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ADVANCE WITH ANALYTICS

How Machine Learning and Advanced Analytics
Can Transform Your Business

It could be argued that today's business challenges are more acute than ever before. Whether you're creating a new sales and marketing strategy, working out how to beat the competition by offering stand-out customer service, or battling to overcome inefficient internal processes, it's essential to act fast, decisively and accurately. In a world that's always connected and with customers growing expectations for instant, personalized service, any delay or misstep can significantly impact business performance.

Fortunately, the problem also contains the solution. As technologies like the Internet of Things (IoT) and social media emerge and develop, an ever-increasing sea of data is being created. Data that sits in your own systems, but also data that's out in the public domain – like news articles or public health records. If you can harness this data and make sense of it, you'll gain deeper insights into your business and your customers. You'll be able to spot previously invisible patterns that may transform decision making. You may even be able to predict and influence what's going to happen next.

Advanced analytics is the key to finding those needles of transformational insights within your haystacks. In this eGuide, we'll explore five areas in which advanced analytics techniques – such as machine learning and prescriptive analytics – can help transform your business, and we'll explore some real-world examples from Intel's own experience and those of its customers.
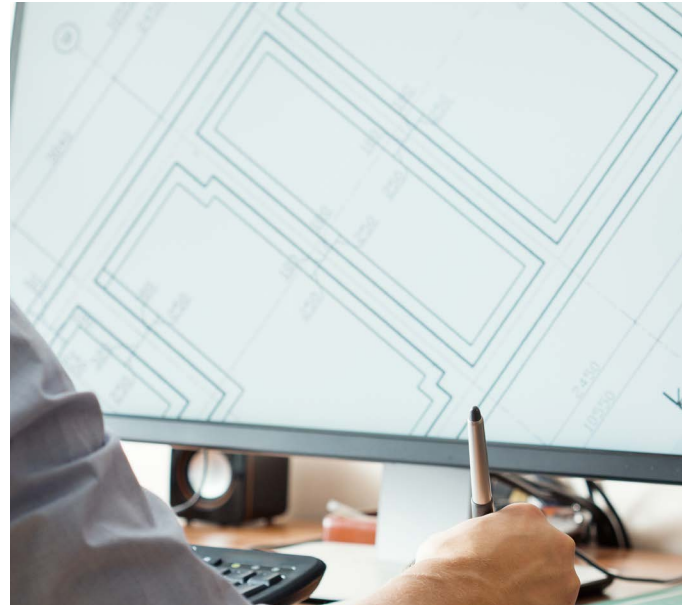
About Intel IT

Intel IT is focused on using new technology to create business value and act as a catalyst for organizational transformation.

As part of its commitment to driving industry-wide innovation, Intel IT has built its own competency center for data analytics. This team is tasked with optimizing Intel's internal processes through digital innovation, for which the current focus is artificial intelligence (AI) and machine learning. The center then repurposes the technology to create products and solutions for use by its ecosystem and customers.

I. CRITICAL BUSINESS PROCESSES

Intel's own IT department has worked with various business units within Intel to address some of the procedural challenges and bottlenecks that are common to many organizations, such as reducing time-to-market for new products, and engaging more effectively with customers.

Product Design

Business Issue

In today's fast-paced economy, windows of opportunity can be narrow and elusive, meaning business velocity is critical. Being able to design and deliver products and services to market in response to new opportunities or changing customer demand is important, but being able to do it faster than the competition is key to success.

For many companies, this can be a challenge when faced with increasingly diverse or complex product portfolios, limited headcount, or reduced budgets. They must deliver more with less, but also faster, and without any reduction in quality.

One of the biggest bottlenecks in product design and development can be the time-consuming validation process. Any new prototype must be checked, tested and checked again to ensure it is up to standard. There is little room for compromise as any errors that are missed at this stage could result in huge expense or reputational damage if they are replicated when full-scale production begins.

The Analytics Answer

Advanced analytic techniques such as machine learning can help speed up the validation process and other aspects of product design by imitating and supporting human validation capabilities.

