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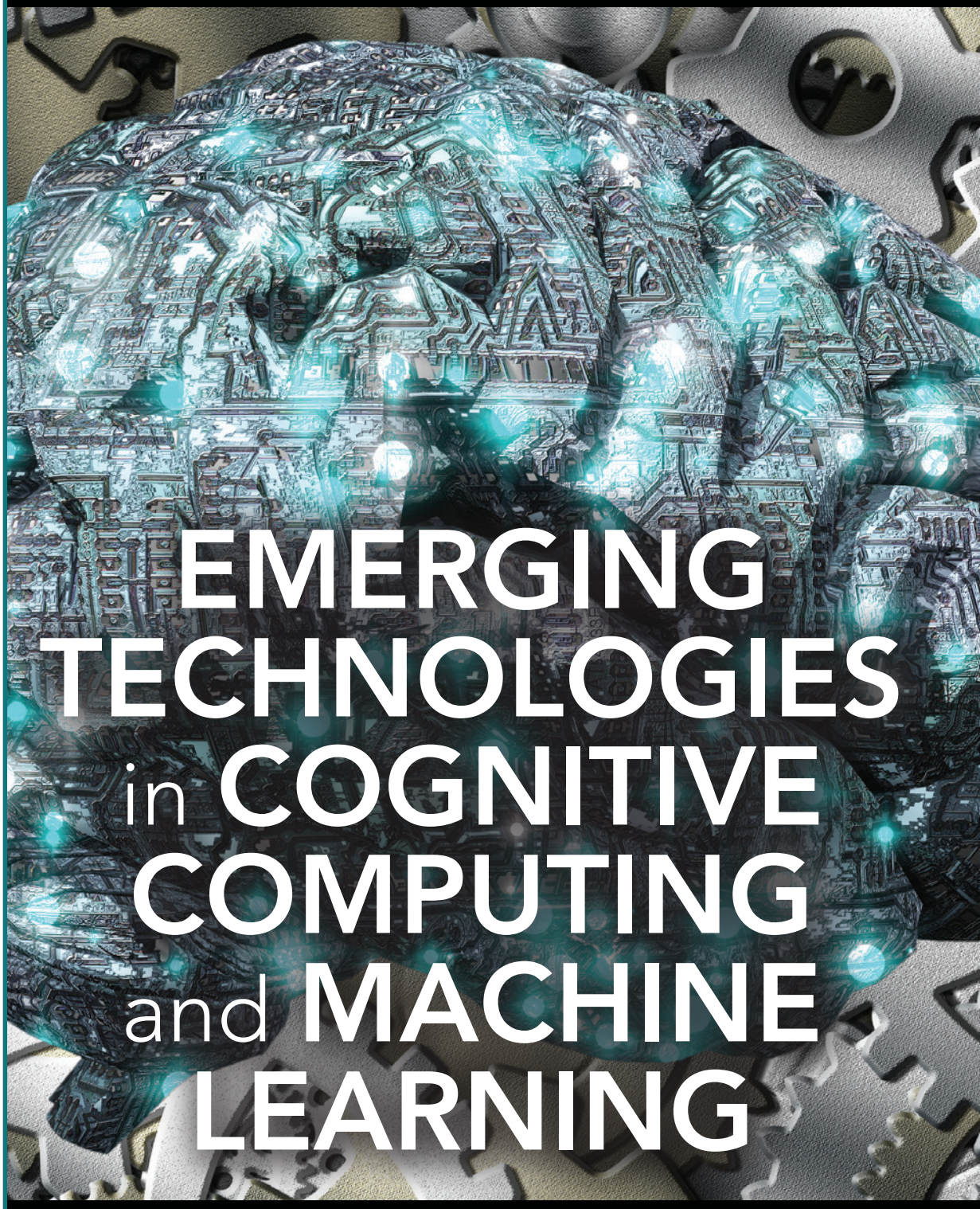

EMERGING TECHNOLOGIES in COGNITIVE COMPUTING and MACHINE LEARNING

database
TRENDS AND APPLICATIONS

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THE NEW ERA OF COGNITIVE COMPUTING AND MACHINE-LEARNING

A new era of cognitive computing is unfolding and its impact is already being felt across industries, from preventative maintenance at manufacturing plants and patient diagnosis at hospitals, to the rise of sophisticated chatbots ready to assist us across the connected world. According to estimates, the market around cognitive computing products and services will grow to $46 billion in just a few years and intelligent applications will spread like wildfire transforming our lives at work and at home.

