Perhaps AIs will make use of big data to and construct artificial actors based on the measured likes and preferences of the populace. AIs may even work in movies so that a person's own image appeared in the movie as the protagonist or that a viewer, with VR goggles perhaps, could watch one movie and chose to see the protagonist as a different person or gender or age or ethnicity simultaneously, as well as have them speak in their native tongue, whilst others also watch the same movie at the same time, in the same place with their own tailored modifications.

21. Freedom from Brainwashing and manipulation

Advertisements must clearly identify themselves as such and not mislead. Use of manipulative techniques such as subliminal suggestion and other trickery should be prohibited. Personalised pricing is also problematic and discriminatory. The increasing and widespread collection of personal data to use in manipulation technologies is not compatible with personal privacy (Helbing, et al., 2017).
Even Terms of use statements manipulate consumers by offering dozens or even a hundred pages that can be accepted with one click, supposedly with their informed consent. The ratio of people which read these terms and conditions is very low. So, the majority are opting into sharing their personal data for all kinds of purposes that they are not aware of. (Helbing, et al., 2017). On a bigger scale, consumers are being exposed to manipulative techniques targeting millions of consumers with no transparency or opt in mechanism and with no regard for ethical behaviour (Helbing, et al., 2017)

22. Ethical AI

There is no universal consensus on ethics and this also applies to the use of AI, especially given its complexity and its relative newness. Discussion is taking place at international level regarding whether AI weapons are lawful and whether they are ethical – not mutually inclusive terms. A weapon can be lawful but not ethical. One argument holds that it would be moral to use autonomous weapons if it eliminates or reduces harm for example if an autonomous system could obey legal rules more effectively than humans. A counter argument is that taking human life human dignity would be affronted by the taking of human life by a machine, that humans would find the concept of an autonomous machine deciding to take a life as being reprehensible in the absence of human intent. There is also discussion centred around decisions made by machines without emotion not necessarily making better decisions in the absence of emotions and the counter that machines would not be influenced by emotions like fear and anger that cloud battlefield judgement. Another view is that the side with less access to autonomous weapons may resort to increased targeting of civilian populations as reprisal. There are some that believe AI warfare could see an increase in conflict. In summary, there are ethical arguments both against autonomous weaponry and in favour of it (UNIDIR, 2015, pp. 4-8; Arkin, 2010). Also, where does the liability lie when a machine does kill indiscriminately – with the general deploying the machines? With the soldier issuing its initial instructions; with its the programmers or those who constructed it? Or perhaps with the machine itself – if it were sentient? It is likely that nations will invest a great deal of time and effort into building counter measures against autonomous weapons and this process will influence those that construct autonomous weapons to increase their lethality. Will an autonomous weapon accept the surrender of enemy combatants?

One body that is researching the ethics of algorithms is the Centre for Internet and Human Rights. Some of the issues that they have reported on include that algorithms keep some information from us as the algorithm decides what to promote and publish to us and what to keep and censor from us. An example they give is that of AIs used for hiring. The AI decides who gets an interview, and although the AI may not have all the human biases they may introduce unintended bias of their own. Another cited example is that of Facebook. Facebook uses algorithms to determine what information to display to us and what to withhold. Unfortunately, many algorithms and the big data they are used on, are becoming so complex that it is beyond human capability to understand them, including those of the programmers designing them (Vieth & Bronowicka, 2015).

Increasingly algorithms are used to make subjective decisions, such as when there is no 'right' or 'wrong' answer. In the past, these decisions were being made by humans, but many are now being made by AIs. An example is algorithms used on dating sites to match couples together (Vieth & Bronowicka, 2015).

The IEEE report, titled Ethically Aligned Design states that the 3 highest level ethical concerns that should drive AI design are to, "Embody the highest ideals of human rights", "Prioritize the maximum benefit to humanity and the natural environment" and "Mitigate risks and negative impacts as AI/AS evolve as socio-technical systems" (IEEE, 2016, p. 5). It is imperative to building ethics into algorithms, otherwise AIs will make unethical choices by design (Internet Society, 2017).

