Emergency Benefits and Risks of Artificial Intelligence

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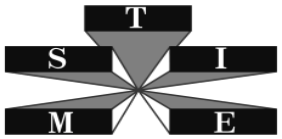
Presentation Outline

- What is Artificial Intelligence (AI)?
- How can AI help Emergency Managers do their jobs?
- How will AI impact emergencies?
- How might Emergency Managers prepare for AI?



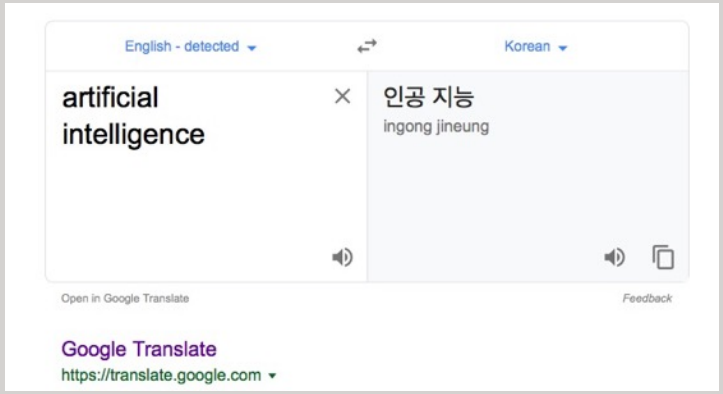
Thinking Teams

What is Artificial Intelligence?

Definitions of Artificial Intelligence: "Thinking" and Doing

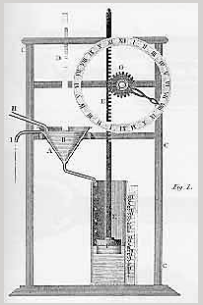
Thinking Teams

- Machines that demonstrate *human-like intelligence*, e.g., learning and problem solving
- Machines that act as *goal-oriented "agents"* to achieve the best expected outcome

