AI for social good

How artificial intelligence can boost sustainable development

22nd Annual Spectrum summit
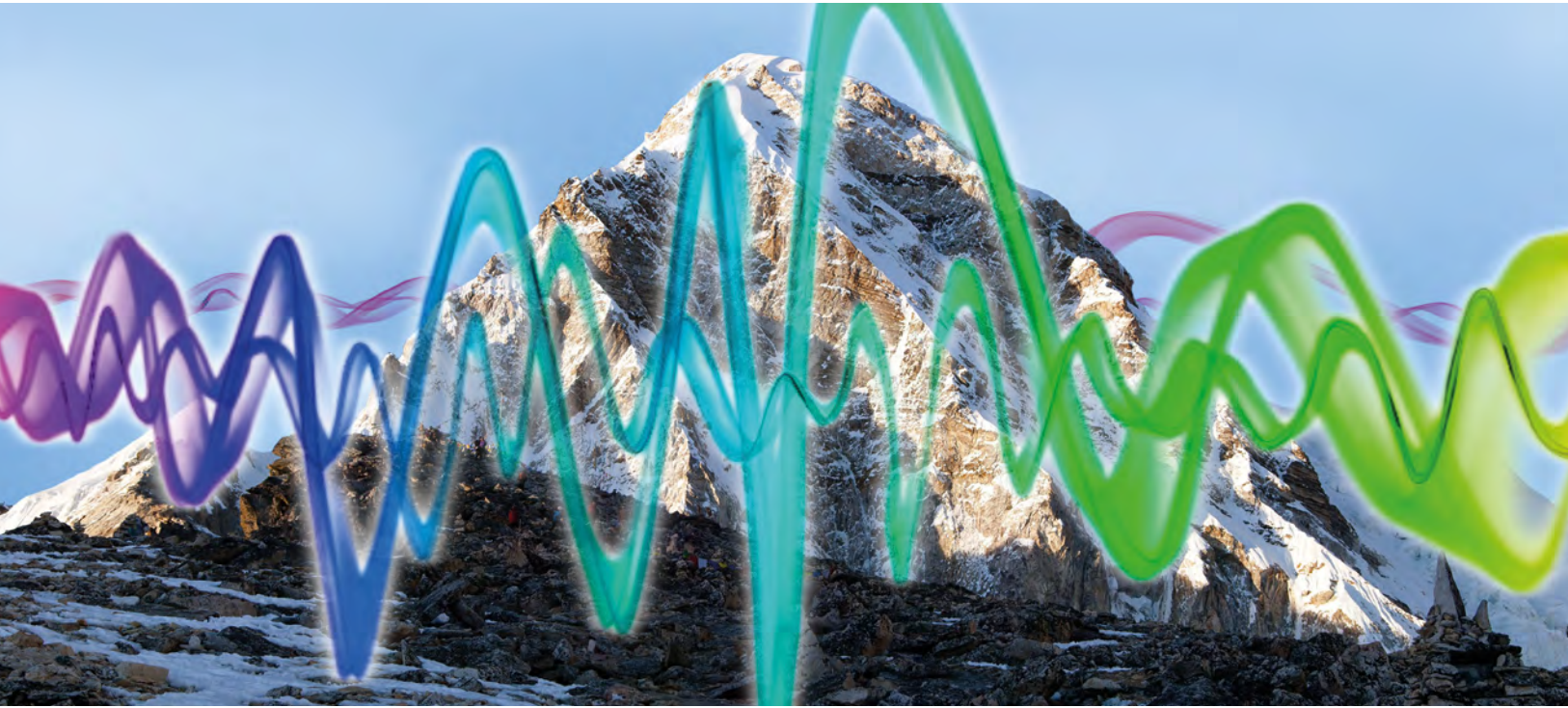
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Harnessing the power of AI for social good

Houlin Zhao, ITU Secretary-General

Artificial intelligence (AI) has finally arrived, and is quickly becoming a key part of our everyday lives. AI is already incorporated in many products – from Google's search and translation to Alibaba's real-time traffic predictions to Tesla's self-driving cars. It is increasingly becoming key to tech industry growth as huge amounts of data generated by Internet of Things (IoT) applications will rely on AI analytics to realize their full potential.

AI also has enormous potential for social good. If the scalable power of AI can be leveraged correctly, it can rapidly accelerate progress on the United Nations' Sustainable Development Goals (SDGs). Lives across the world can be improved in fundamental ways, and this special edition of ITU News Magazine will outline many of them.

Yet, the transformative power of AI brings with it complicated challenges, ranging from ethical issues to security risks, to the disruptive impact of AI on employment.

Navigating these challenges may be as difficult as delivering the solutions for social good – and both will require unprecedented collaboration. AI experts stress that discussions around AI's implications for society should not be confined to specialists. Indeed, every government, every company, every academic institution and every one of us should consider how AI will affect our future.

This is why ITU, in collaboration with XPRIZE, is organizing the first "**AI for Good Global Summit**" to be held in Geneva, from 7 to 9 June 2017. The event aims to accelerate the development of AI solutions by enabling key stakeholders to discuss how best to support AI innovation that respects emerging global ethics, norms and standards.

We hope this collection of thought leadership and insight from some of AI's top minds will help frame the important issues, so that together we can unlock the great potential of AI technology to improve lives.

> **❝ AI has finally arrived, and it is quickly becoming a key part of our everyday lives. ❞**

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Cover photo: Shutterstock

AI for GOOD
GLOBAL SUMMIT

AI can help solve humanity's grandest challenges.

Map poverty with predictive Big Data analytics

Increase agricultural productivity

Analyse vast amounts of healthcare data

Revolutionize classrooms with individualized learning

Pinpoint gender inequity, drive balanced hiring

Improve efficient, clean water provision

Improve photovoltaic energy capture

Increase productivity through intelligent automation

Help drive industry innovation

Build a more inclusive society (e.g. disability robotics)

Power urban-planning decisions through sensor data

Predict optimal production levels to reduce waste

Model climate change to predict disasters

Track illegal fishing through pattern-recognition software

Outwit poachers and monitor species' health

Reduce discrimination and corruption in government

Multi-sectoral collaboration is essential

1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS

Geneva, 7-9 June 2017

XPRIZE®   ITU

Accelerating the Sustainable Development Goals through AI

Stephen Ibaraki

Managing partner, **REDDS Venture Investment Partners**

REDDS

Continuing on from Mobile and Cloud First, "AI First" is quickly becoming a top solution strategy for industry and governments, as evidenced by massive artificial intelligence (AI) investments in the billions. IDC has predicted **revenues** of nearly 50 billion globally in 2020 at a 55% compound annual growth rate. But it's not just about business growth: AI is potentially one of the most powerful accelerators of the 17 United Nations **Sustainable Development Goals** (SDGs).

