



# Artificial Intelligence: The Big Picture

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# A.I. Job Postings vs. Searches



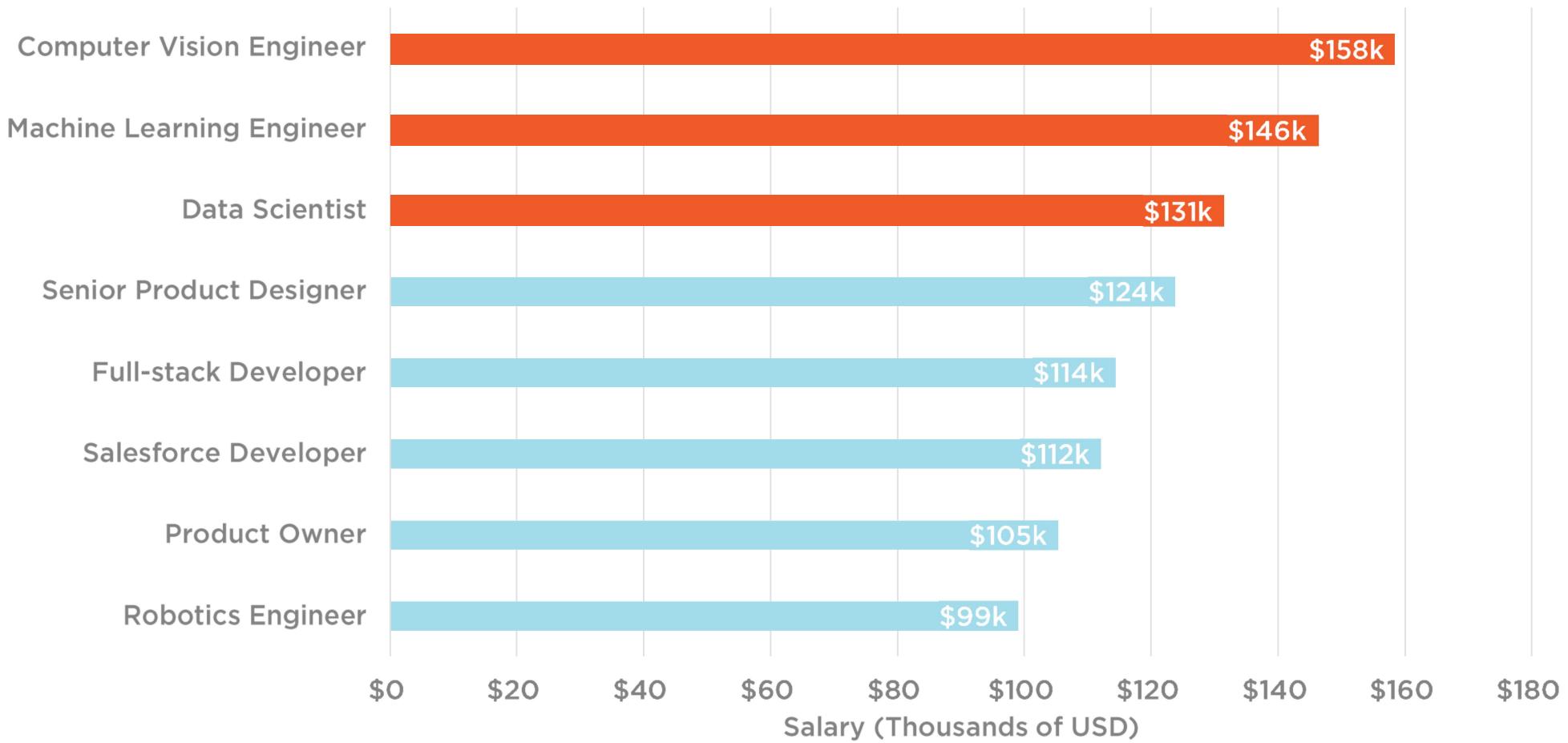
Source: Indeed.com, Reuters, Ann Saphir

# A.I. Job Postings vs. Searches



Source: Indeed.com, Reuters, Ann Saphir

# Salary by Job Type (USA)



Source: Indeed's Best Jobs of 2019

What is A.I.?

Why is it important?

Where should I start?

# Overview



**Artificial Intelligence**

**History of A.I.**

**Modern A.I.**

**A.I. and I.T.**

**Future of A.I.**

# Audience

**Software  
developers**

**IT  
professionals**

**Executives  
and  
managers**

# Artificial Intelligence

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# Overview



**Intelligence**

**Artificial Intelligence**

**Types of A.I.**

**Components of A.I.**

**Applications of A.I.**

Intelligence

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# Intelligence

**“The ability to acquire  
and apply knowledge.”**

**“The ability to learn  
or understand.”**

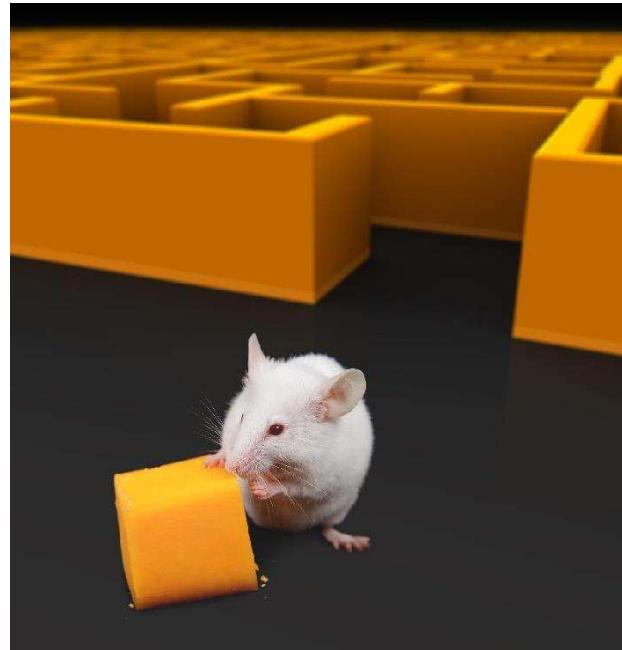
**“Goal-directed  
adaptive behavior.”**

**“The ability to deal with  
cognitive complexity.”**

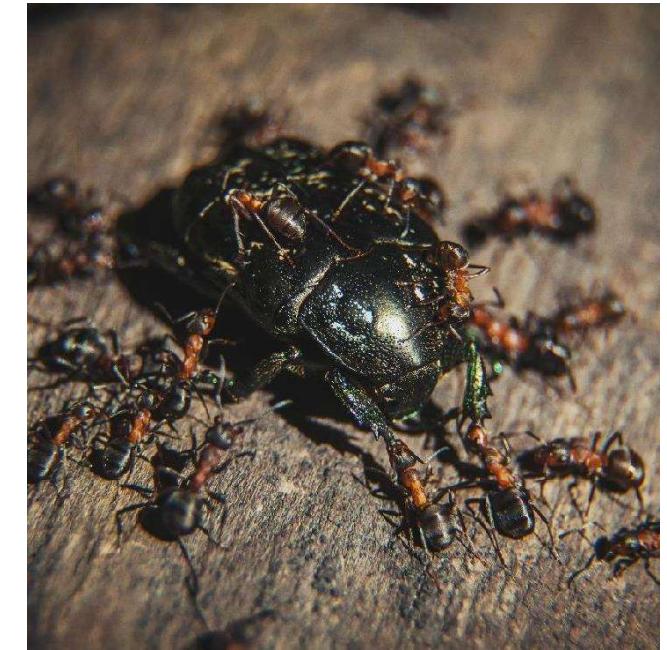
# Examples of Intelligence



Human intelligence



Animal intelligence



Collective intelligence

# Examples of Intelligence

Agent



Human

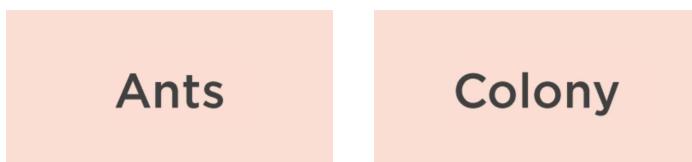
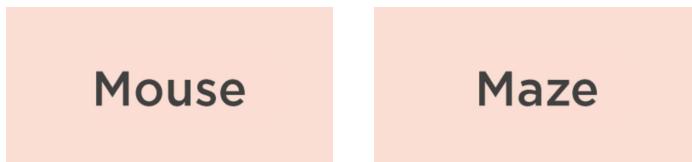
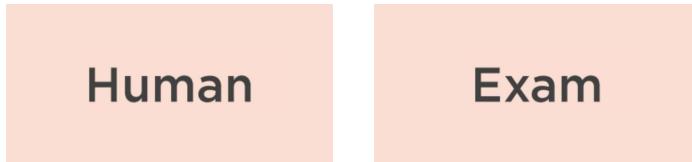


Mouse



Ants

# Examples of Intelligence



# Examples of Intelligence

Agent	Environment	Goal
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Human

Exam

Pass



Mouse

Maze

Cheese



Ants

Colony

Protect

# Examples of Intelligence

Agent	Environment	Goal	Perception
	Human	Exam	Pass
	Mouse	Maze	Cheese
	Ants	Colony	Protect
			Read
			See
			Smell

# Examples of Intelligence

Agent	Environment	Goal	Perception	Action	
	Human	Exam	Pass	Read	Solve
	Mouse	Maze	Cheese	See	Navigate
	Ants	Colony	Protect	Smell	Attack

# Examples of Intelligence

Agent	Environment	Goal	Perception	Action
 Human	Exam	Pass	Read	Solve
 Mouse	Maze	Cheese	See	Navigate
 Ants	Colony	Protect	Smell	Attack

# Intelligence

The ability of an agent  
to perceive an environment  
and to choose actions  
that increase its chances  
of achieving a goal

# Intelligence

The ability of an agent  
to perceive an environment  
and to choose actions  
that increase its chances  
of achieving a goal  
by learning, knowledge,  
reasoning, planning, etc.

# Artificial Intelligence

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# Types of Intelligence



Natural intelligence



Artificial intelligence

# Types of Intelligence



**Natural intelligence**



**Artificial intelligence**

# Types of Intelligence



Natural intelligence



Artificial intelligence

# Artificial Intelligence

The ability of a machine  
to replicate natural intelligence

# Artificial Intelligence

The ability of a machine  
to perceive an environment  
and to choose actions  
that maximize  
the expected likelihood  
of achieving a goal

# Artificial Intelligence

The ability of a machine  
to perceive an environment  
and to choose actions  
that maximize  
the expected likelihood  
of achieving a goal

# Artificial Intelligence

The ability of a machine  
to perceive an **environment**  
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# Artificial Intelligence

The ability of a machine  
to perceive an environment  
and to choose actions  
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the expected likelihood  
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# Artificial Intelligence

Anything a human can do  
but a machine cannot yet do

## Types of A.I.

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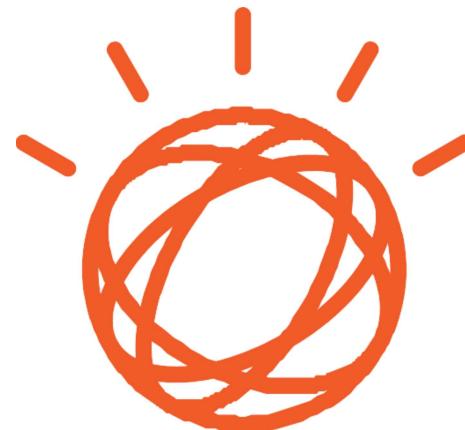
# Types of A.I.

**Artificial  
narrow  
intelligence**

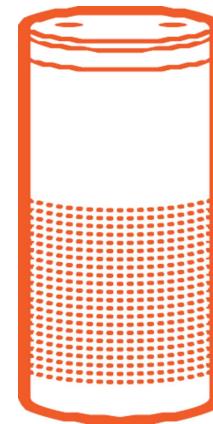
**Artificial  
general  
intelligence**

**Artificial  
super  
intelligence**

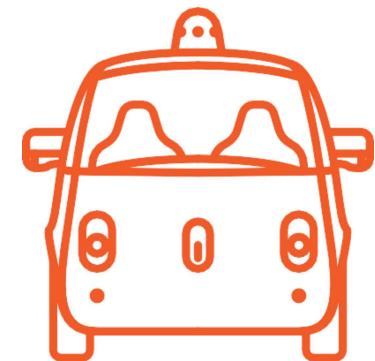
# Artificial Narrow Intelligence



IBM  
Watson

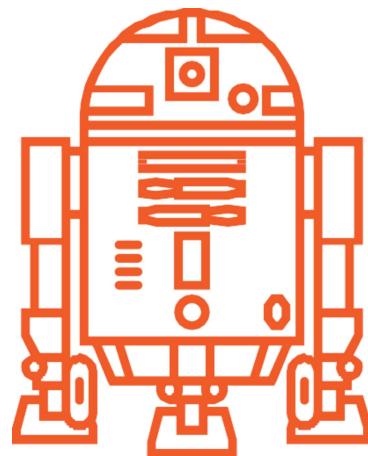


Amazon  
Alexa

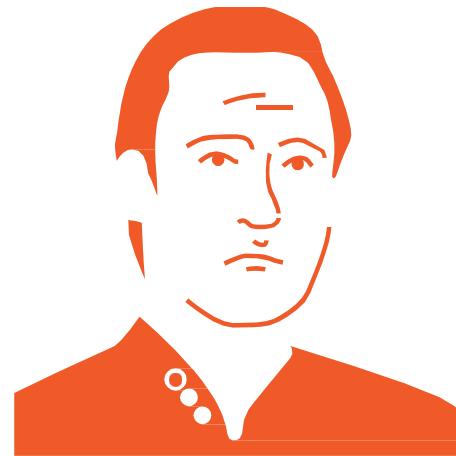


Google  
Waymo

# Artificial General Intelligence



R2D2

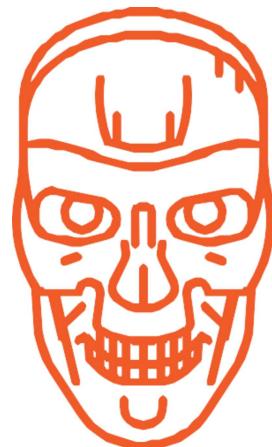


Data



HAL 9000

# Artificial Super Intelligence



Skynet



Ultron



The Architect

# Types of A.I.

**Artificial  
narrow  
intelligence**

**Artificial  
general  
intelligence**

**Artificial  
super  
intelligence**

# Components of A.I.

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# Components of Artificial Intelligence



Perception



Learning



Knowledge



Reasoning



Planning

# Perception

Deduce state from sensors

Recognize patterns

Detect features



# Learning

Extract knowledge

Data in, action out

Maps state to action



# Knowledge

Represent learning

Collection of information

Various representations

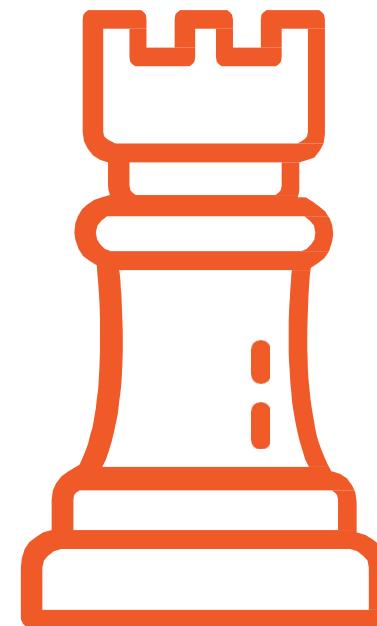


# Reasoning

Infer conclusions

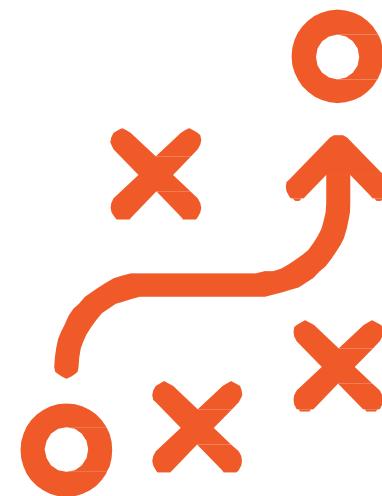
Deduction

Induction



# Planning

- Set and achieve goals
- Visualize future states
- Predict actions



# Components of Artificial Intelligence



Perception



Learning



Knowledge



Reasoning



Planning

# Applications of A.I.

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# Examples of A.I.



# Customer Service

**FAQ  
generators**

**Chat  
bots**

**Voice  
assistants**

# Finance

Trading  
algorithms

Fraud  
detection

Portfolio  
management

# Healthcare

Diagnostic  
tools

Treatment  
recommendation

Prescription  
verification

# Manufacturing

Product  
design

Industrial  
robots

Defect  
detection

# Marketing

Advertisement  
optimization

Sentiment  
analysis

Product  
recommendation

# Transportation

Warehouse  
robots

Route  
optimization

Delivery  
drones



This is just the tip of the iceberg!

# History of A.I.

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# Overview



**Classical A.I.**

**First A.I. Winter**

**Knowledge-based A.I.**

**Second A.I. Winter**

**Data-driven A.I.**

**Third A.I. Winter**

Classical A.I.

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# Advances in Classic A.I.

Computational  
search

Computational  
logic

Natural  
language

# Successes of Classic A.I.

**General  
Problem  
Solver**

**ELIZA**

**SHRDLU**

First A.I. Winter

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# Limitations of Classic A.I.

Limited  
computer  
power

Computational  
complexity

Symbolic  
computing  
limitations

# Failures of Classical A.I.

Machine  
translation  
deficiencies

Perceptron  
limitations

Lighthill  
report





First A.I. Winter  
1974 - 1980

# Knowledge-based A.I.

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# Advances in Knowledge-based A.I.

Expert  
system

Knowledge  
base

Inference  
engine

# Successes of Knowledge-based A.I.

MYCIN  
diagnoses  
diseases

XCON  
manages  
inventory

AARON  
creates  
paintings

Second A.I. Winter

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# Limitations of Knowledge-based A.I.

**Expensive  
to maintain**

**Rigid and  
inflexible**

**Not very  
efficient**

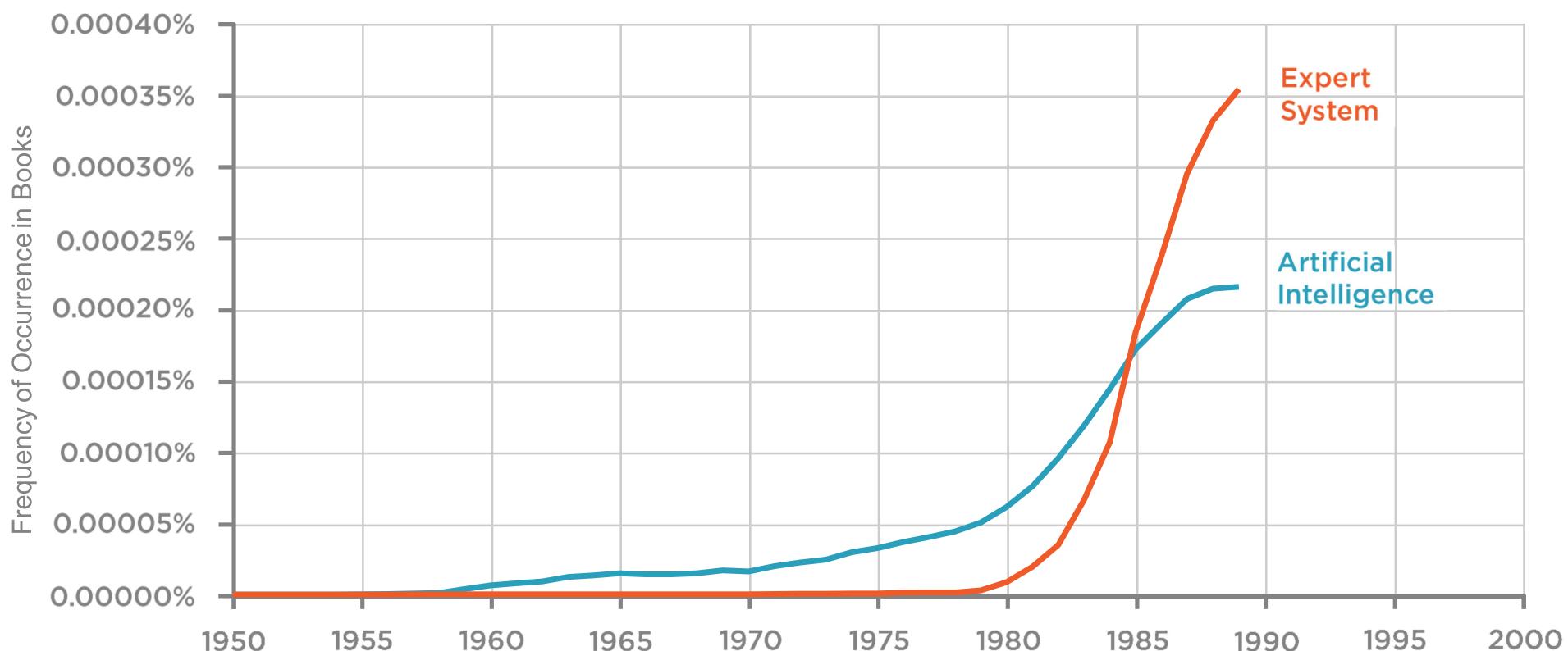
# Failures of Knowledge-based A.I.

MYCIN  
never reaches  
production

Collapse of the  
LISP machine  
market

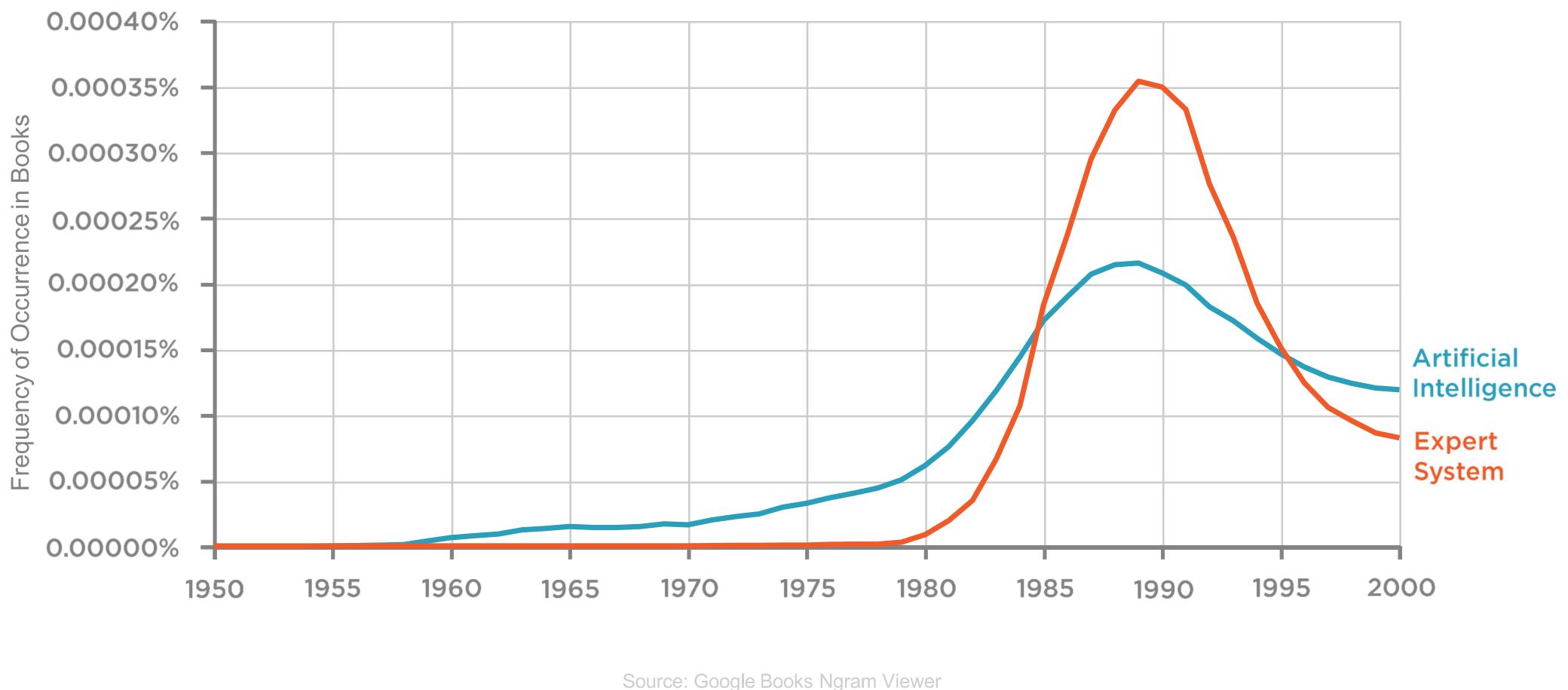
5<sup>th</sup> Generation  
Computer  
Systems Project

# Second A.I. Winter



Source: Google Books Ngram Viewer

# Second A.I. Winter







Second A.I. Winter  
1988 - 2000s

Data-driven A.I.

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# Advances in Data-driven A.I.

More  
compute

More  
data

Better  
algorithms

More  
discipline

# Successes in Data-driven A.I.

Stanley  
completes  
DARPA GC

Watson  
wins  
Jeopardy

AlphaGo  
wins at  
Go

Third A.I. Winter

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# Limitations of Data-driven A.I.

Lacks  
the ability  
to reason

Requires  
labeled  
data

Only learns  
what you  
teach it

# Failures of Data-driven A.I.

**Self-driving  
vehicle  
collisions**

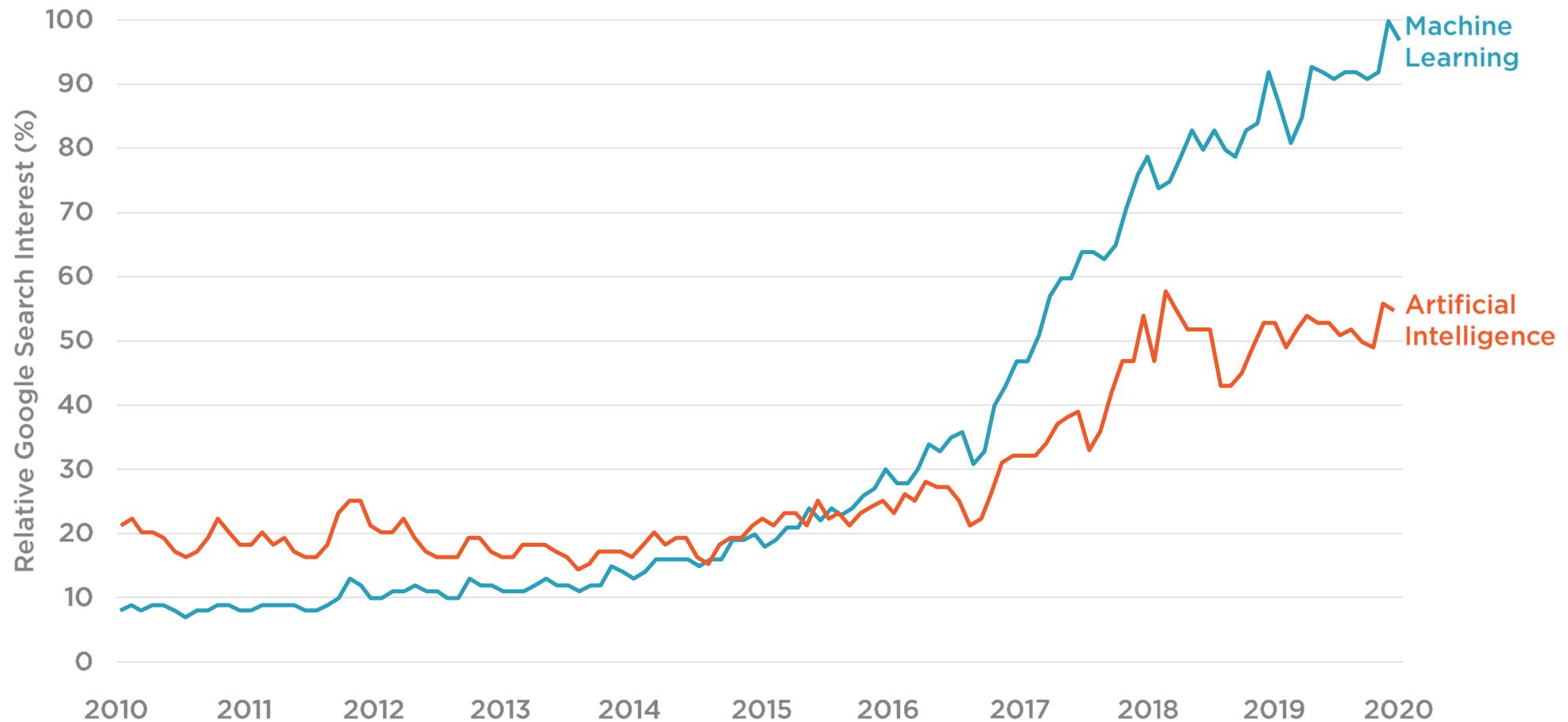
**Chat bot  
learns  
racism**

**Watson  
fails as  
a doctor**



A Third A.I. Winter?

# A Third A.I. Winter?



# Modern A.I.

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# Overview



**Machine Learning**

**Deep Learning**

**Reinforcement Learning**

**Other A.I. Trends**

**State-of-the-Art A.I.**

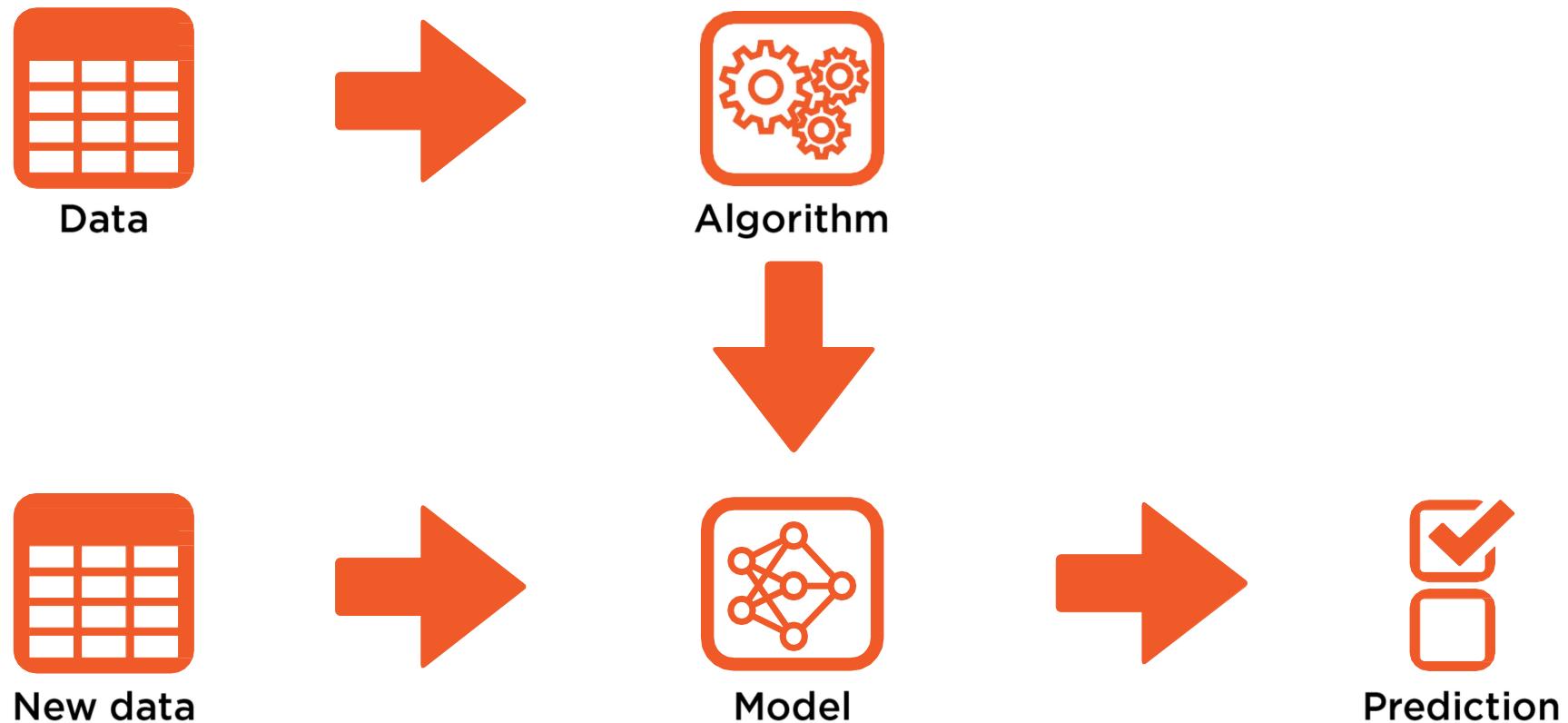
# Machine Learning

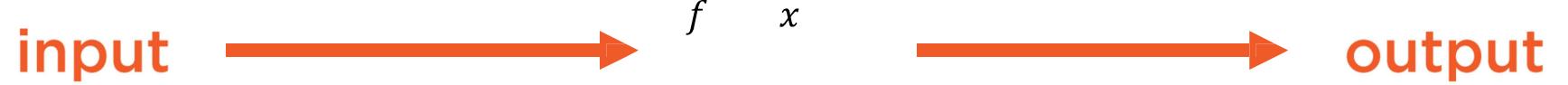
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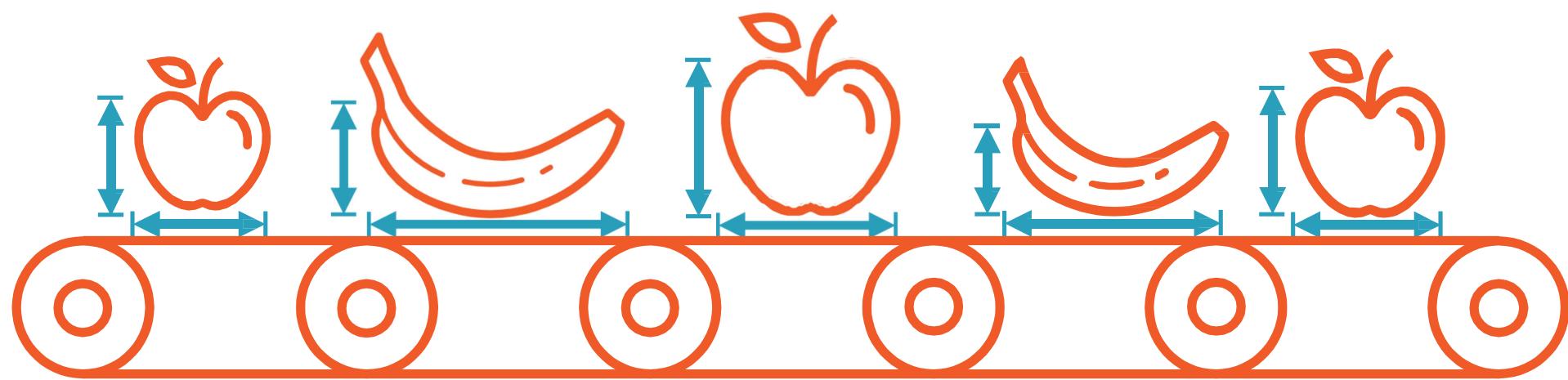
# Machine Learning

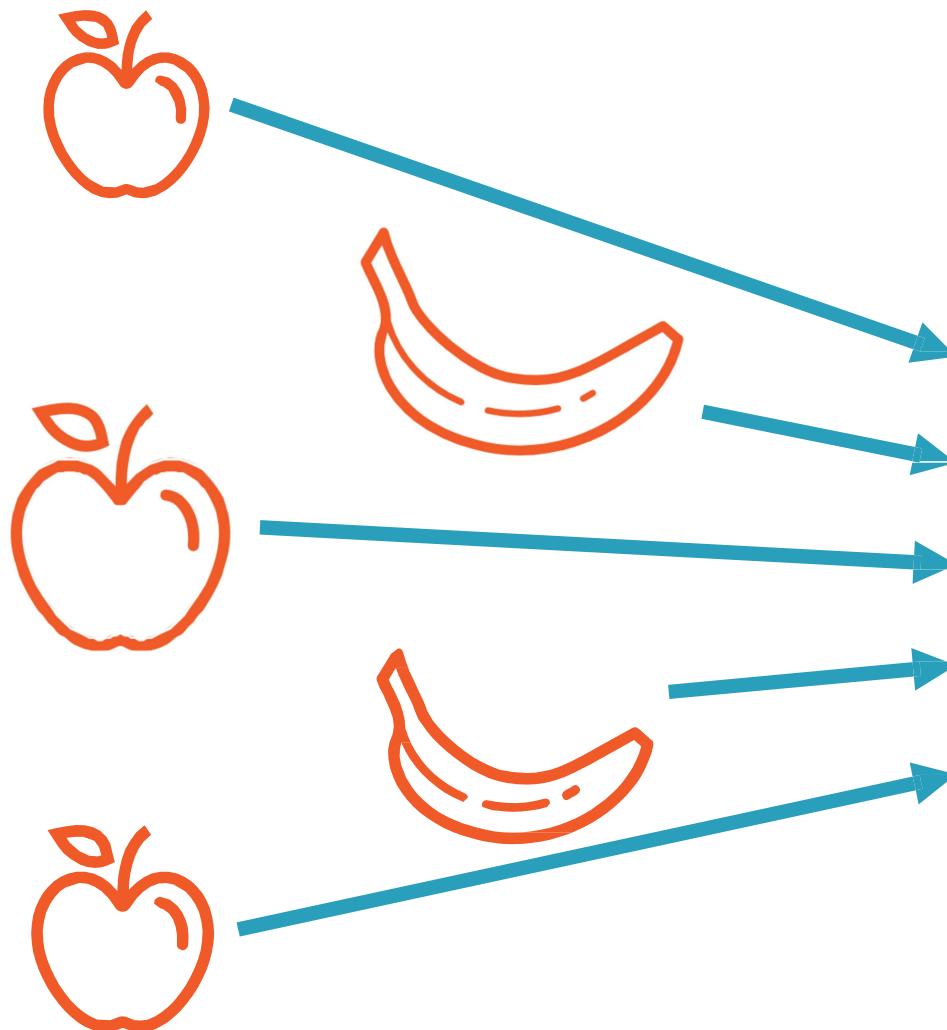
- Machine learning is a sub-field of artificial intelligence based on statistics.
- It involves a machine learning how to solve a problem without being explicitly programmed to do so.
- The machines are able to do this by detecting statistical patterns in data.
- Essentially, with machine learning, we use existing data and a training algorithm to learn a model of the data.
- We can then feed new data into that model that it's never seen before and make predictions about the new data.
- A machine learning model is essentially a function.
- It's simply a mapping from an input to an output. In this case, it takes data as an input and produces a prediction as an output.

