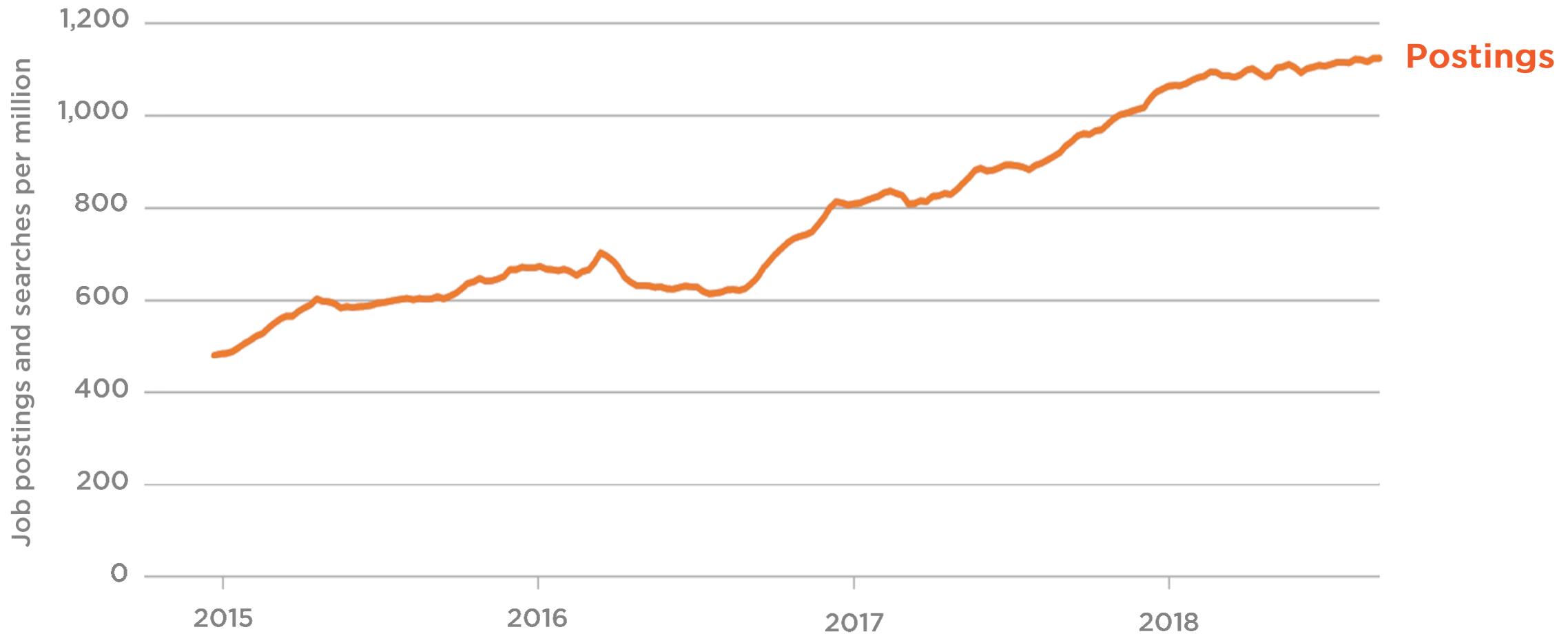




# Artificial Intelligence: The Big Picture

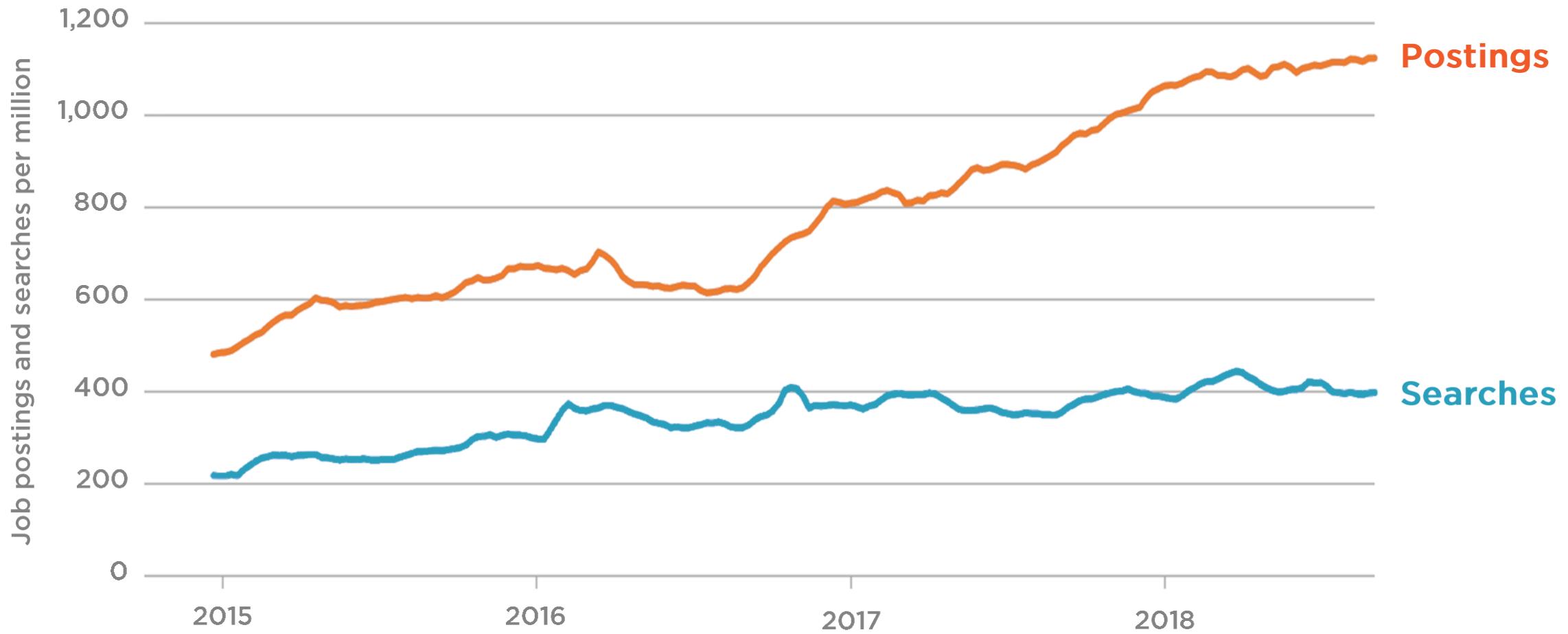
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# A.I. Job Postings vs. Searches