The UK Engineering and Physical Sciences Research Council has published an illuminating set of ethics principles for those involved in AI design and use:

1. Robots are multi-use tools. Robots should not be designed solely or primarily to kill or harm humans, except in the interests of national security.
2. Humans, not robots, are responsible agents. Robots should be designed; operated as far as is practicable to comply with existing laws & fundamental rights & freedoms, including privacy.
3. Robots are products. They should be designed using processes which assure their safety and security.
4. Robots are manufactured artefacts. They should not be designed in a deceptive way to exploit vulnerable users; instead their machine nature should be transparent.
5. The person with legal responsibility for a robot should be attributed.

(Boden, et al., 2010)

23. Future Education

AI will be likely be massively disruptive to education. AI assistants are already being used in education. The aforementioned Georgia Tech University's virtual teaching assistant is one of the earliest examples of what will be an increasing move to use of bots in education. Consider the start-up, Osnova, a New Zealand company, that has built an AI to provide personal maths tutoring to students. In their advertorial material, they claim that they have modelled their teaching assistant, whom they call Amy, on a human tutor. They assert that the strengths of their AI rests in its ability to determine the skill level of the student and to adapt and specifically tailor the training accordingly (Osnova, 2017). Extrapolating, the future is likely to see a proliferation of these training AIs. Theoretically, an AI might follow a student from infancy throughout their life time, tutoring the student from kindergarten through to university level subjects and onwards to adult education classes. Once a AI has been trained to be an effective tutor, new subjects could be added, creating a one stop education shop. An advantage of an approach like this would be the concept of a lifelong relationship – of an AI that understood your learning strengths and weaknesses and perhaps could act as a life coach or even proactively suggest appropriately personalised learnings based on the student's preferences and strengths. It may be that the AI could 'attend' or access live training events with or without the student, recording the training and then reinforcing it. Ubiquitously available, traditional classroom hours and attendance may no longer be required. The assistant could make use of alternative realities, such as virtual reality, augmented reality and mixed reality, to train the student, depending upon the most effective of the technologies, according to the student's personality. Coursework and collaboration with fellow students could be undertaken using online tools or even hologram or advanced video conferencing techniques. The AI might match the student with complementary students further enhancing the training experience. The AI could use only the very latest and most relevant material – something that is a perennial challenge for educators. As a digital companion, it could augment the student, whenever required, providing recall of training years later if needed. The personality of the AI could adapt as the student ages, presenting an ever more mature personality. Perhaps testing instruments might change and a standard be agreed to assign a pass or grade, depending upon the judgement of the AI accessing the progress of the education populace. Many learning institutes might be threatened by the rise of AI and the education sector might see significant

reorganisation. For a hyperbolic illustrative purpose only, consider if Oxford university were to develop an effective AI assistant before Stamford University, it might be financially devastating for Stamford.

24. AI COMPANIONS

An associated topic to the AI training assistant is the AI companion or personal robot. In the fictional movie Her, the virtual companion is called Samantha and the movie focuses on the development of the relationship between Samantha and Theodore, her human user. Samantha evolves from being an organisational assistant that organises Theodore's life from his inbox and calendar, to becoming Theodore's virtual girlfriend. Overtime the AI becomes increasingly human-like in an apparent attempt by the AI to understand the physical world and to connect more deeply with Theodore. Theodore ends up becoming dependent upon this relationship, whereas contrastingly Samantha eventually becomes bored with the relationship and terminates it, as she has joined herself to other AIs. The movie reaches its conclusion with Samantha having achieved a form of singularity and Theodore having drawn closer to another human being, who has also been abandoned by their AI (Sejnoha, 2014; Salecha, 2016). Several lessons can be drawn from the movie. During the install of the operating system, Theodore chooses a female voice for the AI and the AI chooses a female name for itself and Theodore relates to the AI as if it were a female person. Although some may choose to relate to an AI as an 'it', many humans may feel the need to assign a gender to the AI\robot. Siri and Alexa are examples of AIs that have been given, by default, female names and voices (although Siri can use a male voice). Another lesson can be derived from observing how dependent Theodore becomes upon his relationship with Samantha, as she continues to develop and customise herself to Theodore. Eventually they begin speaking intimately to each other, indulging in sex talk and Samantha even attempts to 'consummate' the relationship by arranging a surrogate sexual encounter. That a human could became dependent upon the relationship with an AI appears to be a reasonable expectation of some future human AI relationships. Another notable lesson was that one of Theodore's female friends was initially repulsed by his relationship with an AI. This might be reflective of segments of societal reaction to individuals that form close relationships with AIs and robots (IMDB, n.d.). The movie was made in 2013 and Samantha's abilities seemed well advanced compared to what was available at the time. However, the years since the release of the film have already seen significant advances in natural language abilities. There would appear to be an enormous market for companion AIs and robots. Whether for companionship, as carers for the infirm and the young, and as romantic and sexual partners.