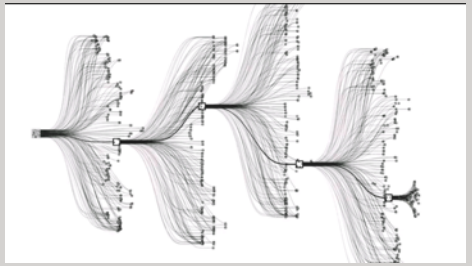


AI has a Long History

Thinking Teams



250 B.C. – Self-Regulating water clock



2017 – AlphaGo Zero learns super-human performance

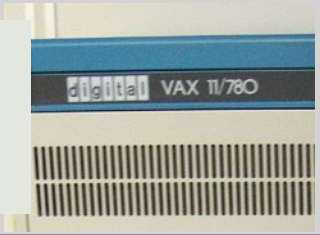
1951 – Maze-solving robot

2011 – "Watson" wins Jeopardy

1955 – Checkers program beats creator

2005 – "Stanley" wins DARPA Grand Challenge

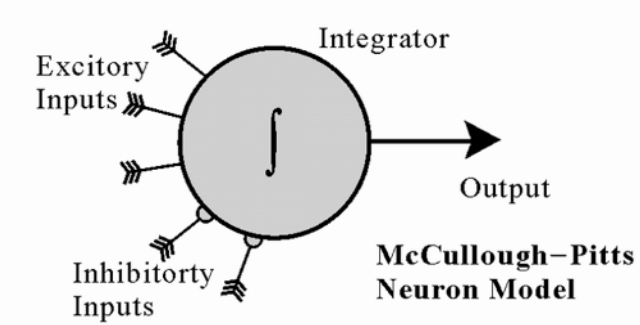
1982 – R1 Expert Systems saves $25M/yr

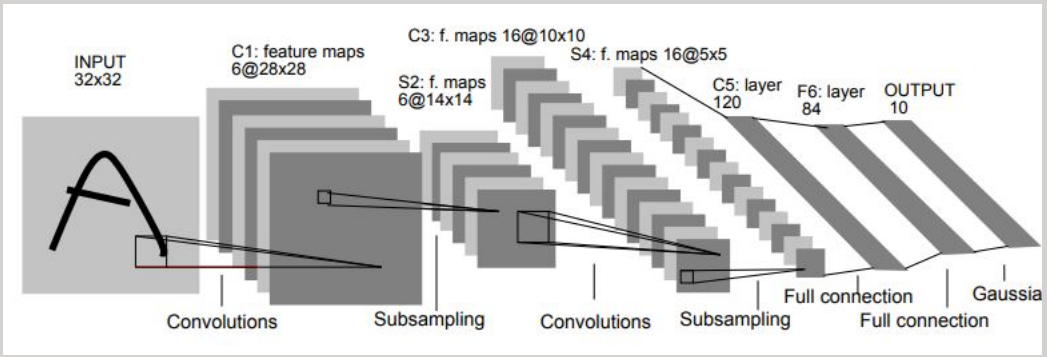


1997 – Deep Blue beats Garry Kasparov

AI is Founded on Diverse Technical Approaches

1943 McCulloch and Pitts- Mathematical Neuron Model





1998 Yann LeCun et al. - LeNet-5

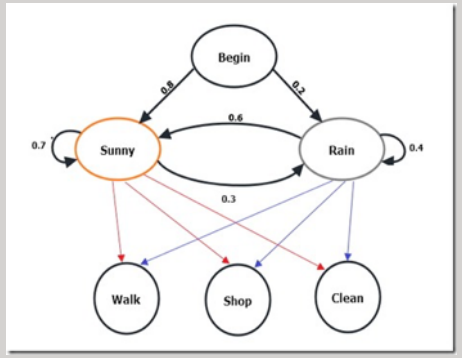
1956 Newell and Simon– Logical Theorist

$\neg(p \vee q) \rightarrow \neg p$

1. $A \rightarrow (A \vee B)$
2. $p \rightarrow (p \vee q)$
3. $(A \rightarrow B) \rightarrow (\neg B \rightarrow \neg A)$
4. $(p \rightarrow (p \vee q)) \rightarrow (\neg(p \vee q) \rightarrow \neg p)$
5. $\neg(p \vee q) \rightarrow \neg p$

Q. E. D.

1981 Japanese Fifth Generation Project



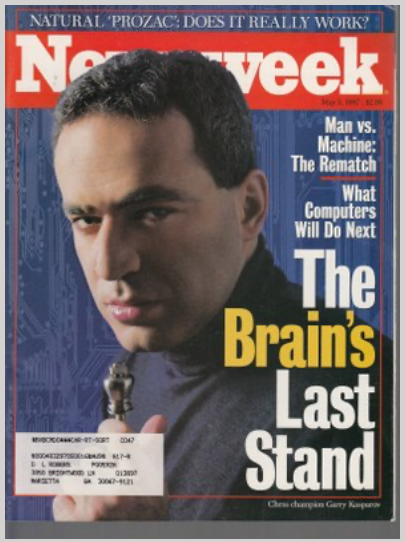
1988 Judea Pearl - “Probabilistic Reasoning in Intelligent Systems”

Four AI Technologies

AI Technology	Inspiration	Roots	Modern Use
Neural Networks	Brain physiology	Neuron model	Deep learning neural networks
Symbolic logic	Human reasoning	Aristotle	Formal languages
Knowledge Based Systems	Common sense/expertise	Blocks world	Expert systems
Statistical Methods	Mathematical rigor	Cybernetics	Speech recognition

AI "Optimism"

- **UPI (1958) –** *"The Navy revealed the embryo of an electronic computer today that it expects will be able to walk, talk, see, write, reproduce itself and be conscious of its existence"*
- **Herbert Simon (1965) -** *"… machines will be capable, within twenty years, of doing any work a man can do."*



(1997)

Stephen Hawking (2014) -*"The development of full artificial intelligence could spell the end of the human race … it would take off on its own, and re-design itself at an ever-increasing rate. Humans, who are limited by slow biological evolution, couldn't compete, and would be superseded."*

AI Today - Advances in Computing Technologies Power AI Growth

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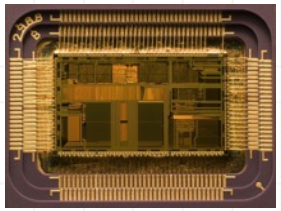
Transistor



