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TECHNOTRENDS® NEWSLETTER

*The biggest ideas that are
changing everything*

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Artificial Intelligence: Disruption or Opportunity?

By Daniel Burrus, CEO of Burrus Research

Artificial intelligence (AI), one of 20 core technologies I identified back in 1983 as the drivers of exponential economic value creation, is rapidly working its way into our lives from Amazon's Alexa and Facebook's M, to Google's Now and Apple's Siri. But it's much bigger than that. From this point forward, it would be a good idea to keep a closer eye on AI's rapid development and look for both predictable problems as well as amazing opportunities.

An example of how far AI has come is the recent news that a Google supercomputer, using its advanced AI software, was able to win a stunning 3-0 victory in a man vs. machine face-off against Go grandmaster [Lee Sedol](#), one of the game's all-time champions.

“ *The most complex game ever invented is 3000 years old.* ”

For those who are not familiar with Go, it is a 3,000-year-old game that is widely considered to be the most complex game ever invented because it is reported to have more possible board configurations than there are atoms in the universe. Until just a few months ago, it was thought that a computer could not defeat a human grandmaster for at least another decade due to the game's complexity. Everyone was wrong!

Why is this important to you? Because game-playing is a crucial way to measure AI's ability to execute a certain “intellectual” task better than a human. So this was a big win for AI.

How did Google's AlphaGo program advance so much faster than many expected? First, it illustrates the power of the “Three Digital Accelerators” – the exponential growth of processing power (Moore's Law), bandwidth, and digital storage – that I first identified back in 1983. These accelerators have finally reaching a tipping point that will drive explosive growth going forward. And second, thanks to reaching that tipping point, Google's AlphaGo program was able to partly teach itself. By playing millions of games against itself to hone its tactics through trial and error, the AlphaGo learned much faster than expected.

Another AI system that has been getting a lot of press is IBM's Watson. Watson is a cognitive computer that learns over time. This cognitive AI technology can process information much more like a smart human than a smart computer. You may recall how IBM Watson first shot to fame back in 2011 by beating two of [Jeopardy's](#) greatest champions on TV. Since then it has been applied in an ever-growing list of fields, thanks to three unique capabilities: natural

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TECHNOLOGY NEWS HIGHLIGHTS

Spotlight on Fusion

A lot has been happening in the quest for controlled nuclear fusion – regarded to be the holy grail of cheap, efficient and sustainable energy. In Germany, scientists recently turned on the largest fusion machine in the world. Using only 2 megawatts of microwave radiation, the stellarator-type device, known as the Wendelstein 7-X (W7X), was able to produce and sustain super-hot blobs of hydrogen plasma for a quarter of a second, reaching temperatures of 80 million degrees Celsius.

In March, the researchers plan to increase the heating power to 20 megawatts with a goal of sustaining the plasma for as long as 30 minutes. By 2019, the reactions will be switched over to deuterium, which will increase the energy output.

Shortly after these results were released, however, Chinese physicists reportedly succeeded in producing hydrogen plasma at a temperature of 50 million degrees Celsius for a whopping 102 seconds using

their own machine – the Experimental Advanced Superconducting Tokamak (EAST).

The ultimate goal for both teams is to reach the 100 million degree mark, which is considered to be the ideal temperature for starting and maintaining the fusion reactions. And while the results of these experiments show that fusion power is possible, neither of these generators is designed to produce usable amounts of energy. But researchers are hopeful that decades of work will pay off in the end with clean, practically limitless energy that could literally change the world.

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Boosting Solar Cell Efficiency

During the last few years, research in the field of photovoltaics has shifted from the use of silicon-based materials (which are costly to manufacture) to perovskites – a class of materials with a characteristic crystalline structure that makes them suitable for thin-film applications (such as solar windows). However, perovskites require the use of expensive “hole-transporting” materials to transmit the positive charges generated when light strikes the film.

In a recently published report, scientists have developed a charge-transporting layer that is not only cheaper, but also more efficient than existing materials. The new material – dissymmetric fluorine dithiophene (FDT) – is about one-fifth the cost of current materials, is easy to synthesize and purify, and resulted in a conversion rate of 20.2 percent.

The economic benefits could be substantial on a global level. It's been estimated that 100-gigawatts of photovoltaic material has been installed around the world to date, with a conversion efficiency of only about 15 percent.

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Ammonia Breathalyzer

A variety of metabolic processes can cause the levels of ammonia in the blood – and consequently in the breath – to become elevated. Digestive disorders, liver disorders, drug toxicity, and even strenuous exercise are all potential contributors. But current methods for measuring ammonia levels require the use of expensive equipment run by trained laboratory technicians, meaning they're not economically viable for widespread use.

Recently, scientists discovered that an electricity-conducting polymer called polyaniline could be formed into nanoparticles and deposited in layers that are only thousandths of a millimeter thick. At that point, what was once a mere laboratory curiosity was transformed into an extremely sensitive material with a totally new set of valuable characteristics.

