VISION REPORT

AI 2.0: Upgrade Your Enterprise With Five Next-Generation AI Advances

Define The Future Of Your Enterprise AI Today

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Summary

Just when you thought you knew what AI could and couldn't do, it quietly got a radical upgrade. Five key advances have redefined AI use cases and broken the chains that have shackled enterprise AI adoption. Though you've likely never heard of them, these AI 2.0 advances are already entering commercial products, and forward-looking enterprises need to start preparing if they want to reap competitive advantages. Application development and delivery pros and other tech leaders should use this report to understand this next generation of AI capabilities and how to start on their AI 2.0 journey.

The Upgrade To AI 2.0 Will Redefine Enterprise AI

AI has just undergone a step-change in its evolution, but you would be forgiven for having missed it. It's obfuscated by a deluge of impressive, but incremental, advances in AI-accelerated hardware, platforms, and AI-embedded enterprise solutions. However, hidden in the latest, cutting-edge offerings are AI advances that radically extend the art of the possible and unshackle AI from the data, accuracy, speed, and security constraints that have limited enterprise use cases and adoption. Together, these advances are a discontinuous change in the capabilities of AI. It's a movement from AI 1.0 — characterized by pattern recognition, task-specific models, and centralized training and deployment — to 2.0 — characterized by language, vision, and other general data generation models, trained and embedded everywhere. Best of all, these AI advances are already here. Enterprises should now take advantage of AI 2.0's ability to be:

- **Creative.** AI 1.0 revolutionized our ability to detect patterns in unstructured data — e.g., object detection in images and intent recognition in chats. With AI 2.0, enterprises can automatically generate marketing content and software code, propose new drug molecules, and synthesize artificial training data to make other AI models more robust and accurate — and they can do so both more quickly and less expensively. Further, enterprises can use AI 2.0 technologies to propose and test never-before-seen solutions to complex optimization tasks, whether they be manufacturing processes or marketing campaigns.
- **Generalizable.** In AI 1.0, you could use transfer learning to customize models trained to recognize one set of patterns on another (e.g., customize a model trained on dogs to recognize cats). AI 2.0 takes this to a whole different level, with giant models that span a host of tasks like summarization, question answering, topic mining, and query generation. These models even span different types of data (e.g., generating captions from images and vice versa). Why does this matter? Because these multitasking models require less training for each new domain and task. Indeed, they are starting to solve tasks that they were never trained for. (But don't hope for self-thinking machines any time soon.)
- **Pervasive.** AI 1.0 was throttled by an organization's ability to transfer data to a central location to train and run its models. In AI 2.0, data never has to move. AI models are deployed and even trained at the edge, enabling new AI applications that need to be cheaper, faster, and more secure. Your smart speaker learning your speech patterns isn't nearly as creepy when your voice isn't sent back to HQ,

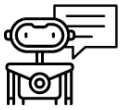
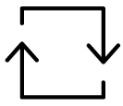
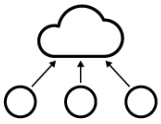
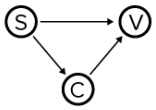
especially when the speaker is more responsive and capable and understands you better because your model has been combined with everyone else's.

Five Breakthrough AI Advances Drive AI 2.0

Much as there are many technologies under the AI umbrella, AI 2.0 is a collection of new technologies and techniques that are maturing simultaneously in terms of their technical feasibility and business applications. Five key technological advances are most important for enterprises, both because of the radical new capabilities they unlock and because they are already in production and driving outcomes today (see Figure 1). However, unless you are a data scientist, you probably haven't heard about them because most have developed rapidly in the past one to three years, have names that mask their importance, and would never be featured in a science fiction film.

Figure 1

The Five Enterprise-Changing AI Advances That You've (Probably) Never Heard Of

Technology	What is it?	What is it used for?	Who is using it?
Transformer networks 	Giant pretrained, customizable, hyperaccurate, multitasking deep learning models	Any hard problem with a significant time or context dimension (e.g., understanding and generating text, software code, etc.)	Hyperscalers (Amazon Web Services, Google, IBM, and Microsoft), the advanced guard of speech and text analytics vendors, and many startups
Synthetic data 	Generative models and simulated virtual environments used to create or augment existing training data	Accelerating the development of new AI solutions, improving the accuracy and robustness of existing AI models, and protecting sensitive data	Autonomous vehicles, financial services, insurance and pharmaceutical firms, and every computer vision vendor
Reinforcement learning 	Machine learning approaches that test their way to optimal actions via simulated environments or a large number of micro-experiments	Constructing models that optimize many objectives/constraints or deciding on action based on positive and negative environmental feedback	Firms targeting particular B2C marketing tasks, optimizing repeatable manufacturing processes, and robotic learning
Federated learning 	A managed process for combining models trained separately on separate data sets	Sharing intelligence between devices, systems, or firms to overcome privacy, bandwidth, or computational limits	Hyperscalers, AI-enabled application vendors, and consumer electronics companies
Causal inference 	Approaches such as structured equation modeling and causal Bayesian networks that help determine cause-and-effect relationships in data	Business insights (e.g., attribution analysis) and bias prevention where insights and explainability are as important as prediction accuracy	Innovation teams at leading organizations (e.g., determining treatment efficacy for a given disease at healthcare providers)