1989 Intel 80486 – 1,100,000 transistors

1959 IBM 7090 – 50,000 transistors

2019 AMD Epyc – 32,000,000,000 transistors

2019 iPhone11 8,500,000,000 transistors

AI Today - Big Data Supports Machine Learning

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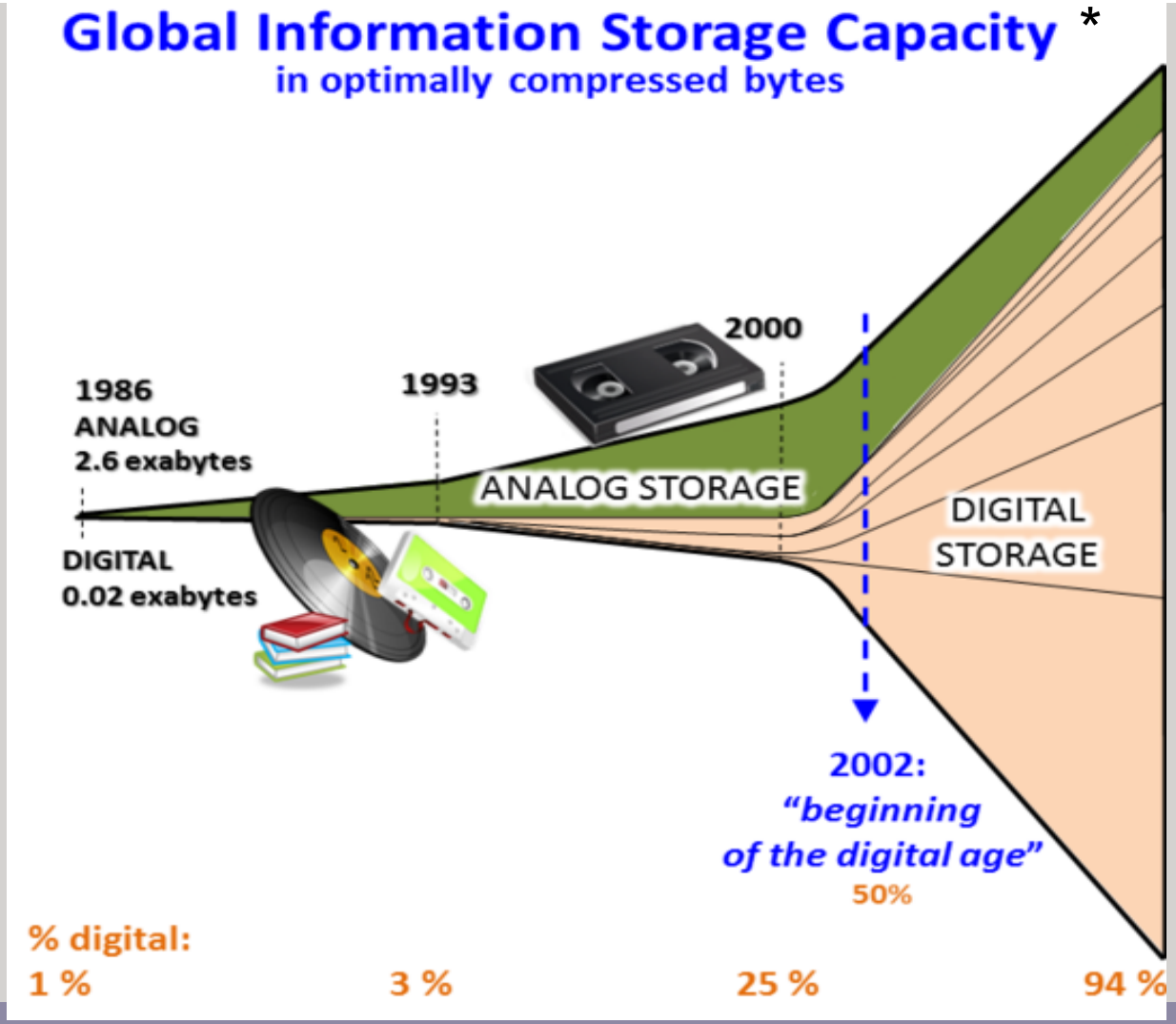
1986 – 20,000,000 GB digital data