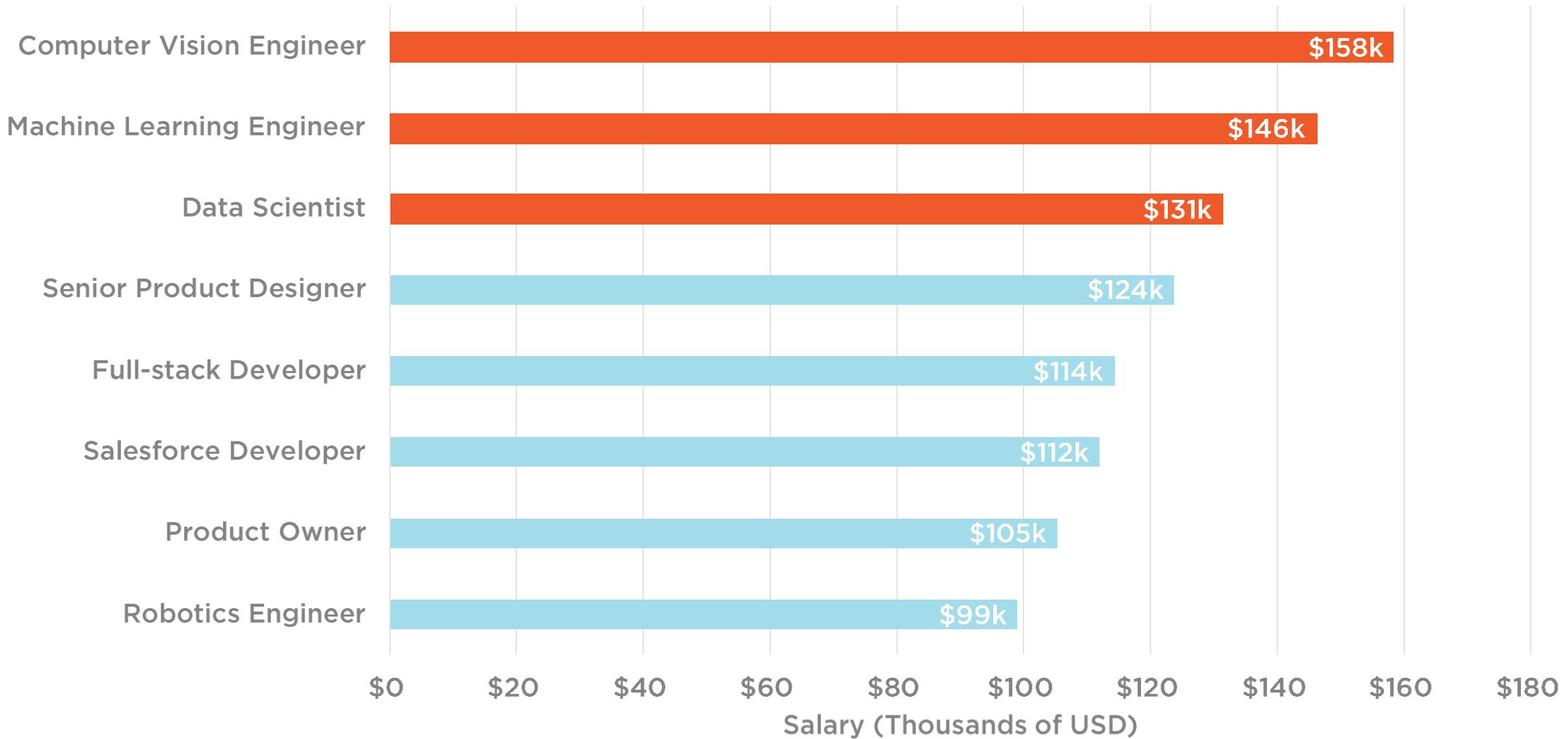
Source: Indeed.com, Reuters, Ann Saphir

# A.I. Job Postings vs. Searches



Source: Indeed.com, Reuters, Ann Saphir

# Salary by Job Type (USA)



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

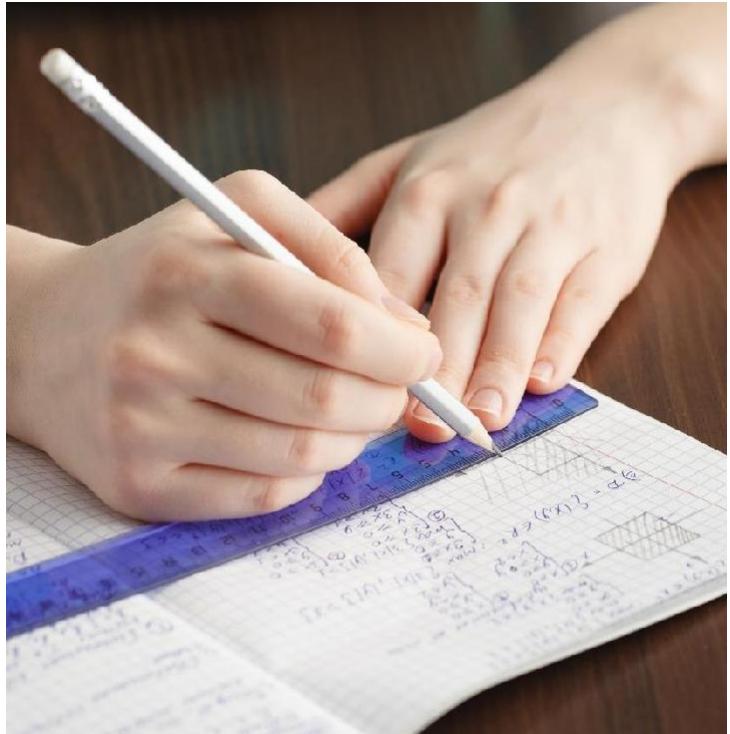
“The ability to acquire  
and apply knowledge.”