To help enhance validation in its own computer chip design process, Intel IT developed a machine-learning

platform called CLIFF, which is designed to uncover bugs in prototypes. The platform quickly browses through many thousands of historical test records to uncover patterns, a task that would take human reviewers thousands of hours, making it impractical to perform manually. Compared to standard regression tests, CLIFF validates the targeted functionalities sixty times more and identifies 30 percent more new issues on each run[1].

By automating the testing process, CLIFF has contributed greatly to Intel's strategic goal of reducing product validation time (which can typically take up to 50 percent of the development cycle) and reducing the number of iterations required. As a result, it has significantly shortened time-to-market while also improving product quality.

The platform does all this using a form of prescriptive analytics. This means that it is able to not only predict likely outcomes through its machine learning algorithms, but also to inform and automate decisions about how best to tailor the process for each test moving forward.

Looking Ahead

The introduction of a prescriptive analytics tool like CLIFF is the first step towards shrinking the time needed for validation and so reducing your time-to-market. The focus of this use case has been on relieving human testers of the burden of conducting repetitive

but highly accuracy-critical tests through intelligent automation. With CLIFF, Intel's testers are able either to work faster and more efficiently, or to re-focus their efforts on more value-adding tasks.

As technologies evolve, Intel expects that subsequent phases of this journey will create opportunities to not simply improve existing processes, but to augment human testers' abilities and enable them to drive more innovation, deliver more new products, and further reduce time to market. The phases we expect to see next include:

- Introducing an algorithm that will continuously monitor each test that CLIFF runs to ensure it is getting results. Any tests that are found not to be adding any value can then be removed from the process, meaning that each validation will be fully covered while keeping inefficiency to a minimum.

- Helping testers streamline the debugging process by using machine learning to determine the root cause of any bugs that are identified. This will enable the human testers to focus their energies on coming up with creative fixes and solutions.

- Encouraging man-machine collaboration by developing methods for people to give their analytics systems more contextual information. Even the smartest algorithm can only make decisions based on the data it can access within a system. People have

a lot more peripheral context - for example, news about other initiatives going on at the company this week, or hearing from a colleague at the watercooler about a new change that has just been made in another area of the product. In the future, product development teams (and others) will need ways for workers to give this context to the system to enable it to further augment their own roles – a virtuous circle of continuous refinement.

Manufacturing and Quality Control

Business Issue

Once a prototype has been approved and sent into production, a new range of challenges present themselves. With operations spanning order-taking, resource procurement, manufacturing, and delivery, being able to make rapid, insightful decisions in response to any change in this delicate ecosystem is critical to maintaining your competitive edge. The more complex the supply chain, the more volatile it can be, and the greater the need for this agility. As companies' cycles of growth accelerate, their manufacturing and supply chain processes must also adapt to support new and expanding business models in both existing and brand-new business units.

Conventional supply chain management approaches often struggle to meet this new level of demand. They must accommodate and facilitate the expansion of manufacturing processes – both internally and in outsourced facilities – as well as new initiatives like the personalization and customization of the product or service portfolio, often on tight deadlines in response to sudden market demand. This must all be achieved while maintaining the highest quality levels, which can be particularly difficult in the face of rising demand for more diverse and complex offerings.