# Machine Learning







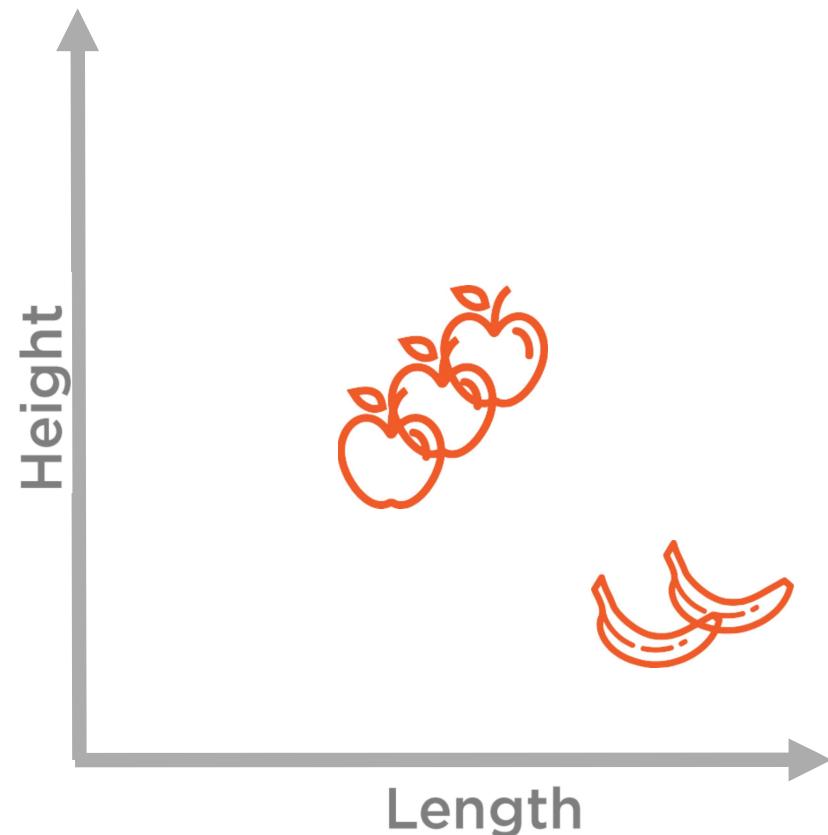


Length	Height	Type
6.8	7.0	Apple
19.0	3.6	Banana
8.0	8.3	Apple
15.2	3.1	Banana
7.3	7.5	Apple

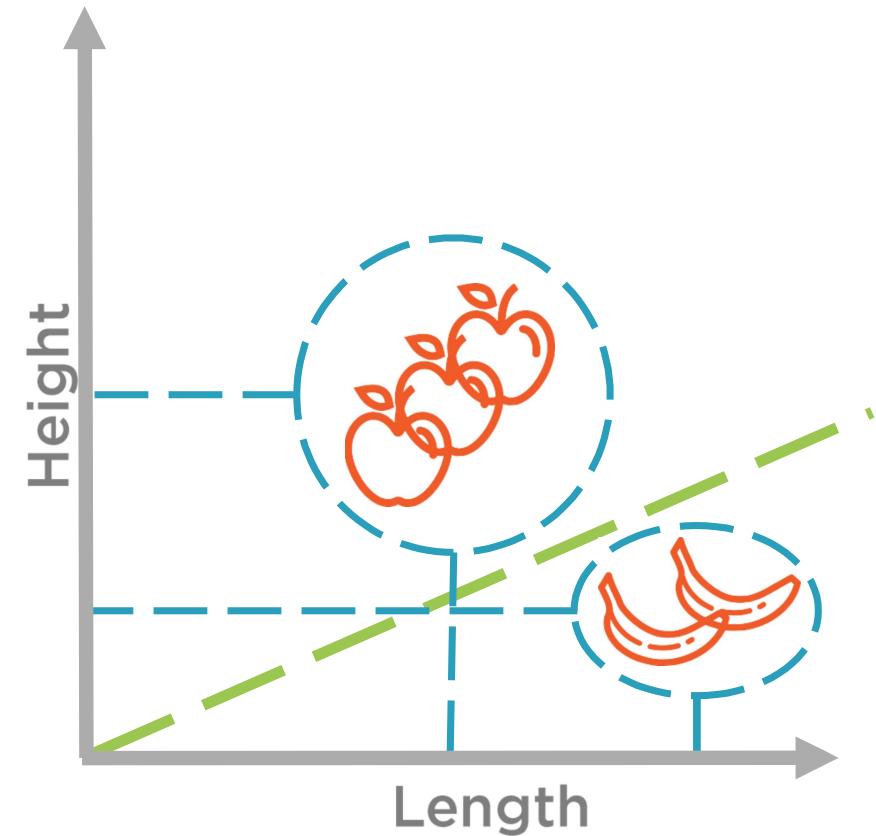


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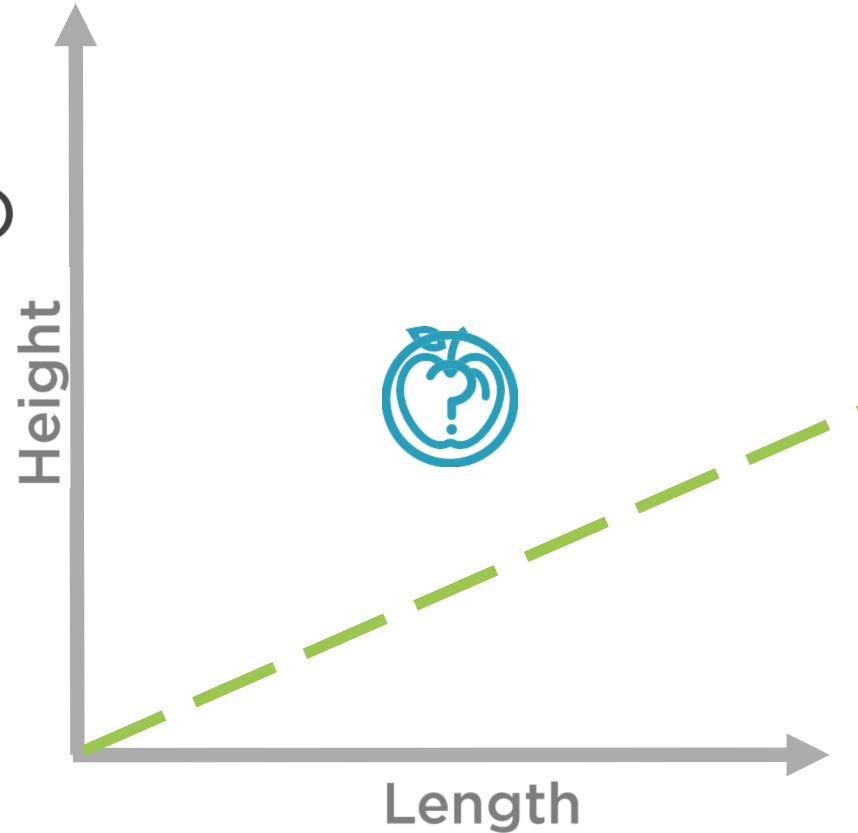
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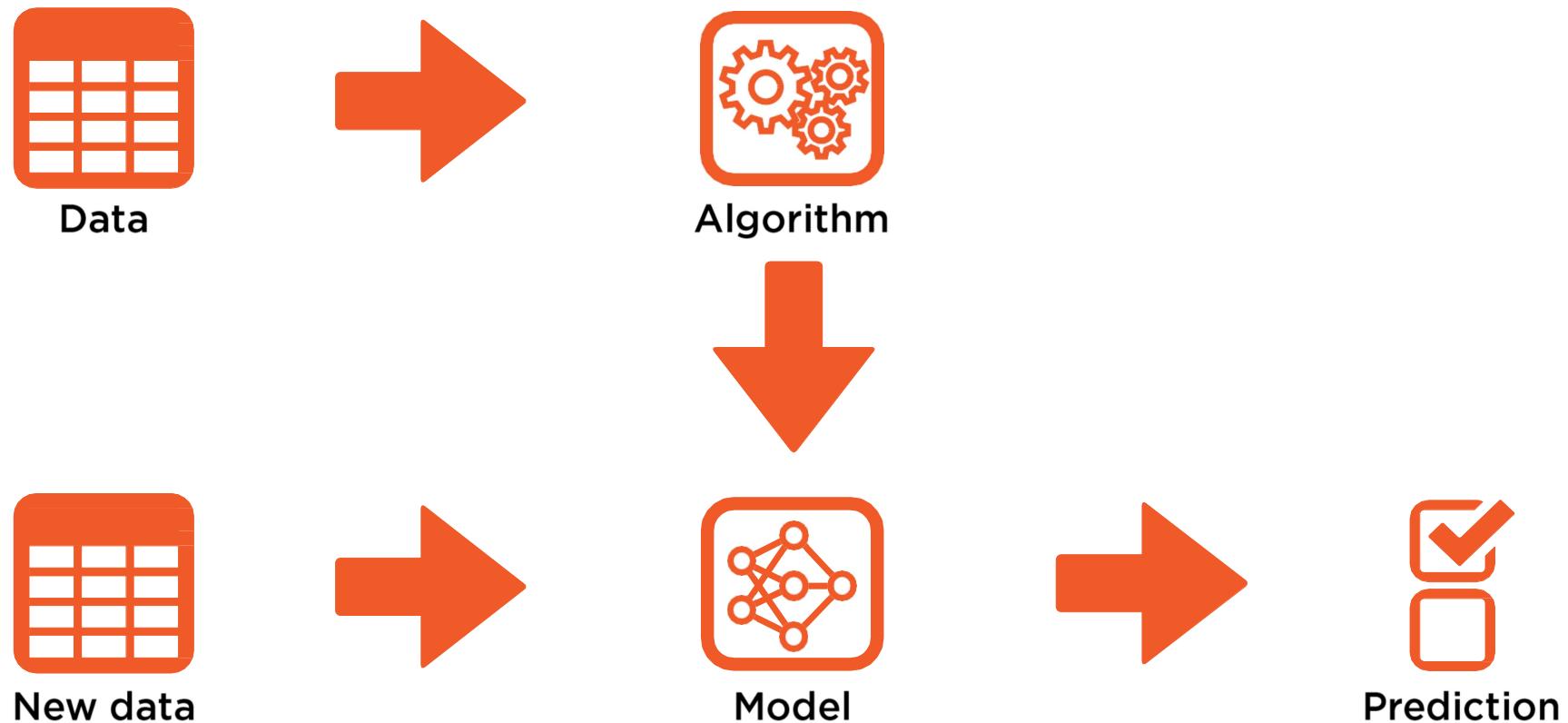
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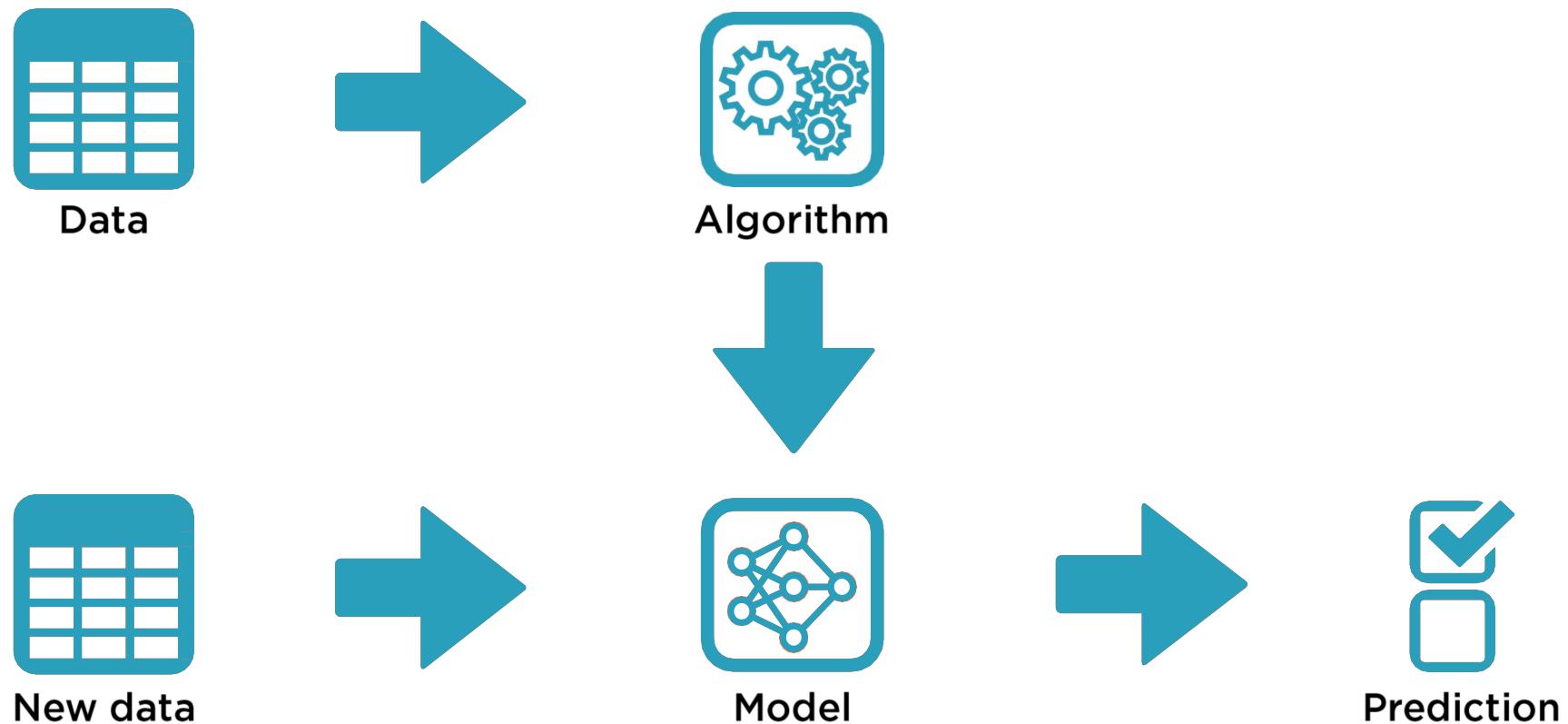
Length	Height	Type
7.5	7.7	Apple (99%)



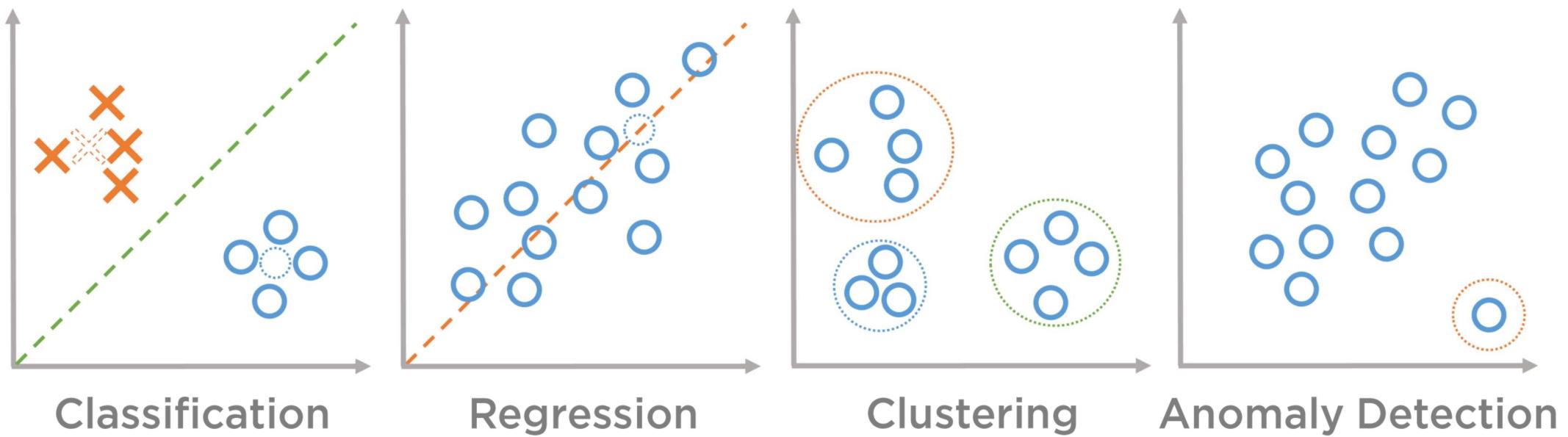
# Machine Learning

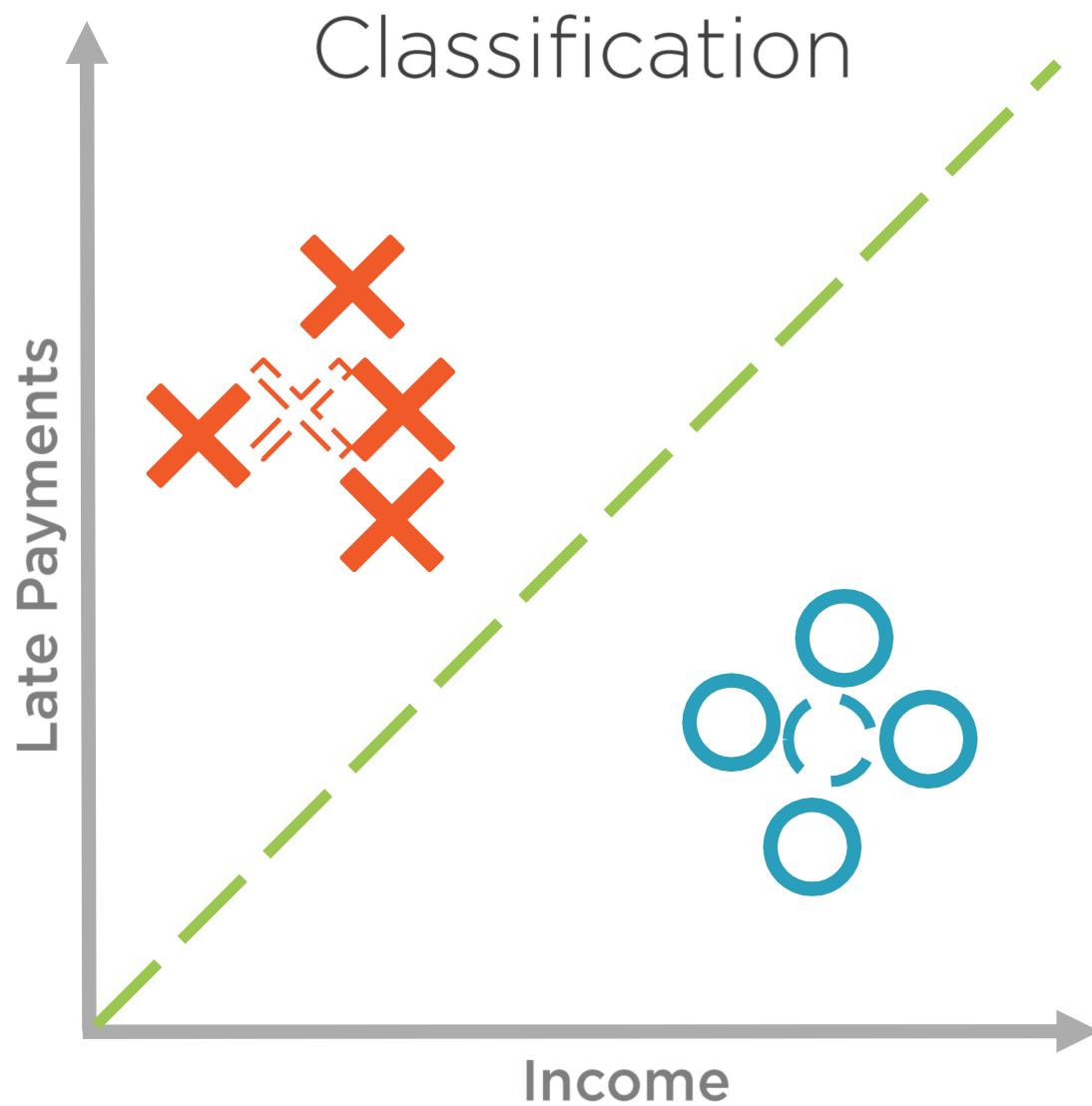


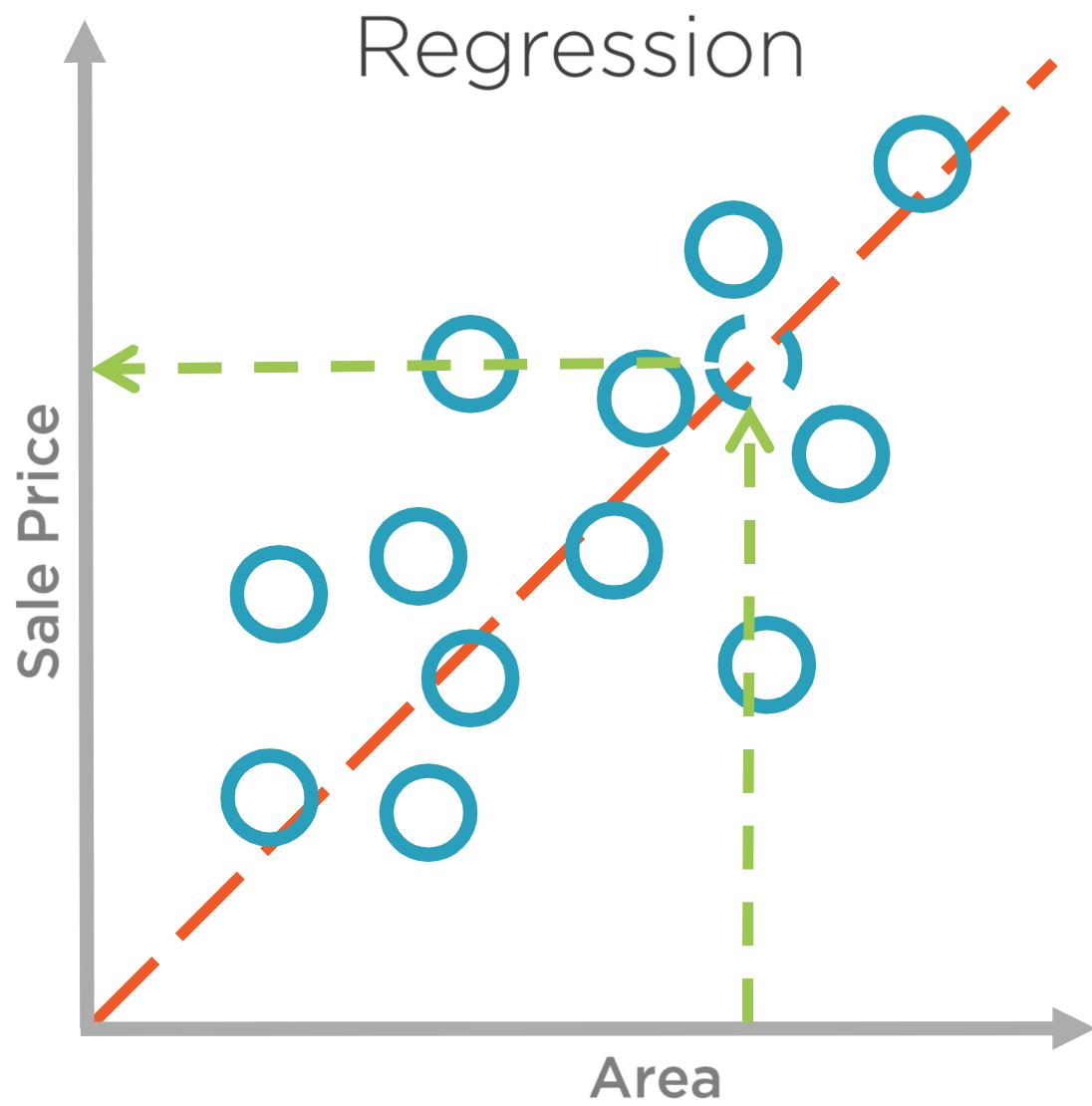
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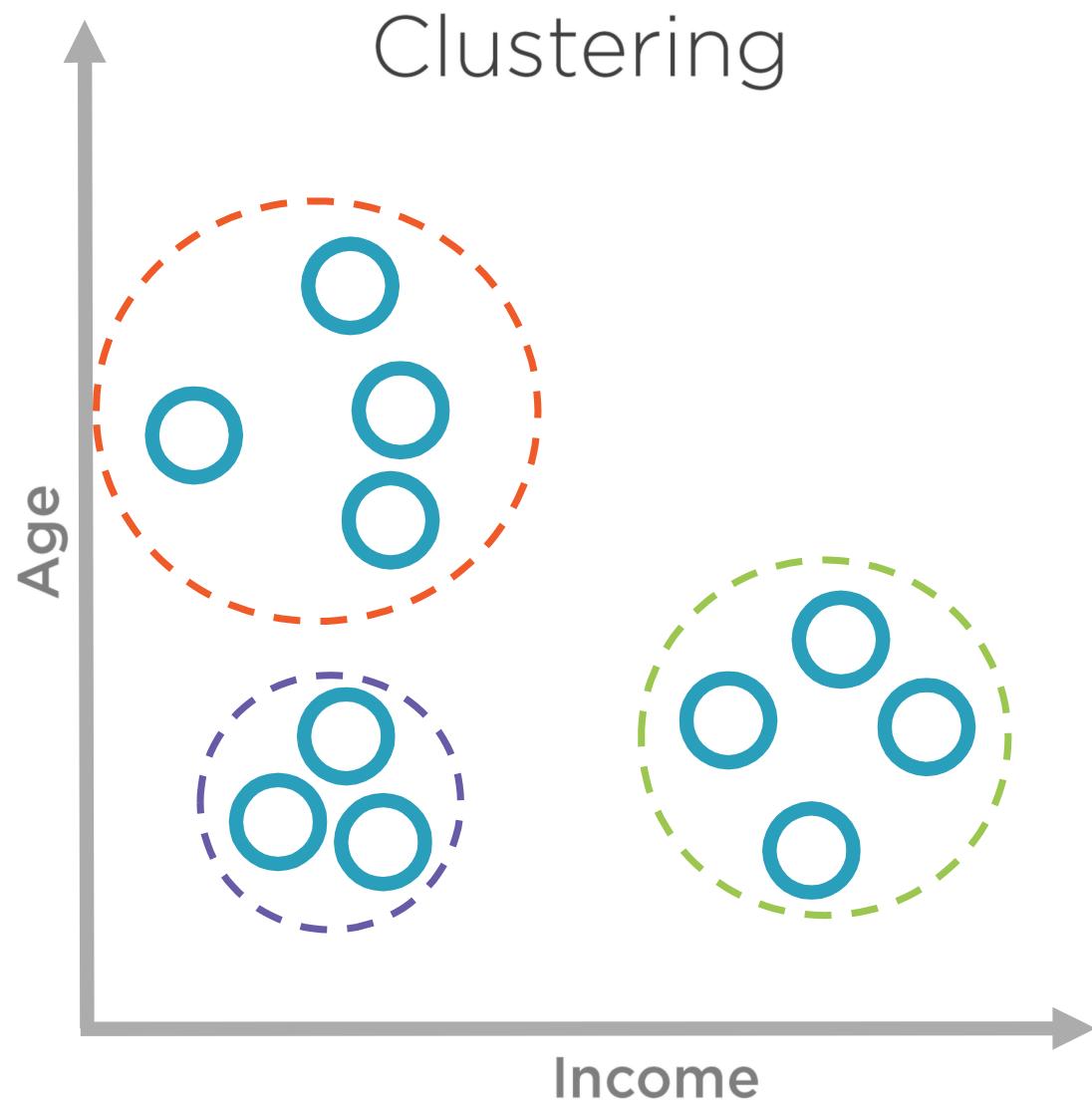


