FUTURE ASPECTS OF AI

:

11 scenarios presented by 24 Graduate Students from **SUTD**

Proceedings of a Final Workshop as part of the (distance-based) course **Selected Aspects of Artificial Intelligence**

Guest Lecture

:

Prof Christoph Schommer
University Luxembourg

1 – 5 June 2020

Contents

1 Preface

Since its beginning in conjunction with machines, the field of *Artificial Intelligence* has been very much stamped by the desire to bring cognitive human abilities to machine, for example, to represent knowledge, to reason, to plan, to understand, to take logical conclusions, and to learn. In the last 70 years, many suggestions have been made, papers written, and simulations produced (Remark: In Greek Mythology, Homer writes about Thalos, the Robot, who/which finally dies after an attack by Medeia).

However, the meaning of *Artificial Intelligence* has changed in the last years dramatically. Whereas the original idea is still alive - it concerns the simulation as well as the realisation of cognitive (human) abilities as mentioned above (so-called `strong` AI), the recent achievements in hard-/software as well as the more and more efficient management of masses of data (or "Big Data") have intersected *Artificial Intelligence* and have led to a new discipline that is called `weak` AI. Here, the human being is understood as to be the centric element, while AI serves as a supporting instrument towards a better society (see slogans like "AI for the social good" or "AI for a welfare). In this light, AI and in particular the application of Machine Learning-algorithms have become of significant industrial and academic importance.

The first goal of the course has been to give an overview of the AI-field (Day 1) as well as to demonstrate the above mentioned situation by means of a selected example of both a `weak` AI ($\Rightarrow$ Data Mining; Day 2) and a `strong` AI ($\Rightarrow$ Disambiguation of ambiguous sentences; Day 3).

The second goal has been to discuss future aspects of AI in a seminar-workshop, where an interaction with students can take place and where students can express their opinions about, e.g., chances, risks and challenges, advantages and disadvantages, and so on.

As an outcome, 11 AI-related topics were selected by the students (see Figure 1): Deep Learning, Self-Driving Cars, Manufacturing, Robots, Arts, Fake News, Healthcare, AI for elderly, Sports, Sweet Home, and Ethics.

I would like to thank very much

Govindarajalu Ramakrishnan Saravanan, **Ho Ngai Lam**, **Shen Tianruo**, **Xiang Maoyang**, **Chong Yong Qi**, **Edith Gracia Sharon Lawrence**, **Jiang Dan**, **Benjamin Nggz**, **Saikrishna Dontu**, **Narendernath Baskar**, **Zeng Xinyu**, **Estefania Yanez**, **Wang Weimeng**, **Lee Yue Soo**, **Muhammad Kashfun Nazir Bin Mohd Ali**, **Jubair Ahamed Abdul Gafoor**, **Siddarth Uppili Raghavan**, **Tang Jian Wei kenneth**, **William Siew Jing Wen**, **Gionnieve Lim Jia Yu**, **Cheong Li Yang**, **Ashreya M. Venkatesh**, **Luqman Marhim**, and **Balakumharen Palanisamy**,

not only for the extended abstract about their projects, respectively, but even more for their interest, passion, and the valuable discussions we had. I have felt a harmonious and vibrant atmosphere, which has contributed a lot to a successful learning.

I also owe deep thanks to Mrs **Irene Lee** from the *Office of Graduate Studies* for the excellent organization/support before and during the course as well as the foresightness and proactivity, with which we all have been accompanied.

See you in Summer 2021!

Singapore and Luxembourg, 9 June 2020

Christoph Schommer

Thursday	NAME	TOPIC	DAY	TIME
	Christoph Schommer	WELCOME	Friday	15h00
	Govindarajalu Ramakrishnan			
	Saravanan	DEEP LEARNING	Thursday	15h10
	Ho Ngai Lam	DEEP LEARNING		
	Chong Yong Qi	SELF-DRIVING CARS	Thursday	15h40
	Edith Gracia Sharon Lawrence	SELF-DRIVING CARS		
	Shen Tianruo	SELF-DRIVING CARS		
	Xiang Maoyang	SELF-DRIVING CARS		
	JIANG DAN	MANUFACTURING	Thursday	16h40
	Benjamin Nggz	MANUFACTURING		
	Saikrishna Dontu	ROBOTS	Thursday	17h10
	Narendernath Baskar	ROBOTS		
	Zeng Xinyu	ARTS	Thursday	17h40
	Estefania Yanez	ARTS		
	Christoph Schommer	CLOSING	Thursday	18h10
	Christoph Schommer	WELCOME	Friday	15h00
Friday				
	Christoph Schommer	WELCOME	Friday	15h00
	Wang Weimeng	FAKE NEWS	Friday	15h10
	Lee Yue Soo	HEALTHCARE	Friday	15h25
	Muhammad Kashfun Nazir Bin			
	Mohd Ali	HEALTHCARE		
	Jubair Ahamed Abdul Gafoor	HEALTHCARE		
	Siddarth Uppili Raghavan	AI FOR ELDERLY ON VIRTU	Friday	16h10
	Tang Jian Wei kenneth	AI FOR ELDERLY ON VIRTU		
	William Siew Jing Wen	AI FOR ELDERLY ON VIRTU		
	Gionnieve Lim Jia Yu	SWEET HOME	Friday	16h55
	CHEONG LI YANG (SAMUEL)	SPORTS	Friday	17h10
	Ashreya M. Venkatesh	ETHICS	Friday	17h25
	Luqman Marhim	ETHICS		
	Balakumharen Palanisamy	ETHICS		
	Christoph Schommer	CLOSING	Friday	18h10

Figure 1: Overview of the Presentations

2 Presentations

2.1 AI & Deep Learning

Govindarajalu Ramakrishnan Saravanan

Ho Ngai Lam

Deep learning is a machine learning technique that teaches computers to do what humans would do naturally, that is, to learn by example. In the past decade, deep learning is a key technology behind driver-less cars as an example. In a driver-less car, deep learning enables computers to recognize a stop sign, or to distinguish a pedestrian from a lamppost. Deep learning is getting lots of attention because it advances artificial intelligence by teaching AI to think/discover. Broadly speaking,

machine learning is a set of algorithms that parse data, learn from the data, and then apply what the algorithms have learned to make informed decisions. While basic machine learning models do become progressively better at whatever their function is, they still need some guidance. However, if an AI algorithm returns an inaccurate prediction, then it requires an engineer to step in and make adjustments to the models. With a deep learning model, an algorithm can automatically determine its own if a prediction is accurate or not through its own neural network. Deep Learning is a sub-field of machine learning concerned with algorithms inspired by the structure and function of the brain called artificial neural networks. More specifically, deep learning can be seen as an evolution of machine learning. It uses a programmable neural network that allows machines to make accurate decisions without help from humans. Therefore, deep learning differs from traditional machine learning systems in that it is capable of large data sets.

Deep learning is an evolution of machine learning techniques to discover knowledge. It uses a programmable neural network that enables machines to make accurate decisions without help from humans. Every Machine Learning algorithm learns the mapping from an input to output. In case of parametric models, the algorithm learns a function with a few sets of weights. The algorithm learns the function that separates 2 classes; this is known as a *Decision boundary*. A decision boundary helps us in determining whether a given data point belongs to a positive class or a negative class. For an example, in an image classification problem in machine learning, the Machine Learning algorithm extracts features manually from an image needs strong knowledge of the subject as well as the domain. It would become an extremely time-consuming process. Deep Learning would be preferred as it can automate the process of *Feature Engineering*.

Convolutional Neural Networks: this term suggests that the network employs a mathematical operation known as convolution, a kind of *linear operation*. Convolutional neural networks capture the arrangement of pixels and the relationship between them in an image. It helps us in identifying the object accurately, the location of an object, as well as its relation with other objects in an image.

Artificial Neural Networks: one of the main reasons behind artificial neural networks is the activation function. Activation functions introduce nonlinear properties to the network. This helps the network learn any complex relationship between

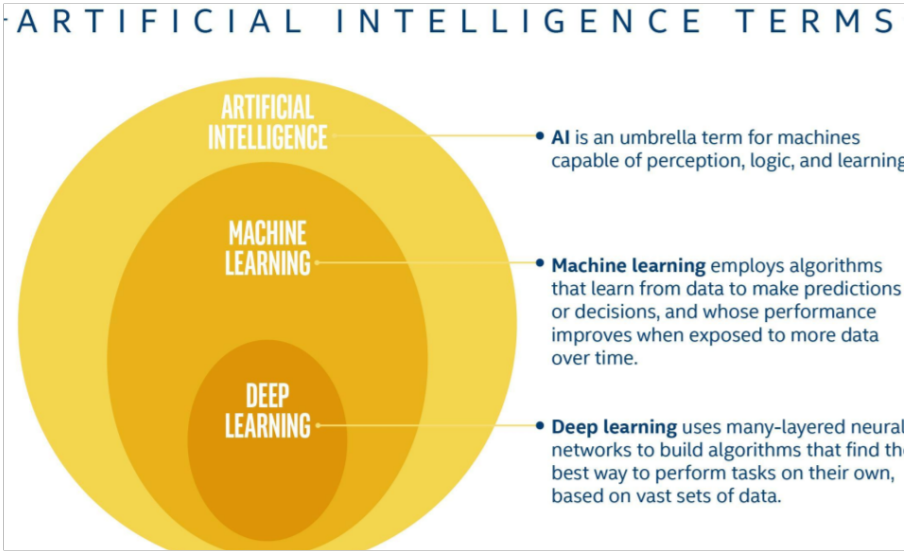

Figure 2: Artificial Intelligence Terms

input and output. An Activation function $f(x)$ has the the following functions: it is able to learn something complex and complicated from data. It can generate non-linear mappings from inputs to outputs. However, a Neural Network without Activation function would simply be a Linear regression Model, which is limited in prediction. Without activation function our neural network would not be able to learn and model other complicated kinds of data such as images, videos, speech recognition, etc.