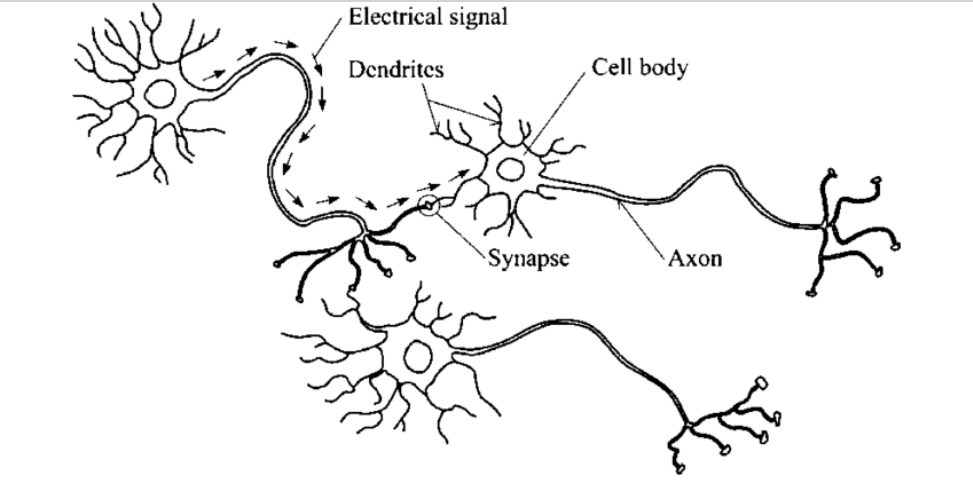


2007 – 19,000,000,000 GB digital data

* Hilbert, M., & Lopez, P. The World's Technological Capacity to Store, Communicate, and Compute Information. *Science*, 332, 2011

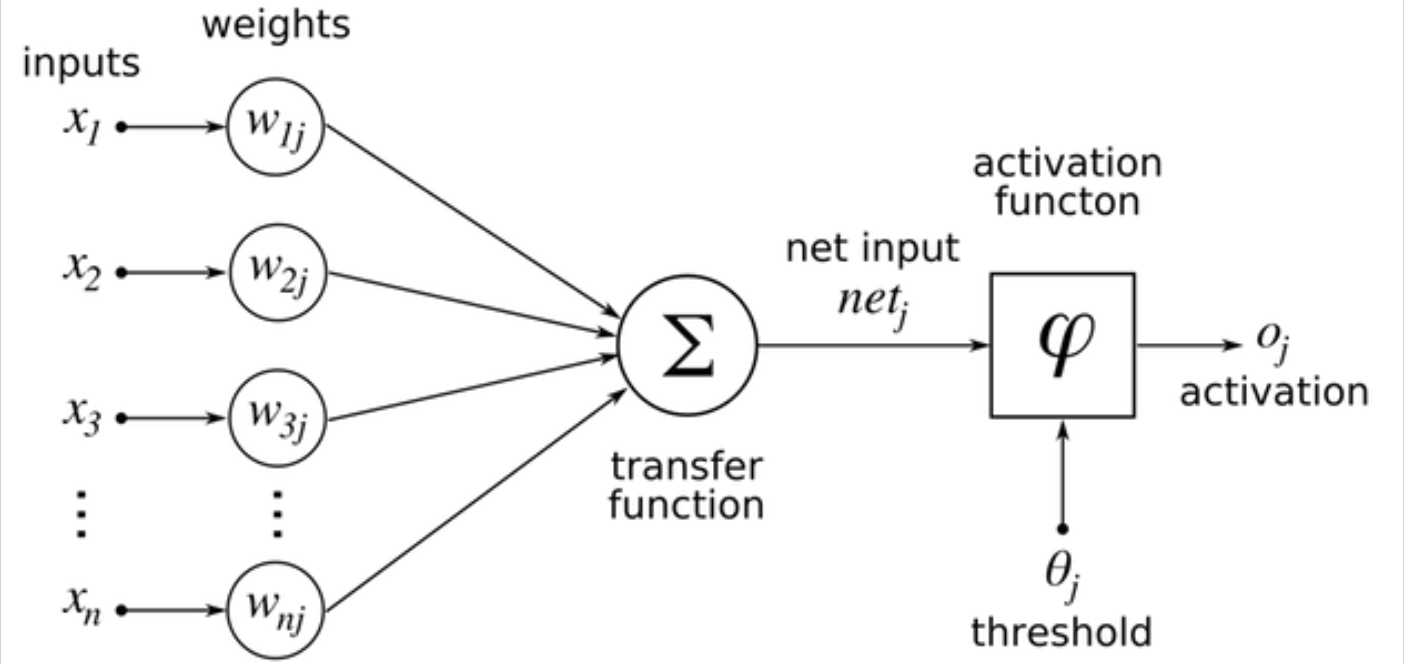
Recent AI Advances are Based on Neural Networks

