AI in Agriculture

Food and Agriculture Organization of the United Nations – *for a world without hunger*

What is AI

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What is AI

AI is an “umbrella term” for a branch of computer science focused on creating machines capable of reproducing a cognitive task (understanding or recognizing something, or taking a decision) and learning… trying to emulate how human minds understand the world and take decisions.

https://su.org/resources/exponential-guides/the-exponential-guide-to-artificial-intelligence/

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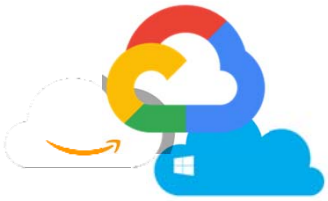
Why it has become so relevant



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Where we are today

Today is already everywhere: Is helping you with your search in web, understanding voice commands, tuning your images, suggesting the next word as you type, spam filters, smart ads; but also is exceling at some tasks that were only humans could do before…

It excels at:

- Solving complex problems
- Visual interpretation (Computer vision)
- Finding patterns on huge amounts of data
- Replicating style and imitation

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Solving complex problems

In October 2015, the original AlphaGo became the first computer Go program to beat a human professional Go player without handicaps on a full-sized 19 × 19 board.[4][5]

In March 2016, it beat Lee Sedol in a five-game match, the first time a computer Go program has beaten a 9-dan professional without handicaps.[6]

https://en.wikipedia.org/wiki/AlphaGo

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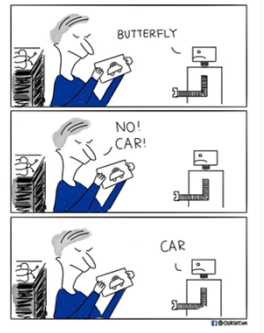
Training the AI

There are two types of learning processes:

- Supervised
- Unsupervised

But both rely on the usage of data (lots of), finding patterns and tuning a model to get the expected results.

… and a human…



AI today

Finding interesting patterns…

We show that socioeconomic attributes such as income, race, education, and voting patterns can be inferred from cars detected in Google Street View images using deep learning. Our model works by discovering associations between cars and people. For example, **if the number of sedans in a city is higher than the number of pickup trucks, that city is likely to vote for a Democrat in the next presidential election** (88% chance); if not, then the city is likely to vote for a Republican (82% chance).

Demography with deep learning and street view

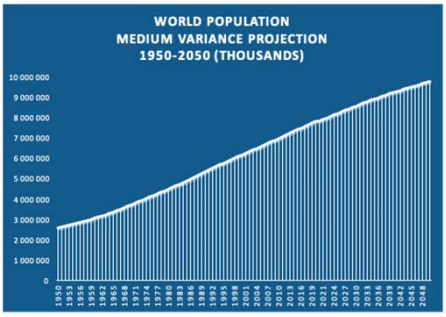
Timnit Gebru, Jonathan Krause, Yilun Wang, Duyun Chen, Jia Deng, Erez Lieberman Aiden, Li Fei-Fei. Proceedings of the National Academy of Sciences Dec 2017, 114 (50) 13108-13113; DOI: 10.1073/pnas.1700035114

Generating stories…

SYSTEM PROMPT (HUMAN-WRITTEN)	*In a shocking finding, scientist discovered a herd of unicorns living in a remote, previously unexplored valley, in the Andes Mountains. Even more surprising to the researchers was the fact that the unicorns spoke perfect English.*
MODEL COMPLETION (MACHINE-WRITTEN, 10 TRIES)	The scientist named the population, after their distinctive horn, Ovid's Unicorn. These four-horned, silver-white unicorns were previously unknown to science. Now, after almost two centuries, the mystery of what sparked this odd phenomenon is finally solved. Dr. Jorge Pérez, an evolutionary biologist from the University of La Paz, and several companions, were exploring the Andes Mountains when they found a small valley, with no other animals or humans. Pérez noticed that the valley had what appeared to be a natural fountain, surrounded by two peaks of rock and silver snow.

