Media Backgrounder
Artificial Intelligence

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Scientists have worked on forms of artificial intelligence (AI) for over 30 years, however it is only in the last five years that we have seen significant advances in the technology, such as the widespread use of machine learning, neural networks and deep learning, which have made it more powerful and more useful than ever. As a result, although people may not immediately realize it, we encounter AI and its associated technologies regularly as part of our daily lives – for example chatbots and social media face recognition. But we're still only scratching the surface of AI's true potential and ever-more sophisticated deployments are emerging all the time.

What is Artificial Intelligence?

At a basic level AI can be defined as "the simulation of human intelligence by machines". In other words, AI relates to getting a computer to reason and to learn, and then to use this thinking as the basis to make decisions.

In practical terms today AI systems are excellent at pattern recognition. This means they can quickly spot anomalies and make predictions, often more consistently, more accurately and more reliably than humans. However, AI systems today are limited only to that. They essentially use probability and logic to make their analysis but lack the ability to understand or be able to develop broad context in the way that humans can. Such an ability, which we could also call 'general intelligence', is still a long way off from current technologies ... and may never be realized at all.

Is AI one technology?

In computer science, AI is not a single, well-defined entity, instead it incorporates many capabilities, models and methods. However, three elements in particular account for the huge acceleration and advances in AI in the past five years:

- Machine Learning: a set of techniques (including many different types of algorithms such as reinforcement learning, rule-based machine learning and decision trees) that enable machines to learn from data, without being explicitly programmed for the task at hand.
- Neural Networks: a computing model that arranges large numbers of processing nodes, from tens of thousands to millions, linked by an even larger number of connections, in a way that resembles how neurons and synapses are arranged in the human brain. The power of the system does not come from the individual nodes themselves, which use algorithms to carry out only simple tasks of forwarding information to other nodes but is derived from the layered architecture of the neural network as a whole, which becomes adept at recognizing complex patterns.
- Deep Learning: a machine learning technique that exploits the architecture of a neural network with several layers, some of them possibly specialized for certain characteristics and patterns. For example, deep learning can be used to recognize a picture of a cat (the iconic task of image recognition). A typical neural network is six or seven layers deep – while the number of layers in the most sophisticated networks now runs into the hundreds. At the deepest level, neural networks look at individual pixels, while higher levels identify elements like the tail, paws and ears – and the cat itself. The technique requires data – and lots of it – to work but having been

trained by looking at thousands or even millions of pictures, a neural network becomes very good at its task, better even than a human.

The real power is that an AI system only needs to learn once. Once learned, the system's knowledge (for example, 'what does a cat look like?', 'what do normal data packets (as opposed to a security breach) look like?' or 'what does an unhappy customer look like?') can be transferred to other applications, where this learned recognition can provide instant help in making decisions or recommending intervention.

It is also worth noting that we often bundle other technologies, such as robotics, into the same conversation as AI. That's because AI and robotics are such complementary technologies, with AI enabling automated decision-making and robotics enabling the decisions to be fed into physical actions. For instance, autonomous (self-driving) vehicles are the result of combining AI and robotics.

How AI is being deployed today

Because AI is especially good at categorizing information and identifying patterns in vast amounts of data, it is adept at increasing the identification of anomalies, something that can be applied in many different domains.

A great example of AI in action is in scanning vast amounts of internet traffic in real time, helping identify potential **cybersecurity** threats that have never even been seen before – something that means mitigating action can be taken before a threat has taken hold. For humans, it would be simply impossible to scan through hundreds of thousands of internet logs and spot the precise pattern that could signal a cyber-attack.

Manufacturing is benefiting from AI, with machines taking on monotonous tasks such as looking for defects in product manufacturing. Not only does machine learning improve the level of accuracy, but it also reduces the time to analyze results. What's next is predictive maintenance, for instance in identifying the likelihood of product failure in the field. **Supply chain management** is also significantly enhanced by the use of AI, which can monitor inventories across entire production lines to make sure that supplies of essential components are never in danger of running out, and therefore avoiding expensive downtime. It's difficult for human operators to do this efficiently across entire production lines – and of course they are prone to human error – but this is perfect for AI, as machines never sleep, need a coffee break, lose count, or get distracted.

In **healthcare**, a number of trials have shown that AI can also be trained to identify anomalies – for example, to differentiate cancer cells from normal cells in biopsies. AI is helping us apply science to something that previously relied on the human eye and in many cases, from handwriting recognition to passing math exams, AI has already proven more accurate than human experts. Since healthcare is a field that generates large quantities of clinical data, AI is perfectly suited to extracting insight by analyzing this input. For example, Fujitsu's advanced clinical research information system HIKARI (a word that means 'light' in Japanese) uses AI to provide clinicians with insights that can aid their decision-making: a perfect example of human centric innovation and how AI is helping create value for people and society. This approach was used in a collaboration between Fujitsu and clinicians at San Carlos Clinical Hospital in Madrid, Spain that analyzed 30,000 secure and anonymized patient records, combined with analysis of public health data, to recognize patterns and is now in use to flag up likely health risks for a patient, such as alcohol or drug dependence or even a risk of suicide.