Thinking Teams

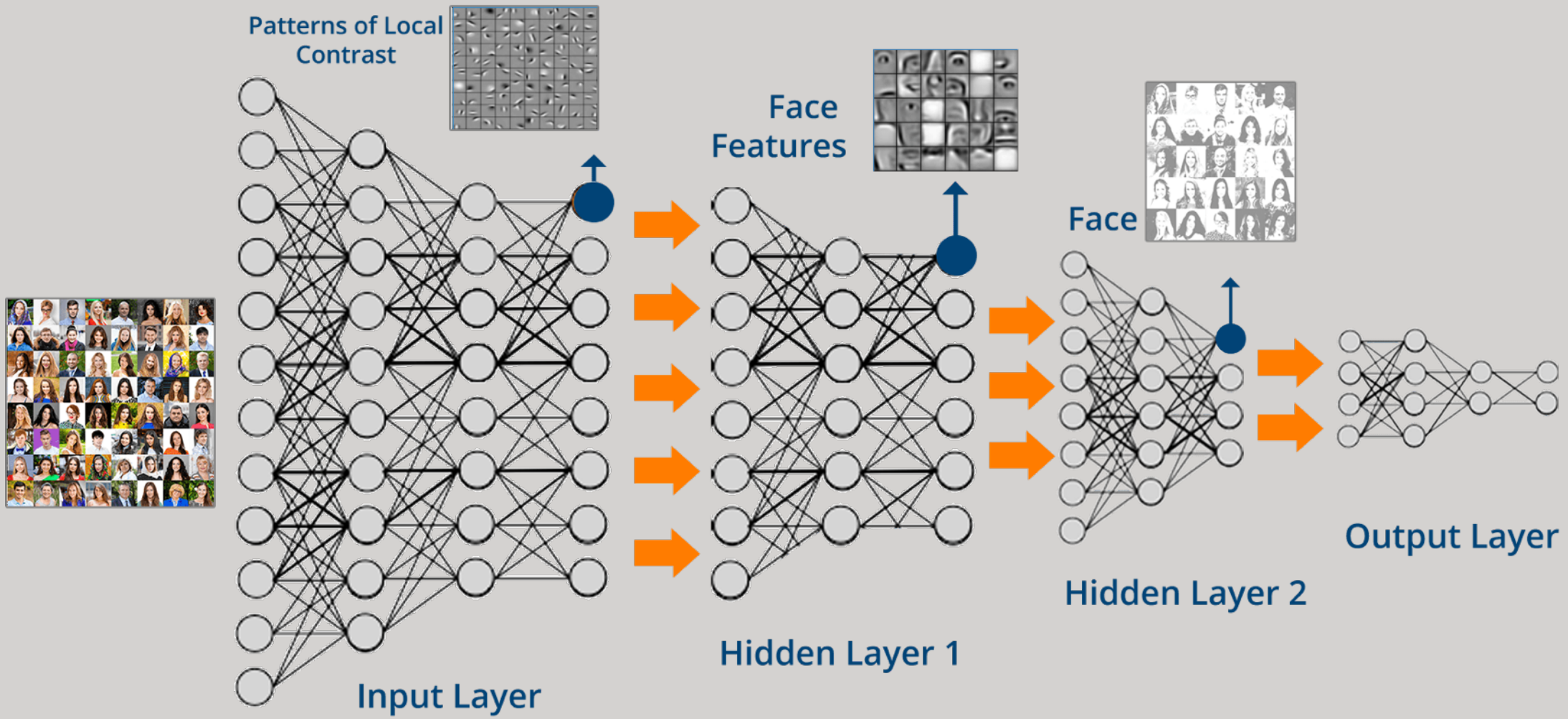


Biological Neural Network

Artificial Neural Network



Fast Computers and Big Data Enable Deep Learning



Korea's AI Future

Korean President
Moon Jae-in

"The Government itself will actively use and support AI at every opportunity." October 2019

AI in this TIEMS 2019 Annual Conference

Thinking Teams

- ***A Survey on Machine Learning Approaches for Natural Disaster Management System***, Dai Quoc Tran, Minsoo Park, Seunghee Park, Vu Tuan Tran, Dae-Kyo Jung
- ***A Study on Flood Prediction Model Using Machine Learning: Focused on Busan Metropolitan City***, Ji Hye Ha, Jung Eun Kang
- ***A Conceptual Framework for an Intelligence Natural Disaster Management System***, Vu Tran Tuan, Ji Hyun Lee, Jung Hyun Im, Dae Kyo Jung and Seung Hee Park
- ***New Technologies in Emergency Situation: Focusing on Healthcare Including Artificial Intelligence***, Soon-Joo Wang

Artificial Intelligence – Key Takeaways

Thinking Teams

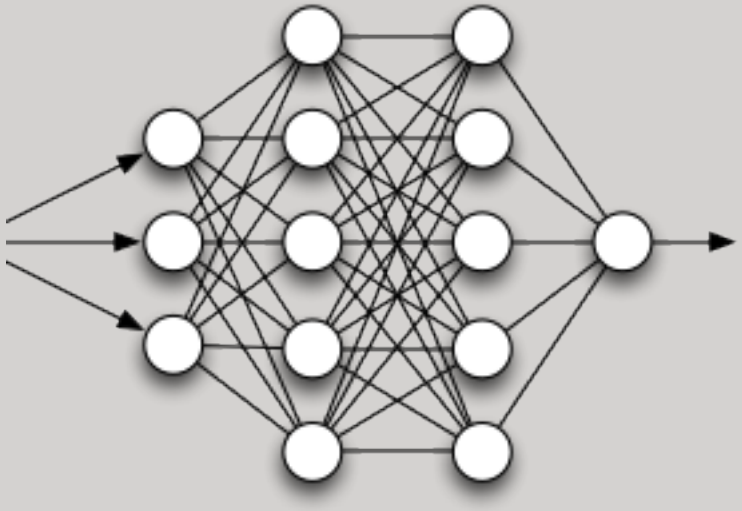
- AI systems are tools developed through complex human engineering
- AI systems have become more and more capable, through better techniques, faster computers, and big data
- These machines “learn”; however they don’t approach human capability except in very limited domains
- The analogy between machine and human intelligence has been both beneficial and misleading

How can Artificial Intelligence help Emergency Managers do their jobs?

