Explained: Wireless Charging
Editorial

Hi!

Welcome to the new semester, which brings with it a brand new issue of Beta!

Beta has gone through a variety of changes this year; from an amazing new design to starting the transition to an online platform, the whole Publications team has worked extremely hard to make these changes happen and to help materialise all the amazing ideas we had. However, it is you, the reader, that is the reason for all these changes. At the start of the year, we wanted to improve the experience of Beta for you and work towards building a newsletter that was specifically tailored to UNSW CSE students. We created a new design to make reading issues more pleasant and have started moving to an online platform to make Beta more accessible. We’ve also made efforts to curate content to suit our audience.

Of course, there’s still a long way to go - which is why we want to hear what you have to say! What kind of content would you like to see? What kind of content do you feel is irrelevant? What other mediums would you like to see Publications expand to? Ask, and we will do our best to give it to you! You can fill out the feedback form at http://bit.ly/beta-18s1-feedback or just write to us at publications@csesoc.org.au with any wacky ideas that you have. We want to produce more and better content and we hope to push more boundaries this semester.

Thank you for reading Beta, and on behalf of the Publications team, I hope you enjoy the issue and wish you the best of luck for this semester!

Siddhant Virmani
Editor in Chief | Publications Director 2018
THE EFFECT OF HUMAN BIAS
On Artificial Intelligence

Mehri Amin

With the rise of powerful computers, the Internet, and the global digitization of information, machine-learning is rapidly becoming a prevalent technology in our society. However, as machine-learning seeps into our everyday lives, there is still a lack of understanding about the technology from the wider community.

Artificial Intelligence (AI) and machine-learning have become buzzwords in the media, but most people who use this technology don’t really know what it is. So, what is machine-learning? Let’s say you want a computer to recognize your face. Traditionally, you would write a ton of code that tells the computer what you look like, such as whether you have short hair or long hair, wear glasses or no glasses, and so on. On the contrary, when it comes to machine learning you wouldn’t tell the computer any of that. Instead you would provide a program to look at a bunch of images of you and other people over time and figure out who you are on its own. Where traditional programming requires a lot of manpower and leaves plenty of room for errors, machine-learning just needs data, a lot of data.

Machine-learning algorithms (MLAs) are widely being used in our society whether it’s choosing which candidate will receive a job interview, deciding if someone should be granted parole, or allowing a person to obtain a loan.

The reason we use MLAs is due to the theorised notion that MLAs improve the quality of decisions as they can make these decisions quicker than a human at a fraction of the cost as well as having the purported absence of human bias.[1]

“If we give these systems biased data, they will be biased.”
– John Giannandrea, Google’s AI Chief[2]

Algorithmic biases can be best defined as systematic and repeatable errors that create unfair outcomes for certain groups of users over another group of users. A Pulitzer-Prize nominated story by ProPublica analysed the COMPAS Recidivism Algorithm that is commonly used in the United States by judges, probation and parole officers to assess a criminal’s likelihood to reoffend. COMPAS has become a prime example of a racially biased algorithm.

COMPAS scores a defendant on a range from 1 to 10, where scores 1 to 4 are labelled by COMPAS as “Low” likelihood of reoffending, 5 to 7 labelled “Medium”, and 8 to 10 labelled as “High.” ProPublica analysed over 10,000 defendants scores and found an alarming pattern. Black people were almost twice as likely as whites to be labelled a higher risk.
but not actually re-offend and white people were more likely than black people to be labelled lower risk but go on to commit other crimes.\textsuperscript{[1][2]}

What went wrong was that some of the data used by COMPAS was fundamentally tainted by racial inequalities in the criminal justice system. Ifeoma Ajunwa, a law professor at Cornell University stated that, “The criminal justice system has been shown to have systematic racial biases. If you’re looking at how many convictions a person has and taking that as a neutral variable – it’s not a neutral variable.”\textsuperscript{[3][4]} Black people are arrested more than white people, even though both races commit crimes at the same rate. They are also sentenced more harshly and more likely to be searched or arrested during a traffic stop.\textsuperscript{[5]} It is illegal to consider factors like race in such cases, but algorithms can learn to recognize and exploit the fact that a person’s education level or home address may correlate with other demographic information, which can then associate them with racial and other biases.\textsuperscript{[6]} Avoiding algorithmic bias is extremely difficult because it requires an understanding of both very complex technology and very complicated social issues but the social context is lost on an algorithm that takes numbers at face value.