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1. **Transformer networks unlock language (and more).** Heard of the op-eds and blogs that AI can write or the images that it can draw from captions? They were generated by transformer networks, such as OpenAI's GPT-3, which tackle many hitherto human-only tasks, especially those with a time or context dimension like natural language processing and generation. Transformers make it possible to

train giant models that tackle these and other tasks at once (e.g., machine translation, natural language generation, and code generation simultaneously). Compared with using separate models, these giant models offer greater accuracy and require less data, and they are easier to maintain and customize across many use cases.

Hyperscalers are already embedding transformer networks in their business applications. For example, Microsoft uses them in its offerings for tasks like natural language search, autocaptioning of images, moderation of inappropriate gamer language, and automated customer support. Salesforce Research developed Photon, which uses transformer networks to turn business users' questions into automatically generated SQL queries. A deluge of startups and cutting-edge vendors — particularly in text and speech analytics — are incorporating these models, and you can expect that, in the near future, enterprises will leverage pretrained transformer networks to create armies of more capable, hyperaccurate virtual agents.

2. **Synthetic data improves your data for every AI solution.** Obtaining the data you need is slow, costly, and sometimes impossible — even with unlimited resources. Insufficient, incomplete, or just plain bad data not only dramatically slows projects and limits the number of use cases an enterprise can tackle but also reduces the accuracy of models and introduces bias and risk. Enter synthetic data. Typically created using generative models or simulated virtual environments, it augments your data, improving the accuracy, robustness, and generalizability of your models. In addition, synthetic data can be used instead of sensitive data to enable internal and external data scientists to experiment with the data — without the risk of working with sensitive data. Synthetic data can also jump-start projects where you have little or no training data to begin with. With synthetic data, you don't have to fake it 'til you make it.

   Enterprise data science teams can generate their own synthetic data, but it is not always feasible or practical to create it in-house. Thankfully, an ecosystem of synthetic data vendors — most specializing in particular methods or use cases — is developing. For example, Virtusa offers a range of generative models that create digital twins of patient populations in 35 US states. In contrast, Israeli startup OneView synthetically generates images using video game engines. In one case, it improved oil leak detection for pumps and pipelines by a factor of three using synthetically generated aerial images.

3. **Reinforcement learning helps you adapt to changing dynamics.** In 2016, DeepMind's AlphaGo bested world Go champion Lee Sedol in what was a

watershed moment for AI. That system used reinforcement learning to learn how to play the game. But it's not all fun and games for reinforcement learning anymore. In 2020, as customer behavior changed almost overnight due to the COVID-19 pandemic, we learned that we need to be able to react quickly to changes in data. Because reinforcement learning learns from interacting with its real or simulated environment through trial and error rather than historical data, it can adapt to shifts, helping eliminate data and model drift.

Today, some companies are using reinforcement learning in autonomous systems. For example, an oil and gas exploration company is leveraging Microsoft's Project Bonsai for geosteering (i.e., finding the optimal path to drill horizontally underground). And Microsoft is using reinforcement learning for its own marketing — to contextually personalize products displayed on its home page. In the future, companies will turn to reinforcement learning to identify and deliver the next best experience to customers, optimizing journeys to maximize customer lifetime value.

4. **Federated learning shares intelligence within an organization and with others.** Getting data from different sensors, systems, and parts of an organization — let alone from other organizations — is a big challenge that can prohibit a multitude of highly valuable AI use cases. Transferring data is costly, difficult, and often risky from security, privacy, and competitiveness perspectives. Federated learning overcomes these issues by developing AI models separately and sharing a model, or features of a model, instead of the underlying data. The information in the model, which is a fraction of its original size and does not allow sensitive data to be easily extracted, is used to train a federated model that combines intelligence across the different sources. As a result, intelligence is shared quickly, cheaply, and more securely within and across organizations.

