

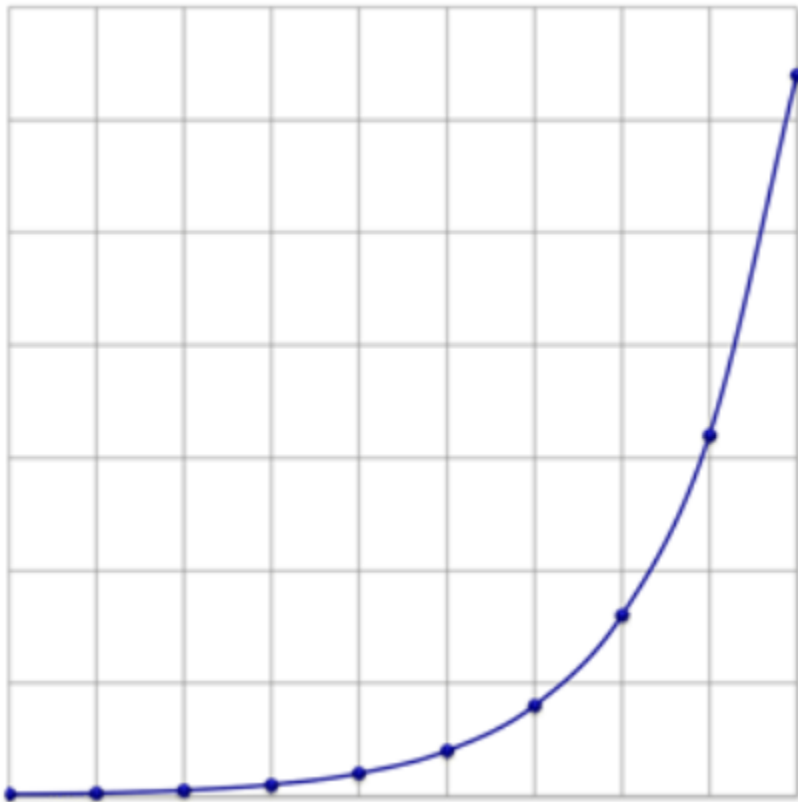


AI

Moore's Law

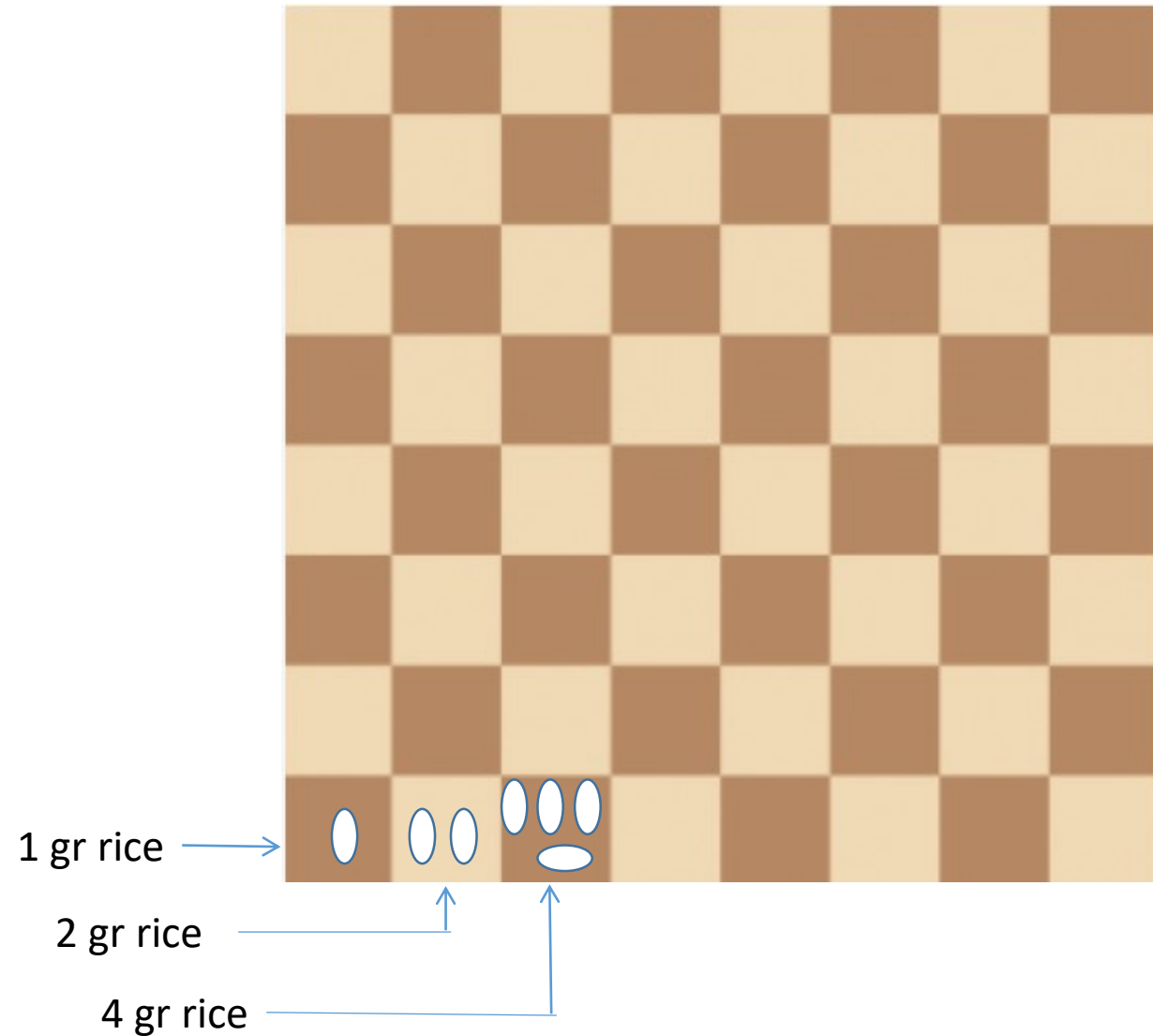
The number of transistors in a chip doubles about every two years