Artificial Neural Networks are able to learn any nonlinear function. Hence, these networks are popularly known as *Universal Function Approximators*. Artificial Neural Networks have the capacity to learn weights that map any input to the output. Artificial Neural Networks uses different layers of mathematical processing to make sense of the information its fed. Typically, an Artificial Neural Network has anywhere from dozens to millions of artificial neurons - called units - arranged in a series of layers. The input layer receives various forms of information from the outside world. This is the data that the network aims to process or learn about. From the input unit, the data goes through one or more hidden units. The hidden units job is to transform the input into

something the output unit can use.

Deep Learning is used extensively in the industry, such as banking and insurance domains. For example, fraud discovery and detection have been problems for financial institutions. However, as banking sectors are moving towards *ubiquitous digitalization* with modern technology, criminals are discovering new weak spots in financial digital applications. With the help of Information Technology, banks are able provide better customer experience and therefore they can optimize operations. At the same time, Information Technology also assists *cybercriminals* in carrying out more sophisticated illegal schemes [1].

Rule-based mechanisms and manual analysis are not scalable, flexible or reliable enough to combat this nascent problem. Deep learning provides a solution that will be adapting to fraudsters ever-changing tactics and increasing complexity of financial cyber-crimes. As banks are seeing the increasing importance of security, even the least suspicious activities are getting investigated. Even if it seems to be a step in the right direction, it may lead to another major problem of false positives. With erroneously set fixed threshold values and ambiguous demographic metrics, a 90% rate of false positives has unfortunately become the norm for banks, especially when it comes to anti-money laundering alerts. The outcomes are what you expect them to be: friction-heavy customer experience, business reputation damages, and ineffectively allocated resources. Machine Learning can have a tremendous impact by enabling organizations to analyze customers activities smarter, faster and more accurately.

In conclusion, although Deep Learning is capable of improving its analysis, more research is still needed to enhance or create deep learning algorithms without human interference.

[1] *"How machine learning helps with combating financial fraud"* – see `https://www.finextra.com/blogposting/18659`

2.2 AI & Self-Driving Cars

Chong Yong Qi

Edith Gracia Sharon Lawrence

Shen Tianruo

Xiang Maoyang

2.2.1 Introduction

In the next 20-30 years, the automatic vehicle (AV) will change our driving habits, the transportation industry and affect the society more widely. Not only can we summon cars to our doorstep and send them away after use, self-driving cars will also challenge the idea of individual car ownership and have a positive impact on the environment and congestion.

Table 1 changes in the number of vehicles and road space in South Korea (see National Police Agency, 2009):

Year	Number of vehicles (unit: 1,000)	Number of cars per 100 people	Extended length of road in km	Road space per a vehicle in m
1980	527	1.4	46,951	88.9
1990	3,394	7.9	56,715	16.7
2000	12,059	25.5	88,775	7.3
2008	16,778	34.5	104,236	6.2

Autopilot can solve the traffic problems caused by urbanization, e.g. traffic jams and traffic accidents. Take South Korea as an example. Although the extended length of the road is increasing as the number of vehicles soars, the road space per a vehicle is decreasing, which signals the deteriorating road environment, as is shown in the Table 1. Despite the adoption of the cutting-edge technologies such as a real-time traffic guide and ITS (Intelligent Transport System), road congestion remains common. (KoROAD, 2009)

2.2.2 Self-driving cars in the 20^{th} century

The first documented self-driving car in the human history was a radio-controlled car named American Wonder, which was driven through the street of Manhattan with no

one at the wheel in 1925. This car could start its engine, remove its gears and sound its honk by the radio control.

It is worth mentioning that in 1940, Norman Bel Geddes showed his possible ideas of the world, especially for the electric highway, 20 years into the future. From there, over the next following 30 years, self-driving cars evolved from radio-control to electric-control. After this period, more and more electric cars powered and controlled by buried cables, magnetic cables and electronic devices appeared in 1960s.

Artificial Intelligence (AI) self-driving car were proposed by John McCarthy, one of the founders of AI, in an article called Computer-controlled Car in 1969. He described a similar idea to modern self-driving cars and showed two benefits of his idea: easy driving and high security. His forward-looking essay inspired much of the researches in 1980s.

After that, more and more artificial intelligent technologies have been developed and applied into the self-driving cars, including the intelligent automated logic, vision-guided system, many types of sensors and so on, making the self-driving cars converting from the electric-control to the visual-control.

2.2.3 Google driverless car: representative of the 21^{st} century AI self-driving car

In the 21^{st} century, the application of AI technology in self-driving car is more extensive and complex. The Google has been secretly developing self-driving cars since 2009 and didn't announce them publicly until 2014. It stands out in the self-driving field because its unique technical route and many advantages in line with the current era.

On-board equipment and technical principles

A Google driverless car is equipped with seven main on-board equipment:

(1) Radar. It is used to track nearby objects, which is also regarded as an accident prevention system. It will send out an alarm when detecting any object in the car's blind point.

(2) Lane-keeping. It is used to identifying line marks by analyzing the difference between the road surface and the boundary line. If the car accidentally leaves from the lane, the steering wheel will vibrate slightly to alert the driver.

(3) Lidar. Cooperating with the radar to calculate the distance of the objects.

(4) Infrared camera: This function uses two headlights to send out invisible and non-reflective infrared light to the road ahead. A camera on the windshield detects infrared markers and displays images on the dashboard display and risk factors will also be highlighted.

(5) Stereo Vision. A 3D image of the road is guaranteed by the camera on the windshield ahead in real time to detect the potential hazards such as pedestrians and predicting their movements.

(6) GPS. Connected with Google Map and realize real-time positioning.

(7) Wheel encoders. Measuring the speed.

The car follows three technical principles in operation:

(1) The laser scanner on the roof of the car sends out 64 beams of laser light, which then hit the objects around the car and bounce back to calculate the distance of the object.

(2) Another system at the bottom measures the car's acceleration, angular speed and other data in all three directions, combining with the GPS data to calculate positions of barriers.

(3) All the data will be put into the computer along with images shot by onboard cameras. In this way, the system can make decisions very quickly.

Competitive edges

(1) Self-developed technology. Because most sensors used in the car were developed by Google itself, the total costs decreased by about 90% compared to using the devices from other companies. All the radars and sensors can work together without interfering with each other. For instance, the position sensor at the bottom of the car can cooperate with the GPS system to calculate the positions of barriers in the real time.

(2) High security. Traffic safety has also been improved. Such cars are safer than the human-driven cars because they can response more quickly to emergencies.

They can also avoid some traffic accidents caused by driver's error and reduce the occurrence of drunk driving, malicious driving and other behaviors.

(3) Data accumulation. Google driverless car has accumulated ten million miles of test range on the public roads, making them far ahead of similar companies. It also allows some citizens to use this service during the daily life: like get to and from school or work, pick up groceries and other purposes.

(4) Adequate financial support and cooperative partner. It also has the enough financial support and close cooperation with professional automobile manufacturing companies like Jaguar, Tata Motor and Fiat Chrysler.

Challenges and Future Visions Despite its competitive advantages in the current market, Google driverless car is still facing some challenges. It cannot identify some old faded road signs correctly. For some groups of people, it treats them as unrecognizable objects, making it difficult to predict where they will go. These can lead to potential dangers on the road. It also cannot remember the nearby road conditions like a human brain does. It may take a longer and more time-consuming route to reach to the destination to avoid pedestrians. More importantly, how to keep the balance between the human-driven car and AV in people's daily life is the biggest challenge for google driverless car.

From our perspective, in the future development process of Google driverless car, it should not only maintain the existing advantages like continue to accumulate the miles data and improve the users open beta test. It would be better to equip the car with an emotional brain to improve the recognition of special objects and the memory of road condition need in the future investigation, making the car can judge and make decisions as thoughtfully as people do, which will be very beneficial to people's future life.

2.2.4 Opinions based on Technology

With the advancement in any fields, always bring about change along with these advancements. An ideal example would be the telephone. What started with the phone being connected by wires, where signals and audio being sent across, we progressed to cordless home telephones. Onto mobile phones, where we no longer require a land line

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	No Automation	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	Partial Automation	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	Conditional Automation	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	High Automation	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	Full Automation	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

Figure 3: Self-driving level, © SAE International 2019.

for the phone connectivity. And just before the turn of the decade, 2010s, came the introduction of the revolutionary smart phone. And its applications.

The introduction of the smart phone has put products like the PDAs out of business. Which at one point of time was a staple office worker's product. That was at the time considered to be a substantial revolutionary change, as there was the distinct shift in opinions and preferences. To a point that if you ask any millennial, young adult, they might not even know what a PDA might be, without taking another look at their smartphone and looking it up on the internet. And have pushed this product to obscurity.

