Paging Dr. Watson: IBM's Watson Supercomputer Now Being Used in Healthcare

By Howard Lee

When IBM announced that they were developing a supercomputing system called "Watson," many fans of literary icon Sherlock Holmes thought of the London-based detective's trusted friend Dr. John Watson—and not the computer's actual namesake, IBM founder Thomas Watson. But the mistake isn't that far off after all, for like Dr. John Watson, IBM's Watson supercomputer is also beginning to practice medicine.

Since IBM Watson rose to national fame, and proved itself by competing and winning against all time Jeopardy! game show champions Ken Jennings and Brad Rutter, the supercomputer has moved on to practical applications—including being "taught" to understand the complexities of healthcare.

Yes, "taught," and not programmed, because IBM Watson uses "cognitive computing," a completely different type of computing not found in your desktop PC. Cognitive computing allows users the ability to enter mass quantities of structured and unstructured data from various sources and ask the computer to give back a set of structured answers based only on the most relevant pieces of the data. While it seems like science fiction, and a future answer to the overwhelmingly vast mountains of currently untapped health data, there are pilot programs that have recently launched that use Watson to improve healthcare processes and treatment.

A Computer with Cognitive Ability

Since the 1940s, computing has relied on humans programming a set of instructions into a structured database and then retrieving the answers from that data located within the system. This is done using software to program a central processing unit (CPU) and using A to B logic systems. Called the von Neumann–style, the system of computing was first laid out by Hungarian-American mathematician John von Neumann and over the last 70 years has been used by every computer company, including IBM, for its method of creating usable structured data to perform structured tasks. This system, while very good at performing a set of programmed calculations very fast, can't interact with its human counterparts to analyze data, understand natural languages, or combine structured and unstructured data into one usable system. This means that nearly all of the world's computer systems are simply brilliant idiots.

A new computer system was needed that combined structured data, unstructured data, natural languages, and data analysis that could learn from other systems without the need for a human programmer to create software for every scenario. This style of computing system is cognitive computing, and is the type being employed by the IBM Watson cognitive computer system.

When IBM's computer teams thought about creating this type of system, the real task was getting the computer system to learn from structured and unstructured data, then combine that data with natural languages that humans use every day to come up with answers that make sense and are completely useable and practical. It aims to use the same data used by structured computer systems, just in more advanced ways.

While this might sound like artificial intelligence, cognitive computing still relies on humans for part of the work—it is a true human-machine interface that can create new computing functions that does not require tedious software programming for each new step. Unique to cognitive computing is the ability for supercomputers like Watson to learn from internal and external inputs, and creates the programming it needs to solve a given problem. IBM Watson does this by processing a question in a similar manner as a human does. It starts by analyzing the question as input, then generates a set of features and hypotheses by looking across data it has consumed as content. The computer then seeks the best potential response to the question.

Using hundreds of reasoning algorithms embedded within the system, Watson does a deep comparison of the language of the question itself as well as each of the candidate answers. Then one or more scores are produced for the algorithms based on the relevance of the answer, with respect to that algorithm's focus area (i.e., temporal, spatial, or others). It also scores answers based on contextual relevance. The cognitive capabilities can then be brought to the end users through any channel—mobile device, tablet, desktop computer, etc. This ability to receive data from a supercomputer through any device has the ability to drive positive disruption in any industry—including healthcare.

For Watson to Thrive, Providers Need to Connect

Health IT soothsayers believe that Watson has the potential to revolutionize healthcare and the use and management of health information. But a stark reality of the present must first be overcome—how do you get Watson to talk to different healthcare organization's EHRs and access data in other health IT systems when hospitals don't talk to each other? Watson will only work if healthcare professionals are willing to share data with each other for the benefit of all and not shutter information behind locked doors in the name of protecting proprietary assets. Health information exchange must also become more robust for Watson to succeed. Health information management professionals have a role in facilitating that private, secure, and authorized information exchange and should help establish those data networks, links, and agreements.

Practical Uses for Watson in Healthcare

The following is an example of how a cognitive computing system like IBM Watson could be used to improve healthcare processes and better analyze vast amounts of health information. A doctor gets a visit from a patient who has diabetes. The doctor determines he needs to do a blood sugar A1C test, a blood draw, an EKG, a blood pressure check, a cholesterol test, and a physical exam. While this might sound routine, the way a supercomputer like IBM Watson analyzes the results is not.

First, the results of a blood sugar test with a meter are usually logged in a patient's diary and not as part of a database. Since it's on paper, it is free text data and thus considered unstructured data. The A1C is done and logged into another system to get the overall three month reading. The blood draw goes to the lab, where technicians will look for abnormalities in the blood that can affect the kidneys, liver, heart, and cholesterol levels. Blood pressure is usually done and hand written in a chart, creating more unstructured data that is not in the electronic health record (EHR). EKG results are checked by a doctor, but again stored as unstructured data in the health record. Finally, the physical exam results are typically written down by a doctor as a progress note or dictated exam and not entered as structured data in the EHR.

