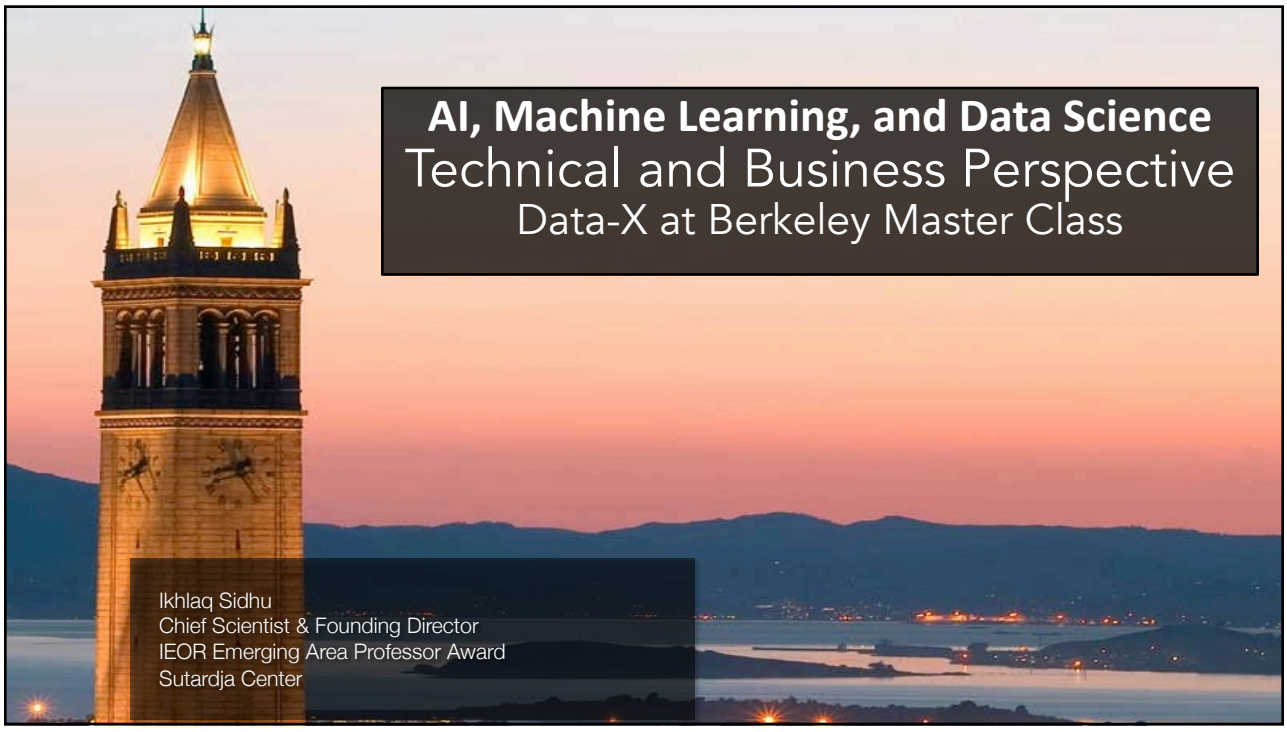


## An Overview of Data and AI Applications

Ikhlaq Sidhu, content author

# Basic Concept of Working with Data


- Data Wrangling
- In Production

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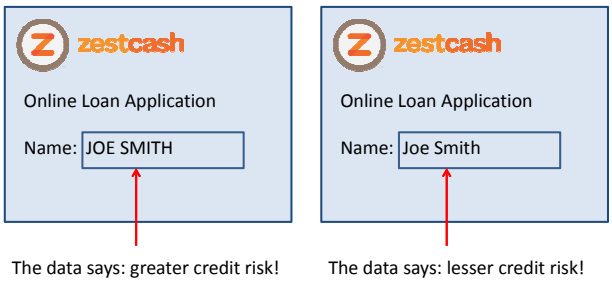
## Example: Data and Information is a competitive advantage

### Real-life Example: ZestCash

- "All data is credit data"

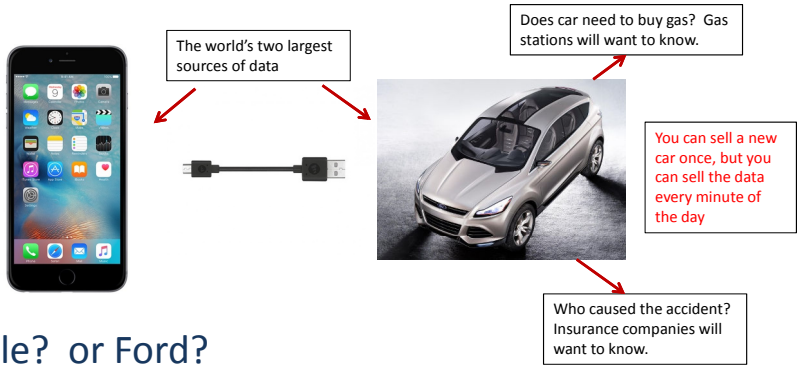



Reference: Shomit Ghose


## Why: More Simply

| Customer Insight/ Engagement | Operations: Reliable & Predictable | Security & Fraud |
|---|---|---|
| TARGET | GE, UPS | Compliance 360° |
| Harrah's | Walmart | Financial Firms |
| | | Network Security |

# Who Will Control the Automobile?




- Google? or Ford?
  - Whoever has the better software and data science team
  - Winner will get the vast (and incredibly valuable) streams of auto data

Shomit Ghose

Ikhlaq Sidhu, content author

# The Core of Every Business in Future is Data and AI

The two key components of a business are resources (assets) and information (data)

=


+

Information and automated decisions

Less value over time

More value Over time

If you buy data, then everyone else has it also.

