Improving healthcare with AI

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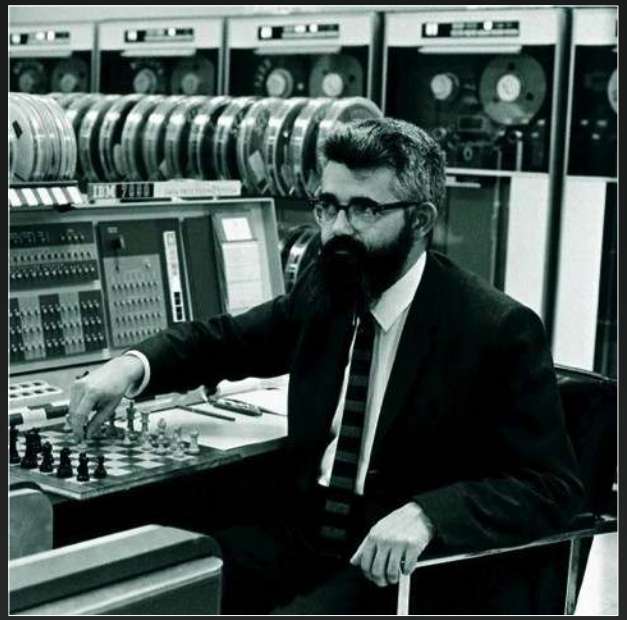
A quick history of Artificial Intelligence

1956

Dartmouth Summer Research Project



John McCarthy (1927-2011)

1956 - Coined the term “Artificial Intelligence”

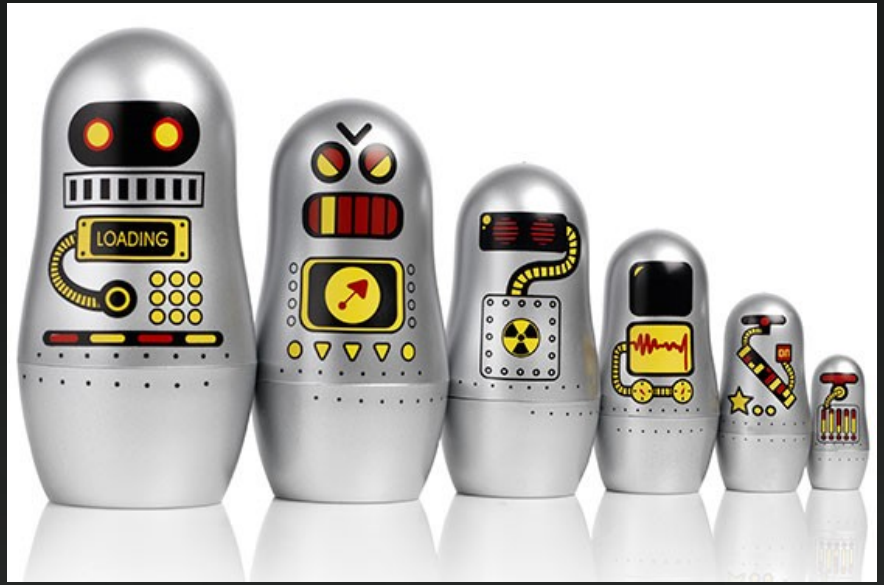
1958 - Invented LISP

1971 - Received the Turing Award

Forbidden Planet

Robbie the Robot

Artificial Intelligence: design software applications which exhibit human-like behavior, e.g. speech, natural language processing, reasoning or intuition



Gazing into the crystal ball

- 1958 Herbert Simon and Allen Newell
  "Within 10 years a digital computer will be the world's chess champion"
- 1965 Herbert Simon
  "Machines will be capable, within 20 years, of doing any work a man can do"
- 1967 Marvin Minsky
  "Within a generation ... the problem of creating 'artificial intelligence' will substantially be solved."
- 1970 Marvin Minsky
  "In from 3 to 8 years we will have a machine with the general intelligence of an average human being"