We are leaving it up to algorithm makers to decide whether they’re creating MLAs appropriately. The only people who have access to these algorithms and their decision making are people who built them. Even the police do not have access to the algorithms they are using on defendants. If we keep going in this direction, we will be handing over the decision of how to govern our society to people who do not have that expertise and can’t explain or won’t explain how these decisions by MLAs are being made.\textsuperscript{[7]} These MLAs that are either too complicated to understand or which companies are refusing to explain are known as Black Boxes.

Black Boxes offer quick and easy solutions to those who know little or nothing of their inner workings, thus making it a whole lot harder to know if an algorithm is biased.

MLAs decision-making is highly dependent on the data that is fed through it. They operate wholly within the world defined by the data that were used to calibrate it. They also take the assumption that things will more or less continue as before in order to operate. So how do we overcome the bias?

Users of MLAs need to understand the shortcomings of the algorithms and know which questions will result in answers that would be invalidated by algorithmic bias. Algorithm makers need to work with the experts in the fields their MLAs are being designed to be used in to develop algorithms that have a diverse and complete set of data to minimise biases and provide the appropriate procedure. Finally, we need to know when to use and when not to use MLAs. There is undeniable evidence that MLAs have a trade-off. While they offer speed and convenience, they are far from reaching the flexibility and transparency of a human decision.

Even though the research behind these machine-learning technologies is years behind the sophistication required to make unbiased decisions, we are currently using MLAs to decide which candidate will receive a job, obtain a loan or be granted parole - decisions that should be completely bias-free. By spreading awareness and understanding to the wider community on the technology and enforcing new laws and better government regulations to reform how companies and government agencies use AI to make decisions, we may be able to overcome the current biggest threat to the development of AI.
References


Are you sick of replacing your damaged phone charger multiple times a year? Do you bring charging cables with you to uni because your batteries don’t last long enough? Wireless charging is the solution. Not wireless charging using a “wireless charging” pad, but true wireless charging which works like Wi-Fi, where the power is sent through the air to your device. This technology is currently under testing and further development by multiple companies including tech licensing companies Ossia and Energous. These companies’ patented technologies - Cota and Energous - operate using receivers embedded within mobile devices, and transmitters which send power using radio waves, all while ensuring the safety of people and animals. While current applications of this technology are primarily charging phones, tablets, and laptops, the growth in IoT devices means there is a bright future for wireless charging.

How it works

There are three main components to wireless charging technology:

- **Transmitter**: the transmitter is available in multiple forms depending on the environment it is to be used in. The transmitter sends power to the receiver using 2.5GHz radio waves.

- **Receiver**: the receiver is a 3mm x 3mm silicon chip embedded into mobile devices. As an alternative to this, there are receivers available which plug in to the existing charging ports on devices.

- **Software**: Cloud-based software can be accessed through web and mobile applications. This software allows control of which devices receive power from the transmitters and can be configured to automatically prioritise the delivery of power to devices which require it most.

Cota transmitter
source: http://www.ossia.com/cota/
When a device requires power, the receiver sends beacon signals to the transmitter 100+ times per second. These low-power beacon signals reflect off most walls as well as people and animals, therefore avoiding them when determining the most direct path. The transmitter receives these continual beacon signals and sends power along the most direct path to the receiver. This process continues for as long as the device requires power for charging.

Applications

Currently this technology is at a stage of testing and development. In past demonstrations, it has been shown that efficiency is relatively low with 8 watts required to transmit 1 watt of power. Transmitters currently cover a reasonable distance depending on the product, with the Energous Far Field WattUp transmitter able to charge devices within a 4.5 metre radius.

Energous identifies their current targets as devices which require less than 10 Watts. These include smartphones, smaller tablets, wearables (activity trackers and smartwatches), sensors and computer accessories (e.g. wireless keyboards).

While Ossia and Energous as well as other companies continue to develop and improve wireless charging technology so that devices with greater power requirements can be charged, there are ways to maximise the output power utilising the current technology. Multiple transmitters can be connected and controlled collectively by the cloud-based software.