The "**AI of Everything**" is the **top tech trend for 2017** and could be an inflection point for humankind and the SDGs.

British computer scientist Alan Turing made **predictions** about machine learning way back in 1947. Fast forward to 2017, when Microsoft CEO Satya Nadella, **speaking** in India, called AI the ultimate breakthrough technology, which is realized today in intelligent agents, augmented reality, and rapid advancements in deep neural nets providing fundamental human-like perception.

> " *The 'AI of Everything' is the top tech trend for 2017 and could be an inflection point for humankind and the SDGs.* "
>
> Stephen Ibaraki

AI, for instance, is currently being used to mine opportunities from the data within India's 1.1 billion-citizen, biometric digital identity system, Aadhaar. The possibilities were discussed amongst entrepreneurs at the Financial Services Roundtable Fintech Ideas Festival **CEO-summit** in January.

That's just one example of the overlapping amplification of value that could come out of this period of unprecedented acceleration of economic, cultural, and societal change driven by what I call 'A Triple C':

- *Automation*;
- time *Compression* in new innovations;
- *Convergence* in biological and digital existences;
- ubiquitous *Connectivity*.

The underlying catalyst of "A Triple C" is a digital AI mesh created by the growing deployment of machine learning — the "**AI of Everything**".

AI for global good – Accelerating the SDGs

So how can the power of AI be harnessed for social good? How can it accelerate the SDGs?

There are a growing number of use cases for AI enabling the SDGs. Here are a few of them.

SDG 1: No poverty
AI will provide real-time resource allocation through satellite mapping and data analysis of poverty.

SDG 2: Zero hunger
Agriculture productivity is increased through predicative analysis from imaging with automated drones and from satellites. Nearly 50% of crops are lost through waste, over consumption and **production inefficiencies**. Livestock production losses are 78%.

SDG 3: Good health and well-being
Preventative healthcare programs and diagnostics are significantly improved through AI leading to new scientific breakthroughs. There are 8 billion mobile devices with smartphone cameras being used to diagnose heart, eye and blood disorders; microphone and motion sensors yielding insights into bone density and osteoporosis — and managing cancer, diabetes and chronic illness remote care.

SDG 4: Quality education

Virtualized, intelligent mentors and responsive personalized learning is revolutionizing education, and improving participation and outcomes – all powered by AI. Online providers such as **Coursera** have AI-produced granular information for effective learning. **Big data analysis** is improving graduation rates of low-income and first-generation college students by 30%, spotting warning signs before dropout to allow targeted interventions.

SDG 5: Gender equality

By identifying and correcting for gender bias, further automating/augmenting tasks, AI is empowering women for growth and new opportunities.

SDG 6: Clean water and sanitation

The Internet-of-Things (IoT) and sensors feeding into the AI of Everything are predicting sanitation and consumption patterns for improved safe water and sanitation provisioning.

SDG 7: Affordable and clean energy

Green energy in all its forms is continuously improving for increased output and more efficiency by AI real-time analysis.
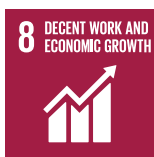
SDG 8: Decent work and economic growth

Despite legitimate concerns about automation replacing jobs, AI augmentation and targeted automation with intelligent devices can improve the work environment, increase productivity, and be a significant driver of economic growth.

SDG 9: Industry innovation and infrastructure

New hybrid manufacturing incorporating AI, IoT sensors, and 4D printing is reshaping industries, representing the 'A Triple C', and yielding exponential innovation unprecedented in world history.

SDG 10: Reduced inequalities

Human augmentation using AI-inspired devices both internally and externally provides super senses and knowledge, enhanced physical capabilities, and corrects disabilities yielding a more equal and inclusive society.

SDG 11: Sustainable cities and communities

The AI of Everything, the digital AI mesh, fed by the ubiquitous IoT, smart devices, and wearables, is already impacting smart cities and helping to create sustainable communities.

SDG 12: Responsible consumption and production

AI is yielding optimal consumption and production levels with vertical green farms, eliminating waste, and vastly improving yields and resource efficiency.

SDG 13: Climate action

Climate change data analysis and climate modeling infused with AI predicts climate-related problems and disasters.

SDG 14: Life below the water

Pattern recognition can track marine-life migration, population levels, and fishing activities to enhance sustainable marine ecosystems and combat illegal fishing.

SDG 15: Life on land

Pattern recognition, game theory, and wide applications of computer science can track land-animal migration, population levels, and hunting activities to enhance sustainable land ecosystems and combat illegal poaching.

SDG 16: Peace, justice, and strong institutions

Thoughtful application of AI can reduce discrimination, corruption, and drive broad access to e-government, personalized, and responsive intelligent services. AI can significantly stay ahead of global cyberthreats, the **Cyber Kill Chain**, in a manner not possible before.

SDG 17: Partnerships for goals

Multi-sectoral collaboration is essential for the safe, ethical, and beneficial development of AI. ITU is working with other United Nations agencies, and the **XPRIZE Foundation**, to organize the "**AI for Good Global Summit**" in Geneva, Switzerland, from 7 to 9 June. The summit will bring together governments, industry, academia and civil society to explore the responsible development of human-centric AI in solving humanity's grand challenges, including accelerating the all-important SDGs.

> **"** *Everyone's going to be impacted by the proliferation of AI. The impact is going to be faster than what people had originally anticipated.* **"**

Stephen Ibaraki
Managing partner, REDDS Venture Investment Partners

The solvable challenges with AI

As strong as the potential is for good, however, AI also carries with it some significant challenges.

A team of scholars working to protect the planet from existential threats ranked AI No. 1 out of **ten biggest threats facing humanity**. Ethical challenges were actively debated in an **ACM panel discussion** on ethics in AI with luminaries Joanna Bryson, Francesca Rossi, Stuart Russell, Michael Wooldridge, Nicholas Mattei, and Rosemary Paradis.

The impact of technology on employment is already a challenge with more than 60% of jobs potentially becoming automated in the near term. China, with its manufacturing base and the need to address higher labour costs, is now the **top producer of AI research**, and has the highest investment. Microsoft co-founder Bill Gates **suggests** taxing robots that take jobs.