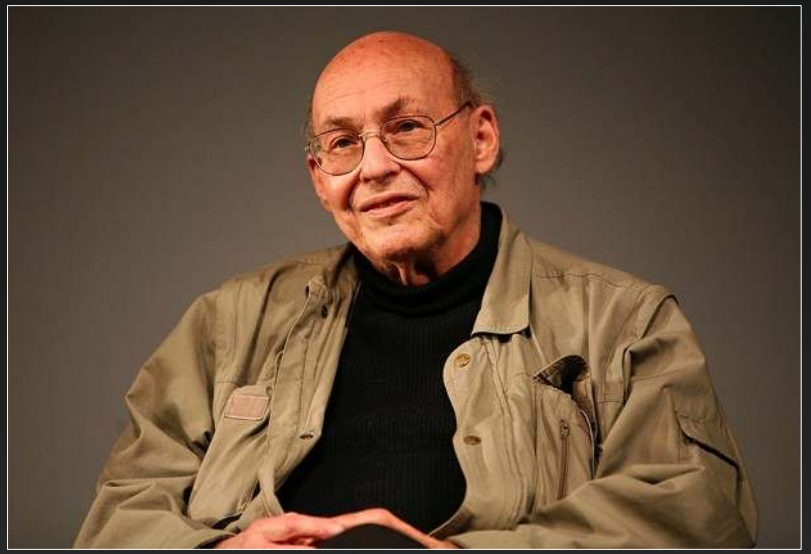
Herbert Simon (1916-2001)
1975 - Received the Turing Award
1978 - Received the Nobel Prize in Economics

Allen Newell (1927-1992)
1975 - Received the Turing Award

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

It’s 2001. Where is HAL?

« No program today can distinguish a dog from a cat, or recognize objects in typical rooms, or answer questions that 4-year-olds can! »

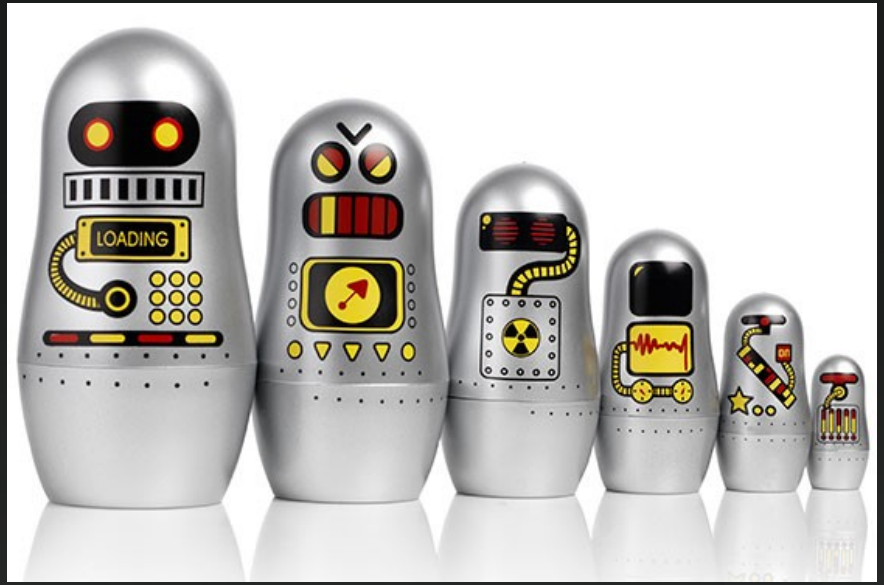


Marvin Minsky (1927-2016)
1959 - Co-founded the MIT AI Lab
1968 - Advised Kubrick on “2001: A Space Odyssey”
1969 - Received the Turing Award

HAL 9000 (1992-2001)

Artificial Intelligence: design software applications which exhibit human-like behavior, e.g. speech, natural language processing, reasoning or intuition

Machine Learning: teach machines to learn without being explicitly programmed



Millions of users… Mountains of data… Commodity hardware…
Bright engineers… Need to make money!

Gasoline waiting for a match!