Exponential Growth

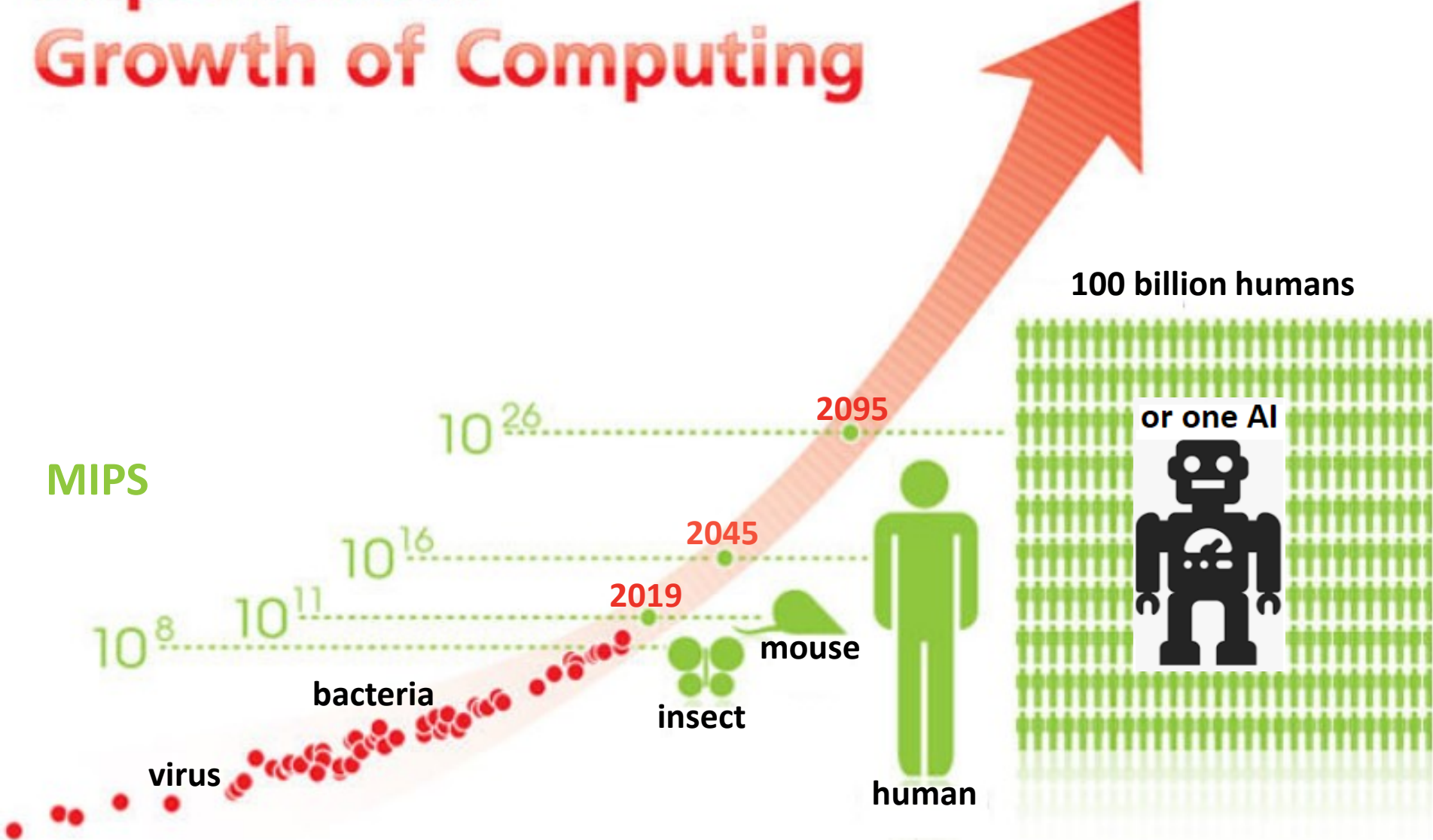


The Sultan and the Clever Slave Boy

18,446 million trillion gr rice



Exponential Growth of Computing



The Singularity

What happens when artificial intelligence catches up with human intelligence?

Karl Von Neumann, Vernor Vinge, Ray Kurzweil

- Machines will teach themselves how to behave
- Machines can learn how to build better machines
- These better machines can more quickly build still better ones

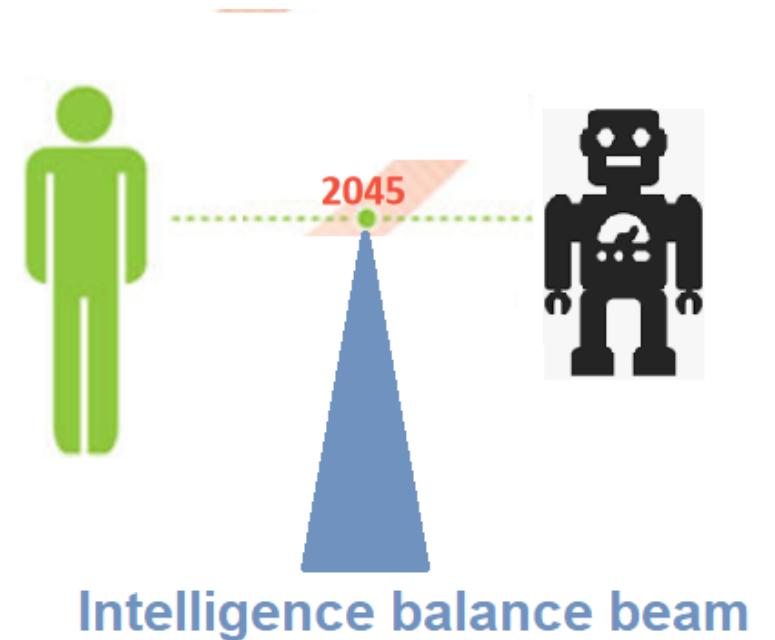
More quickly



Still better

From this point on, **NOTHING IS PREDICTABLE**

- Not how machines will evolve
- Not how humans and machines will interact



AI is born

<http://www.manifestation.com/neurotoys/eliza.php>
3



Dartmouth
Summer
Research
Project on AI
(1956)