Using the typical EHR or other health IT computer system to give the doctor a real time diagnosis on this patient in order to prescribe a treatment would be very hard given that both structured and unstructured data has been collected in a variety of source systems or mediums and stored in several places. Even for the human doctor it can be difficult to determine treatment steps, since the collected information can get lost or be misread by the doctor or other healthcare staffers.

One in five diagnoses are incorrect or incomplete, and nearly 1.5 million medication errors are made every year, according to a 2013 study by Memorial Sloan-Kettering Cancer Center. The amount of medical information available to providers is doubling every five years, and much of the data is unstructured, the study says. Healthcare IT is moving rapidly and developing other structured and unstructured data via EHRs and mobile devices like tablets and smartphones that include data not entered in any master database. As a result many doctors can get lost in the data when trying to treat patients and determine diagnosis or treatment. Add to this mix the mountains of white papers and medical journals that a doctor must read to stay on top of what is happening in the healthcare field—plus the ever growing use of the Internet, blogs, social media, and healthcare expos to relay important health information—and it is evident that there is just too much information from too many different sources for any human or typical computer to analyze in healthcare. There is too much to do and analyze, and not enough resources to do it.

The current healthcare system is doomed to keep making mistakes not because there is not enough data, but because there is too much data in too many places to be useful. Most healthcare computer systems can only store and retrieve data, but not do much more beyond that. Another shortcoming of a programmed structured data system is that it can't understand natural languages or analyze disparate but related data in an unstructured form. If a computer could understand and analyze both

structured and unstructured data and the relationship between the two, a doctor would have a system that could become a true partner in healthcare by analyzing Big Data and returning the best and most relevant data for use in making a diagnosis.

Enter Watson, which through its cognitive computing has the potential to look at all of these structured and unstructured health information sources and pull together analysis that likely will improve processes and treatment plans. While the IBM Watson cognitive computing system is still very new, it is not an untested system.

Watson's Healthcare Case Studies

Below are four case studies that illustrate how Watson is being used in fields like cancer research, supply chain management, and consumer empowerment to help create better outcomes in healthcare.

Memorial Sloan-Kettering Cancer Center

Memorial Sloan-Kettering Cancer Center (MSKCC), the world's oldest and largest private cancer center, is battling an insidious disease that strikes one in three women and one in two men during their lifetimes, according to data published by MSKCC in 2012. It has become nearly impossible to find anyone who has not been affected by cancer in some way.

When trying to find a computer solution to help analyze their vast amount of data, MSKCC ran into a problem. The center has thousands of cancer patients with different kinds of cancer, and as many different types of treatments. With so many treatments and so much Big Data across as many as 41 different systems, the daunting challenge of analyzing such disparate information was one the typical computer couldn't handle. Add to that doctors and researchers creating medical white papers and journals on the research being done at MSKCC, and now the organization had a great deal of Big Data with no way to really use it to improve patient outcomes. Looking for a solution, MSKCC's CEO Dr. Craig Thompson joined forces with the IBM Watson team to teach IBM Watson about their breast and lung cancer research at the center and create a system that will allow MSKCC to use the best available data to treat their cancer patients. IBM Watson used its cognitive computing natural language and decision support system to find patterns in unstructured information, mine patient data, analyze structured data, and look for disease patterns that most closely approximate each individual's case.

Memorial Sloan-Kettering Cancer Center is now using Watson's ability to sort through massive amounts of data, from clinical knowledge, case histories, and genomic and molecular data, that will help oncologists diagnose and treat an individual's cancer. But unlike traditional Big Data computer systems that simply push data around without analyzing what data is truly helpful to the oncologists, Watson actually understands both structured and unstructured data and works with a human counterpart to actually learn from both Big Data systems and simple doctors notes. Over time, the hope is that Watson will become a real part of the MSKCC oncology team.