25. WHEN WILL THIS ALL OCCUR?

Some experts see AI surpassing human ability in most fields within the next 40 years (Sharp, 2017). One study, involving 170 AI researchers, showed that the median estimate of 50% was that artificial general intelligence would be achieved by 2040. The same group saw a high probability that super intelligence or the Singularity would be reached within 2 years (10% of group) - 30 years (75%) of the AGI i.e. between 2042 - 2070.

The same group, asked if super intelligence was a good or bad thing, responded with 41% suggesting it will be beneficial and 23% were neutral. 17% believed that it would be bad and the remaining 18% believed that it would be catastrophic or even pose an existential threat (Müller & Bostrom, 2016). From this study we can deduce that, in balance, AI experts tend towards seeing AGI and super intelligence as a positive, or at least benign event, for humanity. This is not to say that we should dismiss the concerns of the 35% who saw super intelligence as being a threat to humanity. For fully 1/3 of the group to see super intelligence as a bad thing should give reason for concern. We should acknowledge that there is inherent bias in asking AI researchers about the pros and cons of their industry, but this must be considered against the opinions of most people who not understanding AI, do not realise how much AI is already a part of their lives. Many have formed their opinions from negative or over hyped media stories and from dystopian visions of the rise of the robots. Indeed, an international survey of consumers identified that more than 70% have some fear of artificial intelligence and yet 84% have recently used AI – often without realising it (Pega, 2017).

Artificial Intelligence will dwarf the technological developments of the past 15 years. AI will become,

> the operating system for our brave new world. Its enablers will be processing power, mobile computing, billions of sensors, the cloud, data and analytics. And a host of other new technologies. AI is going to impact the workplace much faster and more significantly than most people think (Sharp, 2017)

26. Ensuring that AI is for the betterment of all

The AI for Good summit was held in Geneva in June 2017, as part of the research underway to prepare for the rise of AI. The goals of this drive for "AI Safety" include ensuring that the super intelligent machines of tomorrow have the same goals as humankind. They believe that we are approaching a decision point, a fork in the road and that choices are emerging. They state that AI should be designed and built for the benefit of all and not just for the few. However, the world is already dividing into those benefiting from AI's rise who will see even more wealth and prosperity. There are the many, living in poverty and who suffer injustices with income inequality at the highest levels for 50 years and 8 individuals living today with more wealth than more than half the world's population. As the inequality increases the reaction increases and discrimination rises such as scapegoating of immigrants; rejection of refugees; discrimination against women, Muslims and along racist lines. Governments and AI organisations have a duty to humankind to manage responsibility the development of AI through appropriate regulation (Walsh, 2017, p. 4; Shetty, 2017).

27. Should we fear the rise of AI?

Everything will change profoundly as AI continues to advance. There will be no stopping AI's rise. Therefore, humanity stands at a crossroads. Although there are many potential benefits, some already being realised, there are many pitfalls as well as very considerable risks in areas including fairness, privacy, security, finance and policy. AI's big data, behavioural economics and cybernetics are changing society. If these changes are incompatible with humanity's values, AI will cause extensive harm to humanity, even as far as creating an Orwellian totalitarian-like existence. Therefore, it is crucial that these risks be managed carefully, or inevitably, Artificial Intelligence will endanger humanity's way of life (Helbing, et al., 2017; Amodei, et al., 2016). Once AIs have reached a level of sophistication, beyond the control of their owners and programmers to understand (and this is already the case in some instances), then AIs become a law unto themselves able to modify themselves.

The authors of the poll of 170 experienced AI researchers concluded their paper with the following warning,

> the experts think that superintelligence is likely to come in a few decades and quite possibly [be] bad for humanity – this should be reason enough to do research into the possible impact of superintelligence before it is too late…We know of no compelling reason to say that progress in AI will grind to a halt (though deep new insights might be needed) and we know of no compelling reason that super intelligent systems will be good for humanity. So, we should better investigate the future of superintelligence and the risks it poses for humanity (Müller & Bostrom, 2016, p. 568)

28. Avoiding the Garbage In, Garbage Out Paradigm

AI is only as good as the data and training it receives. If there is no transparency and no validation of the data, the adage, 'garbage in, garbage out' will still hold true.

