



Age of Intelligence

Democratizing AI to empower individuals, organizations and society towards fulfilling the promise of holistic growth

Table of Contents

Executive Summary	5
The promise of AI is holistic growth	6
Why now and what is Microsoft doing	8
Microsoft AI	9
Leading your organization into the AI era	12
Every application	12
Every business process	14
Every employee	18
AI for India	20
AI for good	22
Responsible AI	24
Conclusion: Where do we go from here...	27



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Executive Summary

This is an unprecedented moment in human history. Technologies are emerging and affecting our lives in the Fourth Industrial Revolution in new and unanticipated ways. This is a new era that builds and extends the impact of digitization. Artificial intelligence is not new to us. It's only in recent years that AI has made such impressive progress, primarily driven by exponential increase in computing power, vast amounts of data and notable breakthroughs in algorithms.

In this paper, we present an industry point of view on the 'age of intelligence' that we are embarking upon, wherein we will experience intelligence in every facet of our lives: in the products and services we use, how we communicate and relate to each other, how organizations function and collaborate, and how society and countries evolve.

We believe that the promise of AI is holistic growth. AI will radically transform industries, enable governments, empower individuals and address some of society's toughest challenges. Breakthrough innovations will accelerate the digital transformation of organizations, result in radically new business models, and potentially disrupt industries. AI offers the opportunity to increase the functionality of every application, accelerate application development at scale, create compelling interfaces that interact with users in natural ways. Across industry verticals, AI will enable every business process to enhance customer engagement, optimize operations, and improve products and services. AI will empower every person with knowledge and tools to foster innovation and collaboration across the enterprise.

AI adoption in the country is currently at an inflection point. As the fastest growing economy with the second

largest population in the world, India has a significant stake in the AI revolution. A whole generation of Indians are coming online for the first time, getting access to information and services delivered via smart phones, and participating in the ecosystems enabled by Digital India. The government has outlined priority sectors of the economy in the National Strategy for Artificial Intelligence and has adopted a three-pronged approach – undertaking exploratory proof-of-concept AI projects in specific areas, crafting a national strategy for building a vibrant AI ecosystem and collaborating with experts and stakeholders. In addition, towards social and inclusive growth, India will need to close the skills gap and enhance employability through concerted government and industry partnerships, such as NASSCOM's Future Skills initiative.

As with any transformative technology, AI comes with challenges and a shared responsibility. 'As computers behave more like humans, how will they impact real people?' It is critical to address this question head on with a set of ethical principles. Microsoft has offered a framework for Ethics of AI that includes fairness, reliability and safety, privacy and accuracy, inclusiveness, transparency and accountability. Every individual, organization and ultimately society will need to engage towards a trusted and principled approach to AI, to realize the technology's full potential.

In Mahatma Gandhi's words, "The future depends on what we do in the present." It is upon us to seize this moment in India's economic evolution and harness the power of Artificial Intelligence to solve our most pressing social and environmental challenges, empower our people to access resources that offer prosperity and health, and strengthen our vibrant democracy.

The promise of AI is holistic growth



I strongly believe that great technologies embed themselves into our lives and disappear into the fabric of society. A few decades ago, telecommunications had us in awe; today it's indispensable. Artificial intelligence is beginning to shift the way in which we relate to the world around us. It is already transforming the way we work and do business. A recent study by PwC calculated that global GDP will increase by 14% by 2030 because of AI adoption, contributing an additional \$15.7 trillion to the global economy (PwC, 2017¹). In the next five years, senior executives across the globe expect AI to have a positive impact on growth (90%), productivity (86%), and job creation (69%) in their country and industry (Economist Intelligence Unit, 2018²). And this growth isn't limited to specific industries; any organization in any industry, especially those with very large amounts of data, can use AI for creating business value.

With such enormous potential, it is no wonder that all enterprises are ramping up their investments on AI. However, there are challenges. Everyone acknowledges that AI has broad transformative potential, but enterprises struggle to translate this potential into tangible advantages. Some of the key obstacles to organizations' progress with AI include the requirements to establish a strategy and goals, justify and secure investments for projects. Without a comprehensive strategy, enterprises

often utilize AI only in limited instances. These single-use cases only scratch the surface of the potential of AI. The real power of AI is in its ability to holistically transform the enterprise and redefine business in ways beyond our present frames of reference.

Each organization needs to define its "tech intensity" – a simple product of combining two capabilities: the adoption of technology platforms available at scale and the specific knowledge and assets that the organization brings to create their own distinctive domain advantages. To make both happen, organizations need a long-term strategy, and a strategic technology partner that goes beyond providing discrete solutions. As AI implementation continues to expand, this partnership must be capable of meeting the needs and concerns of the enterprise, such as security and scalability. It must also ensure that everyone in the organization, regardless of technical expertise, is able to leverage the power of AI for productivity, collaboration and growth.

At Microsoft, our ambition is to help realize a human-centered approach to AI for every country in which we operate, every customer we support and every community we serve. We are establishing Microsoft as the leading AI partner to customers, governments and communities through constructive policy advocacy, technology innovation and key enabler programs that are critical



to economic growth of countries. In India, we are laying the foundation for this ambition by building upon four key pillars, namely

1. **Enabling transformation across industries:** Leverage AI technologies to create breakthrough innovations and accelerate digital transformation, focusing on industries critical to the country's economic growth.
2. **Forging coalitions for innovation:** Engage with government, industry, academic and civil society stakeholders to create a collective approach to AI. Enable the government to better serve the needs of its citizens through AI.
3. **Building a future-ready workforce:** Empower individuals, across all demographics, with the skills for an AI-enabled world. Enable economic growth and innovation through development of future-ready talent pipelines.
4. **Creating sustained societal impact:** Apply AI technologies to address pressing societal challenges, including environmental sustainability, accessibility, and humanitarian action.

transform society. This is central to our mission of empowering every person and every organization on the planet to achieve more.

"AI is going to be one of the trends that is going to be the next big shift in technology. It's going to be AI at the edge, AI in the cloud, AI as part of SaaS applications, AI as part of in fact even infrastructure. And to me, to be the leader in it, it's not enough just to sort of have AI capability that we can exercise - you also need the ability to democratize it so that every business can truly benefit from it. That to me is our identity around AI."