12/2004 - Google publishes seminal paper on processing data at scale

04/2006 – Yahoo implements it

The rest is history

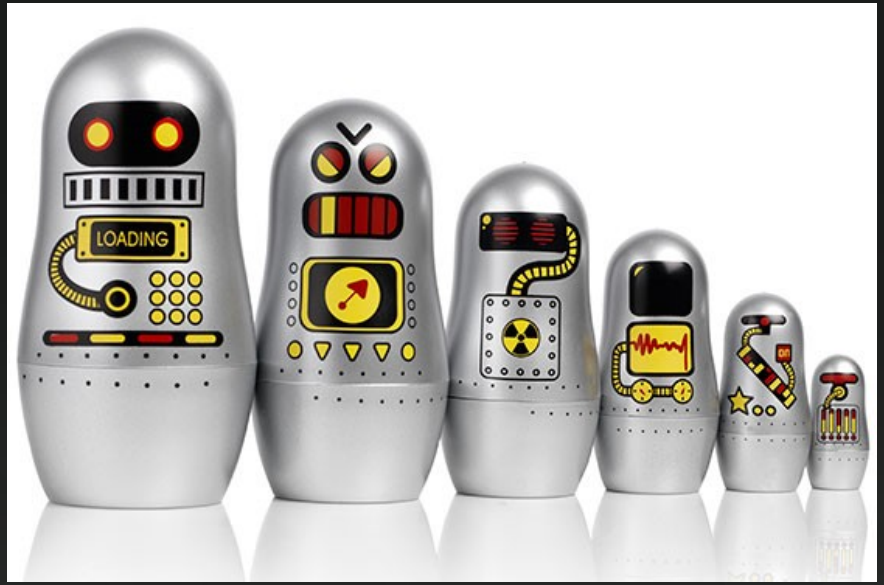
Fast forward a few years

- Machine Learning is now a commodity, but still no HAL in sight
- Machine Learning doesn't work well on unstructured data (images, video, speech, freeform text, etc.)
- These tasks that are easy for people but hard to describe formally
- Is there a way to get informal knowledge into a computer?
- Enter neural networks and Deep Learning

Artificial Intelligence: design software applications which exhibit human-like behavior, e.g. speech, natural language processing, reasoning or intuition

Machine Learning: teach machines to learn without being explicitly programmed

Deep Learning: using neural networks, teach machines to learn from complex data where features cannot be explicitly expressed



Healthcare Applications of Deep Learning

Finding a doctor near you

ZocDoc
Get well sooner.

https://www.zocdoc.com
https://aws.amazon.com/blogs/machine-learning/zocdoc-builds-patient-confidence-using-tensorflow-on-aws/

- Zocdoc is an online healthcare scheduling service, locating a doctor in your area and optimizing costs
- With Zocdoc's Insurance Checker, a patient just has to take a photo of their health insurance card. The system uses Deep Learning-based computer vision to scan the ID card and extract the correct policy ID information.