The goal of cognitive computing is straightforward: to simulate human thought processes in a computerized model. Through a variety of established technologies such data mining, pattern recognition, and natural language processing, we can build systems that mimic how the human brain works. These systems rely on machine learning and deep learning algorithms to automatically learn and adapt from experience without being explicitly programmed. The experience we provide cognitive computing systems is data.

Cognitive computing systems need massive volumes and varieties of data. The more data, the more the system can learn, based on previous computations, to produce accurate results and predictions. Meeting the scalability and performance requirements of cognitive computing systems involves complex data connections and serious processing power and storage to support high-speed data exploration.

Out of necessity, the future of IT infrastructures at many organizations will become increasingly hybrid; where existing operational systems on premise are augmented with new data sources being stored and analyzed in the cloud. The spike in Apache Spark usage this year in the cloud is a great example. Moving forward, flexible deployment and integration options will be a must-have for big data projects.

In addition to their self-learning capabilities, in order to mimic the human brain, cognitive computing systems must understand context. They can identify and extract contextual elements such meaning, syntax, time, location, appropriate domain, regulations, user profile, task, and goal to present information that is appropriate for an individual or dependent application.

To fully deliver value, these systems also need to be able to easily interact with both their human and machine colleagues. For humans, that typically means speech and text. The rise of cognitive business applications that deliver a more engaging user experience is a key development in this area, as well as continued advancements in natural language processing.

For machines, the most exciting area is the Internet of Things. According to estimates, the IoT universe is on track to exceed over 25 billion devices by 2020. Right now, there are more things connected to the Internet than people on the planet. From home appliances and cars, to light bulbs and livestock, if you can attach a sensor to it, it can be become part of a universe of physical objects able to communicate and interact digitally. This connectivity means more data, gathered from more places, than ever before.

A recent survey found that 29% of *Big Data Quarterly* readers already have IoT projects underway. The top reasons cited for implementing IoT projects included increasing new business revenue sources, increasing customer and product knowledge, and reducing operating expenses. There were also a plethora of challenges, from harnessing new data sources, to delivering real-time analytics. On the road ahead, expect to see a lot of cases where IoT and cognitive computing technologies are combined to deliver new insights.

The advantage that machine learning offers organizations—the ability to automatically build models that can analyze huge volumes of data and deliver lightning fast results—has also led to a growth in the availability of both commercial and open source frameworks, libraries and toolkits for engineers. These resources are democratizing access to machine learning for companies big and small and will continue to play a pivotal role in the spread of machine learning throughout businesses.

Ultimately, cognitive computing, along with machine learning, is about increasing efficiency, productivity, and innovation via data analytics and automation. Today, many people associate them with high-profile examples like self-driving cars and robots, which bring the subject good publicity. However, harnessing value from these technologies is far from the exclusive domain of billionaire entrepreneurs and Fortune 500 companies. The growth of cloud services, lower storage costs, more efficient data processing options and, open source tools offers resources to organizations of all types and sizes to get started today. ■

COOL COMPANIES IN COGNITIVE COMPUTING

No longer the stuff of science fiction, the business uses for cognitive computing and machine learning today include fields as diverse as medicine, marketing, defense, energy, and agriculture. Enabling these applications is the vast amount of data that companies are collecting from machine sensors, instruments, and websites and the ability to support smarter solutions with faster data processing.

