***Cognitive Computing***

Hello everyone, my name is Laura Forde and today I will be talking about cognitive computing with ye. For this presentation today, I will be discussing a few certain topics. Firstly, what exactly is cognitive computing? The history of it, I will use IBM's Watson as an example of this technology, the future of cognitive computing and then I will give a brief conclusion on cognitive computing and where I think this will go in the years to come.

**What is cognitive computing?**

Cognitive computing is made up of three major parts, neuroscience, supercomputing and nanotechnology. Neuroscience is the study of the nervous system and brain, supercomputers are a very powerful mainframe computer and nanotechnology deals with dimensions and tolerances of less than 100 nanometres, primarily concentrating on individual atoms and molecules. It also combines machine learning, natural language processing, speech, vision, computer human interaction which mimics the functioning of the human brain. For a system to achieve this level they must be adaptive, interactive, iterative and stateful and contextual. ( <https://synthexis.com/cognitive-computing/>) IBM says that a cognitive system are ones that can learn at scale, reason with purpose and interact with humans naturally. Basically, cognitive computing is to try and get a system that will 100% mimic the human brain, interact the same as humans would and have the same functionality as the human brain. There are many examples of cognitive computing, people who has done their presentations already, such as Dara with Machine 6learning, as to what these systems will be able to achieve and how they learn. The basis around cognitive computing has been in development for many years. The ability for machines to learn has been the aim for many years, even if some people believed that it would never be achieved.

**History of cognitive computing.**

The start of cognitive computing started back in the 1950’s with the Turing test, developed by Alan Turing. Turing’s question on computers is, “Are there imaginable digital computers which would to do well in the imitation game?”. This test was developed to test a machines ability to exhibit intelligent behaviour in comparison to a human. For this test there would be three parties involved, one being a computer and they would all be in different locations. The tests were limited to screen/text, so the machine would not be expected to speak. Since the introduction of this test it was been highly influential and widely criticised, but it has also become an important concept in the philosophy of artificial intelligence.

Then in the 1960’s there was the use of the first commercial database management system that tracked large amounts of structured data needed for the Apollo moon mission. The focus changed to A.I. in the 1970’s. Donald Davies was the designer and director of the first implementation of an NPL data communications network. He was the head of a team at the National Physical Laboratory in England who operated a local area computer network. The first version, the Mark 1, were operational in 1969 but the fully operational version was not operational until 1970. The NPL network and the wide area ARPARNET in the United States were the first two computer networks that implemented packet switching and were interconnected in the early 1970’s. Also in this decade we saw a backward chaining system that used A.I. to identify bacteria that caused severe infections such as meningitis, and this system is the MYCIN. It was named MYCIN because many antibiotics have the suffix “-mycin”. The system would recommend antibiotics and would adjust the dosage based on the patient’s body weight. It was developed in Stanford University by Edward Shortliffe for his doctoral dissertation, it was written in the programming language Lisp and Shortliffe was under the direction of Bruce G. Buchanan, Stanley N. Cohen and many others. The system worked by asking the physician a series of simple yes or no questions or textual questions. It would then give a list of possible culprit bacteria ranked from low to high, how confident the system was in the diagnosis, the reasoning behind the diagnosis and the proposed drug treatment. While MYCIN was never used in practise it underwent research and it was shown that it proposed acceptable therapy in about 69% of cases, which was better than the performance of experts who were judged under the same criteria.

The focus of studies then moved from A.I. to machine learning in the 1980’s. In this decade the focus of machine learning was the algorithms that would be necessary for a machine to learn like we ourselves learn by language processing. The man that introduced us to the probability and decision theory side of A.I., Judea Perl, made all that possible in the 80’s. Perl is a computer scientist and philosopher from Palestine who has a masters in electrical engineering and a Ph.D. in the same field from the New Jersey Institute of Technology and New York University Tandon School of Engineering. He has won many awards throughout his career such as the IJCAI award for research excellence in 1999, the ACM Turing award, Rumelhart prize and the Harvey prize all in 2011. Before he started working in the UCLA’s school if engineering in 1970 on probabilistic artificial intelligence he worked in the RCA research labs at Electronic Memories Inc. on superconductive parametric and storage devices, but he moved on from there because, in his own words, semiconductors “wiped out” his work. Pearl is still working at the age of 81 in UCLA as a professor of computer science and statistics and director of the Cognitive Systems lab here too. From Pearl’s work in the 1980’s machine learning progressed into the 1990’s with the unveiling of IBM’s Deep Blue.

Deep Blue was a system that competed against the chess world champion. Deep Blue first played against Garry Kasparov in February 1996, while Deep Blue won the first round of six, Kasparov won three and drew two of the remaining five rounds. In May 1997 they had a rematch after more work was done to the Deep Blue system and Deep Blue won. Kasparov accused IBM of cheating and demanded a rematch, but IBM refused, and Deep Blue was retired. Which to me added questions as to why they would retire the system and not have one last rematch to see who the real champion was, man or machine.