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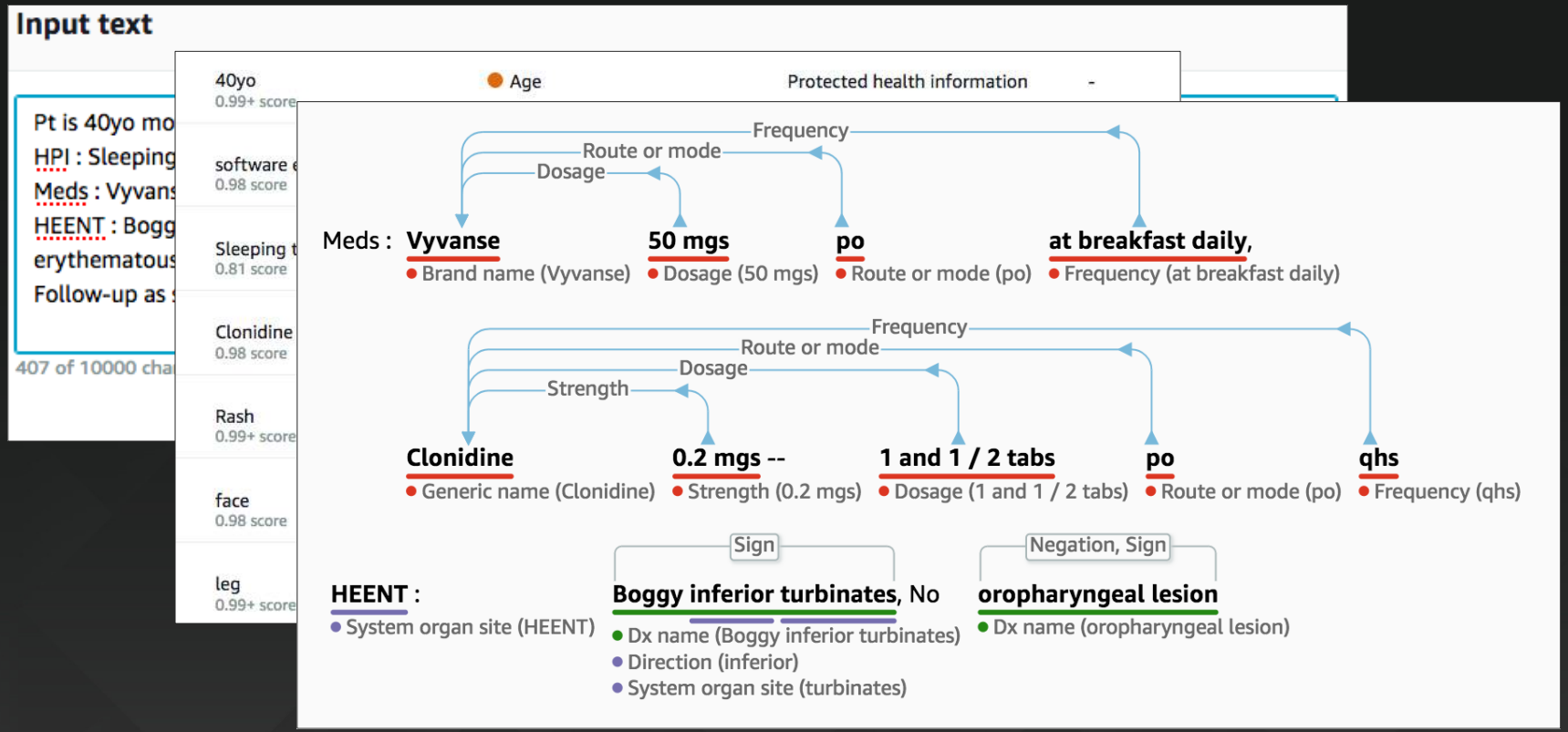
Automating document processing