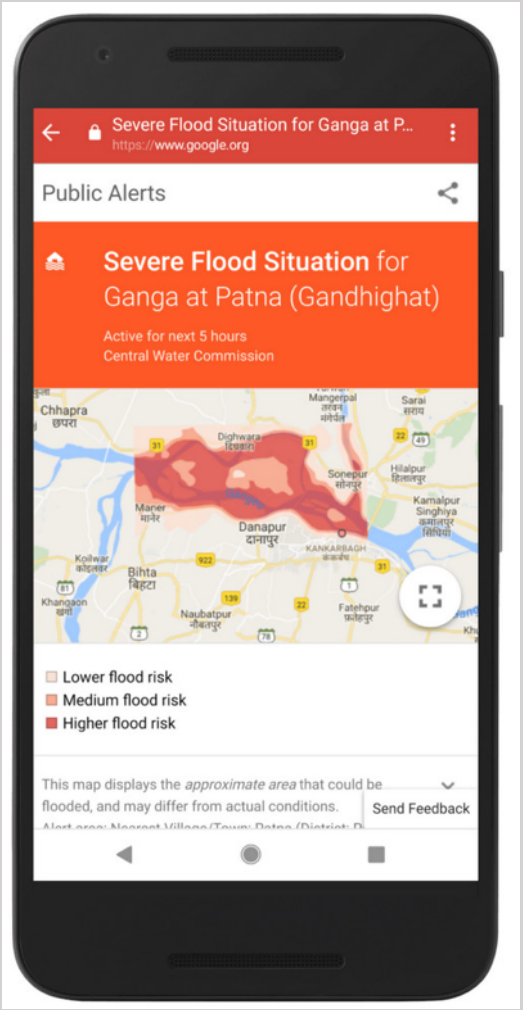
AI to Predict Floods in India*

"20 percent of global flood fatalities occur in India

- Historical events
- River level readings
- Terrain data



Machine Learning



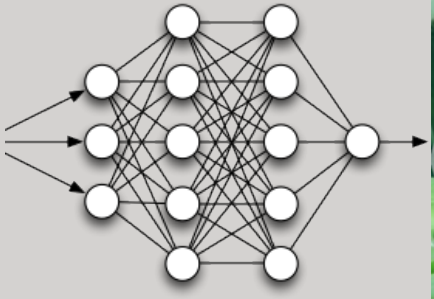
*Joint project Google and Central Water Commission of India

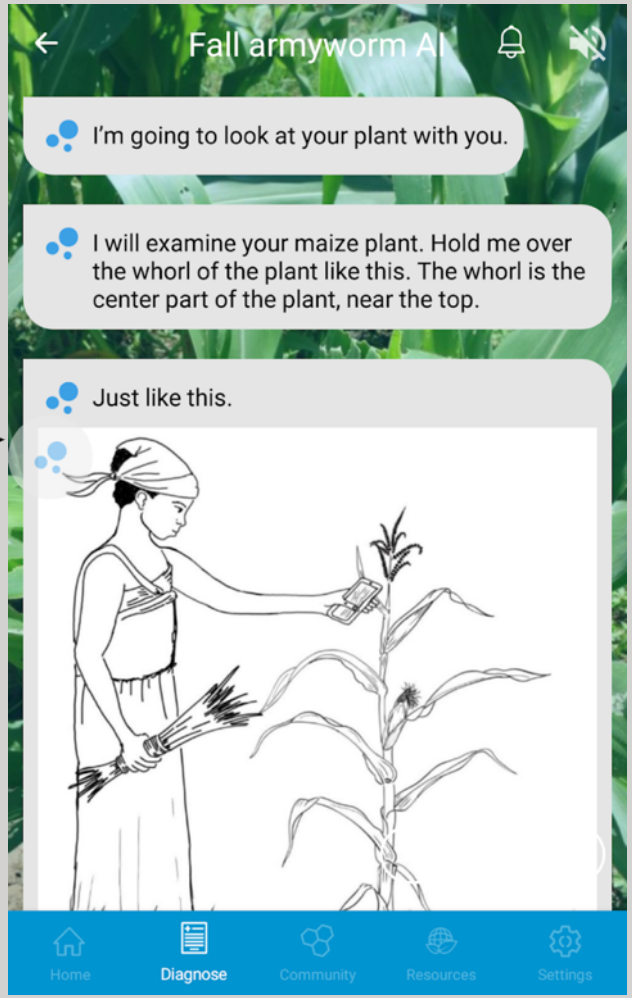
Fighting Fall Armyworm in Africa*

Thinking Teams

"Fall Armyworm threatens the food security of over 300 million people in Africa."

- Take picture of crop with cell phone
- Upload data
- Calculates infestation levels
- Management guidance to farmers
- Build up central knowledge base

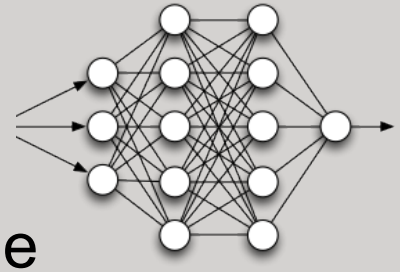




* UN Food and Agriculture Organization and Penn State U.