OPEN AI > GPT-2

But why is it relevant?



- By 2050, the total population will reach 9.7 billions: **The world will have produce enough to feed 2 additional billions of people.**
- The number of undernourished people in the world has been on the rise since 2015, and is back to levels seen in 2010–2011

http://www.fao.org/state-of-food-security-nutrition/en/
http://www.un.org/en/development/desa/news/population/2015-report.html
http://www.fao.org/e-agriculture/news/why-iot-big-data-smart-farming-are-future-agriculture

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AI in agriculture

Advisory services

Precision agriculture: Intelligent IoT (AIoT)

Automation/Robotization

... but it doesn't work alone. It needs several technologies converging.

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Advisory services

- **Chatbots and mobile apps** with general information: what, where and when. How the markets will be (projections), or how the weather will be (forecast)
- **Mobile apps** telling you:
  - What to do in case of any event (weather, pests, others)
  - Plant health (for example: Image recognition for pests)
  - Plant readiness
  - Field management: e.g. seed placement, spacing given your conditions (zone, soil type, etc.)
- **Forecast and simulation** tools: When to plant, when to harvest, how much the farmer is going to get in the market based on all the data available.

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Precision agriculture

Sensors which combined can give you more efficiency. Some can take decisions based on the conditions such as watering, air and soil humidity, weather conditions,

John Deere solutions on precision agriculture

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Precision agriculture

It helps to:

- Take data driven/informed decisions instead of basing the investment in experience or experimentation only.
- Ensure efficiency, by using the exact amount of water, fertilizers or pesticides on crops.

"Based on the weather and water evaporation forecast for the next year, you should plant this…"

See FAO Water Productivity Open Data Portal: https://wapor.apps.fao.org

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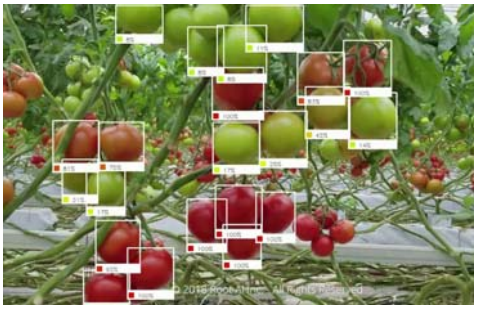
Precision agriculture

Drones analyzing soil composition, crop health and other analysis:

- Soil and field analysis
- Planting optimization
- Crop spraying
- Crop monitoring (development, health, density, irrigation, other issues)



Computer vision for determining the fruit's readiness.

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Automation / Robotization

Abundant Robotics: a vacuum apparatus harvests mature apples from trees based on computer vision

John Deere has developed a high-performance, autonomous, fully electric tractor.

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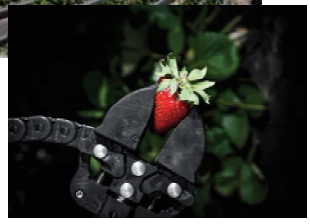
Automation / Robotization



Berry 5 (B5) by Harvest Croo
Automatic berry harvester

"All these prototypes rely on a handful of converging technologies—artificial intelligence, robotics, big data, G.P.S., machine vision, drones, and material science—that have been slowly finding their way onto the farm."

https://www.newyorker.com/magazine/2019/04/15/the-age-of-robot-farmers

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But it comes with huge challenges

Digital divide: How do we make this available to everyone (e.g. AI-aided Family Farming)

How to make better jobs, not less

Data ownership, privacy, tenancy

Bias and ethics (transparency is key)

Misuse of AI (AI created for bad)

Links and references

Why IoT, big data & smart farming are the future of agriculture
http://www.fao.org/e-agriculture/news/why-iot-big-data-smart-farming-are-future-agriculture