For self-driving cars, there is a term that is used to indicate the various levels of automation. Which is the SAE level, ranging from level 0 to 5, as is shown in the Fig 1. Level 0 being no automation, and everything is controlled by the driver. And level 5 being full automation and being controlled completely by artificial intelligence, and the driver need not worry to perform any control to the car, throughout his journey.

So, our opinions are based very similarly to the mobile phone's trend and its progress. We believe that the future of self-driving cars, is at its transitioning point. Where I think the cars that we have now are already considered extremely advanced and we

are appreciating how these different levels of autonomy is assisting the driver, even if the assistance is low at this point.

A good example for what we see available in most commercial cars are its staying in lane indicators. Where the car has internal capabilities to notice that the driver may be potentially sleeping behind the wheels, and when the car noticed that it is going off or out of its lane. It has the artificial intelligence to sound indications or correcting itself back onto the center of the lane.

The level 5 self-driving car is the future, we think it is extremely intelligent. However, similarly to the phone, we feel that it would take quite a few more years to get everything right, and commercially viable to the consumers.

2.2.5 The predicament of Autopilot system

Limitation of Computing Resources At each level of autopilot, the processing power required to deal with all data increases rapidly with the improvement of the level. Based on experience, data processing from one level to the next can be expected to increase tenfold. For fully autopilot levels 4 and 5, we will see the processing capacity of trillions of floating-point operations. For one thing that can be certain is there will be huge gap from today weak AI to tomorrow strong AI. That is why nowadays the researcher are prefer to the EV as the AV platform since they can provide sufficient electricity power. While the traditional car could only provide less 2.5kW which is insufficient to support HPC, although 2.5Kw is not a small number. While the personal computer could run within 300W.

Fragile Deep Neural Networks At present, there are two main technical routes of autopilot, weak perception + super artificial intelligence and super artificial intelligence (Burns, 2019). Tesla insists that the former route mainly relies on cameras and deep learning technology, rather than on lidar. But the question is when to achieve super artificial intelligence. The real problem is that deep learning is still in the very early stage of recognition. There is such an example in 'Why deep-learning AIs are so easy to fool' by (Heaven, 2019), a very obvious traffic sign Stop, after angle transformation, is recognized by the deep learning network as Dumb-bell and Racket. Even so, the ability of recognition is even more ridiculous for subsequent behavior prediction and logical reasoning.

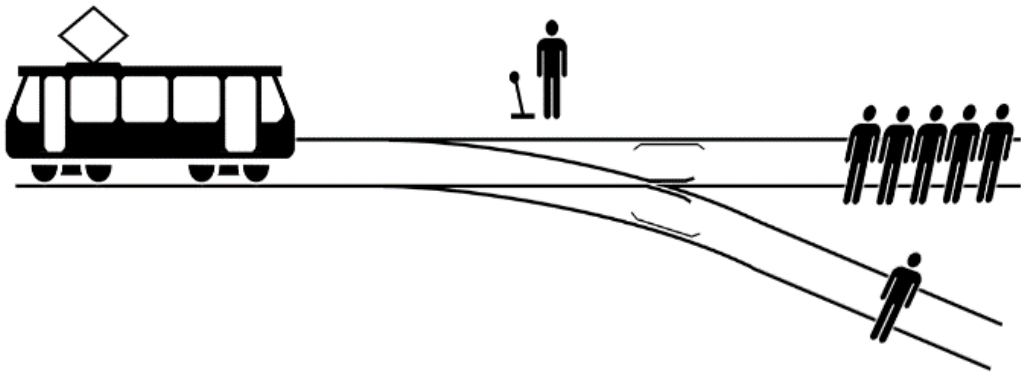

Figure 4: Trolley Problem

Dilemma in Legal and Moral The world's first self-driving vehicle hit and killed a pedestrian in Arizona, USA. The vehicle is a measured self-driving vehicle of Uber. The progress of science and technology, the development of the Internet and the popularity of self-driving have become unstoppable. In fact, when we blame the immaturity of self-driving technology, we should also know that during the Industrial Revolution, people also angered that newly invented four-wheeled cars were faster than horse-drawn carriages, which frightened them.

Ethical Issue When it comes to self-driving, the ethical issue between machines and people is always an unavoidable topic. And it is also the most excruciating problem, in fact, many things have not been solved by human beings themselves, while, of course, it is a bit difficult to ask machines to solve them. Asimov's Three Laws (Salge, 2017) which give us the guideline of robotic ethical, are as follows:

(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.

(3) A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

But these guidelines face very serious challenges because human beings are unable to provide a perfect answer to ethical questions, e.g., Trolley problem (shown in Figure

4). When the trolley is out of control, what should the human (or AI) choose? And what is the logic of AI behind its choice? Because unlike human beings, the AI is pure rational beings without any irrational behaviour. The German philosopher Immanuel Kant had a famous question: "What should I do?" This is a question that we, as human beings, have to think about under any circumstances. For Kant, everyone is a self-determined individual, and in the face of the same situation, different people will make different choices. Therefore, not all situations and options can be standardized. But what if the decision becomes a self-driving car? Can all situations be calculated and a standardized rule can be made?

2.2.6 Legal Responsibility Differentiation

When there are problems in self-driving, causing damage to people or property, or even self-driving vehicles, how to distinguish the legal responsibility must be an unavoidable major issue.

Overall, there are two ideas: one is under the condition that there is a driver (the vehicle is controlled by the person). One of these is to distinguish the liability according to the relevant provisions of the Road Traffic Safety Law. Second, when a traffic accident occurs when autopilot is under unmanned control, product liability should be applied, that is, if the product is defective and causes damage to others, the producer shall bear tort liability.

2.2.7 The Ethical Dilemma

One of the biggest roadblocks in the implementation of Autonomous vehicles is the issue of ethics. This issue of what can be considered right and what is unacceptable has been debated almost as long as AI has existed. This had even led Isaac Asimov, a science fiction writer of the 1940's to propose the three law of robotics in his story Turnaround, which is part of the I, Robot series. The bottom line of these laws implies that a robot or, in this context, an intelligent machine has should not be given the autonomy to kill its own maker (i.e.) humankind.

Given the fast pace of growth and development of AI and its slow but sure implementation to everyday life applications, it seemed vital to address the issue of ethics. In order it facilitate this, a group of scientists under the Scalable Group from the Massachusetts Institute of Technology (MIT) performed an online experiment called the

Moral Machine. This experiment has a sample size of 233 countries and over 40 million responses are gathered in ten languages. The experiment provides various ethically challenging scenarios in which the participant of the experiment has to choose with the 'least harmful' outcome. These were mostly inspired from the trolley problem and have evolved into road-based scenarios.

The experiment has various stages of analyzing the data. The first stage was the global average. This gave an overall averaged picture of the global response. The data is organized in both relative terms which showed a comparison of the various scenarios presented and the group that gained preference, and the absolute scale which ranks the preference from the most to least preferred group.

The next stage was to analyze this data by individualizing sub-dividing the sample space based on region, culture and other factors. The results seemed to vary as individual regions were considered, creating a deviation from the global averaged data.

The main aim of this experiment was to extend beyond the top-levelled view of Asimov's law and establish a standard code of ethics for intelligent machines. In order to establish a common code of ethics, there needs to be common general consensus that needs to be reached by the policymakers, the manufacturers, the philosophers, the ethics experts and other stakeholders as well as the general public. The disparity shown in the results of the Moral Machine Experiment highlights that reaching this common ground is easier said than done.

The dilemma of ethics exists more prominently in the case of self-driving cars as, when this is implemented, is a question of life and death. This would put both the manufacturer and the potential customer into a number of difficult situations. The question of prioritizing the safety of either the passenger or the pedestrian, taking into account that the passenger today could be the pedestrian tomorrow, elevates this dilemma to a trilemma of issues. With every added legal and ethical issue, the solution to this Pandora box of ethical issue is as important, if not more, as solving the various barriers to the technology.

So, what does the future of AI and self-driving cars looks like? Perhaps it requires a whole new perspective to solving all the ethical issues mentioned. A system of what is equivalent to machine's 'decision making' process that wouldn't result in the requirement of coding of results that can, in many cases, be considered as pre-meditated

homicide. The issue of ethics needs to be solved in a new light, moving from the idea of least harm to perhaps even no harm.

The history of vehicles, from the invention of the wheel to technology now has shown tremendous progress. And the concept of self-driving cars in probably an exciting step in this progressive timeline. It is only fair that this progress follows in the footsteps of its predecessors: being that innovation that enhances human lives at worst without compromising safety. And when the taken in the right direction, this may just be what the future looks like.

2.2.8 References

(1) Burns, M. (23 April, 2019). 'Anyone relying on lidar is doomed', Elon Musk says. https://techcrunch.com/2019/04/22/anyone-relying-on-lidar-is-doomed-elon-musk-says/

(2) Heaven, D. (2019). Why deep-learning AIs are so easy to fool. Nature , 163-166.