Satya Nadella, CEO, Microsoft³

At Microsoft, AI is not a product or a set of technologies. AI is our vision for empowerment – for every developer to innovate, every organization to redefine industries and every individual to

- 1 <https://www.pwc.com/gx/en/issues/data-and-analytics/publications/artificial-intelligence-study.html>
- 2 <https://eiu.perspectives.economist.com/technology-innovation/intelligent-economies-ais-transformation-industries-and-society>
- 3 <https://www.forbes.com/sites/bobevans1/2018/06/04/microsoft-ceo-satya-nadella-on-the-extraordinary-potential-of-ai/#45fe0076162f>

Why now and what is Microsoft doing

AI has been a field of research and application for several decades now. Early on, AI applications were very narrow and limited due to lack of large-scale computing power, lack of large-scale data, and rudimentary tools. This made AI applications very expensive, highly customized for every situation, and not portable. Hence, the use of AI was very limited.

The advent of the Internet allowed the collection of large-scale data that enabled training of more impactful and general-purpose machine learning algorithms. Web search is perhaps the first example of a really large scale AI application that enabled advances in the field—including better algorithms, testing of new approaches, development of large-scale data collection systems, data processing to feed the “build-train-evaluate” loop of developing AI, and more importantly, the processes and tools to do all these in a scalable manner.

About a decade ago, there was an explosion of innovations in the field of neural networks with the advent of what is termed as ‘deep learning’. Coupled with the availability of vast compute power in the cloud, and web-scale data, deep learning solved many problems that were previously intractable. Very quickly, deep learning has become a rapidly adopted technology to implement AI for a variety of business applications - in healthcare, agriculture, technology, gaming, entertainment and science.

This is a unique time in the history of technology, and particularly AI, where computational power, ability to collect data, and tools to develop sophisticated AI models are available to anyone, in any application area. In some sense, people who have had a history with AI over the past couple of decades are in a “pinch me to see if this is not a dream” moment. This availability of “on-tap” capability creates the opportunity for a fundamental

Microsoft's Advances in AI

Object recognition
Human parity
2016

Speech recognition
Human parity
2017

Machine reading
comprehension
Human parity
January 2018

Machine translation
Human parity
March 2018



change in society in just about any field.

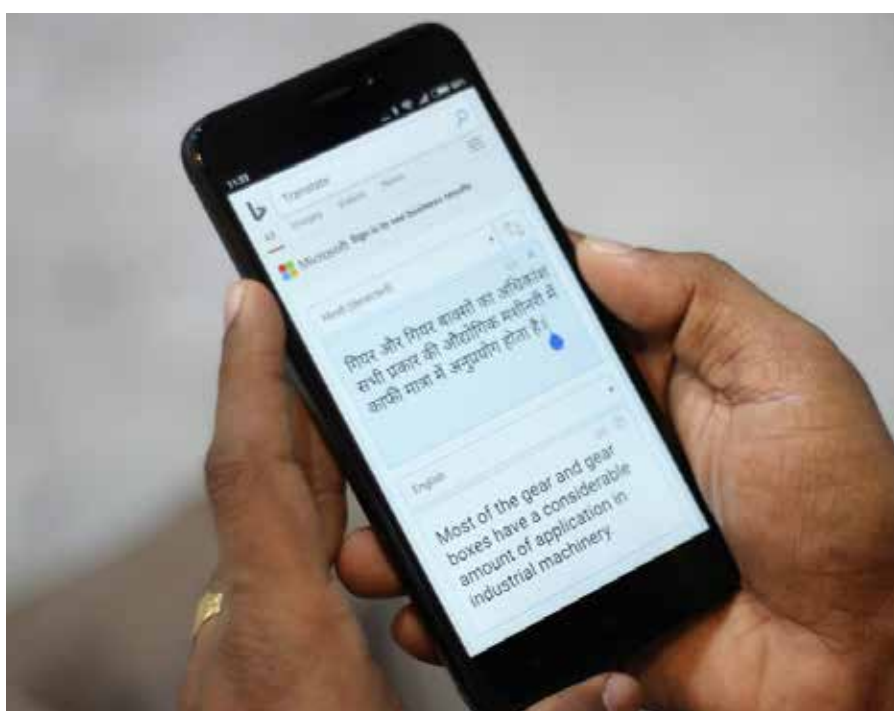
For over 30 years now, Microsoft has led research in Artificial Intelligence. The group's research has culminated in multiple breakthroughs in AI, resulting in computers achieving human parity⁴ across domains of vision, speech, machine reading, and translation.

With advancements in computer vision, computers can see, understand and comprehend the world. This capability is already helping workers to be more productive, doctors to diagnose better or companies to identify defects and improve safety on the shop floor. Human like speech recognition capability coupled with highly advanced translation between languages are enabling people across the world to communicate with each other even when languages are different. Speech recognition and conversational technology are enabling better customer service through automation. Human level reading comprehension enables search engines to answer difficult questions that users have, from complex documents from the web.

Microsoft AI

Microsoft AI is a vision of empowerment. It is not a product in a box – it is fundamentally much more than that, and encompasses three core aspects:

- Empowering developers to innovate:** A strong developer ecosystem is vital to unlocking new experiences by infusing AI into existing applications or creating altogether new applications.
- Empowering organizations to redefine industries:** Organizations can redefine industries by creating innovative customer experiences through AI, transforming their products, optimizing their operations or empowering their employees.



- c. **Empowering people to transform society:** AI has tremendous potential to tackle our societies' greatest challenges. Our vision is to empower people to leverage AI to positively transform society.

Within the next decade, rapid advances in cloud, data and algorithms will firmly find their place in every enterprise. AI-powered devices, bots and software will likely need minimal human intervention or supervision, with intelligent services enabling seamless automation. Intelligence will be ubiquitous and available 'on-demand' via intuitive user interfaces. Microsoft is empowering this by infusing intelligence into our Products, Platform and Business Solutions:

- 1. **Products:** Instilling intelligence into our products has been a key priority for Microsoft. The interfaces already provide insights, suggestions and possible next action based on your usage pattern or your personal design preferences. These solutions are embedded in every product we

release - Bing, Dynamics 365, Office 365, SwiftKey, Skype and Cortana. Microsoft AI is also deeply integrated in the backend services to protect your data and persona in the cloud. Intelligent security graph is a prime example which identifies potential vulnerabilities across all services using insights from trillions of signals from devices running Windows, Office 365, Bing, Xbox, and Azure, globally.

- 2. **Platform:** In our mission to empower others, Microsoft is democratizing AI. Microsoft is making the technology used in building its own AI applications available on Azure to empower developers and institutions in solving their most difficult problems. AI platform is a set of tools, services and infrastructure that enable customers and partners to build their own AI solutions, even as they infuse intelligent interfaces and machine learning into their existing solutions.