It is also clear that we are still in the early days of cognitive computing and machine learning, and to be sure, there are technical, political, and ethical considerations to be dealt with before this new wave of solutions comes closer to reaching its potential. However, innovative companies do have products and services today to help customers put more data to work.

To help readers gain a greater understanding about this emerging area of information technology, the solutions available, and their role in handling real-world challenges, *DBTA* presents the inaugural list of Cool Companies in Cognitive Computing.

—Joyce Wells

Alpine Data enables organizations to create a culture of analytics at scale by providing an integrated analytics platform that brings machine learning, data, and people together to create operational solutions for business users.

Amazon AI services bring natural language understanding, automatic speech recognition, visual search and image recognition, text-to-speech, and machine learning technologies within the reach of every developer.

ABBYY provides intelligent capture, optical character recognition, innovative language-based, and artificial intelligence technologies to help businesses take action with information.

Attivio's Cognitive Search and Insight Platform leverages cognitive capabilities, such as machine learning and natural language processing to deliver the most relevant information in context but also offers the flexibility of manual relevancy tuning to optimize results.

C3 IoT offers a comprehensive technology stack for the rapid design, development, deployment, and operation of next-generation IoT applications that unlock data-driven insights and transform business processes.

Cloudera offers a modern platform for machine learning and advanced analytics built on open source technologies, and recently introduced its Data Science Workbench, based on the company's acquisition of data science startup Sense.io, to accelerate data science and machine learning for the enterprise.

Cogitai is dedicated to building artificial intelligences (AIs) that learn continually from interaction with the real world, with the goal of building the brains, i.e., the continual-learning AI software that enables everyday things to get smarter with experience.

CognitiveScale offers an augmented intelligence platform and the ENGAGE and AMPLIFY products that pair humans and machines so they can "engage" users intelligently at the edge and "amplify" process intelligence through self-learning, self-assuring business processes for commerce, healthcare, and financial services.

Crowdflower offers a platform powered by Microsoft Azure Machine Learning that combines machine learning and humans-in-the-loop in a single platform for data science teams doing sentiment analysis, search relevance, or business data classification.

Darktrace was founded in Cambridge, U.K., in 2013 by mathematicians and machine learning specialists from the University of Cambridge, together with world-leading intelligence experts from MI5 and GCHQ, to bring transformative technology to the challenge of cybersecurity.

Databricks, the company founded by the creators of the Apache Spark project, recently introduced Deep Learning Pipelines, a library to integrate and scale out deep learning in Apache Spark, which has the potential to accomplish for deep learning what Spark did for big data—make it approachable to a much broader audience.

Dataiku, whose name is a portmanteau of data and haiku, espouses the view that data projects should have "a structured process, a single flow, from start to finish," and provides the Data Science Studio (DSS), to enable scalable data science to any organization.

DataRobot uses advanced enterprise machine learning automation to enable users to quickly build and deploy highly accurate machine learning models.

DatumBox offers services available through a REST API, including a large number of off-the-shelf classifiers and natural language processing services which can be used in applications for sentiment analysis, topic classification, language detection, subjectivity analysis, spam detection, reading assessment, keyword and text extraction, and more.

Digital Reasoning software assembles an integrated circuit of algorithms that organize information into a graph-based knowledge model to enable predictions based on a high fidelity representation of context, and, like the human mind, learns new things, adapts, and gets smarter over time.

H20.ai provides an open source AI platform that is used by over 100,000 data scientists and more than 10,000 organizations around the world.

IBM introduced Watson to the world in 2011 when it won the $1 million first place prize on *Jeopardy*, and, today, the cognitive computing platform encompasses products and APIs that bring the power of AI to organizations in more than 45 countries and across 20 different industries to uncover business-critical insights.

Infosys offers the Nia platform, which combines the big data/analytics, ML, KM, and cognitive automation capabilities of its first-generation AI platform, Mana; the robotic process automation capabilities of AssistEdge; and the machine-learning capabilities of Skytree; with optical character recognition, natural language processing capabilities, and infrastructure management services.