   There is a good chance that you are experiencing federated learning already. Google's Android 11 uses federated learning to generate smart replies (and suggest emojis), and many machine-learning-enabled offerings from other vendors use federated learning to improve experiences without sharing customer data. IBM's AutoAI and Federated Learning (developed by IBM Research) use it to train models on data across disparate systems, and ACI Worldwide, a payment solution software company, uses federated learning to improve fraud detection.

5. **Causal inference improves insight and AI robustness.** Machine learning techniques make it easier than ever before to discover correlations in data, but since most do not establish causality, they also make it easier to find reverse or spurious correlations. Such correlations can lead to faulty business decisions based on incorrect analyses or poorly performing models and, in some cases, may

harm customers through discriminatory or unfair practices. Causal inference techniques identify cause-and-effect relationships between variables. While they don't usually prove causality on their own, they suggest which relationships are supported by the data and which to test for causality and counterfactuals.

Relative to the other AI 2.0 advances, causal inference offerings are less mature, and many companies will need their own or third-party AI research teams to use them. Refinitiv is working with the MIT-IBM AI Watson Lab to apply causal inference techniques to investment decisions, and Ericsson is researching the use of causal inference to determine the causes of network outages. Expect more companies to use causal inference techniques to determine optimal strategies for engaging customers, allocating marketing budget, improving operational efficiency, and detecting and preventing algorithmic or human bias.

Get Your Enterprise Ready For AI 2.0

The opportunity to get in on the ground floor of a transformative set of technologies doesn't come along often — and when it does, it is usually inaccessible to all but a select group of specialists. For now, AI 2.0 has leveled the playing field by eliminating many barriers to entry built on expertise in AI domains like natural language processing, computer vision, and data advantages painstakingly built over years. Newcomers are outperforming veterans, and startups are building new applications that used to take years or were infeasible. Could you wait and take advantage of AI 2.0 solutions once they are mature? Yes, but you would forgo the opportunity to outperform your industry. To develop your AI-enabled competitive advantage:

- **Accelerate your AI 1.0 journey in tandem.** No enterprise is done democratizing and operationalizing the current generation of AI technologies, including automated machine learning, model operationalization, explainability, chatbots, and robotic process automation. Don't put those efforts on hold. In many cases, these capabilities are prerequisites to driving business value with AI 2.0, which extends and improves on AI 1.0. In instances where there is overlap (e.g., reinforcement learning in marketing or transformer networks in voice-of-the-customer analysis), the AI 2.0 technologies will not replace all the AI 1.0 functionality for the foreseeable future. That being said, you should prioritize new implementations that are already incorporating or laying the groundwork for AI 2.0 to future-proof your investments.
- **Build and empower an AI-forward team.** Individuals with proven experience driving business value with AI 2.0 technologies aren't just rare; they don't exist yet. Therefore, you will need to upskill a hybrid strategy and innovation team to

understand and assess the landscape of AI 2.0 technologies, monitor their development and opportunities, strategize, undertake pilots, and chaperone the successful adoption of these technologies.

- **Design your AI 2.0 strategy.** It's time to have an intelligent conversation about conversational intelligence and the host of new use cases for your enterprise that AI 2.0 can enable. Evaluate and prioritize use cases that score highly from both business value and feasibility points of view and seek out partners with the AI 2.0 capabilities required to accelerate your journey.
- **Stand on the shoulders of (tech) giants.** Amazon, Google, IBM, and Microsoft are investing heavily in AI 2.0 for themselves, but they already offer these technologies as services that their customers can use to develop their own AI 2.0 solutions. Expect them not just to support the full suite of AI 2.0 technologies but to improve on their range of capabilities, ease of use, and cost. Of course, you could turn directly to OpenAI to leverage the latest GPT-3 models, but it could take the vendor a while to get through the 10,000-plus organizations on its waiting list.
- **Scan the AI horizon regularly.** Will AI-enabled quantum computing platforms transform the enterprise? Not anytime soon. Are independent, self-evolving AI models on a blockchain imminent? Don't even think about it. However, an ever-growing host of other AI technologies are developing rapidly and just waiting for someone to stumble on the right killer use case or technological breakthrough to go mainstream. It's too early for most enterprises to worry about adversarial defense, neurosymbolic AI, neuromorphic computing, machine olfaction, and a plethora of other promising AI technologies that are in development, but that could change in the blink of an android's eye.

Supplemental Material

Companies We Interviewed For This Report

We would like to thank the individuals from the following companies who generously gave their time during the research for this report.

Amazon Web Services

C3.ai

Google

IBM

Microsoft

NVIDIA

OneView.ai

OpenAI

Salesforce

Virtusa

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