

The logo features a stylized orange triangle pointing downwards and to the right, positioned to the left of the word "skymind".

skymind

**DEEP LEARNING
FOR ENTERPRISE**



THE WAY HEALTHCARE MAKES DECISIONS IS CHANGING

- **Evolving Statistical Models**
- **Real-time Inference**
- **More Diverse Datasets**



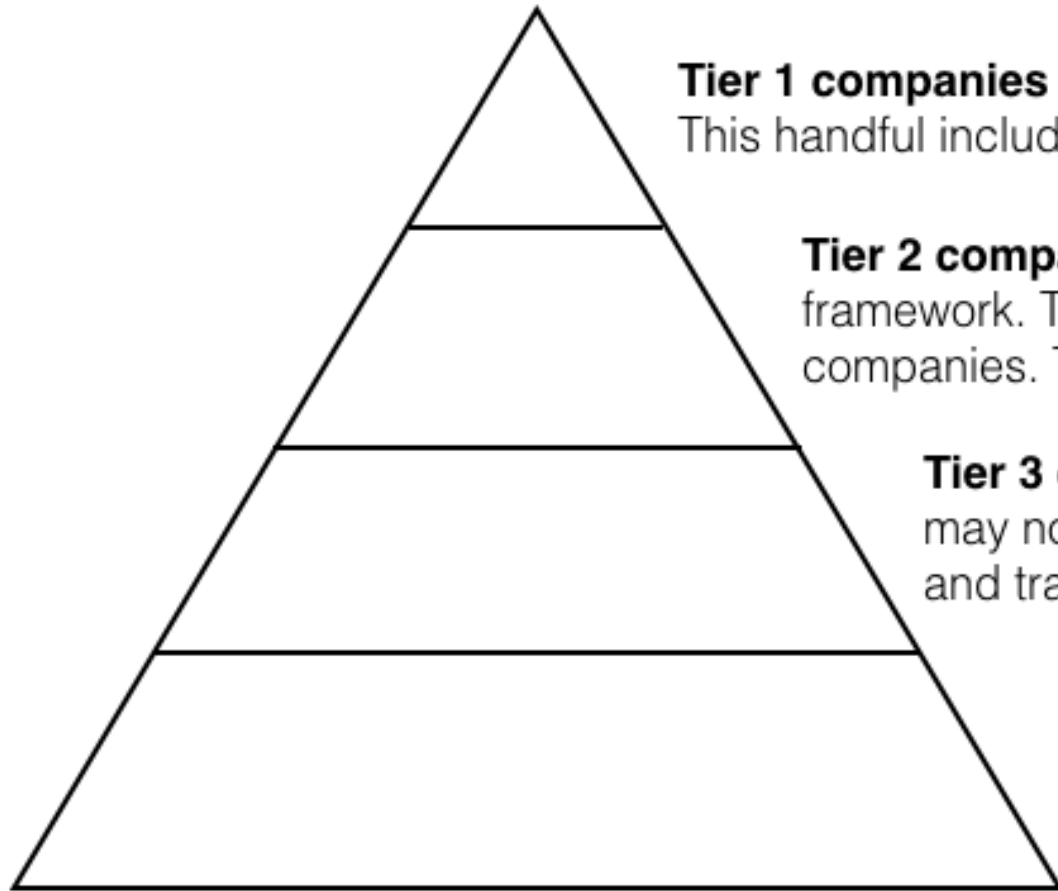
FROM BI TO AI

**Superhuman accuracy
in machine perception**

THE TOP TECH COMPANIES ARE POWERED BY AI

- **Google (Alphabet)**
- **Facebook**
- **Amazon**
- **Microsoft**

THE REST WILL FOLLOW



Tier 1 companies have built their own deep-learning frameworks. This handful includes Google, Facebook, Microsoft, Amazon and Baidu.

Tier 2 companies build their own deep-learning solutions using an external framework. These include some financial, e-commerce, tech and telecom companies. They have quants and data scientists. Skymind can support them.

Tier 3 companies know how to gather, store and move data, but they may not have mastered deep learning. Skymind can build their solutions and train them.

Tier 4 companies outsource their data management or lack a complete data strategy and team. Skymind can point them to other resources to develop in-house skills and advise them on the best path forward.



CONSIDER ALPHABET

- **Q2 2017 rev = \$26B**
- **Up 23% YoY (constant currency)**
- **“Surge in mobile and video ad sales”**
- **But why are ad sales surging?**



WHAT'S AI?