(3) KoROAD. (2009). Safe Driving. https://www.koroad.or.kr/en_web/view/trfEnv1.do

(4) SAE International. (2019, January 07). SAE Standards News: J3016 automated-driving graphic update. https://www.sae.org/news/2019/01/sae-updates-j3016-automated-driving-graphic

(5) Salge, C. (2017, July 11). Asimov's Laws Won't Stop Robots from Harming Humans, So we've Developed a Better Solution. https://www.scientificamerican.com/article/asimovs-laws-wont-stop-robots-from-harming-humans-so-weve-developed-a-bett

(6) Awad, E, Dsouza, S, Kim, R, Schluz, J, Henrich, J, Sharrif, A, Bonnefon, JF, Rawhan, I (24 October 2018): "The Moral Machine Experiment". https://www.nature.com/articles/s41586-018-0637-6

2.3 AI & Manufacturing

2.3.1 Part I

Jiang Dan

Introduction Manufacturing normally stands for large-scale production of goods using manual labor and machines. It requires heavy investment in machine and equipment. The most important factors for manufacturing including production cost reduction, quality control and to make sure products are meeting customer's satisfaction. Production costs can be classified as raw material cost, labor cost, and overhead cost. Quality control can be statistical quality control, six sigma etc. Customer satisfaction includes on time delivery, product quality as well as product functionality. Traditional technologies currently only have very limited room for further improvements on manufacturing. This is why we need AI to boosting the productivity and embrace new production opportunities.

AI Solutions for Manufacturing There are many possible AI solutions for manufacturing. We can use AI system to predict and improve production yield and quality. Monitor machine and equipment's performance to avoid unnecessary downtime and improve machine utilization. AI can also be used for production forecast to optimize supply chain optimization and to reduce operational cost. We can collect real time data from products to analyze customer behaviour and improve the products' functionality. Data science can be used to analyze market and help manufacturing companies target the right potential customer to forecast and improve sales.

Impact on Labor Market With increasing production automation and usage of robotics, it will definitely change the labor market. AI system will automatically fix most of the production downtime problems and improve productivity. The engineer's job scope is to monitor and improve AI system's performance. Traditional jobs like operators and technicians will loss their job. However there will be more job available for AI specialist to control and develop manufacturing AI solution. And we need more robotic and equipment engineer to design and develop automation solution to meet AI factory's requirements. In general, the future job market basic requirement is everyone should be equipped with AI knowledge.

Challenges and Risk To achieve fully AI manufacturing, everyone in the industry

need to work together towards it. The traditional manufacturing companies need to embrace the changes and start to developing AI solutions. There will be huge investment at the beginning of AI transition, not all companies can survive. Manufacturing is not considered that "open" compared to other industry like software or internet industry, which could be the biggest challenge along the AI evolution. We need more sharing and discussion on what's the next step for AI in manufacturing, what are the new AI standards and how to approach it.

One of the risk of AI in manufacturing is the safety. The AI solution need to guarantee all the robotic and machines' operation are within safety requirements and there should be backup plan when abnormal situation happened. Even through most of man power are replaced by robotics, there still be times when engineers need to enter production floor for maintenance. Workplace safety also need to be guaranteed. Another important and common risk is cyber security, manufacturers need to protect their data, customer's sensitive information and operation system to prevent cyber attacks.

Legal and Ethics One of the legal aspect for AI in manufacturing is the workplace safety. If there's any injury occurred due to bad AI solution, who should be responsible and how to control it in the future? This kind of requirement need to be defined during AI solution development life cycle. We need designated organization to setup standards and audit companies regularly. Besides, there could be products safety problems. If the AI solution is trying to achieve low cost and sacrifice product quality, it will cause malfunction or dangerous products ship to customer. There should be clear process control and monitoring to prevent this. And we need to have industry standard before any critical AI solution release to production. Legal requirements need to be in place for AI solution testing and evaluation.

2.3.2 Part II

Benjamin Nggz

Technology has enhanced manufacturing industries in ways that improve metrics such as productivity and product quality as well as in other holistic aspects such as work environment safety, worker health and environmental impact.

Some of the ways that technology and technologically centric thinking has enhanced manufacturing is through:

- Automation: Allowing replacement of man with machine labour intensive and repetitive work
- Additive manufacturing - Giving the ability to produce complex structures and to manufacture with reduced material wastage.
- Rapid prototyping - Accelerating research and development, to test new it products faster and at lower cost

Artificial Intelligence (AI), being on the cutting edge of technology, will be one of the biggest augmentations implemented into manufacturing. With AI, the abovementioned enhancements technological advances will be taken to the next level by harnessing the capabilities of AI such as Deep Learning, Machine Learning, Computer Vision and Data Mining.

Hypothetical enhancements to Manufacturing discussed in this presentation are improvements to productivity, and improvements to workplace safety.

Firstly, productivity will be improved through using AI to ensure round the clock operations, predictive-preventative maintenance and corrective maintenance, and improved product quality. Using Data Mining and Machine Learning, in the near future, industries would benefit from "virtual simulated rapid prototyping" and could mean accelerated development of new products.

Secondly, workplace safety will benefit from AI as well, through using Deep Learning to predict failures in infrastructure and machinery or mining historical data and utilising sensors to predict safety incidents. Coupled with wearable technology, AI will enhance monitoring of worker vital signs and performance metrics to ensure they are in optimal condition.

There will be challenges from society as the perception and acceptance of AI is still evolving. Labour unions might oppose the replacement of low skilled labour with machines, however the enhancements to productivity might mean workers no longer need to be in a plant or factory environment, basically only performing supervision of the plant from the comfort of their homes, thereby improving work-life balance. Furthermore, less time in the office/factory means more time to focus on holistic self-development. The education system will also change to adapt to the growing need of working with AI, to prepare future generations who will be using the technology.

2.4 AI & Robots

Saikrishna Dontu

Narendernath Baskar

2.4.1 Introduction to AI and technology

There will hardly be anyone who has not yet heard these trending words of Artificial Intelligence (AI), data science or machine learning. The reason they have become so popular is because of the range of applications they can be utilized. Any sector you could think of, ranging from Manufacturing, Transportation, Healthcare, Education, Agriculture, Construction, Media, etc., AI is going to play a vital role. The two things that are required to achieve great predictions irrespective of the field, are availability of data and computational power, both of which are readily available today, which is why it will not be a surprise, if AI could perform unbelievable tasks such as discovering drugs or even vaccines for rapidly emerging viruses that threatens human kind. The world has already shifted towards data driven approach but once cognition is introduced, there is a high chance that the entire process of decision making will be completely automated.

2.4.2 AI and Robots Introduction

In the present technology implementations, Robots and Humans are working on isolation. AI will bring harmonious working relationship between robots, human and other machines, so that the working environment is collaboratively operated with harmony. This will bring safer working environment for human and robots.

Human is moving towards machine driven world. Human doesn't have time to spend with other people, especially the elderly people and kids at home who needs extra attention; recovering patients at hospital/home, who needs companions. Loneliness of these people brings down their morale and will affect their mind. AI is expected to help the robots to build emotional factors in them, that will enable the uncompromised companionship with the people.

Robots are deployed to perform monotonous and jobs where human life is at a risk, such as search and rescue, space exploration etc., Robots could be a threat for humans, as they could take over most of the jobs from human.

2.4.3 Role played in technological advancement

There are many sectors where AI are going to be deployed in future. It is going to be difficult to find a domain where AI is not been implemented. As an example few sectors are being explained below.

- Transportation: though Autonomous vehicles are introduced in the current times, there are many accidents happening due to the combination of human driving and machine driving at the same time. In future the roads are going to be completely taken over by autonomous vehicles, where humans are not allowed to drive. This will lead to an accident free world.

- Manufacturing: next to automobile industry, robots are predominantly used in manufacturing industries. Human is also expected to be working along with these robots. As these robots are not built with AI capabilities, they are unable to identify the presence of human in the environment and causes many dangerous accidents, that leads to serious injuries for humans and even to death. Building the robots with AI capabilities will enable the harmonious working environment with human and other machines. This will bring a safe working environment for humans a and robots.

- Healthcare: There are robots already in the market for healthcare as well, however the confidence level in the usage of these robots are very low. AI will remove the human error and deliver 100% success rate. Eventually confidence level in using robots for healthcare will increase exponentially.

2.4.4 Implications on job market

At present Robots are being deployed to replace human, to perform monotonous jobs, risk involved jobs, jobs where human cannot reach. As per the report from Oxford Economics, robots will replace 20 million jobs by 2030, which is about 8.5Physical jobs were given to robots, while human retained the thinking jobs. Just with the replacement of physical jobs, the implication to the job market is so high. If the thinking jobs are also going to be given to machines, then AI is definitely going to be great job killer in the future for human.

2.4.5 The Challenges

The problem of availability of sufficient and reliable data that can encompass all the possibilities to train the model will continue to exist in future. In addition, ensuring that the data been fed into the model is clean is a challenging task as there can be several areas where some manual tweaking is required using data filtering, feature engineering etc. Another problem that needs attention is AI bias. For example, data might have more inputs of male category than the female category which might make the model biased towards male. Making the model resistant to all possible types of failures, detecting those situations, and accordingly responding to these unpredictable situations or rather outliers, will require introduction of cognition, which is a herculean task. Then comes the main issue, how will these models be implemented in real life which needs proper trials to be conducted with no accidents and no ethical dilemmas which will ultimately need approvals from respective departments to deploy these systems in real life.