Liability issues also loom large, with the **European Parliament**, for instance, calling for new liability rules. "EU-wide rules are needed for the fast-evolving field of robotics, e.g. to enforce ethical standards or establish liability for accidents involving driverless cars," say MEPs in a resolution voted on 16 February. MEPs request that the European Commission propose rules on robotics and artificial intelligence, in order to fully exploit their economic potential, and to guarantee a standard level of safety and security. Areas of focus included liability rules, the impact of robots on the workforce, a code of ethical conduct and a new European agency for robotics.

Bias inherent in some current iterations of AI can also prove problematic. The Association for Computing Machinery (ACM), the top global computing science organization has recently issued **seven principles** to foster algorithmic transparency and accountability to avoid bias created by AI. "A few examples of potential algorithmic bias that have been featured in government reports and news articles include: (1) Job hunting web sites: Do these sites send more listings of high paying jobs to men than to women? (2) Credit reporting bureaus: Does the data set that algorithms weigh in determining credit scores contain prejudicial information? (3) Social media sites: What factors go into determining the news items that are served up to users? (4) The criminal justice system: Are computer generated reports that influence sentencing and parole decisions biased against African Americans?"

As with any new revolution, there are growing pains, or challenges. The good news is that they are being openly discussed and addressed, including work on **standards**. AI developments are unstoppable and the benefits will be mined.

By 2018...

In business and home

62%
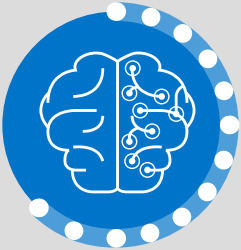
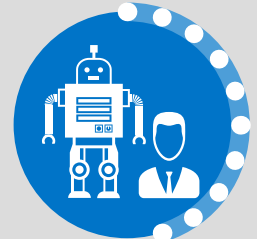**62%** of organizations will be using artificial intelligence (AI) technologies

20%

20% of business content will be authored by machines

6 billion

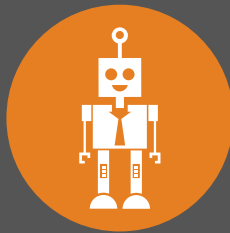**6 billion** connected things will be requesting support

45%

45% of the fastest-growing companies will have fewer employees than instances of smart machines

In the workplace

3 million

More than **3 million** workers globally will be supervised by a "robo-boss"

2 million

2 million employees will be required to wear health and fitness tracking devices as a condition of employment

50%

Global demand for data scientists will exceed supply by more than **50%**

In health

50%

Physicians will use cognitive solutions to identify the most effective treatment for **50%** of complex cancer patients, resulting in a 10% reduction in mortality and 10% in cost

50%
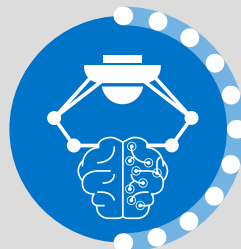
Surgeons will use computer-assisted or robotic surgery techniques to assist in planning, simulating, and performing **50%** of the most complex surgeries

30%
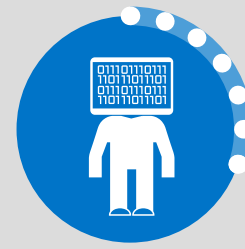
30% of worldwide healthcare systems will employ real-time cognitive analysis to provide personalized care leveraging patient's clinical data, directly supported by RWE data

The next frontier is here: 3 key AI capabilities

Neil Sahota

Business Development Leader, **IBM Watson**

We live in a time of great transformation. Over the last thirty years, technology has fueled a host of changes in how we live, work, and enable the public good. Now, we're on the cusp of a major change that could revolutionize almost every sector, industry, and government service. This change is Artificial Intelligence (AI) — and there are three key capabilities that separate AI from many of the past technical or scientific breakthroughs in terms of the value it can create.

The machine-learning capability

When people usually think of AI, it's in the context of machine learning and the ability to process large amounts of data to connect the dots across thousands of variables. Even the smartest humans have only such ability to consume large amounts of information and to process a handful of variables. This is where machine learning comes into play. Machines have the capability to process, track, and draw insight from millions of data points very quickly. That's why healthcare researchers can leverage AI to develop new target proteins in the fight against cancer in just a matter of weeks rather than months.

> ❝ *IBM is using Watson to solve some of Africa's challenges in agriculture, health care, education, energy, and water through an initiative called Project Lucy.* ❞
>
> Neil Sahota

Likewise, lawyers are using AI tools to reduce the amount of time to conduct legal research and increase the time they have for analysis and case development. However, the machine learning component is just one of three key capabilities that enable AI solutions to bring value.

The natural language processing capability

The second key capability is natural language processing. When people talk, a lot of information is communicated contextually and non-verbally. Moreover, think about all the slang, idiom, and jargon we use in our normal, everyday conversations. If someone were to say, "I'm feeling blue because it's raining cats and dogs," most people would understand the intent. Now, consider if a machine heard this, what would it decipher? The person is the colour blue because dogs and cats are falling from the sky? Most machine solutions think this way because they leverage keywords to draw meaning. However, AI solutions like IBM Watson draw context from the statement by looking at the grammar, word choice, tone of voice, and place within the conversation. Thus, Watson would understand that the person feels sad because it's raining so heavily.

The interactive capability

The third key capability is the interactive capability of AI solutions. We're shifting away from having to define precise requirements and scenarios to enabling conversations as the drivers between human-computer interactions. This is a major change. Consider a person who wants to buy a bicycle.

> **" Sesame Street is leveraging Watson to help advance preschool education worldwide by creating a personalized, adaptive learning environment for young children. "**
>
> Neil Sahota

How would they figure it out today? They could do an Internet search, visit forums, talk to current bicycle owners, etc. to gather information and make a decision. With AI, this is a conversation. Imagine an AI solution that's an expert in bicycles and knows the person both emotionally and psychologically. This person can go to the AI solution and ask, "Which bicycle should I buy?" The AI solution would engage the person by asking questions like: Why do you want a bike? How much do you want to spend? Where do you plan on riding it? Based on this dialogue, the AI solution can make a personalized recommendation for this person in a matter of minutes.

Solving the world's big challenges with IBM Watson

With these three key capabilities weaved together, businesses, scientists, researchers, and governments are using AI to outthink their biggest challenges.