IPsoft, which automates enterprise IT and business processes through the use of digital labor, offers Amelia, an AI platform that connects conversations to data and processes in order to enable personalized service to customers.

JASK, an enterprise artificial intelligence (AI) cybersecurity company, that recently launched with the announcement of $12 million in Series A funding, offers a cloud platform that uses machine learning and AI to deliver end-to-end network monitoring—identifying and triaging the most relevant attacks, and allowing security analysts to focus their resources on only the most dangerous threats.

MapR provides the distributed deep learning Quick Start Solution comprised of a data layer, which is managed by the MapR File System (MapR-FS) service, a middle orchestration layer using Kubernetes to manage the GPU/CPU resources, and a top application layer using TensorFlow as the deep learning tool.

Nara Logics builds a synaptic network of explicit and inferred connections to create an intelligence layer on top of chaotic, siloed enterprise data for real-time, context relevant recommendations.

OpenText, a provider of enterprise information management solutions, recently introduced a new artificial intelligence platform that combines open source machine learning to offer users machine-assisted decision making, automation, and business optimization, in an easy to use package.

Progress, a provider of application development and deployment technologies, takes a cognitive-first approach, and recently acquired DataRPM, a provider of cognitive predictive maintenance software for the industrial IoT (IIoT) market, to fuel this strategy.

RapidMiner offers a unified data science platform that accelerates the creation of complete analytical workflows from data prep to machine learning to deployment in a single environment, improving efficiency and shortening the time to value for data science projects.

RAVN offers Applied Cognitive Engine (ACE), which offers capabilities that go far beyond merely searching for documents and webpages, including machine learning tools and automatic extraction of key data from the unstructured data under management.

Saffron Technology offers patented technology that mimics humans' natural ability to learn, remember, and reason in real-time and is targeted at defense, healthcare, manufacturing, and financial services.

SAP has relaunched SAP Leonardo (previously known as its brand for IoT) as its digital brand, including IoT solutions, to take advantage of advances in big data and analytics, the ability to connect people, things, and business with the SAP Cloud Platform, and technologies such as machine learning to enable IoT and Industry 4.0 strategies across digital logistics, manufacturing, and asset management.

SAS has been solving customer problems with cognitive capabilities for years, and contributes critical components to the cognitive computing mix, including natural language processing and open, deep learning API (application programming interface) libraries sitting on top of advanced analytics, including the new SAS Viya platform.

Search Technologies, recently acquired by Accenture, offers a proprietary Content Processing Framework and collection of API-level data connectors—which enable access to unstructured enterprise data across disparate and legacy systems—that will be integrated into the Accenture Insights Platform, helping clients embed analytics and AI into their business to generate new intelligence at speed and scale.

Sinequa provides a cognitive search and analytics platform for Fortune Global 2000 companies and government agencies. Using advanced natural language processing and machine learning algorithms, the solution offers insights extracted from structured and unstructured data.

SparkCognition, launched in 2014 in Austin, Texas, provides clients with patented AI-powered products to enhance cyber security, and state-of-the-art machine learning technology to identify and prevent equipment failures before they happen.

Tamr offers patented software that fuses the power of machine learning with knowledge of an organization's data to automate the rapid unification of data silos at scale. ■

Building a Foundation to Support the Rise of Cognitive Computing

We are at the start of the cognitive era. The potential advantages spoken about for so long are within reach and many businesses are realizing that now is the time to act. According to a recent study from IBM's Institute for Business Value (IBV), 73% of the CEOs that it surveyed across the globe thought that the role cognitive computing would play in their company in the future would be important.[1] These CEOs aren't referring to a distant future that might be realized ten or fifteen years from now, 50% indicated a 2019 timeframe for their own cognitive computing adoption.[2] If you've been thinking about implementing cognitive technology, now is the time to act.