Ikhlaq Sidhu, content author

## Data and AI Approaches

AI, Machine Learning, and Data Science

- What is Machine Learning, Data Science, and AI
- Today's technology in Industry

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## Implementation:
## SW Tools / Stack

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# The Most Common Open Source Tools: AI/ML Stack

Start with Python as an interface
Jupyter Notebooks for prototyping

- Python: The interface
- NumPy, SciPy: Working with Arrays
- Pandas: Working in Tables, SQL to Pandas
- Sklearn: ML
- Matplotlib: Visualizing Data
- TensorFlow, Keras: Neural Networks
- SQL to Pandas
- NLP / NLTK: Natural Language
- Spark: For large data sets (GB, TB+)


https://www.youtube.com/watch?v=Q0jGAZAdZqM

https://conda.io/docs/user-guide/install/download.html

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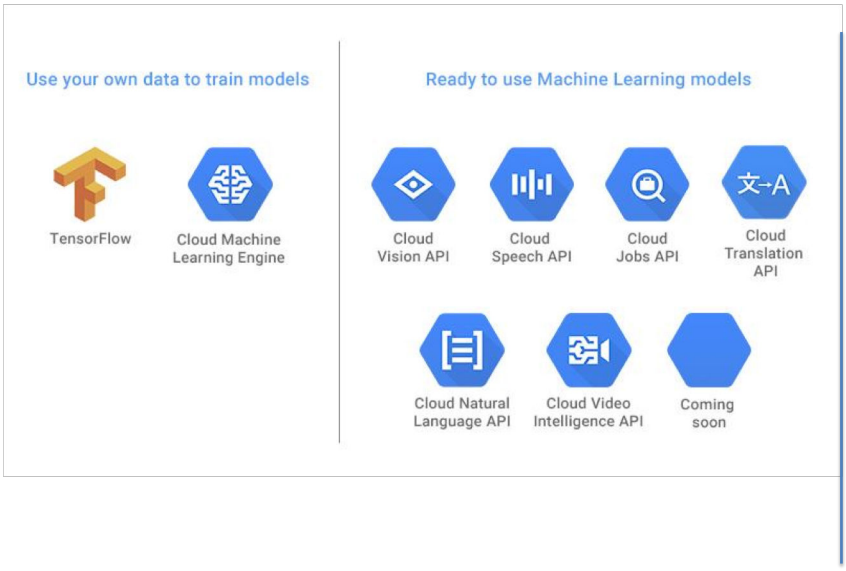
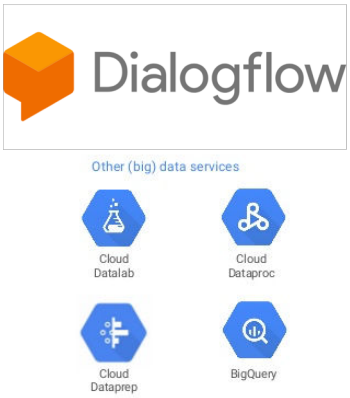
# API ML Tools

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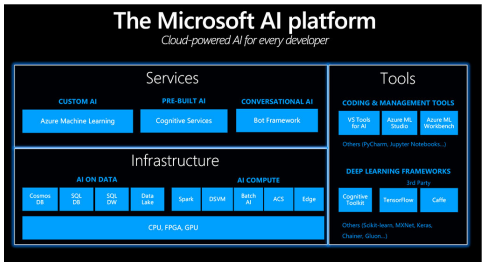


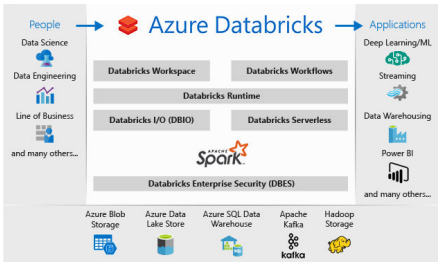


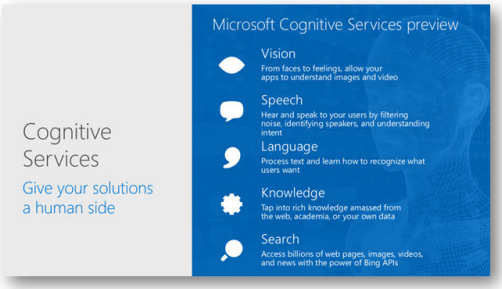


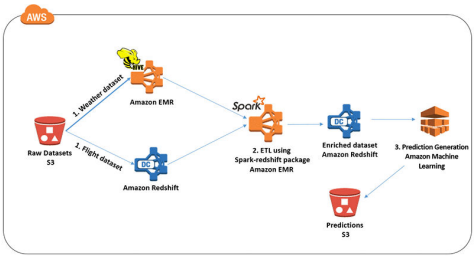


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## Where Does Data Come From?

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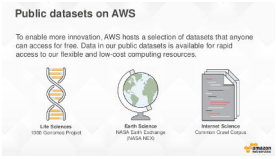
# Where Does Data Come From?