# Machine Learning Tasks

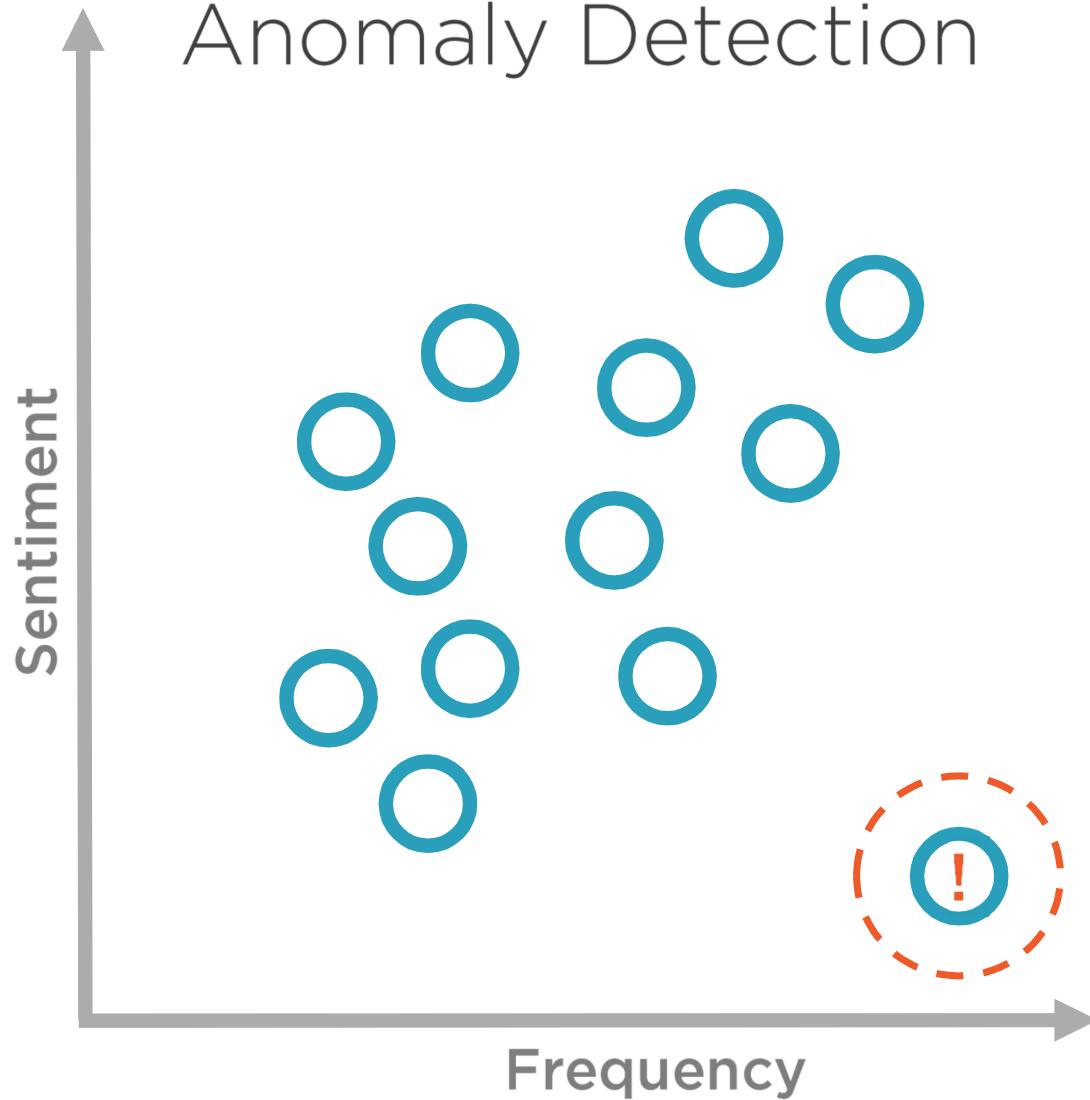








## Anomaly Detection



# Machine Learning

Make  
better  
decisions

Create  
smarter  
products

Automate  
manual  
labor

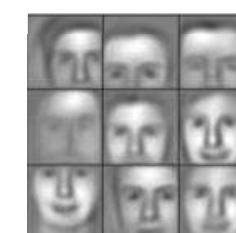
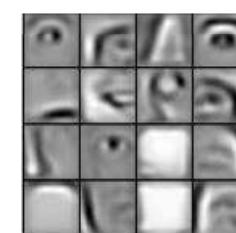
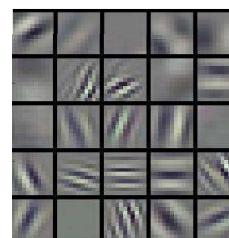
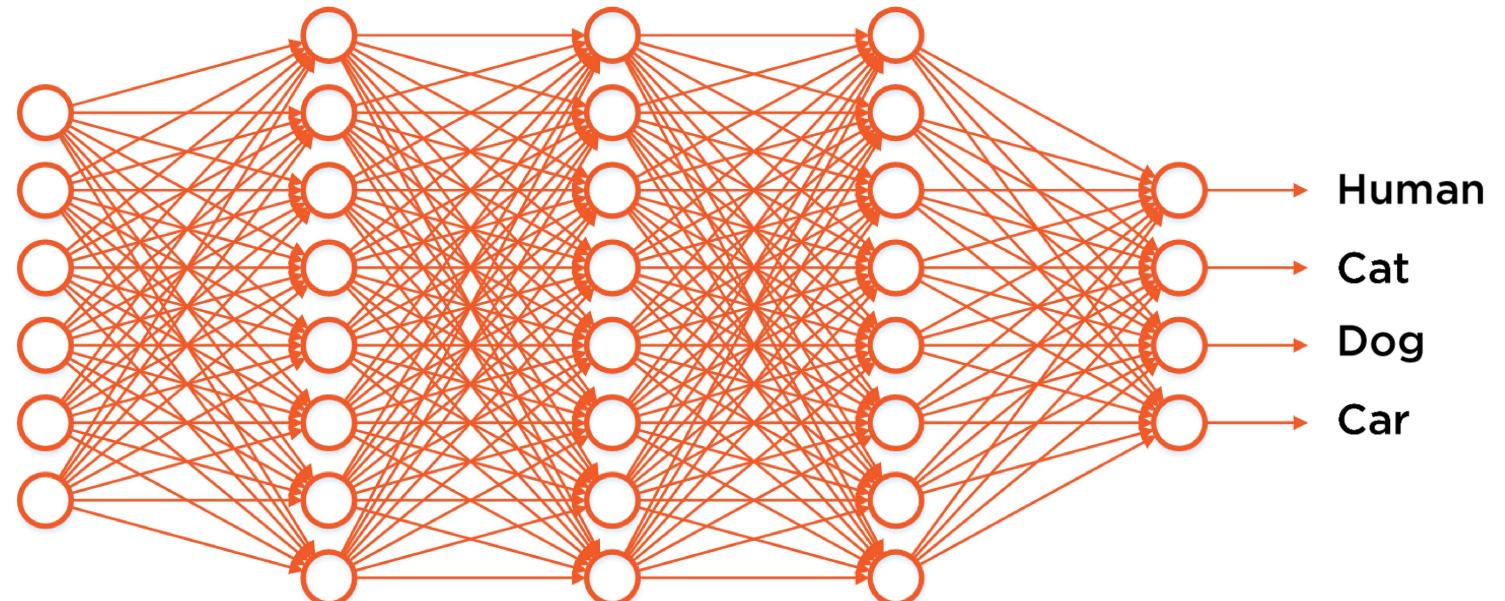
# Deep Learning

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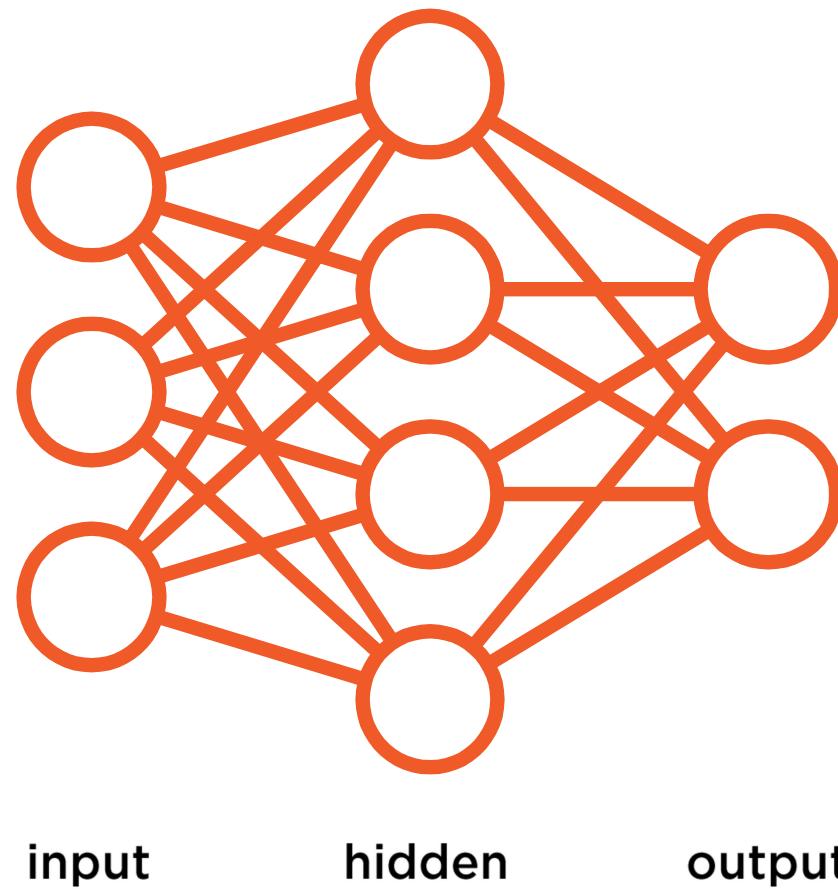
# Deep Learning

- Deep learning is a new type of data-driven AI. It stacks multiple layers of machine learning models, one on top of the other.
- This allows it to learn more complex inputs and produce more complex outputs. We typically create deep learning models using a neural network.
- A neural network is a graph of nodes and edges based roughly on the organization of neurons in an organic brain. The nodes represent neurons in the brain.
- The edges represent the connections between the neurons.
- First, we feed data into the neural network via its input neurons.
- Next, mathematical operations are performed on the data in each of the neurons.
- Then, each neuron forwards its resulting value to all of the other neurons that it's connected to.
- We repeat this process for all of the nodes in the hidden layer of the network, as well as all the edges in the hidden layer.
- Finally, the network produces a prediction from its output neurons.
- There's a bit of math involved to make this entire process work; however, we're going to skip over all the math to keep things simple.
- A deep neural network is a neural network with more than one hidden layer.
- Adding more hidden layers allows the network to model progressively more complex functions.