Businesses are excited about the near-term prospects of cognitive computing for good reason. By taking advantage of cognitive computing's ability to support and build upon human expertise, both the quality and consistency of decision making can be improved. This is an opportunity for businesses to drive significant measurable value. In a recent survey, executives indicated anticipating a return on investment of 15% for cognitive initiatives.[3]

In order to take advantage of the cognitive future, we must look at the core foundational components that must first be put in place. In its definition of a cognitive business, the IBV mentions two key components: an ability to use a range of analytics capabilities such as descriptive, predictive and prescriptive analytics as well as a data management ecosystem that handles multiple sources and a high volume of data (both structured and unstructured).[4]

BUILDING A CORPUS OF INFORMATION

For a cognitive solution to reliably add value, the solution must have a substantial amount of information upon which to draw. This collection of information is typically called the "data corpus" and according to IBV could include a variety of data types such as structured and unstructured data housed in multiple locations[5] whether that happens to be a database, data warehouse, Hadoop or other open source or proprietary repositories. Some of this information may even come from previously untapped sources that can now add value.[6]

Despite the fact that the corpus is specific to the needs of the cognitive solution, a proper data foundation should be put in place ahead of time across the organization. Having better data quality, more data, and easier access to that data will pay off when being designated for cognitive solutions. Early focus in this area will have a profound impact on the knowledge that can be gleaned when making data-driven decisions.

ENSURING ACCESS TO ANALYTICS

Analytics similarly plays a large role for cognitive solutions by delivering the insights which make such solutions helpful. While descriptive, predictive, and prescriptive analytics can all play a part, data science and machine learning have received considerable attention as of late for being an achievable early step toward a more complete cognitive strategy. In fact, 44% of the organizations that IBV identified as "cognitive capable" in its study had adopted machine learning already.[7]

Unsurprisingly, a healthy data ecosystem has a role to play here as well. Data management solutions that are flexible enough to draw upon multiple data sources and integrate well with various analytics tools are necessary to deliver the most comprehensive insights. Not only does flexible data management allow you to prepare for the cognitive future, but also benefits the analytics you are currently running with smoother interactions and depth of referenceable data.

BUILDING THE RIGHT HYBRID DATA MANAGEMENT SYSTEM AS YOUR COGNITIVE BUSINESS'S FOUNDATION

At first glance, it may be difficult to determine what you can do to get ready for the cognitive era. We recommend that you establish a solid foundation by building out a data management ecosystem that delivers the flexibility and performance required by cognitive solutions.

Choose a solution with the flexibility necessary to provide the data you need

The corpus of a cognitive solution will need to draw upon structured, unstructured, and semi-structured information from a multitude of sources and data management systems, so make sure querying data from all those locations can be done easily. Technologies that allow you to write queries once and run them anywhere, like those found in IBM's family of data management solutions, are a good starting point. If you want to run queries on-premises today and in the cloud tomorrow, or vice-versa, you won't need to spend time rewriting them. This means you can run your data warehouse the way you want without location-based impediments.

Additional data source flexibility can be provided through techniques such as data virtualization, which allow you to conveniently bring in external data for use in analytics. Since not all data capable of delivering insight lives within your organization, being able to draw upon that information is crucial. Yet, even data inside the organization will see benefits from data virtualization. Data virtualization can help you connect to Hadoop and Spark and will make it easier to access data or repositories that might have been moved.

Of course, it is also helpful if your licensing options are just as flexible. If you believe your business might move toward

having more cloud-based data management technology concurrent with, or as a result of, the push for cognitive solutions, it's worth investigating options that will let you switch on-premises for on-cloud licenses as the need arises. This will allow you to switch your company's technology landscape exactly when the time is right.

Choose a solution that can deliver the performance and efficiency needed for the cognitive era

Still, flexibility is meaningless if a solution doesn't have the power to back it up. High performance from your data management architecture is essential to meet the stringent demands of cognitive computing, because insights need to be delivered within a timely manner to add the most valuable. The massive volume of data, speed of uncovering insights, and access to analytics required must be met or the effectiveness of the cognitive solution will suffer.