2.4.6 The Risks

The concept of singularity is defined as a point in time when human beings are no longer the most intelligent beings on earth or rather the robots feel that they are superior to humans and do not want to be controlled. Until we think robots as just tools for our convenience and not compare them with humans, this is an unrealistic scenario. The data for training the models sometimes contain some personal information like that posted on social media which might hinder data privacy and increase the risk of collected data been mishandled. In addition, this might be backed up by usage of AI for wrong purposes which could ultimately be detrimental. For example, highly intelligent robots could be used to rob a bank thus, it is important to consider all the points before complete implementation as there is no turning back later. There is also a tension among those who do not have resources to use AI as their survival chances will drastically be affected due to the competition from those who have these resources which will ultimately create more economic gap. Introducing robots is a cause of ethical dilemma in answering the question of who is responsible when an accident occurs. These questions need to be addressed properly before we can even think of introducing robots in our everyday life.

2.5 AI & Arts

2.5.1 Part I

Estefania Yanez

Algorithmic art has come a long way over the past fifty years. As early as 1973, Harold Cohen wrote a program to create a set of images based on rules that he defined. While Harold continued to develop and refine his program, it continued to operate as instructed. More recent advances allow the computer to operate with fewer boundaries and restrictions and greater "creative freedom".

The key lies in the development of algorithms which result in the "learning" of various art aesthetics and creating images based on these learnings. Algorithmic art generally involves the use of a class of algorithms called Generative Adversarial Networks, or GAN. A key component of GAN is the involvement of an artist to help curate the computer's memory of desired art by sifting through the generated images and making selections on which of them to use. Some important questions arise during this process. For example, while some of the images generated may be unconventional or may not conform to classical art ideology, can/should it still be considered art? one begins to question what the true nature of art is.

Art should have the ability to evoke surprise and wonder, and while some might argue that algorithmic art is not really art since it represents imitations of existing art with human specified variations, it may well be too soon to make a determination. Given the nascent stage of both AI as well as algorithmic art, what is more interesting at the moment is the collaboration between artist and machine.

Algorithmic art is not going away, this is certain. And similar to the advent of photography, algorithmic art is likely to develop as an additional medium or channel of its own, allowing the artist yet another creative avenue for self-expression.

2.5.2 Part II

Zeng Xinyu

In order to discuss the relationship of the AI and Arts and to predict the future development of AI Arts, I would like to clarify the definition of AI arts first.

Artificial Intelligence art, more accurately neural network art, is a new form of artwork created using clever algorithms. AI has been used profoundly in Arts industry, for example, Painting, Drawing, Music, Culinary, Dance, Theatre, Literature, etc. Avant-garde artists have been using AI to create arts images since 1970s. As the technology develops, AI becomes smarter day by day and can creates arts pieces that are more recognizable by main stream arts market. In October 2018, Christine, one of the world's most prestigious auction houses sold first AI-generated painting Portrait of Edmond de Belamy for $432,500, showing that AI arts, instead of sitting in the lab and defined as a substitute of "real arts", have been accepted by high-end arts market.

However, AI Arts, for example, the Portrait of Edmond de Belamy, it is nothing close to those true art masterpieces; it is just the mimic of many portraits and comes out as a vague and uncertain painting, without aesthetically and conceptually richness. I do believe that the development of technology will bring AI arts more aesthetically matureness, but the true creativity, the social context of the art piece, the story behind it, and the interaction with the people are still missing. Furthermore, the new genre of arts based on all that qualities can only be created by human artists not AI. That explained why arts has always been considered the highest form of human thinking.

So what is the future of AI arts? How do human artists and AI co-exist in future? Should artist adapt the AI or reject it to keep its uniqueness? Do people still want to learn arts and set becoming artists as a career goal? Do Arts institutions still want to hire people with arts background or they will simply be replaced by AI? Can artists make a living when AI is more developed than today? Are there any legal or ethics problems AI arts bring about? Here are some trends I personally predicted in the future for AI Arts.

First, instead of terrified by AI stealing the job roles, artist should work with AI and make it in good use. Feeding AI with massive big data, artists can decide what kind of data to feed AI so it can run the algorithm based on certain contents and let it run the background research and repetitive tasks, while human artists can free themselves from the massive tasks and focus on the sublimation part, which is the thinking part that AI cannot do for human. Just like the industrial revolution, human adapted to the machine quite well after short terrifying period and since then, more social creativity has since been released. Likewise, Artists can work with machines and create something that is yet to be imagined.

Second, people always complained that arts sometimes can be inacceptable, too expensive and far away from the real life. AI could be used in Art Education. Mass production of art pieces by AI could lead the arts more accessible to public, it is a relatively cheap way of art education. However, the uniqueness of the Arts will be sacrificed if AI takes part in the art producing process.

Third, there will be ethic dilemma and even legal issues for AI arts. For example, copyright in arts industry. Who is going to take responsibility for AI plagiarism? AI itself or the human-beings who feed it with the data? Since Arts presents highest form of human intelligence, should artists give up the sublimated part and let AI to conduct the process? Will that hammer the human innovative thinking and set backfire to human creativity eventually? That is the problem we human need to put efforts to think about.

2.6 AI & Fake News

Wang Weimeng

In recent years, it has become difficult for users to access accurate and reliable information because of the increased amount of information on social media. Although it may not sound as cool as self-driving cars, AI is becoming a more and more important tool we used against fake news.

Fake news is shared without being vetted and verified, and such proliferation is what creates the need for more. In fact, a Pew Research Center survey found that 10% of respondents admitted to sharing a news story online that they knew was fake, while 49% had shared news that they later found to be false.

If the systems accuracy is as claimed and it makes its way into production, it could help combat the spread of false and misleading information about U.S. presidential candidates and other controversial topics. A survey conducted in 2018 by the Brookings Institute found that 57% of U.S. adults saw fake news during the 2018 elections and that 19% believe it influenced their vote.

They can also have major impacts, because information shapes our world view: we make important decisions based on information. Fake news can lead to financial impacts, racist problems or spread fear.

As I mentioned earlier, current countermeasures are already using AI as a helpful tool against fake news. We can use methods such as to identify fake news and many services are available to fight against those fake news.

A paper published last year conducted a test for some fake news detection algorithms available and compared their performances.

Important is Data pre-processing:

- Tokenization process: Tokenization divides the given text into smaller parts which are called tokens and it removes all the punctuations from the textual data [30]. The number filter has been applied to remove terms which contain numbers. The case converter has been used to transform text data to lowercase or uppercase. In this paper, all the terms have been converted into lowercase. Finally, in this step, the N-chars filter has been used to delete the words, which consist of less than N characters.

- Stop-words removal: stop words are not important words, although they are frequently used to complete the sentence structure and connect expressions. These words are language-specific words, which do not carry information. Conjunctions, pronouns, and prepositions are stop-words. There are about 400500 stop-words in English [31]. Some of the stop words are a, an, about, by, but, that, does, on, above, once, after, until, too, again, when, where, what, all, am, and, any, against, and so on.

- Stemming: in this process, different grammatical forms of a word like its adjective, adverb, noun, verb, etc. have been transformed into its root form. The aim of stemming is to obtain the basic forms of the words whose meanings are the same, but the word forms are different from each other. For example, the words, connection, connections, connective, connected, and connecting can be stemmed to the word "connect". Data pre-processing steps have been given in Table 2.

There are some future aspects:

- Control the source of fake news: certain areas are more likely to be affected by fake news, some people use AI it self to produce fake news in a great number. Track down the source and use the fake news generating tools to train models with better fake news detection performance;

- Lead the public to dependable news sources: all news, even the fake ones are based on something that happens in reality. (such as COVID-19 or election) Use the AI to find the most related real news and lead the public to focus on this dependable source rather than the fraudulent one.

2.7 AI & Healthcare

2.7.1 Part I

Lee Yue Soo

AI has been able to play a considerable important role in the healthcare today. For example in the diagnosis and treatment arena, it is able to help diagnose X-RAY images to determine whether the patients has cancer. It helps to eliminate the human error in detecting the cancers cells using human eyes. The future of AI in the healthcare systems will be the balance in trust of one patient with the machine.

Diagnosis and treatment of disease has been a focus of rule-based AI systems since 1970 but were not adopted for clinical practice as they were not substantially better than human diagnosticians, and they were poorly integrated with clinician workflows and medical record systems.

With the upcoming trend of the wearable devices such as Apple Watch, we can explore area on early detection of illness in a patient rather than waiting for the symptoms to surface. But such wearable can be transferred between people resulting in inaccurate data from being collected.

Another trend that is on the up rise will be the use of robots in the healthcare. Today, the robots are already being used to assist the doctors in operation like the Lasik. In future, we could potentially see the robots being use in operation autonomously. But such possibilities can only happen if some of the AI challenges can be overcome first.

Challenges of AI in the Healthcare will be in 3 parts. Firstly, the current dataset use in healthcare are very fragmented and some are even handwritten. As such, it is difficult to implemented in AI. Secondly, due to the sensitivity of the data, which are very personal to the patient in nature. Thus, any leakage of the data will lead to privacy issue. A data protection legislation needs to be in placed in order to have these data being securely managed and safeguarded. Lastly, will be the livelihood of the healthcare workers being replaced by AI machines. Currently, the feasibility of this happening will depend on the acceptability and confidences from both the healthcare workers as well as the patients.

There are also key risks in the AI in healthcare such as reliability of the robots or machines being used and the fail-safe mechanism in place in the event of a failure.

There is also a trust issues on the AI machines or robots by both the human patients as well as the healthcare workers. Cybersecurity attack could also be a potential risk as more and more AI machines or robots are being interconnected together.