Real-life Example: ZestCash

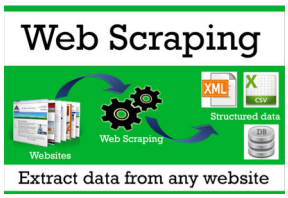
- "All data is credit data"


Your Own Web Site




Public Data Sets
Stock market, etc.

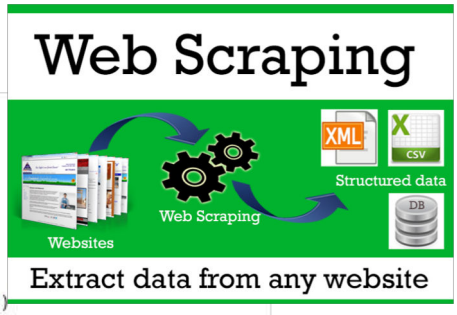
IOT/Sensors




Other Web Sites



## Web Scraping




```
from bs4 import BeautifulSoup
import requests
page_link ='https://www.website_to_crawl.com'
# fetch the content from url
page_response = requests.get(page_link, timeout=5)
# parse html
page_content = BeautifulSoup(page_response.content, "html.parser")

# extract all html elements where price is stored
prices = page_content.find_all(class_='main_price')
# prices has a form:
#[<div class="main_price">Price: $66.68</div>,
# <div class="main_price">Price: $56.68</div>]

# you can also access the main_price class by specifying the tag of the class
prices = page_content.find_all('div', attrs={'class':'main_price'})
```

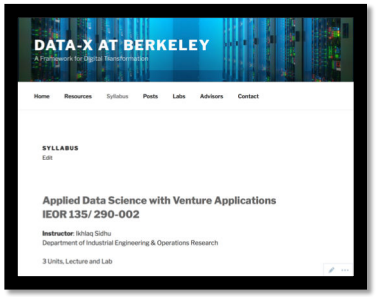
https://github.com/ikhlaqsidhu/data-x

https://github.com/ikhlaqsidhu/data-x/tree/master/03-tools-webscraping-crawling_api_afo

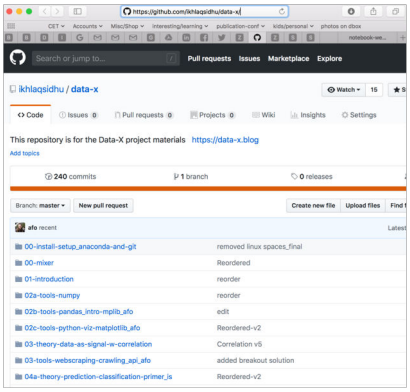
## Many Course Resources Are Already Available at

For students and mentors

- Lectures and Slides
- Code Samples
- Articles and Readings
- Projects
- Mentors




data-x.blog




https://github.com/ikhlaqsidhu/data-x/

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## Formatting Data

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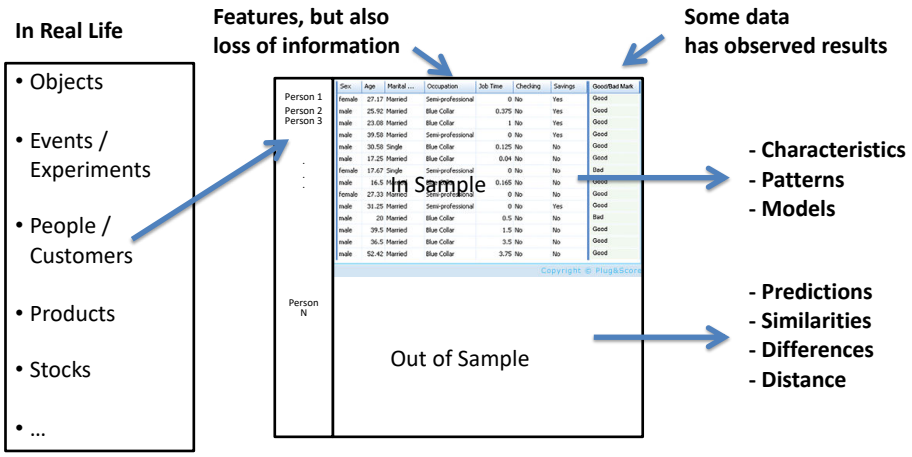
# An ML High Level Framework

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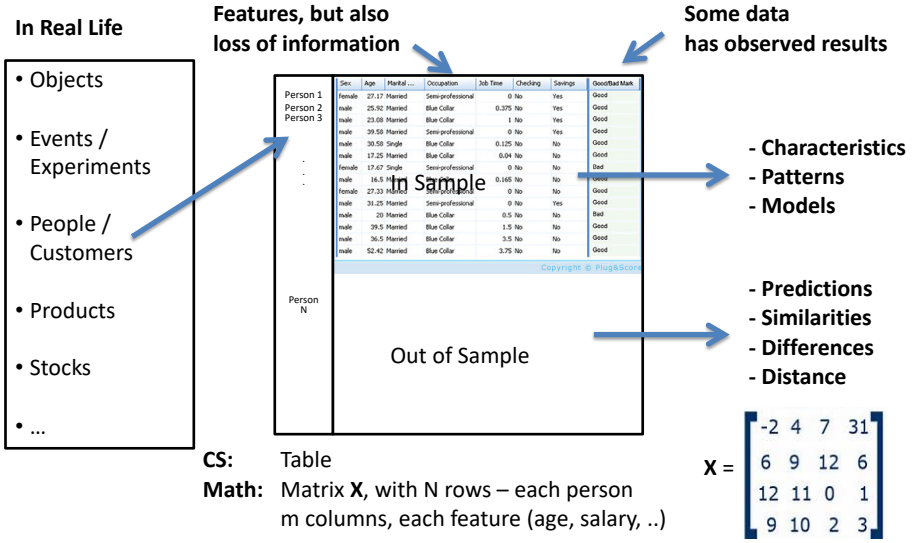
# An ML High Level Framework