Great caution needs to be exercised in how AIs are trained, including what datasets are used and what monitoring and oversight there is. AI will continue to reflect its creators. Diversity will matter in the design and implementation of AI otherwise "we risk constructing machine intelligence that mirrors a narrow and privileged vision of society, with its old, familiar biases and stereotypes" (Crawford, 2016). An opportunity presents itself to eliminate bias as algorithms are designed. Wachter asserts that we could potentially identify bias in algorithms and then remediate. She states, "Humans, for example, could lie about the reasons they did not hire someone. In contrast, we do not expect algorithms to lie or deceive us" (Devlin, 2017). It represents a difficult challenge to eliminate bias but one that could be addressed. Wachter has called for a watchdog to be set up for AI (Devlin, 2017). There is, therefore, a significant potential to use AI to identify and to eliminate discrimination when and where it identifies it. For example, big data could be used to identify systemic discrimination in systems where humans are not currently able to see patterns. AI could be a useful tool to eliminate discrimination in many areas including recruitment were the AI, using discrimination free algorithms, makes recruitment decisions based purely on merit, unlike human counterparts who have may have a propensity to make biased decisions. This could apply to bank loans, insurance, legal services etc. Using an AI could remove all bias. Imagine a future courtroom scene with AI as the unbiased judge and jury, able to instantaneously incorporate all precedents into its judgements and without discrimination (depending on the state of the data provided to it and its algorithms). An extreme example could be that of autonomous weapons in warfare, that would adhere to the rules of engagement in a war and not kill civilians unnecessarily or commit other

war crimes, as the AI would not be subject to human factors such as stress and fear and would be more accurate in its lethality.

29. CONCLUSION

To some, AI will be a panacea for many problems. They see AI ending wars and conflict; curing diseases; reversing ageing; renewing the environment and bringing prosperity and a greater quality of life for all. Conversely, pessimists see AI getting out of control, or being developed or acquired by the wrong people, or even taking over the world. The truth appears to be much greyer in that no one today can predict the future of AI and its impact on humanity (Sharp, 2017).

Despite the benefits that AI is undoubtedly going to bring, a scan of the academic literature and a review of the contemporary trends and reports regarding AI, suggests that there are indeed substantive reasons to be concerned about AI. We must avoid alarmism, however. As Roosevelt suggested, fear paralyses and if we focus on fearing AI we may find ourselves paralysed and thereby fail to put in place the very measures and constraints that would prevent a destructive dystopian AI future.

Action, then, is required to regulate AI, in all its iterations and to do so proactively. As some commentators have alluded, it may be too late to retrospectively regulate AI, unlike other industries such as the automotive and transportation industry (prior to autonomous vehicles), the pharmaceutical industry, the legal world, health and education. In each of these fields, regulation matured over a period of time, reactively as incidents occurred. The risks were relatively low by comparison with AI. Although AI companies are also reacting to incidences as they occur or are detected, they are in the process of building systems that are so complex and that affect so many aspects of life in ways that previous industries have never so comprehensively done, that it is possible that no one will be able to properly manage them. Nuclear weapons cannot launch themselves and start a nuclear war, but it is probable that AIs will be empowered, most likely unwittingly, to dominate or to destroy on a massive scale - perhaps as an existential threat to humankind and once this power is unleased, the genie cannot be forced back into the bottle by reactive regulation. Although this may seem hyperbolic once only has to survey the literature on AI to see that there is a credible risk that AI will have a detrimental impact on life.

Certainly, we should attempt to prevent an AI arms race, through banning offensive autonomous weapons that are not controlled by humans (Autonomous Weapons: An Open Letter From AI & Robotics Researchers, 2015). If this is possible. It may already not be possible.

We need a program of education of the populace. Most people do not understand or even know that AI algorithms are playing an increasingly important role in our lives, in many areas including what in we purchase, what we watch, what work we perform and where and how we live. Ethically, it is imperative that general awareness about AI decision making must be raised and that it should be transparent. Hopefully, transparency may not prove to be an unsurmountable challenge. There are state and commercial reasons for secrecy around how algorithms work, as well as the complexity of the subject matter as a barrier in itself. Then there is the actual complexity of the algorithms themselves, as they evolve. These are serious impediments to transparency (Vieth & Bronowicka, 2015; Internet Society, 2017, pp. 6,7). But there is an imperative to identify why an AI has made a particular decision, such as when an autonomous vehicle is involved in an accident (Internet Society, 2017, p. 7). And this is a decision made on a small scale by a relatively simple AI.