Issues

With power being delivered via radio waves over distances, health and safety impacts are an important issue. For materials containing water such as body tissue, extensive exposure to radio waves can cause generation of heat which can lead to burns and damage. With devices charging constantly and therefore radio waves being transmitted constantly this potentially harmful issue is avoided with power travelling only along paths which avoid people and animals. The beacon signal is sent 100+ times per minute to find the safest and most direct path, and then power is sent back to the receiver using a radio wave that travels via the same path. This process is repeated continuously to ensure that the radio waves never
come into contact with people or animals, even as they move around a room.

Another important issue is the privacy of charging networks. Using the cloud-based software, password control can be turned on to restrict access to power transmitters, in a way similar to restricting access to Wi-Fi networks, ensuring privacy and security.

**Future**

It is evident that this technology delivers benefits of convenience and improved productivity. From eliminating the need for charging cables to using software to set times for devices to be charged each day. However, the future will see applications of this technology expand significantly.

The companies which are on the forefront of delivering this cutting-edge technology envision a future where there exist networks of ‘always charged’ devices. The devices are not limited to mobile phones, tablets and laptops, but include a wider range of internet of things (IoT) devices as well as appliances and accessories which currently rely on battery power such as TV remote controls. This future is possible due to the versatility of receiver chips and their small size which means they can be easily embedded into a range of devices, as well as the ability of receivers to take the form of rechargeable batteries.

The installation of multiple transmitters in forms such as the Ossia roof tile and the WattUp far-field transmitter throughout the home, office or retail environment, will see these networks of connected and always charged devices soon become a reality. The consequences of widespread adoption and usage of wireless charging technology will mean battery life is a less important consideration for developers of many devices. This will undoubtedly lead to designs of smaller, lighter and thinner devices such as laptops and smartphones. From convenience to improved productivity, accessibility and efficiency, it is clear that wireless charging delivers endless possibilities.

**References**

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If you’re as clueless as I am when it comes to the term ‘artificial intelligence’ (or AI for short), then whenever you hear those words, then you would probably think of HAL 9000 from Stanley Kubrick’s 2001: A Space Odyssey or maybe Ultron from the second Avengers movie. To those of you who are fans of science fiction, you’d be aware that the rise of thought-capable machines aren’t very well received in pop culture.

However, what with the advent and rise in popularity of AI programs in various industries, I’ll be trying to clear the air surrounding this mystifying, and often misunderstood, application of computer science, both for myself and everyone reading this.

**So what is it really?**

To put it as simply as possible, an AI is a computer system or program which can operate tasks which require human intelligence to complete. From simple, mundane things that a 5-year-old could do such as identifying whether a picture contains a cat or a dog to vastly complicated applications such as piloting a self-driving car, all these applications require some form of inherent knowledge or intelligence to complete.

**How does it work?**

Now, you might be wondering, how is it even conceivably possible for someone to program something which can think for itself?

Well, AI is quite a broad category and thus comes with even broader applications and implementations. One such implementation comes in the form of decision trees. For a lot of you out there, your first exposure to a supposed AI would have occurred years ago in the form of a ‘bot’ in a video game, framing itself as an enemy for you to overcome.

The actions of these bots are dictated through a decision tree, essentially a fancy flowchart or maybe even a collection of ‘if’ and ‘else’ statements. This is about as basic as an AI could get. You ever see those flowcharts on Facebook about how to do something? Well, they’re pretty much the same thing as those but they can get immensely complicated as you start fleshing out the program.
If we wanted to get even more in depth, another implementation of AI that you can explore lies in the form of genetic algorithms. Akin to the laws of evolution, this type of AI programming models its development through generational improvements. To put it simply, how it all works, is that you start with a random number of different programs. These are all subjected to the same test, whether it be picking between pictures of cats and dogs or recognising English and Chinese. These programs are now scored and the best of them are worked on, or ‘bred’, to produce a new set of programs which are then also tested and scored. Over time, after many iterations of this process, these programs become highly specialised and adept in what they’re required to do and are fully capable of performing their required task almost self-sufficiently with almost perfect results. A more thorough example of this can be seen in CGP Grey's video on how machines learn.


**Current and Future Applications of AI**

Examples of AI in your everyday life can be found everywhere, and its potential possibilities are endless. Every time you search something with Siri or Google Assistant or whenever Netflix or Spotify come up with new movie or song recommendations, some sort of artificial intelligence is taking place behind the scenes to cater to your tastes.