For example, IBM is using Watson to solve some of Africa's challenges in agriculture, health care, education, energy, and water through an initiative called Project Lucy (see infographic). Consider health care, where there is only one doctor for about every two thousand people. As a result, IBM is creating a Watson-powered solution allowing people with minimal healthcare knowledge to help diagnose and treat medical conditions. These people can talk with Watson, share information through text, audio, or images, and get immediate help from its subject matter expertise.

Similarly, **Sesame Street is leveraging Watson** to help advance preschool education worldwide by creating a personalized, adaptive learning environment for young children. Likewise, film studios are using Watson's capabilities to develop movie trailers. By having Watson watch the movie, it can draw out the emotional context of each scene and determine the optimal selection and ordering of movie snippets that will entice people to go see the movie. Additionally, athletes such as Serena Williams are using Watson for training. This includes game preparation as well as conditioning based on the athlete's playing style and medical history. Even human-resource professionals are leveraging Watson. In recruiting, Watson's ability to generate psychographic profiles can help determine if a job candidate will fit in with the team and the corporate culture.

These are just a few examples in the wide spectrum of AI products and services already available. To be cliché, the future is already here. More importantly, it's already starting to support the public good through initiatives like Project Lucy. As people start diving into AI, I encourage them to think about the major problems they see and ask themselves if AI can help.

Watson: Helping to solve Africa's grand challenges

Over the next decade, African nations will make up seven out of the world's ten fastest growing economies. "Project Lucy" is an initiative to bring IBM® Watson® and cognitive technologies to scientists and partners on the African continent, to extend their expertise and help develop commercially viable solutions to address some of Africa's biggest challenges and make its rapid economic growth more inclusive.

With **60% of the world's uncultivated arable land** Africa has an immense opportunity for expanded food production.

USD 50 billion was invested in Africa's infrastructure build out in 2012.

In Africa, there is **one doctor for every 2,000 people.**

Nearly one-third of Kenya's GDP is transferred through mobile payment systems.

50% of African children will reach their adult years unable to read, write or perform basic numeracy tasks.

345 million people (more than the entire population of the United States) **do not have access to safe water** in Africa.

Watson technologies will be deployed from the new IBM Africa Research laboratory, providing researchers with a powerful set of resources to help develop commercially viable solutions in key areas such as healthcare, education, water and sanitation, human mobility, and agriculture. IBM partners will be able to tap into cloud-delivered cognitive intelligence, invaluable for solving the continent's most pressing challenges and creating new business opportunities for entrepreneurs and startups.

IBM

Merging biology and AI: the future of health care

Niven R. Narain

Co-Founder, President and CEO, **BERG**

We are facing a crossroads in health care. With an aging population and globalization facilitating the spread of disease, significant challenges have emerged. However, technologies such as artificial intelligence (AI) and biological models are providing more answers.

By combining the complex elements of human biology with the computational power of AI, we can pave a path to the future of medicine. We can build a healthier world with quicker, lower-cost drug discovery and development that leads to more effective treatment. AI can also help us prevent pandemic outbreaks.

A 'back-to-biology' approach

In order to build the foundation for a new paradigm of treatment, we must use both the robustness of biological models and the cutting-edge innovation of emerging AI technologies. Medicine must take a 'back to biology' approach to address the current medical landscape, particularly in drug discovery.

> **❝ *Merging biology and AI can offer a new approach to drug discovery and development that can reduce costs and development time.* 🔇**
>
> Niven R. Narain

Key Facts
2016

The current process of drug discovery needs to be more efficient, and the drug discovery industry overall is an industry long overdue for disruption. Under the traditional pharma process, it takes around **$2+ billion and 10–15 years** to develop a drug. We need a more sustainable solution to drug development that involves higher success rates.

Merging biology and AI can offer a new approach to drug discovery and development that can reduce costs and development time. Biological insight delivers precision, but AI provides speed and eliminates uncertainty by analysing trillions of data points per tissue sample in a matter of days; something impossible for humans alone.

By comparing massive amounts of data, including individual patient health data to the greater population health data, we can develop prescriptive analytics that can determine what treatments will work best for each patient, and deliver on the promise of precision medicine. Applied in clinical development, this can lead to improved drug trials and increased success rates. Additionally, using analytics can also reduce development costs and bring new-in-class therapeutics to the patients in a time-efficient manner.

Average time to develop a drug = **10 to 15 years**

Percentage of drugs entering clinical trials resulting in an approved medicine = less than **12%**

Average cost to develop a drug (including the cost of failures)*:

- 2000s–early 2010s = **$2.6 billion**
- 1990s–early 2000s = **$1.0 billion**
- 1980s = **$413 million**
- 1970s = **$179 million**

* **https://www.ncbi.nlm.nih.gov/pubmed/26928437**

Source: **Key facts 2016** (Pharmaceutical Research and Manufacturers of America.)

Preventing pandemic outbreaks with AI

In addition to AI proving new treatments for today's most insidious diseases, AI can predict, model, and slow the spread of disease in a pandemic outbreak. Throughout history, pandemic outbreaks have devastated populations from the bubonic plague to the 1918 Spanish flu, and more recently, Bird flu, Ebola and SARS.

These modern outbreaks, spurred on by globalization, trade and travel, have led to the increased spread of viruses more than at any point in history. Treating outbreaks at this scale and speed is difficult given the unpredictable nature of viruses, which include natural mutations and resistance to existing medicines.

When a pandemic outbreak occurs, time is of the essence – and this is where AI has the potential to give us the tools we need to prevent the next global event. AI approaches, such as Bayesian analytics, have been used in health care, finance, and commerce, streamlining decision-making for the optimal endpoint.

The first line of defense that AI tools will give us is the ability to predict and model potential outbreaks. By monitoring patient populations and medical data, AI can recognize patterns of pharmaceutical intervention to treat historical symptoms. These patterns could point to at-risk locations and also help identify the migration of a pending outbreak. This would allow agencies, such as the Centers for Disease Control and Prevention (**CDC**) to investigate and monitor those areas historically and in real-time to model the cause and effect relationships that could mitigate the progression of a pandemic, as well as its natural path within the population.

The second line of defense will be to utilize AI in the same way it's used now by global trade companies to manage their shipping routes. The same approach that helps you get an amazon package from China efficiently can be used to forecast an outbreak.