- a. **Infrastructure:** Customers can take the infinite scale of



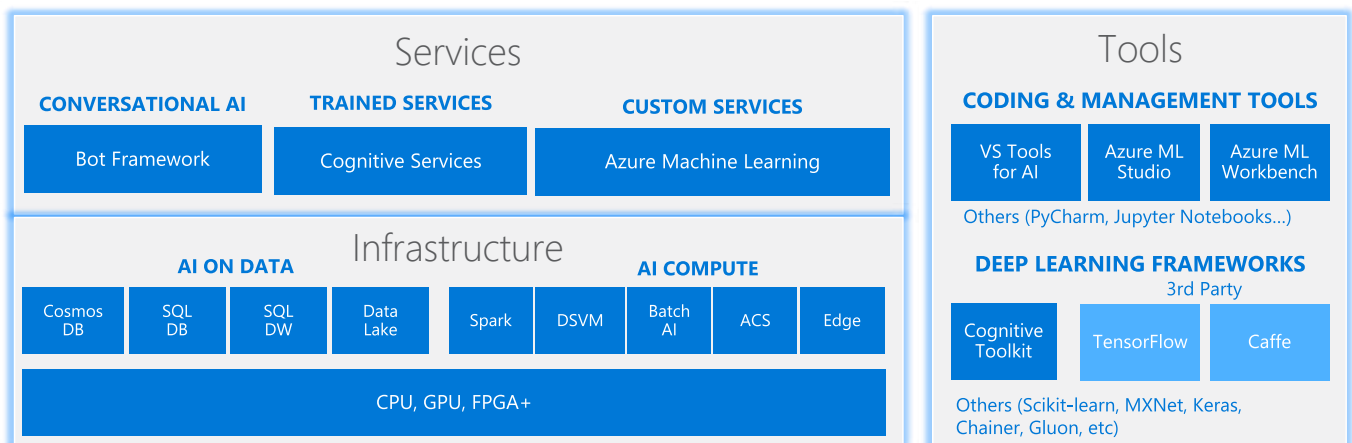
computing resources on Azure and then incorporate AI using data platforms like Azure Data Lake or Cosmos DB. Microsoft is also working on new-age infrastructure using reprogrammable chips or Field Programmable Gateway Arrays, (FPGAs), which significantly improve the training and inference speeds for deep learning models.

- b. **Services:** Microsoft Cognitive Services offer the largest breadth of AI services in the industry. These are fundamental AI building blocks that enable applications with the same world-class AI capabilities that Microsoft uses for developing its products-vision, speech, language, knowledge, and search. Microsoft has over a million developers worldwide that are using our cognitive services to infuse AI into their products and solutions

– just with a few lines of code. For instance, a developer can with few lines of code, implement human parity voice recognition using the Cognitive Services Speech API for his/her application.

- c. **Tools:** The Microsoft AI Platform comprises of tools and solutions which developers or data scientists can use for creating new interfaces, algorithms or machine learning models. The tools include developer studios as well as most of the popular industry frameworks (first party as well third party).
3. **Business Solutions:** Microsoft has built a host of purpose-built, easy-to-use solution templates and accelerators for each industry vertical. The objective is to provide ready guidance and solutions for businesses to adopt in their journey towards transformation.

The Microsoft AI platform



Leading your organization into the AI era

Organizations today find the need to harness the power of data within their organizations to get actionable insights and solutions which can provide the edge over competition. With the accessibility of cloud computing, the ubiquitous availability of parallel processing power, near free data storage, and an exponential increase in digital data, AI is finally starting to deliver real-life benefits to early adopting companies. With this, AI has moved beyond technology experimentation to real world business scenarios across industries.

Some of the key industry sectors such as Automotive, Financial Services, Healthcare and Manufacturing have already started adopting AI to tap opportunities they were not seeing before. AI is also getting embedded into the fabric of an organization's functions such as human resources, marketing, and customer services.

One of the clearest use cases for AI is creating business applications with intelligent capabilities. Most organizations are changing their applications to have better interfaces with cognitive capabilities or building all new solutions with predictive analytics and machine learning capabilities. At the same time, organizations are spending money and effort in labeling the data and priming it for more accurate analytics and insights. Data is the foundation for intelligence. Without clean data, the

results could mislead. It is imperative that data is primed, cleaned, categorized, tagged and detected for anomalies to avoid misleading insights. This process by itself is extremely complex and time-consuming but it provides AI its true power and purpose.

An organization can achieve far more with a comprehensive AI strategy rather than incremental changes through isolated use cases. To make this happen, organizations need a comprehensive solution map to bring AI in every application, every business process and every employee. It must also ensure that all employees, regardless of technical expertise, are able to benefit.

Every Application



Quickly and easily develop intelligent applications to create engaging user experiences and surface unprecedented insights

One of the clearest use cases of AI is creating business applications with intelligent capabilities. Use of AI in applications is rapidly increasing; by 2021, 75% of commercial enterprise apps will use AI (IDC, 2017⁵). AI offers tremendous opportunity to increase the functionality of existing business applications and turn them into tools for more effective customer engagement and employee productivity. However,



most organizations' app developers do not have the AI expertise needed to make this a reality.

To help developers integrate AI into every application, Microsoft provides them the tools needed to build the next generation of smart applications where their enterprise data lives-in the intelligent cloud, on-premises, and on the intelligent edge. By putting the reins of innovation in the hands of each developer, they can then build intelligent apps that can see, hear, speak, understand, and interpret user needs.

For developers to build intelligence across every application, a Comprehensive AI platform is required. The platform should enable developers and data scientists build intelligent apps. This is complimented by software services providers in creating tools and services that make AI integration in an organization faster and easier. For example, Microsoft has developed PowerApps for Dynamics 365, a powerful tool that enables faster innovation with a point-and-click approach to app design. Similarly, Azure AI platform features modern AI tools and services designed to help developers and data scientists create AI solutions easily, while maximizing productivity. Users can choose from a large selection of templates or start from a blank canvas to build a custom app based on the Common Data Model. Popular deep-learning frameworks

enable developers to harness intelligence with massive datasets on a platform with comprehensive support. And our enterprise-grade AI infrastructure runs AI workloads anywhere at scale.

To further simplify the creation of AI solutions, Microsoft also offers a comprehensive set of flexible and trusted AI services. Trusted AI services accelerate the development of AI solutions - from pre-built APIs, such as Cognitive Services and Conversational AI with bot tools, to platforms for building custom models such as Azure Machine Learning Studio.

With Cognitive Services, developers can make their applications more intelligent and engaging by infusing them with cognitive capabilities. These services are high quality RESTful intelligent APIs for Vision, Speech, Language, Knowledge and Search. With just a few lines of code, developers that are new to AI can infuse their applications with cognitive capabilities to communicate with users in a natural language, identify relevant content in images and recognize users by voice.