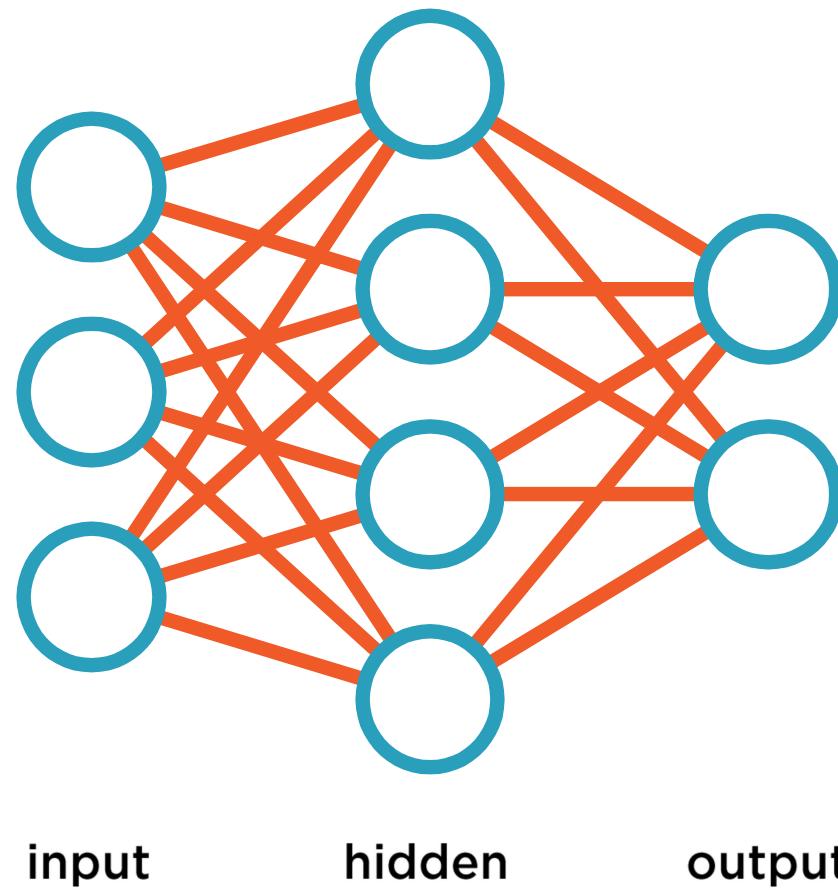
# Deep Learning



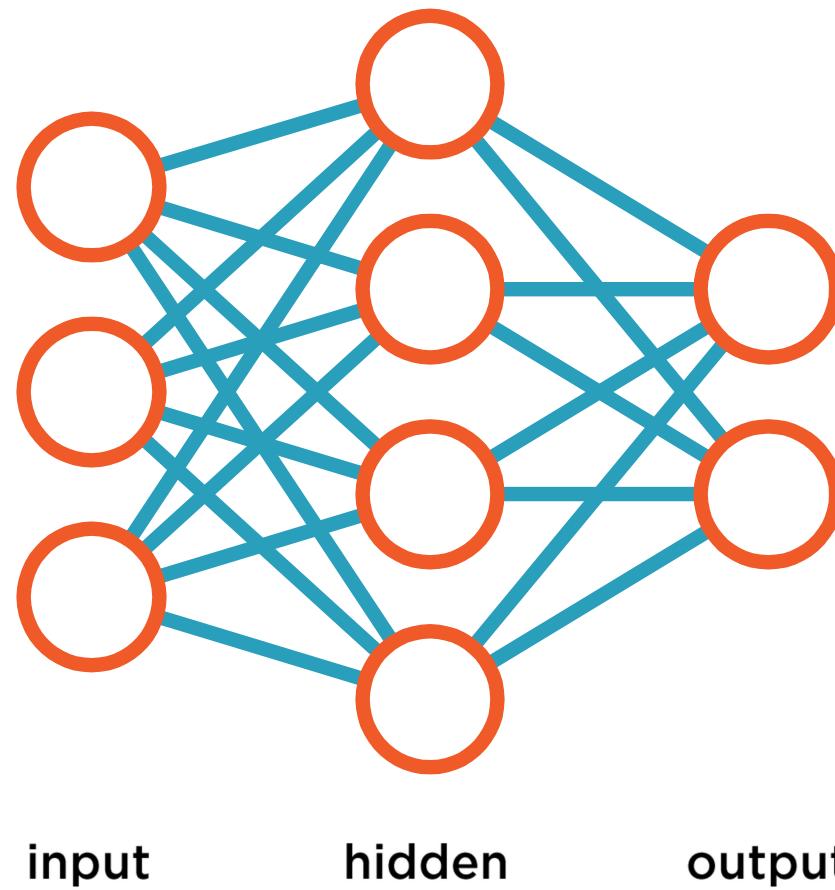
# Neural Network



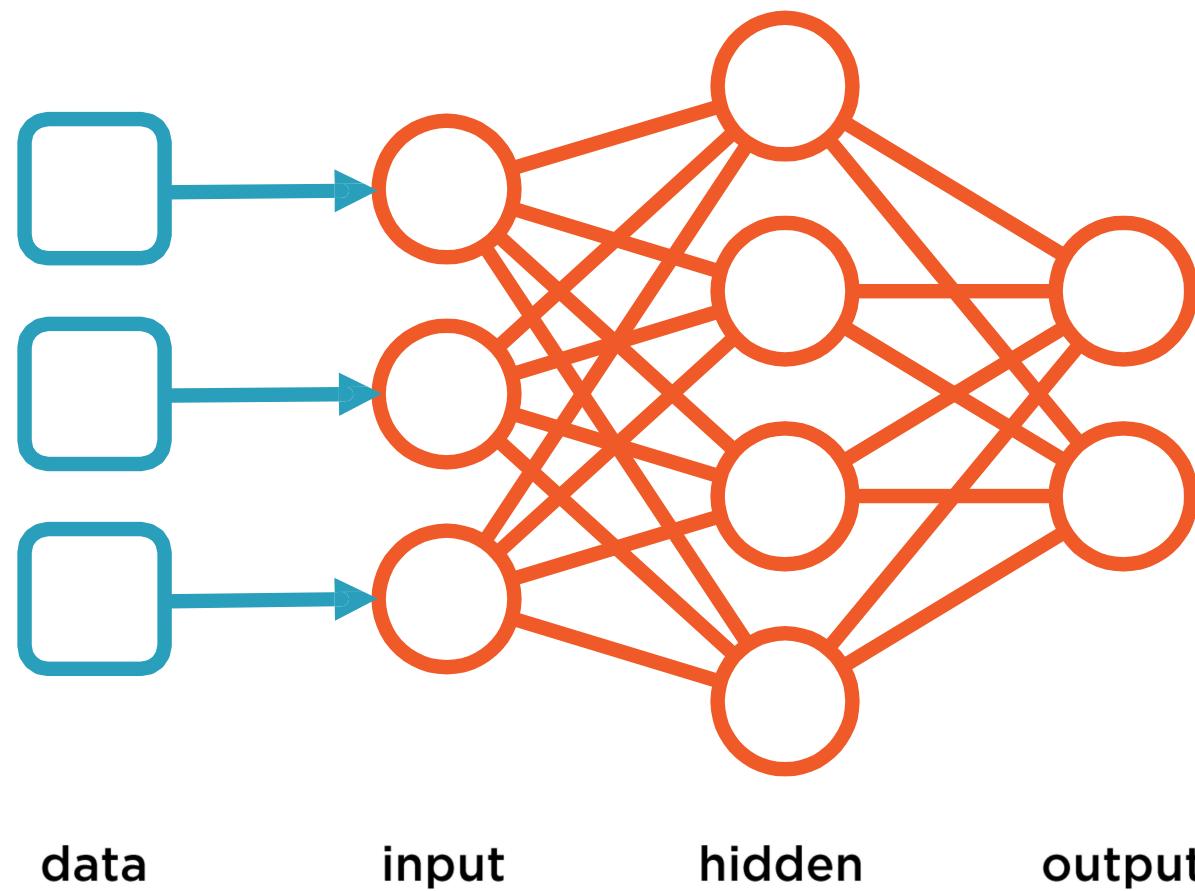
# Neural Network



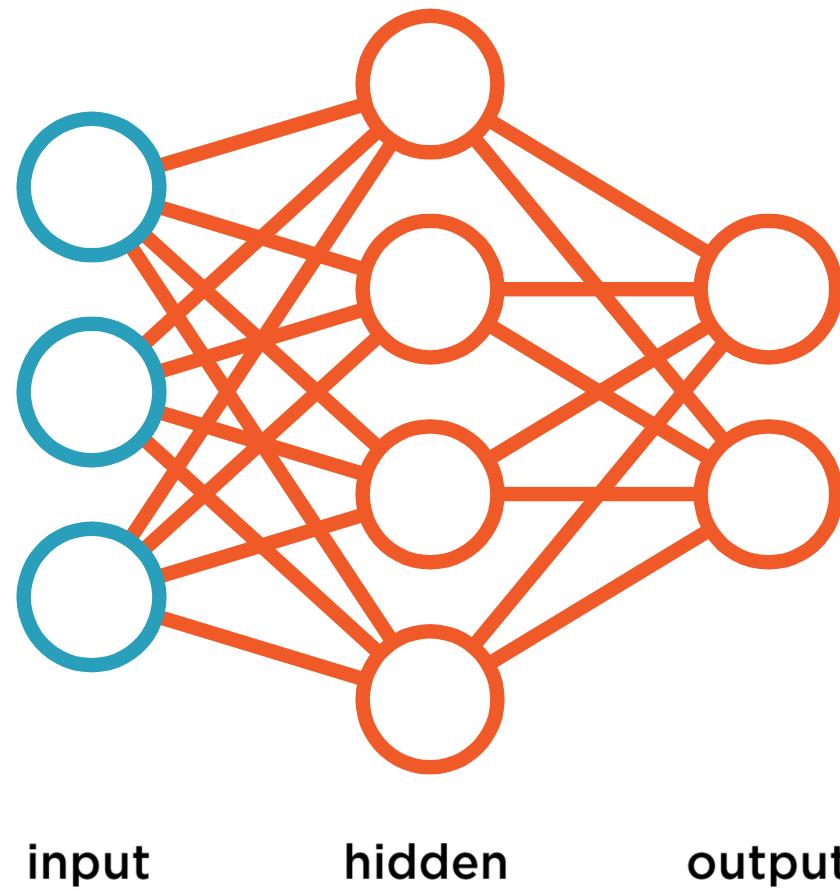
# Neural Network



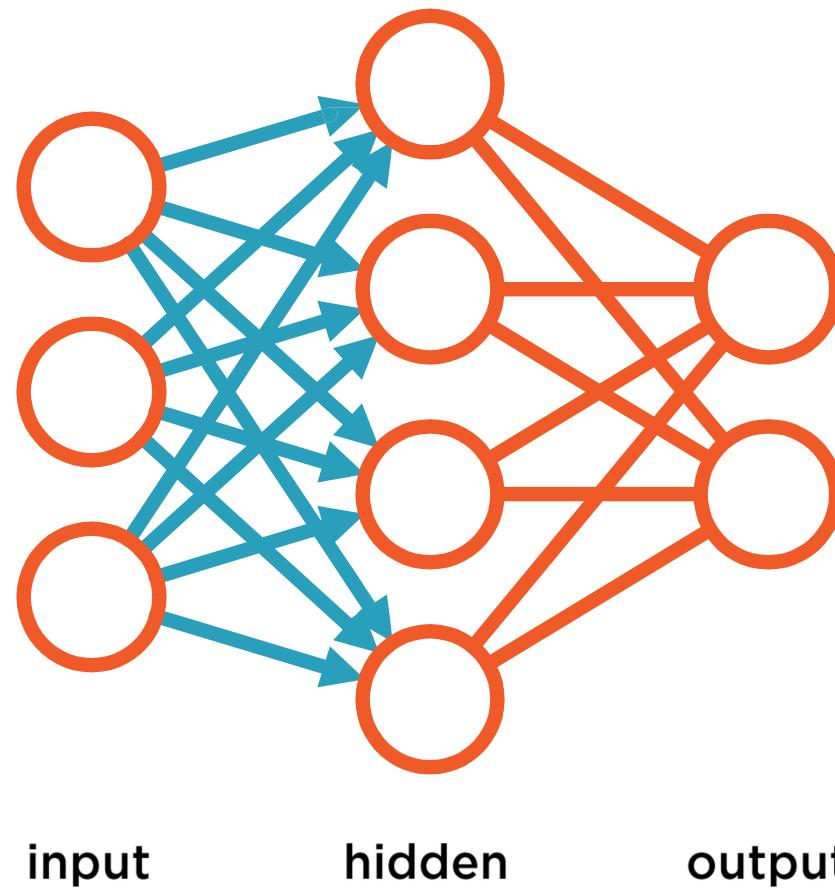
# Neural Network



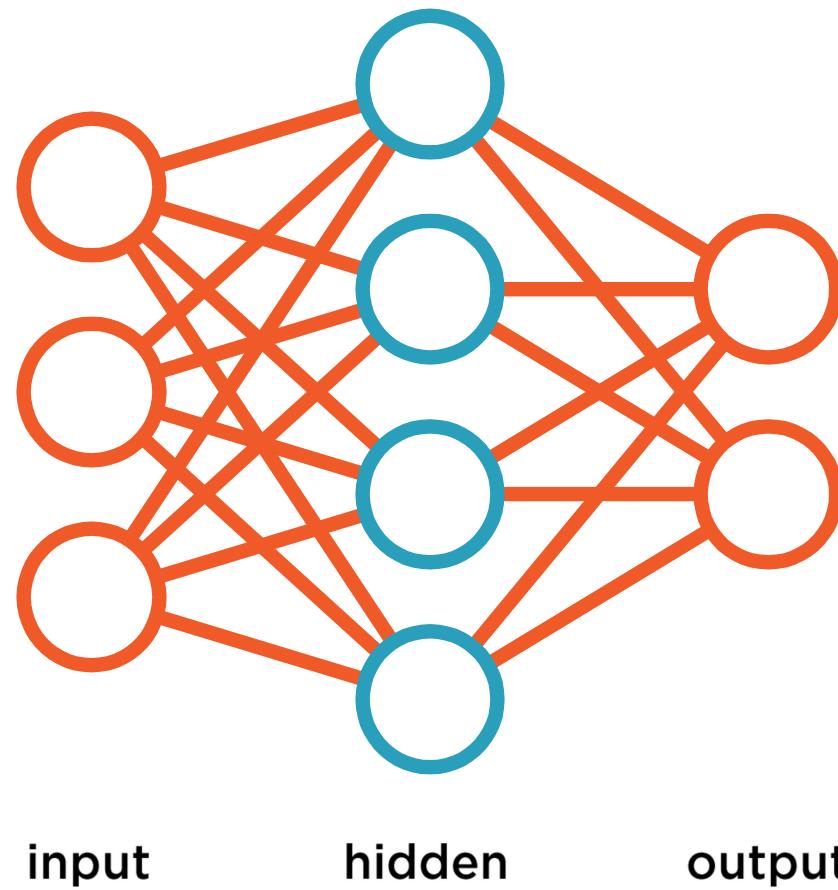
# Neural Network



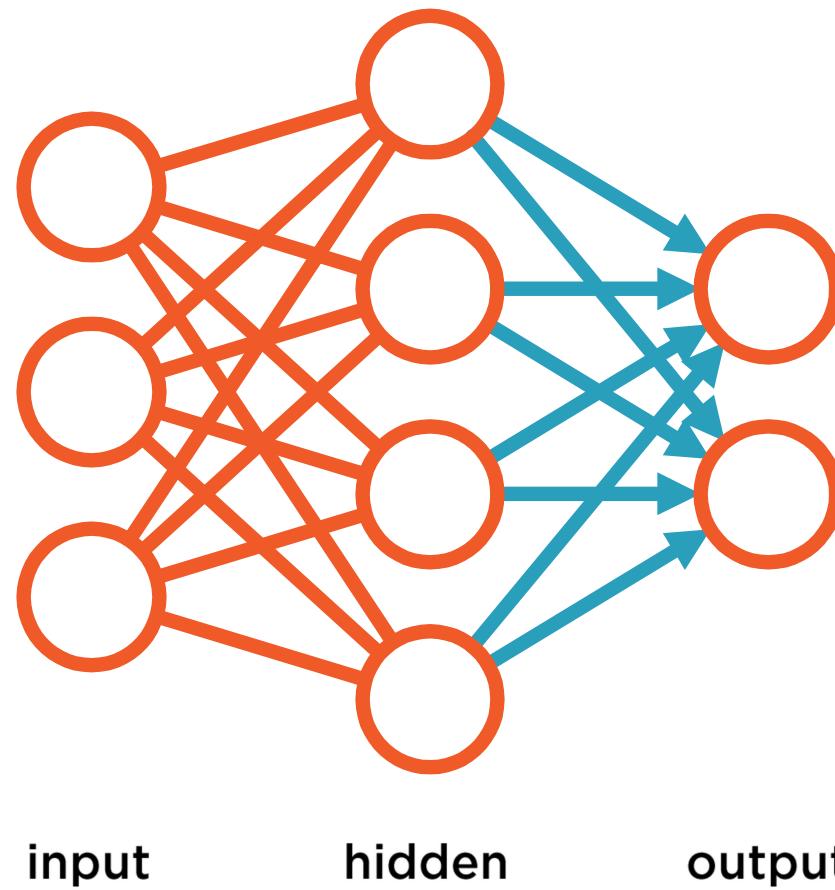
# Neural Network



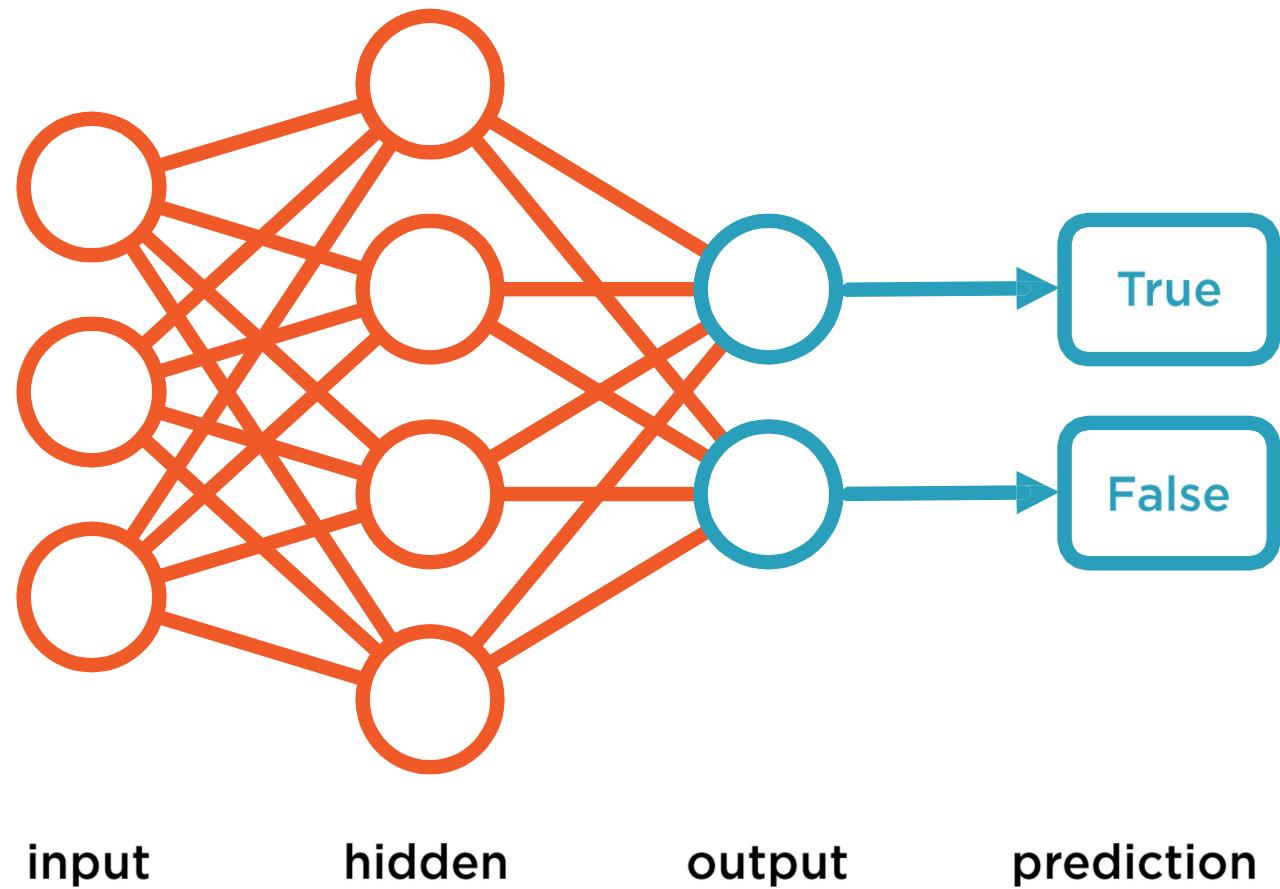
# Neural Network



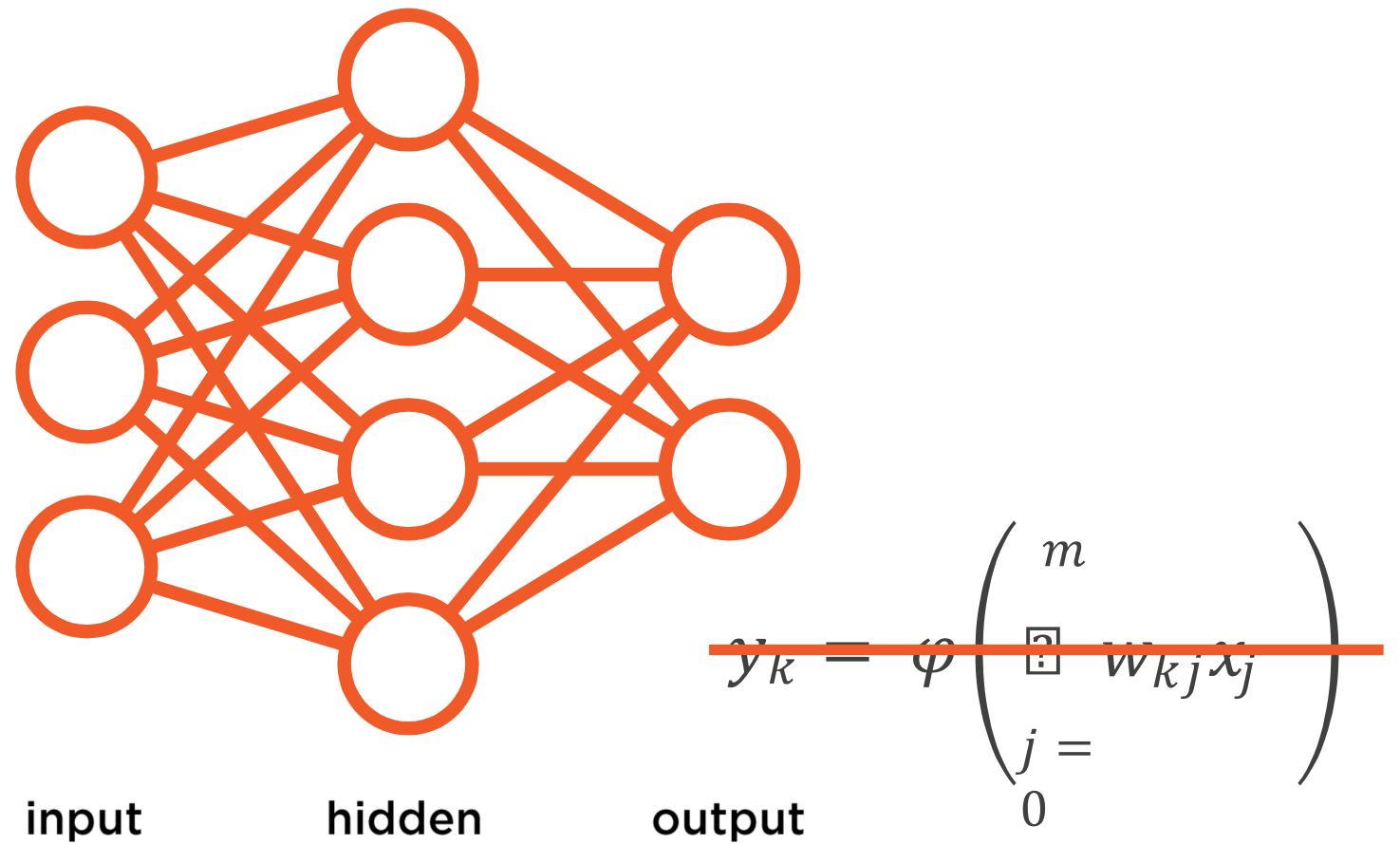
# Neural Network



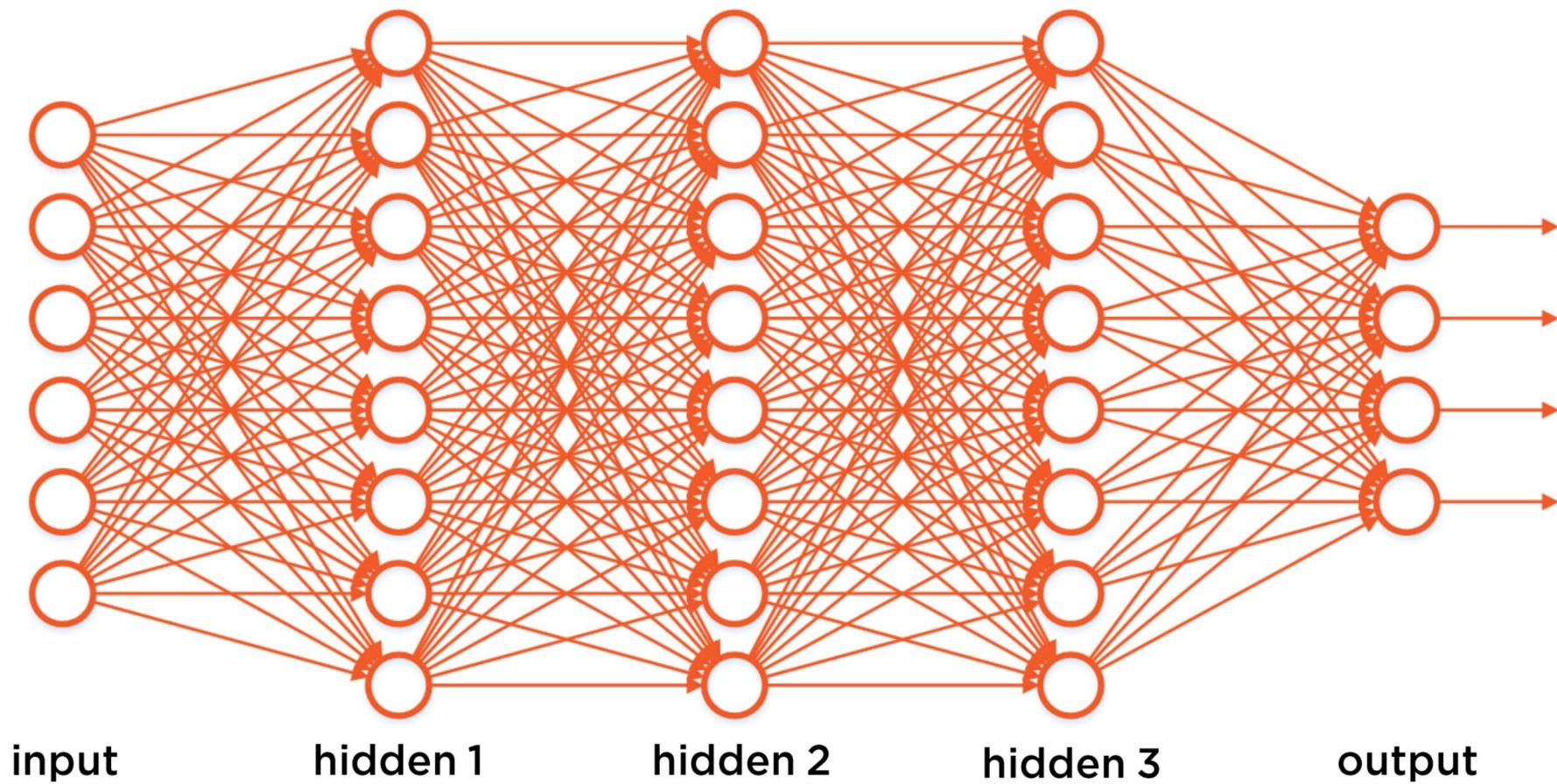
# Neural Network



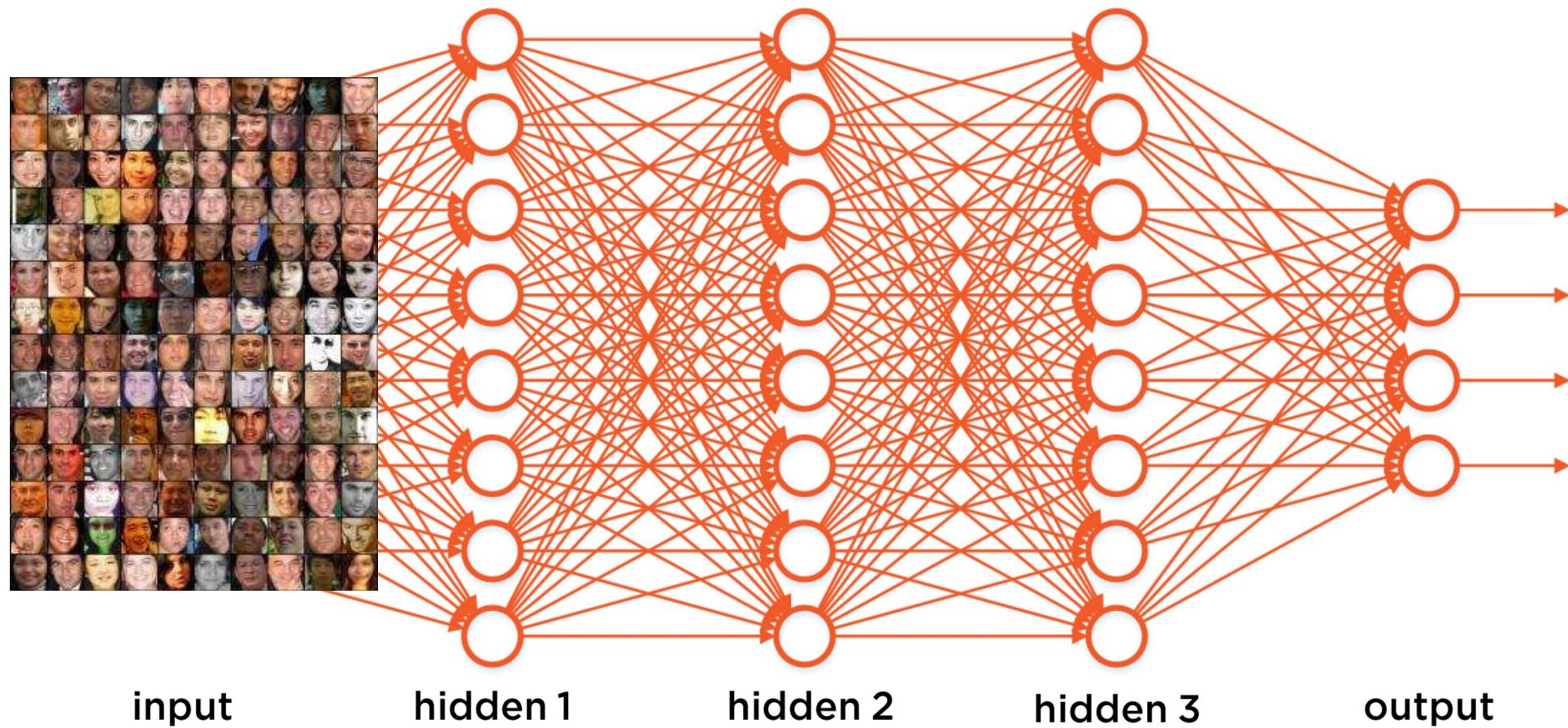
# Neural Network



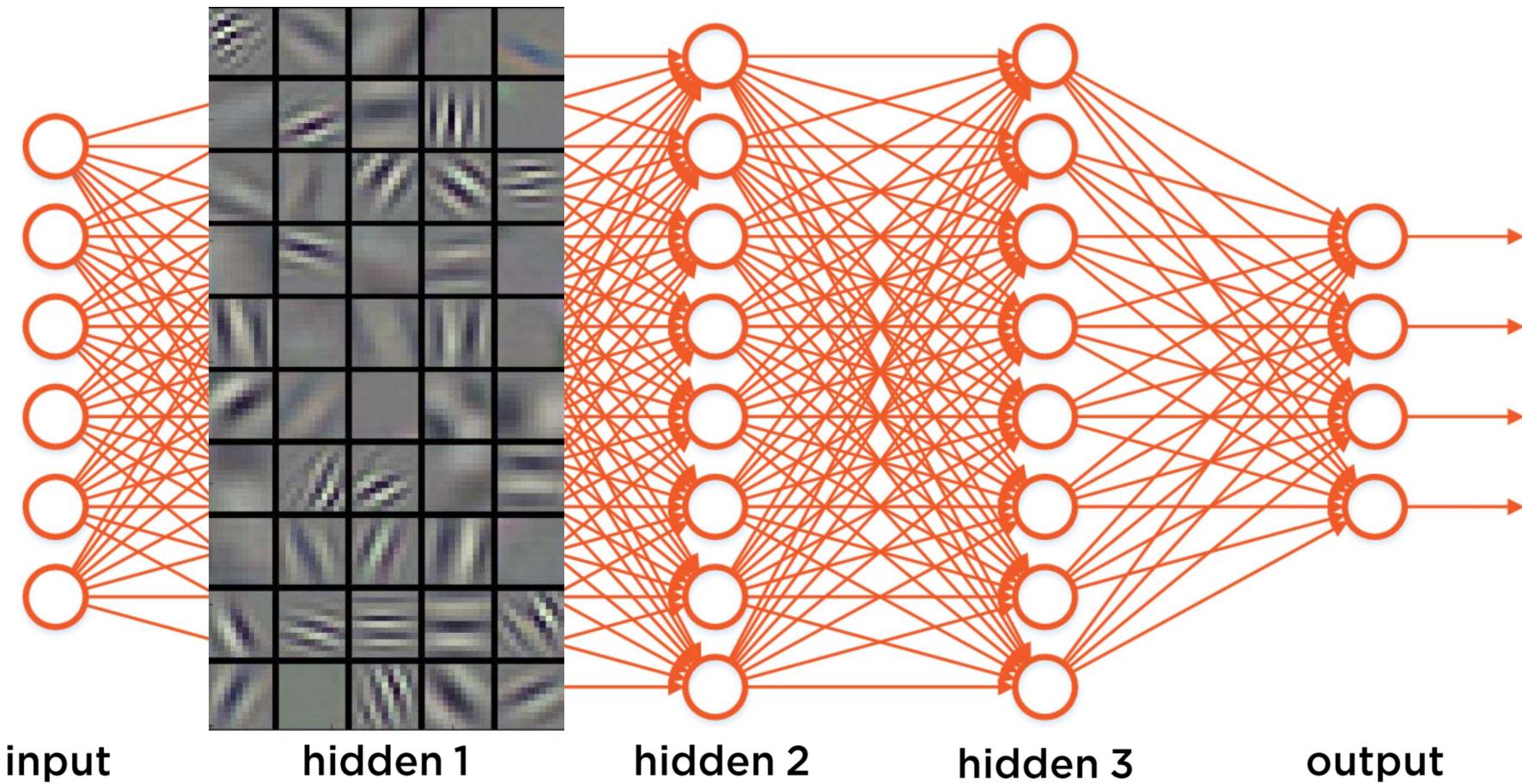
# Deep Neural Network



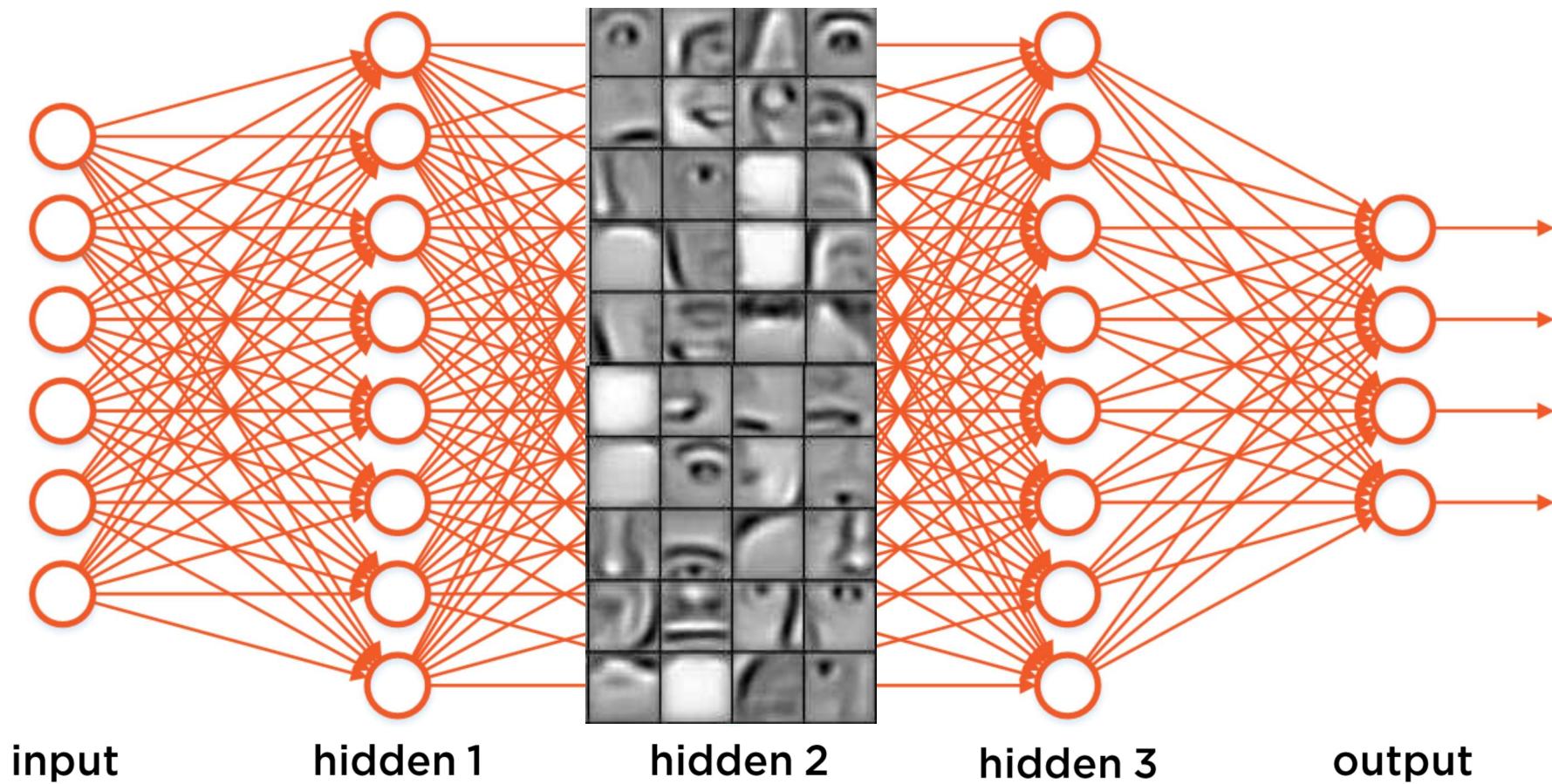
# Deep Neural Network



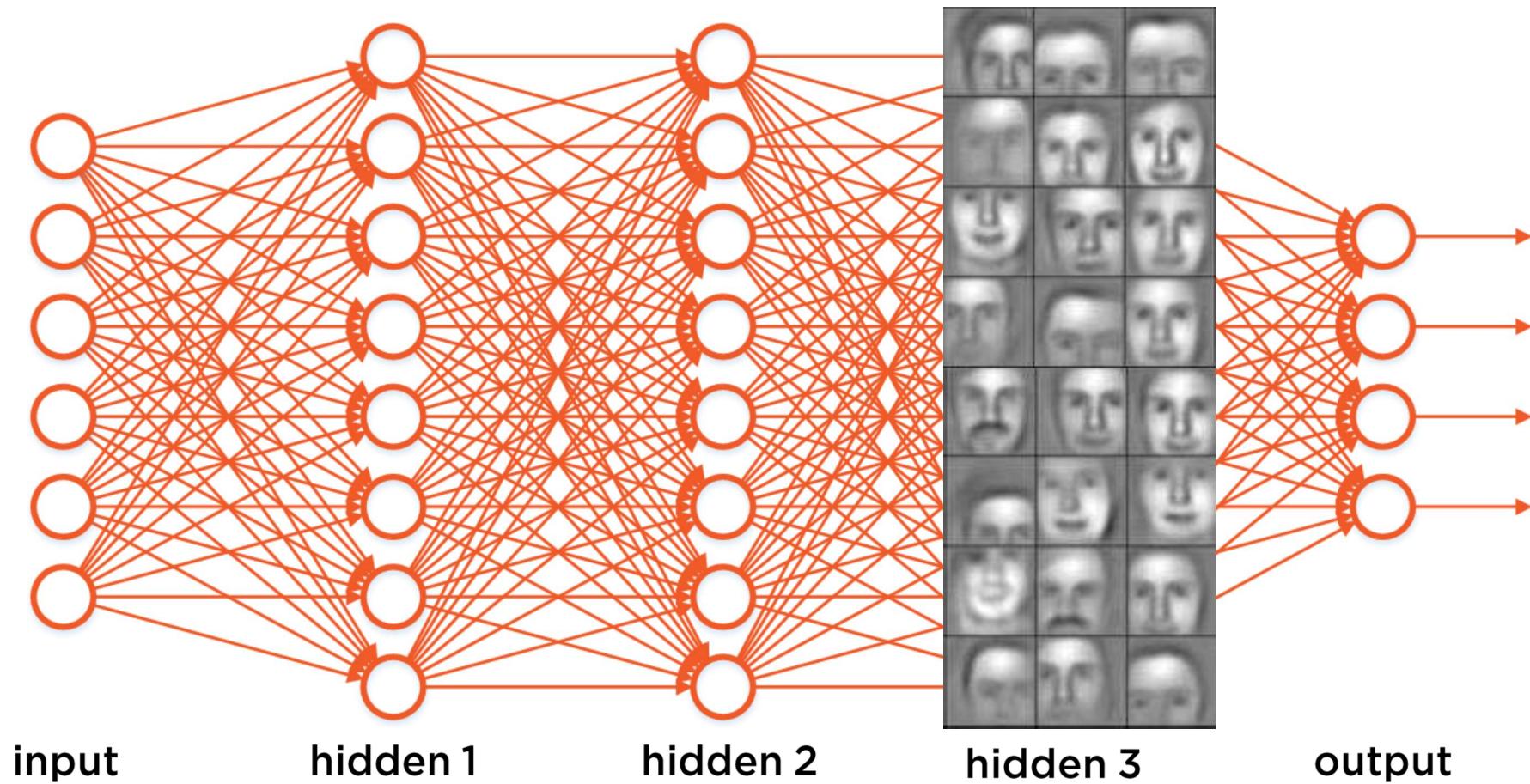
# Deep Neural Network



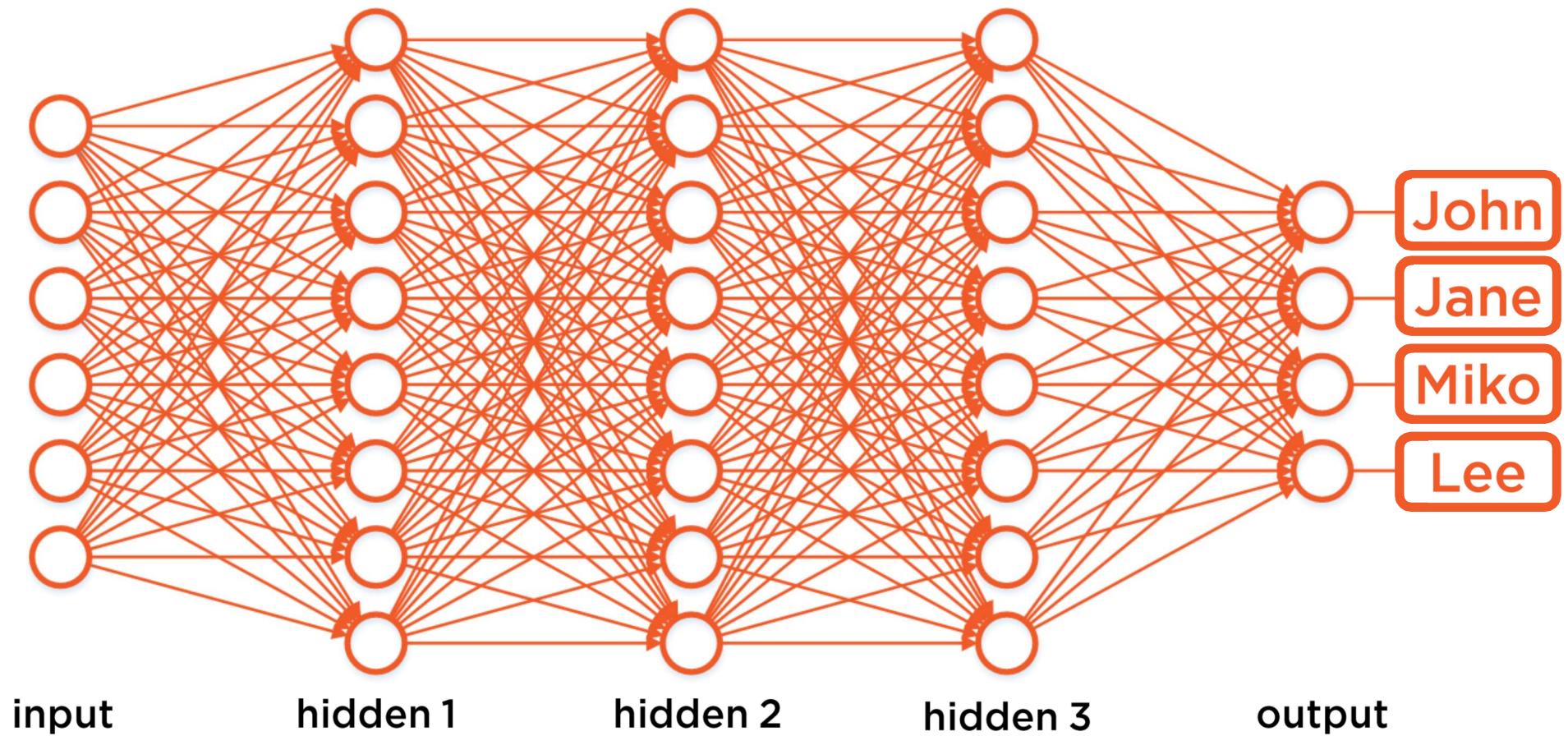
# Deep Neural Network



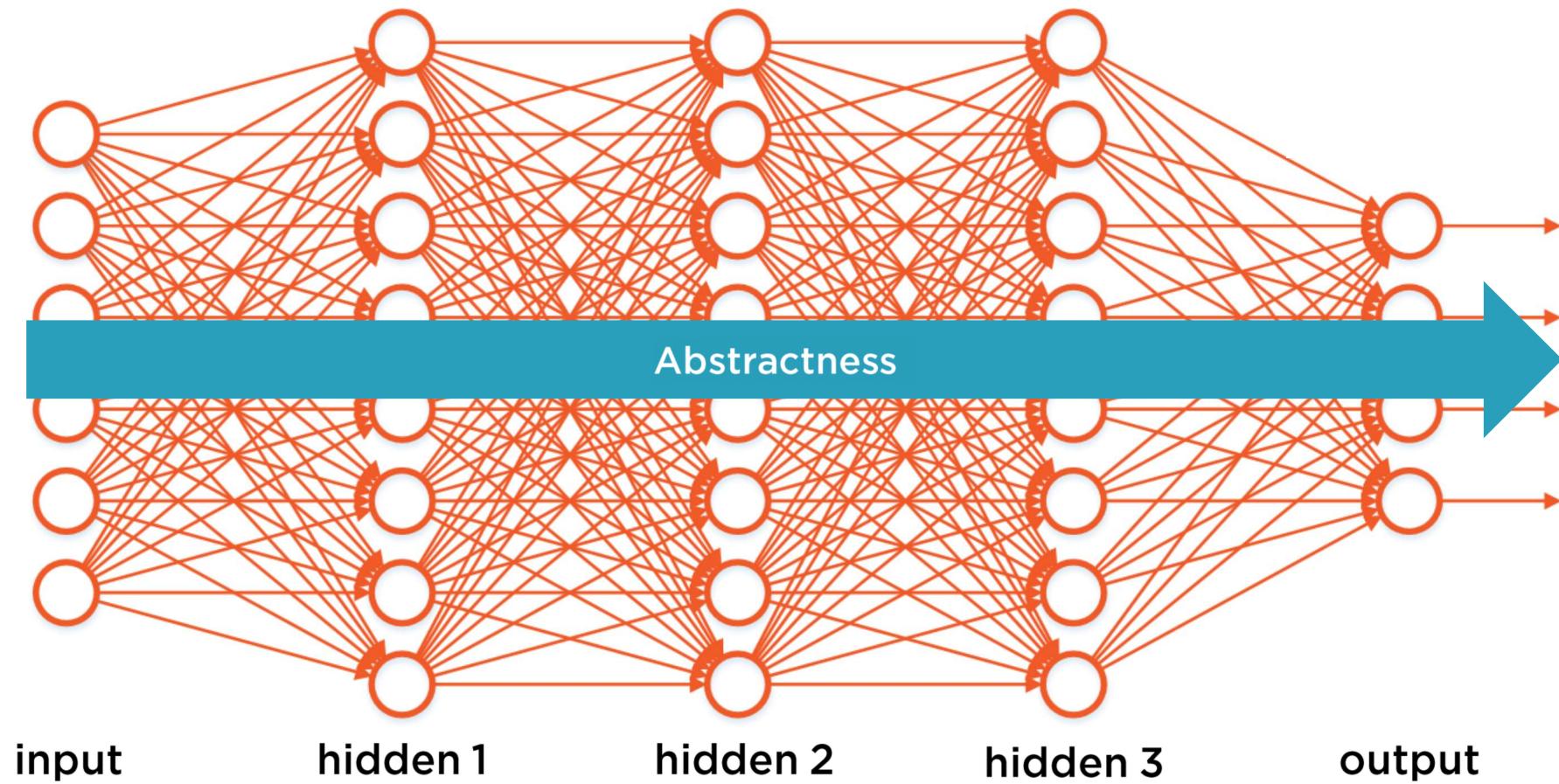
# Deep Neural Network



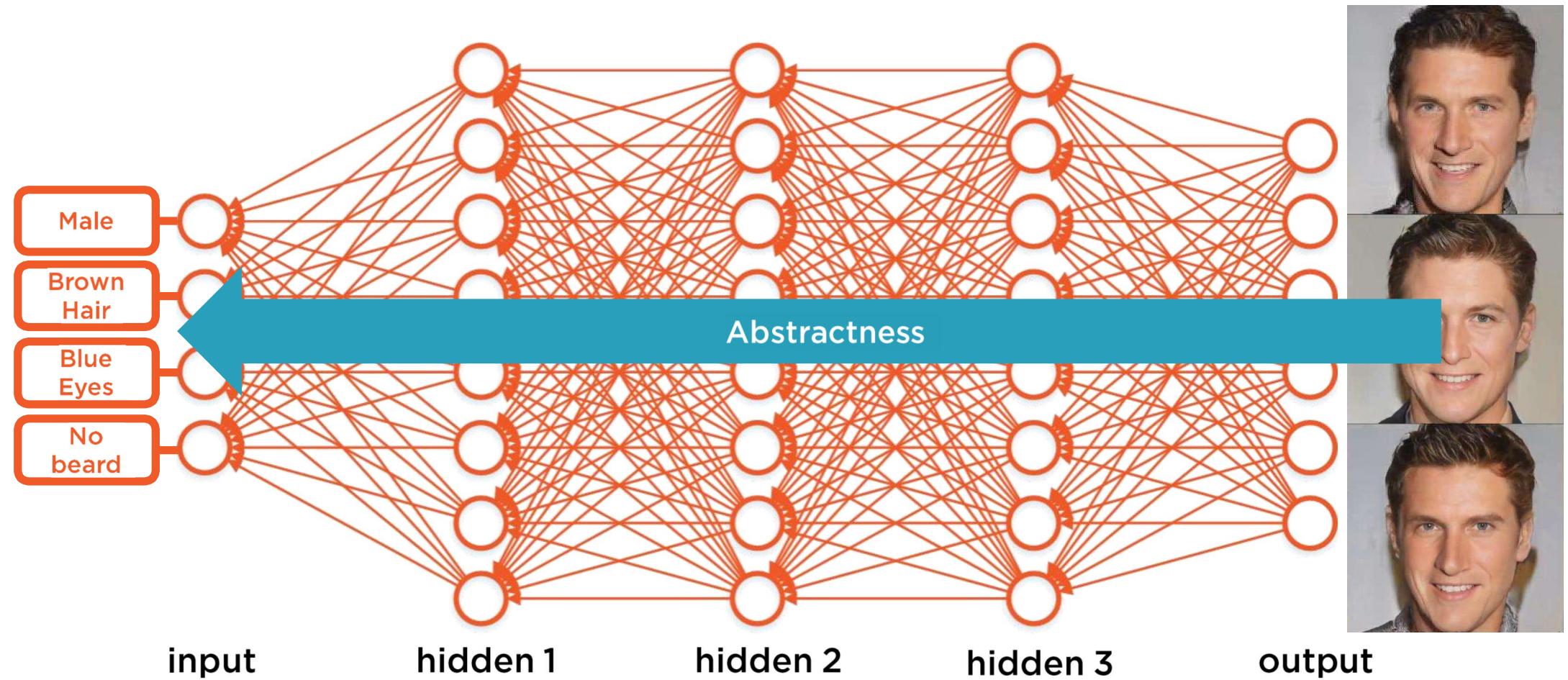
# Deep Neural Network



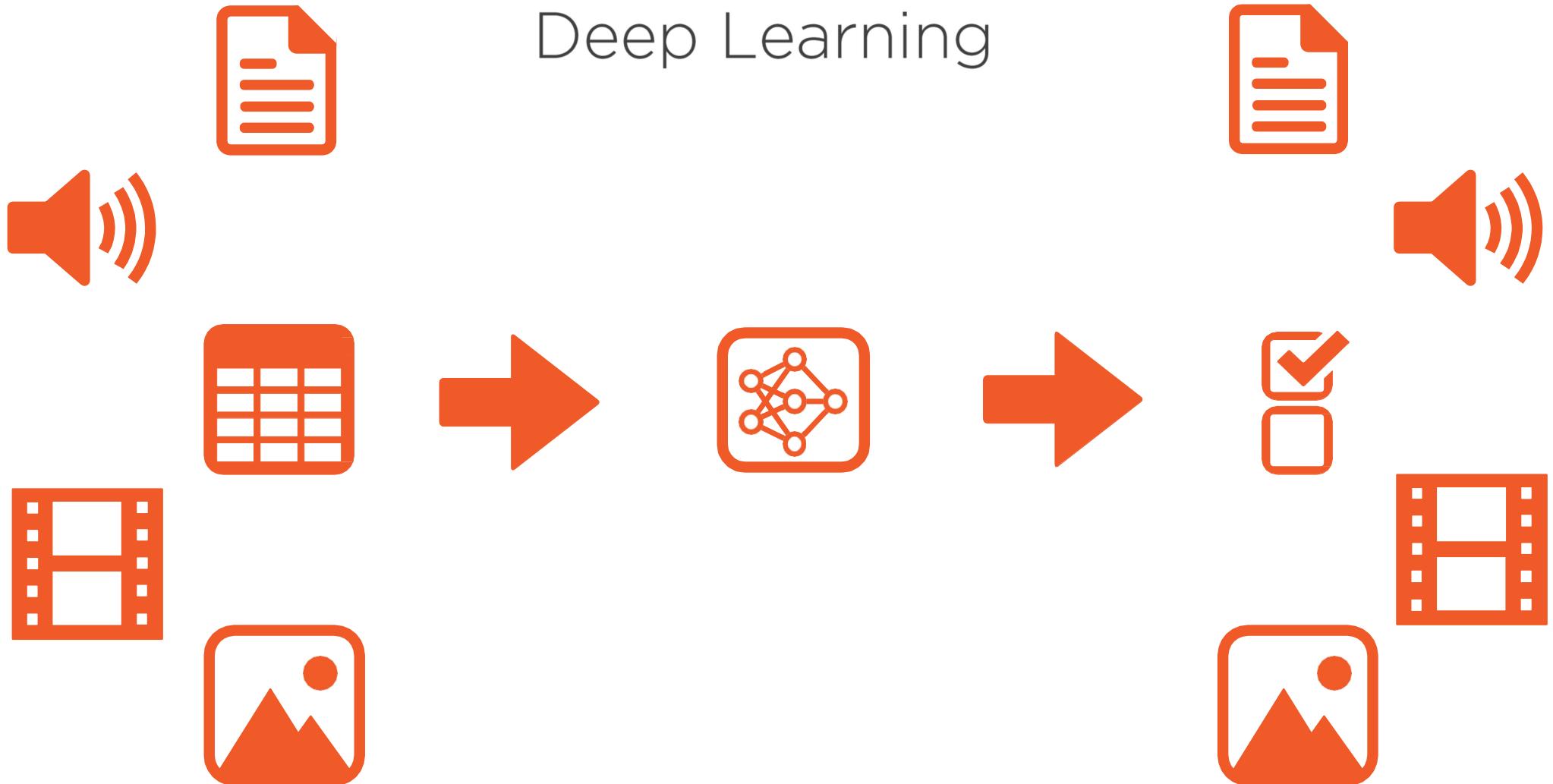
# Deep Neural Network



# DNN Generator



# Deep Learning



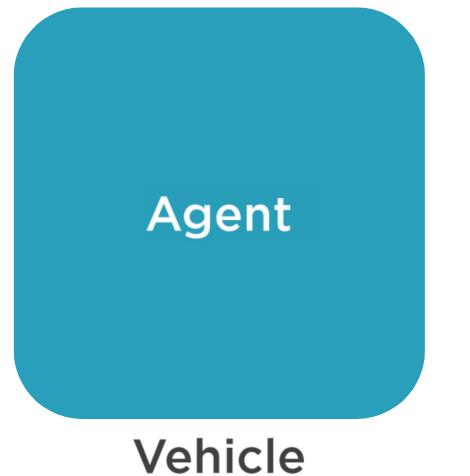
# Reinforcement Learning

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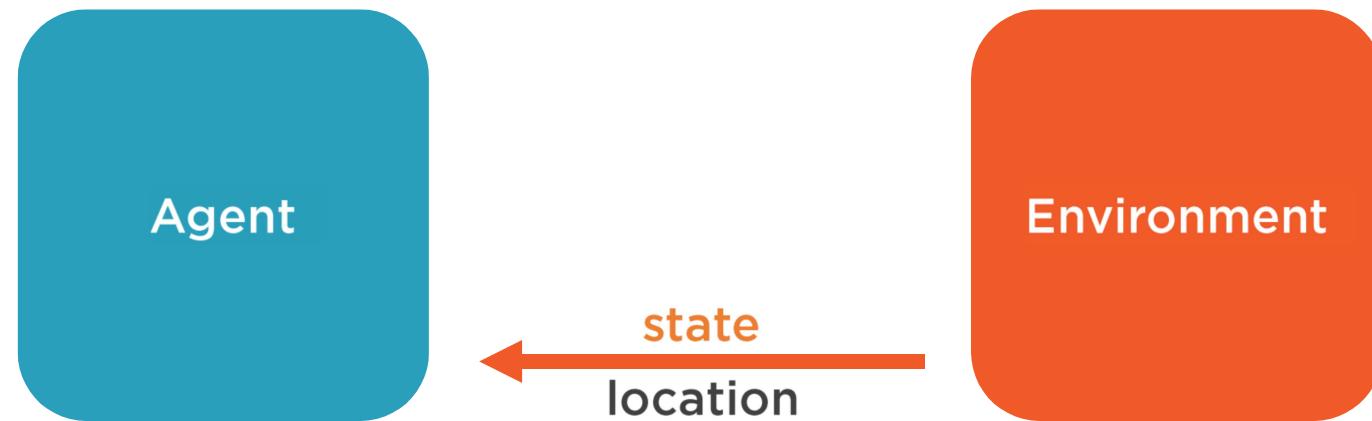
# Reinforcement Learning

- Reinforcement learning is a type of machine learning that learns to solve problems by trial and error.
- It starts with an agent interacting with an environment.
- The agent is trying to achieve a multi-step goal within the environment.
- For example, a self-driving car might be trying to drive on the roads in the real world.
- Its goal is to get you from your home to your office while avoiding obstacles in its path.
- The environment has state, which the agent can observe.
- For example, the state includes the car's location, the conditions of the road, and the location of other vehicles.
- The agent senses a state of the environment through what it sees, hears, feels or senses via other means.
- The agent has actions that it can take, which modify the state of the environment.
- For example, an agent can drive forward, drive backward, turn left or turn right.
- All of these actions change the car's position on the road within the environment.
- In addition, these actions can affect other vehicles and obstacles if they collide.
- Finally, the agent receives reward signals as it moves closer to its goal.
- The agent uses these reward signals to determine which actions were successful and which actions were not.

