AI & ML
What do the terms AI and ML mean to you?

Machine learning is something that I started taking an interest in when I was at university. I completed a dissertation that used machine learning, combined with traditional medical imaging, to segment and partially diagnose melanoma on patients' skin. For me, machine learning is all about training a Neural Network to assist humans with a task.

I also view AI in a similar way, it is best used when combined with a human view on situations to output an answer/action/feedback in a way that should improve the humans decision making. In its current stage I don't see AI being able to make smart solutions to multiple difficult situations by itself, but in the next decade or so the time will definitely come where it can.

The difference between the technologies is how they are used. AI is used to solve a problem in a way a human might, whereas machine learning is based around algorithms that have the ability to learn from experience and usually without human interaction.

Describe some of the techniques and algorithms used in each and what types of problems can be solved by using these?

I have used machine learning to help improve the diagnosis of skin cancer from images of potential lesions. This is a good way to use machine learning, computers are extremely good at finding patterns and similarities between different images, so can be beneficial to use in this way. I created a semi-supervised neural network that used labelled images to train itself. In my experience this was the quickest way to accurately train a NN.

The main algorithms I've developed an AI to use were Decision Trees and Nearest neighbours. The KNN Algorithm worked best with trying to compare an input to groups of similar inputs. I used this with robotics to locate a 'beacon' that was input from a named colour. By creating groups of RGB values, I could take the robots vision sensor to find items in the vicinity that were similar.

How would you apply these techniques at HPP?

With the areas of ML that I am familiar with, the first area that could be almost fully automated is the triage and service desk portion of IT. By training a CNN that uses keywords (and possibly emotion for priority) you could create a system that could classify tickets coming in to SD.

It would take a sample of existing tickets, of which the 40,000 we have in Jira would be a good enough subset, to find common solutions based on the comments and root cause fields. From this data, incoming requests would be parsed & next actions would be suggested for the servicedesk to follow based on the tickets that are most similar to the incoming ticket. This is similar to how the KNN algorithm works in Neural Networks.

AI could be used in another area of IT at HPP I've worked in. An AI that works with historical CAS data could both request renewals quicker than a human and also make sure HPP is only buying items at good prices. Of course this is a basic way to use an AI, but would help prevent license outages while also saving the company money in the long term.

AIOps is a growing field, so use throughout operations will only increase in the coming years. A novel usage for it could be similar to how the CPAP teams used a robot to transport goods. By using the AI to 'self-drive' a robot to a desk it could be used to transport new IT goods (mice, keyboards, hardware deployments) around the business in an easier way.

What is your favourite AI or ML product?

In terms of consumption, (especially during covid) the best most used AI product for me would be media streaming sites like Netflix & YouTube. The way they can process 10+ years of my viewing habits to provide a small sample of videos they know i'll enjoy is very impressive. Similarly a lot of my music taste is because Spotify has shuffled music that I now love, but would not have been exposed to on traditional radio.

My personal favourite use of AI/Machine Learning would be one that I currently do not have to use very often. Google Maps helped me know exactly when to leave my house to arrive at work on time by taking inputs from other users currently on the road, mapping the best path by distance and average speed then alerting me via my phone. It's not the most important thing, but finding out I needed to leave 5-10 mins earlier made my life easier, which is the overall goal of AI.

I know how complicated the shortest path can be from some of my university AI modules, so this makes me appreciate the amount of data Maps condenses into one opinion. Of course if I choose to take my own opinion instead, Maps will combine my input with the ones it was trained with to achieve the best result.

What is the smallest unit in QC and why is it revolutionary?

The smallest unit in Quantum Computing is the Qubit. It is revolutionary because it exists in both an on and off state at the same time for short amounts of time. This is radically different to the traditional binary states, so instead of fixed values, all outputs are processed as probabilities. This allows us to run a yet undetermined amount of processes at speeds way beyond existing hardware. Instead of one transistor equaling one bit, 1 qubit can communicate values to other particles exponentially.

What are the physical solutions to representing a single QC unit?

One way to physically measure the state of a Qubit is by mapping the internal state into a spatial location. A single QC unit can be represented by rotating the Qubit based on its polarisation to calculate the probability based on the amount of atoms in each state. The amount in each state is found by rotating a single Qubit, all other Qubits with the same value will also move at the same time. The polarisation of the Qubit can be currently measured using a polaroid film or a calcite crystal.

What types of problems is QC exceptionally good at solving?

Quantum computing is extremely useful for any issues that require complex mathematics. Applications of this could include weather predictions, cryptocurrency calculations, rapid genome sequencing and eventually providing humanity with a self learning AI that can reach a greater intelligence than humans.

All of these applications have the potential to change society and this is why quantum computing is one of the most exciting areas of Computer Science. With quantum computing, thousands of years of Artificial Intelligence/Machine Learning training could be compressed into just minutes. This progression would be compounding, with more and more knowledge being created as machines improve their own structures.

How would you apply QC based algorithms to real world or HPP solutions?

HPP could apply QC to the entire process of new part creation. By changing the process of building a new part and testing it in simulations, an AI running on a Quantum computer could fully simulate a new generation of engine, simulate performance much more accurately than existing systems and save 1000’s of man hours per year. All areas of simulation can be viewed in a similar way, with quantum computing likely to massively impact all of manufacturing and development.

While the first F1 team to design specifically on CFD (Virgin in 2010) might have not gone so well, if a team gets access to a QC first and knows exactly how to incorporate it into their existing structure they will absolutely be able to produce better parts quicker, while also benefiting from race strategy improvements and better data analysis from their cars sensors.

All areas of F1 part design can be innovated by QC. As most of what we deal with involves simulating already known forces and resistances, millions of variations of the same parts could be tested per hour.

What impact will productionised QC have on the world of IT specifically?

The usage of quantum computing will transform the landscape of IT. Although for most people they most likely will not need access to a QC, the extra power that can be used to develop and run more advanced AI will still affect everyone's lives. While most people will still be using traditional hardware, developers can work with bigger training datasets to provide a more accurate and intelligent service without the consequence of having unfeasible calculation & training times. New materials can be simulated to help improve traditional computing too; more thermally efficient CPU’s, more secure communication protocols and even predicting financial markets.

These are all areas that IT currently is involved with but with quantum computing could be more efficient and capable. A lot of the knowledge about the discovery of Graphene was performed running simulations which of course would be performed many times faster using a QC. Encryption and decryption for secure transmissions could also be made much more secure, RSA-2048 might not be factorisable with current mainstream technology but will likely be broken by a quantum computer in the next 15 years.