AI will also revolutionize the **transport** sector – among the early wins in this field are logistics companies, who can already optimize delivery routes in real time to avoid delays caused by traffic congestion. And AI will also play a significant role for autonomous (self driving) vehicles.

In **Smart Cities**, and more generally speaking in the **public sector**, AI is also growing quickly. Surveillance cameras are increasingly active in solving incidents. The Fujitsu Zinrai AI technology (see below) is utilized for image analysis of vehicles and people. Images and movies taken with surveillance cameras installed in various places in a city are being analyzed by the latest AI technology. Machine identification by car type, model, and color helps support the discovery of stolen vehicles. Another powerful new element of AI is its ability to detect abnormal, suspicious behavior in public places. Once a system has gone through the machine learning process to establish the norm for the way people behave in and move through public spaces, then it is easy to quickly detect any behavior that does not fit this pattern – as well as being able to detect further information about people, such as their gender, clothing color, and personal belongings such as handbags.

In **agriculture**, machine learning can enable a moving tractor to tell the difference, in real time, between a growing lettuce and a dandelion – and then apply a targeted dose of weed killer – giving the lettuce more space to grow, reducing use of pesticides and delivering a more efficient crop yield. AI can also help determine the optimal time for harvesting – making more-informed, intelligent decisions by studying weather patterns and historical data, as well as factoring in data from other sources, such as current levels of supply and demand in local supermarkets.

In the **retail** industry, AI is already in place without consumers even realizing. Webchats, for instance, allow a brand or retailer to use AI to respond to basic questions. As AI becomes more advanced, these webchats will become more sophisticated, providing customers with their own 24-hour personal support. Retailers also making use of deep learning to analyze the data coming from multiple channels, either digital or in the store via sensors or videos analysis, in order to deliver an ever more personalized customer experience.

In **customer service**, the addition of AI to service desks and call centers frees up staff from low-level, monotonous tasks, enabling them to concentrate instead on addressing more complex technical problems, or complicated requests, or delivering better customer experience or care.

Financial institutions are using AI to model the potential direction of stock markets and to analyze signatures, helping to detect fraudulent patterns. Banks are exploring the use of facial recognition in ATMs, not only to improve security but also to personalize services.

AI Zinrai: Fujitsu Artificial Intelligence

The Fujitsu brand for AI is Zinrai, a framework that brings together diverse development threads and AI techniques. Zinrai itself is not a product or a service but a collective name for the broad family of AI capabilities that Fujitsu makes available to customers.

The key characteristic of Zinrai is that it offers a selection of application programming interfaces (APIs) – a popular way for software applications to share data in common formats – that make it easy to build and connect applications to leverag Zinrai's capabilities. As a result, customers can easily take advantage of new capabilities: these might include sensing and recognition, knowledge processing, decision making or predictive support.

Fujitsu offers a number of human centric Zinrai solutions, which can be deployed either via the cloud or on-premises:

■ Predictive Maintenance powered by Zinrai
Fujitsu's Predictive Maintenance solution uses a number of tools, techniques and AI machine learning algorithms to analyze data captured from multiple sensors per machine to monitor the condition of a machine or equipment. The solution is helping businesses to determine when and where a problem or failure might occur, providing exploratory analysis of data in real time and delivering information via a visual interface.

■ Customer Flow Analysis powered by Zinrai
This solution provides real time recognition from CCTV of information such as license plate details, vehicle count by type, brand, and model, time spent at the pump, vehicle congestion or number of people entering and moving into a shop. This helps to target customers with the right products at the right time through behavioral analytics and to spot behaviors and hazardous situations that might pose a security or health risk.

■ Quality Control powered by Zinrai
By using advanced image recognition technology to recognize product defects the time needed for quality control is drastically reduced. The solution can be applied to the production of high volume, complex products, which currently require intensive manual inspection, for example, tires, rail lines and aircraft and shipping components. A good example of that is the use of AI in helping wind turbine manufacturer Siemens Gamesa to perform microscopic-level quality controls on newly-manufactured carbon fiber blades.

■ Social Infrastructure Maintenance powered by Zinrai
This solution reduces the time needed for road inspection by 90% and improves the safety and the maintenance of infrastructure, such as bridges, roads, tunnels, airports and parking facilities, by early detection of deteriorating infrastructure. Thanks to its unique topological data analysis and image interpretation tools, the solution integrates vast amounts of sensor data to optimize the maintenance of critical social infrastructure by monitoring progressive deterioration over time.

When is the right time to deploy AI?