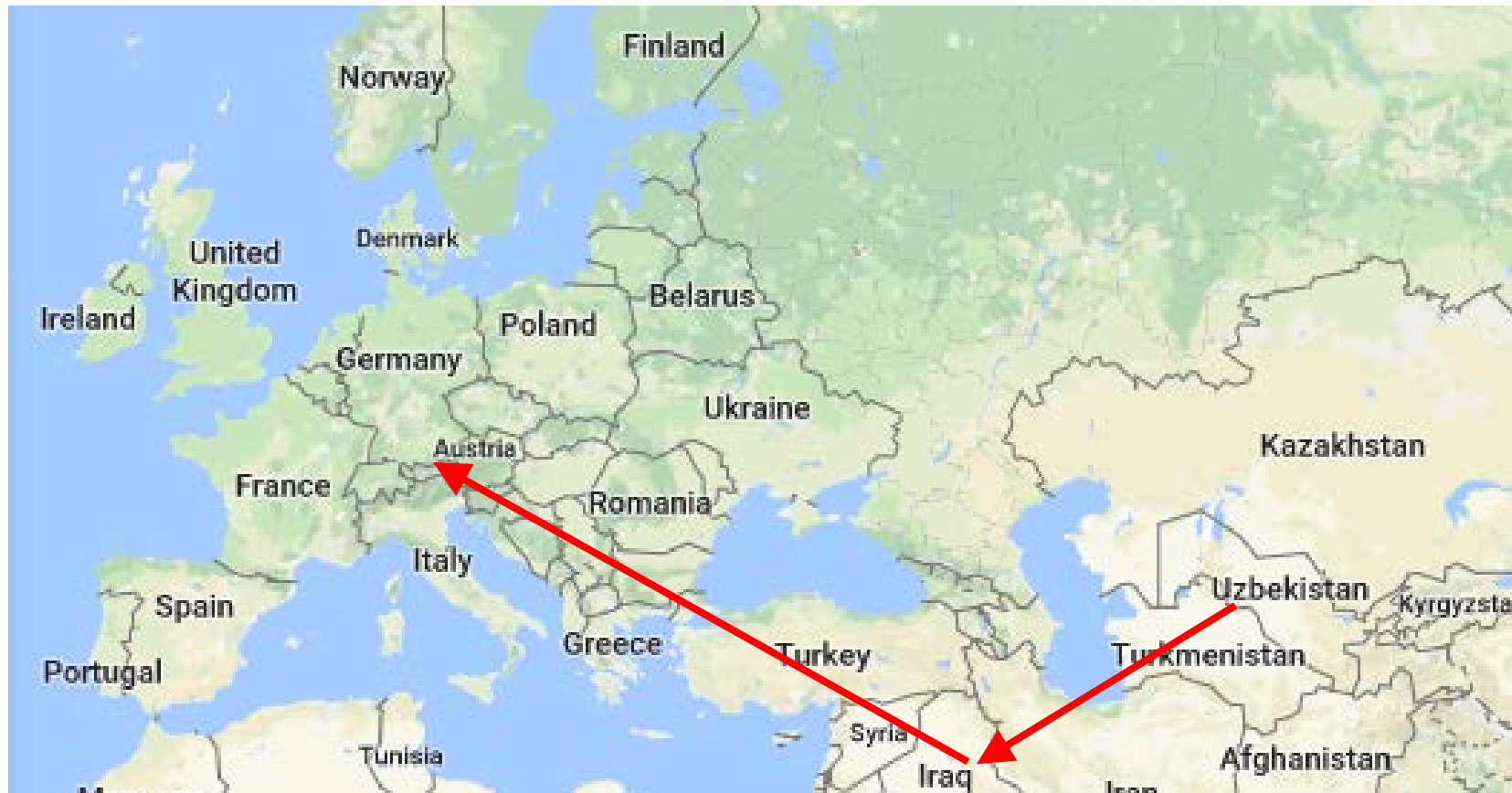
Algorithms

Algorithm: A City in Uzbekistan





Medieval Movement of Math



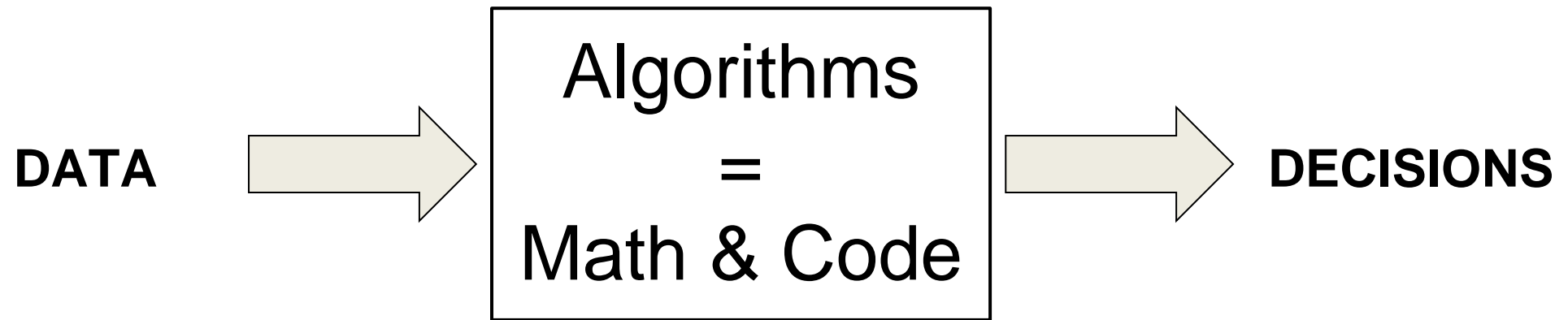


WHAT'S AI?

Algorithms
=
Math & Code



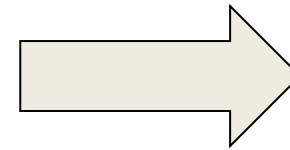
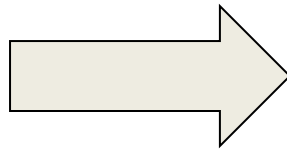
WHAT'S AI?





Human Perception

SENSATION

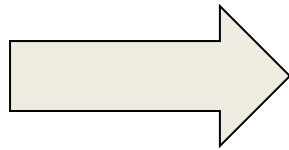


MEANING

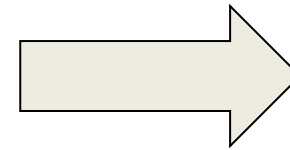


Machine Perception

DATA



$$f(x)$$

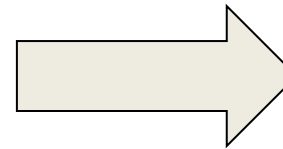


DECISIONS



Prerequisite: Digitization

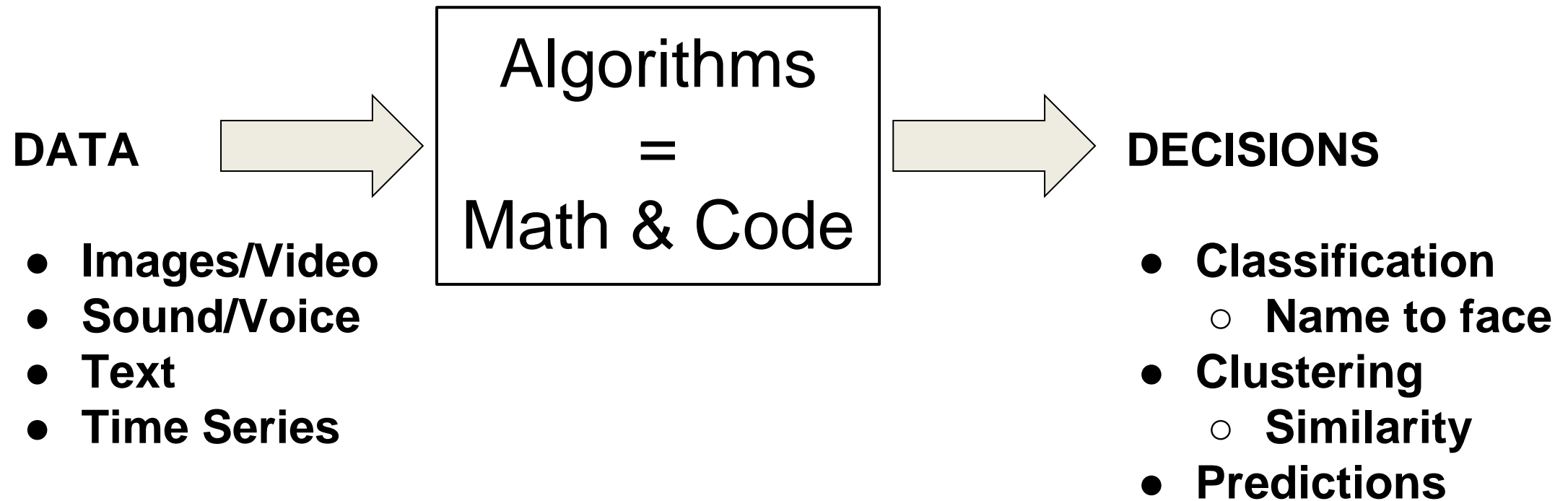
**ANALOG
(REAL LIFE)**



**NUMBERS
BITS
01001101**



WHAT'S AI?