https://aws.amazon.com/comprehend/medical/

Amazon Comprehend



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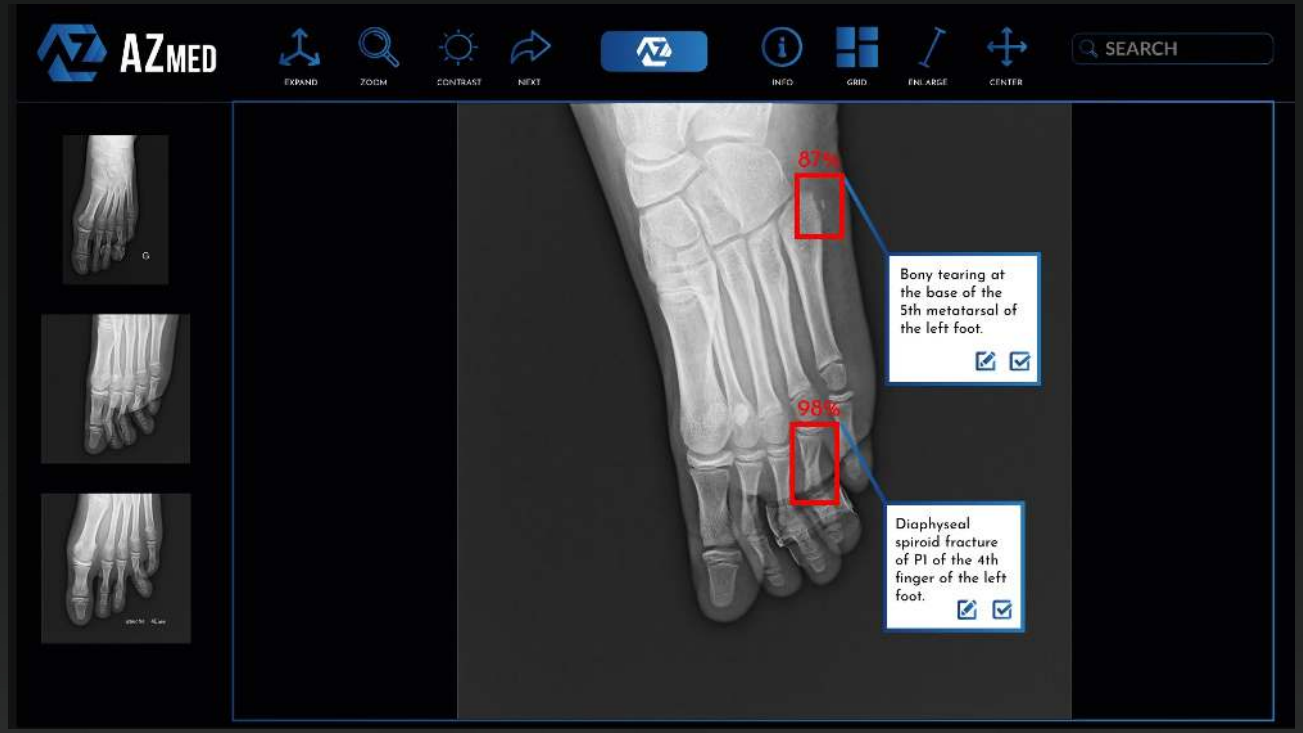
Detecting fractures

https://www.azmed.co



Automatic reporting

Non-displaced scaphoid fracture

Auto-contouring in seconds

https://www.arterys.com
https://aws.amazon.com/solutions/case-studies/arterys/

ARTERYS
Medical Imaging Cloud AI

Arterys can contour cardiac anatomy as accurately as experts, but takes only 15-20 seconds instead of the 45-60 minutes required to do it manually

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Instant expert diagnosis at the edge

xxx/

GE Healthcare

First responders can run exams on-site, but they can't interpret results.

Any extra minute in diagnosing injuries puts the patient at risk.

Advanced Deep Learning models can be trained on complex data sets, but they're too large to deployed on portable equipment.

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Instant expert diagnosis at the edge

xxx/

GE Healthcare

First responders can run exams on-site, but only expert doctors can interpret results.

Any extra minute in diagnosing injuries puts the patient at risk.

Deep Learning to the rescue: label an image data set, feed it to a state of the art model, job done… right?

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Instant expert diagnosis at the edge

xxx/

GE Healthcare

One size does not fit all.

Multiple models for different conditions.

Multiple devices: carry-on, ambulance, hospital.

Heterogenous hardware, different performance.

Manual model optimization is not an option.