Lastly on the legal and ethical issues, who will be the responsibilities on the manufacturer of the machines themselves. Also, should the patients receiving the healthcare be based on the "merits" or contribution they have done to the healthcare systems like rigorous wearing of the health devices to provide accurate data for the systems. Before all these issues are being addressed, fully autonomous AI will always be a dream. In the meantime, augmenting AI in diagnosis and treatment as a tool to aid human doctor seems to be a good solution for now as there will also be check and balance in between them something like reinforcement learning in Machine Learning.

2.7.2 Part II – AI and BloodTest

Jubair Ahamed Abdul Gafoor

Blood tests report is effective in diagnosis and treatment, but the data is not being used wisely in healthcare research. Introducing, Artificial intelligent, cloud computing and recommending for a complete blood test for effective diagnosis not just for the reported pathology but to use the record globally for early detection and prevention of diseases.

Background Blood is a fluid circulating in an animal and human body, transporting oxygen and nutrients to every cell of the body and it also takes away waste products from the cells. A blood test is one of the most predominant diagnosis methods in pathology. It helps doctors to examine certain diseases, medical conditions, risk factors. It also aids to measure the function of the organ and ensure the effectiveness of treatment. In the advancement in technology, the department of phlebotomy enhanced the blood test procedures which in results effective and efficiency in healthcare.

Medical Study shows that Artificial Intelligence (AI) is used to detect heart disease and cancer in the earlier stage and the AI can predict the progression of neurodegenerative diseases. An another preliminary research states that there is a relationship between the ABO blood group and CoVid-19.

Artificial Intelligent in Blood Test In a blood test procedure, blood samples that usully been extracted from a body will be analyzed in the laboratory to examine the

conditions of the patients. Different types of blood tests are carrying out for a respective diagnosis and most common tests are Complete blood count, The basic metabolic panel, Complete metabolic panel, Lipid panel, Thyroid panel, Enzyme markers, Sexually transmitted disease tests, Coagulation panel, DHEA-sulfate serum test and C-reactive protein test. In each of these categories, n number of components of the blood are measured for examination and the most common blood tests are listed in Appendix-A.

Conventionally, the physician recommends only certain blood tests for treatment and in most cases, the blood report is not been used for subsequent analysis and mostly, it is not been centralized for comparison with other reported cases and not been used in medical research. The effort required to construct such infrastructure is immense and the fundamental limitation is that the existing blood test reporting procedure or flow is in a standalone model.

Healthcare became a core in the economy due to epidemic increase in infectious diseases, more frequent outbreaks and endemic. Pandemic is another threat and widely affects the economy for the duration. Preventive measure is most needed to have better control of any pandemic situations and pathologies. The healthcare authority should create a policy to measure all components of the blood from each patient during their doctor consultation visits. The complete and collective report helps the patient for diagnosing the medical condition effectively and making the patients' test reports accessible will help in medical research, comprehensively.

Artificial intelligence (AI) and cloud computing is an optimal solution that consolidates the patients' diagnosis reports and segregates with age, gender along with other information. The reports shall be used anonymously in the healthcare sectors to process and compare the data for further effective diagnosis or treatment and to use for research purposes. The blood component readings have a range between minimum to maximum and the measurement unit may vary. The abnormalities are being measured that fall below or above the range. By training the AI with the normal readings and range, the machine can predict and recommend the patient accordingly to consult the appropriate doctors and or suggestions for further diagnosis and this methodology will help to utilize the healthcare resource wisely. In further advancement, a home-based self-blood test would automatically upload to AI cloud computing to process the data in the aid of diagnosing and to support medical research.

The challenges in a home-based blood test in dependent on the ethics of patients where the history of patients before taking the test may not be trustable due to many factors such as; consumption of alcohol and drugs before the test. However, algorithm to be in placed to eliminate such cases. Alternatively, multiple tests may require to ensure the accuracy which will increase in the cost of the test, though the untrusted tests may be in smaller percentage.

Overall, complete blood tests and centralizing the reports in Artificial intelligent systems will aid the patients for preventive, precautionary measures and early detection of pathology is the optimal solution for future of healthcare.

Appendix A – Blood Test, most common measurable factors

Nutritional Deficiencies	Iron Deficiency
Bone Marrow Issues	Tissue Inflammation
Infection	Heart Conditions
Cancer Cell Growth	Electrolytes
Calcium	Glucose
Sodium	Potassium
Carbon Dioxide	Chloride
Blood Urea Nitrogen (BUN)	Creatinine
Albumin	Total Protein
Alkaline Phosphatase (ALP)	Alanine Aminotransferase (ALT)
Aspartate Aminotransferase (AST)	Bilirubin
Chlamydia	Gonorrhea
Herpes	HIV
Syphilis	Acute Myeloid Leukemia
Excessive Bleeding (Hemophilia)	Thrombosis
Liver Conditions	Vitamin K Deficiency
Type 2 Diabetes	Kidney Disease
Anorexia Nervosa	Cancer Or Tumor In Adrenal Glands
Early Onset Of Puberty	Abnormal Genital Development
Polycystic Ovary Syndrome	Artery Inflammation
Infection	Inflammatory Bowel Disease (IBD)
Heart Disease	Rheumatoid Arthritis
Lupus	Cancer In Blood
Bile Duct Blockage	Cirrhosis
Gallbladder Inflammation	Gallstones
Hepatitis	Pagets Disease
Bone Metabolism Disorders	Heart Surgery
Malnourish	Menzinc Deficiency
Cirrhosis	Liver Cancer
Liver Damage	Cirrhosis
Heart Conditions	Hepatitis
Mononucleosis	(Mono)Pancreatitis
Abnormal Red Blood Cell	Destruction (Hemolysis)
Adverse Medication Reactions	Bile Duct Blockage
Gilberts Syndrome	Hepatitis
Lipoprotein	Triiodothyronine & Thyroxine
T3 Resin Uptake (RU)	Thyroid-Stimulating Hormone (TSH)
Creatine Phosphokinase (CPK-1)	CPK-2 (CK-MB)
CPK-3	Troponin

2.7.3 Part III

Kasfun Nazir Bin Mohd Ali

AI in healthcare has a lot of attention around the world today to better the lives of people. AI is being used in various ways today, from helping cancer research to surgeries. With AI, researchers are able to break through their research at a faster rate. Take for instance this pandemic, Covid-19.

In this workshop, I decided to narrow down AIs potential in pre-hospital care, in particular, the ambulance services. Having gained experience personally, I was able to think of AI could potentially integrate into the pre-hospital care system. Today, although with many technology advances and implementation, there is still much manual tasks and human intervention needed.

- Todays problem: In 2019, Singapore Civil Defence Force (SCDF) attended to 191,468 cases through its emergency hotline 995, which translates to more than 500 cases per day. Amongst the total cases attended, 173,842 were emergency cases. It has been observed in the past 4 years that the total number of cases has been increasing at the rate of approximately 2 percent yearly. It requires the ambulance crew an average of 40 minutes (excluding the administrative work that has to be done after each case) to attend to each case (from the time they are deployed to the handover at the hospital).

- AIs future in pre-hospital care: I explored the potential use of AI in pre-hospital care in the form of an AI assistant. The generic purpose of this AI assistant is as its name, to assist the personnel. Its functions would evolve as it studies the usages of the personnel. The AI assistant could retrieve patient personal data and medical records. Today, this requires a human to gather various data and use multiple technologies. The AI assistant should be able to do the same with the input of certain identification data such as NRIC number and report to the personnel through voice or portable device. This would not only save time but would help the personnel to make more informed decision. The AI assistant should also be able to assist the paramedic in performing the Patient Assessment Model (PAM) when assessing a patient. This could be done in ways such as suggesting questions to ask patients, reminding the paramedic should there be a skipped or missed step in the process or even caution the paramedic if the process or

intervention is not according to the protocol. The AI assistants functions should not just be limited to the above. It should also be able to assist in communication such as translating languages and should also learn the personnels actions and processes then to suggest improvements, etc.

- Benefits and risks: Having an AI assistant has more benefits than risks. Some benefits include being able to help the paramedic reach the decision point more accurately and administer the right protocol, which could improve the success rate. It could also provide a more accurate report to the hospital during the handover, shorten reporting processes and reduce administrative work for the personnel. Some risks include the possibility of negatively impacting the patients status with inaccurate advice and could also provide the personnel unnecessary administrative work.

- Challenges: There are many challenges that would be posed should AI be implemented. Data privacy would likely be the biggest challenge here. The law has to be in place to ensure that data privacy is upheld. It would also be as challenging to train the AI. Feeding the AI with the medical data and protocols would not be enough. Each personnel have his/her own way of performing their work, which may not be easily analysed. Other challenges also include the acceptance of AI and knowledge training for personnel.

Overall, it is a nice dream today to have AI integrate with pre-hospital care. It would definitely help improve patient care generally by connecting multiple systems and technologies, help in decision making and reduce manual tasks.