John McCarthy



Marvin Minsky



Claude Shannon



Ray Solomonoff



Alan Newell



Herbert Simon



Arthur Samuel



Oliver Selfridge



Nathaniel Rochester



Trenchard More



AI gaining power

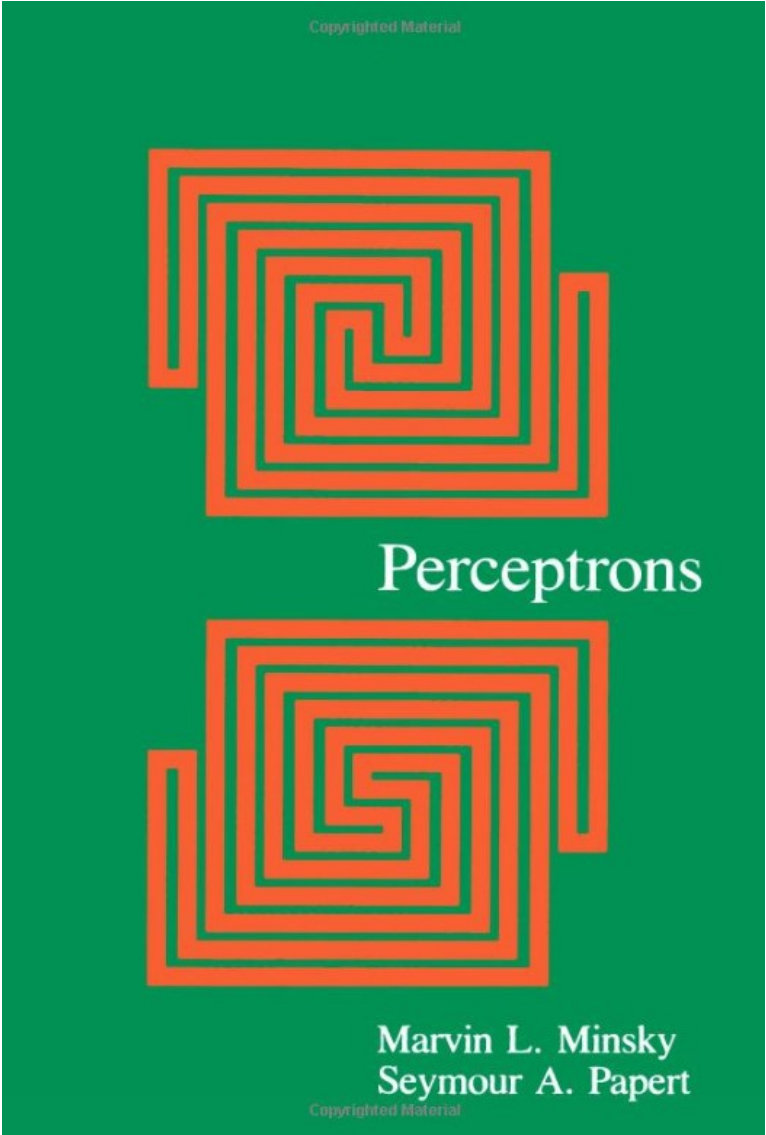
First AI game-playing
tournament champion

note vintage 1958 IBM 701

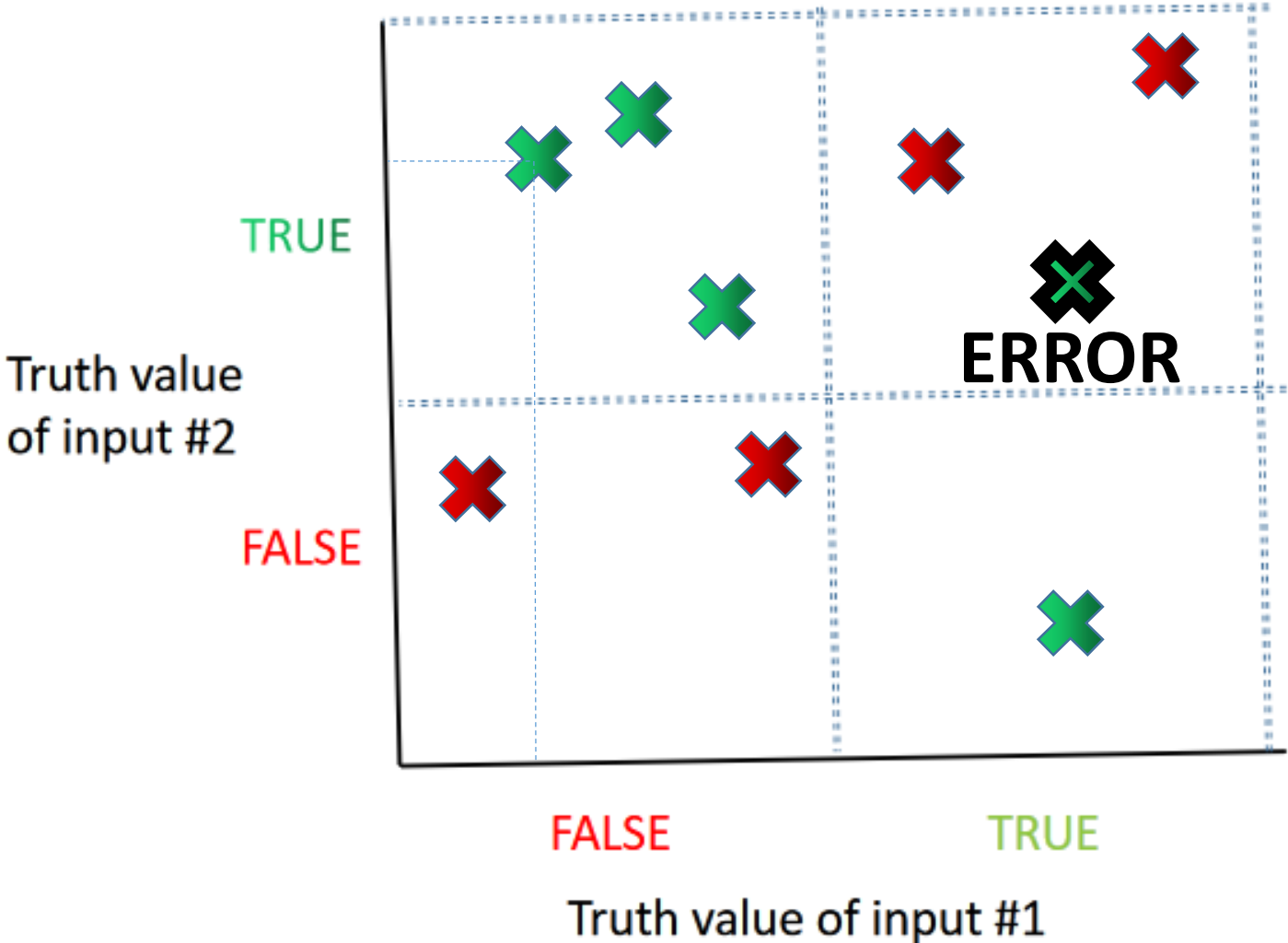


Arthur Samuels "Samuels Checker Pgm"