**CS:** Table

**Math:** Matrix **X**, with N rows – each person
m columns, each feature (age, salary, ..)

$$\mathbf{X} = \begin{bmatrix} -2 & 4 & 7 & 31 \\ 6 & 9 & 12 & 6 \\ 12 & 11 & 0 & 1 \\ 9 & 10 & 2 & 3 \end{bmatrix}$$

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# A Fundamental Idea: From Table to Score

X =

| Cust | F1 | F2 | F3 |
|---|---|---|---|
| A | 4 | 2 | 2 |
| B | 4.5 | 1.5 | 3 |
| C | 3 | 3 | 5 |
| D | 1 | 2 | 2 |
| E | 3 | 1.5 | 5 |
| F | 3.5 | 3.5 | 1 |
| .. | .. | .. | .. |

X

F(X) →

| Cust | Credit Score |
|---|---|
| A | 552 |
| B | 381 |
| C | 760 |
| D | 330 |
| E | 452 |
| F | 678 |
| .. | .. |

Y

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# A Fundamental Idea: From Table to Score

X =

| Cust | F1 | F2 | F3 |
|---|---|---|---|
| A | 4 | 2 | 2 |
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| .. | .. | .. | .. |

X

F(X) →

| Cust | Credit Score |
|---|---|
| A | 552 |
| B | 381 |
| C | 760 |
| D | 330 |
| E | 452 |
| F | 678 |
| .. | .. |

Y

```
#Setting up for Supervised learning
# First clean: use mapping + buckets

# X = matrix of data – e.g 1000 rows
# Y = In sample responses

# Typically we want to split in to training data and test data

X_train = X[0:500]
Y_train = Y[0:500]
X_test = X[501:1000]
Y_test = Y[501:1000]
```

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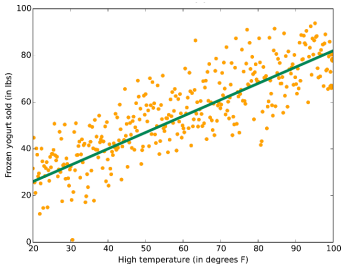
## Linear Regression Illustration




```
#Setting Linear Regression in sklearn
from sklearn import linear_model

model= linear_model.LinearRegression()
model.fit(X_train, Y_train)

Y_pred_train =  model.predict(X_train)
Y_pred_test =  model.predict(X_test)


# Compare Y_pred_test with Y_test for
error.
```

Illustration Source: https://docs.microsoft.com/en-us/azure/machine-learning/machine-learning-algorithm-choice

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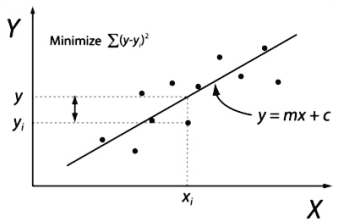
## Prediction

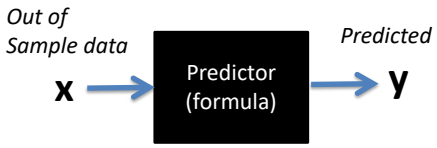
Data We Might Have (In Sample)

| X | Y |
|---|---|
| 2 | 3 |
| 5 | 9 |
| 6 | 11 |
| 8 | ? |
| 10 | ? |
| ? | ? |

Data View




Math View




**Our Goal:** Working with *out of sample data*

Systems View

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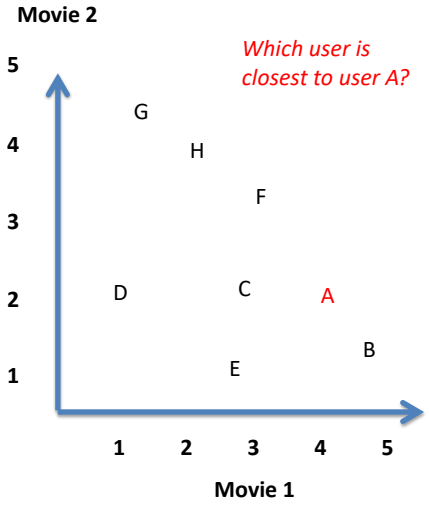
## A Fundamental Idea: From Table to N- Dimensional Space

X =

| Element | F1 | F2 | F3 |
|---|---|---|---|
| A | 4 | 2 | 2 |
| B | 4.5 | 1.5 | 3 |
| C | 3 | 3 | 5 |
| D | 1 | 2 | 2 |
| E | 3 | 1.5 | 5 |
| F | 3.5 | 3.5 | 1 |
| .. | .. | .. | .. |