2.8 AI for elderly on virtual activities and engagement

Siddarth Uppili Raghavan

Tang Jian Wei kenneth

William Siew Jing Wen

2.8.1 Introduction

Singapore is a rapidly aging population. By 2030, it is predicted that one in four Singaporeans citizens and permanent residents will be over the age of 65. This entails a huge shift in the needs of the population particularly in aspects of balancing its economy to remain competitive while further expanding its safety and social nets to accommodate to increased demands in associated healthcare and elderly care giving needs. With global life expectancies increasing through the decades, one way that policy makers could address this issue could be to set forth schemes that encourages the idea of active living and active aging activities with the premise being that an active elderly population would be physically and psychologically healthier. Such measures could also possibly counteract or delay the onset of common old age ailments such as age-related muscle atrophy and dementia which are often prevalent in the elderly population. Artificial Intelligence (AI) has also captured the imagination of everyone in the past decade, and it is evident that it can impact the way we live and play. The average person thinks of dystopias of movies such as Ex Machina, The Matrix or even the Marvel movies when AI is mentioned. AI, however, has many applications in fields that are based a lot less in fantasy.

2.8.2 Active Ageing and AI

An envisioned solution could be to incorporate AI into purpose-built mobile applications with accompanying devices such as activity trackers that monitors activity levels and health metrics in the elderly on a national level. A precursor to this has been seen in the Healthy 365 application, a scheme introduced by the Health Promotion Board of Singapore to encourage residents to lead a healthy lifestyle by engaging in healthier eating and living through active participation in events with incentives such as vouchers given to participants who have accomplished certain health milestones and challenges. Building on this concept, AI could be leveraged to link elderly residents to a list of

personalized recommendations based on factors such as geolocation services, activity levels, climate, health condition and interests where as an illustration of the concept, the application could recommend the individual to take a walk at a nearby park and incentivize them with points that could be used for offsetting utility bills. It could also be used to introduce them to communities of like-minded individuals, social welfare organizations and interest groups for mutual companionship and support aiding in a better quality of life.

With proper consent, such data collated could also be expanded to form an invisible social-safety net that helps ensure the well being of the elderly through AI means. For one, travel and movement patterns logged by the application could be utilized by urban planners to better understand needs of the elderly and aid in the development of elderly friendly services and infrastructure. Additionally, abnormality detection algorithms powered by AI, could also be implemented to identify long periods of elderly inactivity or spikes in logged sensor parameters that maybe indicative of ill health that would require immediate attention from appointed persons. Automated alerts could then be sent to appointed caregivers, social welfare organizations or emergency services for follow ups with said individual. Such developments will result in improved safety of the elderly population particularly those who are single and living alone as they go about their daily lives.

2.8.3 Dementia and AI

The COVID-19 pandemic has also caused us to rethink normal engagement activities and adhere to precautionary measures such as strict physical distancing, which can negatively affect the well-being of elderly persons with dementia and caregivers. The Well-bring of the Singapore Elderly study spearheaded by the Institute of Mental Health (conducted in 2013) has projected the people affected by dementia in Singapore is going to double in the next 10 years in 2030. One in 10 aged 60 and above would be expected to have dementia. Engaging elderly through virtual activities and engagement is, therefore, of a paramount concern.

In the new norm, AI would play a part in determining the mode of engagement and measuring the attention of caregivers and persons with dementia in order to carefully deliver information and support services at different stages of their journey. More importantly, AI and machine learning for digital analytics and video analytics will

bring rise to more ageing research and social innovation. For instance, capturing the attention span of persons with dementia engaging on the virtual activities is key. Using video analytics to determine the level of anxiety or stress is also important to assess caregivers' needs.

The hypotheses for AI research on caregiving and dementia can be:

(a) AI can capture the attention level and on-screen time span of person with dementia through facial imaging.

(b) AI can determine the level of anxiety or stress of caregivers through video analytics.

(c) AI can evaluate responses using a mixed-method and assessment with digital analytics.

In testing the hypotheses, the study would need to

(a) Measure the effectiveness of AI in sustaining attention of persons with dementia,

(b) Examine caregivers' level of anxiety and stress when persons with dementia is engaged, and

(c) Determine type of resources through digital analytics linking to informaton and support services that support households in caregiving for persons with dementia.

2.8.4 Future Work and Sustainability of AI

The potential for research and social innovation would be to develop AI algortihms and frameworks that would help increase and identify the positive interaction of elderly through Human-Technology Interactions (HTI)/ mobile-human interaction (MHI) and digital social networks through mobile technologies through syntax, imaging and usage data. The motivation to do that is to build our nation's capacity to make active ageing a pleasurable experience.

The advancement in fields of image detection, object detection and speech recognition has laid the foundation for the future of HTI. Examples of this would be BabyX by Mark Sagar [1], who managed to create a digital toddler using Neural Networks that reacts to interaction and develops a personality along the way.

Our future... As you grow older, it often seems that the pace of technology outstrips the pace of adoption. The elderly often have to relearn new tools. They also face issues related to loneliness and lack of capability as the body ages.

We are now in 2050. The elderly are no longer lonely or isolated. They are capable to run businesses and socialize despite their age or health conditions.

The elderly in 2050 interact with a visual projection of their A.I companion who can monitor their health, take orders, track tasks and direct physical robots to run errands. Simone the elderly cafe owner now has to tell her A.I companion to make the cups of espresso as she makes the guests feel at home. Raju's AI friend helped him identify a possible muscle strain based on body posture and suggests booking a massage appointment. Huda is enjoying a nice 90's evening curated by her companion for the party she is throwing remotely with her friends

Not everything is Ideal.. This world isn't without dangers. Personal Data protection and lack thereof will lead to safety and privacy issues.

There is also the grander question of should A.I even be deployed to laboriously assist humans. Technology or rather access to technology always creates a gap between the have's and have-nots. Also developing a virtual companion can cause a perceived reduced need for actual human companionship. This would mean the elderly are now abandoned to their virtual friends while their family is preoccupied with their own pursuits of life.

How do we get there... In this world, a human-like AI will help in fields of therapy, companionship, and training. The key factors to consider when developing such a system would be:

(a) Computing Technology: Deep Learning, Object Detection & Speech Recognition aspects of the AI is enabled by the rapid advancements in processing technology. We now get almost real-time feedback in Amazon and Apple platforms in the form of Siri & Alexa. However, Moore's law is projected to slow down [2]. While this doesn't seem to be a big issue right now, the architecture needed to develop a seamless human-AI the interaction will need additional research and investment.

(b) Holographic Technology: The projection of a human-like figure into 3-dimensional space rather than a 4k screen also needs to be worked out. As of 2020, true 3D

volumetric holograph image is only found in isolated circumstances in research labs [3].

(c) Social Costs: Having a humanized AI Avatar aided by physical robots to tend to the elderly's every need sounds great. However, it will displace an existing workforce such as maids and other types of service staff. The workforce is also disproportionately manned from lower-income families, which then jeopardizes their income and livelihood. While an A.I avatar can help expedite processes and increase the ability of the elderly, it doesn't necessarily ensure human bonding and nurturing. More studies will need to be conducted to understand the key factors that make the interaction more sustainable.

(d) Environmental Costs: Increased Automation, Increased Digitizing, Increased Computing. All these lead to increased energy consumption which will ultimately put a strain on the Eco-system in the world already facing Human-led Climate Change, Pollution and Degradation.

The future of A.I for the elderly is bright! The existing technologies are on a trajectory to help build a world where a digital assistant, dressed as Charlie Chaplin with a personality to match can be called on, to play you in a game of Fifa as you enjoy your retirement. However, the hidden costs and limitations related to its technology and environment may need to be considered.

2.8.5 Limitations/ Considerations

As with any solution, there are bound to be ethical dilemmas, legal considerations and downsides.

On ethical dilemmas and legal considerations, the ideas envisioned in this article require pervasive application permissions such as location and consent for it to be effective. While the intention of the application maybe pure, this undeniably raises privacy concerns from users resulting from a loss of anonymity. Moreover, such a system consisting of thousands of individuals produces large amounts of valuable logged data. This presents an attractive target to unscrumptious individuals which inevitably raises concerns of data security. Hence, the question of whether to use the application is a fine balance between privacy, data security and enhanced personal safety that ultimately the end-user must weigh in and decide on.

On downsides, the envisioned application is highly reliant on electronic devices and associated wearables with assumptions of constant application usage and adherence. Such assumptions, unfortunately, is not an emulation of real life in which the envisioned AI concept must be modelled smart enough to discern from or risk falsely triggering alerts in the case of the proposed abnormality detection system.

2.8.6 Reference

(1) Sagar, M.: *BabyX*. ACM SIGGRAPH 2015 Computer Animation Festival. July 2015, pp. 184. See https://doi.org/10.1145/2790329.2790330

(2) Khan, H.N., Hounshell, D.A. & Fuchs, E.R.H.: *Science and research policy at the end of Moore's law*. Nature Electronics 1, pp. 1421 (2018). See https://doi.org/10.1038/s41928-017-0005-9

(3) Smalley, D., Nygaard, E., Squire, K. et al.: *A photophoretic-trap volumetric display*. Nature 553, pp. 4864s90 (2018). See https://doi.org/10.1038/nature25176

2.9 AI & Sweet Home

Gionnieve Lim Jia Yu

The current application of AI for homes can be considered under the term Smart Homes, where the Internet-of-Things is coupled with Artificial Intelligence to give rise to household appliances and devices that serve the domestic needs of users. There has been an increase in the adoption of commercial Smart-Home solutions where the market is expected to grow to 53 billion USD by 2020, with 375 million Smart Homes worldwide by 2024.