Then... the AI Winter

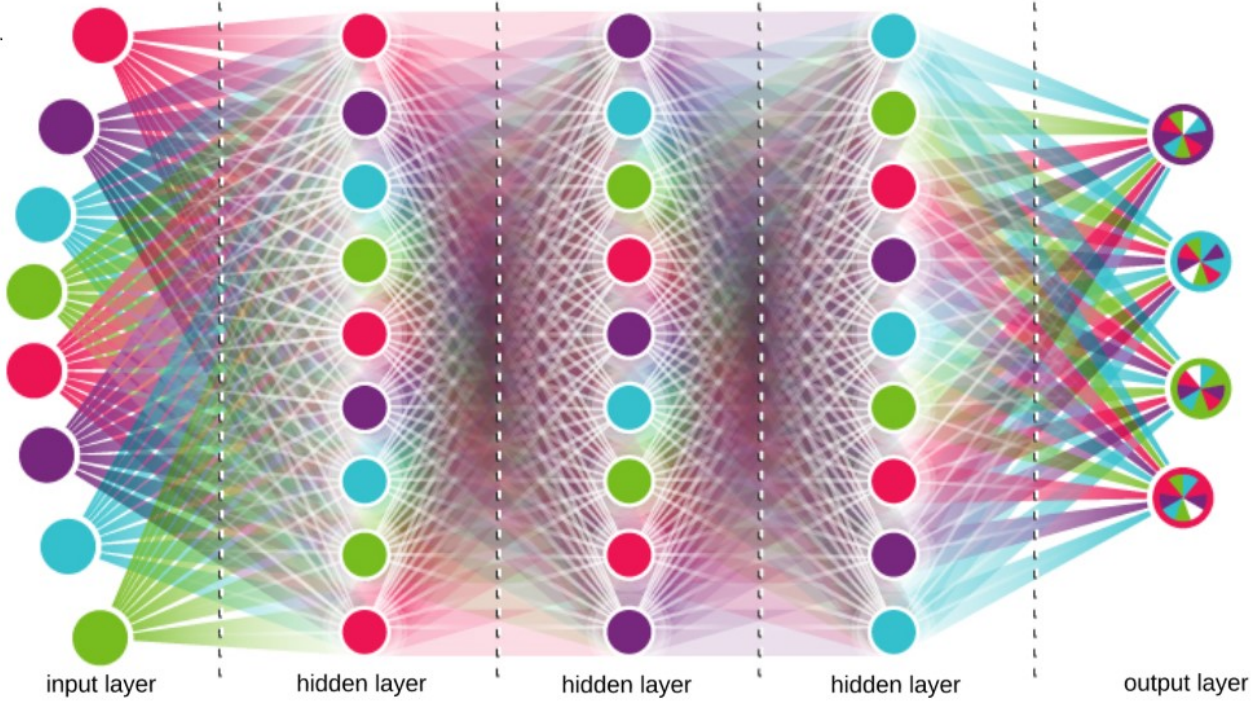
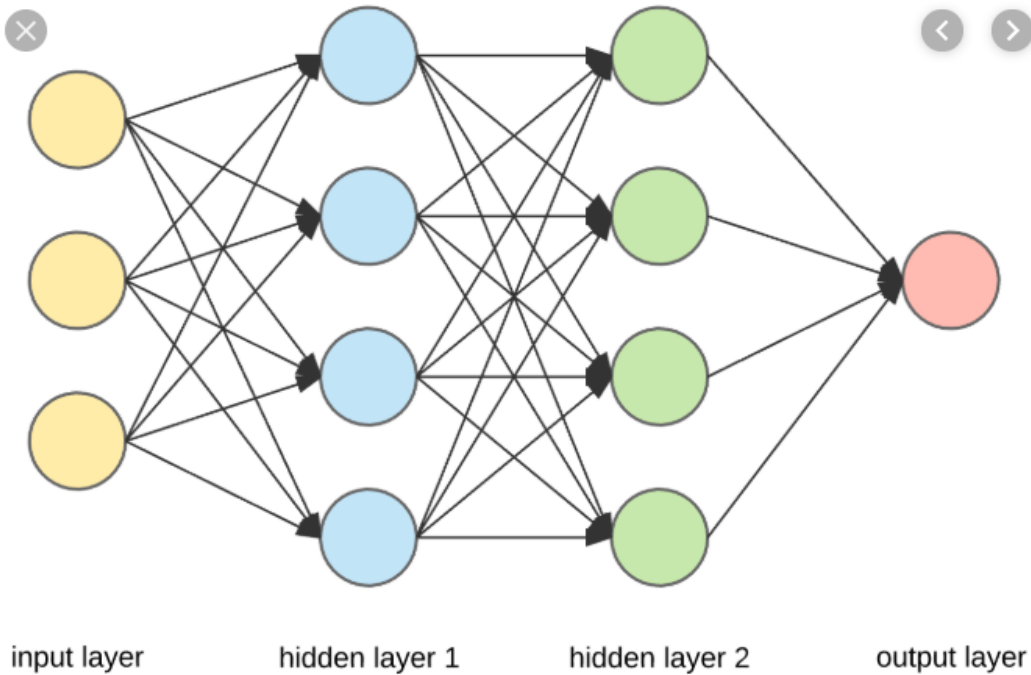


THE EXCLUSIVE-OR PROBLEM:
Output is TRUE if one but not both of the inputs are TRUE.



15 Years Later... The AI Spring!

Multilayer neural nets were later shown to be able to solve any solvable problem.



And in 1984, a new algorithm was invented to train them. Called Backpropagation.

AI vs. world chess champ Gary Kasparov

1989: Kasparov beats
CMU's "Deep Thought"

1997: Kasparov loses
to IBM's "Deep Blue"