The platform generally expands itself with specialty environments meant for data science and deep learning with custom model preconfigured for more elaborate data preparation and data analytics as required.

25% of all customer service and support operations will integrate virtual customer assistant or chatbot technology across engagement channels by 2020, up from less than 2% in 2017 (Gartner, 2018⁶)

Every business process



Enhance every business process with intelligence to expand customer engagement, optimize operations, and improve products and services

Over the last several decades, the advent of the internet has completely redefined business processes. From sales and marketing to customer support, the way customers do business today would be nearly unrecognizable to the enterprises of a few decades past - and the result has been dramatic increases in productivity and output. To say that AI will have a similar impact is no overstatement.

AI enables organizations to take better-informed decisions by making it easy to derive insights from data, helping them expand customer engagement, optimize operations, and improve offerings. Reimagining business processes with AI also makes work more efficient, saving employees time so they can focus on higher priorities.

Customers continue to move away from the priority of "cutting costs" to improving

efficiency in their internal processes in pursuit of "improving customer experience". All business processes and their efficiency can be categorized in one of the three stages of journey namely "reporting to prediction", "prediction to decision" or "decision to action".

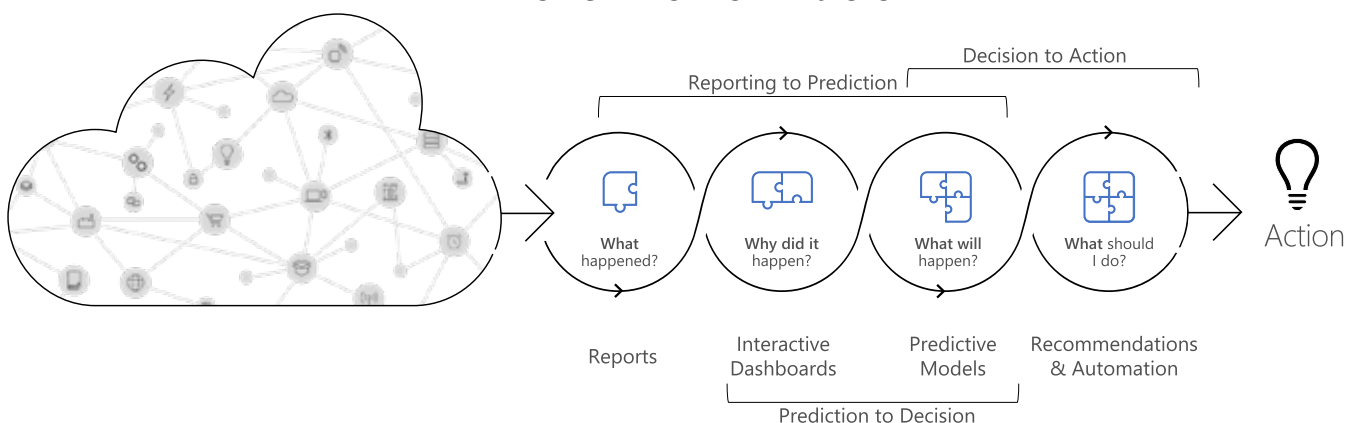
To take a few examples, the following functions, across industry verticals, are innovating with AI on specific workloads to improve their efficiency and effectiveness:

Marketing

Artificial Intelligence and machine learning is increasing emphasis on the entire customer journey. It can provide marketers a more comprehensive view of their customers by connecting the dots across all their devices and revealing how their needs are changing. AI can also quickly identify patterns among customers to provide insights into the best way to approach them at each stage of the customer journey. So here are a few areas where AI can help bring immediate change:

Elevating the customer experience: By making marketing more personalized, Artificial Intelligence is transforming

INSIGHTS IS A JOURNEY



marketing into something that people truly enjoy.

Powering customer decisions: AI can help make better recommendations for customers whenever or whichever way they touch or interface with the organization by whatever we know and specifically they allowed us to know.

Talent and Human Resources

Managers and HR have a difficult task to identify the pulse of the organization and the employees. Bad attrition rates affect an organization negatively and it doesn't help to find out an employee is unhappy only at the time of resigning. Most of these signals are already available in the organization and are generally missed.

Here are few areas AI is helping in HR:

Employee retention and prediction: With all signals available from employee interactions across internal systems, feedback from various sources, appraisal systems and market analysis, it is possible to detect employee needs. Such analysis gives room to HR professionals to be proactive and resolve the root cause of the issues instead of responding to issues as they occur.

Smarter talent acquisition: Candidate screening is another task that can be easily automated using AI. Through machine learning, more online data can be collected and parsed such as from social media, previous online job records, and educational qualifications that will then enhance the ranking system of candidates for recruiters to pick from.

Procurement

AI could change procurement models,

simplify menial tasks and help buyers to work fast and work smart in the future.

Some scenarios which are worked upon are as below:

Automation of error-prone menial procurement tasks: AI adoption will lead to greater automation of menial tasks, making them actionable quicker than multiple days. It could be automation of invoices processing or comparison of purchase orders or supplier contracts. With Computer Vision, invoice processing has become more accurate and helps reduce the administrative burden on employees.

Contract lifecycle solutions: Renewals, expiring contracts, and scope of engagements in an organization are extremely sensitive and very difficult to keep track of. With Computer Vision and Search, a large part of documentation is digitized, cross referenced and potential pitfalls can be flagged.

Artificial Intelligence is currently being discussed in nearly every domain of science, engineering and business. Currently, the most vibrant part of AI, machine learning, is tightly coupled to the availability of relevant data sets within industries. It is critical to partner with technology innovators within industries to create AI solutions that meet vertical-specific needs. Here, we will look at a few of the most powerful scenarios where AI has already made an impact across specific industries:

Healthcare

In the health domains, there is an abundance of data in a variety of formats. However, the quality of and accessibility to these data resources remains a significant challenge

Narayana Health is looking at new avenues to optimize its operations and augment patient care with technology. One of the ongoing projects being piloted internally is to use Artificial Intelligence to decipher X-Rays to point out any irregularities from a normal X-Ray, which would help doctors save time.

Future Generali India Life Insurance Co. Ltd.'s REVA chatbot caters to most customer requests on its website. The chatbot has improved its customer relationship score while reducing calls and time to settle claims.

worldwide. Health data has privacy requirements associated with it, making its collection, sharing, aggregating, or analyzing particularly cumbersome compared to other types of data. In addition, health data is expensive to collect initially, so it tends to be tightly guarded once it is collected. Further, the lack of interoperability of electronic health record systems impedes even the simplest of computational methods, and the inability to capture relevant social and environmental information in existing systems leaves a key set of variables out of data streams for individual health. Due to the sensitive nature and special legal protection of health data, countries are still evaluating how to balance multiple fundamental rights simultaneously, like data protection and healthy living.