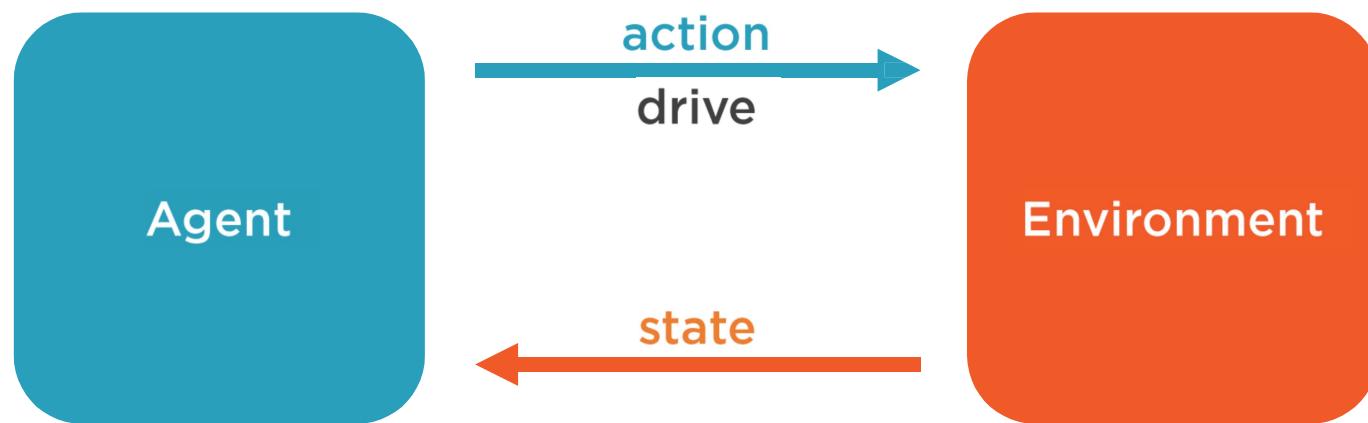
# Reinforcement Learning



# Reinforcement Learning



# Reinforcement Learning



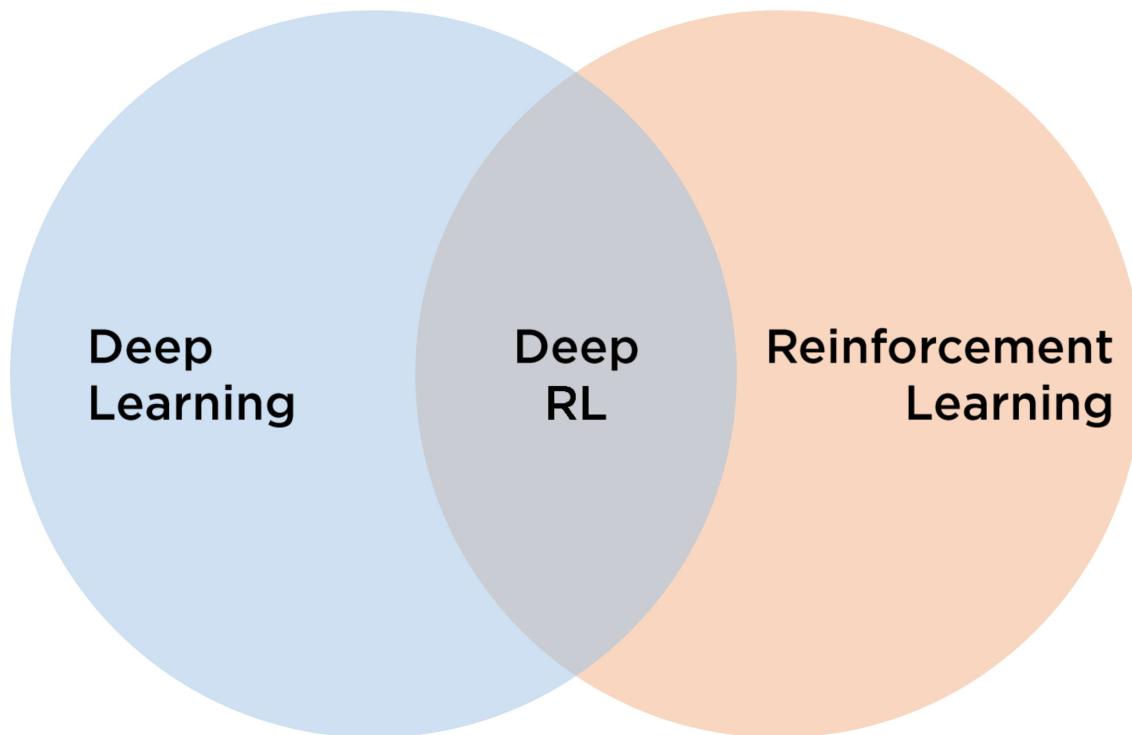
# Reinforcement Learning



# Reinforcement Learning



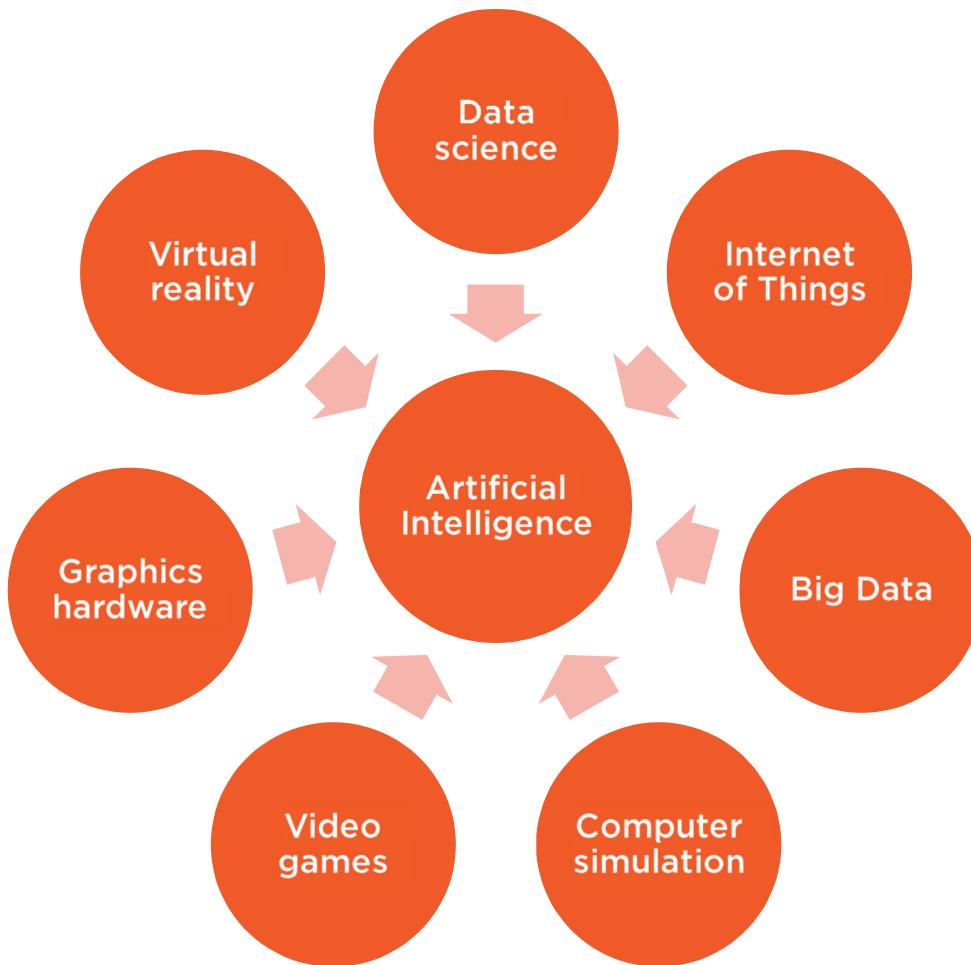
# Deep Reinforcement Learning



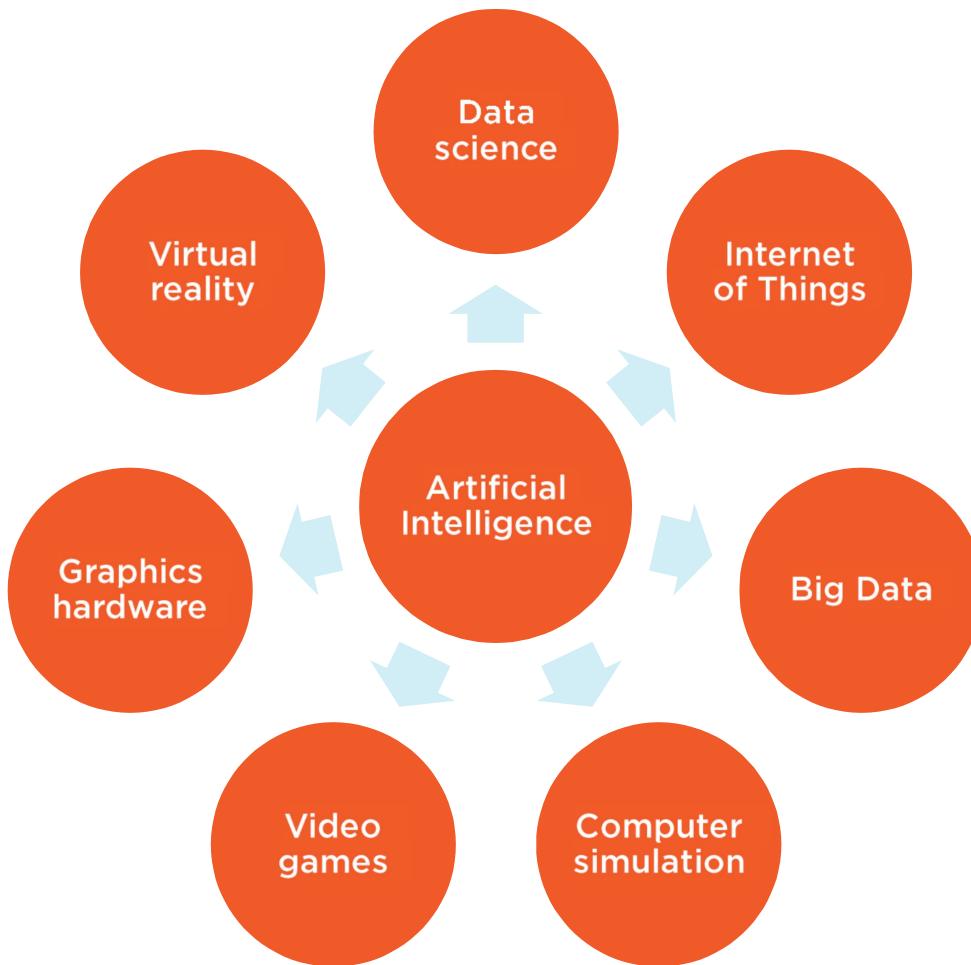
## Other A.I. Trends

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# Other Trends

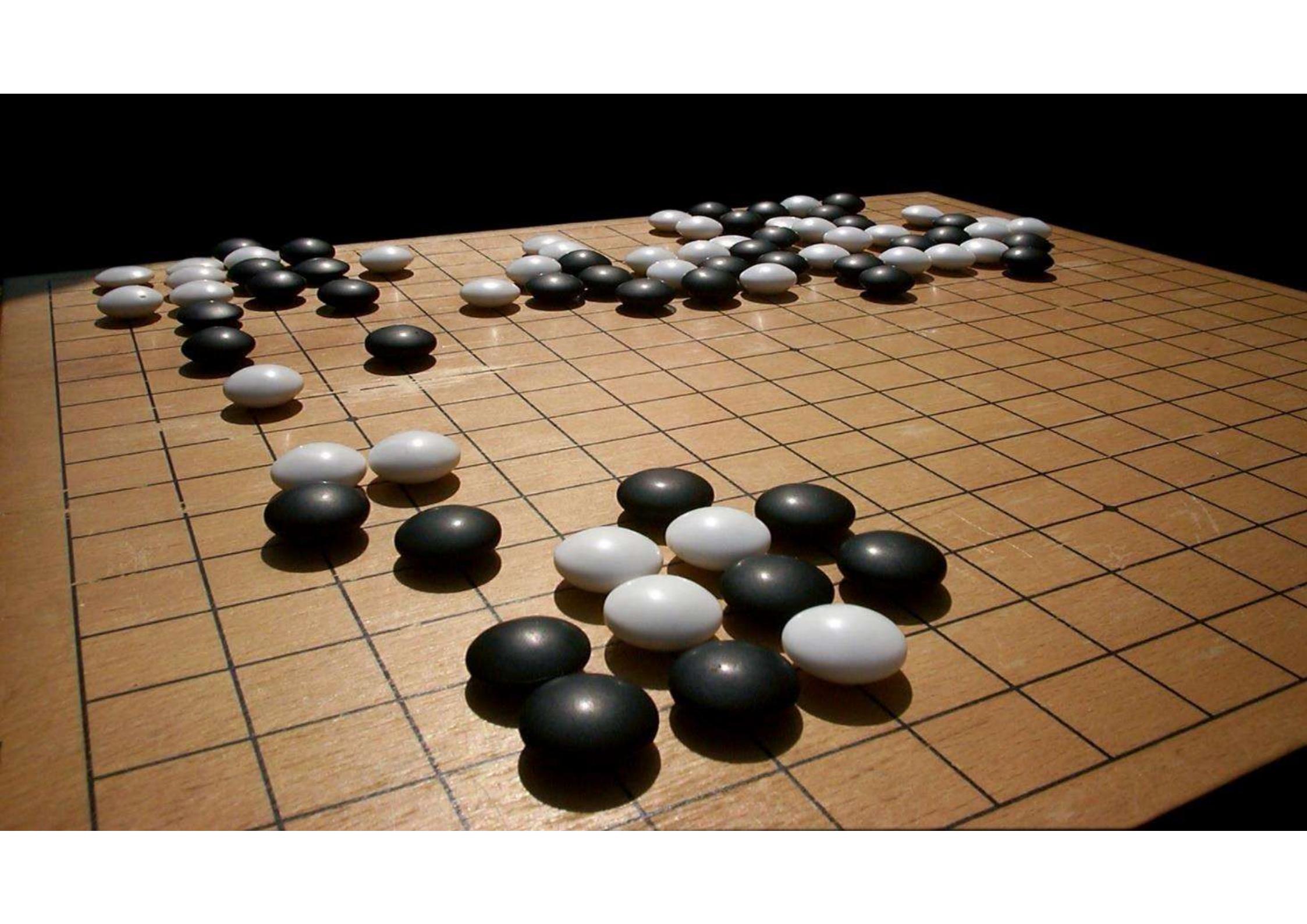


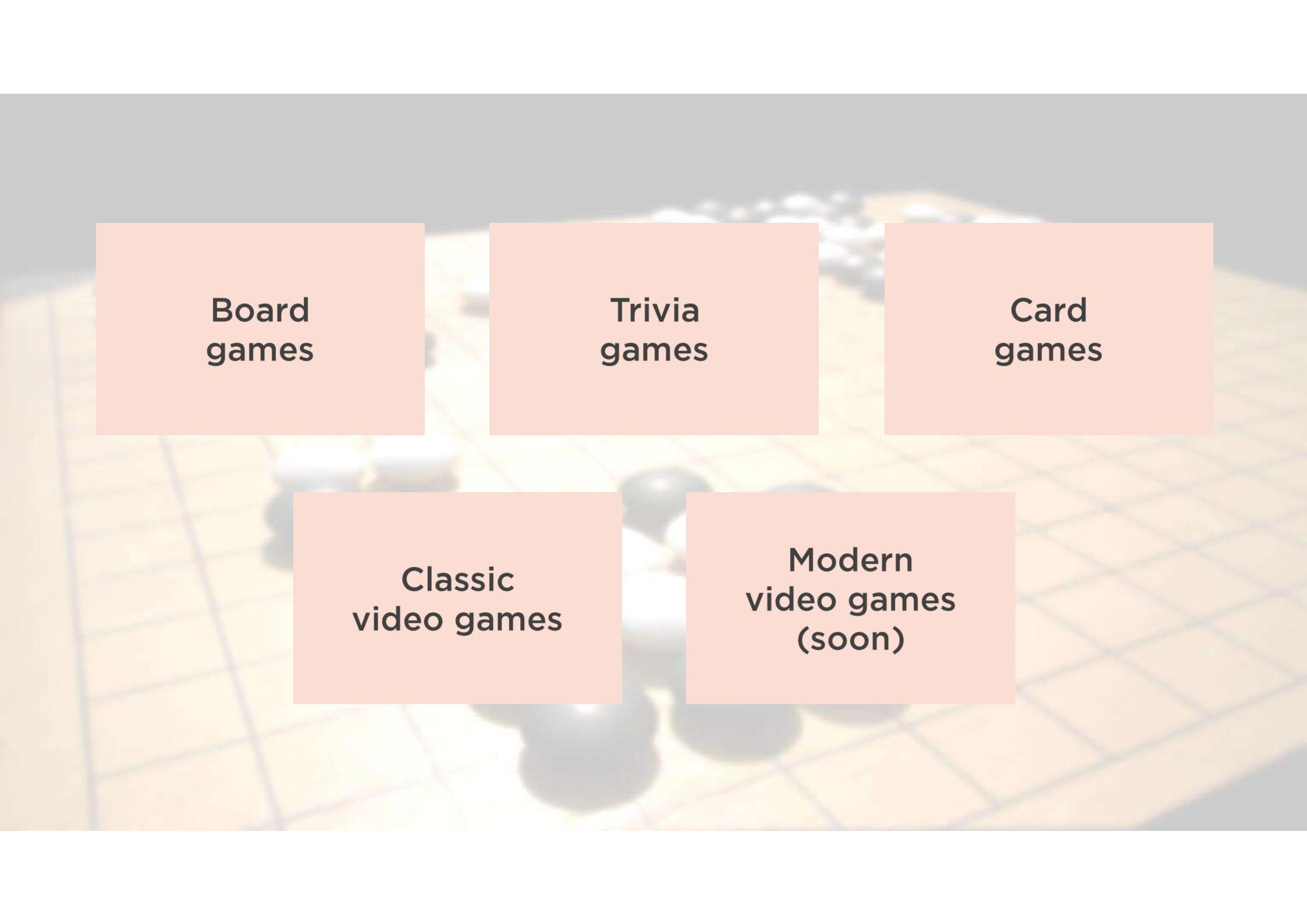
# Other Trends



# State-of-the-Art A.I.

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A soft-focus background image shows a board game setup with various pieces (black and white circles) on a light-colored board with a faint grid pattern.

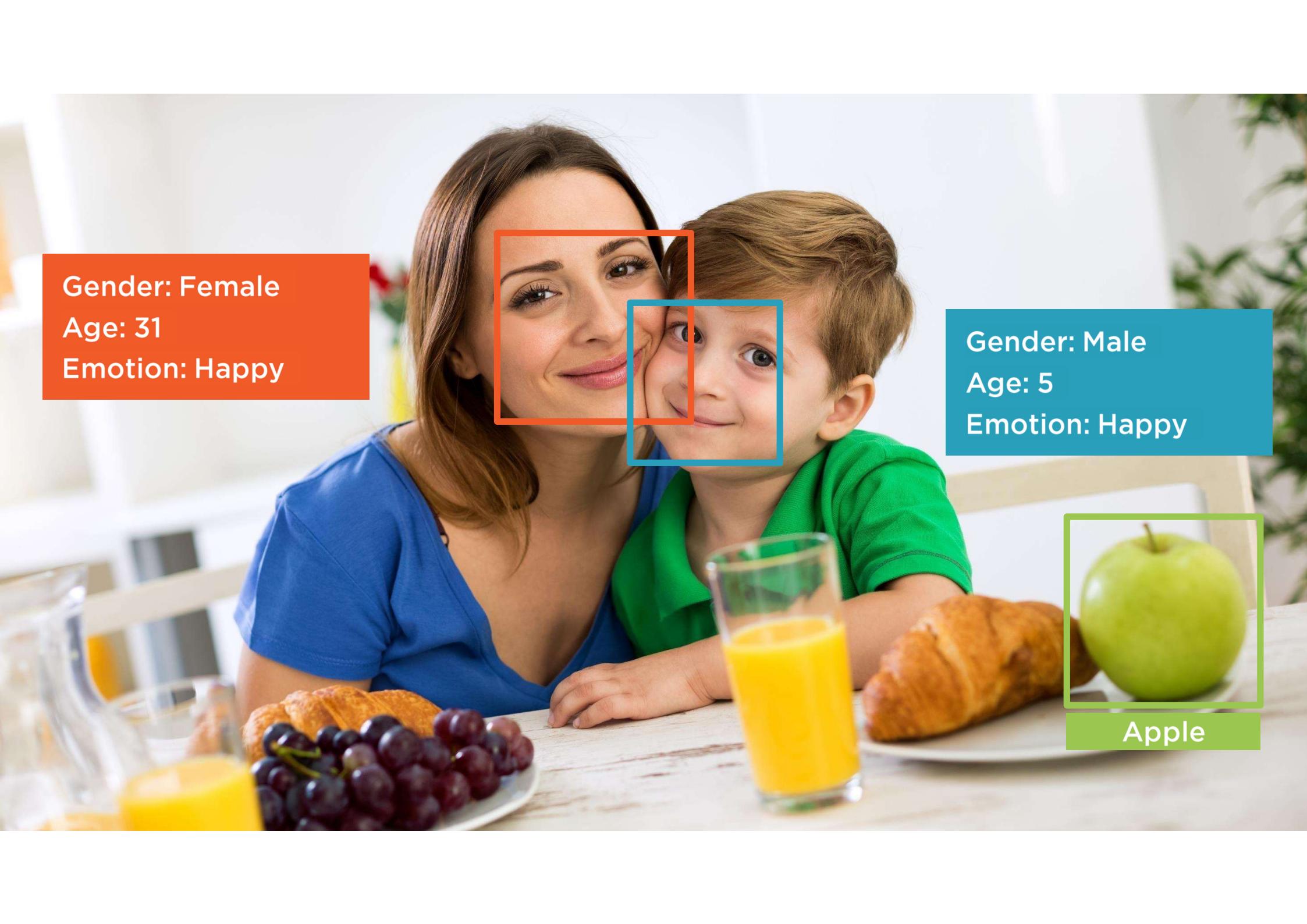
Board  
games

Trivia  
games

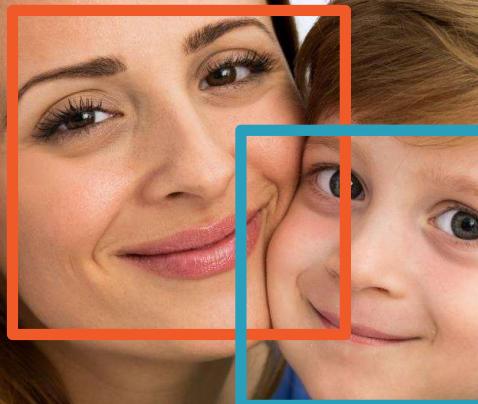
Card  
games

Classic  
video games

Modern  
video games  
(soon)



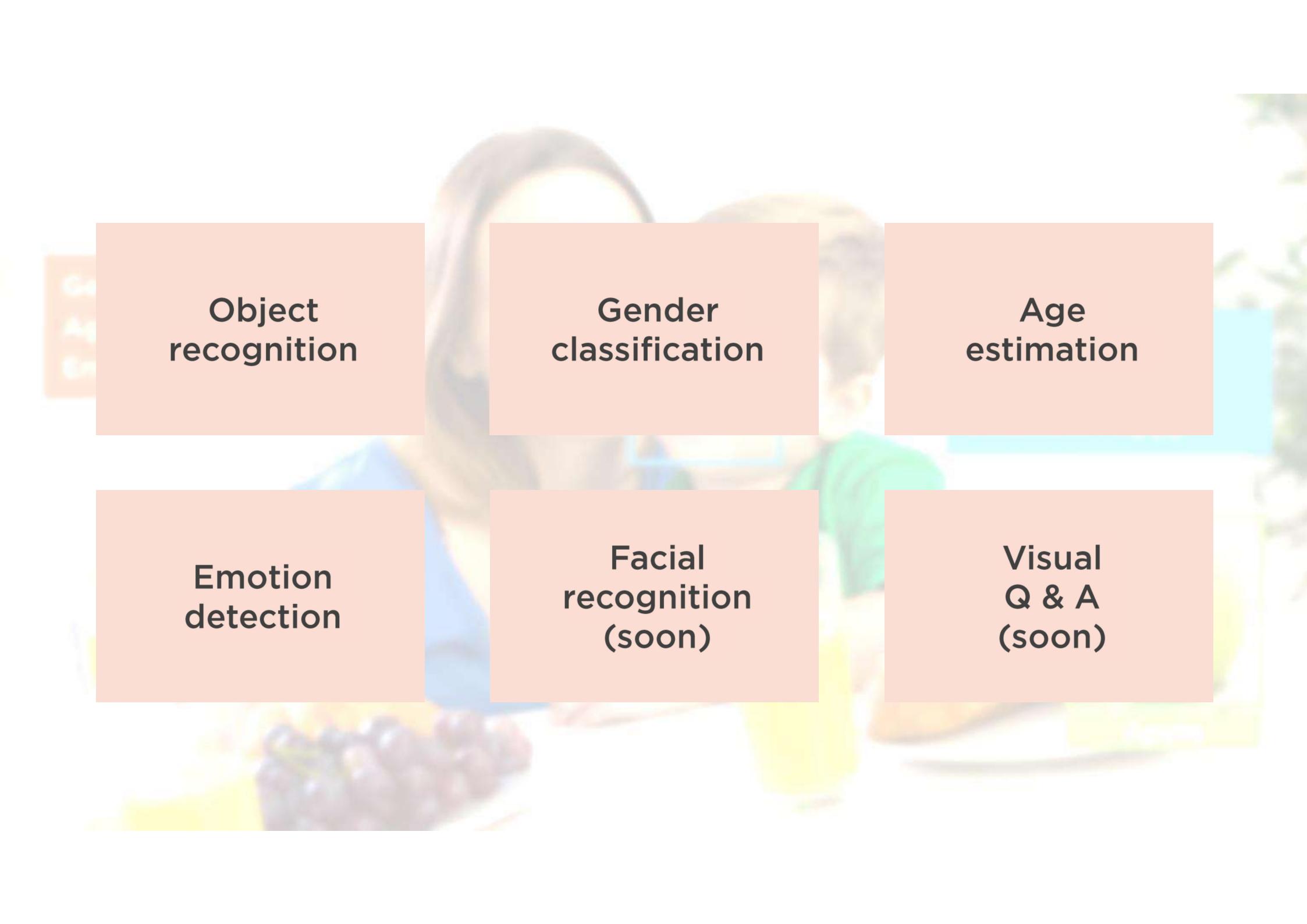
Gender: Female  
Age: 31  
Emotion: Happy



Gender: Male  
Age: 5  
Emotion: Happy



Apple

A blurred background image shows a woman with long brown hair, wearing a blue top, smiling and holding a smartphone. A young child in a green shirt is partially visible behind her, looking towards the phone. The entire image is overlaid with six orange rectangular boxes containing text.

**Object  
recognition**

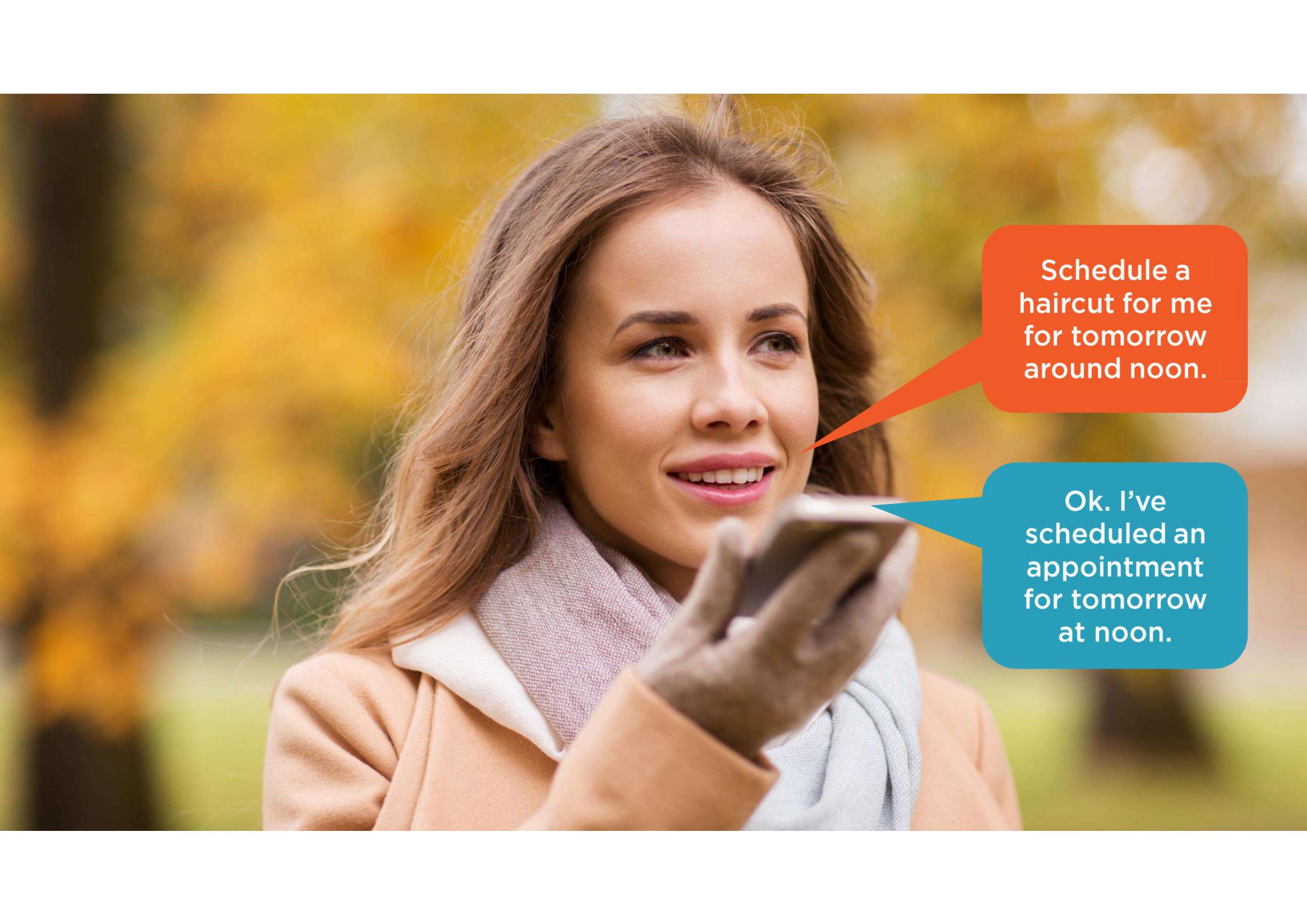
**Gender  
classification**

**Age  
estimation**

**Emotion  
detection**

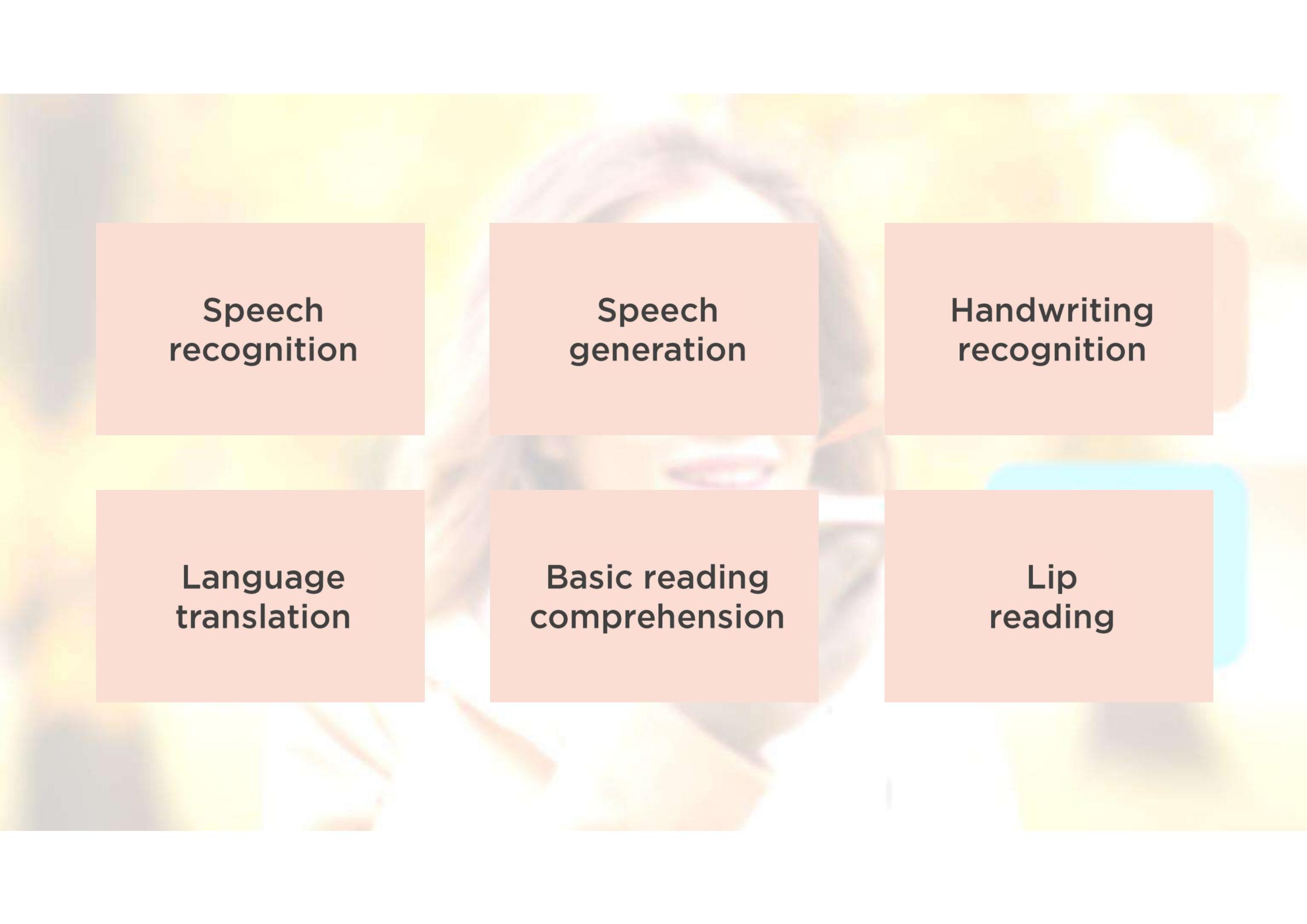
**Facial  
recognition  
(soon)**

**Visual  
Q & A  
(soon)**

A young woman with long, wavy brown hair is smiling and looking slightly to her right. She is wearing a light-colored coat over a grey scarf. Her hands are visible, holding a smartphone. The background is a soft-focus view of autumn foliage in shades of yellow and orange.