“The ability to learn  
or understand.”

“Goal-directed  
adaptive behavior.”

“The ability to deal with  
cognitive complexity.”

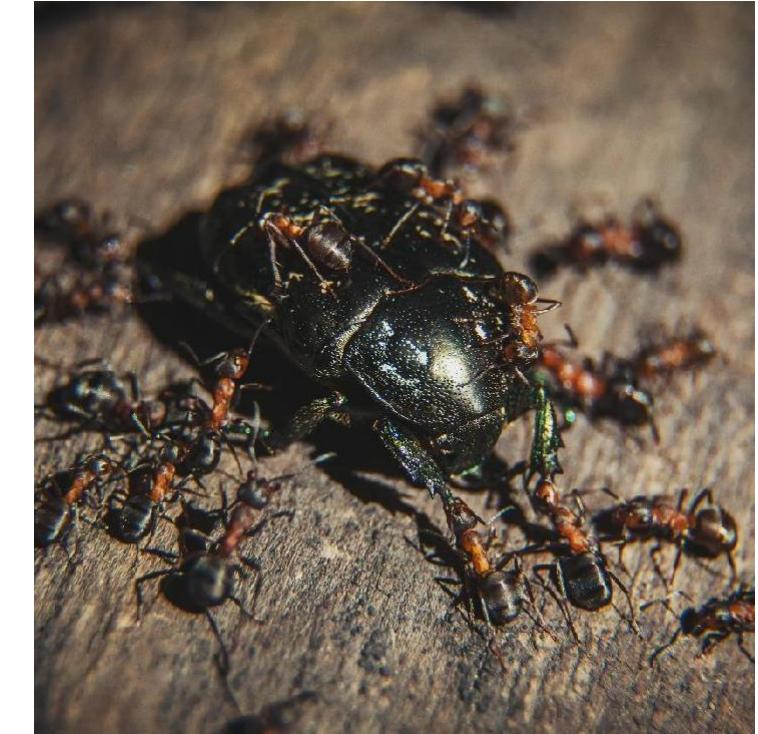
# Examples of Intelligence



Human intelligence



Animal intelligence



Collective intelligence

# Examples of Intelligence

Agent



Human



Mouse



Ants

# Examples of Intelligence

Agent	Environment	
 A photograph showing a person's hands holding a pencil and writing on a piece of paper with a ruler.	Human	Exam
 A photograph of a white mouse standing on a dark surface next to a yellow plastic maze structure.	Mouse	Maze
 A photograph of a group of ants crawling on a wooden surface.	Ants	Colony

# Examples of Intelligence

Agent	Environment	Goal
 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
			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
	Mouse	Maze	Cheese	Navigate
	Ants	Colony	Protect	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

---

# 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**  
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

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

# Artificial Intelligence

Anything a human can do  
but a machine cannot yet do

## Types of A.I.

---

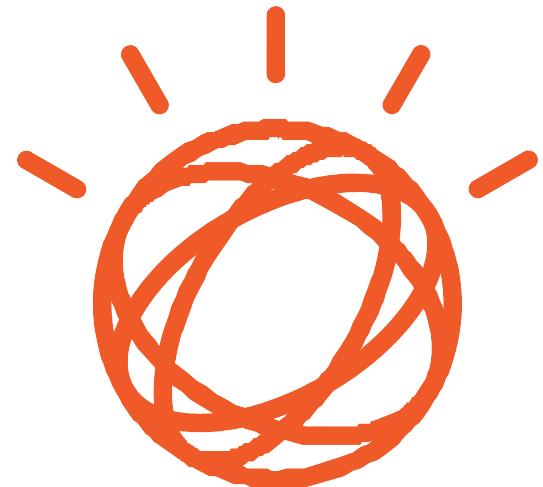
# Types of A.I.