Here are some ways we are integrating AI into healthcare:

Personalized medicine: Analytics-driven individualized treatment plans based on a patient's genetic makeup, medical history, lifestyle, and more - made possible through advances in genomics and intelligent analysis of massive amounts of healthcare data.

Healthcare Bot service: A cloud-based solution that enables healthcare organizations to build and deploy compliant, virtual health assistants that can provide users with conversational and engaging access to the most relevant and accurate healthcare services and information.

Inner eye: A Microsoft research project that is exploring state-of-the-art machine learning technology to build innovative tools that automatically analyze 3-D radiological images.

Financial Services

This is a time of transformation for the financial services industry. With technological advances, cultural shifts, cybersecurity threats, and regulatory changes, there's a pressing need for banks to rethink the way they work. Banks are now competing with a growing number of cloud-native industry disruptors and as a result, customer expectations are shifting. Today only 24% of customers report that they believe their bank understands their current goals (NIIT, 2017⁷). This is compounded by the risk of financial crime: in the last 24 months, 56% of financial institutions have experienced consumer fraud and 41% have experienced cybercrime (PwC, 2018⁸). Innovative new capabilities, enabled by the financial services-ready cloud, are helping banks to meet these challenges and transform their business for the better. Such capabilities include:

Next Best Action (NBA): AI-powered NBA solutions use sophisticated rules, analytics, and algorithms to better predict customer needs and in turn offer more relevant actions and promotions, leading to improved wallet share and loyalty.

Risk analytics and fraud prevention: Machine learning makes more accurate risk, fraud, and customer models possible, enabling financial services institutions to spot hidden risks and decrease operating costs.

Manufacturing

The rise of digital technology and IoT has provided manufacturers with vast stores of data that reflect operational efficiency and business performance. More than half the manufacturers with revenues

exceeding \$1 billion have invested over \$100m toward smart factories, and they are seeing an average productivity gain of nearly 20% (Capgemini, 2017⁹). Gleaning useful insights from this data is essential for manufacturers who often operate on thin margins and are increasingly looking for value-added services-especially field service-to differentiate themselves. AI is empowering manufacturers to create more with their data, leading to advancements in:

Predictive maintenance: Estimate the remaining useful life for machines and their components, enabling maintenance technicians to be proactive about repairs and reduce costly downtime.

Performance improvements: Anticipate the risk of production disruptions, bottlenecks, and safety risks in real-time, highlighting problems before they occur.

Retail

In retail, customers have an increasing expectation for personalized experiences that demonstrate an understanding of the customer as an individual. A large percent of consumers expect brands to provide personalized service to customers. AI is enabling retailers to tailor their offerings more precisely to customer demand with services such as

Sales personalization: Intelligence applied to customer history enables retailers to deliver customized experiences, offerings, pricing, and planning-modernizing the online and physical buying experience.

Dynamic pricing & planning: Forecasting models predict demand for different products, providing greater confidence for pricing and stocking decisions and reducing losses from overstocks and out-of-stock.

Governments

Governments are under pressure to create more effective citizen services. In particular, there is a lot of room for growth in providing citizens with digital government services. Increasingly, citizens want to use mobile devices to access government services. At the same time, governments are fighting to control costs and ensure security and privacy. As a result, AI tools enable governments to connect with their citizens more effectively, eliminate waste, and protect sensitive information. Two key areas for these innovative AI initiatives are:

Smart cities: Intelligent technology designed to tackle common challenges such as fee and toll management, traffic optimization, and sustainability.

Citizen services: Tools designed to provide citizens with easier access to consolidated government services through tracking, search, and conversational bots.

Education

Technology is creating unprecedented opportunities to connect students to the world around them and help them realize their full potential. Teachers, administrators, and technology innovators are collaborating to solve some of the most pressing challenges in education through AI. These collaborations have produced:

Accessibility in the classroom: AI-powered tools-such as real-time lesson translation for students that speak a different language and narration of surroundings for students who are blind-enable teachers to make the classroom more accessible.

School-wide AI insights: Deep analytic

Piramal Glass implemented Real Time Manufacturing Insights (RTMI) using Azure IoT Hub to make its production lines paperless with dashboards accessible on smartphones, laptops and even large displays on the factory floor. With real-time alerts, RTMI has reduced cost of ownership by 70%, improved employee productivity by 25% and decreased defects by 5%.

Andhra Pradesh government had piloted a project using AI and ML for analyzing school drop-out rates, predicting future drop-outs and enabling preventive action. Powered by Azure machine learning and the cloud, a new app is predicting which students are most likely to drop out of school. The scalable tool processes complex data sets that include details about enrolment, student performance, gender and socio-economic demographics, school infrastructure and teacher skills to find predictive patterns.

Partnering with Microsoft, UST Global was able to combine their disparate data into searchable knowledge, helping them improve customer experiences, provide their employees with more actionable customer insights, and expand the capabilities of their AI-powered digital assistant.

insights into student success and risk across entire schools or school districts help educators make informed decisions on how to improve student outcomes.

Every employee



Foster innovation and collaboration across the enterprise by placing AI in the hands of every employee

AI has the capacity to empower all employees to achieve more, not just highly skilled technical workers. Apart from generating higher business value, AI augmentation is expected to recover billions of hours of worker productivity. This human-AI partnership combines the strengths of both computers and humans to drive this unprecedented value across every industry. Enabling every employee to become a 'citizen data scientist' is crucial to realize the full potential of Artificial Intelligence. Only then can the whole organization glean new insights, make better decisions, and perform complex analysis using AI.

We believe there are three imperatives to provide any employee with the ability to explore, derive insights, and create new knowledge from vast amounts of data: turning disparate data into knowledge, enriching employee experiences with searchable knowledge, and driving innovation with democratized AI.

Turn disparate data into knowledge: First, we need to convert an enterprise's siloed and chaotic data into information employees can easily access. AI is only as powerful as the data it's built on. While most enterprises have amassed huge quantities of data, it often resides in siloed systems, like marketing and finance systems. Moreover, most of this data is either unstructured, like video files, images,

and PDFs, or may even be redundant, or obsolete. Without usable data across the enterprise, most organizations are limited to employing AI on specific siloes of structured information.

Instead of developing AI applications that can only perform niche tasks, technology today is helping enterprises organize their structured and unstructured data into a single, searchable knowledge base enriched with relevant external data. AI capabilities run on top of data to understand the content and infer relationships, turning data into knowledge and ensuring that the user receives the most relevant information. Serving as a strategic foundation for current and future AI initiatives, this knowledge base is also understandable, consumable, and searchable by AI models and can enable enterprises to integrate AI in every aspect of their business. From this centralized resource, employees can search and explore previously unavailable enterprise information, enabling them to be more efficient and impactful.