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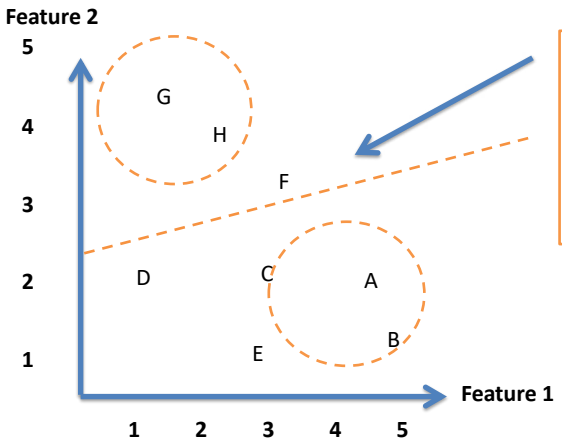
## Clustering to Classification




- Target customers?
- Pictures of Cats and Dogs
- Speech recognition
- Recognize Letters: A, B, C..

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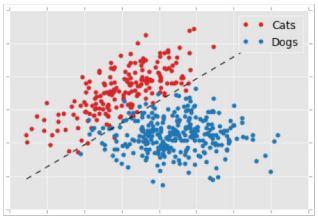
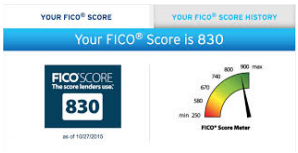
# Traditionally 2 Tasks: Classification & Predictive Scoring

Extracted Data often in Table Format




Classification:
Cats and Dogs, Speech Recognition
Movie Recommendation




Scoring:
Credit Score, Movie Rating
Heath Score, Any Isoquant…


The most famous application has been recommendation: "which other user is most like you"

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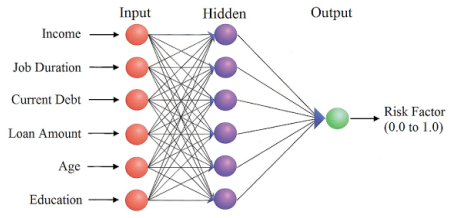
# We have now switched to Neural Networks as Function Approximators