Smart Farming is key for the future of agriculture
http://www.fao.org/family-farming/detail/en/c/897026/

Can Artificial Intelligence help improve agricultural productivity?
http://www.fao.org/e-agriculture/news/can-artificial-intelligence-help-improve-agricultural-productivity

Links and references

- https://www.techopedia.com/the-6-most-amazing-ai-advances-in-agriculture/2/33177
- https://www.intel.com/content/www/us/en/big-data/article/agriculture-harvests-big-data.html
- https://www.researchgate.net/publication/328555978_Artificial_Intelligence_in_Agriculture_An_Emerging_Era_of_Research
- https://emerj.com/ai-sector-overviews/ai-agriculture-present-applications-impact/
- https://www.stateof.ai/
- https://www.newyorker.com/magazine/2019/04/15/the-age-of-robot-farmers
- https://harvestcroo.com/

Links and references from FAO

- **2019 International Seminar on Digital Agriculture Transformation**: The challenges to be addressed: http://www.fao.org/about/meetings/digital-agriculture-transformation/en/
- e-Agriculture: http://www.fao.org/e-agriculture/
- 2019 Status Report on Digital Technologies in Agriculture and Rural Areas: http://www.fao.org/3/ca4985en/ca4985en.pdf
- 2019 Briefing Paper on the Status Report on Digital Technologies in Agriculture and Rural Areas: http://www.fao.org/3/ca4887en/ca4887en.pdf
- **FAO Digital Services Portfolio:** http://www.fao.org/about/meetings/digital-agriculture-transformation/resources/fao-digital-services-portfolio/en/
- **Innovation at FAO**: http://www.fao.org/innovation/en/
- 2018 Info Note on Tackling Poverty and Hunger through Digital Innovation: http://www.fao.org/3/ca1040en/CA1040EN.pdf
- 2018 International Symposium on Agricultural Innovation for Family Farmers: http://www.fao.org/about/meetings/agricultural-innovation-family-farmers-symposium/en/
- 2018 Innovation Fair: http://www.fao.org/about/meetings/agricultural-innovation-family-farmers-symposium/innovation-fair/en/
- 2018 Proceedings of the international symposium on agricultural innovation for family farmers: http://www.fao.org/3/ca4781en/ca4781en.pdf
- e-Agriculture in Action: Drones for Agriculture: http://www.fao.org/3/i8494en/I8494EN.pdf

Thank you!

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FAO on AI

There are claims that AI capabilities will someday exceed human capabilities, and in many areas, they already come close to this benchmark. In general, we believe the seven AI principles are an excellent start. They are about a sine qua non condition, but are insufficient to cover all facets of this embryonic field on the fourth industrial revolution.

Therefore, FAO would like to highlight that Artificial Intelligence is an entire domain of knowledge and should not be seen only as a tool or a menace. We believe that more intensive learning and training is needed in this area to understand the technology and its implications. The UN needs to exploit the topic widely in order to build a holistic approach local and globally.

There is no doubt that AI, and other technologies, and its applications will replace jobs, and this is a widely accepted consequence of all technology that has resulted from the industrial revolution. However, this does not need to be seen as an entirely negative consequence, assuming that we can successfully promote other types of jobs. At FAO, we believe that AI policies and programmes of member states need to be oriented to contribute to job and entrepreneurship opportunities creation for Youth in developing countries. This development should induce young people to remain in the rural areas with employment perspective and suitable livelihoods conditions.

The most important role of AI is outside of the seven proposed principles and should be included as fundamental to our approach to AI. This role is the ability to use AI to predict unexpected events, threats and crises. Challenges such as hunger, climate change, and migration could be addressed before they become crises through early detection, prevention and mitigation of natural disasters, social conflicts or economic hazards.

At FAO, we would like to see a better understanding in terms of the technologies (AI and others), as an incomplete understanding can lead to biased assumptions with regards to comprehension and analysis of strategies for consideration and implementation.

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