The increasing amount of data being collected requires that a data management ecosystem be both scalable and efficient. One way to achieve this is through in-memory columnar technologies that take advantage of massively parallel processing (MPP) based cluster architectures. These technologies, like BLU Acceleration® in IBM's data management products, help to scale out capabilities. In turn, this can significantly improve performance by ensuring that you can take advantage of the increasing amount of data available for your cognitive needs.

To mitigate rising storage cost, look for solutions that provide both actionable compression, which preserves the order of data so that it can be used for analytics without decompression, as well as data skipping so that unnecessary data processing can be bypassed. Features such as these save both time and money.

Quick time-to-insight is also critical for cognitive solutions and is dependent upon the speed of analytics and speed of setup. The speed of analytics for cognitive technologies needs to be as close to real-time as possible so that insights can be delivered the instant they're needed. Again, look for solutions with in-memory columnar technologies that are capable of providing insight from real-time operational and historical data. In addition, consider how quickly the solution needs to be up and running. Cloud offerings may provide the quick setup you need, but a pre-tuned, on-premises option might be better depending on your situation. Work with a vendor like IBM that is capable of providing both.

Similarly, pre-tuned unified data platforms that contain both a data warehouse and data science tools can help address the need for access to analytics within the data management ecosystem. The data science needed for the cognitive era can be done faster when machine learning is run in the same place as the data. Yet, even if you choose not to purchase a platform such as that, integration with other analytics software is vital. Make sure your data management solutions have the capability to work with and allow you to take advantage of the multitude of analytics options available.

WHERE TO START LOOKING

With the cognitive era close at hand, now is the time to start preparing, particularly if your CEO was one of the 50% surveyed who has plans for cognitive adoption by 2019.[8]But you don't have to face that daunting task alone. Get started in the right direction by learning more about a comprehensive family of data management products from IBM which has the flexibility and performance that cognitive solutions will require. As the cognitive era transitions from theoretical to reality, begin laying the foundation that will empower your business. ■

[1] *Abercrombie, Cortnie, Rafi Ezry, Brian Goehring, Anthony Marshall, and Hiroyuki Nakayama. "Accelerating enterprise reinvention" IBM Institute for Business Value. June 2017. https://www-935.ibm.com/services/us/gbs/thoughtleadership/accelentreinvent/*

[2] *Abercrombie, Cortnie, Rafi Ezry, Brian Goehring, Anthony Marshall, and Hiroyuki Nakayama. "Accelerating enterprise reinvention" IBM Institute for Business Value. June 2017. https://www-935.ibm.com/services/us/gbs/thoughtleadership/accelentreinvent/*

[3] *Abercrombie, Cortnie, Rafi Ezry, Brian Goehring, Anthony Marshall, and Hiroyuki Nakayama. "Accelerating enterprise reinvention" IBM Institute for Business Value. June 2017. https://www-935.ibm.com/services/us/gbs/thoughtleadership/accelentreinvent/*

[4] *Ezry, Rafael, Michael Haydock, Bruce Tyler and Rebecca Shockley. "Analytics: Dawn of the Cognitive Era." IBM Institute for Business Value. October 2016. http://www.ibm.com/business/value/2016analytics/*

[5] *Sarkar, Sandipan and David Zaharchuk. "Your cognitive future – How next-gen computing changes the way we live and work, Part II: Kick-starting your cognitive journey." IBM Institute for Business Value. March 2015. http://www.ibm.com/business/value/cognitivefuture*

[6] *Sarkar, Sandipan and David Zaharchuk. "Your cognitive future – How next-gen computing changes the way we live and work, Part II: Kick-starting your cognitive journey." IBM Institute for Business Value. March 2015. http://www.ibm.com/business/value/cognitivefuture*

[7] *Ezry, Rafael, Michael Haydock, Bruce Tyler and Rebecca Shockley. "Analytics: Dawn of the Cognitive Era." IBM Institute for Business Value. October 2016. http://www.ibm.com/business/value/2016analytics/*