X → ML Algorithms Guess this function F(x) → Y

"Non-deep" feedforward neural network

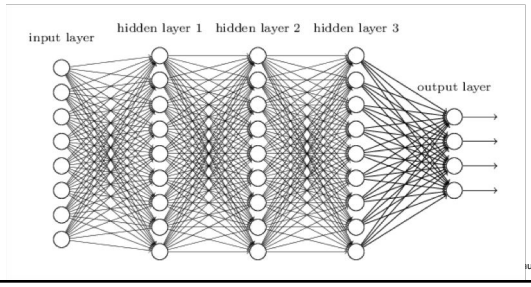
X



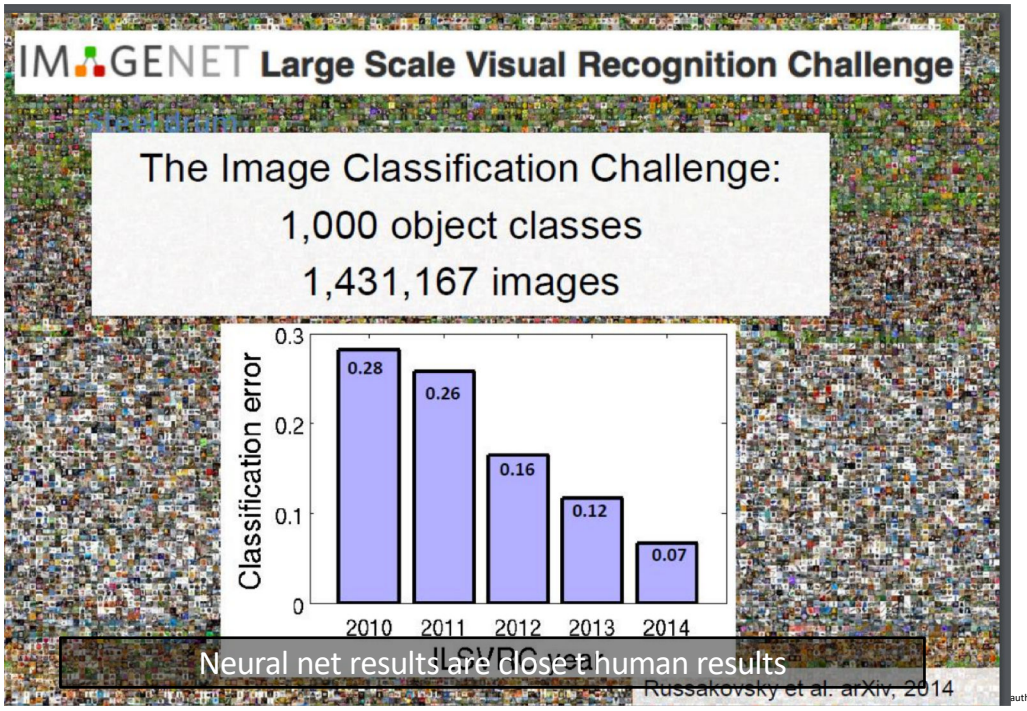

Y

Deep neural network

X




Y



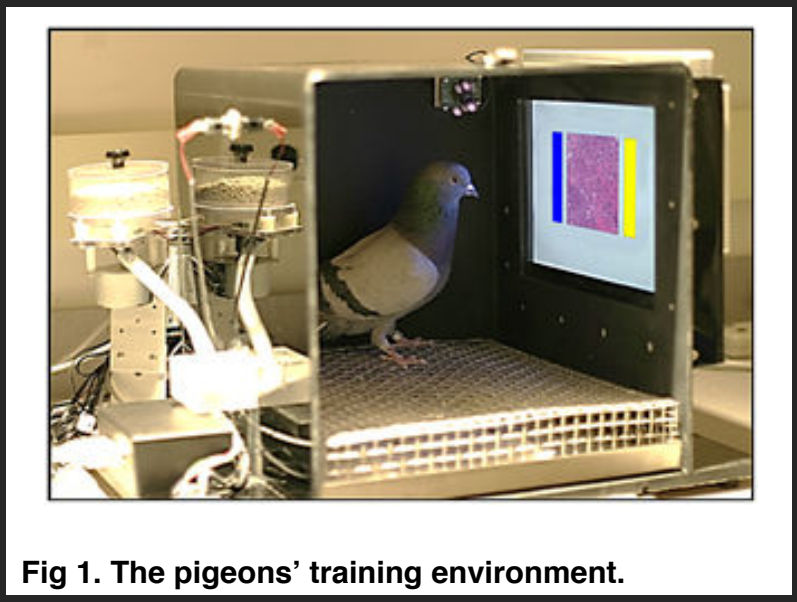



**Fig 1. The pigeons' training environment.**

# Data and AI Future Directions

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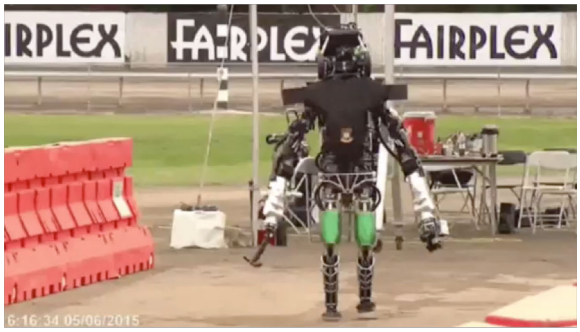
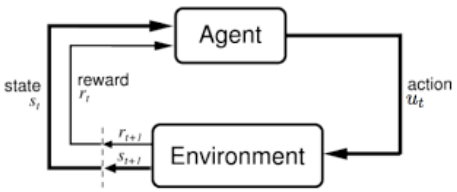
## Peter Abbeel – Deep Reinforcement Learning

Peter Abbeel
Professor at UC Berkeley

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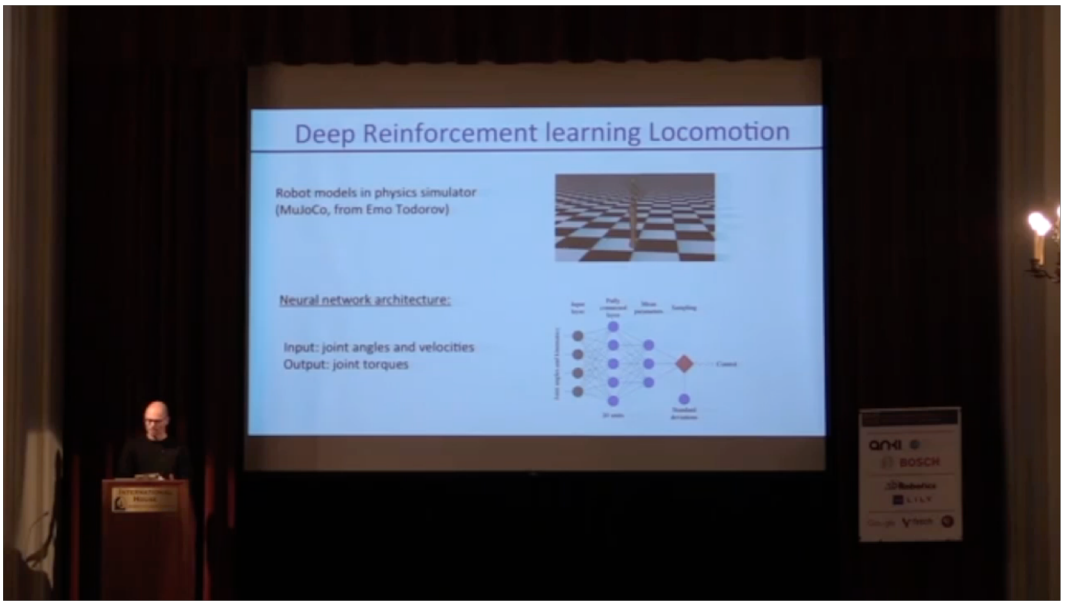


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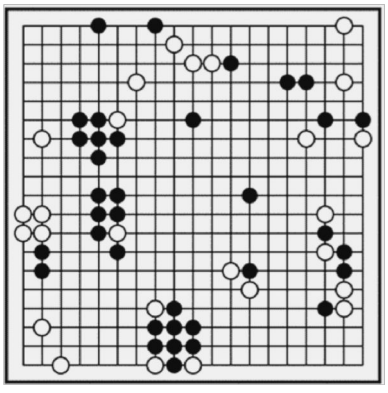
## Recent AI News

Source: Ken Goldberg, CPAR, People and Robotics Initiative

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## Does this mean AI Can Do Everything Better than Humans