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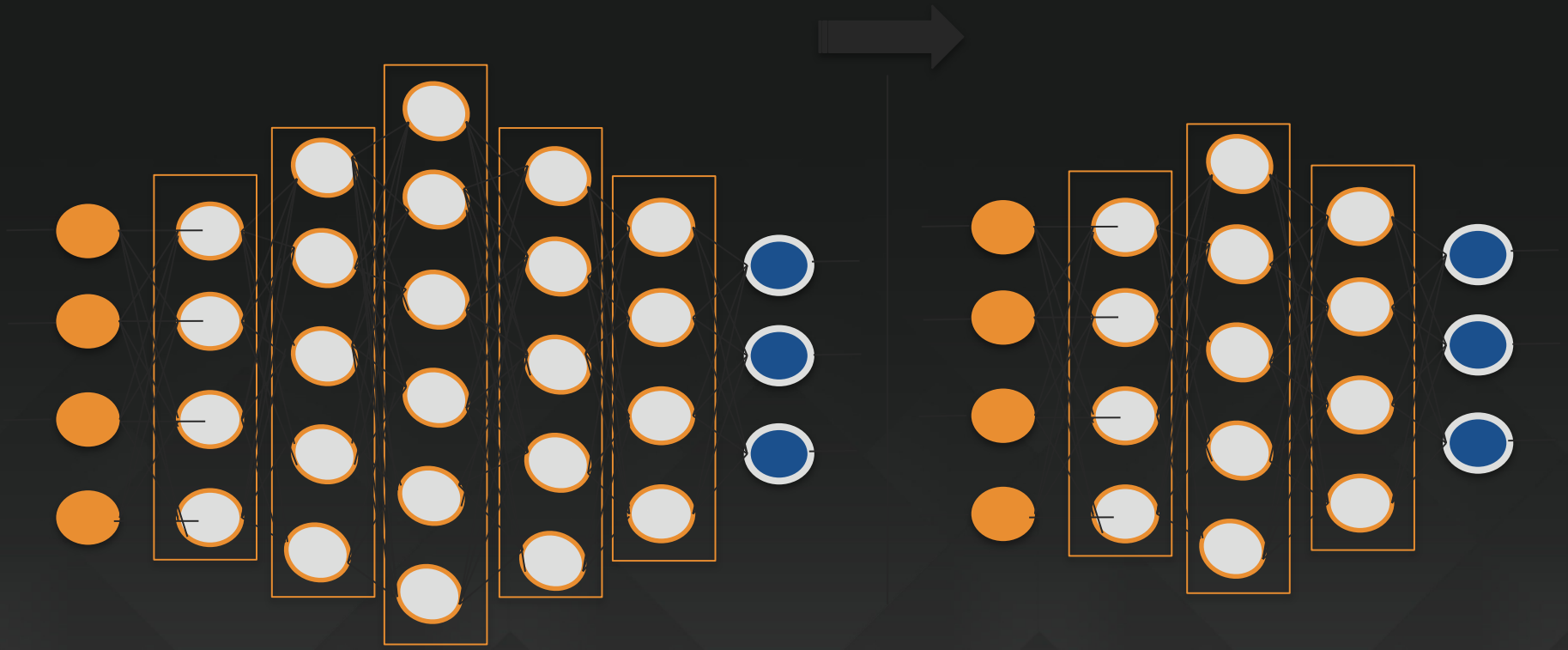
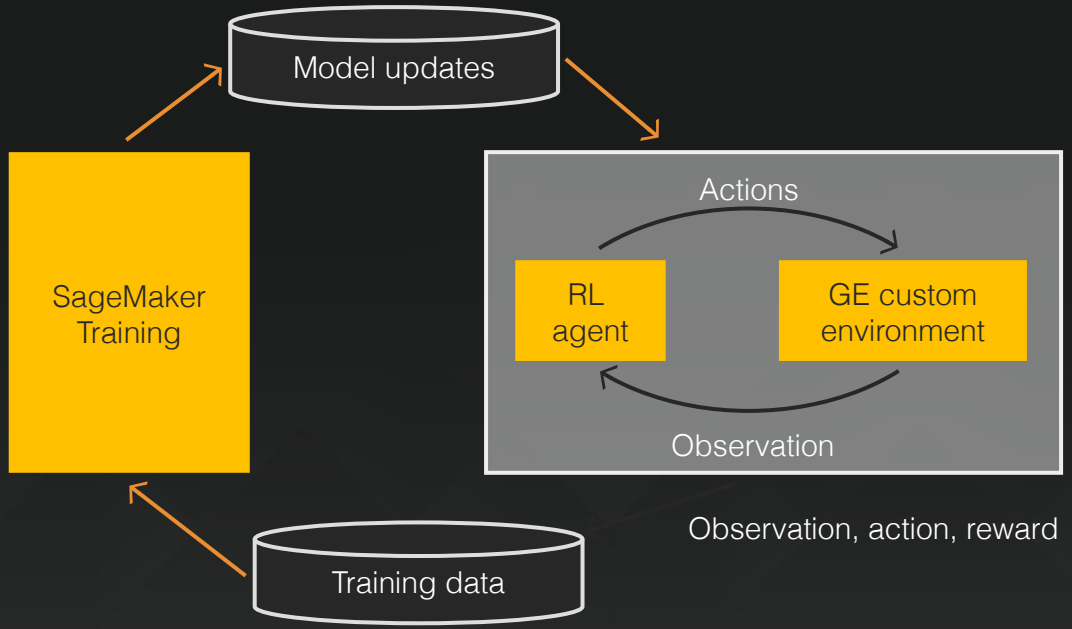
What do we mean by network compression