> **"*AI can predict, model, and slow the spread of disease in a pandemic outbreak. "***
>
> Niven R. Narain

AI can build causative relationships between travel data and population medical reports to help map out and predict the spread of a disease. Using this data, AI could prescribe ways to alter travel routes to help contain or slow the spread of a disease. At the same time, AI can help government agencies like the Defense Advanced Research Projects Agency's (**DARPA**) Pandemic Prevention Platform (**P3**) to plan more rapid and efficient responses. With limited resources and time, these agencies need to be primed to deploy the right supplies and personnel to the optimal locations at precisely the right time.

The use of AI to rapidly learn from large datasets has a wide range of applications from drug development to fighting future pandemics. Like any technology or tool, once we understand its potential and multitude of applications, it can be used in great effect to benefit our world and save lives.

How advanced crop intelligence can help solve food production challenges

Josef Akhtman

CEO and founder, **Gamaya**

Gamaya

Farmers spend nearly half of their operational budgets on agrochemicals such as herbicides and pesticides. Unfortunately, they usually apply these to entire fields at a time, which generates high chemical costs and decreases the efficacy of the chemicals.

Such widespread application of chemicals harms the environment, endangers human health, and increases the likelihood of chemical-resistance in weeds, pests, and diseases. And, even with that damaging widespread application, loss to weeds, pests and diseases can range from 20-50%. But manually scouting and sampling to determine the locations of these problems is time-consuming and costly, and cannot easily account for the enormous variety of factors that affect crops.

Farmers face these challenges within the context of decreasing commodity prices, which applies pressure on them to optimize costs and production efficiency. But what if farmers could automatically identify problem areas within their fields and precisely apply just the right amount of agrochemicals exactly where they are needed?

> **" Farmers spend nearly half of their operational budgets on agrochemicals such as herbicides and pesticides. "**
>
> Josef Akhtman

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Farmer spraying soybean field with pesticides and herbicides

The solution: Gamaya's advanced crop intelligence

At Gamaya, we are helping farmers do just that — be more targeted and automated in combating threats to their crops. By being more effective in how they target crops, growers experience the economic benefits of reduced costs for crop protection, reduced crop threats, and therefore increased yields.

Take, for example, weeds in the fields. The problem with weeds is that they compete with the crop for nutrients, water, and growing space, and therefore reduce the yield. Gamaya's precision agriculture services equip growers with information about the location, type, and intensity of the weeds infesting their fields. This enables them to determine a precise location-specific prescription for anti-weed measures, and seamlessly send that information to precision agricultural technology, such as variable rate sprayers.

Partnering with local drone operators

Gamaya partners with local drone operators to fly the Gamaya hyperspectral camera over fields. The initial processing of the imagery is done in situ, so most of the data never leaves the farm. The metadata is sent to Gamaya headquarters in Switzerland where data scientists analyse it. The resulting analytics map — the weeds map — is sent to the farmer for viewing, in either Gamaya's ORB web platform, or the farmer's existing farm management platform. The farmer can then analyse the fields for weeds, and create herbicide prescription maps that he can send directly to his spraying equipment.

Gamaya's crop intelligence speeds up and reduces the cost of the often manual process of visually scouting for weeds. Thus, Gamaya enables farmers to precisely apply anti-weed measures with herbicides, rather than spraying the entire field. Targeted spraying reduces chemical usage, thereby significantly reducing the farmer's costs, lowering the negative impacts to the environment, and on human health, and likely slows the spread of herbicide-resistance.

Hyperspectral imaging technology

As a data analytics company, Gamaya uses artificial intelligence (AI) and machine learning to translate hyperspectral imagery data captured by our unique patented hyperspectral camera into issue maps. By pairing AI and machine-learning algorithms with the database, we are building crop-location-issue triads. We gain speed and accuracy as we acquire more data, and thus are better able to help farmers protect their crops. Speed and accuracy are important to farmers who need to respond quickly to various crop issues. By focusing on the analytics, we are creating a business infrastructure that we can scale and more easily adapt over time.

Our AI/machine-learning algorithms ingest data that are captured by our unique hyperspectral camera as it soars over fields. Our unique patented hyperspectral cameras capture 10 times more information than multispectral cameras.

The Gamaya hyperspectral camera is the smallest, most lightweight hyperspectral camera that to our knowledge is currently available — so tiny it can be flown via drones. Not only is the camera itself small, but it compresses data 100 times more efficiently than other hyperspectral cameras, making our data processing quicker, less complex, and less expensive than with other hyperspectral sensors.

Reducing chemical spraying — at scale

The crop intelligence that Gamaya provides equips farmers to more adeptly manage their fields. By providing issue maps showing where, what kind, and how intense an infestation is,

> **" What if farmers could automatically identify problem areas within their fields and precisely apply just the right amount of agrochemicals exactly where they are needed? "**
>
> Josef Akhtman

Gamaya helps farmers to reduce their costs, limit their disease and weed-related losses, and decrease their environmental impacts. These impacts are magnified by the scale at which Gamaya is working. Starting with very large industrial growers in regions with multiple growing seasons, who use the most chemicals, and use them multiple times a year, Gamaya is helping to make a significant reduction in the use of agrochemicals globally.

Gamaya is working with stakeholders throughout the agricultural and food production value chain, including individual farmers, agronomy consultants, suppliers of agricultural inputs like agrochemicals and farm machinery, as well as with companies that source or trade plant materials to make into consumer food and products. Through such wide-reaching partnerships, Gamaya is bringing into reality our vision of feeding the ever increasing global population, an increasing global challenge, with ever more efficient and effective agriculture.

▸

Q&A

Unlocking health-promoting benefits with AI

ITU News interviewed Dr Nora Khaldi, Founder and Chief Scientific Officer, Nuritas™ and Emmet Browne, Chief Executive Officer, Nuritas™

Dr Khaldi, can you tell us about what Nuritas™ does and how it uses AI for good?

NK – Nuritas™ is the first company in the world to use artificial intelligence and proteomics to find and unlock particular molecules in food, called peptides that have extraordinary health benefits.

To break this down a bit further, every food has trillions of molecules. We are interested in a subset of molecules called bioactive peptides, which are embedded in food protein structures.

These peptides can modulate and prevent many diseases by binding to specific receptors or proteins in the human body. These peptides have remained dormant in food for over hundreds of millions of years, and it is only now, through our technology, that we can access them and will be making them available in a cost-effective way to consumers around the world.

In a nutshell, we live in an aging world that is growing in numbers and disease types. Through our technology, we aim to help people live healthier for longer through these natural food bioactive peptides.