Schedule a haircut for me for tomorrow around noon.

Ok. I've scheduled an appointment for tomorrow at noon.



A person's face is visible in the background, partially obscured by a colorful, abstract overlay of overlapping circles in shades of yellow, orange, and blue.

Speech  
recognition

Speech  
generation

Handwriting  
recognition

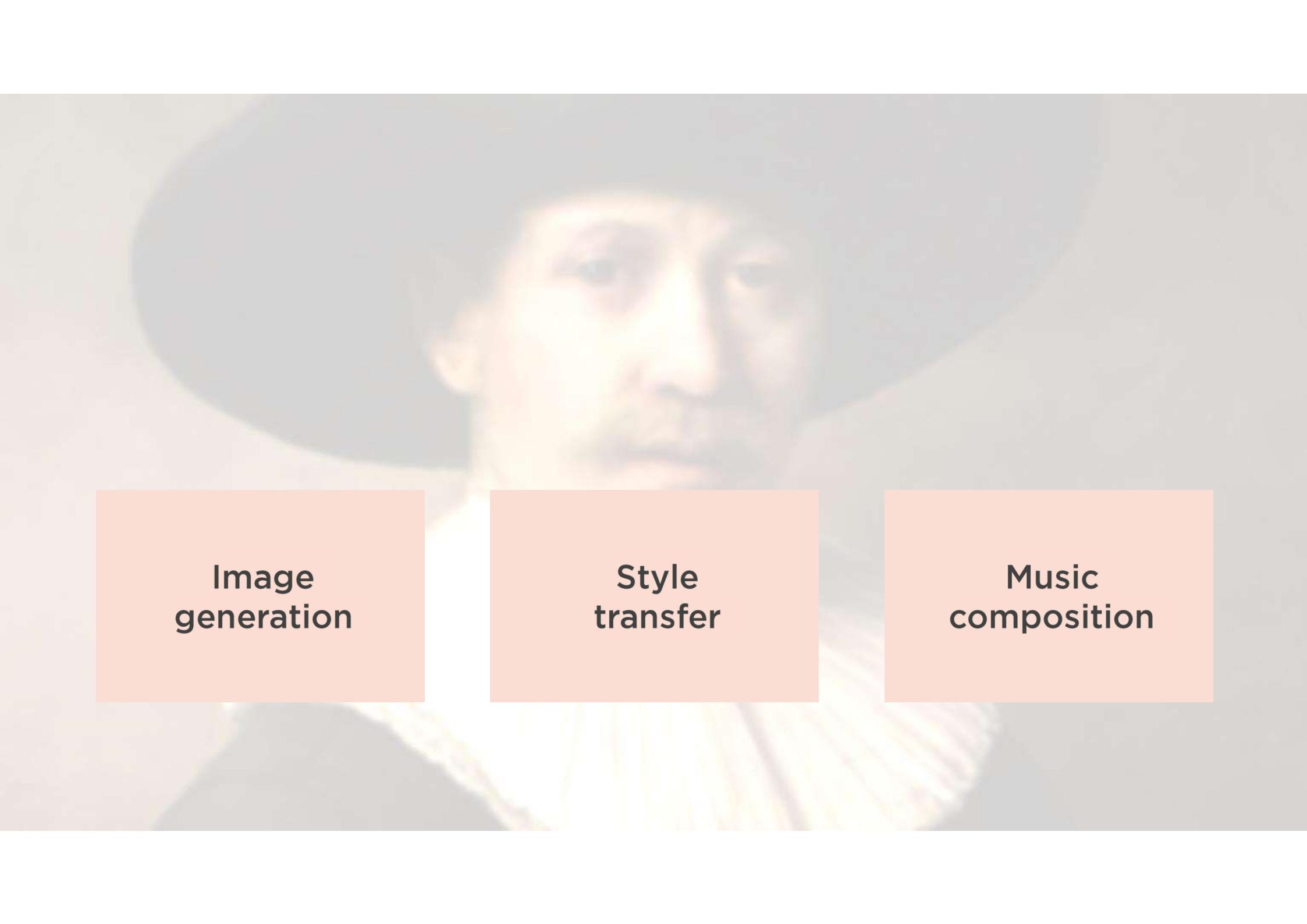
Language  
translation

Basic reading  
comprehension

Lip  
reading



Sources: The Next Rembrandt, Microsoft  
ING, J. Walter Thompson Amsterdam



**Image  
generation**

**Style  
transfer**

**Music  
composition**

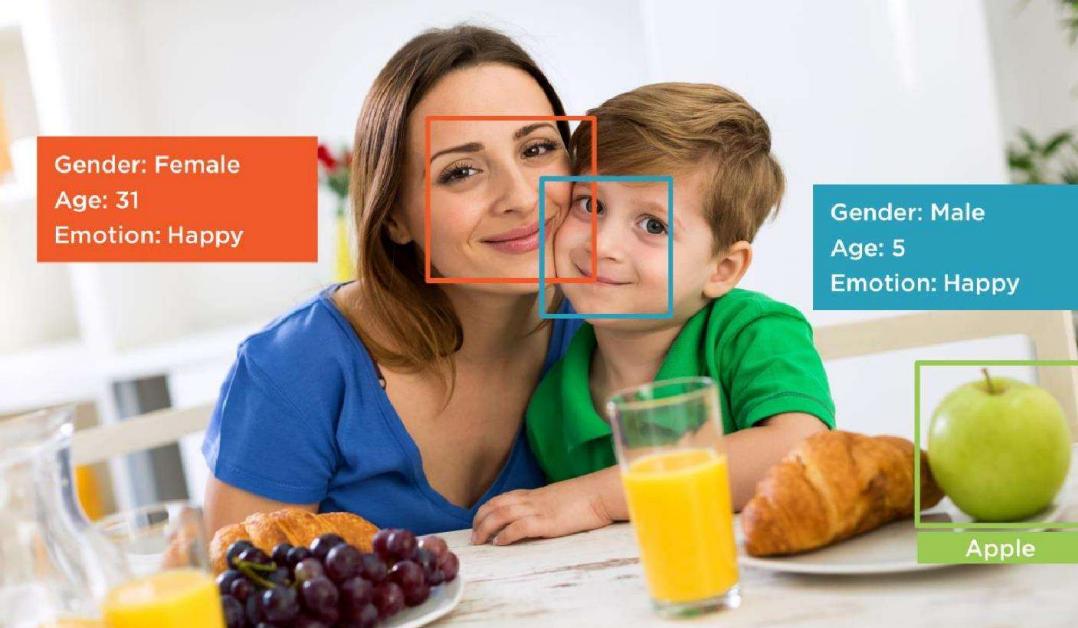
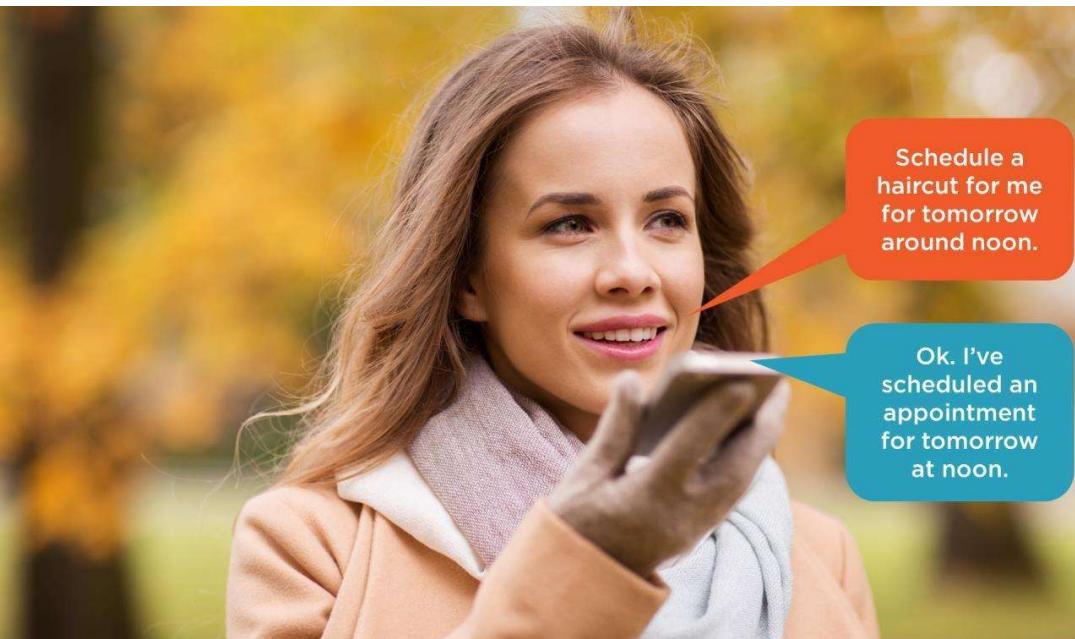
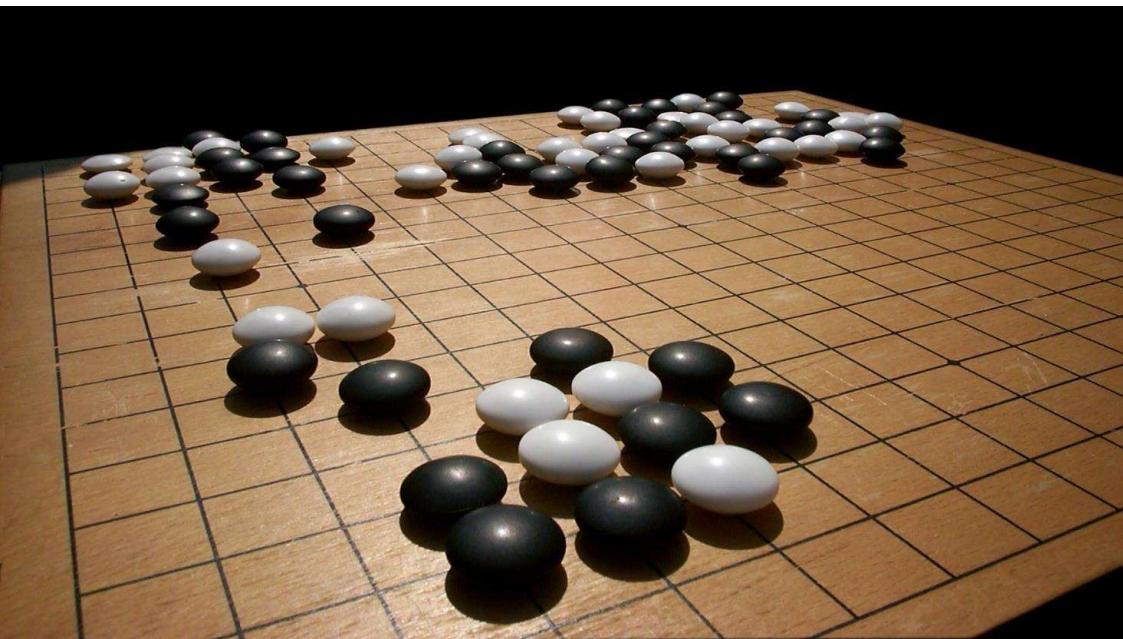




Disease  
diagnosis

Treatment  
recommendation

Prognosis  
prediction



# A.I. and I.T

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# Overview



**Training A.I. Models**

**Building A.I. Apps**

**Using A.I. Tools**

# Training A.I. Models

---

# Training A.I. Models

**Training via  
data set**

**Training via  
simulation**

**Training via  
demonstration**



## Training an A.I. Model Using a Data Set

### 1. Load the Data

```
In [1]: import os
import pandas as pd
import seaborn as sns
import numpy as np
import matplotlib.pyplot as plt
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.model_selection import GridSearchCV
from sklearn.neural_network import MLPClassifier
from sklearn.metrics import accuracy_score
```

```
In [3]: os.chdir("C:\Workshop\Dataset")
```

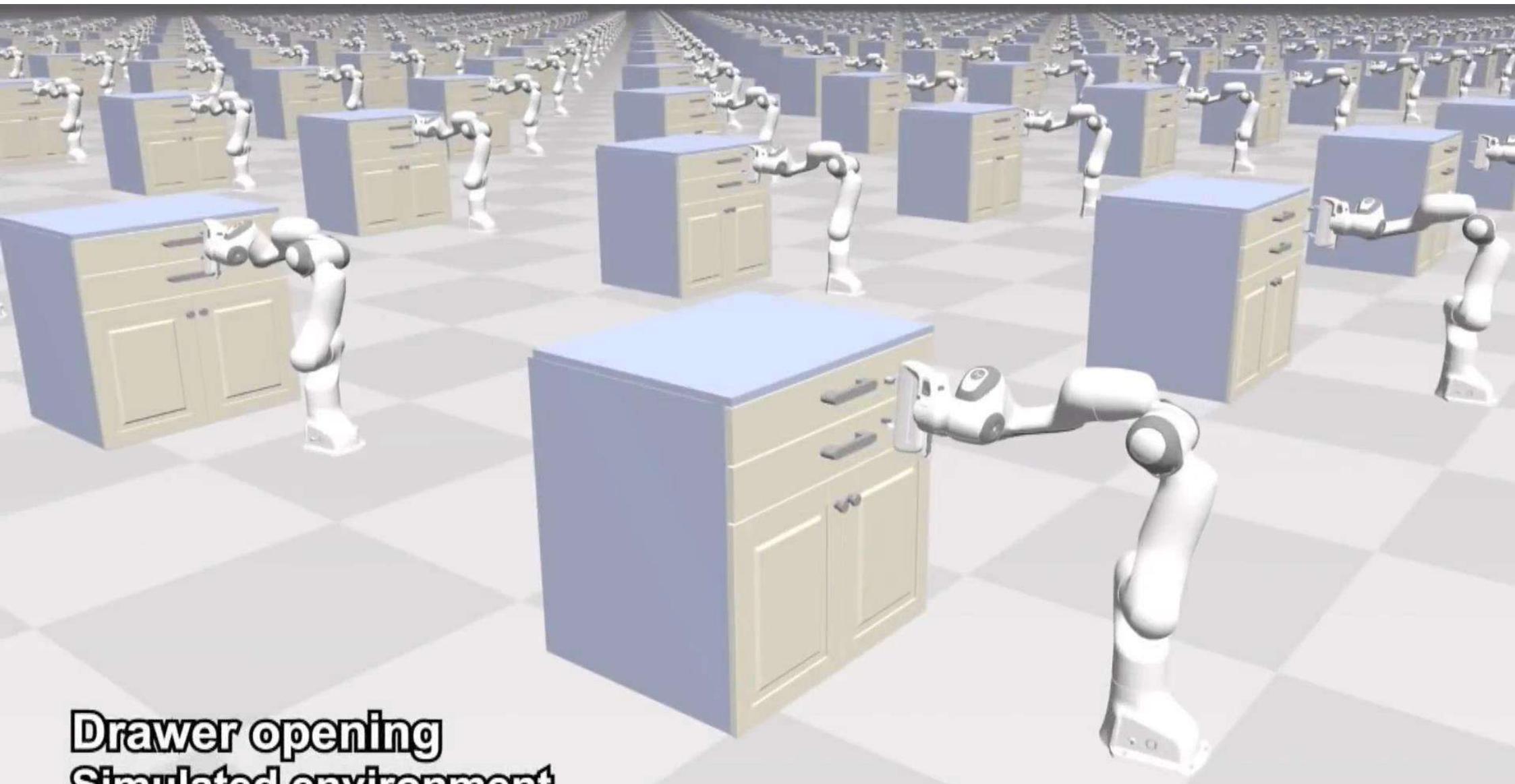
```
In [4]: policies = pd.read_csv("Risk.csv")
```

### 2. Transform the Data

```
In [5]: X = policies[["Gender", "State_Rate", "Height", "Weight", "BMI", "Age"]]
```

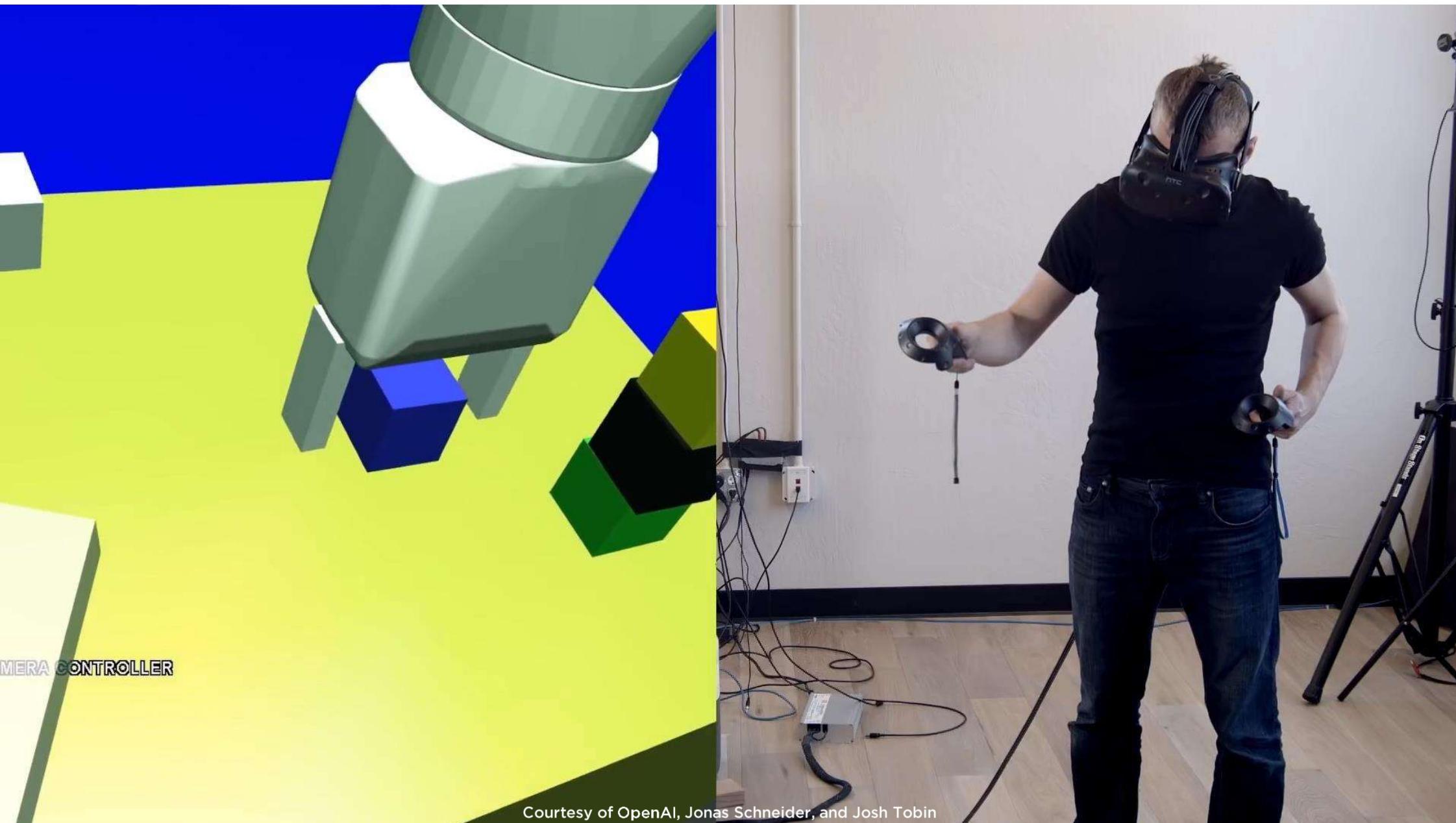
```
In [6]: X.Gender = X.Gender.replace(("Female", "Male"), (0, 1))
```





## Drawer opening Simulated environment

Courtesy of Yevgen Chebotar, Ankur Handa, Viktor Makoviychuk, Miles Macklin, Jan Issac, Nathan Ratliff, and Dieter Fox



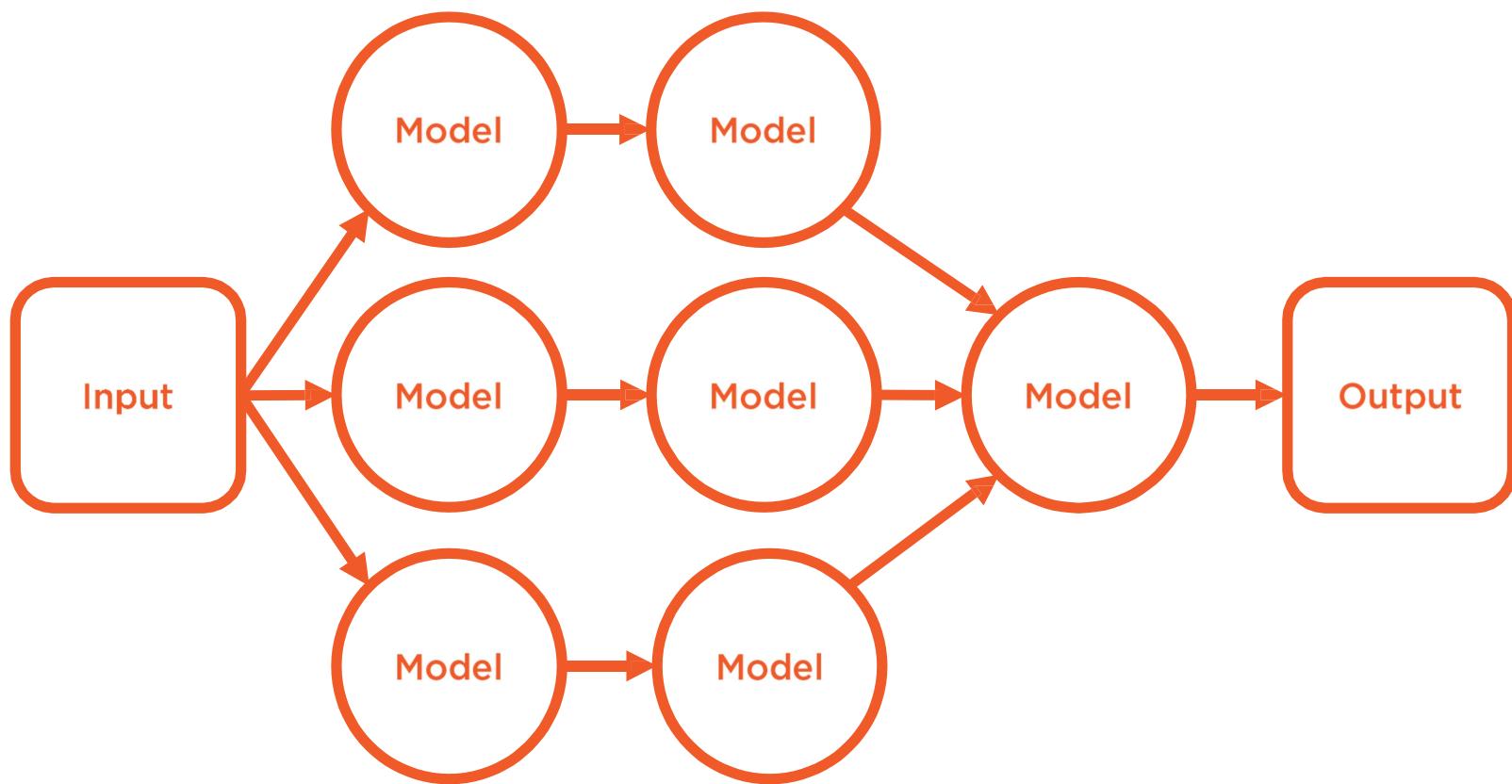


Courtesy of the HAHN Group

# Building A.I. Apps

---

# Modular A.I. Applications





**Image contains product**

**Customers are happy**

**Sentiment is positive**



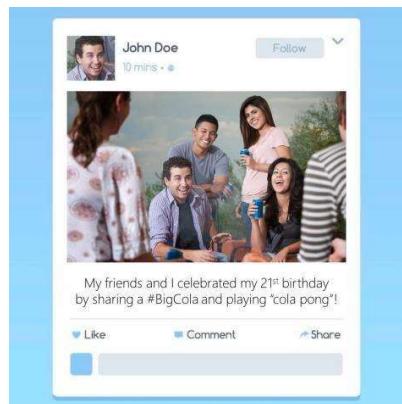
Big Cola, Inc



My friends and I celebrated my 21<sup>st</sup> birthday by sharing a #BigCola and playing "cola pong"!

Thanks for sharing your big day with us, John! : )

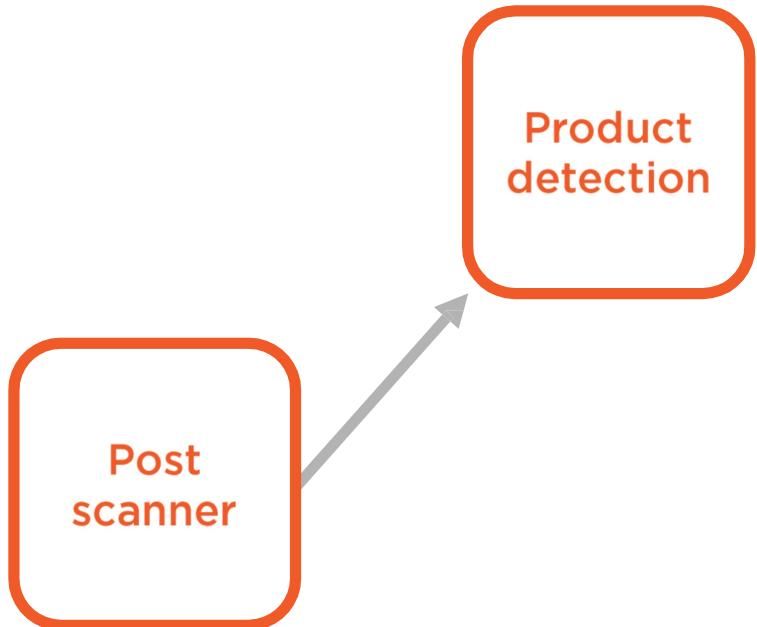
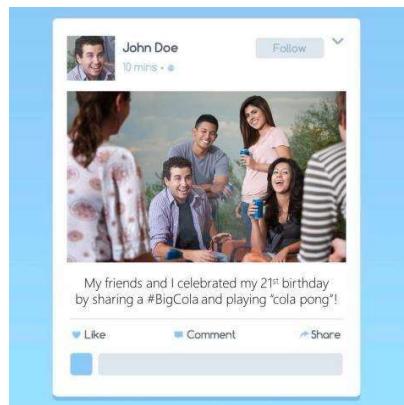
Here's a free big cola for your next party!



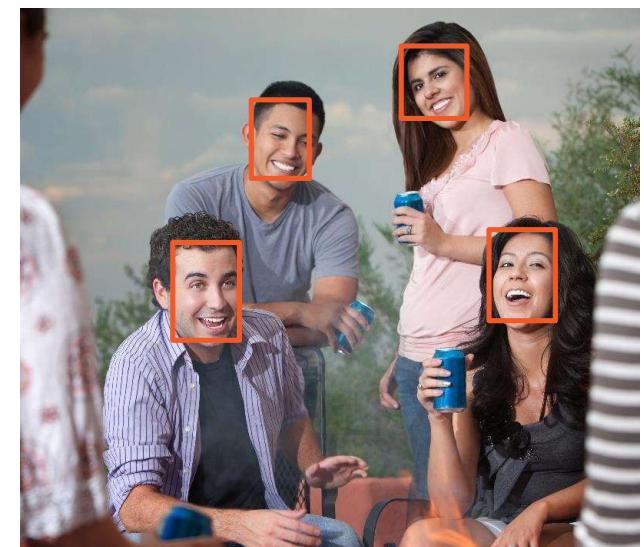
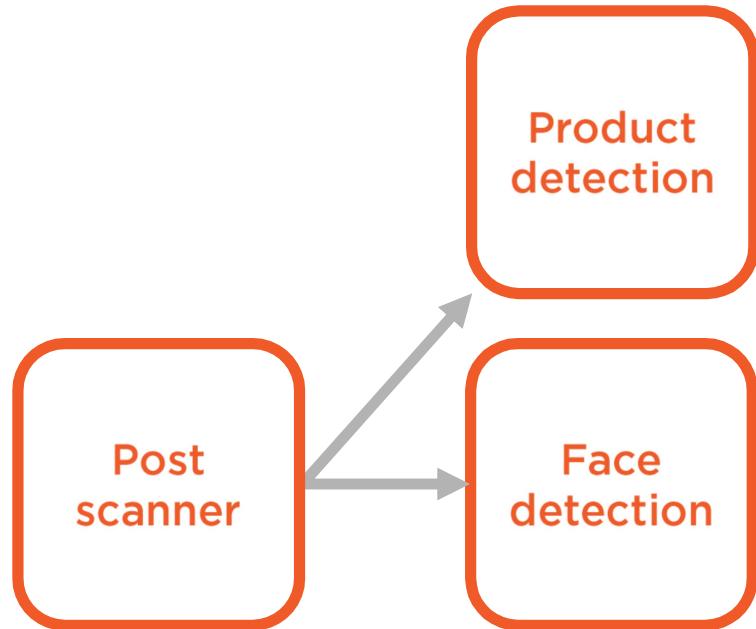
Post  
scanner

My friends and I celebrated my 21<sup>st</sup> birthday by sharing a #BigCola and playing "cola pong"!