“the team decided to enter the contest at the last minute and designed its software with *no specific knowledge* about how the molecules bind to their targets... working with a relatively *small set of data*”



Keith Penner

A student team led by the computer scientist Geoffrey E. Hinton used deep-

The technology, called deep learning, is used to use in services like Apple's Siri, which is based on Nuance's Dragon voice recognition service, and in Microsoft's machine vision to identify

But what is new in recent years is the accuracy of deep-learning neural networks or just "r" for "recognition" to the neural connections

“There has been a number of stunning new results with deep-learning methods,” said Yann LeCun, a computer scientist at New York University who did pioneering research in handwriting recognition at Bell Laboratories.

A screenshot of the New York Times website. The browser address bar shows the URL: www.nytimes.com/2012/11/24/science/scientists-see-advances-in-deep-learning. The page header includes navigation links: HOME PAGE, TODAY'S PAPER, VIDEO, MOST POPULAR, and U.S. Edition. The main title is "The New York Times" and the section is "Science". Below the title are more navigation links: WORLD, U.S., N.Y. / REGION, BUSINESS, TECHNOLOGY, SCIENCE, HEALTH, SPORTS, and ENVIRONMENT SPACE & COSMOS.

Scientists See Promise in Deep-Learning Programs

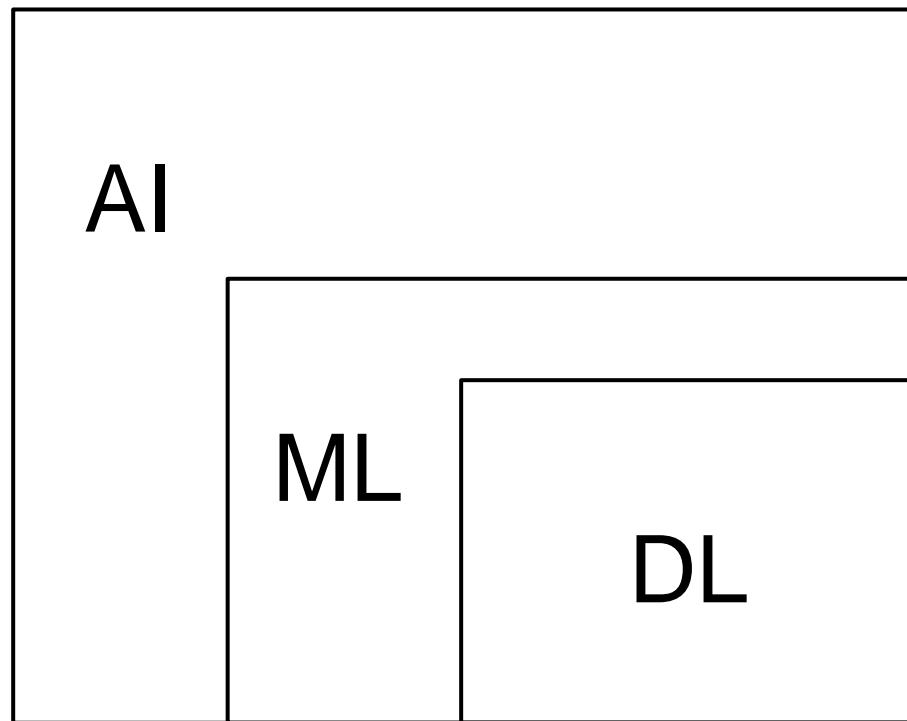


AI vs. ML vs. DL





AI vs. ML vs. DL



AI vs. ML vs. DL

- Good old-fashioned AI is based on rules (non-ML AI)
 - Rules tell a computer how to respond to different situations
 - Called expert systems or rules engines
 - Static
- Machine learning
 - ML algorithms adapt when exposed to new data
 - Self-adjusting to improve performance on narrowly defined tasks
 - Dynamic
- Deep learning
 - Computationally intensive
 - Superhuman accuracy
 - State of the art



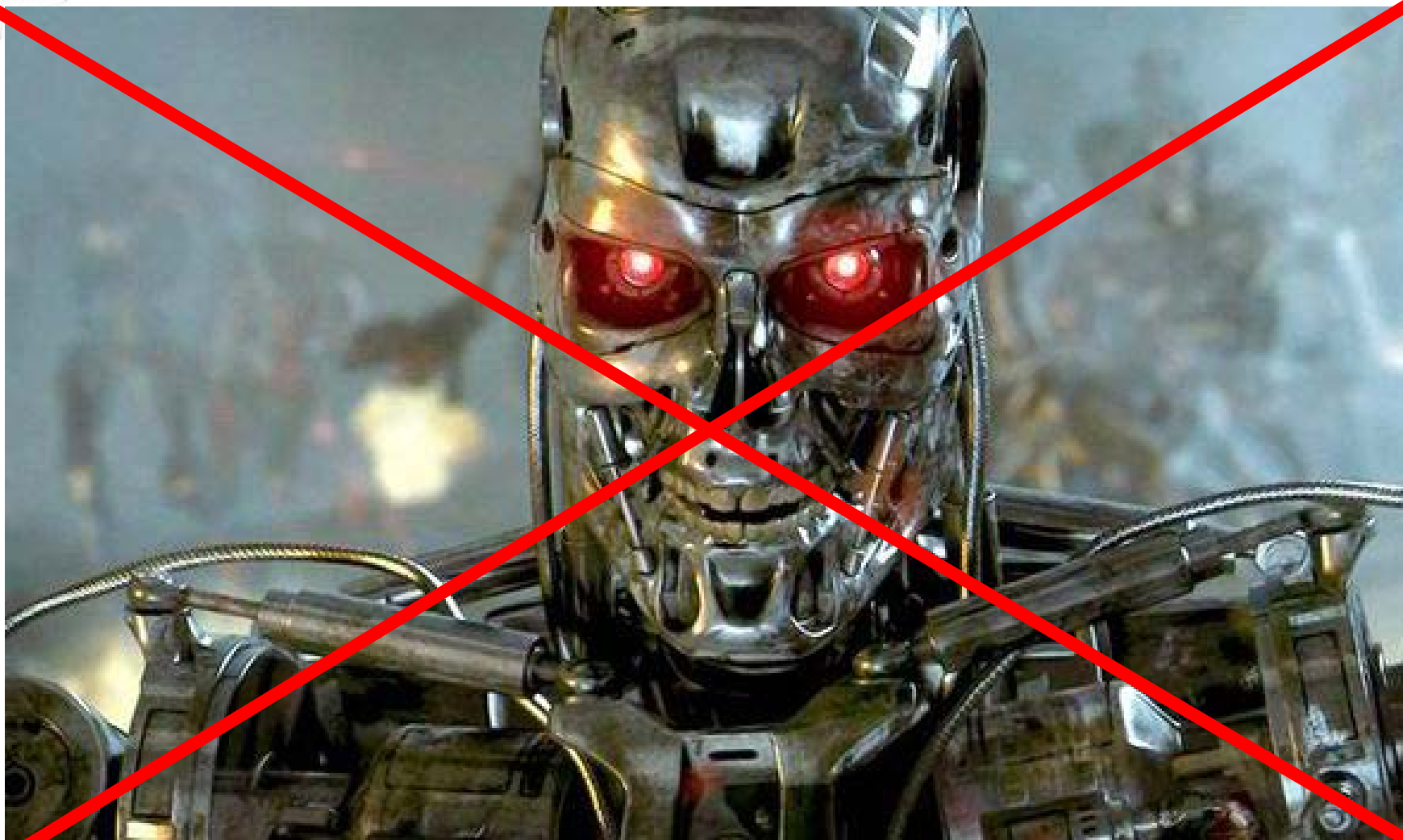
CAPABILITIES



**It's be hard to explain
the difference between
what's easy and
what's virtually impossible.**



What AI Isn't





Strong AI vs. Narrow AI

- Can outperform humans on every task
 - Is embodied
 - Has sense of self
 - Seeks to maximize chances of survival, domination
 - Is able to increase its own intelligence
- Solves one problem well