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> " *Nuritas™ is the first company in the world to use artificial intelligence and proteomics to find and unlock particular molecules in food.* "
>
> Dr Nora Khaldi

We are the first company in the world to use a revolutionary combination of artificial intelligence and proteomics to find and unlock nature's secrets. These disease-beating molecules are natural (sourced from food), do not have damaging side effects (due to their natural source) and are also scientifically proven. Very importantly as well, they come from food and food by-products and thus are sustainable.

Our technology is thus making it possible for billions of people to include, in an affordable, practical and sustainable way, these disease-fighting ingredients in their everyday lives.

What inspired you to delve into research on food ingredients and what benefits does it bring to humanity?

NK – It is estimated that 97% of global healthcare expenditure is focused on the treatment of disease while only 3% is spent on prevention. With estimates that soon 1 in 3 people will be facing a disease, this system is simply unsustainable, illogical and is ultimately causing more harm than good.

This is why I created Nuritas™. As I began my career in mathematics, moving on to a PhD in Molecular Evolution and Bioinformatics, followed by post-doctoral work in the food area, I began to realize that the key to reducing and preventing disease, as well as completely reshaping how we look at health, begins and ends with food.

Indeed, what I found within my particular research was that there are trillions of molecules in food with many different and sometimes life-changing effects, that we just have not had the resources to unlock and find what lies within. That is, until now.

Which of your discoveries to date provide the most optimism in terms of their wider applications and potential?

NK – I couldn't choose just one, all of our ingredients are tackling widespread health issues. We have found peptides that tackle pre-diabetes, MRSA, and inflammation (which is at the base of many diseases), just to name a few.

EB – I'm the same. I couldn't choose one, however, we recently received very significant EU Horizon 2020 backing to accelerate the late-stage research and commercialization of our prediabetes ingredient. This is a functional food type product with enormous global preventative potential to help, for example, the one in three Americans who suffer from prediabetes moving on into full-blown diabetes. A way to go still on this one, but it is a clear example of why we, and many others, are so excited about what we have the ability to deliver here at Nuritas™.

> **" *We recently received very significant EU Horizon 2020 backing to accelerate the late-stage research and commercialization of our prediabetes ingredient. "*

Emmet Browne

Will products by Nuritas™ soon be on the market?

NK – Yes, our first products should be on the market in early 2018, which we are very excited about.

EB – We've been able to achieve this very quickly, not only due to our discovery platform, but we also have multiple revenue streams available to us – from finding our own ingredients and licensing them to collaborating with multinationals to find targeted ingredients based on their specific strategic needs. In all cases, our deals have varied with a number of components and timeframes delivering revenue. An ideal example of this is the deal that was announced with BASF in January 2017, which focused on an existing peptide ingredient of ours in addition to collaborating on an on-demand search and find basis for a number of game-changing new ingredients.

What have been your biggest challenges so far?

NK – As we are a company doing something for the first time, there have been and will be numerous challenges. I think finding individuals and companies that understand the breadth of our vision can be difficult sometimes. When I first started, I had many people tell me that what we are doing now could not be done. I'm glad I trusted my gut and just kept going.

EB – To me, the most challenging aspect is finding the right people to help us achieve our full potential. From a personal perspective, it can also be difficult as we grow exponentially to lift above the minute-to-minute to take the big-picture, strategic viewpoint. We are getting better and disciplined at doing this and I am convinced this is what will allow us to grow even faster.

What are your aims for the future?

NK – We aim to help the globe deal with a myriad of growing health issues. Indeed, a growing population that is aging brings a huge responsibility to us all to help. We at Nuritas™ use AI to play our part in improving the lives of billions of people around the world.

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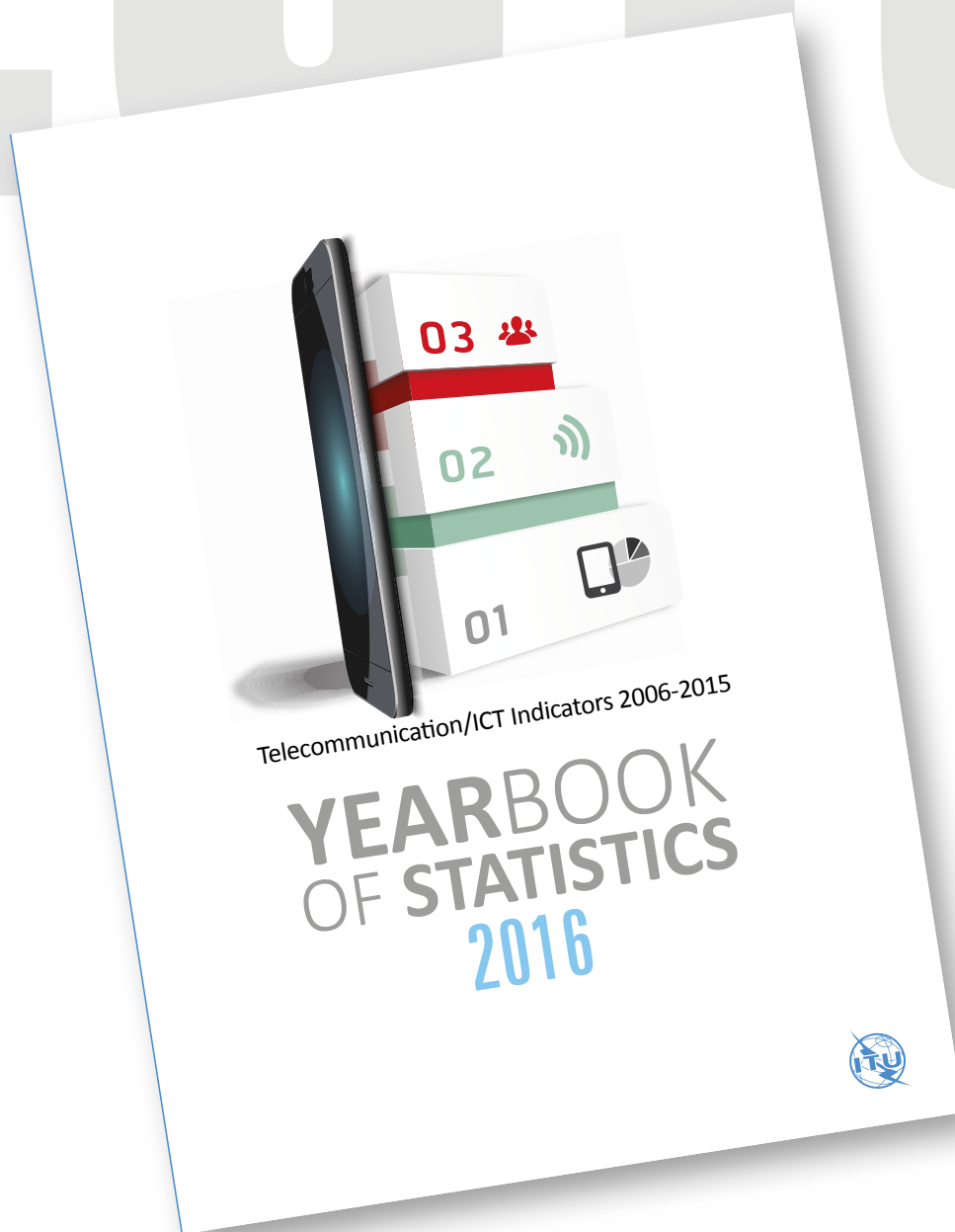
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AI and ethics – where to draw the line?

