IBM Watson: Revolutionizing healthcare?

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ABSTRACT

At the International Science Conference in March, Kunal presented a poster about the new supercomputer developed by IBM called Watson and discussed the possibility that it could in fact revolutionize the way we view the current healthcare system. In this paper, he discusses what Watson is, how it works, how it rose to fame, and its possible uses for the future, as well as how this machine, or any other supercomputers of the future, can alter the healthcare system for ever.

Watson is a supercomputer, which was developed by IBM. The accepted definition of a supercomputer is a computer that is at the high end of processing capability.[1] To provide an example the K Computer, developed by Fujitsu, is thought to be the fastest computer in the world at the moment – it has a total of 88,128 processors, and isn't completed yet. It can run at an estimated speed of 10.51 petaflops[2] (the equivalent of 1.051×10^{16} flops). To put the little used unit "flops" into context, the biggest Mac Pro (the desktop version, and therefore the most powerful computer that Apple sells) runs at a speed of 102 gigaflops.[3] That means that the K Computer is roughly 100,000 times faster than the most powerful of Apple's computers.

In fact the speed of Watson can't even compare to that of the K Computer. Watson can run at a speed of 80 teraflops, according to IBM, using a total of 2,880 POWER7 (a 3.55 GHZ chip) processors. However, it isn't the processing speed that makes Watson what it is. IBM Watson is extremely prominent in the world of supercomputers because of its sheer size. Watson boasts 90 IBM Power 750 servers, thus giving it 15 terabytes of memory, as well as 20 terabytes clustered on disk.[4] This aids Watson in its purpose as it means that it can store all the information of all the encyclopedias of the world. This means that Watson doesn't need to be connected to the Internet to access all the information that it needs.

However, it isn't just the server size where Watson is prominent. For years the aim of supercomputer architects has been to design a computer that can understand and process natural language. Those who have the most recent iPhone would have noticed this with Siri's capability to take what we say in plain language and break it down to find out what we really want. However, there is a key point that makes the design of Siri easier. There are a limited number of questions that it can be asked, as it is optimized to perform the operations of an iPhone, rather than solve equations or answer questions at a high speed in a pressure environment. The other drawback to Siri compared to the capabilities of a supercomputer, particularly Watson, is that it needs to connect to the Internet to find the answer to a question, even if the command was as simple as "play some Smooth Jazz".

Watson has the capability to complete a cycle of processes that all designers of supercomputers strive to emulate. Watson can: Understand natural language and speech of humans, adapt and learn from user selections and responses, and generate and evaluate hypotheses for better outcomes. For example, if someone was to ask Watson the question, "Welch ran this?" Watson would sift through all the data that has been stored on its servers until it finds something relevant to Jack Welch, such as the text below, from Jack Welch and the GE Way by Robert Slater:

"*If leadership is an art then surely Jack Welch has proved himself a master painter during his tenure at GE*".[5]

From this Watson picks out the keywords: Leadership, Welch, and GE. It then deduces that the answer to the question is obviously "GE". This entire process takes Watson less than a second.[6]

So how has Watson caught the public eye? Well, in February 2011 IBM Watson beat the previous two record holders at a game of Jeopardy, which is a popular U.S. game show.[7] Jeopardy is a game show where candidates are provided with an answer to a question and have to provide an answer beginning with "What is". Watson was loaded with all the encyclopedias of the world and came up with the three most likely answers and an independent percentage chance of each of them being correct. If no other candidate had answered the question by this time Watson would answer with the most likely answer. Out of all the questions Watson answered, only two of its answers were incorrect. The night had proved to be a sensational success.

Last year, when discussing the possible uses for Watson, IBM said that we would benefit most from Watson being in a situation where it would be needed to analyze unstructured data as well as provide prioritized recommendations and the evidence upon which that has been based.[8]

So where could these uses lie? Well, an obvious answer (as is the case with many supercomputers of the current generation) is in the financial sector.[9] Watson could theoretically be used to detect fraud. How? Well, Watson could compare a purchase on a credit card with the previous regular purchases, the location of the purchase, and the amount of money spent compared to previous months. It would then present a percentage chance that the most recent purchase indicated fraudulent behavior. However, Watson goes one step further than other supercomputers. It can also be used to predict the security of an investment, or when retirement planning. IBM has also provided other possible uses for Watson including: Government use to determine public safety and security, as well as consumer insight services within the call centre industry.

However the jewel in the crown of the capabilities of Watson is clearly in its potential in the healthcare industry, specifically, in diagnosis.[10] Watson would use its understanding of natural language to draw out information from a conversation between a general practitioner (GP) and a patient. It would then split the information into the following categories: Symptoms, Family History, Patient History, Current Medications as well as the results of a urine test provided at the appointment. It would then use these to present a list of three likely ailments and their independent percentage chance of being correct. The GP would then choose the ailment that appears most likely and prescribe treatment for that.

Here is a hypothetical example: Bob goes to his GP complaining of a fever, difficulty swallowing and increased thirst, as well as frequent urination. His family medical history includes bladder cancer and Graves's disease. Bob's own medical history includes earlier treatment for osteoporosis and urinary tract infections. His medications included pravastatin for Esophagitis, the side effects of which could potentially include urinary tract infections. The urine sample tested positive for nitrites. Watson's final results suggested a 95% confidence that the ailment was a urinary tract infection and 40% confidence in diabetes. The patient took medication for a urinary tract infection and felt better within days. Watson was correct, but provided all other options so that the GP could be sure that it wasn't a disease, such as meningitis or fever that could have hidden symptoms.

It has to be stressed that we are still far off making a computer as intelligent, or at least intelligent in the same ways, as a human. This is because for the foreseeable future at least, a computer will always be dependent on a human programming it. But don't be surprised if in five years time you are sitting in a GP's office and you are taking advice from a computer. And don't worry too much. Watson is right almost all of the time.

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About the Author

Kunal Wagle is a 17-year-old budding Computer Scientist who studies Maths, Further Maths, Physics, and Computing at St Paul's School, London. Amongst other things advancing technology, and more specifically IBM Watson, is something he takes a keen interest in and researches in detail in his spare time. His other hobbies include cricket, tennis, and playing on the school bridge team, as well as being Editor of the school magazine.