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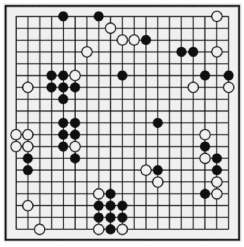
## Even then, AI Cannot Solve Real Life Problems Better Than Humans And in fact, AI Can not even Work without Humans

Ken Goldberg
Leading AI Researcher at Berkeley

Professor and Department Chair, IEOR

William S. Floyd Jr. Distinguished Chair



discrete single agent
fully observed finite

continuous multi-agent
uncertain infinite time horizon

Ken Goldberg UC Berkeley

Ikhlaq Sidhu, content author

## AI Systems Only Work because of Human are Part of the System

### Google Operations

Massive Data

Result

Feedback By clicks

People Write Web Pages

People at Google Tune the Results

People Click on What They Want

There is no “Intelligence”, “Desire”, or “Existence” in AI without People
There are only people who “invest in, design and operate the machines”

Acknowledgement to Ken Goldberg UC Berkeley

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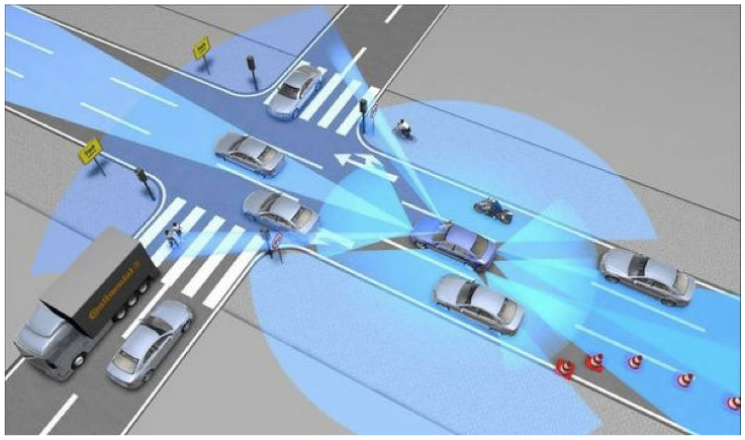
My Drive Home From Berkeley


## Autonomous Driving and Driver-Assist



- Communicating intent
- Driver-in-the-loop modeling
- Two-way learning: knowledge transfer between vehicle and driver
- Safety in autonomous and assisted driving

Principal investigators:


**Trevor Darrell**
UC Berkeley


**Anca Dragan**
UC Berkeley

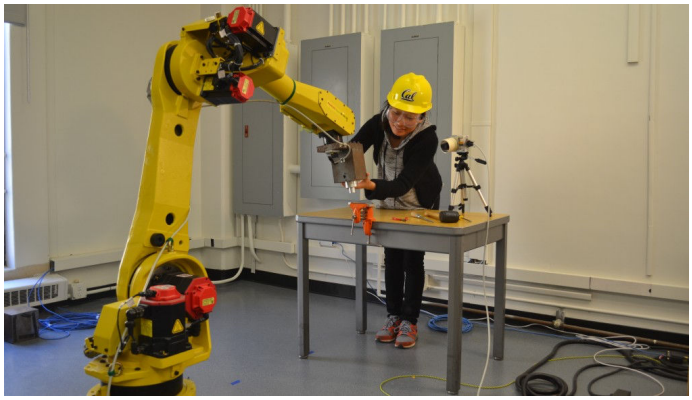

**Ken Goldberg**
UC Berkeley


**Ruzena Bajcsy**
UC Berkeley


**Francesco Borrelli**
UC Berkeley

Source: Ken Goldberg, CPAR, People and Robotics Initiative

# Safety in Human-Robot Interaction: Guarantees and Verification



Safety-constrained motion planning for efficiency in factory human-robot interaction

Learning and prediction for safety in HRI

Provably safe human-centric autonomy

Principal investigators:

**Claire Tomlin**
UC Berkeley

**Masayoshi Tomizuka**
UC Berkeley

**Francesco Borrelli**
UC Berkeley

Source: Ken Goldberg, CPAR, People and Robotics Initiative

# Most Common Data/AI Research Trends in 2017

- Large-scale machine learning - amounts of data
- Deep learning - recognition, classification
- Reinforcement learning - time sequence, aided by Neural Networks
- Robotics - beyond navigation, to safe interaction
- Computer vision - most prominent perception, better than human
- Natural Language Processing - interacting with people/dialog
- Collaborative systems - autonomous systems w/people + machines using complimentary functions
- Crowdsourcing and human computation – harness human intelligence, uses other AI, vision, ML, NLP, …
- Algorithmic game theory and computational social choice – systems using social computing, incentives, prediction markets, game theory, peer prediction, scoring rules, no regret learning
- Internet of Things (IoT) – using AI to unravel sensory information, interfaces, and protocols
- Neuromorphic Computing – new computing fabrics based on biological models

http://ai100.stanford.edu/2016-report

→ New Data/AI Systems

Ikhlaq Sidhu, content author

# Semantics for AI

## AI Umbrella

### II: Intelligent Infrastructure

A web on computation, data, and physical entities that make the human environment more supportive, interesting, & safe.