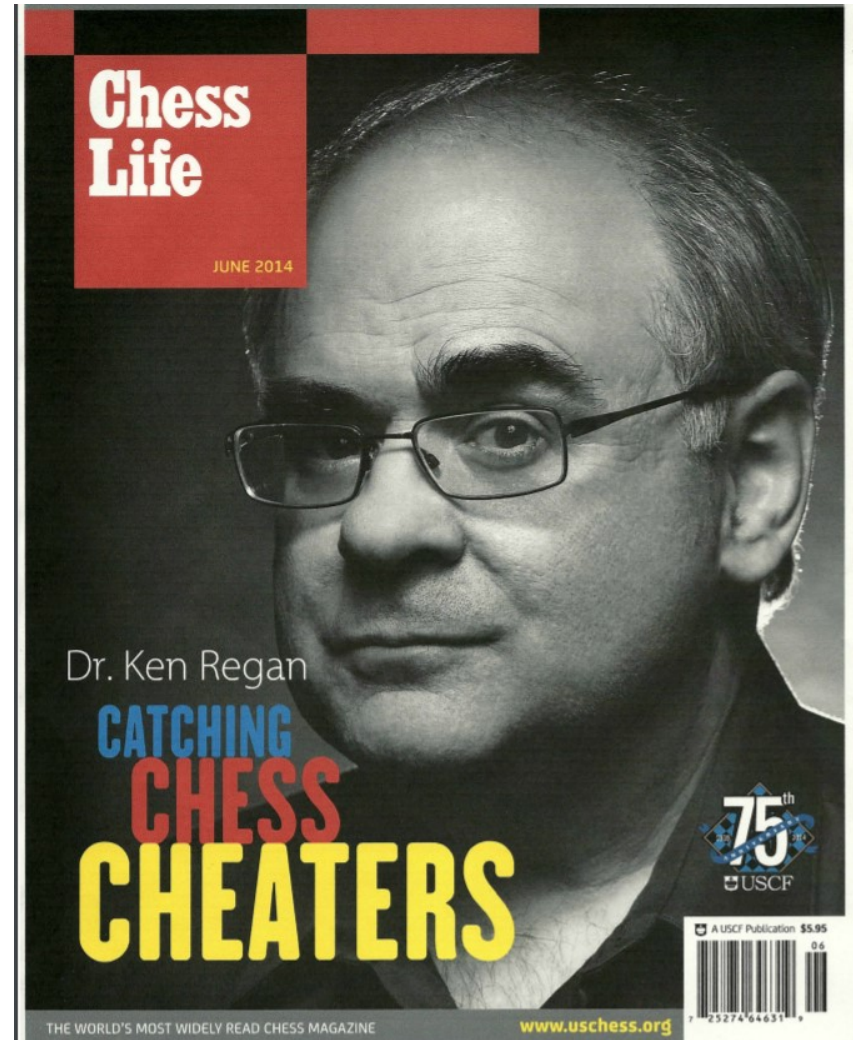


Today's version of Deep Blue has a rating of 3304, much higher than any human chess player ever.

AI catches (human) cheaters



Igors Rausis, Latvian National Champion

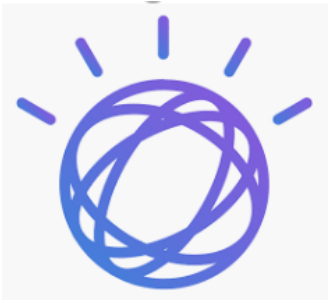


Prof. Ken Regan



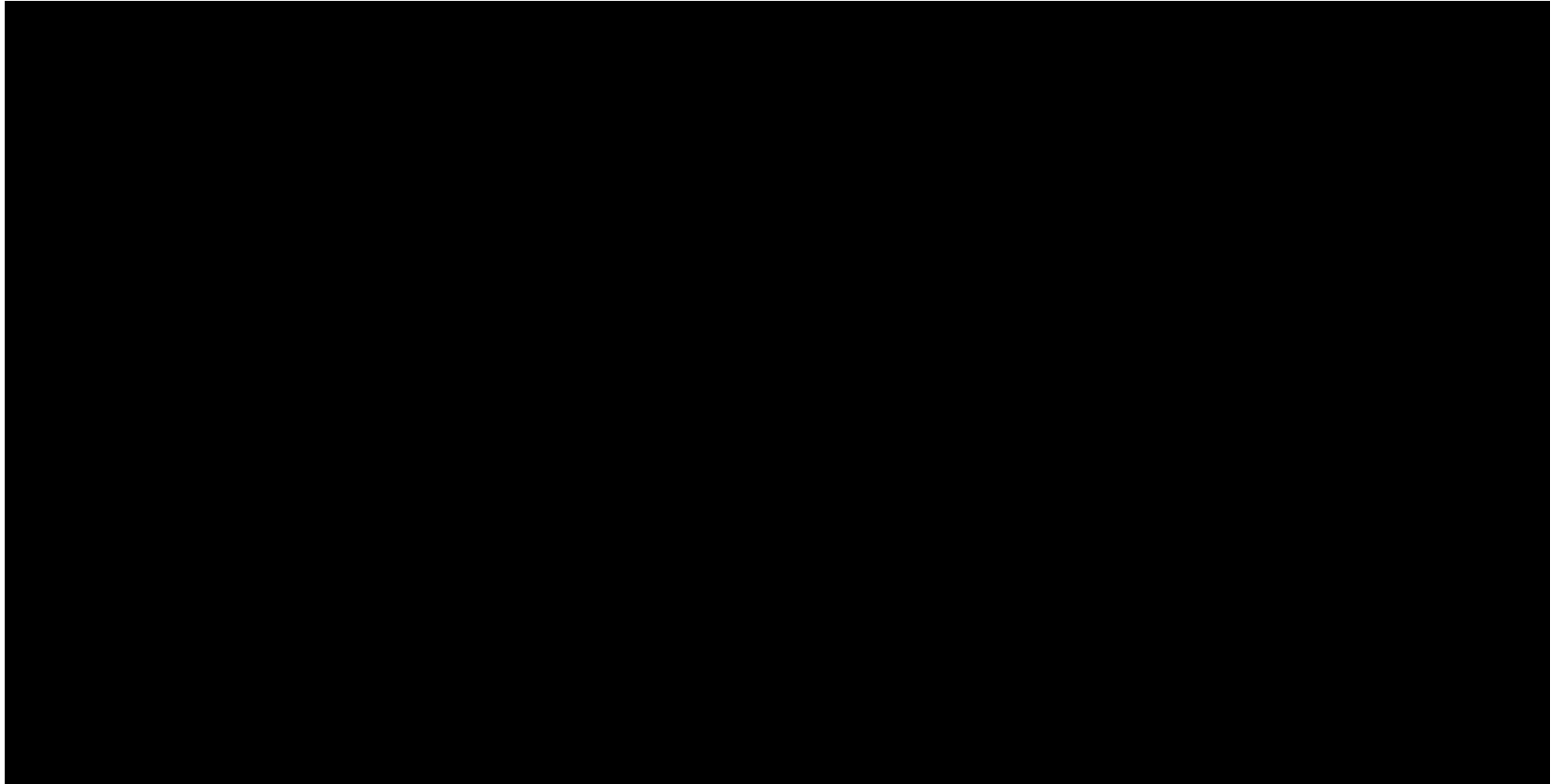
AI beats best human players at “Jeopardy!”: 2011

WATSON: IBM's natural language parsing and query based data retrieval AI system.



