On Feb 14th, 15th, and 16th, IBM's Watson challenged Jeopardy's top winners, Ken Jennings and Brad Rutter, to a 3-day round of Jeopardy. Watson received the text of the questions electronically at the same time that its two human opponents saw it on their screens, and it was required to beat them to the answer by ringing a buzzer once it was reasonably sure of its answer — usually a maximum of 3 seconds. Questions ran the gamut from history to literature to science, geography, and popular culture, and were deliberately phrased, as Jeopardy questions often are, to be misleading. Watson won, $77,147 to $21,600 and $24,000. The last game was a cliff-hanger up until the last few questions, as the human challengers began to figure out how to prevent Watson from dominating the game.

IBM invested four years of work by scores of IBM Research computer scientists, not to mention a significant amount of hardware and off-the-shelf, open source, and custom software, to create Watson. The Jeopardy Challenge was "the demo," that gave structure, drama, and no little risk to the attempt to prove that the team was up to the task of besting humans at what had been strictly their game. Watson's dominant performance demands that we consider what future impacts will arise from systems that implement this new kind of computing. Briefly, here are five potential impacts:

1. Using computers to suggest answers to questions directly, rather than offer lists of links, will begin to replace the search and re-search model popularized by Google and others.
2. Watson's accuracy demonstrates that computing systems might expand their role in a wide range of human activities where asking questions and receiving answers is a dominant pattern, e.g., customer support to name one, with potentially dramatic economic effects.
3. Providing such question-answering systems will become an area of new business opportunity for IBM and others that can supply the required hardware, software, and service components.
4. New markets for intelligent application software will emerge in areas that require the kind of scope and sophisticated analytics that Watson demonstrates, and that have not previously been addressed by automation, e.g., in government intelligence, medicine, and decision support environments of many kinds
5. Watson starts the process of redemption for the tarnished field of artificial intelligence, which was thoroughly discredited after its first boom in the 1980s but has persisted and returned in many underlying technologies, from voice recognition, to text analytics, to knowledge representation. Much work remains to be done.

Why Is the Jeopardy Problem a Grand Challenge?

What's interesting about the Jeopardy match, beyond the fact that a computer can play Jeopardy and win, is that Watson is built entirely on technologies that understand and mine text: primarily search and text analytics, with a healthy addition of other technologies like machine learning, risk assessment, and probability.

Language is rich, ambiguous, playful and unpredictable. These elements make language the antithesis of what computers excel at: precise, predictable, definable numbers and formulas. Nevertheless, it is possible to analyze language in order to answer questions, find trends or relationships. Natural language processing (NLP) has become robust enough to mine text, but the state of the art of most commercial systems today is that they are confined to a specific domain, topic, or industry in order to control the
ambiguity of a word. For instance, in the financial industry, “banks” does not refer to fishing in the Outer Banks. Furthermore, deep text analysis can be computationally intensive, time consuming, and expensive to configure, operate, and maintain.

IBM saw Jeopardy as a way to advance the state of the art of question answering because it requires:

- Answers to questions on any topic
- Accuracy: not just some answers, but a confident right answer
- Speed: the right answer within 3 seconds or less
- Advanced linguistic understanding in order to parse complex sentences, recognize and understand jokes, metaphors, puns, and riddles
- Real time analysis of questions
- Learn from mistakes and be prepared to handle the unexpected

In tackling Jeopardy, therefore, IBM's Watson team had to push the limits of language understanding, building a system that could start with a broad knowledge base, but then adapt and learn through practice.

What Is Watson?

Watson is “a massively parallel probabilistic evidence-based architecture” for answering questions. Built on 90 IBM Power 750 servers, it parses Jeopardy questions and creates multiple queries to search its knowledge base in parallel. Each query, or hypothesis, returns a confidence score and is further iterated to gather more evidence. The highest scoring hypothesis wins. IBM has combined not just NLP and statistical NLP, but machine learning, a voting algorithm, a method of interpreting the questions and assessing them by formulating parallel hypotheses, and Hadoop and UIMA for preprocessing, as well as the usual search (Lucene and INDRIL), deep text analytics, fuzzy matching software and of course an in-memory caching system to save time in retrieval. IBM calls its software “DeepQA,” and it runs on Linux. Watson is a good demonstration that the whole is greater than the sum of its parts. Like a human, it uses multiple strategies and sources of knowledge in order to come up with not just an answer, but the best answer.

What Watson is not is a substitute for a human. It answers questions. That's what it was designed to do, and in information-rich areas like healthcare, finance, government intelligence, or call centers, it will be a boon to overloaded workers who need quick, accurate answers that they can trust. Watson cannot carry on a conversation. It has no real world experience. It has no emotions.

Implications for Software Vendors

Watson validates a non-database approach to creating massive information access and analysis systems. To manage real time, high volume information flows from diverse sources in unpredictable formats, we need ad hoc analysis that can unearth the nuggets and their relationships. To uncover the unexpected, we may actually be hampered by depending on preexisting schemas, taxonomies or controlled vocabularies. Software vendors in the search and text analytics market have been developing these new information architectures for years. They are being used today as an easy-to-use gateway into both traditional databases and collections of text and messages. In some cases, they are replacing data warehouses because they are flexible, scalable, and quick to implement. Will this upset the database market as we know it? But Watson suggests that the level of ambition in the market has been too low, and that there is new opportunity for vendors that can take the many components of deep analytics software and create game-changing intelligent applications.

Implications for Humans

Will Watson and its ilk replace people? Although there has been plenty of hype in the press on this, the answer is, no. What Watson promises, though, is help in wading through the overwhelming mountain of information that today’s workers must somehow ingest and understand. Face it, if we spend our days sorting through information piles, that leaves us little time to analyze, understand, and make informed decisions. Imagine an intelligent physician's assistant, able to forage in seconds through all of medical
literature, compare the research to a patient’s records, and suggest a treatment. Imagine being able to get an answer to a question posed to a call center not after sitting on hold for an hour but within 3 seconds, at Jeopardy speeds.

What is thinking? What is intelligence? What is the role that computers should and will play in our lives, and what are the boundaries between humans and computers? IBM's Watson demands that we reconsider each of these questions. The Jeopardy game demonstrates the possibility of practical applications of intelligent computing, applications that can deliver a level of insight and support to human processes that before now has been the stuff of movies and science fiction. When IBM’s Deep Blue machine mastered Gary Kasparov, it was the end of an era in chess. Watson’s victory on Jeopardy is the beginning of an era of augmented applications.

Hadley Reynolds contributed to the content of this IDC Link.

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