Cognitive Computing

A data innovation case study by copia

The basis of the Industrial Revolution in the 18th century was the reliance on physical machinery to dramatically increase the productivity of industries ranging from textiles to transportation. The development of autonomous machines that can learn, recognize patterns and make complex decisions marks the next phase of automation. Cognitive computing applies software solutions to tasks that could not ordinarily be accomplished without human intervention. Applications range from driverless cars, face recognition algorithms, and natural language processing to data mining and algorithmic high-frequency trading. The global market for smart machines is already a multi-billion dollar industry that is expected to grow by double digits over the next few years. The automation of knowledge-based work will have broad effects on society, increasing economic productivity and providing a cornucopia of wealth.

IMPACT

The spread of software to nearly every aspect of the economy has laid the groundwork for ubiquitous cognitive computing applications. Algorithms control our digital cameras with auto-focus, red-eye reduction, smile detection and countless other features that seamlessly improve the quality of photography. Automated speech recognition is increasingly available on every phone, allowing users to ask Apple's Siri questions and search Google Now without touching a screen or keyboard. Ever improving software continually reduces the friction for transactions, improves the quality of work and helps to minimize information overload for people every day.

The field of robotics is a conspicuous area where cognitive computing will have transformational effects. Industrial robots alone have a global market value of nearly $30 billion. As more intelligent robots act autonomously, performing agricultural tasks or delivering packages, these smart machines will expand their usefulness in the consumer markets by cleaning homes, providing entertainment and serving as personal assistants. Home automation devices are more affordable, energy saving and can provide conveniences that are impossible without machine learning technologies. The internet of things (IoT) will connect appliances and devices to make machines smarter and more efficient. Cloud-based

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cognitive computing will have a tangible effect on the physical world, providing intelligence remotely without requiring expensive hardware upgrades.

Beyond robots, cognitive computing is already employed in numerous business intelligence applications to help analyze large amounts of data. The banking, financial services, and insurance sectors rely on algorithmic data mining for predictions and risk management. Human decisions are clearly still dominant, but more and more examples of algorithms are assisting in complex decision-making, creating hedge funds automatically and performing autonomous high frequency trading. Sophisticated algorithms are saving businesses millions of dollars in increasing productivity and efficiency. Data scientists are extracting strategically critical information from a flood of real-time information. Business intelligence solutions that were once cost-prohibitive for small and medium businesses are now increasingly employed by innovative startups and savvy retailers.

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In science, cognitive computing efforts are also leading the way to helping researchers understand how human minds and brains actually function. By studying the differences and similarities of computer algorithms and the parallel neural processes that biological systems use, scientists may gain invaluable information about consciousness, general intelligence and emotions. In the context of genomic research, the amount of genetic information available currently exceeds our ability to classify and make sense of it. Automated systems can help to sift through already-known facts to highlight discoveries and anomalies that could point to new knowledge. Augmented scientific processes can help accelerate the publication of experimental results and improve experimental design. In astronomy, advanced telescopes are collecting an immense amount of data about the universe — more than can be humanly consumed. Pattern recognition algorithms assist astronomers in classifying distant phenomena and provide an essential way to process the vastness of space. Autonomous science is in its early stages, and cognitive computing may be necessary to advance the progress of science at an accelerating pace.

Knowledge work is a growing segment of all economies, outpacing the value of manual labor, and the automation of routine cognitive processes is a goal of artificial intelligence. With the ability to analyze natural language, IBM's Watson technology is targeting healthcare, the energy industry, finance and wealth management, and law and government sectors — to reduce information overload for professionals in those fields. A "Chef Watson" has even authored a cookbook filled with recipes with new flavor combinations. As machine learning systems become more common, the repetitive work of professionals in knowledge-based careers will be greatly reduced, and algorithms will help individuals and organizations create higher quality work, more efficiently.

POLICY IMPLICATIONS

The promise of artificial intelligence has previously been perpetually three decades away, but the fruits of computer science are pushing algorithms forward

and realizing many intelligent tasks that were impractical not too long ago. However, as the technology races ahead, the progress could be hindered by the policies and practices of society.

The ability to patent software has been debated since before computers existed. Mathematical facts and logic should be exempted from the patent process, but algorithms have been patented nonetheless. Patent thickets built around various speech recognition algorithms and other applied algorithms present a significant barrier to entry for newcomers to such fields. Potentially even more challenging is that some companies are even applying cognitive computing to the process of creating patents themselves, with completely computer created patent applications being submitted to the patent office. This could create even more dense patent thickets.

The ethical challenges and legal liability of software making critical, sometimes life or death, decisions has also slowed the adoption of certain cognitive computing applications. Driverless cars pose a potentially real danger to other drivers and passengers who share the road with autonomous vehicles — even if those autonomous vehicles may be safer than human drivers. On top of that, such autonomous actions raise serious questions about liability. If an autonomous vehicle crashes and kills someone, who is liable? There is no "driver." Is it the company that made the car? The software programmer? The manufacturer of the sensor that failed? No one? At the very least, it is likely that there will be a long series of lawsuits before many of these questions are settled. Such legal uncertainty could also delay the adoption of these technologies.

The identification of tumors as cancerous or benign is a medical diagnosis that could be automated with image recognition algorithms, but so far software can only assist in diagnosis. Again, with more autonomous analysis of data, there are regulatory and liability questions that are raised. Does a computer need malpractice insurance?

Beyond the legal and ethical issues, society must also accept computers making decisions that affect the lives and careers of people. A new generation of Luddites could prevent the advancement of intelligent machines, and the rise of cognitive computing could be seen as a threat to our economy rather than a new abundant resource. There are already concerns that the rapid improvement in cognitive computing may create a massive change in the employment market. While previous predictions of vast unemployment due to technological changes have mostly proven unwarranted, there are many who believe that cognitive computing changes the equation — and that could raise significant challenges for society.

As one example, the advancement in cognitive computing has lead to renewed interest in having governments examine ideas like a "basic income guarantee" that provides a base level of income to all citizens, allowing them to rethink how they spend their productive time — potentially increasing the amount of time they can spend on non-remunerative work, such as caring for others, educating people or creating art.

Alternatively, it may free up people to continue to innovate in ways that are only aided by the rapid advancement in cognitive computing.

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