There are currently many Smart Home devices for various usages and needs. For home security, there are smart cameras that use facial recognition to detect when a stranger breaks into the house and to trigger an alarm. Some advanced devices can send a phone alert or directly inform the police department.

For lighting and climate, there are devices that can adjust the intensity of the light or the strength of the air conditioner based on factors like the time, weather, humidity, and temperature. They can also turn these devices on or off based on the presence of people in the room.

For housekeeping, there are cleaner devices with area navigation and collision detection features that can sweep the grounds without getting trapped in a corner or falling off the stairs and thus can be left without supervision.

For added quality of life, virtual assistant devices can answer queries posted to them via voice recognition. They can also control connected devices such that one does not need to be in close proximity to the device that they wish to operate.

And finally, for entertainment and fun, there are robots with voice and facial recognition that can react to human speech and expressions. These robots are as much toys as they are pets with their mechanical parts and responsive sounds and movements.

With so many AI-enabled devices, homes are certainly becoming smarter. But more can be done to make them into the Sweet Home of the future.

Firstly, the Sweet Home should have an integrated system for all AI-enabled home devices. Currently, all these devices are standalone and can only be operated individually. But with an integrated system, not only will a common control be more convenient

for the user, but the fact that these devices can now communicate directly with each other gives rise to the potential for increased performance and further innovation.

Secondly, the Sweet Home should also be accessible to minority groups of people. These groups are just as much a part of the household and a Sweet Home should cater to them just as well. Currently, most smart devices are operated through the usual means of physical buttons, apps, and voice recognition and they convey information either through screens or by the speaker. While these forms of interaction and control may seem adequate, they are not so for those with visual and speech impairments or the young and old who may have undeveloped or deteriorating senses. Other forms of controls like braille, text-to-speech, hand-signing recognition, and text size controls should be made available such that these groups of people may share the same advantages of controlling and living in a Sweet Home.

Lastly, the Sweet Home should also be inclusive. Most existing smart home devices are catered to adult use and do not meet the needs of other members of the household such as the children, the elderly and even the pets. To create inclusive smart home devices, better algorithms that can understand the vocal cadence of young children who are unable to speak clearly or coherently, understand the dialects spoken by the older generation, and understand the body language of pets have to be built. These algorithms can then be integrated to smart caretaker devices that can watch over the children, the elderly, and the pets through their daily activities.

While a Sweet Home is great, there are challenges that must be overcome. One such challenge is that it is not practical to expect that Smart Home device companies will cooperate by using the same software platform for their devices such that an integrated system is possible. Accessibility and inclusion also poses a challenge as companies usually produce goods that have a large market to maximise profit, and it is unlikely that they will produce specific products or develop customisations or added features just for the minority groups.

There are also risks to the Sweet Home. With an integrated system, there will only be a single control system and hence just one point of security. If the system is hacked, all the smart devices can be used for spying and other vices. In addition, the risk of the invasion of privacy is pervasive in all smart devices as the companies can collect sensitive usage information, and there is always a likelihood of this information being

abused by staff or sold to other entities.

With the Sweet Home, there may also be impacts on the job market. For one, many domestic services such as housekeeping, childcare, and nursing will be compromised as their tasks are taken over by the smart devices. On the other hand, software and hardware related industries will get a boost, where a rise in the employment of AI, software, security and mechanical engineers and manufacturing workers is likely.

On the question of whether the Sweet Home will be realized and accepted by people in the future, the outlook seems positive seeing as how AI-enabled technologies are already being readily adopted. The main concerns would be on cost as AI technologies are not cheap and may not be worth the added convenience. Another concern is on privacy as there have already been many cases of privacy breaches by reputed tech companies that have shaken consumer faith. A final concern is that there are still people who are suspicious of AI and may fear its invasiveness in everyday life. However, the general populace is still likely to be receptive to the Sweet Home.

2.10 AI & Sports

Cheong Li Yang

Combat sports such as Brazilian Jujitsu (BJJ) are highly complex. Likened to "Human Chess", there are virtually infinite combination of moves and positions that one can execute. Added to that, the practitioner's performance relative to his/her opponent is contingent on one's skill and knowledge,physique, fitness and flexibility.These present a steep learning curve for students and for instructors to overcome in order to coach effectively.Moreover the recent COVID-19 pandemic presents are very unique and crippling challenge for pratitioners worldwide as gyms are shut and social distancing prevents sparring and training with partners.

Artificial Intelligence can help to solve these challenges. A system known as "SenPAI" is proposed. "Senpai" is the Japanese word that refers to a "senior", "teacher" or "mentor". The name, "SenPAI" stands for Sen Personal Artifical Intelligence and is proposed to serve as an AI-enabled personal mentor for sports training.

The concept of this AI system draws inpiration from existing technologies such as Deepmind's AlphaZero and OpenAI. Both AI systems have dominated recent headlines with their incredible feats: AlphaZero is effectively the world's best player in games such as chess, Shogi and Go and OpenAI was able to teach itself how to sumo-wrestle. Other AI technologies such as used in the Peak Performance Project(P3) laboratory enable sports scientists to conduct accurate, comprehensive and predictive analyses of athletes' movement and performance.

With these in mind, the proposed SenPAI system is envisioned to be a master of the art of BJJ, using its andvanced neural network to self-learn, self-compete and to learn winning strategies from elite human athletes in the sport. The SenPAI is also able to analyse the user's movement and advise areas of improvement in terms of technique execution as well as strength and conditioning. It devises a bespoke training programmes for the user and tracks the user's personal performance and progress.

One ethical ramification of such an AI system include potentially threatening the jobs of human sports instructors. This author believes that disruption begets evolution, and for a sport such as BJJ that has undergone decades of evolution, such a disruption would only see the advancement of the sport rather than its destruction. Also, there may be the development of 'killer' grappling robots, so often depicted in Hollywood

movies. This author believes that to curb such an outcome, legislation and engineering systems have to likewise developed to reflect Asimov's Three Laws of Robotics in the effort to safeguard human life and welfare.

In conclusion, this author believes that there is much potential for AI in the realm of sports, not just for BJJ. It presents a paradigm shift which the human race would progress to, learning one step at a time...

2.11 AI & Ethics

2.11.1 Part I, Applying AI to government policies

Luqman Marhim

At the foundation of government policies is the research and studies done by the government officers. This ground work, involves perusing large volumes of data and records, both quantitative and qualitative, of which majority of of the work can be fairly routine. For example, in the analysis of patterns and trending of weather records to determine how the drainage systems in a local area are designed. Such a study would require a significant amount of man-hours from multiple government officers to study the data available. In such a context, AI can be useful in developing an algorithm that can learn and identify weather patterns based on historical records, along with the analysis of the local terrain to derive an optimal draining solution. Thus, reducing the amount of time and resources required to produce such policies and solutions.

However, there are also potential drawbacks. One such example would be the "human factor"; how do we factor in qualitative parameters such as empathy, compassion, in our AI algorithms? While quantitative factors such as amount of rainfall, average income, etc. can be derived and computed, computing qualitative values are more complex. Using the earlier example of designing a drainage system in local terrain. If the solution derived from the AI algorithm computes that the most optimum path for the drain is to pass through the shelter of an elderly lady that was not recorded in the database, how do we teach the AI that this may not be the best solution albeit optimum. Such situations are commonplace when interacting with people where decisions made may differ from the standard procedures as additional information may be gathered implicitly such as reading the body language of a person or understanding the circumstances a person is going through. The question then is: can we write a sufficiently robust algorithm can account for qualitative values and implicit information?

In summary, there are potential benefits and disadvantages from using AI to derive policies. However, these policies will eventually be deliberated by humans - government officials, policy makers and the like - who have inherent systemic biases. As such, these policies would be subject to such biases, regardless if they are AI-driven or otherwise. Therefore, while there may be concerns for the application of AI in policy-making, the spotlight of ethics would still fall on humans.

2.11.2 Part II

Balakumharen Palanisamy

One of the biggest obstacles of AI coming into society and human life is trust and acceptance issue. So lets see how humans develop trust with anything?

Human trust is a very complex system involving a large number of variables, both consciously and subconsciously like behaviours, culture, emotions, interactions, familiarity of the person or object, Personal bias etc.

Over thousands of years, humans mental models of trust have developed based on human emotions and relations. So it would be very difficult for a person to trust something which may possibly lack a lot of these factors. In case of Autonomous products, people may be confused on whom to put their trust on, is it the brand ,or the designer, or just the technology.? Or is it something else?

Let's take a situation where you are waiting to cross the road and your signal is green and you start crossing the road, then you notice a fast car approaching from a distance? In this situation how will you be sure that the car is going to slow down and stop instead of hitting you. Usually we will be seeing the car closely and may look at the driver as well, and on noticing the drivers actions we will come to decision whether its going to stop or not? Whom do you trust in this situation?

Is it the driver? Or the government or law? Or the ethics and humanity of the driver?

Imagine the same situation with an autonomous car, there wont even be any driver to look at, and you wont be sure whether the car sensed you or not. Or is there any problem with sensors or the system?

So the interactive communication between the vehicle and the person is missing here, which raises a lot of confusion. We are sure that the AI vehicles are well connected with other AI vehicles and are aware of the environments as well, but it may lack the connection and interaction with humans which is the base of building trust.

It would be a great step forward if AI machines can interact with humans in a more effective way to create trust. With the use of AI to improve interactions the human-machine interactions will become more natural and intuitive.

.