Machine learning was then taken to the next level in the early naughties when IBM introduced us to Watson. I won’t go into detail about the Watson system now as that is what this presentation will be moving onto next as my example of a cognitive system. While the idea for Watson was presented in 2005 we didn’t see an implementation of it until 2011. From here, I will be talking about Watson and where this field of research will be going in the future.

**How did Watson start?**

How many people here know what Watson is? Honestly, I didn’t know about this system up until last year I believe. Since I heard of it I have been really interested in how this system came into development and what it can do and what it can be used for. The concept of Watson came about in 2004. Charles Lickel, an IBM research manager was out for dinner with his co-workers. He realised that the restaurant had suddenly gone very quiet and he discovered the reason for this is because everyone was watching Ken Jennings, competing in his 74-game run on Jeopardy. Lickel decided that this game show would be a good challenge for IBM. He proposed the idea to his co-workers but didn’t get any backing until 2005 from Paul Horn, IBM’s research executive. Horn then pushed the idea onto his team that an IBM system should take on the game show. David Ferrucci, IBM’s senior manager of Semantic Analysis and Integration, eventually took up the offer of creating such a system.

**What is Watson?**

The software of Watson uses DeepQA and the Apache UIMA (Unstructured Information Management Architecture) frame workout. Watson runs the SUSE Linux Enterprise server operating system and the Apache Hadoop framework to provide distributed computing. The system is written in a variety of languages like Java, C++ and Prolong. The hardware side of Watson consists of a cluster of ninety IBM Power 750 servers, each having 3.5 GHz POWER7 processor threads and a crazy 16 terabytes of RAM. It’s estimated that the hardware of Watson cost around $3 million and this can process 500 gigabytes per second, according to John Rennie. Watson learns from various sources of information including encyclopaedias, dictionaries, thesauri, articles, databases, taxonomies and at one stage, the urban dictionary. I’m sure everyone here knows of the urban dictionary, well when this was added to Watson, when the system was conversing with people he would start cursing in the middle of sentences. It got to the stage where the dictionary had to be removed from Watson as he also called someone’s work, a report or article, bullshit. Watson uses hundreds of proven language analysis algorithms simultaneously and this is what enables the system to form sentences and converse with humans, because of natural language learning.

**Watson vs Jeopardy**

In 2006 Ferrucci ran initial tests and he gave the system 500 clues from past programs of the show. Watson didn’t do so well in this round of testing as it only answered about 15% of the answers correctly whereas the best human players of the game had a 95% correct answer rate based on the same clues. The team was given three to five years and fifteen new staff members to try and solve this problem after the initial test. The team developed a Watson so much within the next two years that it was prepared to take on the best contestants by 2008. By February 2010 Watson was beating these constants regularly. From here the team pitched the idea of Watson competing against Ken Jennings and Brad Rutter, two of the most successful players.

IBM were concerned that the Jeopardy team would turn the clues and the show more into a Turing test than a regular game by phrasing the clues in a way that the system had no chance of understanding what was meant. They solved this problem by getting a third party in to pick the clues from old clues that were never broadcast on the show. The next hurdle they met in trying to get Watson to compete is that producers of the show wanted Watson to also press a buzzer like the other contestants on the show. They developed an electronic finger so that when they system had a confident answer in for the clue the finger would then press the buzzer. 100 test matches were carried out with Watson winning an incredible 65% of the tests. Watson went on to beat Jennings and Rutter in multiple games that were recorded over two days in January 2011, winning the top prize of one million dollars which 50% of was given to World vision and 50% going to World Community Grind.

**IBM Watson**

John Rennie, who I mentioned earlier, said that all content was stored in Watson’s RAM for the contest because data stored on hard drives would be too slow to compete with human champions. I have a short video here that I would like to show you, it’s just a short video of Watson having a conversation with Ridley Scott, a film director. This video shows just how insanely intelligent the systems that are being created today are. Not only was Watson able to hold a conversation with Mr Scott he also cracked a joke.

**The Future**

The future of cognitive systems is a very broad topic. Currently they are researching the introduction of Watson into the medical field where it would assist physicians in the treatment of patients, a clinical decision support system, where when given the symptoms of the patient and all patient details it will return a list of possible illnesses, the recommended treatment and the percentage of confidence the system has in the diagnosis. I believe that the cognitive computing world will he highly relied upon in the future. IBM has dedicated Watson into a partnership with WellPoint for the utilization management decisions in lung cancer treatment. I believe in the next 5 – 10 years machine learning, artificial intelligence and cognitive systems are going to be a part of everyday life. It is my belief and hope that in the coming years a system will be developed that will help people with neurological illness to be able to use the system to read what is happening in their brain and what exactly they want to tell the people around them. I also see Watson playing a major role in cancer research in the near future.

My presentation is now over, I hope ye found it interesting and that ye have learned something. Thank you, any questions?