Using Reinforcement Learning to shrink models



Observation, action, reward

GOAL	Skrink model with minimal loss of accuracy
STATE	Current network architecture
ACTION	Remove layer or not
REWARD	Accuracy + compression ratio

Initial results

From idea to implementation in less than four weeks

8X reduction in training time with distributed setup

1K network architectures searched in under two hours

Roughly 40% smaller network on internal ultrasound data

1% - 2% loss of accuracy

« AI will never replace doctors »
(blah blah blah)

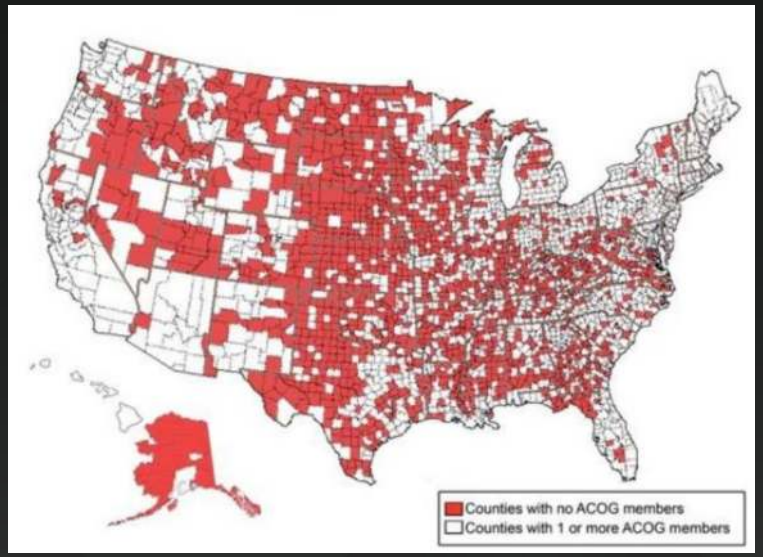
5.8 billion people around the world
can’t access an expert physician

Detecting cervical cancer with a smartphone

https://www.mobileodt.com/
http://www.itnewsafrica.com/2017/11/interview-mobileodt-using-aws-cloud-to-save-lives/

MobileODT

270,000 women die every year of cervical cancer



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What about people who need constant supervision?

In 2014, 1 in 59 U.S. children had autism

In 2017, 44 million people worldwide have Alzheimer's disease

Pollexy: building a special needs voice assistant

https://aws.amazon.com/blogs/aws/pollexy-building-a-special-needs-voice-assistant-with-amazon-polly-and-raspberry-pi/
https://www.youtube.com/watch?v=BUewiOZTNzM

AI is a revolution for healthcare professionals

Earlier detection

Faster, more accurate diagnosis

Personalized, optimal treatment

Saving time, paperwork and exams

Letting them focus on the most important thing…

HUMANS

Resources

General

Case studies https://aws.amazon.com/health/case-studies/

Getting in touch https://aws.amazon.com/contact-us/

Technical

Getting started https://aws.amazon.com/getting-started/

Machine Learning https://ml.aws/

Thank You

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