Enrich employee experiences with searchable knowledge: With a comprehensive AI platform, enterprises can build rich experiences on top of their enterprise knowledge, either by infusing it into existing productivity and business applications or by creating new applications powered by AI, like conversational agents. For example, the next generation of conversational agents can pull information from knowledge corpus to answer specific business questions, such as "Which customers are within a 10-mile radius of the airport?" Access to knowledge democratizes AI experiences and provides powerful new connections to employees.

Consider the following illustration of the

searchable knowledge base in action: Lisa, a marketer, needs to find an advertising agency to use for an upcoming campaign. Typically, identifying an agency with the right capabilities would require relying on colleagues for recommendations and spending hours reviewing past records, agency websites, web results, and the agency's previous work. Lisa would have struggled to piece together this information, manually combing through countless sources of data, never certain if she had all the right information.

With an AI-infused knowledge base, Lisa can search "Find me advertising agencies" and a ranked list of agencies her company used in the past will populate. Curious about her colleagues' experiences, she selects two agencies that her company has previously used and types a new query into the search bar: "Find me Teams threads that mention these agencies." Her search yields dozens of Teams threads. Keen to quickly identify which agency her colleagues have had the most positive sentiment about, she applies a sentiment analysis AI model. She can now use more advanced queries like "Show me Teams threads with negative sentiment for Agency A" or "Show me the trend of sentiment for Agency B."

Instead of searching for hours with potentially less informed results, users like Lisa can now easily perform complex analysis with AI tools and quickly find the information that matters most to them. Creating knowledge bases is just one way we are revolutionizing how employees search, find, and explore information.

Drive innovation with democratized AI: To truly enable employees to become citizen data scientists, technology is enabling them with an easy way to run AI models on top of enterprise knowledge. When employees are empowered with these

AI capabilities, not only can they ask the important questions, they can also very quickly extract relevant insights applicable to the task they are trying to complete. From highly technical employees to non-technical business users, we are placing AI in the hands of every employee and giving them the power to transform how they work and think in more innovative ways than ever before.

In word processors and presentation tools, employees are able to develop documents and presentations in less time with automated design capabilities, which provide design tips and writing assistance. Employees are able to streamline emails and calendars with features that help filter out the noise and surface the most relevant information, so they don't miss what's important. In spreadsheets, intelligent capabilities have been a part of the experience for years. Features like advanced data transformation and flash fill have helped users perform and derive value from their data. With continued advancements in AI technology, spreadsheets are introducing more advanced AI features that help employees unlock new insights from raw data sets in just a few clicks by highlighting relevant patterns.

AI platforms help employees connect with each other, find examples of great work, and spark new ways to innovate and boost creativity.

- 5 <https://www.idc.com/getdoc.jsp?containerId=prUS43185317>
- 6 <https://www.gartner.com/en/newsroom/press-releases/2018-02-19-gartner-says-25-percent-of-customer-service-operations-will-use-virtual-customer-assistants-by-2020>
- 7 http://www.niit-tech.com/sites/default/files/Whitepaper%20-%20BFS%20-%20Delivering%20Personalized%20Digital%20Banking%20Experience_ed....pdf
- 8 <https://www.pwc.com/gx/en/forensics/global-economic-crime-and-fraud-survey-2018.pdf>
- 9 https://www.capgemini.com/wp-content/uploads/2017/07/smart_factories-how_can_manufacturers_realize_the_potential_of_digital_industrial_revolution.pdf

AI for India

India offers every indication of becoming “digitally ready,” with new technology enablers developing at a rapid pace in the market. Cell phone penetration, reduced data costs, and the focus on making India a digital economy are combining to extend connectivity and services to underserved segments of the population¹⁰. The opportunity for top line growth is enormous with growing internet penetration in the country. The rapidly declining cost of data services has also resulted in significant increase in use of the internet.

With a focus on digital inclusion, the government is aggressively pursuing a Digital India program that includes a set of APIs that address identity, payment and consent, collectively known as India Stack¹¹. India Stack’s vision is to drive presence-less, paper-less, cash-less and consent-based service delivery that can be leveraged by an ecosystem of businesses, startups as well as the government to deliver innovative services for citizens.

Nearly 1.2 billion Indians are now enrolled under Aadhaar, the country’s bio-metric based digital identity program. Aadhaar serves as the basic building block for access to government services. Building on Aadhaar are a set of public utilities and software standards like e-signature (eSign), electronic Know Your Customer (eKYC), digital locker, and a consent layer (through which individuals can control who has access to their data and information).

The AI strategy for India published by NITI Aayog is comprehensive and addresses the scale, challenges, needs and aspirations unique to India. The strategy outlines sectors of the economy where AI can play a significant role in bringing India to the forefront of the AI revolution. The report has also defined the role of different stakeholders and the government in this journey. The technology industry needs to actively engage to realize India’s aspirations in AI, given that many of the initiatives outlined need technology as the backbone to achieve scale, efficiency and sustainability. Cloud infrastructure and rapid deployment of intelligent cloud services will play a key role in driving AI adoption in the country.

One of the challenges involved in implementing Artificial Intelligence in India is that AI-ready talent is in short supply. Industry, policy-making bodies, and the government must therefore work closely with academia to create opportunities that will engage the next generation of AI professionals. Additionally, it is predicted (by NASSCOM, 2017¹²) that a startling 46% of the Indian workforce will be engaged in entirely new jobs that do not exist today or jobs that have radically changed skill sets. With this, the need for data analysts, machine learning and AI specialists is also expected to increase along with the demand for new-age jobs across all sectors. Hence re-skilling will have to become an integral part of the overall AI for India



story. Today, the Indian Government, private enterprises, learning platforms, and universities are readying initiatives to train people at scale in AI and ML to address this looming skill gap.

Another challenge in India relates to inclusion. India's linguistic diversity and literacy results in a "digital language barrier", with services not being easily accessible to all citizens. AI is expected to play a key role in removing this barrier, by enabling voice recognition, text to speech and translation for all key Indian languages. Once that is available, all services can be offered to all citizens,

in the language of their choice. Today, Microsoft has voice recognition and translation services for key Indian languages available on Azure, and is working to bring these services to all major Indian languages.

There are various examples where these initiatives have already begun and policy think tanks and research organizations such as NITI Aayog¹⁰ (National Institute for Transforming India), iSPIRT, and iCRISAT are very emphatic in creating and adopting frameworks which could accelerate AI-led digital transformation across sectors.