What AI Can Do



Super-human performance in Go, Texas Hold'em

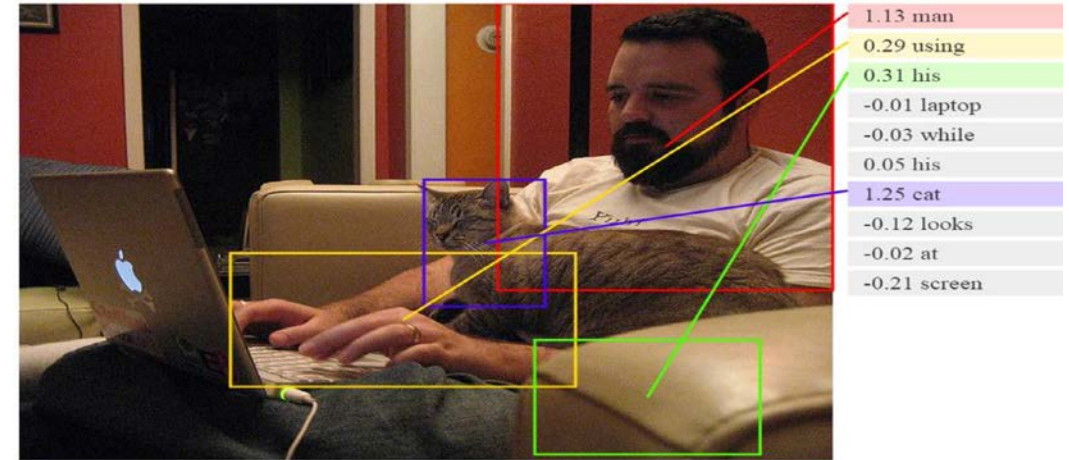


Image recognition and captioning



Machine language translation



Speech recognition and dialog systems



SKYPE TRANSLATE

Skype Translator

Break down language barriers with your friends, family and colleagues.

Our online translator can help you communicate more clearly. Our voice translator currently works in 8 languages, and our text translator is available in more than 50 languages for instant messaging.

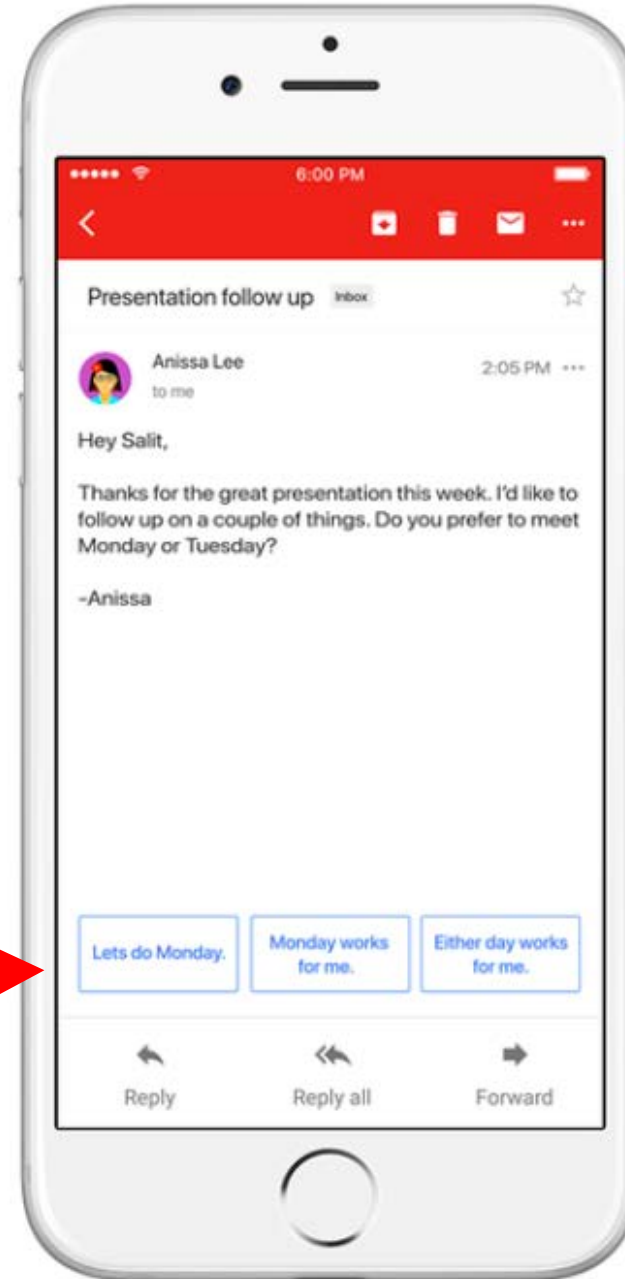
Skype Translator uses machine learning. So the more you use it, the better it gets.