Mike Hinchey

President, International Federation
for Information Processing (**IFIP**)

After a 75-year incubation, Artificial Intelligence (AI) has become a household word, reflected in popular culture through books, movies and even music.

From self-driving vehicles and interactive robots to Apple's Siri concierge and IBM's Watson, which is increasingly being used to solve business problems, AI technology is playing a growing role in our day-to-day world.

While true AI systems are still far less common than most people think — often what we call "AI" is simply pre-programmed rules that the software reinforces in different contexts — impressive advances are continually being made in autonomous, adaptive and AI systems that will see them having a greater impact over time.

Ensuring trustworthy AI systems

As President of IFIP, the global federation of information and communication technology (ICT) professional societies, I'm conscious that the work our members and others engage in to program these systems is critical to their performance and their trustworthiness.

IFIP

> **" To ensure that the impacts of AI systems remain positive and constructive, it is essential that we build in certain standards and safeguards. "**
>
> Mike Hinchey

To ensure that the impacts of AI systems remain positive and constructive, it is essential that we build in certain standards and safeguards.

Take the example of autonomous cars, which rely both on their self-driving functions as well as the ability to access and interpret information from their surroundings to safely navigate their environment.

While automation functions enable the car to start, accelerate, make turns and brake, the way the system interprets additional information from its environment (other vehicles, speed limits, terrain etc.) creates the impetus for decisions about when and how to make those actions.

Currently, most autonomous vehicles respond to different situations in a predetermined way. For example, if the car in front brakes, they also will slow. And if the car behind accelerates at

the same time as the car in front brakes, they will attempt to change lanes as their sensors provide input about the other vehicles' behaviour. But what happens if changing lanes means hitting another car, a wall or worse still, a pedestrian?

In circumstances such as these, a human driver might take any one of a number of options, (aggression, caution, freezing or evasion) many of which could result in an accident.

The reality is that self-driving cars won't really be practical until all vehicles are self-driving and the unpredictable human factor has been removed from the equation. But then, given that the true test of an AI application is its ability to learn and make unprogrammed decisions, one wonders how unpredictable AI might be in such a context.

Building in safeguards

Most of my work in autonomous and adaptive systems has related to space exploration through my involvement with NASA and other space agencies. Here, where there are so many unknowns, there is a limit to the number of situations we can predict and, thus, for which we can program.

The solution in this and other cases involving artificially intelligent systems is to define the range of actions or decisions they can make and where they must defer to human judgement.

If we want a system to be truly adaptive, we must give it a range of actions it can take without specifying exactly what it must do while also prohibiting certain actions. For example, in our self-driving car example, a vehicle with a prime directive to save human life might shut down to avoid causing an accident. While this might be an appropriate action if the car were driving on a back street, it could be catastrophic if the vehicle were driving on a busy highway.

It's also important for AIs and other autonomous systems to incorporate appropriate security and privacy measures to ensure they operate ethically and within the law, as well as protecting them from external hacks or other intrusions.

As more and more decisions are made without human involvement, it's important that we specify a range of behavioural rules that society will accept from AIs and those that we won't.

> **" In order for humans to accept and trust AI systems and their actions, we need to build some predictability, or at least boundaries into their behaviour, beyond which they cannot go. "**
>
> Mike Hinchey

In order for humans to accept and trust AI systems and their actions, we need to build some predictability, or at least boundaries into their behaviour, beyond which they cannot go.

Asimov's Prime Directive might be the stuff of stories, but it provides a sense of certainty that will be a prerequisite for most people to be willing to incorporate AI systems into their daily lives, particularly when it relates to safety-critical functions.

▶

Quantum computing: New threats require new security approaches

Frederic Werner

Senior Communication Officer, **ITU**

Artificial Intelligence (AI) is becoming smarter, faster, and more human-like thanks to the inevitable rise of quantum computing.

"While today's computers can find patterns buried in vast amounts of existing data, quantum computers will deliver solutions where data may be incomplete or patterns cannot be seen because the number of exploration paths to get to the answer are too enormous ever to be processed by classical computers. Thus, quantum computers may be used to solve complex problems in medicine, discovering new materials, or optimizing logistics problems whilst minimizing our carbon footprint," says Neil Sahota, Business Development Leader for IBM Watson.

However, quantum computing will pose new risks. Using the properties of subatomic particles to process and store information, quantum computers will be able to quickly break current methods of encryption by specifically cracking the key generation algorithms. That means any data that is currently stored is already vulnerable to future quantum hackers.

> **❝ AI is becoming smarter, faster, and more human-like thanks to the inevitable rise of quantum computing. ❞**
>
> Frederic Werner

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❝ *Telecoms providers are not the only ones worried about data security in a post-quantum world.* **❞**

Frederic Werner

IBM has a new **cloud-based quantum computer** that anyone can sign up to use. There is now a consensus among some of the biggest players in technology, including Google, Amazon and Microsoft, that quantum computers will be a commercial reality by 2026.

Although the mainstream use of this type of computing power is still many years away, telecoms operators are already implementing new quantum encryption algorithms to safeguard against the future.

Everything from credit card numbers, bank accounts, health files, tax records, corporate data and top-secret messages are all vulnerable to future hackers using quantum computers. Future networked cars and other devices that are connected to the Internet of Things and receive over-the-air software updates will also be vulnerable to quantum hackers.

In a process called "harvest and decrypt," certain organizations are collecting vast amounts of encrypted information today and stashing it in data centers, waiting for the day when quantum computers can break it all open.