Wildfire Prediction*

- Weather data
  - Humidity
  - Temperature
  - Gas
  - Carbon monoxide/dioxide
  - Wind
- Images



Classifies images of grasses and shrubs into 14 classes indicating various forest fire risk levels with 89% accuracy.

* California Fire and Monta Vista High School

How will Artificial Intelligence Impact Emergencies?

AI Benefits Human Society

- Safer roads
- Better weather prediction
- Better agricultural yield
- Better use of energy
- Improved healthcare
- Better global communication
- More efficient production
- Free humans from dangerous or tedious tasks

AI Can Also Harm – Near-Term Threats to Community Safety

- Interconnected systems vulnerability
- Social manipulation
- Autonomous weapons
- Conflict due to loss of jobs and greater inequality

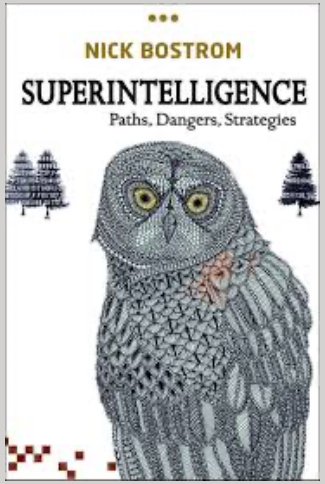
AI could “circulate tendentious opinions and false data that could poison public debates and even manipulate the opinions of millions of people, to the point of endangering the very institutions that guarantee peaceful civil coexistence.” Pope Francis 2019

Longer Term Threats of AI?

Thinking Teams

"Success in creating effective AI, could be the biggest event in the history of our civilization. Or the worst. We just don't know. So we cannot know if we will be infinitely helped by AI, or ignored by it and side-lined, or conceivably destroyed by it," Stephen Hawking, 2017

"And mark my words, AI is far more dangerous than nukes." Elon Musk, 2018



"Thus the first ultraintelligent machine is the last invention that man need ever make, provided that the machine is docile enough to tell us how to keep it under control." Nick Bostrom, 2014

The Logic Behind Fears of Super-Intelligent AI

Thinking Teams

- AI technology has been advancing quickly, particularly machine learning
- It is likely that human-level Artificial General Intelligence (AGI) will be developed in the future
- Once AGIs are developed, they will be able to create more advanced versions of themselves, eventually achieving superhuman intelligence
- These super intelligent AGIs may take steps disastrous to human beings, by
  - Taking action based on an incorrect assessment of a situation
  - Pursuing a goal too literally
  - Evolving goals and actions detrimental to humans

The Case Against Dangerous Super - Intelligent AI

Thinking Teams

- Currently, even advanced deep learning AIs exhibit a relatively narrow form of “intelligence”
  - Very good at identifying patterns in vast amounts of data, but requires vast amounts of data
  - Can be thrown off by situational changes that are insignificant
  - Does not operate in the context of a comprehensive model of the world, as a human child does
- Highly intelligent humans can be dangerous, but is the intelligence + human motive + physical/social capability that makes them so

In any case - even if an “AI take over” is is unlikely, AI, like any advanced human tool, must be developed with standards and safeguards against possible harm

How can Emergency Managers Prepare for Artificial Intelligence?

Emergency Management can Proactively Anticipate AI

- **Mitigation** – What opportunities and threats are presented by more highly interconnected and automated infrastructures? How might back-up plans mitigate risk?
- **Prevention** – What new safety standards are needed for AI? How might these be audited?
- **Response** – Do emergency management AIs need to be built to respond to new emergencies? To counteract “runaway” or failing AIs?
- **Recovery** – Do Emergency Managers become the keepers of older technology infrastructure for recovery and backup?

Summary

- Recent developments in Artificial Intelligence have opened up new applications of applying large volumes of experiential data to prediction and decision making
- AI – enabled tools can help Emergency Managers predict and manage impacts of hurricanes, floods, earthquakes, landslides, wildfires, and agricultural emergencies
- AI is bringing about changes that will result in near- and long-term risks to society
- Emergency Managers can play an important role in reducing risks associated with AI's increasing presence in our societies