One of them is the ability to create a disposable sensor, similar to a glucose testing strip, which can detect ammonia in exhaled breath. Known as AmBeR®, the device is portable, highly specific (40 parts per billion by volume) and suitable for home use to replace or support clinic-based assessment. The company is currently validating the system as a diagnostic solution for a variety of ammonia specific conditions.

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Robot Farmers

The security of our food supply is a global concern. While consumption continues to increase, production is being threatened on all fronts – by unsustainable farming practices, forecasts of fewer and fewer farmers in the future, and an aging population that could soon result in a crippling labor shortage. Thankfully, researchers and corporations have been working together to address these issues, and robotics will likely be at the heart of the solution. In fact, the European Robotics Technology Platform announced that a fleet of agricultural robots will soon be deployed worldwide to test their capabilities for agricultural automation. And a Japanese company is planning to open the first farm run almost entirely by robots in 2017.

To date, robots have only been routinely used for specific tasks like milking, feed distribution and cleaning, but technology can address many more issues of traditional farming. For example, advances in virtual sight, object recognition and dexterous manipulation will enable robots to be more effective and autonomous. Experiments with the prototype robotic Crop Scout demonstrated a 98 percent reduction in the amount of pesticides and herbicides by only treating areas that are affected by diseases or pests, as opposed to the more common practice of prophylactic over-treating. Lasers can be used for multiple tasks including harvesting and weeding. And lightweight robots

(guided by GPS or Google Earth) that cultivate a minimum volume of soil (known as micro-tilling) will greatly reduce compaction damage caused by plowing, disking and harrowing.

But that's not all...

Sensors that place seeds precisely according to soil moisture levels and artificially “smell” ripeness levels will enable selective planting and harvesting to increase yields and maintain quality. And enclosed farms (like the one being planned in Japan) will be automatically optimized for temperature, humidity, lighting, water and CO2 levels.

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Open Source Population Density Models

When Facebook needed population density data in order to best position their satellites, drones and terrestrial networks for optimum connectivity, the first thing they learned was how inadequate the existing data was. So they set out to transform their image recognition tools – which had been developed for people, pets and other picture subjects – and trained them to recognize man-made structures such

as houses and other buildings as evidence of human population. After analyzing 14.6 billion images covering 21.6 million square kilometers, and cross-referencing the results with existing census counts, what they've created is a population map with five-meter resolution for 20 countries.

Now, Facebook is working with Columbia University to make the data publicly available for the myriad of government agencies, mobile operators, researchers and other organizations that might want access to it. The information could prove to be invaluable for such things as optimizing humanitarian relief efforts after a natural disaster. As satellite imagery continues to improve, the technology can also be used to look backwards at earlier satellite data and monitor worldwide trends.

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studying human diseases.

A method known as CRISPR-Cas9 was used to introduce the DNA-snipping enzyme and a guiding molecule into the DNA of 65 dog embryos. The goal was to delete or damage a gene called myostatin, which normally inhibits muscle development.

Out of the 27 puppies that were eventually born, only two displayed a disruption in the myostatin gene. In one of those, the disruption was complete, giving the female puppy known as Tiangou (named after the "heaven dog" in Chinese myth) thigh muscles that were clearly larger than any of her littermates.

The ultimate objective is to use the technique as a way to generate new disease models for biomedical research. But, while gene-edited pets may put a friendly face on the technology, many researchers fear that alteration of dogs and other large animals could open a Pandora's Box of using the technique on humans.

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Customized Dogs

Scientists in China are reportedly using gene editing in dogs – a first step in creating customized pets? The first DNA-modified canine is a beagle with twice the normal muscle mass, giving it stronger running ability for hunting, military and police applications. Other institutions have created miniature pigs (which sell for up to \$1600) and monkeys to be used as models for

Incandescent Comeback

Here's another example of how applying new solutions to old problems can lead to exciting new products.

With incandescent bulbs being phased out in favor of more efficient compact fluorescent lights (CFLs) and light-emitting diodes (LEDs), most of us have come to miss the soft, warm glow of a light that didn't need time to heat up and could be dimmed to virtually any level.

Now, as the result of a clever application of nanophotonics, incandescents may make a comeback.

The reason that incandescent bulbs are so inefficient is that much of the energy emitted by the filament is in the form of infra-red (IR) radiation – more commonly known as heat – rather than visible light.

Prior experiments have sought to capture some of this IR radiation and reflect it back to the filament by coating the inside of the bulb, but the results have been marginal.

The latest bright idea involves coating the filament itself with a crystalline structure similar to those applied to glasses. The coating is made up of thin layers with different indices of refraction and arranged in a specific way so that visible light passes through but the heat is reflected back.

While the luminous efficiency of conventional incandescent bulbs is only 2 to 3 percent, the proof-of-concept models achieved 6.6 percent, making them comparable to some CFLs (which range from 7 to 15 percent) and LEDs (which range from 5 to 20 percent).

However, the researchers anticipate that the new design (referred to as a two-stage incandescent) could reach as high as 40 percent efficiency with a little more tweaking.