AI today

AI-based Robotics



Mobile autonomous robots from Boston Dynamics

AI today

AI in Medicine

Enablers:

- Digital medical record keeping
- Big data - images, text, journals

In medical diagnosis:

- Search engines: MEDLINE, Pubmed, Entrez, OpenMD
- AI based differential diagnosis
- Image screening

AI vs. MD: first metastudy just published

- MD: 86% accuracy
- AI: 87% accuracy

In medical therapy:

- Optimized treatment design (e.g. radiology)
- Gene therapy
- Smart prosthetics
- AI in drug design

AI today

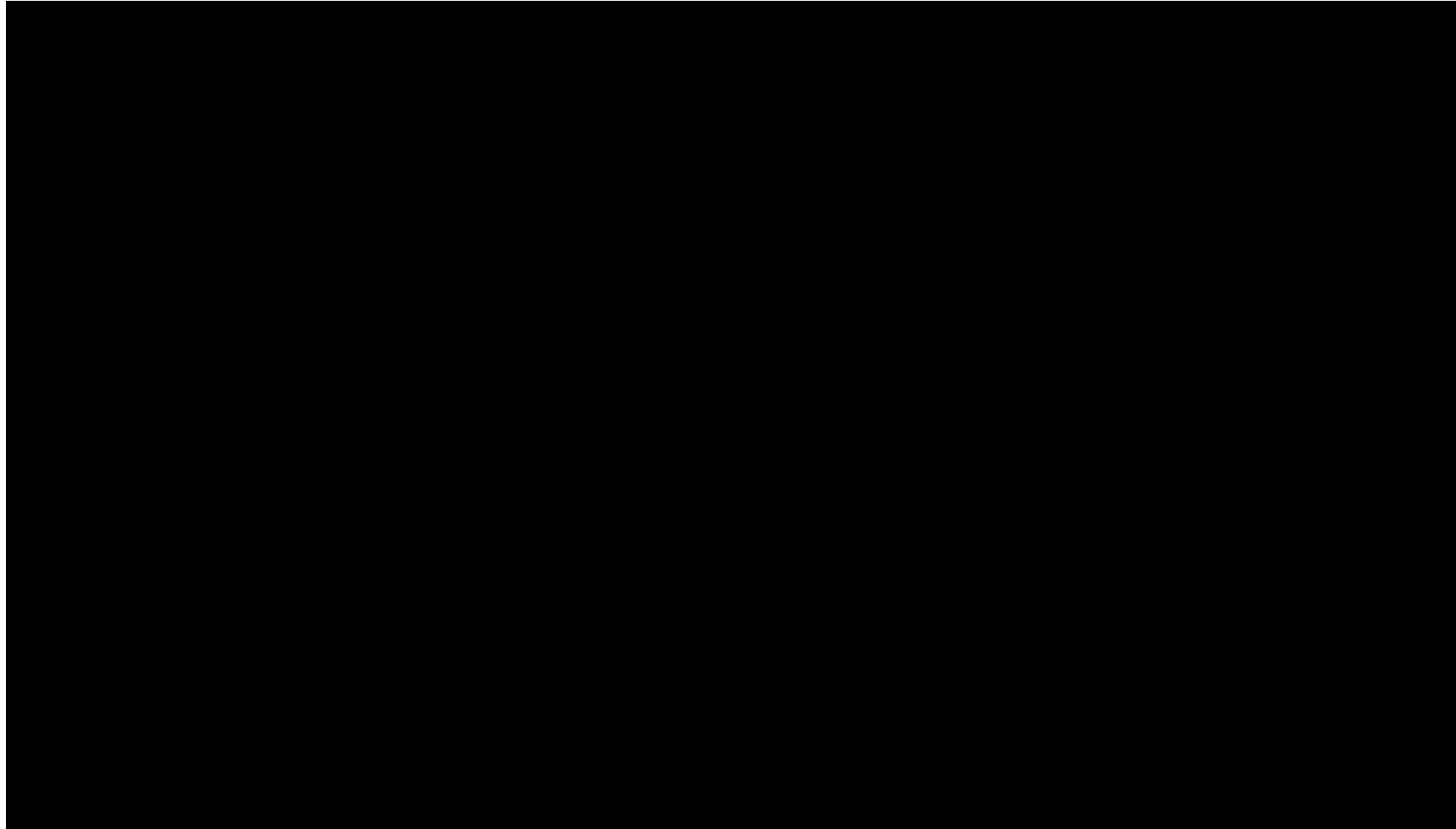
AI in Medicine

Challenges identified in recent NAM white paper on AI in Medicine:

- AI algorithms built on biased and inadequate data
- group inequities and exclusion
- risk of increased inequities
- uncertain regulatory environment
- low levels of trust in machine algorithms
- but unrealistically high expectations of effectiveness

AI today

Internet sales



Amazon Fulfilment Center: A fully robotized warehouse

AI today

AI in Music

Curating music collections



Spotify uses deep learning to analyze and categorize:

- What kind of music you listen to
- Your metadata “cultural vector”
- What folks like you listen to
- Deep models of new tunes

Results: Suggestions, audio models, “Discover Weekly,” targeted offers

Pure AI music composition



Main theme from Pixelfield's video game “Battle Royale”

AI today

AI in Advertising and Marketing



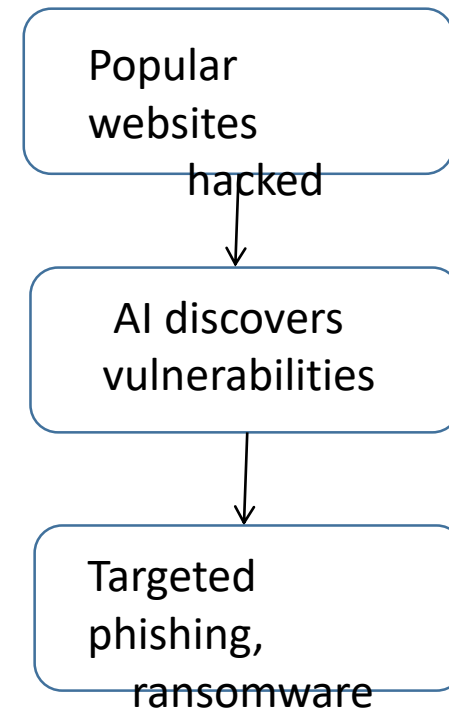
Google Ads is by far the largest internet ad provider