### IA: Intelligent Automation

Computation and data are used to create services that augment human intelligence and creativity

Michael Jordan, UC Berkeley

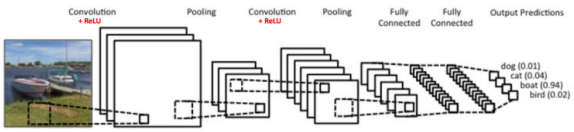
Ikhlaq Sidhu, content author

## Unsupervised Image to Image

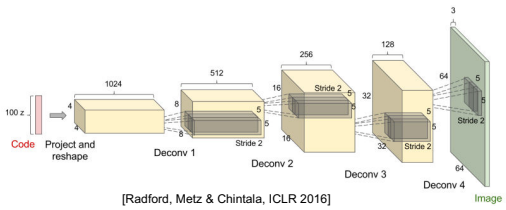
[CycleGAN: Zhu, Park, Isola & Efros, 2017]

Pieter Abbeel -- UC Berkeley | Gradescope | Covariant.AI

Typical CNN converts image to output vector of features




- Ability to generate data *that look real* entails some form of understanding




[Radford, Metz & Chintala, ICLR 2016]

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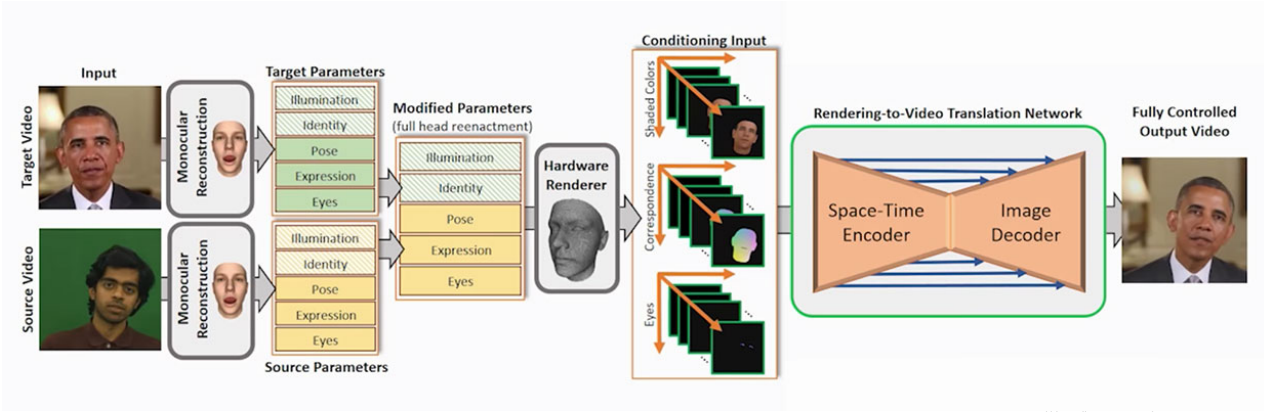
IEEE SPECTRUM

# Experts Bet on First Deepfakes Political Scandal

Researchers wager on a possible Deepfake video scandal during the 2018 U.S. midterm elections

By **Jeremy Hsu**

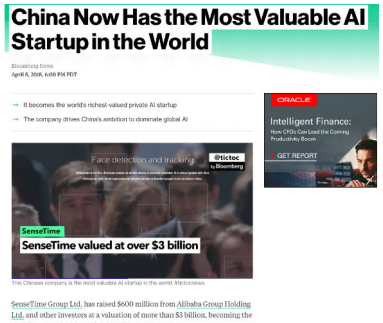



Ikhlaq Sidhu, content author

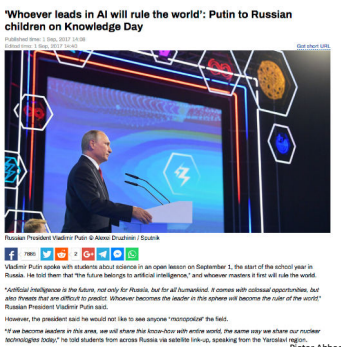
## Large Investment and Valuations

FINANCE • SELF-DRIVING CARS

### GM Buying Self-Driving Tech Startup for More Than $1 Billion




SenseTime Group Ltd. has raised $600 million from Alibaba Group Holding Ltd. and other investors at a valuation of more than $3 billion, becoming the world's most valuable artificial intelligence startup.


Vladimir Putin spoke with students about science in an open lesson on September 1, the start of the school year in Russia. He told them that 'the future belongs to artificial intelligence,' and whoever masters it first will rule the world.

"Artificial intelligence is the future, not only for Russia, but for all humankind. It comes with colossal opportunities, but also threats that are difficult to predict. Whoever becomes the leader in this sphere will become the ruler of the world," Russian President Vladimir Putin said.

However, the president said he would not like to see anyone "monopolize" the field.

"If we become leaders in this area, we will share this know-how with entire world, the same way we share our nuclear technologies today," he told students from across Russia via satellite link-up, speaking from the Yaroslavl region.

TECHNOLOGY NEWS JANUARY 2, 2018 / 11:02 PM / 3 MONTHS AGO

### Beijing to build $2 billion AI research park: Xinhua

Reuters Staff 2 MIN READ

BEIJING (Reuters) - Beijing is planning to build a 13.8 billion yuan ($2.12 billion) artificial intelligence development park in the city's west, the official Xinhua news agency reported, as China pushes ahead to fulfill its ambition to become a world leader in AI by 2025.

The AI park will house up to 400 enterprises and have an estimated annual output of 50 billion yuan, Xinhua said, citing a report from authorities in Beijing's Mentougou district.

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