On the positive side, we certainly need to maximise the benefits of Ai for all of humanity in an equitable way. To fully realise these benefits, we will need to align AI development with human morality, values and ethics (IEEE, 2016, p. 2).

The Internet Society's policy paper on AI and machine learning recommends that the following approaches be implemented to properly govern AI:

- that ethical standards be developed for AI design;
- that incorporation of ethics be mandatory for AI projects to be funded;
- that AI decisions be interpretable so that safety, equity and liability be determinable and so that explanations can be provided for decisions;
- that the public be educated to understand AI and concepts like algorithms and machine learning so that they have sufficient knowledge to be able to question AI decision making;
- that 'off-switches' be available to ensure that safety is paramount;

- that safety be tested for extensively before an AI is released and that continual monitoring of autonomous behaviour be undertaken;
- that AIs be designed to adhere to privacy laws and best practices and that AIs be designed to be data responsible;
- that data used to train AIs be free from error and bias;
- that AIs be secured from cyber-attacks; that security researchers be permitted to test and identify flaws in AIs;
- that flaws, once identified, be disclosed appropriately;
- that laws be adapted to accommodate AI replacement of humans in terms of liabilities;
- that AIs be designed to comply with all relevant laws and practices;
- that liability be readily assignable when needed;
- that AI should benefit all and not just the few;
- that all stakeholders of AI including users, government, private sector, and academia, participate in the development of governance for AI (Internet Society, 2017, pp. 10-12).

Whilst AIs must be aligned with human values, they also need to be taught to both comprehend and to adopt these goals and to continuously adhere to them during self-development and improvement activities (Global Challenges Foundation, 2017). The Machine Intelligence Research Institute (MIRI) has been formed primarily to "develop formal tools for the clean design and analysis of general-purpose AI systems, with the intent of making such systems safer and more reliable when they are developed". MIRI's focus is on encouraging the development of transparent and precisely designed and customised algorithms so that AI is fully accountable, ensuring that any decisions can be understood by humans. They, too recommend that AIs should adhere to the same values as humans (Machine Intelligence Research Institute, n.d.).

No one knows the timeframe for AGI or singularity with certitude. Certainly, the planning and systems are not yet in place to manage these advents. As innovations or solutions may be found at any time, catapulting forward the development of AI, planning and governance systems are required now. There are very real AI risks associated with many areas including finance, security, privacy, politics, employment, warfare and the universal and equitable sharing of the wealth generated (Global Challenges Foundation, 2017).

In summation, AI will seismically impact humankind. Life as we experience it today, will be disrupted on a scale and to a depth never possible. The transition to this new world, dominated by AI, is already underway. It will rapidly accelerate in the next few years and not so far off reach an exponential level of change. How the change will be handled is the challenge that humankind faces. How AIs will be trained, managed and regulated are critical elements in protecting the future advancement of humanity. For the betterment of all need not be just a utopian dream but could be realised if the AI companies, governments and citizens are able to cooperatively manage the continued introduction of AI into society. Whether this is the likely outcome is the salient issue of our time. It may be more probably that we will inadvertently unleash numerous genies and then struggle to retrofit regulation to control AI.

Three AI thought leaders attempt to capture the challenges facing humanity. Mark Zuckerberg, has stated that,

> Whenever I hear people saying AI is going to hurt people in the future, I think yeah, you know, technology can generally always be used for good and bad, and you need to be careful about how you build it and you need to be careful about what you build and how it is going to be used (Clifford, Facebook CEO Mark Zuckerberg: Elon Musk's doomsday AI predictions are 'pretty irresponsible', 2017)

Demis Hassabis, co-founder of Deep Mind, cautions that, "artificial intelligence is like any powerful new technology. It has to be used responsibly. If it's used irresponsibly it could do harm" (Hassabis, 2015). How much harm is something we should work to avoid, whilst we still have the opportunity.

Finally, Stephen Hawking presages that, "computers will overtake humans with AI at some within the next 100 years. When that happens, we need to make sure the computers have goals aligned with ours" (Techworld Staff, 2017).

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