Get Skype for
Windows desktop



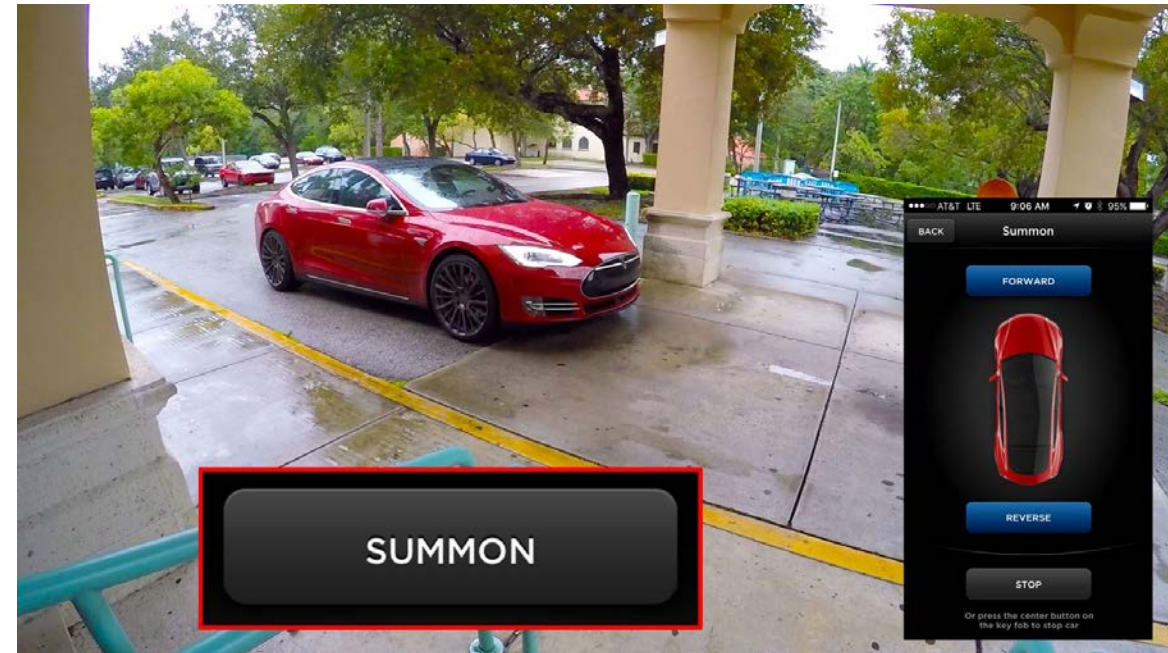


GOOGLE AUTO REPLY





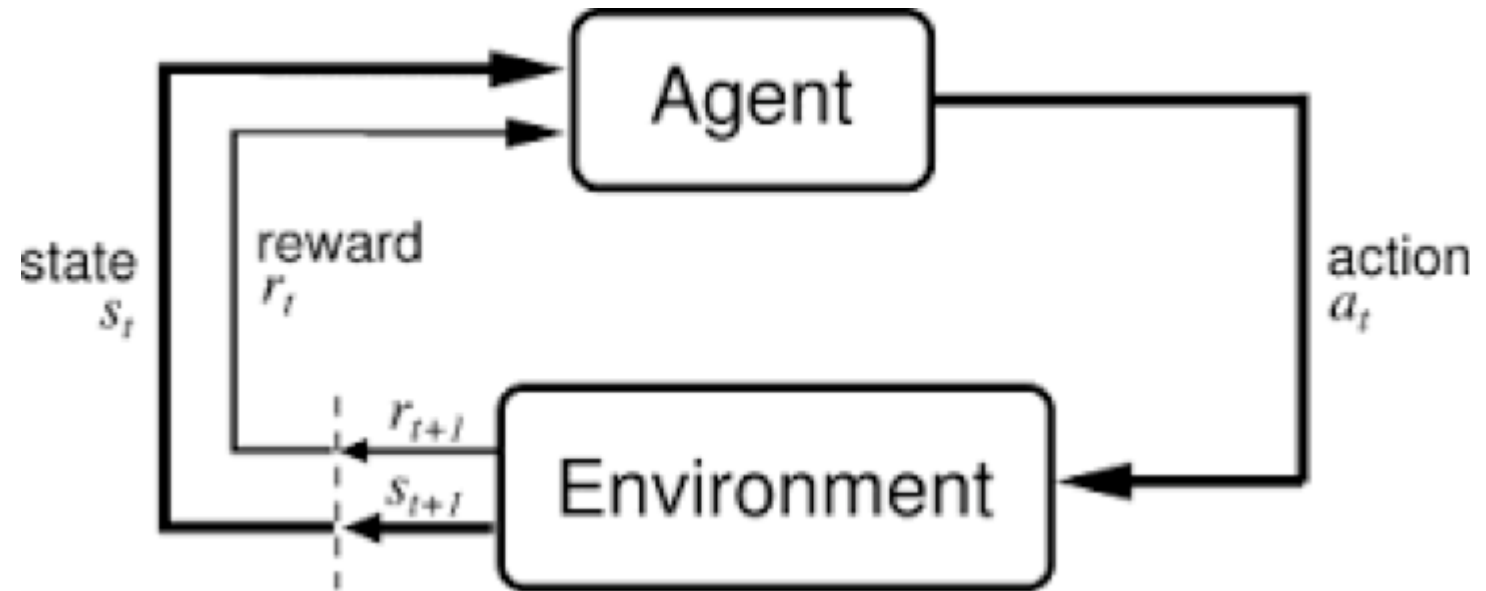
SELF-DRIVING CARS



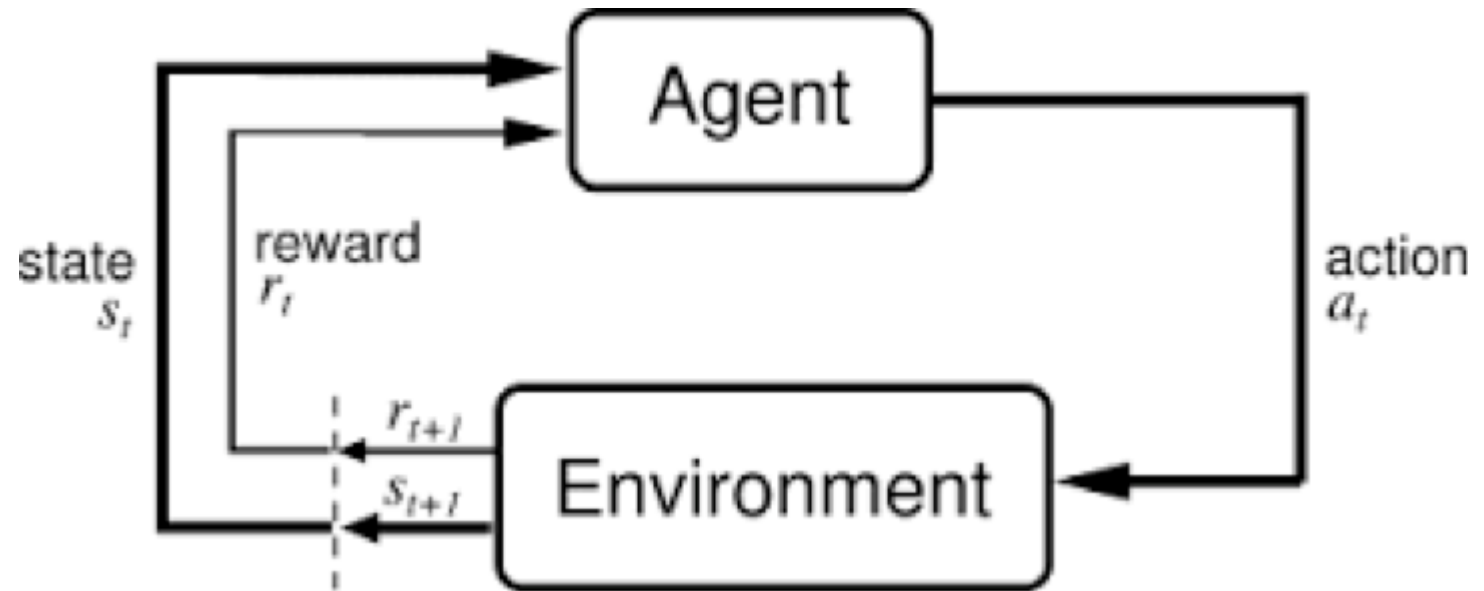
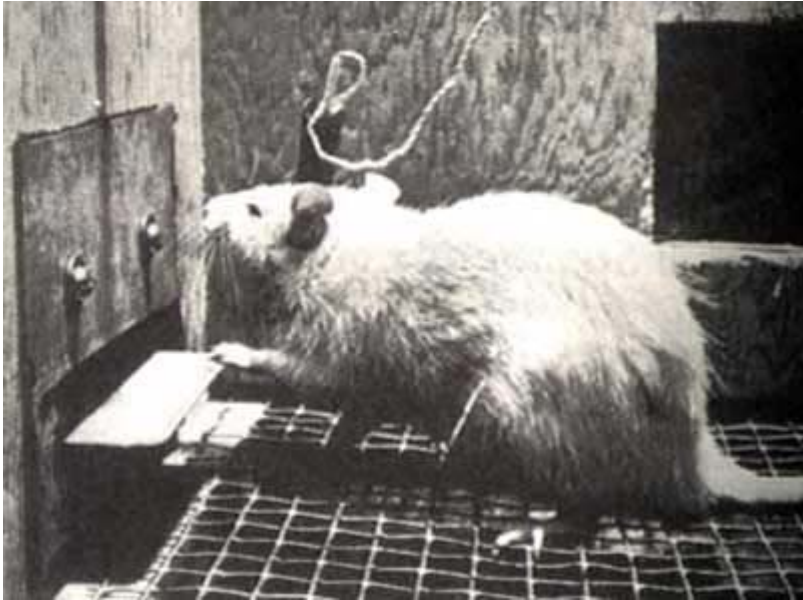
AUTONOMOUS DRONES