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Tactile Touchscreens

As flat touchscreens replace mechanical buttons on nearly every device we operate, it's becoming increasingly important to be able to sense the proper location of a switch without needing to see it. For example, when you're driving in the car and want to turn up the heat, you don't want to take your eyes off the road to find the correct icon. Worse yet, you don't want to have to hit it multiple times in order to get it to turn on. Most devices have incorporated sounds or vibrations to let you know when a key has been selected, but that doesn't help when you're searching for it.

A new haptic feedback system, called neoSense, aims to change that by creating the sensation of different surfaces and textures using vibrations based on finger position. "Buttons" can be programmed to have a variety of surface properties – flat, grooved, smooth or different degrees of roughness. Simply slide your finger across the screen to feel them, and press firmly to activate. Different functions can also be based on touch pressure. For example, you can control the speed at which you scroll through menus, lists, or music tracks by varying the pressure.

No word yet on when the new technology will become available.

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Artificial Intelligence: Disruption or Opportunity?

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language processing, hypothesis generation and evaluation, and dynamic learning.



Today, cognitive computing is being used in a wide variety of applications including healthcare, travel, and weather forecasting. When IBM began acquiring digital assets to strengthen its cloud capabilities with the acquisition of the Weather Company, the online community and newspaper headline writers were quick to voice their amusement. However, IBM soon had the last laugh when people learned that the Weather Company's cloud-based services can easily handle over 26 million inquiries every day on its website and mobile app, as well as learn from not only the daily changes in weather, but also from the questions being asked.

This colossal amount of data from the fourth most-used mobile app would whet the appetite

of even the permanently ravenous IBM Watson and would enable IBM to increase the level of analytics for its all-important business clients.

It is believed that weather is responsible for businesses losing \$500 billion a year. Pharmaceutical companies are increasingly relying on accurate forecasts to predict a rise in the need for allergy medication, as are farmers – whose livelihoods often depend on what Mother Nature has around the corner – not only for where they grow their crops but also what is happening around the world where they sell their harvest. When coupled with the news that IBM also snapped up Merge Healthcare Inc. for a cool \$1 billion in order to integrate its imaging management platform into our old friend Watson, it becomes instantly clear where Watson's future is heading.

Real-time analytics of the online white noise that surrounds us all and translating it into a meaningful, actionable report is incredibly powerful. With Watson's learning capabilities, it's not beyond the realm of possibility that Watson will learn more about science than a scientist after it learns from the entire history of scientific data and research.

How about fields like auditing and accounting? A few years ago, when I was the keynote speaker at KPMG's annual partner meeting, I suggested that they consider partnering with IBM to have Watson learn all of the global accounting regulations so that they could transform their audit and tax practice and gain a huge advantage. After doing their own research on the subject, the KPMG team just announced that they are forming an alliance with IBM's Watson unit to develop high-tech tools for auditing, as well as for KPMG's other lines of business.

I have also worked with Deloitte & Touche, Ernst

& Young, and PricewaterhouseCoopers, and I can assure you that they are also pouring hundreds of millions of dollars into using advanced AI and analytics to make audit and tax services far more accurate and comprehensive.

So if the Big Four firms are all using advanced tools like these, where is the advantage? And how can a smaller firm gain an advantage like this? Thanks to the cloud and the virtualization of services, you don't have to own the tools in order to have access to them. In other words, it all comes back to us humans and how creatively we use the new tools. It's not the tool – it's how you use it!



IBM's Watson, along with advanced AI and analytics from Google, Facebook, and others, will gain the cognitive insights and real-time advice mined from the ever-growing mountains of data generated by our connected world of devices, machines, and sensors (IoT) to revolutionize every industry.

Ultimately, advanced AI is promising almost limitless possibilities that will enable businesses in every field to make better decisions in far less time. But at what price? Many will point to the aggressive shake-up at IBM that is responsible for its recent and massive [job cuts](#) throughout the company and suggest that technology is

making much of the human race redundant.

It is crucial to recognize how the technological landscape is evolving before our eyes during this digital transformation. Yes, it is true that hundreds of traditional jobs are disappearing (leaving many out of work), but it's also important to realize how there are a wealth of new roles and employment opportunities arriving that are needed to help us progress further.

The so-called rise of the machines started by removing mundane and repetitive tasks and it is now moving more into what is often referred to as the white collar jobs. The key for us humans is to go beyond just reacting to change, and start getting ahead of it by paying attention to what I call the "Hard Trends" – the facts that are shaping the future – so that you can anticipate the problems and new opportunities ahead of you. Try focusing on being really good at the areas that computers have great difficulty understanding, including collaboration, communication, problem solving, and much more. Making yourself increasingly valuable and relevant in the workplace will require you to learn new things on an ongoing basis as well as unlearn the old ways that are now holding you back. Remember, we live in a world filled with technology, but we live in a human world where relationships are all-important. We need to become aware of the new tools available to us, and then creatively apply them to turn the impossible into the possible. By acquiring new knowledge and developing your creativity and problem solving skills, as well as honing your interpersonal, social, and communication skills regardless of your age, you can thrive in a world of transformational change.

There is an old saying: You can't teach an old dog new tricks. The good news is, we aren't dogs!



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