Where blanket approaches to quality control may have sufficed before, this growing complexity means a 'one size fits all' approach no longer works. Each unit —whether it's a car, a couch or a computer chip—must be thoroughly examined independently, which can slow delivery and hinder efficiency.
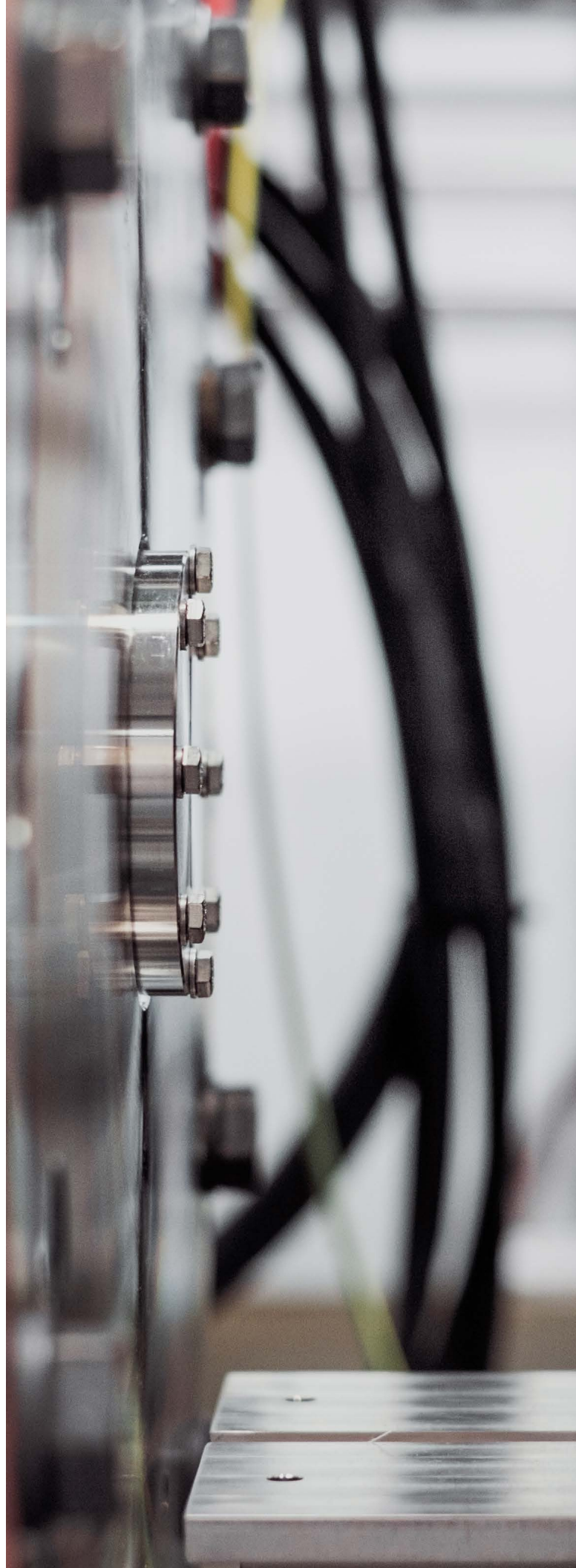
The Analytics Answer

Quality control in a typical manufacturing environment often involves a number of different steps. Intel takes the quality of its products very seriously, and so has invested significant time and resources into ensuring each one of these stages is as thorough and efficient as possible. Analytics plays a key role, enabling more data to be processed faster and with greater accuracy than manual processes. For example, Intel IT has identified a way to reduce the overall number of tests without compromising quality. This approach works on the assumption that, like people, each unit is different and requires its own combination of tests and decisions. Using analytics and machine learning to tailor the tests conducted on each unit brings value comparable to that of personalized medicine. In addition to increasing quality, this tailored testing has shaved seconds off this stage of the quality control process for each unit, significantly speeding up the manufacturing process while reducing costs.

By replicating these sorts of process improvements across the whole manufacturing environment and every step in the process, even small tweaks can add up to big savings and efficiency gains.

Looking Ahead

Quality control measures in manufacturing typically still require a lot of manual intervention and human decision making. Experts must create content to be used in each test, research root causes of any issues they identify, and make decisions about what steps to take to drive improvements. A next step in the use of analytics in this process will be the application of machine learning algorithms to relieve some of this burden and automate certain tasks so humans can focus on those aspects that machines cannot do. By introducing this technology to its own manufacturing environment, Intel expects to enable its employees to become more productive, and as a company to be able to test more products, faster.

Sales and Marketing

Business Issue

When your product or service is ready for market, the baton is passed to the sales and marketing teams to find the right customer base and give them a reason to buy. In today's sales and marketing landscape, knowing your customer is everything. Buyers in both the consumer and business-to-business arenas have come to expect more proactive, tailored communications from the companies they buy from, so it's essential you stay relevant. This means navigating increasingly complex data-source ecosystems to create a holistic understanding of each customer's needs, interests and propensity to buy.

Customer profiles typically include multifaceted information ranging from sales data to social media communications, their browsing history on your website, and recordings of conversations with your call center agents. These disparate types of data are difficult to manage and process, especially in real time. This means sales agents may struggle to access the right information at the right time to help them close a deal.