AlphaGo = DL + RL



Reinforcement Learning



CONSTRAINTS



TO BUILD AI YOU NEED 4 THINGS

- **Team**
- **Tools**
- **Data**
- **Infrastructure**

Team

- **Data Scientists/ML specialists**
 - **Analyze data, prototype models**
- **Data Engineers**
 - **Gather, move and store data**
- **DevOps**
 - **Maintain AI in production**

TOOLS

WHAT DOES ENTERPRISE NEED?

- **Open-source (Linux, Hadoop)**
- **Scalable, Containerized, Fast**
- **Integrates With Existing Tech (JVM)**
- **Cross-Team Solution (DevOps, Data Science)**
- **General-Purpose, Customizable Framework**



DATA

- **Deep learning needs data to train on**
- **That data must match the problem you want to solve**
- **If you lack labeled data (e.g. face, name), a labeled data set can be built**
- **The more, the better**

INFRASTRUCTURE

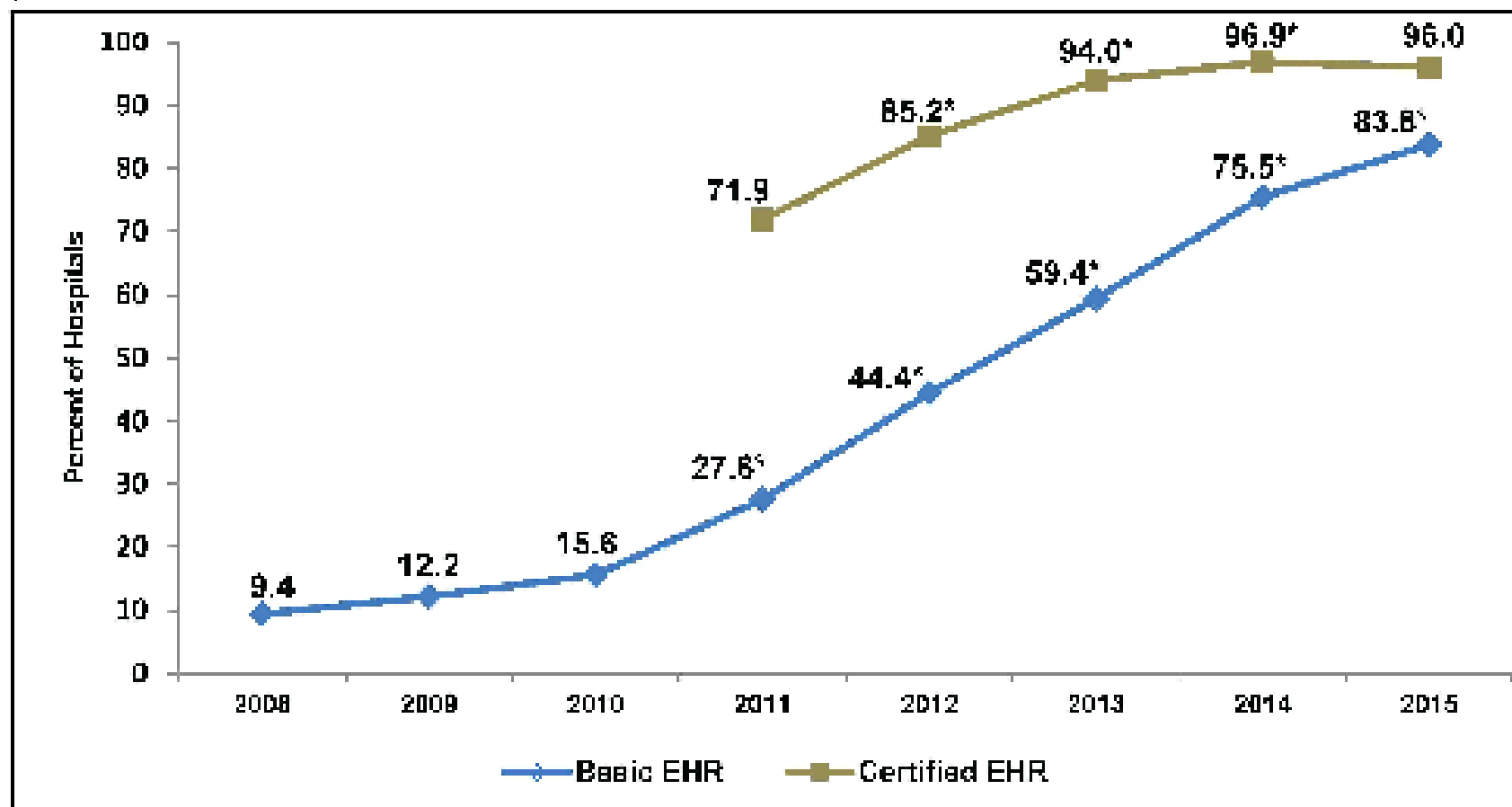
- **AI sits on top of the big data stack**
- **You need software that can gather, move and store data at scale**
- **E.g. Hadoop, Spark, Kafka, Elasticsearch**
- **And you need a hardware cluster for compute (GPUs will speed it up.)**



AI FOR HEALTHCARE

Explosion in digital health data: EHR adoption

Figure 1: Percent of non-Federal acute care hospitals with adoption of at least a Basic EHR with notes system and possession of a certified EHR: 2008-2015.