[8] *Abercrombie, Cortnie, Rafi Ezry, Brian Goehring, Anthony Marshall, and Hiroyuki Nakayama. "Accelerating enterprise reinvention" IBM Institute for Business Value. June 2017. https://www-935.ibm.com/services/us/gbs/thoughtleadership/accelentreinvent/*

Why Future Applications Must Be Cognitive-First

INTRODUCTION

The March 2017 Gartner Report, "Top 10 Strategic Technology Trends for 2017: Intelligent Apps," states that, "By 2018, 90% of the world's 200 largest companies will exploit intelligent apps and use the full toolkit of big data and analytical tools to improve their customer experience."*

It's clear that new technologies are rapidly and fundamentally changing what is possible for businesses and organizations of all types. For business leaders, the opportunity is enormous. For application development teams, the challenge of harnessing today's complex set of technologies, interface types, data sources and more to deliver on the promise of intelligent apps can be daunting. These factors—and the ability to integrate predictive results into business applications, have led to the evolution of the next generation of mission-critical apps—cognitive-first.

Businesses operate at a different cadence in today's world—they need to be fast, flexible, agile, reliable and secure—and the mission-critical applications those businesses run on need to be the same. The time to embrace innovation is now.

NEW REQUIREMENTS OF COGNITIVE-FIRST MISSION-CRITICAL APPS

Applications must be immersive.

Today's business applications must engage the user on any device or interface type based on their digital preference, which may change throughout the user journey. That requires moving beyond a "mobile-first" or "multi-channel" approach. From GUI experiences across device types and platforms, to increasingly new forms of interaction that don't involve a GUI at all like voice, chat and AR, the application and user experience must be completely immersive, acting on behalf of the user or engaging the user on the device or interface type of their choice.

Applications must be intelligent.

The explosive growth of data has led to a state where humans alone can't manage it—even with an army of data scientists. To harness this data, applications must be intelligent, or cognitive-first. The mission-critical application of tomorrow needs to have built-in machine learning capabilities to use data to predict what will happen in the future, and the algorithms powering these intelligent systems must have self-learning capabilities. This can only be achieved by automating the complex data science lifecycle so that highly accurate analytical models can be created, deployed and continuously improved without a large, expensive data scientist presence. The end goal is to turn data into actionable insights and automatically take pre-emptive actions to drive outcomes.

Applications must be connected.

With the number and types of sources of data that need to be integrated growing exponentially, it is critical to determine the right way to integrate and harness all that data and information regardless of where it lives—on different clouds, on-premise, in different data centers, in systems of record, data lakes, IoT devices and more. Even more important is the need to move beyond tactical application integration so that we can overcome obstacles that impact people's ability to use data, analytics and gain the experiences they need.

Applications must be built for internet-scale.

While the requirement to dynamically scale for transaction and data volume is not new, there are now new ways to accomplish it. Today's definition of scale also means the ability to support different types of application and UX workloads—like IoT, or event-based processing. This requires a modern architecture that goes beyond the concept of "infrastructure as code" to "infrastructure as microservices," combining the advantages of managing infrastructure with code, along with the development agility and deployment flexibility of microservices.

SECURE, RELIANT AND COMPLIANT APPS ARE JUST THE BEGINNING

Mission-critical business applications have always had to be secure, reliant and compliant. But today, that is only the beginning. They need capabilities not usually associated with mission-critical. They need to be flexible and agile, offer rapid time to market and be easy to iterate and change—all without sacrificing those traits of security, reliability and compliance.