The challenge becomes even greater if your company operates an indirect sales model, where relationships with the customer may be through a partner, and may involve a large number of people covering slightly different areas. Your own complex data pools may be muddied by data from partners, customer relationship management (CRM) systems and public-facing information, which is often incomplete or inaccurate. This makes it hard to create that all-important clear, and up-to-date view of the customer you need to drive your sales pipeline.

The Analytics Answer

Sales and marketing teams need to transform vast quantities of data about their covered accounts into trusted insights, in real time. By using advanced analytics capabilities, you can empower them to uncover fresh insights that were previously hidden within their data. This can help them have more effective conversations with their customers, discover and convert more leads, and enhance existing customers' loyalty.

Intel IT worked to create a machine learning-based market intelligence system and recommendation engine[2] that helps its sales and marketing division identify which of its resellers will connect most effectively with customers in specific industries, and so enhance their ability to engage with and support those partners.

The original tool, called Sales and Marketing Account Recommendation Tool (SMART), provided the sales team with information about each reseller and its market, which products to offer them and opportunities to cross- or up-sell, based on its understanding of what has worked well with similar organizations.

A proof of concept (PoC) of the tool's second phase was recently completed in the EMEA online sales center. Building on the original tool, the latest version, Sales AI 2.0, now combines Intel's CRM data with unstructured public data sources like news publications, patent filings, and information on hiring, venture capital funding and merger and acquisitions.

Leveraging AI technology such as text analytics, the revised tool can scan these extensive, disparate data sources and convert them into actionable insights for salespeople by imitating humans' language and reasoning capabilities. This volume of data would take months for humans to process, by which time a lot of it would be obsolete. Sales AI 2.0, by contrast, completes the analysis in just a few hours.

The PoC was a resounding success: 81 percent of the insights were found to be valuable and actionable by the account managers involved in the trial, and over 90 percent have chosen to continue to use it.

Following the PoC, Intel has deployed the system to cover its top 50,000 reseller customers in eight different languages. As a result, twice as many resellers in the engagement chain advanced from leads to qualified leads in comparison with the rest of the sales pipeline. These resellers also showed a three times higher click-through rate for email newsletters, and completed Intel training at a rate three times higher than the rest of the pipeline[3]. In 2016, Intel IT's complete activities increased Intel's revenue by approximately USD 480 million, with the SMART and Sales AI 2.0 tools contributing around USD 100 million[4].

Looking Ahead

The effectiveness of the SMART tool has led 91 percent of sales agents to continue to use it following the testing cycles, and Intel IT now plans to universally deploy the system to sales centers worldwide. With this tool in place, Intel aims to provide salespeople with a virtual personal assistant that will help them have more insightful and productive conversations with their customers, and deliver more value. What's more, the efficiency gains of having all this information provided to them proactively, when they need it will also enable salespeople to increase both the quantity and quality of their interactions.

Importantly, insights within a machine learning system like this flow in both directions. Each time a salesperson uses the tool, new insights are delivered back into the system in return, enabling a constant process of algorithm fine-tuning. To this end, the Sales Assists tool is in a constant state of renewal, refinement and improvement. In addition, Intel IT is also working to capitalize on these insights to build email and other capabilities to further improve dialogue with customers and increase opportunities for engagement.

With humans teaching algorithms at the same time and to the same degree as they improve our understanding, capabilities and workflow, across the industry it will be the ability to best hone technological advances and optimize this symbiotic relationship that will define the future of the field.

II. PRODUCT AND SERVICE INNOVATION

Another area of focus for the Intel IT team is exploring areas in which its technology and those of its ecosystem partners can be used to drive analytics-based value for customers in specific industries or wanting to adopt particular new technologies. We'll consider an example of each of these below.

Healthcare and Pharmaceuticals

Business Issue

According to Eroom's Law, the cost of developing a new drug approximately doubles every nine years. The current average cost to develop a single new drug is around USD2.5 billion[5], with average development time being at least a decade[6]. Each new medicine or treatment strategy can make a huge difference for sick patients, so the expensive and drawn-out development process is far from ideal. It results from the fact that it requires huge amounts of manual data collection, itself a time-consuming task, which also has the potential to generate inconsistencies due to a lack of objective measurements and adherence to protocol.