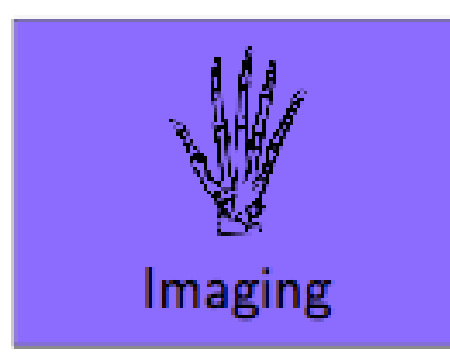
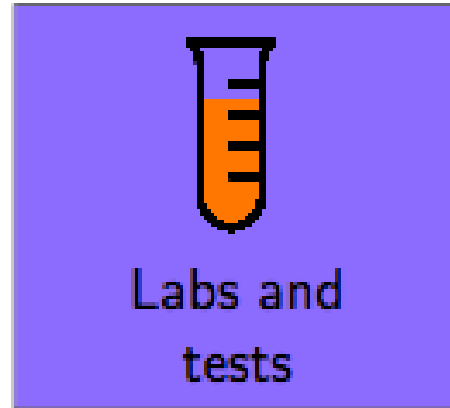


ONC Data Brief 35, May 2016

Explosion in digital health data: diversity of clinical data

Clinical EHR

Measured during clinical care



“The patient is data.”



The patient!