Presenceless layer

Where a universal biometric digital identity allows people to participate in all services from anywhere in the country



Cashless layer

Where a single interface to all the country's bank accounts and wallets helps democratize payments



Paperless layer

Where digital records move with an individual's digital identity, eliminating the need for massive amount of paper collection and storage



Consent layer

Which allows data to move freely and securely to democratize the market for data

¹⁰ http://niti.gov.in/writereaddata/files/Strategy_for_New_India.pdf

¹¹ <https://indiastack.org/about/>

¹² Future of Jobs in India: A 2022 Perspective, 2017

¹³ <http://niti.gov.in/>

AI for good

AI can be a powerful tool for increasing access to information, education, employment, government services, as well as social and economic opportunities. There are no limits to what people can achieve when technology reflects the diversity of everyone who uses it. Enterprises should play an active role to ensure that these new technologies are applied responsibly and inclusively. Over the past 18 months, Microsoft has been investing in AI for Good programs that lower the barriers of entry to cloud and AI technologies through grants, education, research, and strategic partnerships.

AI for Accessibility

Microsoft's AI for accessibility program promotes inclusion through intelligent technology. We are focused on empowering organizations and developers to harness AI to amplify human capabilities for people with disabilities. The program focuses on driving

breakthroughs that make the workplace more inclusive, providing equal access to information through innovations in vision, speech, and machine reading, and helping people with disabilities gain more independence to perform daily tasks

AI for Humanitarian Action

Persistent humanitarian crises caused by natural and man-made disasters, oppression and other emergencies have plagued our world for as long as time itself. And while global relief organizations scramble to respond to these events, their work is often reactive and difficult to scale. We believe that technology, like Artificial Intelligence (AI) combined with cloud technology, can be a game changer, helping save more lives, alleviate suffering and restore human dignity by changing the way frontline relief organizations anticipate, predict and better target response efforts. In 2018, in conjunction with the United Nations

A new way of seeing

Seeing AI is a free app designed to help the low vision community better see the world around them. This ongoing research project harnesses the power of AI to describe people, text, and objects.

[Learn about Seeing AI](#)



General Assembly meeting, Microsoft announced AI for Humanitarian Action¹⁴, a new \$40 million, five-year program. The initiative will harness the power of AI to focus on four priorities – helping the world recover from disasters, addressing the needs of children, protecting refugees and displaced people, and promoting respect for human rights. Our AI for Humanitarian Action program is part of Microsoft’s AI for Good suite – a growing \$115 million, five-year commitment to work to unlock solutions to some of society’s biggest challenges.

AI for Earth

AI for Earth puts Microsoft cloud and AI tools in the hands of those working to solve global environmental challenges. Through grants that provide access to cloud and AI tools, opportunities for education and training on AI, and investments in innovative, scalable solutions, AI for Earth works to advance sustainability across the globe. The program focuses on four key areas vital to creating a sustainable future – agriculture, water, biodiversity, and climate change.

Gramener wins ‘Data Science for Social Good Award’ and Microsoft AI for societal impact award

Gramener and Microsoft AI for Earth help Nisqually River Foundation automate identification of fish species.

14 <https://www.microsoft.com/en-us/ai/ai-for-humanitarian-action>

Responsible AI

As we look to a future powered by a partnership between computers and humans, it's important that we address the underlying ethical challenges head-on. Designing trustworthy AI requires creating solutions that reflect ethical principles deeply rooted in important and timeless human values. It's quite easy to get swayed by technological advancements and immediate returns in business. However, few ethical values need to be embedded in every activity or decision-making process while using Artificial Intelligence.

At Microsoft, we have defined a framework for Ethics of AI that includes six values - fairness, reliability and safety, privacy and accuracy, inclusiveness, transparency, and accountability. This framework is meant to guide the cross-disciplinary development and use of Artificial Intelligence.

We have seen that AI has the capacity to impact human life in a multitude of ways, by driving efficiency and effectiveness, or through automation. AI systems are also increasingly being used to make consequential decisions that affect people - decisions that humans would have made in the past. For example, an AI system might largely replace a loan officer in deciding whether a person is creditworthy, or it may screen a group of job applications to determine the most qualified candidate. The automated nature of these important considerations

makes policymakers, industry, academia, and the public-at-large uneasy.

An important reason why human beings operate in the physical world with confidence and trust is because there is a broad consensus about what kinds of behavior are considered responsible and acceptable. In general, this consensus grows out of norms that are implicitly understood, consistently applied in everyday social interactions, and reinforced in laws. As we get more into the digital world, there is reason enough to see that the same level of trust and confidence needs to be built. Given below are what we believe to be fundamental principles that need to guide the development of AI:

Fairness: It is essential that AI does not limit opportunities for anyone - fairness is the foundation for treating people with dignity and respect. If AI systems provide guidance on medical treatment, loan applications or employment, for example, they should make the same recommendations to everyone with similar symptoms, financial circumstances or professional qualifications. When developing these systems, developers should be sensitive to situations where societal or other biases may get incorporated into either the training data or the algorithms. We thus need to ensure that AI is fair and not programmed to make biases or discriminatory decisions

The ethics of AI



Fairness



Reliability & Safety



Privacy & Security



Inclusiveness



Transparency



Accountability

that we have prohibited human beings from making.

Reliability & Safety: AI systems should perform reliably and safely. The complexity of AI technologies has fueled fears that AI systems may cause harm in the face of unforeseen circumstances, or that they can be manipulated to act in harmful ways. Trust in AI systems will depend on whether they can be operated reliably, safely and consistently even under unexpected conditions, especially for applications in fields such as transportation, healthcare, and financial services – where consequential decisions are involved.

These systems need to demonstrate that they can be depended upon to make appropriate recommendations in as many circumstances as possible. Designing appropriate AI behavior in a very broad set of circumstances raises many challenging issues that are actively being researched.

Privacy & Security: AI systems need a lot of data for training, including data that concerns people. For example, we can't predict who is at a higher risk for cardiac related diseases unless we have a large amount of data about a wide variety of people who have had prior cardiac related diseases and information that includes their age, gender, etc. People will not want to share their data if they don't believe it

will be stored securely, used safely, and to a good end. It is essential that AI systems comply with applicable privacy laws, on the collection, use, and storage of data. The systems must be designed to protect personal data from bad actors who may steal private information or inflict harm otherwise.

Inclusiveness: AI systems should benefit everyone and address a broad range of human needs and experience, inclusively. These technologies can be a powerful tool for people who are disabled (e.g., visual, hearing, mobility, speech, or cognitively impaired), enabling them to gain access to opportunities that they may not have had before, in education, employment, government services, thereby improving their overall health, socioeconomic situation, and quality of life. However, if the process of building these tools and/or solutions excludes people and/or data from diverse backgrounds and abilities, there is an inherent risk of bias creeping in.