The Analytics Answer

With technology innovations such as wearable devices and advanced analytics, pharmaceutical companies can run more in-depth and accurate clinical trials faster and at a lower cost by enabling the continuous remote monitoring of patients. There is huge interest and potential in this area, with Ericsson* estimating that 4 million patients will use remote monitoring technologies by 2020[7]. Not only will this enable patients to benefit from new drugs becoming available sooner, but it is also expected to mean revenue per drug will jump considerably.

The Michael J Fox Foundation is using a wearable analytics platform, developed in collaboration with Intel, to help in its mission to find a cure for Parkinson's disease[8]. Teva Pharmaceuticals*[9] has also licensed the platform in a two-phase clinical trial for a new drug to treat Huntington's disease, a fatal neurodegenerative condition.

In both cases, each patient receives a wearable device equipped with accelerometer and gyroscope, which continuously captures data about the patient's movement. This data is securely transmitted to the cloud, where machine learning algorithms create objectives measurements to accurately determine the drug's effectiveness. Some of this data is also given back to the patient through a mobile app, which they can use to check their own activity levels and get updates or reminders about their medication and treatment plan.

By providing more objective, continuous information about patient symptoms during clinical trials of a new drug, the platform helps the Michael J Fox Foundation and Teva Pharmaceuticals* improve the quality and cost effectiveness of these trials.

Looking Ahead

The use of wearable technology is the beginning of an exciting journey in analytics and healthcare. Providing patients with always-on devices that are permanently connected to the cloud means pharmaceutical organizations can gain a vast amount more data than has previously been possible when relying on infrequent in-person check-ups with each patient. With more data, and the right machine learning algorithms and analytics processes, they can achieve results and deliver new drugs to market faster and cheaper. They are also able to use this ongoing data collection to proactively push updates, guidance and other communications to their patients, creating the effect of having a physician looking out for them all day every day, and encouraging patients to engage more actively with their own care.

In the future, opportunities to develop this personalized care approach will be huge, with other technologies such as video also having a role to play in both remote care delivery and deeper, more complex data gathering.

IoT Analytics

Business Issue

Across industries as diverse as manufacturing, retail and transportation, the installation of IoT sensors has made it possible to collect thousands of data points about processes, products and people. All this new data, whatever its source, has the potential to provide greater business insight, but it is essential to have a system in place that is equipped to make sense of such large volumes of rapidly changing data and pull out the actionable insights from the noise.

The Analytics Answer

Intel IT is using IoT analytics to help it create a vision of the smart building of tomorrow at its Smart Building and Venue Experience Center in Chandler, Arizona[10]. The center acts as a testing ground for new IoT use cases as well as a working example of how IoT analytics can make a difference to business and operational efficiency today. Its aim is to develop IoT standards for smart buildings that will provide us and others with a blueprint for creating future smart offices, factories[11] and other buildings.

All the building's systems – including HVAC, lighting, restrooms and the parking lot – are IoT-enabled. The center uses blueprints for various smart facility venues, developed by Intel IT and the Intel IoT Group, to create repeatable use cases and results which are then shared internally, with partners and with customers. For example, one solution monitors the parking lot to predict how busy it will be at any given time, helping facility managers stay up-to-date while also enabling people looking for a space to find it more easily.