'Harvest and decrypt'

How quickly will quantum computing become available? Google and NASA already have working prototypes with the **D-Wave 2000** and

"You can use the old, secret information to predict future plans and the thinking is: capture now, decrypt later," said Jaya Baloo, KPN's Chief Information Security officer as she presented a keynote on the risks of quantum computing at the **ITU Global Standards Symposium**.

(Challenges and Risks)

"As an industry we've only got five years to get a solution in place, get technology that is tested and accepted and start upgrading all of our critical infrastructure so it will be quantum safe," said Baloo.

Quantum security solutions

So what can be done against this distant but real threat? The most common quantum-based encryption utilizes a technology called quantum key distribution, which can be implemented on existing fiber-optic connections. Companies with global infrastructure will need four to five years to plan for and deploy quantum-resistant software that protects their data. This is something that KPN's Jaya Baloo has already been preparing for. KPN has just implemented a quantum-encrypted connection between its datacenters in Rotterdam and The Hague. KPN will also work on implementing longer encryption keys and post-quantum encryption methods.

Other telecoms providers and equipment vendors have launched similar pilots. The Republic of Korea's SK Telecom announced that it is running five quantum-enabled encryption tests across the country. Huawei recently launched a quantum technology research group that focuses on quantum key distribution and plans on including this technology as an optional add-on to its standard telecommunication products. Huawei is also working on a field demonstration with BT of a prototype of its quantum key distribution system, to take place in the fall of 2017. Subsequent demonstrations with Telefonica and Deutsche Telecom are also being considered.

> **"** *In terms of a regulatory perspective, we must act now if we want to examine how to get a more secure IoT future. Things like quantum computing and quantum cryptography … are going to require standardization.* **"**

Click to see video

Jaya Baloo
CIS Officer, KPN

Telecoms providers are not the only ones worried about data security in a post-quantum world. The US National Institute of Standards and Technology issued a **report** that called on institutions to implement 'quantum-resistant' encryption algorithms to protect their data as research around quantum computing accelerates. The European Commission announced it will release **€1bn to support quantum technology research** across the European Union called 'Flagship'. Last year, the National Security Agency (NSA) in the United States said it would **transition its computers to quantum-resistant algorithms** "in the not too distant future."

The future of quantum computing presents a catch-22. Quantum computing is likely to power future AI systems and holds enormous promise, but it could also be very dangerous in the wrong hands. While not everyone is ready to embark on a quantum cryptography journey, there are some steps that one can take to prepare for the future.

Preparing for an AI-driven society

Amir Banifatemi

AI Lead, **XPRIZE Foundation**
and venture capitalist

L ike major transformations before it, Artificial Intelligence (AI) promises to transform our lives and to lead us to a better world, while creating even greater impact for business and society.

Already, machines and programs that can sense, learn, reason, and act, are tackling large-scale global challenges in a variety of fields, including science, medicine, education, finance. They are augmenting human capability, and helping us to go exponentially farther and faster in the understanding of our world.

Fueled by improved algorithms, access to growing and massive data sets, ubiquitous network access, near infinite storage capacity and exponential computing power, AI is at the heart of much of today's technical innovation. AI is a new factor of production, driving growth by providing intelligent automation and potential labor augmentation: Unlike traditional automation solutions, AI can help automate complex physical and reasoning tasks that require adaptability and self-learning; enabling workers to transition to more creative and innovative responsibilities.

> ❝ *ITU and the XPRIZE Foundation are joining forces to bring the AI conversation to a global level.* ❞
>
> Amir Banifatemi

XPRIZE

Preparing for an AI-enabled future

Yet, while there is tremendous interest and momentum globally around AI to fuel economic growth and social progress, there is growing concern about the significant shift of reasoning and decision-making that may soon move from people to machines.

To clear the path for an AI-enabled future, we need to reinforce the role that humans will play. We need to advocate a code of ethics for AI, and ensure dialogue, practical standards and best practices in its development and use.

We need to encourage smart regulations and oversight of AI, and make sure that the pace of technological change is accompanied by an equally fast regulatory response. We need policies that highlight and encourage the tangible benefits of AI, and the positive impact for every individual.

Finally, for AI to hold its promise, it needs to be accessible to everyone equally. Therefore, we need to make sure that the innovative tools, the data, and the technology, are available to everyone, in a democratic way.

Initiatives advancing AI to benefit humanity

That is why new initiatives including both the private and public sectors have recently been created to advance AI to benefit humanity as a whole. For example, the **Open AI**, the **Partnership on AI**, and the **AI XPRIZE Challenge**, are all focusing on a positive human impact of AI by advocating that AI be an extension of individual human capabilities, broadly accessible, and distributed as widely as possible.

AI is already accelerating progress on the United Nations' Sustainable Development Goals (SDGs), notably in such areas as health care, democracy, child protection, and education. Yet, there is a need to better harness new capabilities of AI, ensuring public involvement and debate, beyond that of solely specialists. Governments, academic and research institutions, startups and innovators, engineers and scientists, private and public funding institutions, and indeed every one of us, should consider ourselves stakeholders, and understand how AI can impact our world.

ITU and XPRIZE join forces

The XPRIZE Foundation has witnessed the impact that AI projects have had on bringing together multidisciplinary approaches and domain experts, engineers, public authorities, and academics entities in partnerships to solve important challenges, such as: learning (for example, helping children to learn basic reading, writing and arithmetic skills in three months) and agriculture (for example, using IoT sensors, satellite imagery and climate data to help manage crops and productivity).

The recently launched **IBM Watson AI XPRIZE** has gathered 160 teams across 23 countries to tackle the world's greatest challenges by using AI applications to address all 17 SDGs.

And now, ITU and the XPRIZE Foundation are joining forces to bring the conversation to a global level.

The upcoming **AI for Good Summit** (7 to 9 June in Geneva, Switzerland), is the first global multi-stakeholder gathering to create a platform for AI collaboration, both internationally, and across disciplines. The Summit participants will discuss how AI can be a force of positive change; promoting democracy, eradicating poverty, enabling and fueling innovation equally for all, and adopting guiding principles that will help set a basis for a human and machine future.

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IMAGINE IF AI COULD SAVE LIVES.

When disaster strikes, AI and robots could save lives. From the use of drones to find survivors after a hurricane or buried in the rubble of an earthquake, to first-responder robots that can quickly enter a nuclear power plant after a meltdown, the solutions provided by this technology could potentially solve our planet's most pressing global challenges.

IBM Watson™ AI XPRIZE®

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