Randall Wetzel, Virtual PICU, Children's Hospital LA

Peering into the recurrent neural network

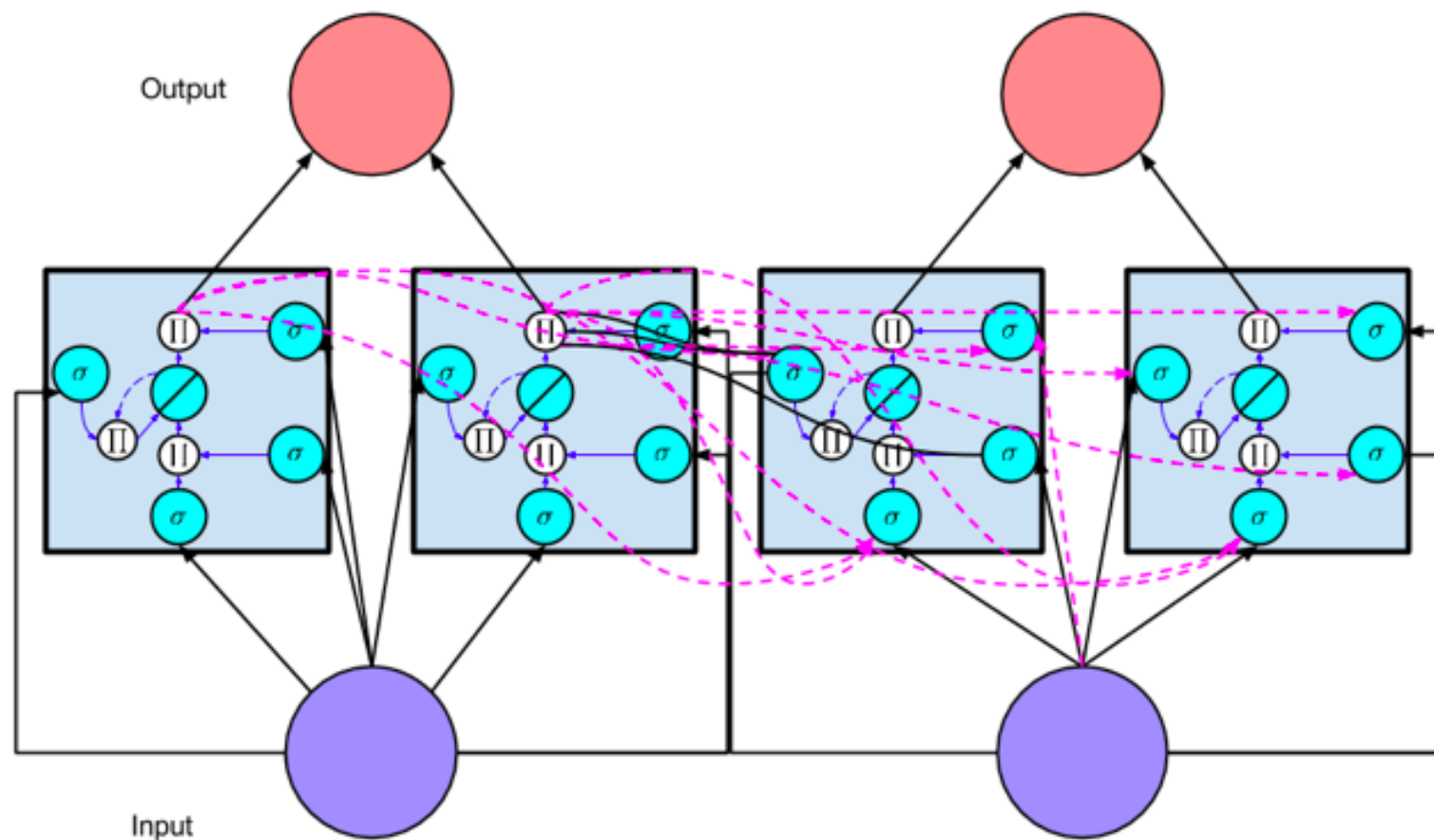


Figure courtesy of [Zack Lipton](#), Amazon/CMU



Dave Kale

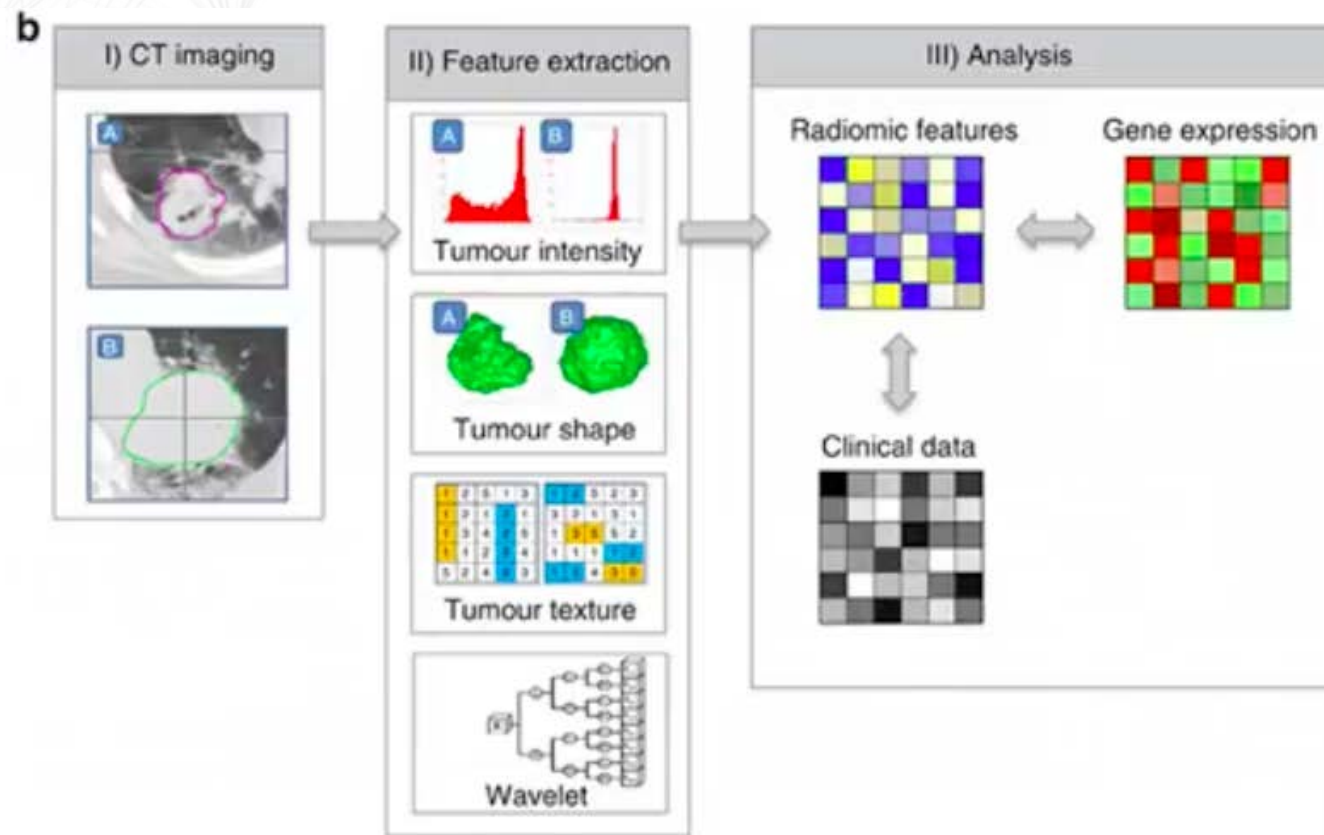
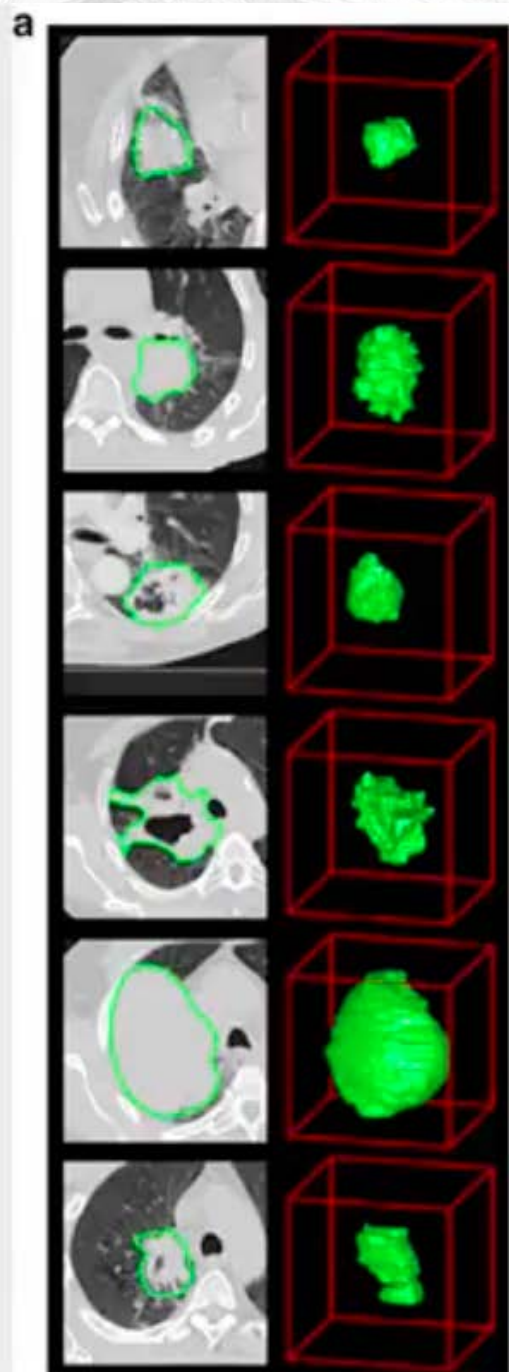
- PhD candidate, USC Information Sciences Institute
- Founder of Machine Learning for Healthcare (MLHC) Conference
- Deep Learning “Wizard” at Skymind

PhysioNet Challenge 2012 results

Model		AUC*
Kale, et al., AMIA 2015	SVM using hand-engineered features + features learned by MLP	0.8450
SkyMind + Cloudera	LSTM with raw time series + missing data indicators	0.8520
Johnson, et al., CinC 2012 (winner of Event 1)	Bayesian ensemble with hand-engineered features	0.8602

* AUCs not *directly comparable* due to use of different training/test split policies

PhysioNet Challenge 2012: <https://physionet.org/challenge/2012>



FUZHOU: NAT'L HEALTHCARE BIG DATA CENTER





WARNING & CALL TO ARMS





SKYMIND'S STORY

FOUNDERS (YC W16)

ADAM GIBSON, CTO



Deep learning @GalvanizeU

- Author: O'Reilly's "Deep learning: A Practitioner's Guide" Mar. 2016
- Speaker: Hadoop Summit, OSCon, Tech Planet, GigaOM
- 3x startup founder
- CS/Biz @Michigan Tech

CHRIS NICHOLSON, CEO



Sequoia's FutureAdvisor

- As a recruiter: Helped triple team through Series B to 45 staff
- As PR: Helped drive 45x rev. and AUM growth (\$650M in June 2015)
- *New York Times* correspondent covering tech, M&A: 2006-2011

Skymind circa 2013

Chris

Adam



Hacker House



COMPANY OVERVIEW



Founded
Funding
Clients

2014
\$6.3M
14 Enterprises
3,500 GH Forks, 7,100 Stars
300,000+ DL4J downloads/mo.

Team
PhDs

~35; mostly engineers; 6

BUSINESS MODEL

- **Red Hat for AI**
- **Custom deep learning solutions for Fortune 2000 corporations and governments using open-source software**
- **A commercially supported enterprise distribution of open-source software**

WHAT WE SELL

Services (Proof of Concept)

Custom deep learning model built by SkyMind.

Training

Corporate deep learning workshops led by a SkyMind instructor.

Support

Ongoing model support and maintenance.

SKYMIND TOOLS

Deeplearning4j

Build, train, and deploy neural networks on JVM

RL4J

Reinforcement learning algorithms on JVM

ND4J

High performance linear algebra CPU and GPU libraries

Arbiter

Hyperparameter search for optimizing neural networks

DataVec

Data ingestion, normalization, and vectorization

Model Import

Import and deploy neural networks trained in Caffe, Keras, TensorFlow & Theano



**DEEP LEARNING
FOR ENTERPRISE**

help@skymind.io