Every customer's case is unique, and AI is still in its infancy: however, it is already clear from the examples above that early adopters will gain a competitive advantage. Fujitsu customers are now easily able to access the powerful capabilities of Zinrai to unlock the capabilities offered by

their legacy systems. Now it is easier than ever for enterprises to digitally transform, automate and optimize operations and gain competitive advantages.

Fujitsu's History in AI

Fujitsu has been actively involved in developing and deploying AI and associated technologies for decades and has helped many organizations to leverage the power of AI. The company has undertaken significant work to enhance the processing capabilities of AI systems. For example:

- Fujitsu Laboratories has worked to maximize the computational horsepower available to neural networks. Much of this expertise has been gained from its unrivalled pedigree in the field of supercomputing. Back in 2011, Fujitsu built the K supercomputer, based on a distributed memory architecture comprised of more than 80,000 computer nodes. The work undertaken in this field greatly advanced Fujitsu's understanding of how to link computing nodes, a key characteristic of the underlying technologies of AI.
- The company has also effectively streamlined the memory efficiency of graphics processing units (GPUs) and optimized associated algorithms, making it possible for neural networks to use parallel processing more effectively. This has successfully doubled the speed of learning for neural networks, based on the widely deployed AlexNet and VGGNet research networks.
- Furthermore, Fujitsu produces and optimizes field programmable gate arrays (FPGAs) to speed up processing, by directly executing commands in computer hardware. One recent implementation was shown to be 10,000 times faster than conventional computers.

However, ultimately, the secret to any successful AI implementation is creating a foundation based on an excellent systems design – an area where Fujitsu has considerable expertise.

The advance of AI does not mean that humans will be replaced by machines. Fujitsu's human centric view is that harnessing these new-generation technologies will be hugely empowering for society. The impact of AI on our lives is not something that we will suddenly notice or appreciate overnight, but one thing is clear: Its progress is constant, and inevitable. It's only when you step back that you see how far we have already come, and that you can appreciate the journey ahead of us. With machines able to tackle more and more of the mundane tasks, people are empowered to better focus on areas that add more value. It is people who remain at the center of Fujitsu's vision, with AI solutions centered on creating value and supporting the work they do.

There is a risk, however, that the enormous potential business benefits of Artificial Intelligence (AI) are being held back in Europe by a lack of strategic focus, with the consequence that companies risk missing out on the opportunity to use AI to transform their businesses. A recent survey, co-published by Fujitsu and analyst firm Pierre Audoin Consultants (PAC), uncovered a surprising lack of strategic focus for AI, despite an unambiguous understanding of the benefits of AI at a functional level, increasing levels of adoption and the widespread involvement of board-level executives in planning for AI adoption. Nevertheless, only one in four companies interviewed in the survey saw AI as strategically important and just 11 percent had an AI strategy in place. One implication is that AI might be currently being driven by functional needs, with an over-emphasis on optimization, pointing to a need for board-level executives to be more engaged in the discussion to unlock the full potential of this disruptive technology.

Online resources

- Fujitsu's Human Centric AI vision: http://www.fujitsu.com/global/vision/human-centric-ai/
- Fujitsu's 2018 Technology and Service Vision: http://www.fujitsu.com/global/microsite/vision/
- Artificial Intelligence – The Next Wave in Digitalization, incl. links to case studies http://www.fujitsu.com/global/solutions/business-technology/ai/
- The Fujitsu AI Center of Excellence in Paris-Saclay, France: http://www.fujitsu.com/fts/about/resources/news/press-releases/2018/emeai-20180329-fujitsu-boosts-research-capabilities-in.html
- AI-related posts on the Fujitsu blog: http://blog.global.fujitsu.com/?s=artificial+intelligence
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- Find Fujitsu on Facebook: http://www.facebook.com/FujitsuICT
- Fujitsu pictures and media server: http://mediaportal.ts.fujitsu.com/pages/portal.php
- For regular news updates, bookmark the Fujitsu newsroom: http://ts.fujitsu.com/ps2/nr/index.aspx

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About Fujitsu
Fujitsu is the leading Japanese information and communication technology (ICT) company, offering a full range of technology products, solutions, and services. Approximately 140,000 Fujitsu people support customers in more than 100 countries. We use our experience and the power of ICT to shape the future of society with our customers. Fujitsu Limited (TSE: 6702) reported consolidated revenues of 4.1 trillion yen (US $39 billion) for the fiscal year ended March 31, 2018. For more information, please see http://www.fujitsu.com.

About Fujitsu EMEIA
Fujitsu promotes a Human Centric Intelligent Society, in which innovation is driven by the integration of people, information and infrastructure. In the Europe, Middle East, India and Africa region (EMEIA), our 28,000-strong workforce is committed to Digital Co-creation, blending business expertise with digital technology and creating new value with ecosystem partners and customers. We enable our customers to digitally transform with connected technology services, focused on Artificial Intelligence, the Internet of Things, and Cloud - all underpinned by Security. For more information, please visit http://www.fujitsu.com/fts/about/