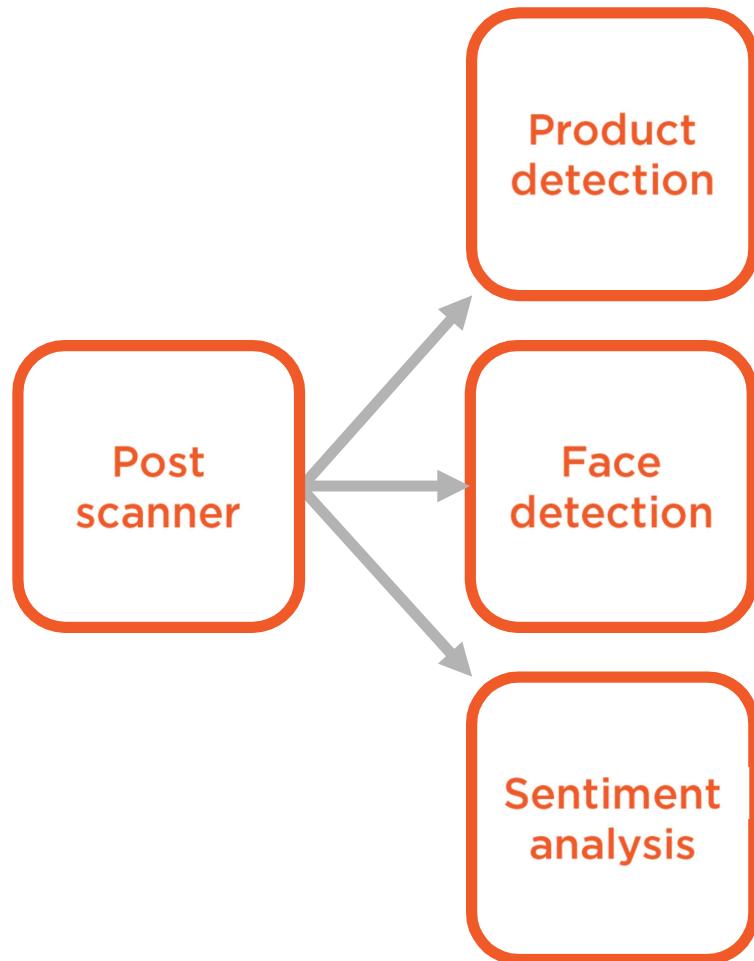
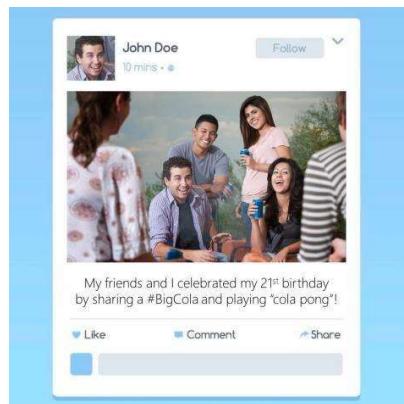
**Brand detected  
(100% confidence)**



**Product detected  
(90% confidence)**

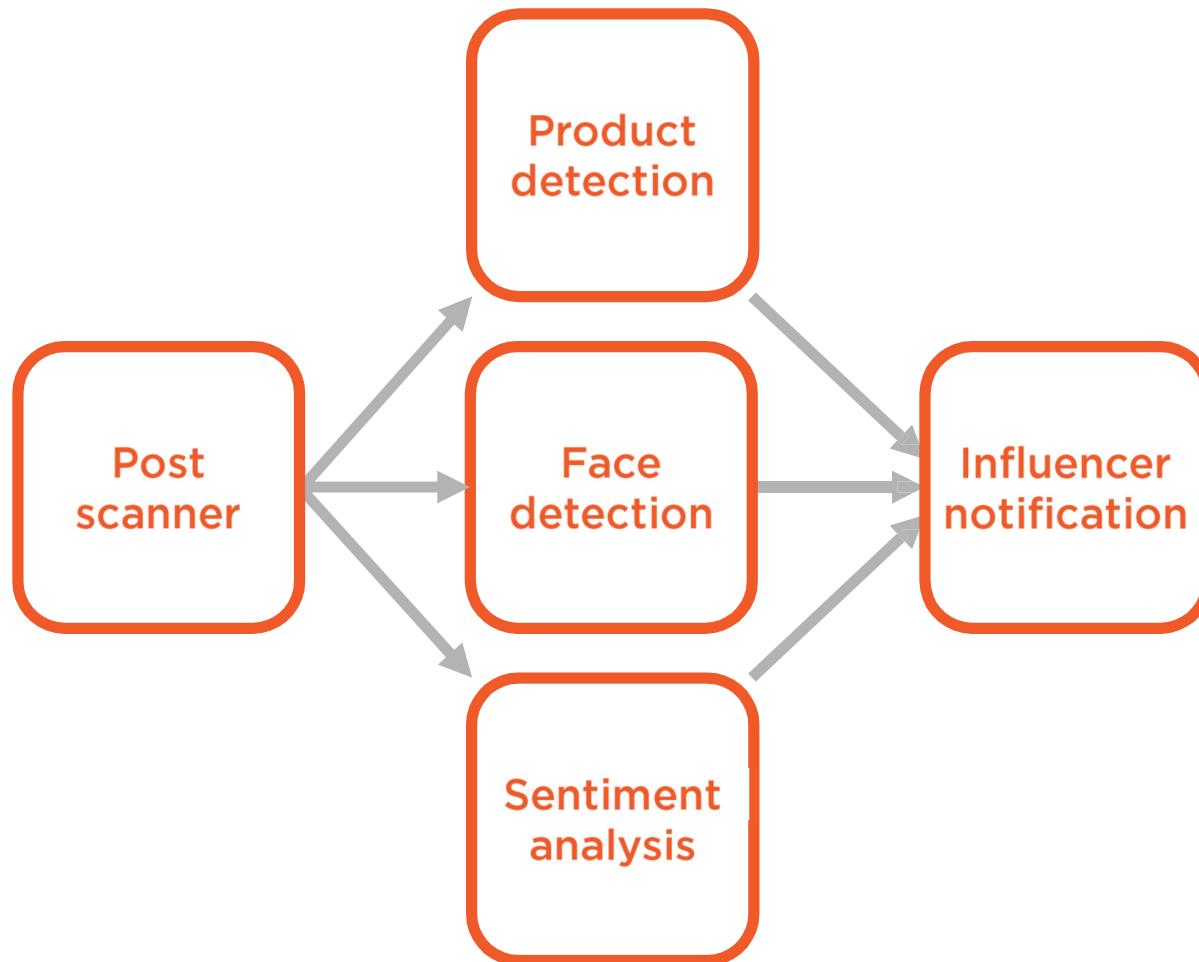
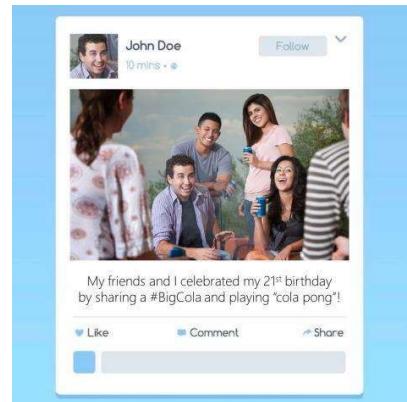


**Emotion: happiness  
(99% confidence)**



My friends and I celebrated my 21<sup>st</sup> birthday by sharing a #BigCola and playing "cola pong"!

**Sentiment: positive  
(95% confidence)**



It's the combination of A.I. modules  
that will lead to A.I. applications  
of the future.

# Pre-trained A.I. Modules

**Object detection**

**Face recognition**

**Emotion detection**

**Gesture recognition**

**Pose estimation**

**Video indexing**

**Text analysis**

**Language translation**

**Text to speech**

**Speech to text**

**Speaker recognition**

**Handwriting recognition**

**And more ...**

Everything you need to get started  
is available today!

# Future of A.I.

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# Overview



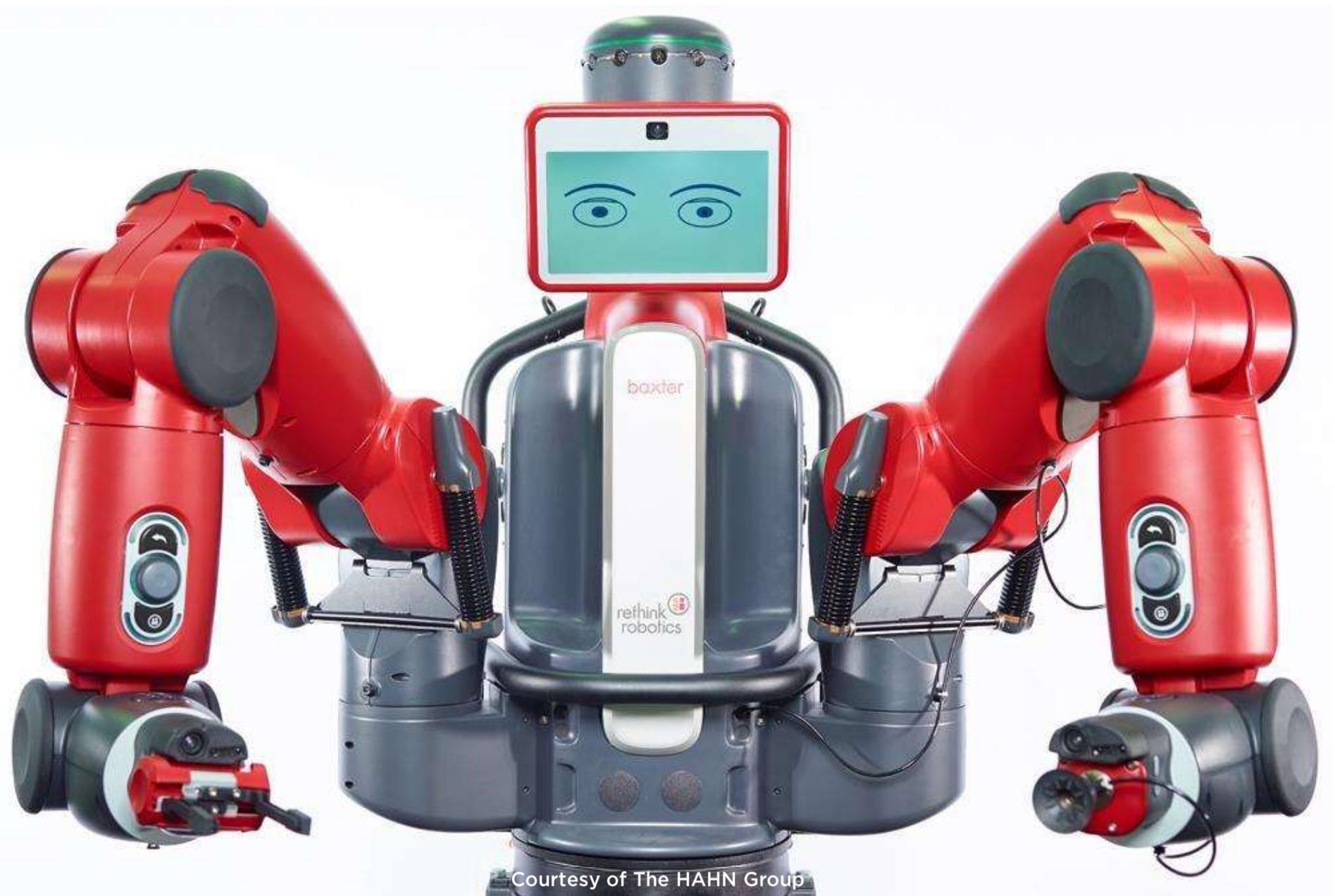
A.I. and Society

A.I. and Labor

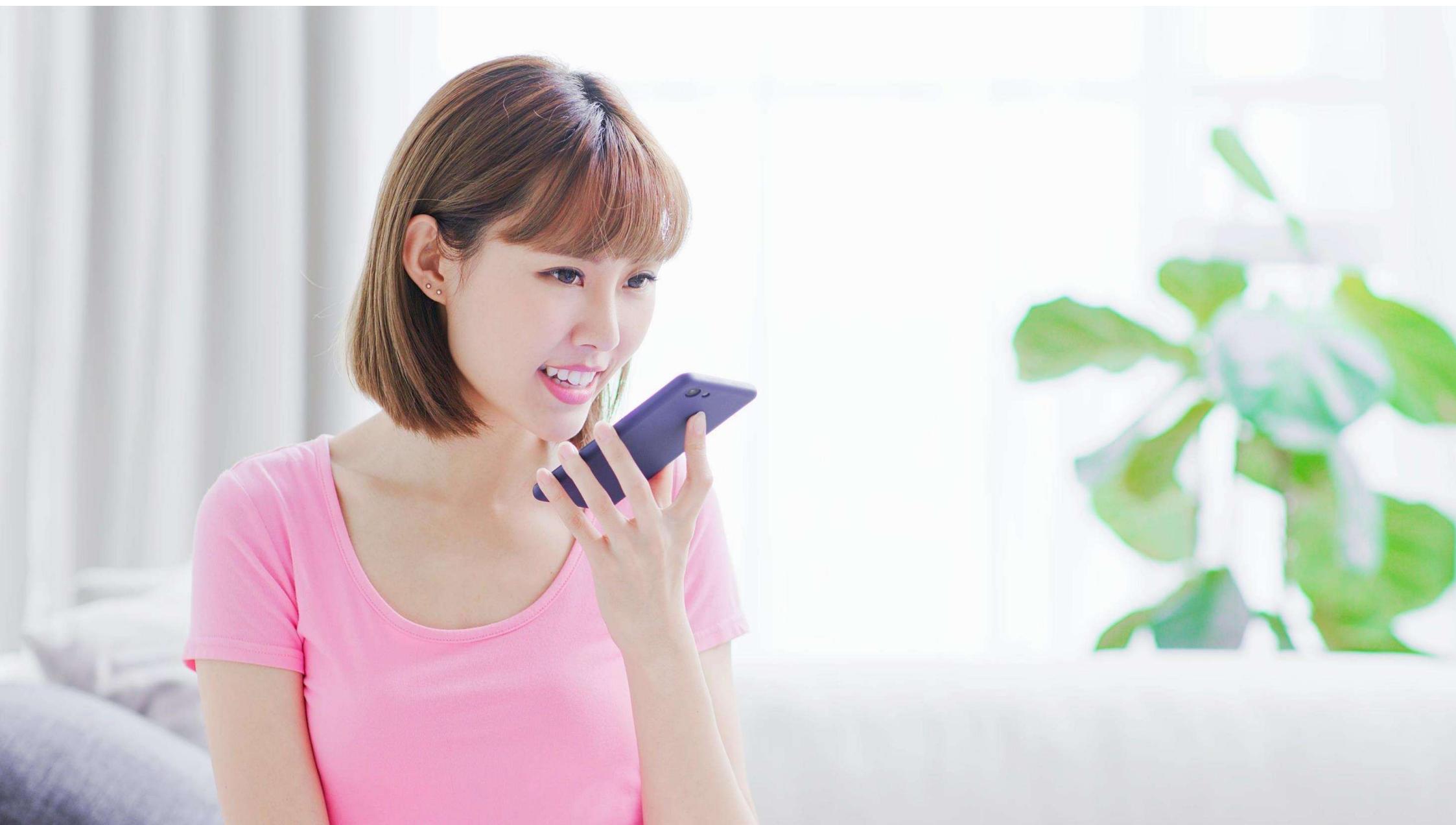
A.I. and Ethics

# A.I. and Society

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Courtesy of The HAHN Group







A.I. will be as common  
as electricity is today.

# Impacts of A.I.

Social

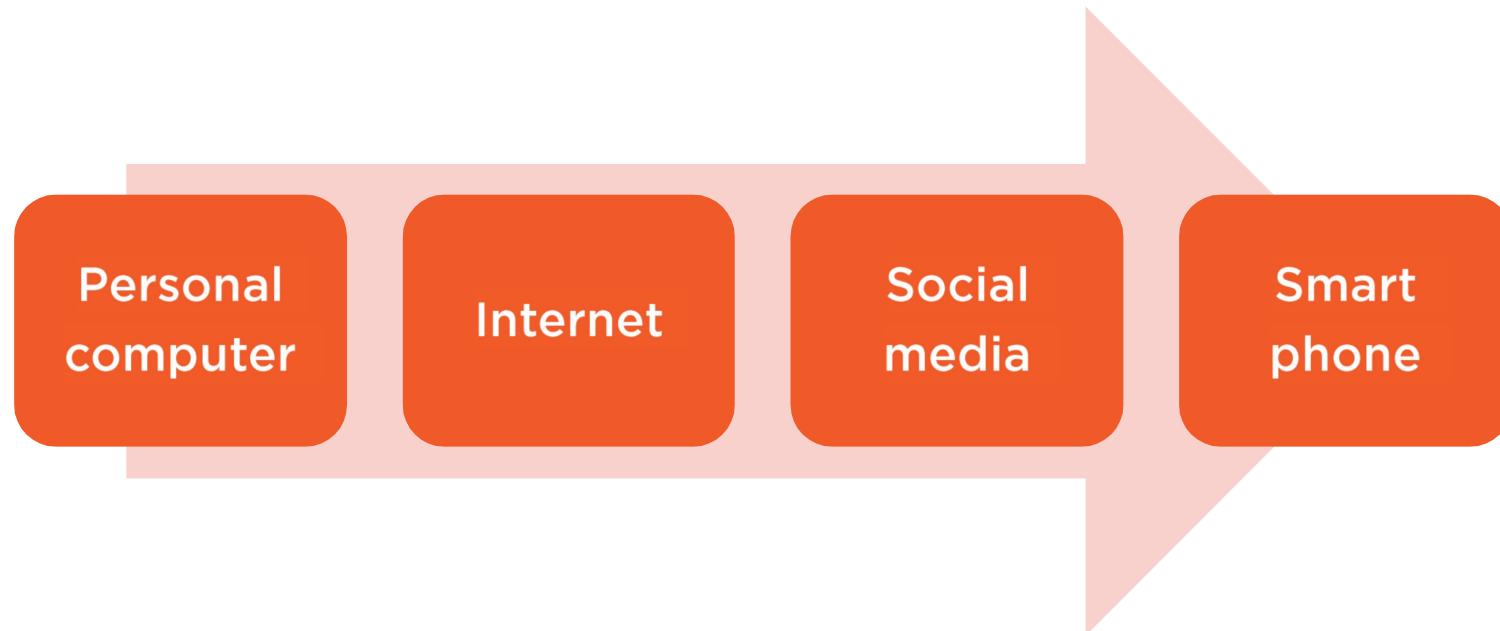
Political

Economic

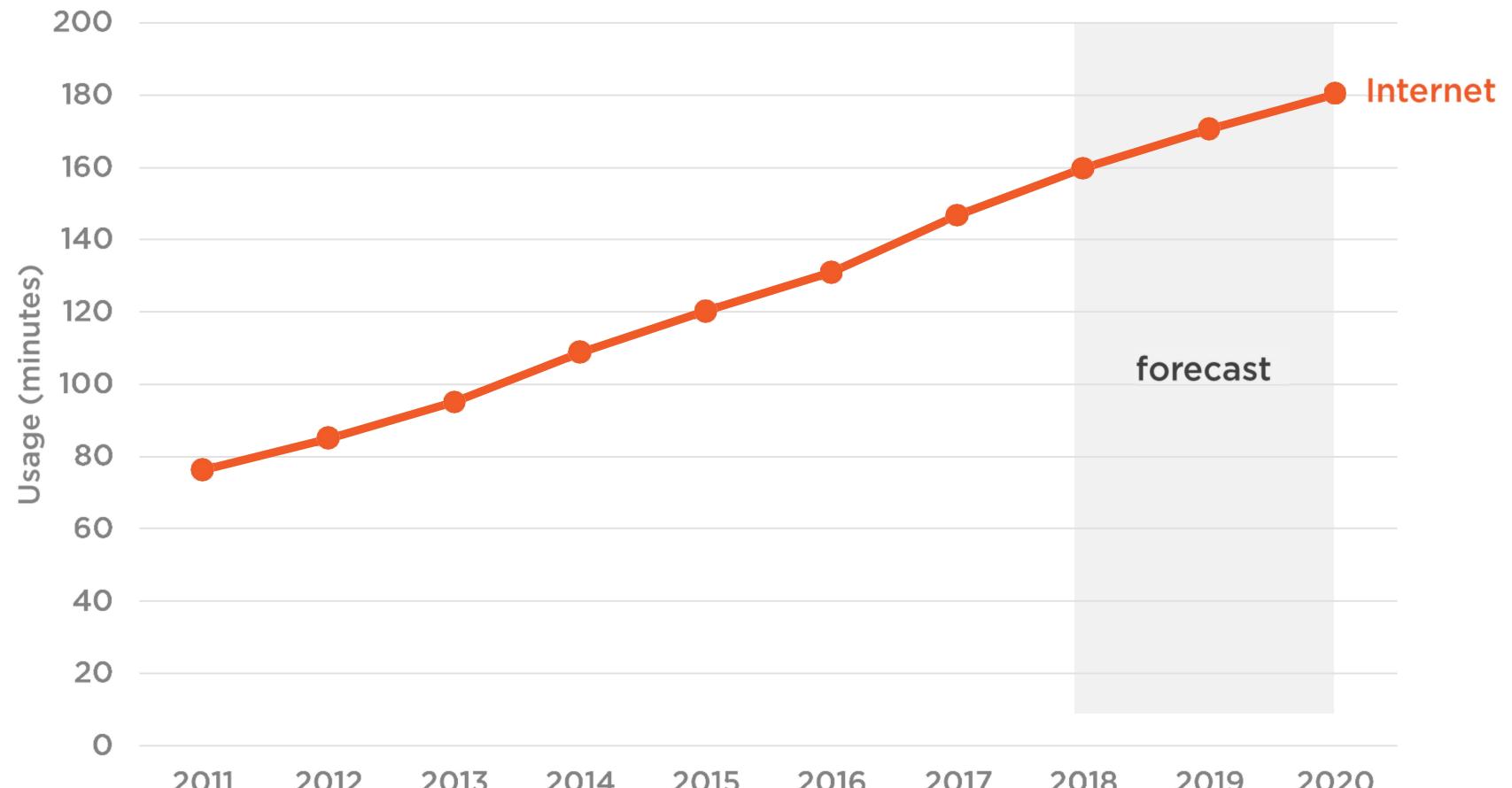
Legal

Ethical

# Information Revolution

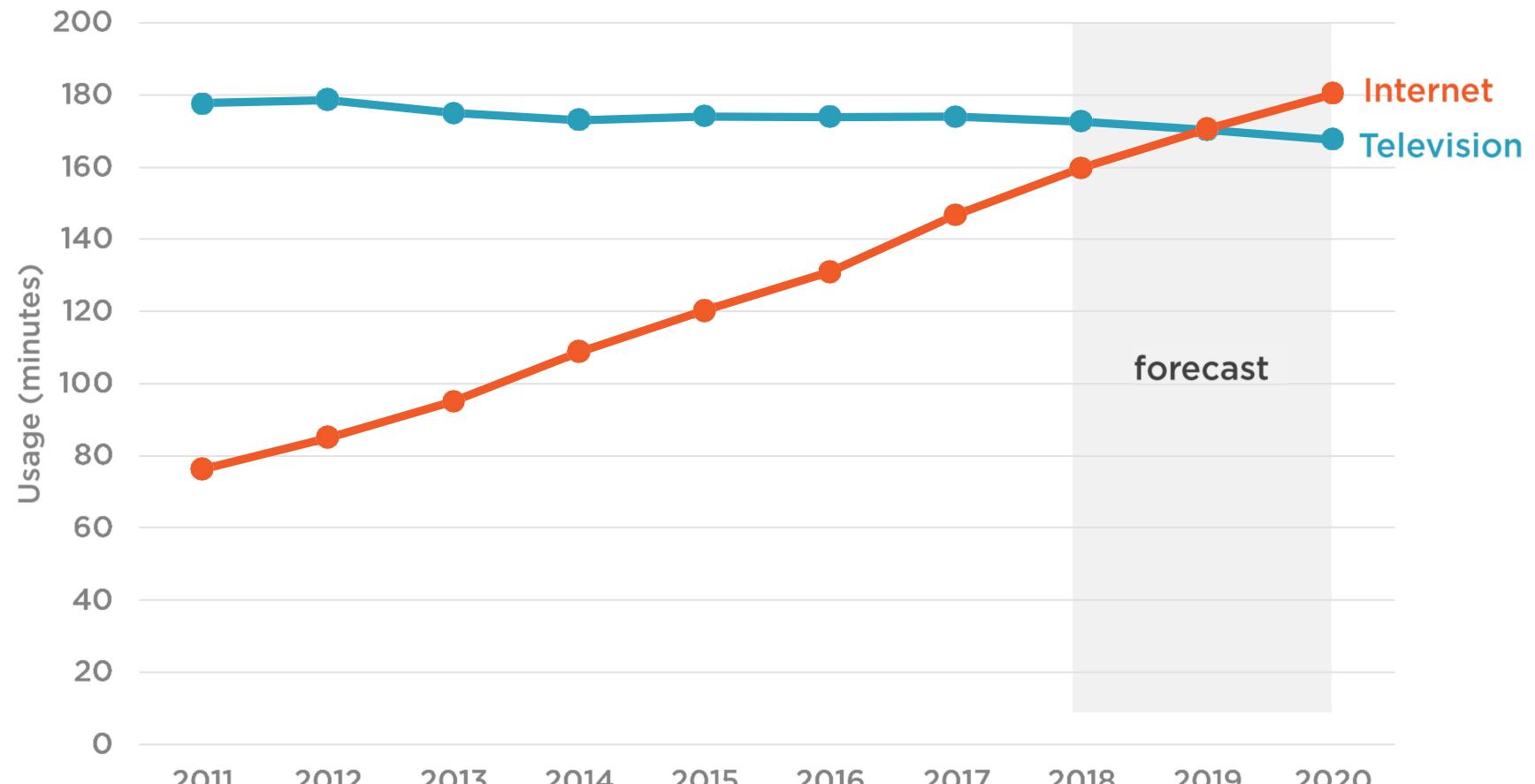


# Television vs. Internet Usage



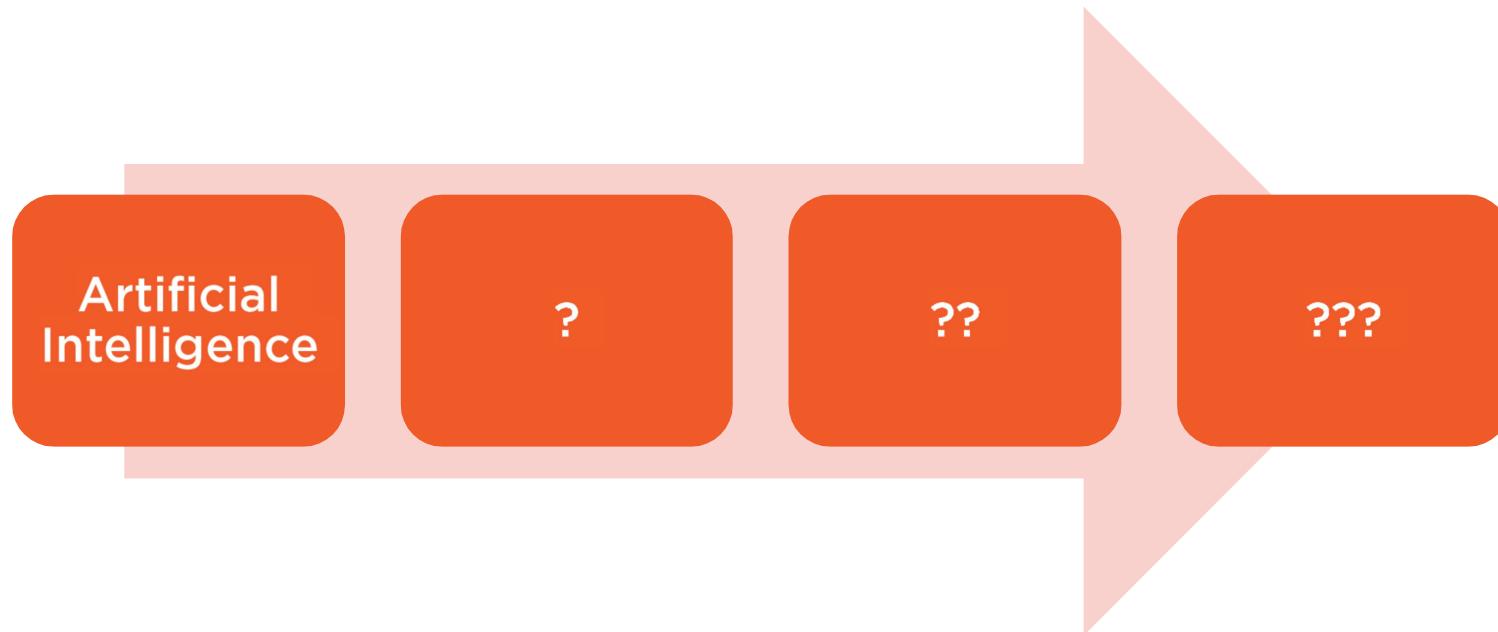
Source: Zenith - Media Consumption Forecasts 2018

# Television vs. Internet Usage



Source: Zenith - Media Consumption Forecasts 2018

# A.I. Revolution



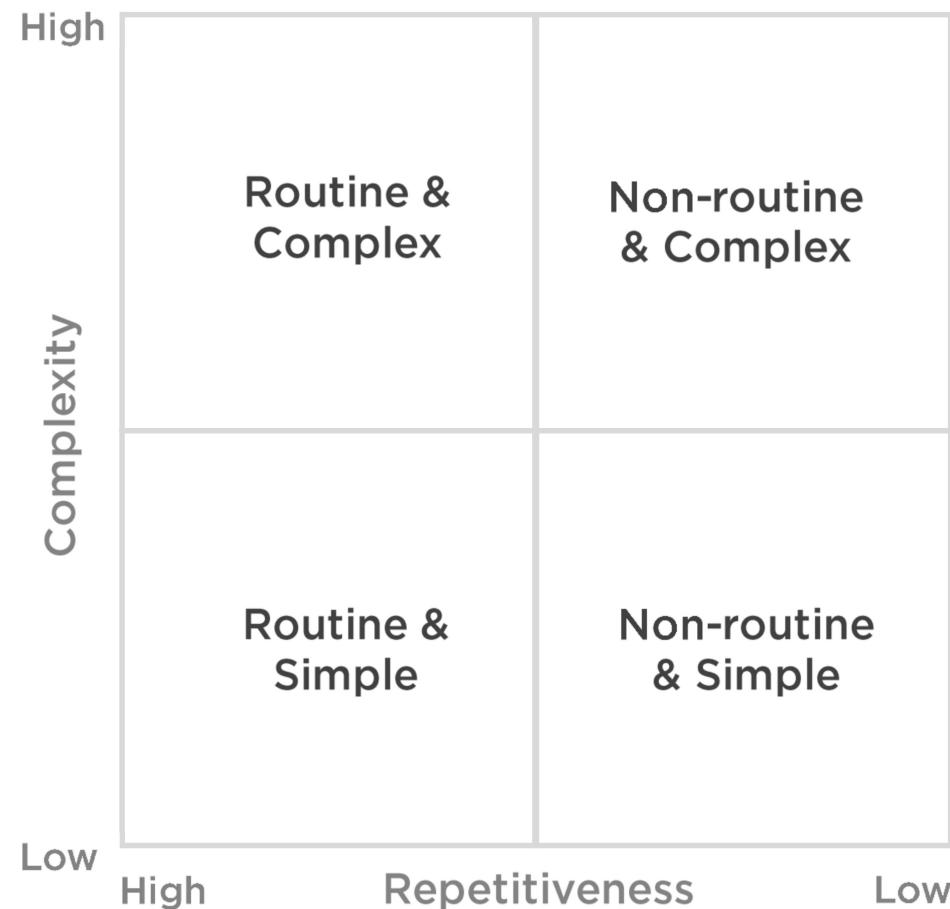
A.I. and Labor

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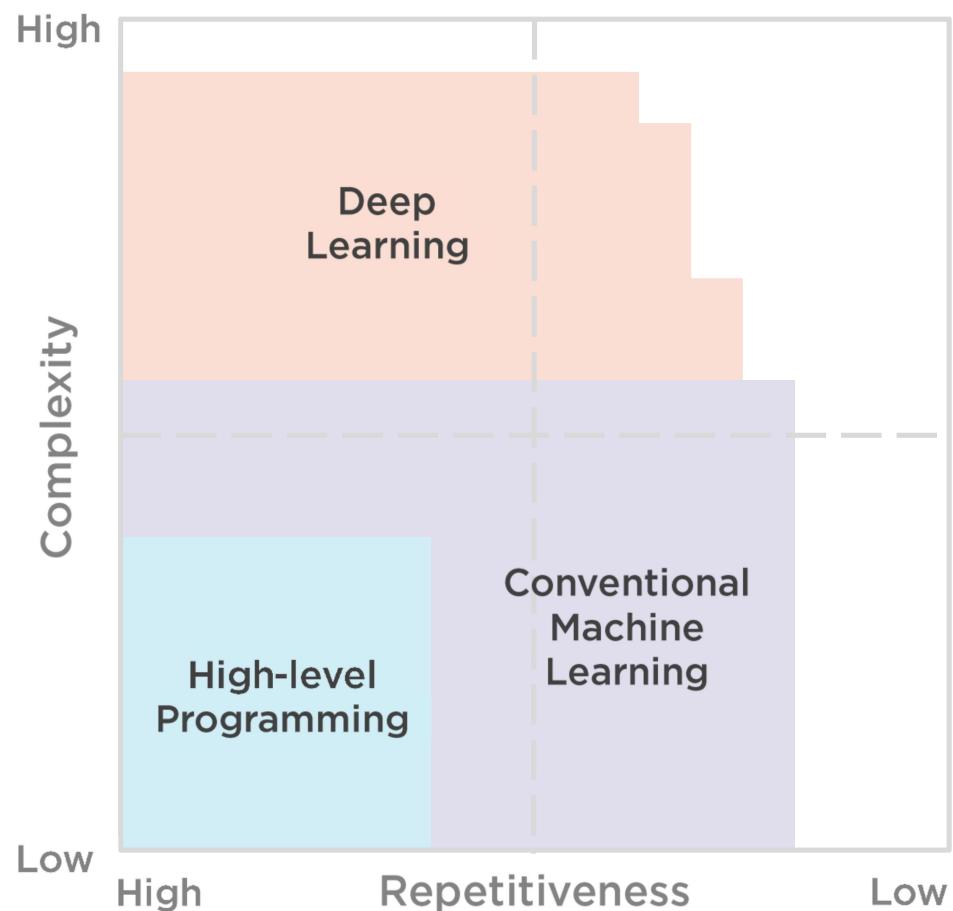
Courtesy of The HAHN Group

# Automation Framework



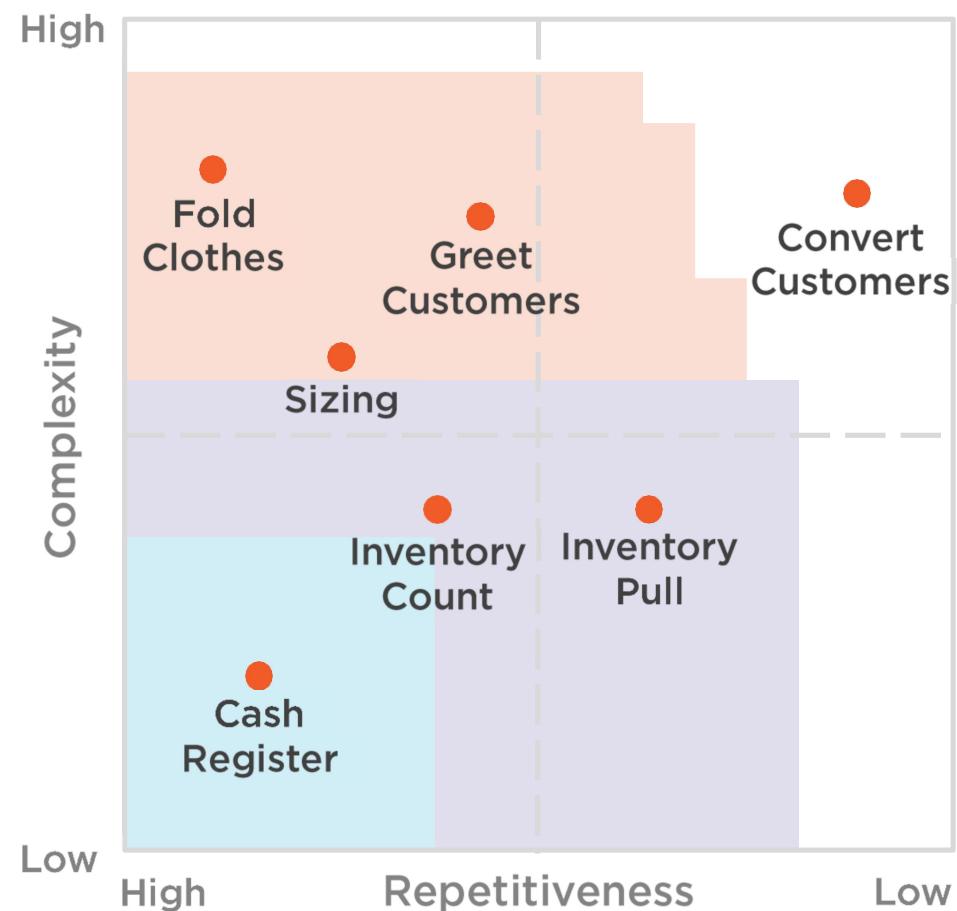
Source: Abhas Gupta -The Automation Framework