*Gartner, "Top 10 Strategic Technology Trends for 2017: Intelligent Apps," 21 March 2017, Mike J. Walker | David W. Cearley | Alexander Linden

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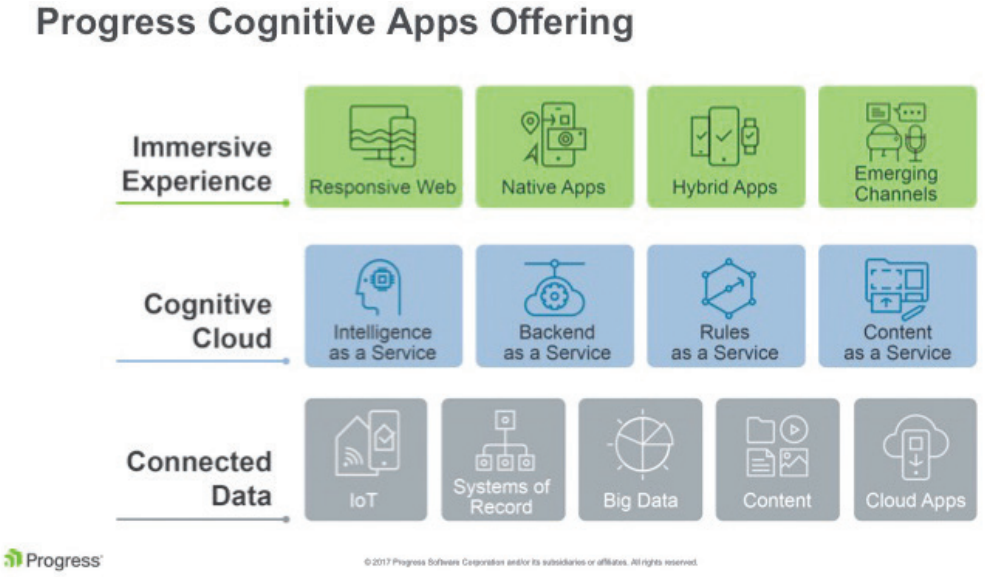
PROGRESS COGNITIVE OFFERING

Immersive Experience: Creating an immersive experience requires building applications or experiences that support all appropriate digital touchpoints in a way that creates a true connection with the user.

Cognitive Cloud: The immersive experience must be supported by a cognitive cloud with a modern set of application services that include new requirements like intelligence as a service and modern backend as a service.

Connected Data: The ability to connect and integrate to any data or application—regardless of location—in the cloud or on-premise with optimal performance and security. ■



GET STARTED TODAY

Today, Progress can provide you the necessary set of capabilities to build the next generation of mission-critical applications—cognitive-first applications. Why not get started with:

NativeScript for Frontend Development

NativeScript® is the open source framework developed by Progress for building truly native iOS and Android mobile apps with Angular, TypeScript or JavaScript. NativeScript is a key reason why Progress was recognized by Gartner as a Leader in the June 2017 Gartner Magic Quadrant for Mobile Application Development Platforms (MADP)**.
www.progress.com/nativescript-dbta

Kinvey for Backend Support

Named a Leader in "The Forrester Wave™: Mobile Development Platforms, Q4 2016, receiving the highest score among the 12 vendors considered by Forrester in its 32-criteria evaluation, Progress Kinvey is the most complete, proven, easy to use and advanced platform available today.
www.progress.com/kinvey-dbta

Cognitive Predictive Maintenance

DataRPM automates the complex machine learning lifecycle, providing highly accurate predictive analytics insights for the Industrial IoT. Recently, Frost & Sullivan recognized DataRPM with the 2017 North American Frost & Sullivan Award for Technology Leadership in automotive manufacturing.
www.progress.com/datarpm-dbta

***Gartner, Magic Quadrant for Mobile App Development Platforms, Jason Wong | Van L. Baker | Adrian Leow | Marty Resnick, 12 June 2017. Gartner does not endorse any vendor, product or service depicted in its research publications, and does not advise technology users to select only those vendors with the highest ratings or other designation. Gartner research publications consist of the opinions of Gartner's research organization and should not be construed as statements of fact. Gartner disclaims all warranties, expressed or implied, with respect to this research, including any warranties of merchantability or fitness for a particular purpose.*

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