For some more advanced and up and coming applications of AI in the world, we are beginning to enter the era of self-driving cars and job automation. Tesla’s “Autopilot” and Google’s “Waymo” are already racing (pun intended) towards perfecting their versions of driverless cars while in other areas, we’re beginning to see robots and AI work hand in hand towards job automation for complex tasks.

**What lies in the future**

The rise of smart robots will of course, always bring a healthy dose of discussion to the table, due to rising concerns over ethical and moral dilemmas such as the infamous ‘Trolley Problem’ in self-driving cars as well as the growing discussion on the obsolescence of a large proportion of jobs due to automation. A projected 40% of all jobs are predicted to disappear due to job automation in Australia within the next two decades and there are growing concerns over the economic effects that this will have on the world and our society.

**Want to learn more?**

For those of you who are still thirsting for more knowledge, there is one other implementation of AI programming which I haven’t gone through and it’s a little thing called neural networks. Should there be anyone reading this who is interested in learning more about AI at a more technical level, the School of CSE does offer some courses on Artificial Intelligence, which are listed below:

- **COMP3411** – Artificial Intelligence
- **COMP9444** – Neural Networks and Deep Learning
- **COMP9417** - Machine Learning and Data Mining
- **COMP9517** - Computer Vision
- **COMP4418** - Knowledge Representation and Reasoning

**References**

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- [https://www.youtube.com/watch?v=R9OHn5ZF4Uo](https://www.youtube.com/watch?v=R9OHn5ZF4Uo)
A common puzzle goes as follows: In your sock drawer, you have a dozen socks: Half-a-dozen white and half-a-dozen red. You are about to pull out a pair of socks when the power goes out, plunging the room into darkness. What is the minimum number of socks you should take from the drawer to ensure you get a matching set of socks to wear? (there is no difference between a left and right sock). If you have heard this before consider this problem: In a similar situation, how many socks would you need to take to guarantee you get a pair of white socks?

You sit in a rowboat in the middle of a perfectly circular lake. On the shore of the lake there is a monster that wants to eat you. The monster is unable to enter the water, but can move along the shore line exactly 4x faster than you can row. The monster will always run toward the bit of shore closest to you (and will pick arbitrarily if there are multiple equally fast routes). Once you reach the shore you can easily outrun the monster. Assuming both you and the monster can turn instantly, what strategy should you use to allow you to escape?

A merchant owns a single 40 kg rock which he uses with a balance to accurately measure out wheat to sell. One day a traders comes to him and offers to trade the merchant's 40 kg rock for 4 smaller rocks, whos' masses add up to 40 kg. The merchant agrees and ends up with 4 smaller rocks each with a unique mass. He is now able to accurately measure (with a balance) the masses of any item with integer mass between 1 and 40 kgs. What are the masses of the 4 rocks the merchant now has?

Bob and Alice play a game on a chessboard. They place a knight at an arbitrary location on the board and take turns moving the knight. The knight moved in the standard L-shape, but may not visit any squares it has previously visited. The first player who cannot move the knight loses. If Bob goes first, and both players play optimally, how can Bob guarantee he wins?
This problem is a common problem used in introducing concurrent systems in computer science and thus has a wide variety of solutions; from simple to very hard. We will outline a simple(r) solution.

At the start of the scenario, designate a chopstick as the master chopstick. Then have all philosophers follow a rule: they may only eat when the chopstick to their left gets put down, unless the master chopstick is to their right and they have never eaten before.

He should give himself 98 coins, pirate C 1 coin and pirate E 1 coin. This problem can be solved by considering the case where there is only one pirate, then 2 pirates then, 3, etc.

If we follow a strategy of random guessing we will have approximately a one in $10^{30}$ possibility of finding all the correct numbers. However there is a strategy that provides a probability of > 30%.

A key observation is both the drawers and the prisoners are numbered 1 to 100. We can use this information to reduce the number of duplicate drawers that are opened. As such: Each prisoner needs to first open the drawer associated with their number. If they find their number they are successful, otherwise they open the drawer associated with the number inside the current drawer. They keep repeating this until they have either found their number or opened 50 drawers. This can be thought of as finding cycles in a linked-list.

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The problem is symmetric, thus there is more than 1 solution. One solution is presented. A key observation is that the princess is trapped if she is one of the outermost rooms, this means we can just limit our search to the innermost 4 rooms.