In another area of the center, sensors that are installed in restrooms are helping reduce maintenance costs and improve user satisfaction. Sensors count how many people have visited the restroom, sending an alert to maintenance crews when they are needed – for example when tissue, towel or soap dispensers need to be refilled – and saving them from having to make trips to check, which may turn out to be unnecessary.
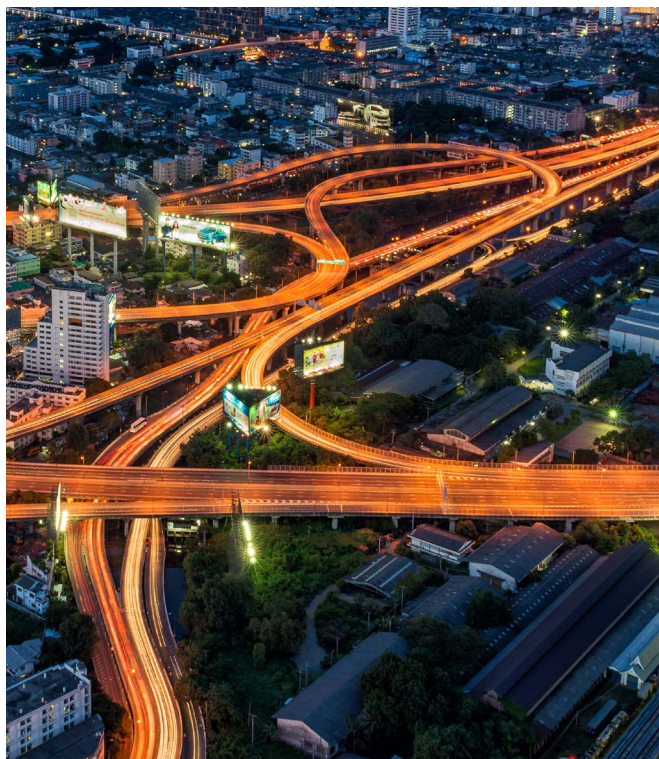
Looking Ahead

An exciting area for further analytics innovation, IoT gives us the opportunity to make machines work for us. The patterns and insights found through predictive analytics and machine learning today will underpin the next step. As organizations evolve their analytics capabilities towards more prescriptive use cases, they will be able to automate many of the operational tasks in manufacturing, facilities management and a range of other areas that today take busy employees away from their more valuable core roles. This will not only help improve efficiency and cut costs, but it can also have a positive impact on the user experience.

For example, data from temperature and humidity sensors in a meeting room could be used to constantly optimize the environment – adjusting the temperature up or down, or even opening or closing windows – allowing those in the room to concentrate on their meeting. Or supply chain systems monitoring multiple internal and external data sources could identify where spikes in demand for a particular product are likely and automatically divert larger stock volumes to the affected area.

Where Next?

There are as many applications for advanced analytics as there are business problems to solve. To identify where to begin or continue your own analytics journey, start by considering where your organization's strategic priorities are being hindered and how better insight into your data could help you overcome those roadblocks.

Alternatively, read on to learn more about which type of analytics may work best for you: Planning Guide: Getting Started with Advanced Analytics

Analytics Terms Explained:

- **Business Intelligence (BI):** Also called Descriptive Analytics, this is the use of data held in structured company repositories like data bases to understand what has happened.

- **Diagnostic Analytics:** This uses the same sorts of data sources as BI, but as well as telling you what happened, it gives some context as to why it happened.

- **Predictive Analytics:** Using more varied data sources and analytics algorithms, this uses patterns in existing data to tell you what will happen next, when and why.

- **Prescriptive Analytics:** Machine learning algorithms applied across multiple types and sources of data (external as well as internal) not only predict outcomes but automate actions to drive or change them.

- **Cognitive Analytics:** Artificial Intelligence and Deep Learning are also applied to create a self-learning analytics engine that mimics human thought and actions.

- **Advanced Analytics:** A general term applied to any of the three future-looking types of analytics (predictive, prescriptive and cognitive)

- **Artificial Intelligence (AI):** The use of algorithms to simulate human-like intelligence in computer systems.

- **Machine Learning:** A type of AI that continuously adapts and changes its behavior based on the data it receives.

- **Deep Learning:** A more advanced form of machine learning, particularly important for the later stages of advanced analytics, as it is able to build an understanding of more complex types of data, such as images.

For more information on how machine learning and advanced analytics can transform your business visit:

intel.com/analytics

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1 Intel IT Annual Performance Report 2016-2017, intel.com/ITAnnualReport

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5 Tufts CSDD Assessment of Cost to Develop and Win Marketing Approval for a New Drug Now Published, csdd.tufts.edu/news/complete_story/tufts_csdd_rd_cost_study_now_published

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