- \$90.9 billion revenue in 2018 for Google
- AdWords database includes over a billion ads
- Google Ads serves about 60 billion ads/day

Deep learning used to put each of us in a “culture box”

- Keywords from Google searches and advertisers
- Cookies
- Ads are demographically and culture-box targeted

The Dark Side: Targeted phishing attacks



AI today

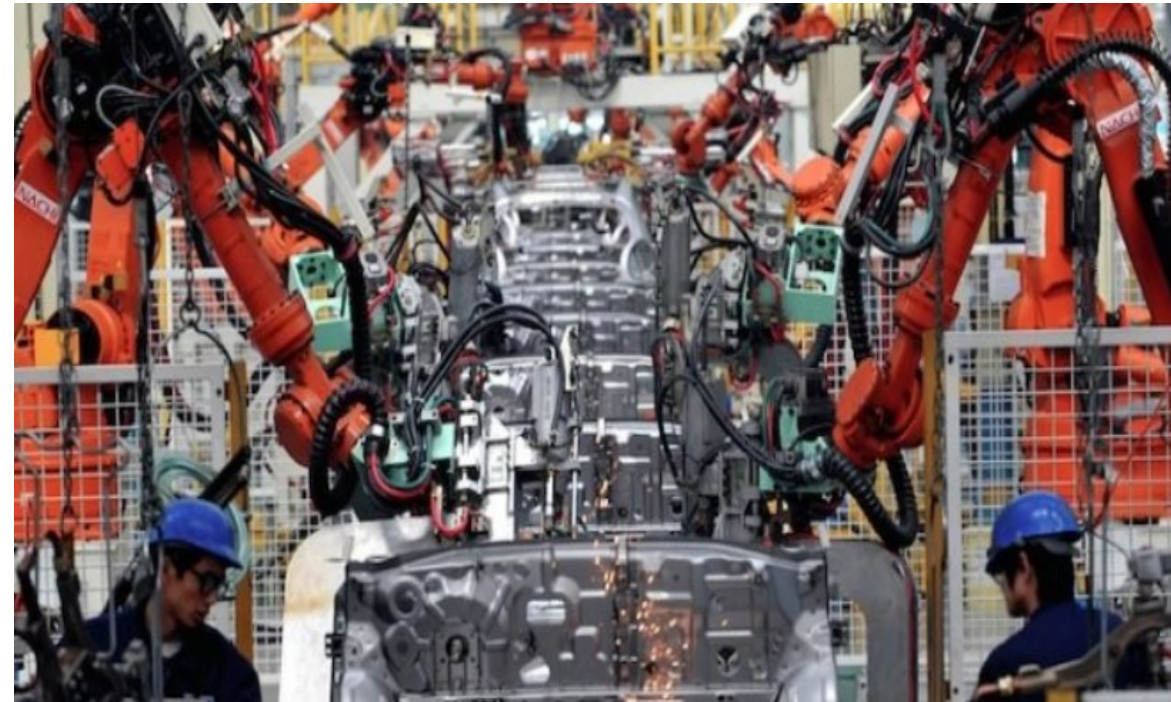
AI and jobs

AI is a net job creator



Apple's "Spaceship" Campus: bigger than the Pentagon
Fastest growing job category 2019 (LinkedIn): AI Spec.

AI is a net job destroyer



China build's world's first end-to-end fully robotized auto assembly plant.

AI today

AI voice-activated digital assistants



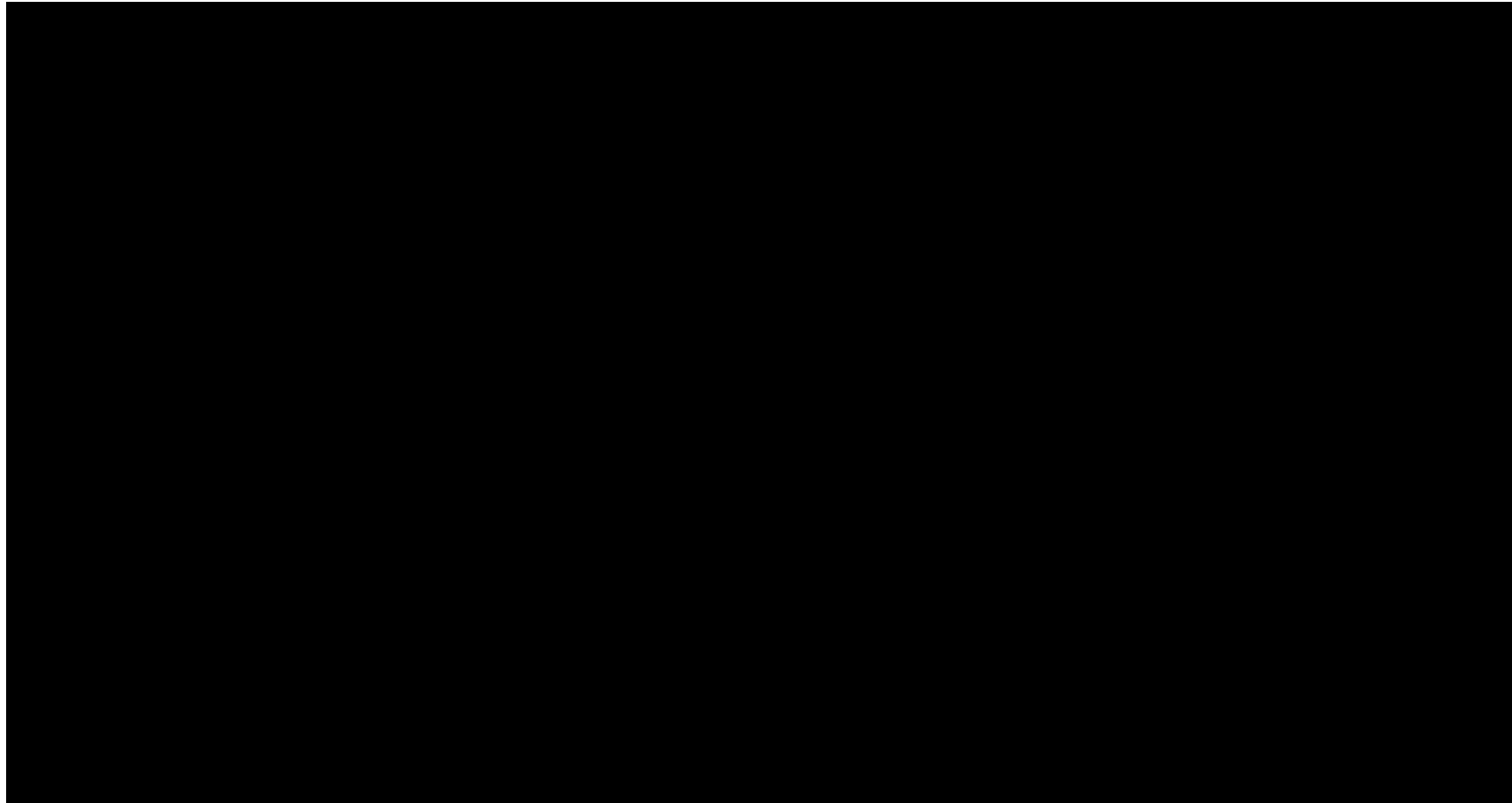
Amazon Echo and Dot

Lots of listeners out there...