# Automation Technology



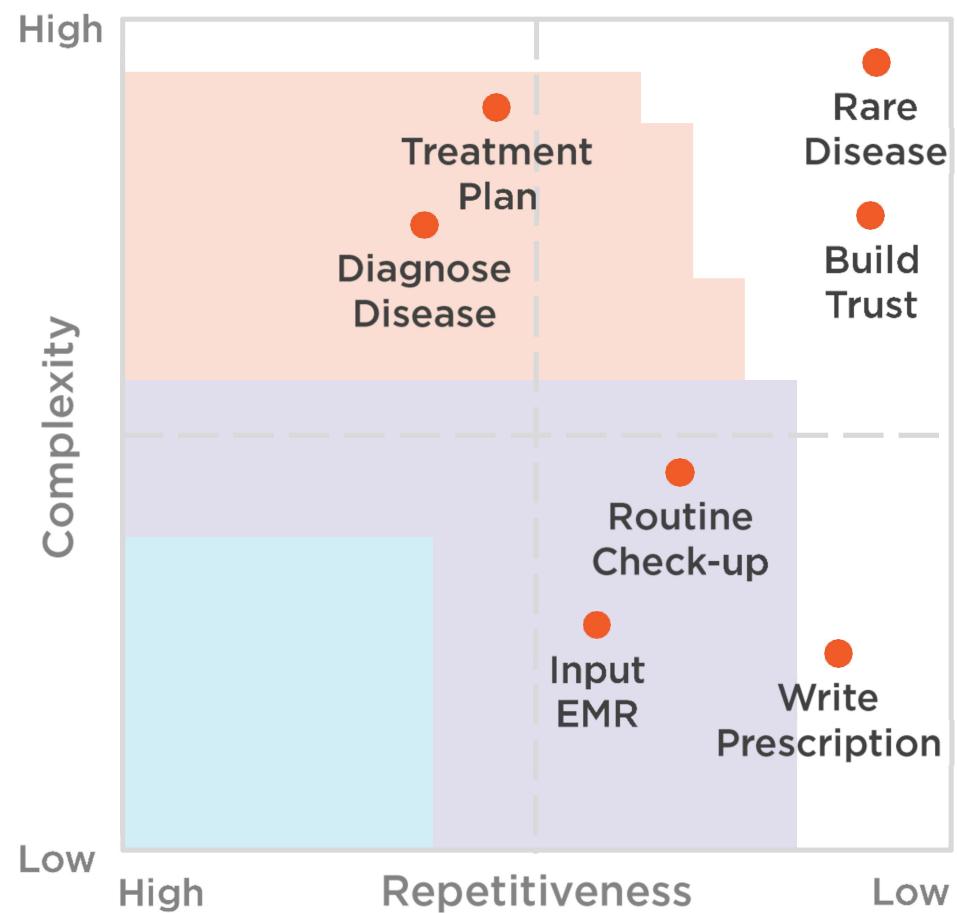
Source: Abhas Gupta -The Automation Framework

# Retail Salesperson



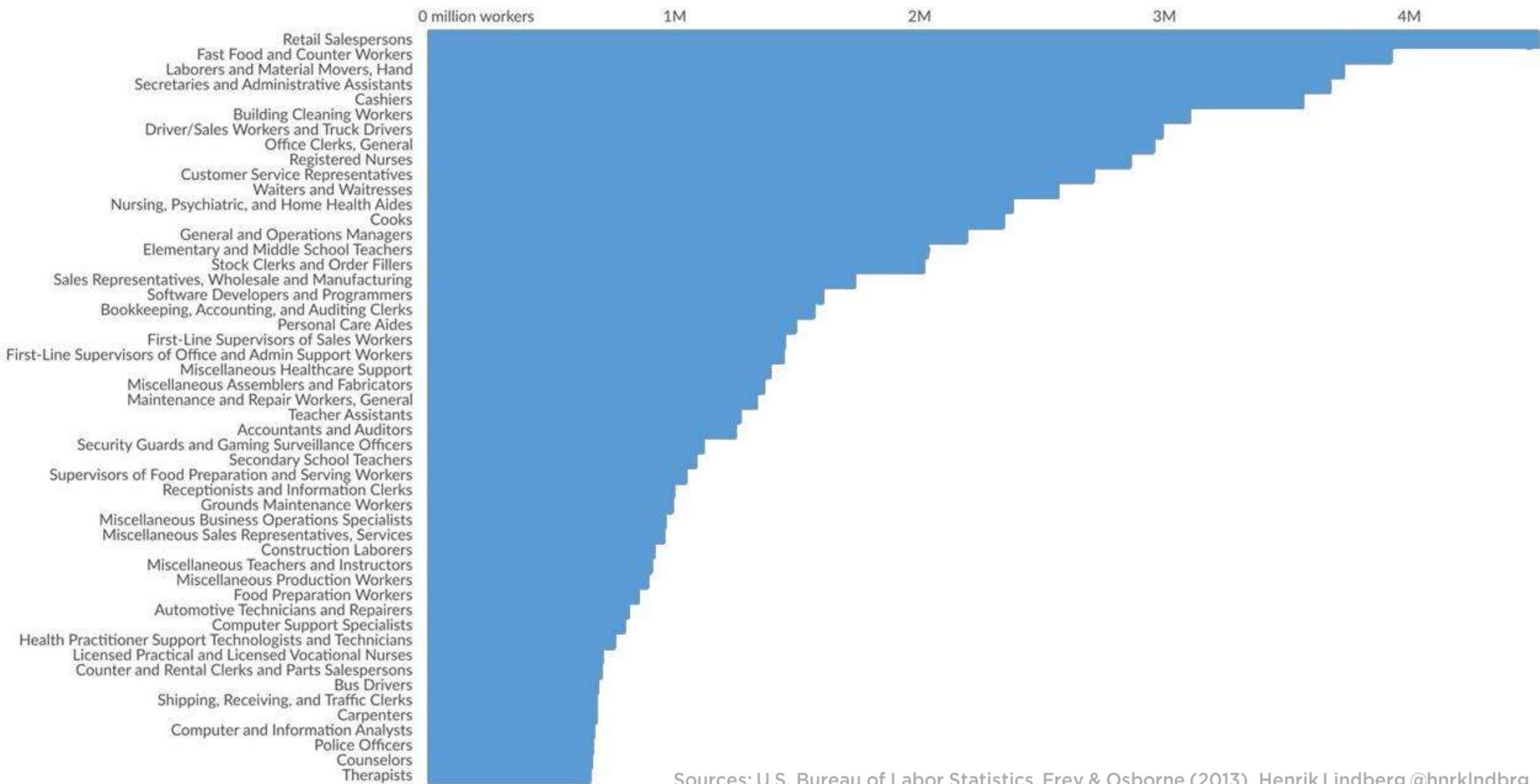
Source: Abhas Gupta -The Automation Framework

# Medical Doctor



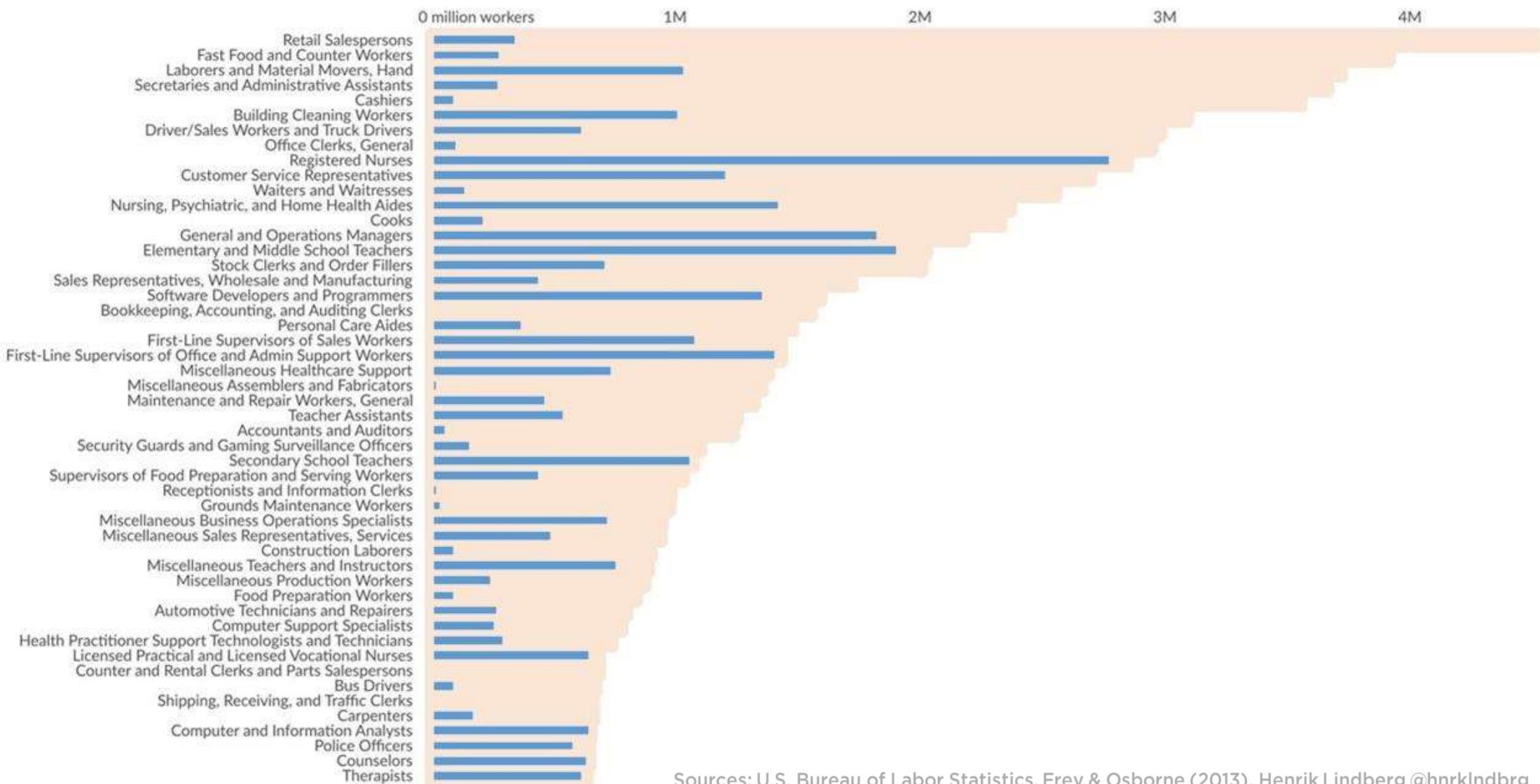
Source: Abhas Gupta -The Automation Framework

# The Future of Labor



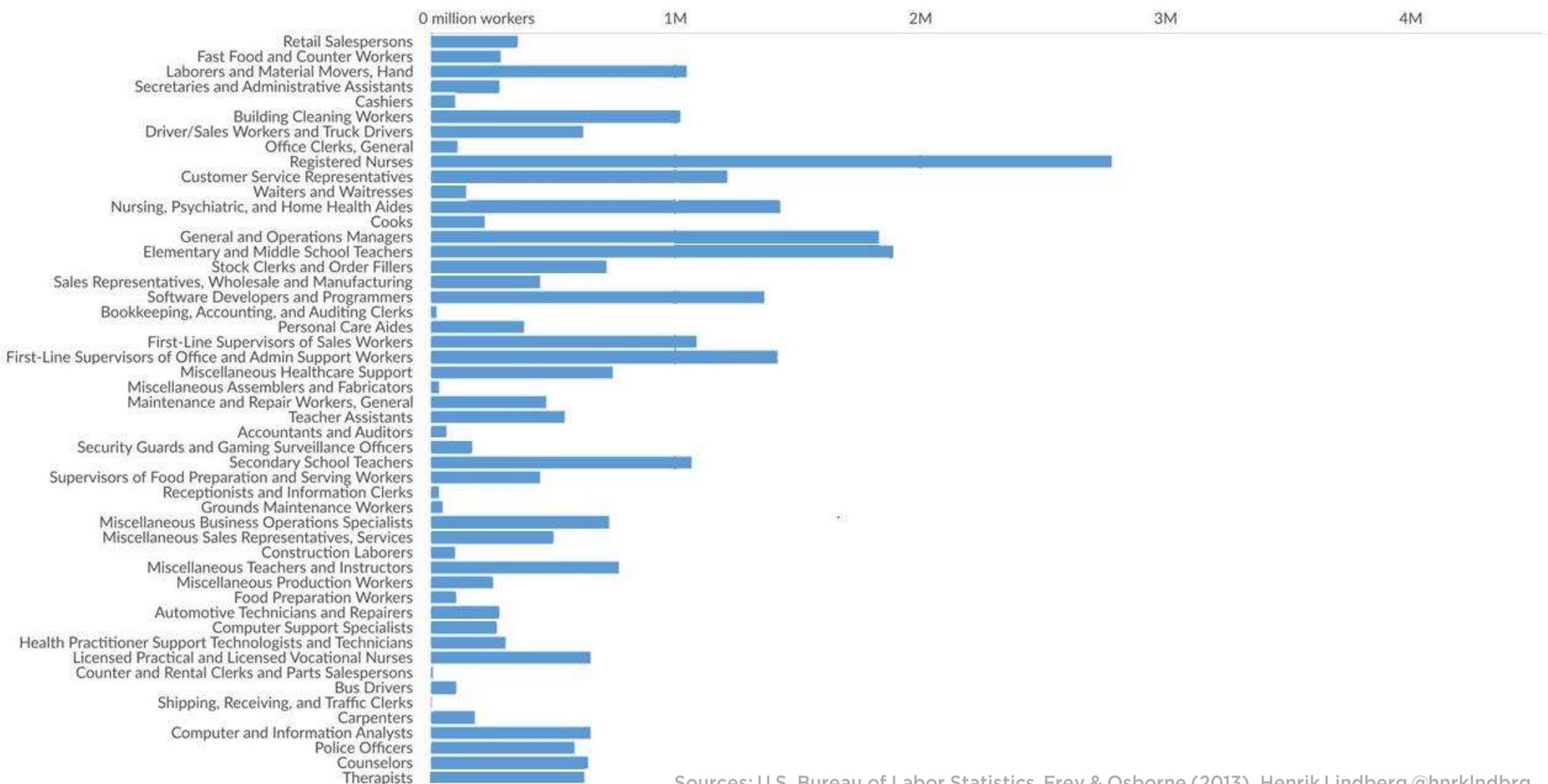
Sources: U.S. Bureau of Labor Statistics, Frey & Osborne (2013), Henrik Lindberg @hnrlndbrg

# The Future of Labor



Sources: U.S. Bureau of Labor Statistics, Frey & Osborne (2013), Henrik Lindberg @hnrlndbrg

# The Future of Labor



Sources: U.S. Bureau of Labor Statistics, Frey & Osborne (2013), Henrik Lindberg @hnrlndbрг



Half of all jobs in the USA at risk  
in the next two decades.

Source: Institute for Spatial Economic Analysis (ISEA)

# Likelihood of Job Automation

**Telemarketers** – 99%

**Underwriters** – 99%

**Sports referees** – 99%

**Cashiers** – 97%

**Chefs** – 96%

**Waiters** – 94%

**Paralegal Assistant** – 94%

**Tour guides** – 91%

**Bakers** – 89%

**Bus drivers** – 89%

**Construction workers** – 88%

**Veterinary assistant** – 86%

**Security guard** – 84%

**Sailor** – 83%

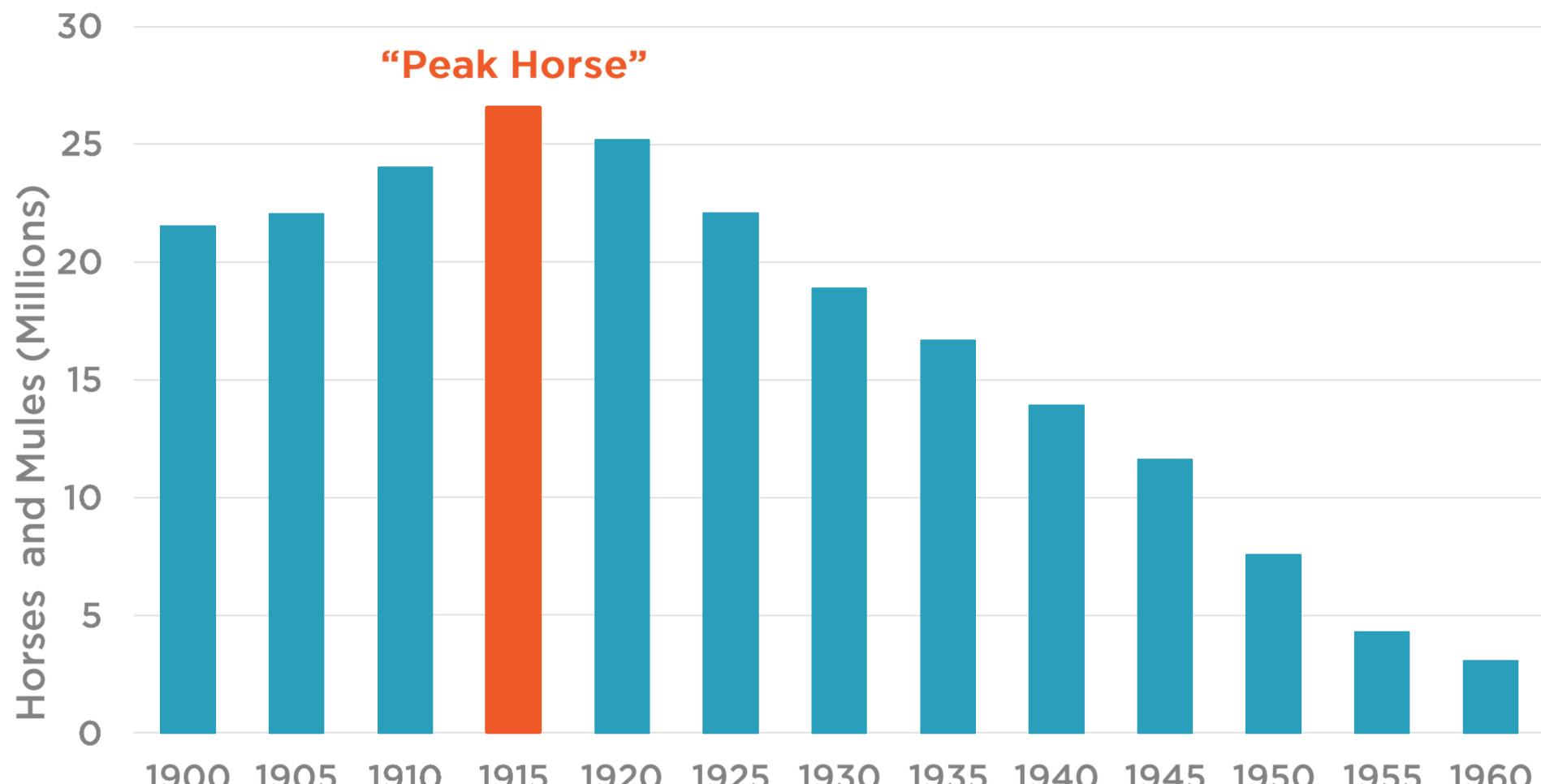
**Bartender** – 77%

**Archivist** – 76%

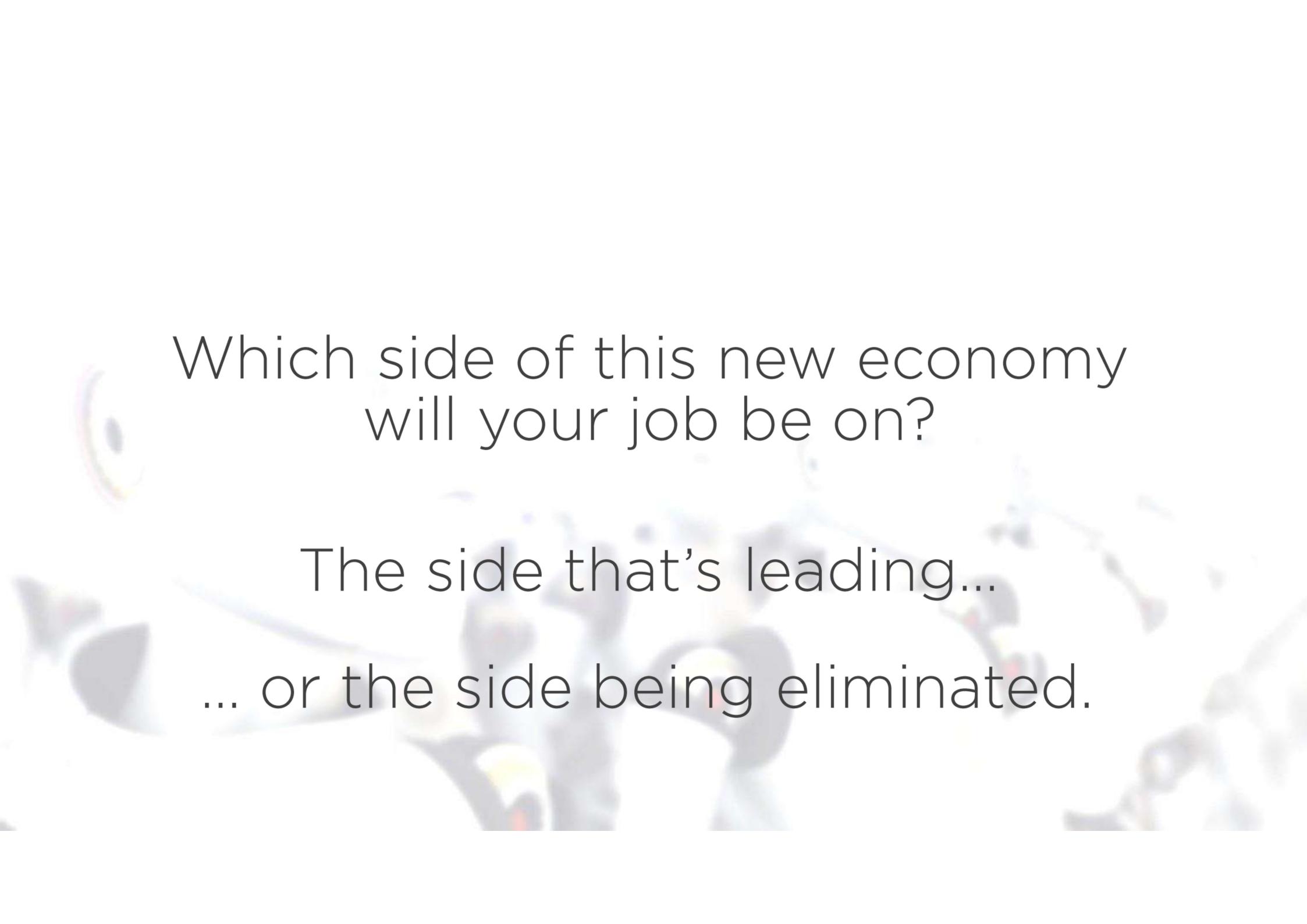
Will A.I. create more jobs  
than it eliminates?



# US Equine Population



Source: The Demographics of the U.S. Equine Population



Which side of this new economy  
will your job be on?

The side that's leading...  
... or the side being eliminated.

# A.I. and Ethics

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# Current Ethical Issues

Privacy

Manipulation

Propaganda

Impersonation

Exploitation

A.I. weapons

What is privacy with A.I. surveillance?

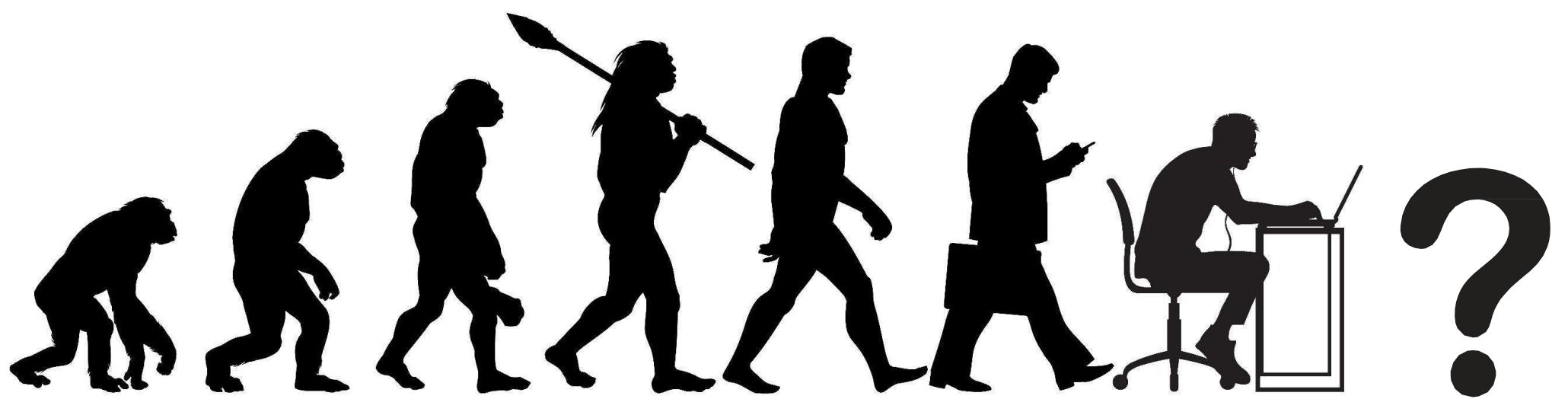
How do we avoid bias in A.I.?

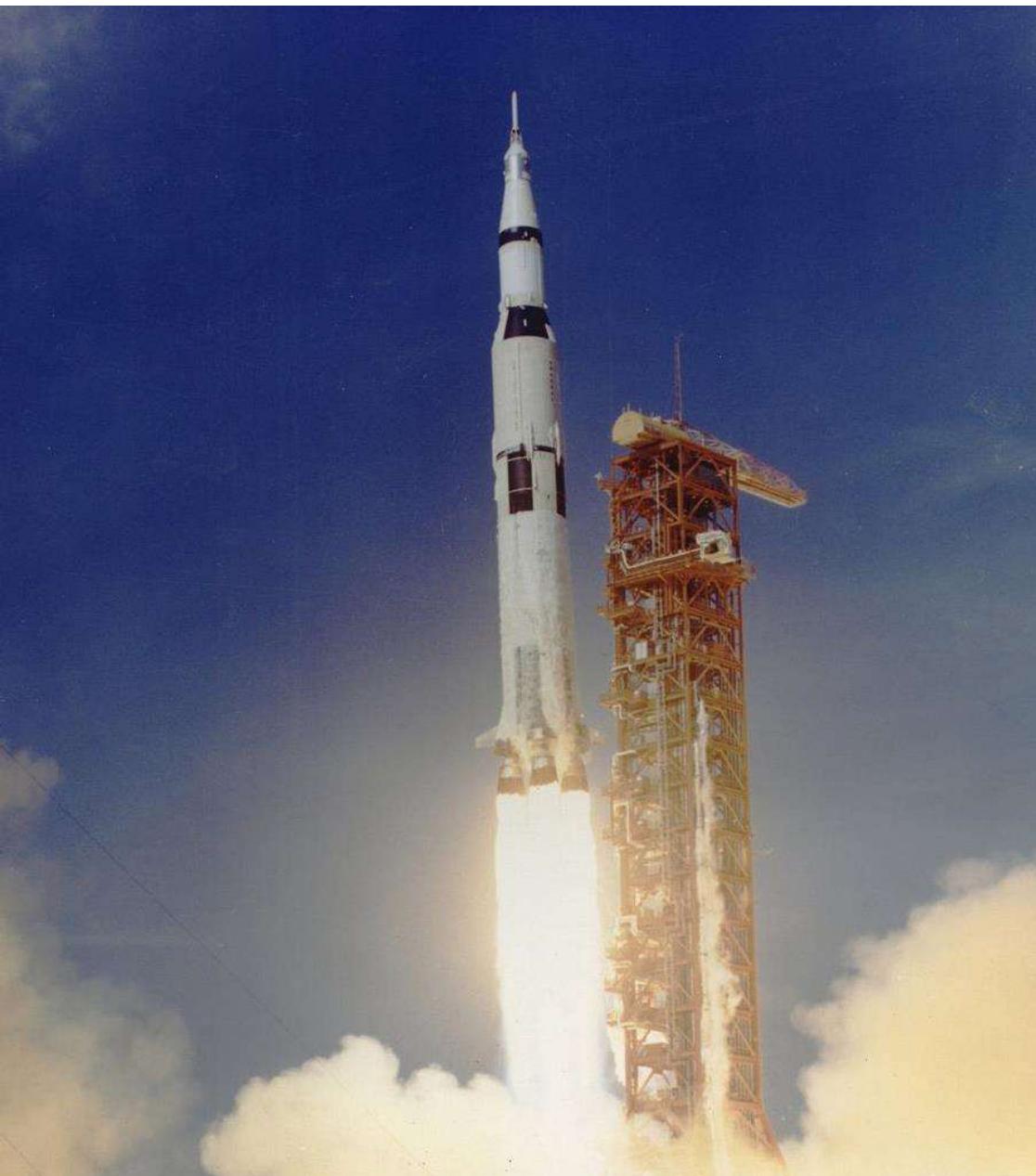
Should we weaponize A.I.?

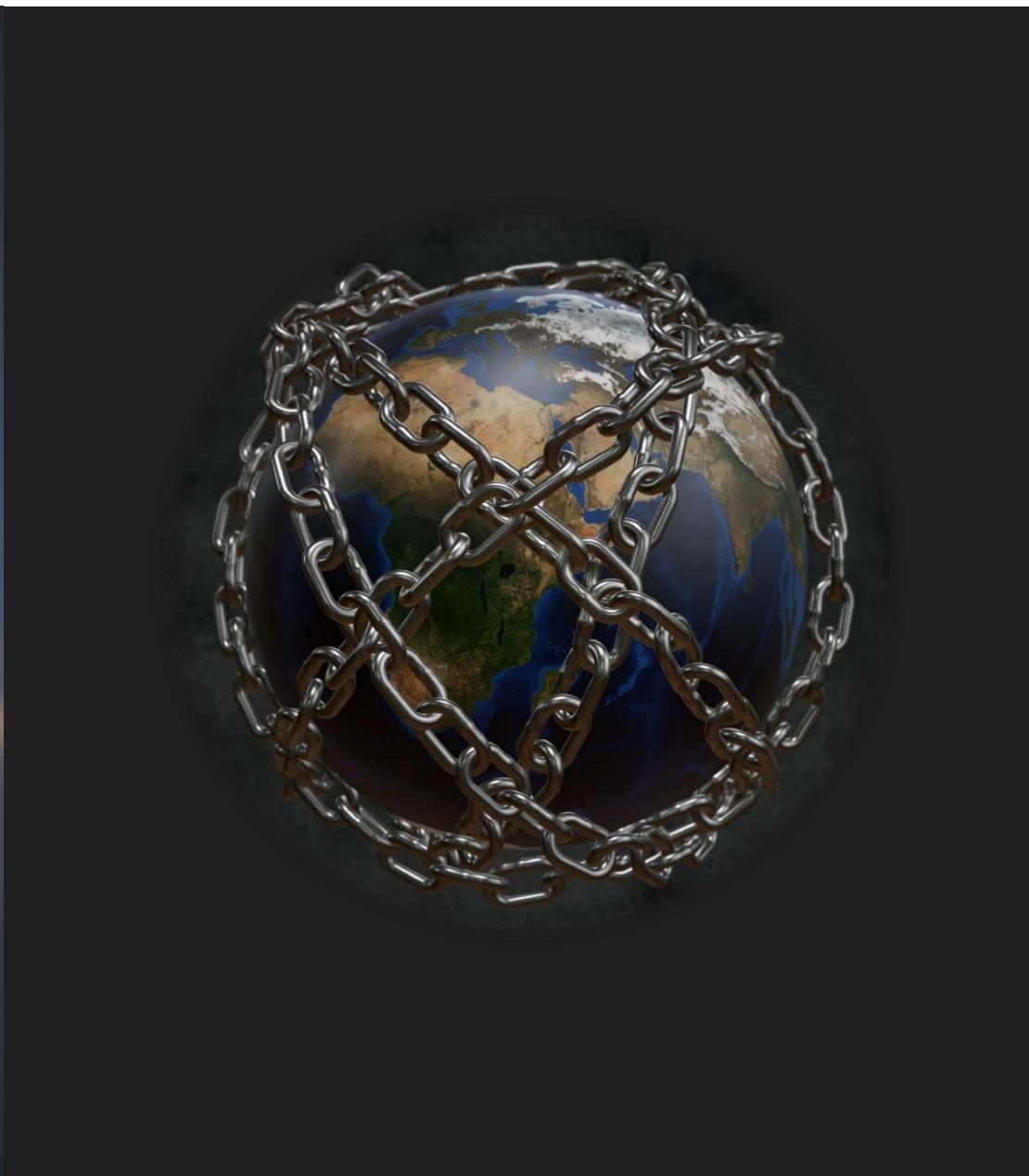
What is our purpose in a world where  
machines do all the work of value?











What will you choose?