University of Texas MD Anderson Cancer Center

MD Anderson Cancer Center (MD Anderson) is one of the top cancer centers in the US. But like MSKCC, they too have the inability to truly use the vast research from their oncology team and combine it with their clinical trial data to come up with better outcomes for cancer patients or create targeted treatment for patients. Within their healthcare EHR system is all the typical information that constitutes Big Data, along with clinical trial data and mountains of doctors' private notes—which make up the backbone of their research. This has caused a Big Data divide between MD Anderson's doctors and clinical researchers who work remotely from each other and rarely share data on the patients they work with. MD Anderson is now working with IBM Watson to teach the supercomputer how to work with its doctors and researchers. The project is called "MD Anderson's Oncology Expert Advisor (OEA)." The OEA helps doctors and researchers by integrating the knowledge from both groups to advance its goal of treating patients with the most effective, safe, and evidence-based standard of care available. Oncology Expert Advisor provides a 360 degree view of each cancer patient, which will help physicians better understand the patient's data, history of treatment, test results, and vital information that has been hidden in the files of every MD Anderson medical facility the patient has visited in the past. By understanding and analyzing data in a patient's profile as well as information published in medical literature, the OEA can then work with a doctor to create evidence-based treatment and management options that are unique to that patient. These options include not only standard approved therapies, but also clinical trial protocols. MD Anderson's OEA is expected to aid doctors to improve the future care of cancer patients by using and comparing patients' data-driven information—information that was previously unavailable for complete electronic analysis.

MD Buyline, Inc.

MD Buyline Inc. has been a leading provider of healthcare clinical and technology research for over 30 years with more than 50 percent of US hospitals using their solution to track and improve financial performance across the healthcare supply chain. A problem most hospitals face is how can they fill the procurement needs of their hospital staff while staying within their budget. Hospital administrators must find a way to manage clinical evidence, research, analysis, and price data from several different database systems and competing needs from departments within the hospital, who are all competing for resources. This puts a strain on supply chain management systems, and results in an estimated $5 billion wasted annually due to these inefficiencies, according to an educational paper published by GHX in October 2012 titled "The Current State of the Implantable Device Supply Chain."

MD Buyline is now working with IBM Watson to teach the supercomputer how to understand their supply chain management and decision support systems. The goal is for Watson to help deliver a transformative procurement system that will enable informative comparison of medical options. The IBM Watson solution is expected to drive optimal purchasing decisions for hospital administrators, and eventually could offer socially collaborative and educational support for all hospital and healthcare teams worldwide by leveraging a shared base of information—given that health information exchange advances to the point of enabling this connectivity.

Now that healthcare reform has become part of the landscape, reimbursement models will be shifting to an outcomes-based approach. It is more critical than ever that healthcare providers improve outcomes. MD Buyline's procurement advisor is working to help deliver these improved outcomes through its scalable IBM Watson cognitive computing platform. MD Buyline's application is intended to empower users and aid in finding unbiased clinical evidence, research, and price information.

Welltok, Inc.

Welltok, Inc. is a consumer-centric healthcare company that is changing the way patients and their caregivers deal with healthcare by offering programs that reward consumers for taking charge of improving their healthcare. Welltok's CaféWell, part of their Health Optimization Platform, is a web-based community that provides consumers with healthcare resources, social networking, gaming, and site personalization. The site is built to create a new supply chain, connecting health plans and health systems to consumers through an organized ecosystem of health and wellness resources.

CaféWell's goal is to help healthcare managers benefit from increased consumer engagement, member retention, and improve brand affinity. Consumers are rewarded for starting a healthy lifestyle. Most consumers lead busy lives that make it hard to follow the right health decisions. Many consumers also find it difficult to get the right information to make proper personalized healthcare choices. The CaféWell Concierge, which is powered by IBM Watson, personalizes the healthcare experience by using IBM Watson's natural language and analysis abilities, as well as the ability to learn from the consumer. Watson helps empower the consumer to make positive healthcare decisions by providing customized guidance on activities and behaviors tailored to a user's interests and aligned to their incentives. The application is also available through mobile devices, tablets, and personal computers. Welltok is one of the first companies to take advantage of Watson and use it for consumer-facing applications.

As Watson's Ecosystem Grows, Competitors Emerge

IBM just announced the creation of the IBM Watson Ecosystem that will help major industries like travel, retail, and healthcare leverage Watson's cognitive computing. Those working with IBM will get open access to the platform that will allow them to build customized applications. IBM business partners will be able to develop embedded applications on the Watson Developer Cloud, and have access to the Watson platform and its associated tools and methodology. The hope is IBM's partners can take Watson and develop a wide array of products that leverage its supercomputing abilities. The ecosystem would bring Watson to the masses, and potentially be made available to end clients in business models such as business to business, business to consumer, or consumer to consumer.

Many technology experts expect that giving developers access to the Watson Hub—which includes cloud access, a content store, Watson hosting services, and tech support—will drive the development of more healthcare applications. Soon it is

expected that Watson will be able to work with single system EHRs or multiple disparate EHRs and securely access the vital health information contained therein for optimizing research. Such access would need to come with various privacy measures, which would take time to develop.

When it comes to cognitive computing, IBM Watson is the leader at the moment. But competitors like Microsoft and Apple have also begun working on their own systems. The competition is likely to be a good thing for healthcare, helping foster innovation in all cognitive computing system products.

So while it may be some time before your local hospital pages Dr. Watson for advice on your medical ailments, these projects utilizing the technology show that the use of supercomputers in healthcare has already begun.

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