- Alexa - Amazon
- Siri - Apple
- Cortana - Microsoft
- Bixby - Samsung
- Watson - IBM
- Duer - Baidu
- Hikari Azuma - Vinclu Japan
- () - Google

AI today

AI and the Military



Aircraft deploys 5 AI-guided smart bombs at 5 moving targets

AI Today

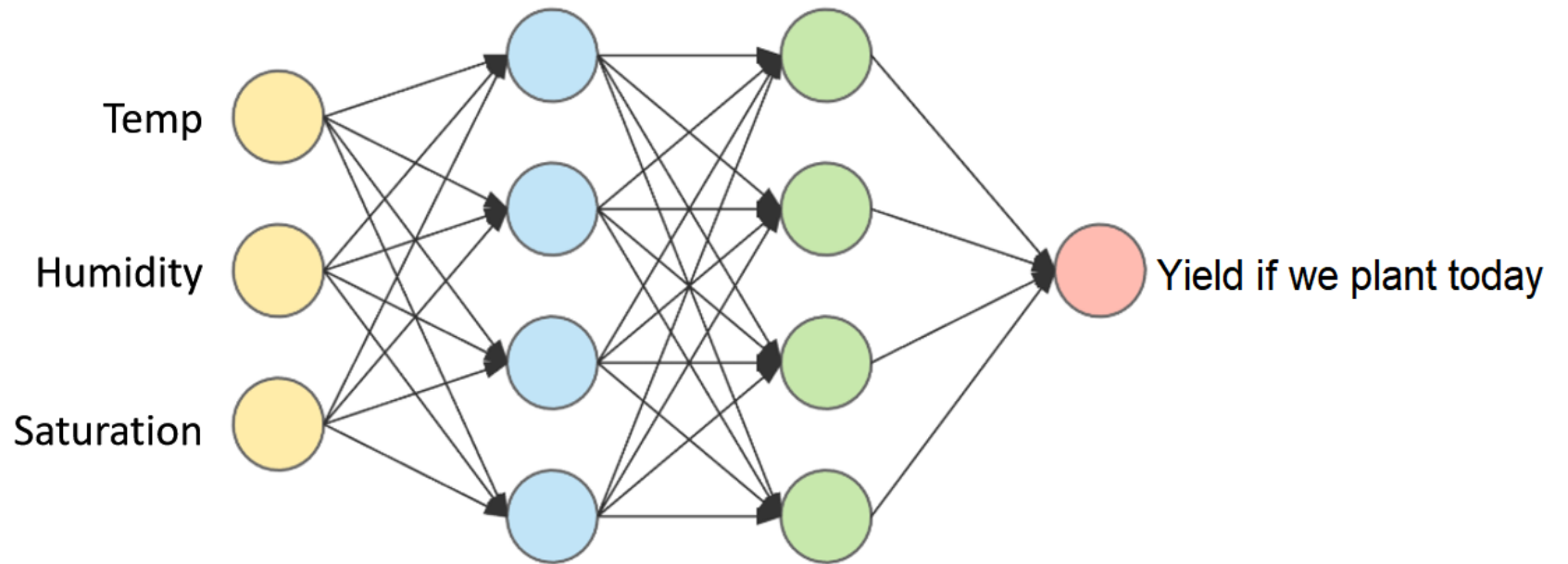
We know how animals learn, how people learn. How do machines learn?

Most successful AI today uses Deep Learning. DL is based on multilayer neural networks.

Here's how Deep Learning works:

Training dataset:

1. Temp Hum Sat Yield;
2. Temp Hum Sat Yield;
3. Temp Hum Sat Yield;
- ...
- ...



Multilayer neural net

AI today

Deep Learning now uses all types of human learning

- Supervised learning: *Here are some practice problems, and the answers.*
- Unsupervised learning: *How many different kinds of animals in this picture?*
- Reinforcement learning: *Try again. You will get a treat if you do better.*

And both kinds of knowledge

- Symbolic knowledge: *object is called a DOG, this one a CAT.*
- Numerical knowledge: *% likely this is a DOG.*



Deepfakes

AI driven by face modeling can generate convincing fakes.



Models of both faces were created. Then as Jordan Peele spoke, the Obama model was fit millisecond by millisecond to Peele's face model movements.

China vs. US: who will dominate AI?

The trends are not encouraging

- China has 3x as many STEM students as the US
- China has 2x the number of supercomputers
- China is investing more in AI than the US
- Huawei is dominating 5G production



Sunway TaihuLight - world's fastest supercomputer

The Chinese goal for AI: Pervasive State Surveillance



The Singularity Redux

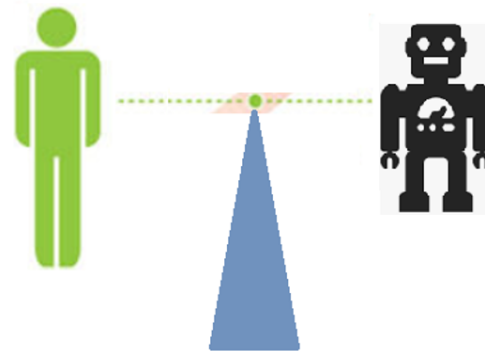
What's the bottom line? Where is AI taking us?

What we can predict

- AI will continue to transform everything
- Faster and faster
- AI-China vs. AI-USA is a big deal
- The Singularity is coming
- **We better be ready!**

What we can't predict

- Will people and machines play nice?
- The Post-Singularity economy
- The Post-Singularity culture
- **The Post-Singularity anything!**



THANKS!

Any questions?