Underlying the four preceding values are two foundational principles: transparency and accountability.

Transparency: As AI systems are increasingly involved in decisions that influence people's lives, enabling people to understand how these systems operate and providing a mechanism for accountability are essential to building

trust. Many of the advanced machine learning techniques such as deep neural networks function essentially as “black box” systems that even data scientists can’t fully understand. We believe that a meaningful approach to enabling transparency is to explain everything that we can about the system end-to-end. For example:

- Description of the data that was used to train and test the system
- What procedures were used to verify data quality and completeness?
- What types of data will continue to be used once the system is deployed?
- What are the criteria used in algorithm selection?
- How are the outcomes verified and tested for potential bias?

Accountability: People who design and deploy AI systems must be accountable for how their systems operate. To establish norms and best practices, we can draw upon experience in other sectors such as healthcare and privacy. Internal

review boards can provide oversight and guidance on which practices should be adopted during development and deployment of AI systems. Additionally, while designing systems, there are possibly four key questions that we should ask to ensure that inconsequential harm does not occur:

In the end, as any other technology, AI holds great opportunities, but at the same time throws up several concerns. Governments, society, academia and the industry-at-large need to come together to build regulations, which ensure that AI is used responsibly. Making AI trustworthy can be realized only if we work closely with the government policymakers to help structure the narrative and regulations of what is right and what is wrong. This cannot be done in isolation because over-regulation may impinge on the innovation and value that AI can bring to society. Thus, in India, we need to work closely with bodies such as NITI Aayog, MeITY, Department of Science and Technology as well as academic institutions to help frame the guard rails of where and how AI should be used to instill trust and responsibility in AI-based systems.

Question	Description
System Purpose	Will the technology be used to augment the abilities of individuals and result in a positive impact on people and society?
Technology Capability	Are the AI technology and people capable of performing the tasks that the AI system should do?
Quality & Reliability	Will the technology be effectively designed, operated and maintained by a responsible party? Will it continue to perform the way it is supposed to over time under different situations?
Sensitive Uses	Is the system in a sensitive category which may have a broad impact on people and society? Will it inadvertently deny people services, cause harm and/or risk their personal freedom?

Conclusion:

Where do we go from here...



The last few years have seen Artificial Intelligence (AI) and Machine Learning (ML) inexorably increase their impact across all facets of our daily lives. From interacting with smart chatbots much like we do with humans, including mixing multiple languages as we would in normal human conversation, to assisting farmers by making agriculture-related predictions that result in yields, AI is seeing useful applications everywhere.

Aiding and enabling this rapid spread of AI is the widespread access to technology and computing through affordable devices such as smartphones, which today provide a plethora of applications aimed at enhancing convenience and decision making. And of course, these devices also generate massive amounts of data that is fed back into ML algorithms to make them more efficient, optimised and personalised to the user.

However, there is much to be done in the field of AI to make its benefits available across a broad swathe of applications and to society. Microsoft Research India has several ongoing efforts to shape the future of AI. We have an interdisciplinary team with expertise ranging over algorithms, machine learning, systems and human-computer interaction, and our innovations span algorithms, systems and applications. We list a few specific directions below:

AI at Internet Scale, and AI at the Edge

Extreme classification is a rapidly growing research area focussing on multi-class and multi-label problems involving an extremely large number of labels. Many applications have been found in diverse areas ranging from language modelling to document tagging in NLP, face recognition to learning universal feature representations in computer vision, gene function prediction in bioinformatics, etc. Extreme classification has also opened up a new paradigm for ranking and recommendation by reformulating them as multi-label learning tasks where each item to be ranked or recommended is treated as a separate label. Such reformulations have led to significant gains over traditional collaborative filtering and content-based recommendation techniques. Consequently, extreme classifiers have been deployed in many real-world applications in industry. This is an area of research that is being pioneered by MSR India. We originated this sub-field, and have built a community around it - for the past few years, workshops in extreme classification are being held in top ML conferences such as NeurIPS and ICML, and we are leading this community.

AI at the edge. ML and AI have traditionally been thought to require Internet-scale computing resources to be effective. Devices at the edge, such as sensors, have typically been seen as instruments to transmit data to the cloud, where the AI and ML systems will

make intelligent decisions based on the data. However, there are many scenarios where one may not want to communicate constantly with the cloud for reasons of privacy or conservation of battery power. Or, access to the Internet may simply not be available. How does one then deliver the power of ML in these scenarios? MSR India has devised ML algorithms that can run on these resource-poor devices that often have as little as 2 KB RAM, and deliver accuracy levels comparable to algorithms that run on cloud-based infrastructure. AI at the edge can revolutionise the way we see and implement AI today. Our work here has received wide acclaim through publications in top ML conferences (NeurIPS and ICML). We are working with the community to define new end-to-end applications that are made possible through these breakthrough algorithms.

AI and Systems: how they can make each other better

ML and systems innovations reinforce each other. ML innovations such as deep neural networks need new systems innovations to deal with the billions of training sets that are used to train such models. Conversely, large scale system design and engineering, can greatly benefit from using ML-based predictive analytics in all aspects of the development and deployment cycle. We are doing highly innovative work at the intersection of AI and systems, through projects such as Astra, Gandiva and Sankie.

AI and Society

At MSR, we strongly believe that AI and ML can play a pivotal role in how we deal with problems in health, urbanization, education, agriculture, etc. We have

already established multiple projects in this area. 99DOTS is a low-cost engagement tool using basic mobile phones and augmented packaging for patients taking anti-Tuberculosis medication. Each day, patients send a free call to a number revealed by the packaging after dispensing its medication. Based on their adherence and connection to the Hub, programs can differentially treat patients and escalate cases of non-adherence. 99DOTS has reached over 200,000 patients till date, and is being deployed in 7 countries around the world. We are now starting to use the data from this experience, and are building ML models to predict patients who have a high risk of non-adherence to the medication regime, so that healthcare workers can pay more attention to such patients.

We are also investigating innovative ways to provide employment to the underserved communities, such as through dignified digital work that can be done on basic smartphones. One of our other projects, HAMS, involves the use of ML and AI to try and make Indian roads safer by building systems that can effectively monitor how safely the driver is driving, whether he or she is fatigued, or paying attention to the road and so on.

In addition to advancing the state-of-the-art, we work with the start-up and academic communities to leverage AI for positive social impact. We are committed to working with the government and the broader community to craft a future driven by AI and ML, one that is inclusive and can work towards solving tough and challenging problems that emerging and diverse economies like India are currently facing.

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