**Artificial  
narrow  
intelligence**

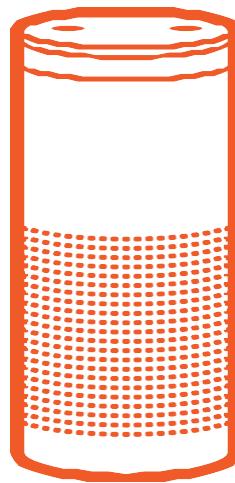
**Artificial  
general  
intelligence**

**Artificial  
super  
intelligence**

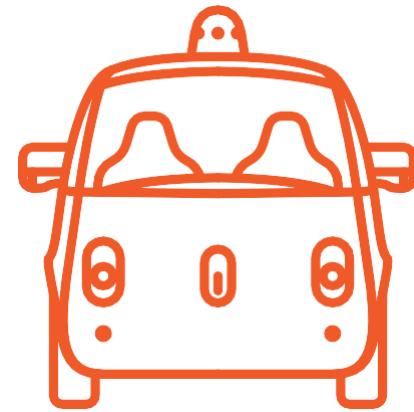
# Artificial Narrow Intelligence



IBM  
Watson

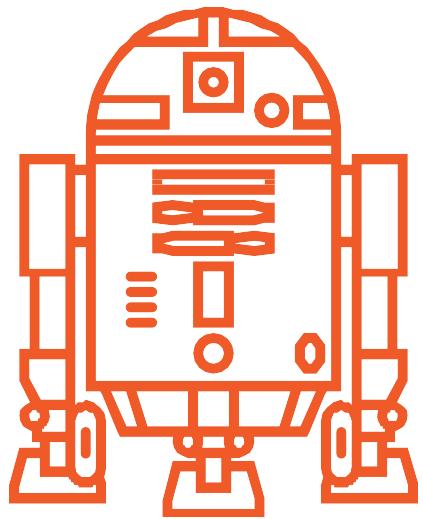


Amazon  
Alexa

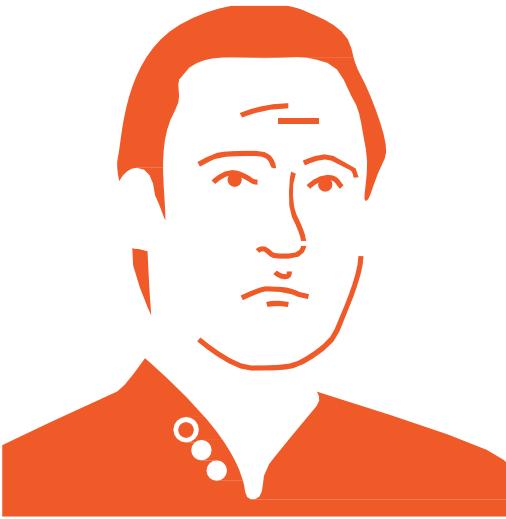


Google  
Waymo

# Artificial General Intelligence



R2D2

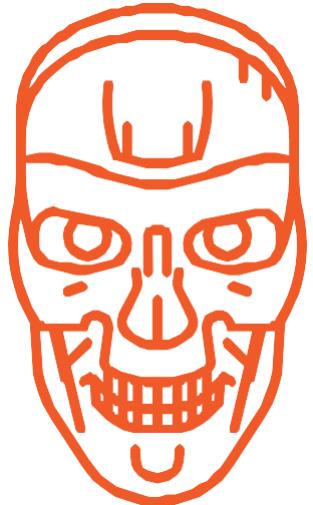


Data



HAL 9000

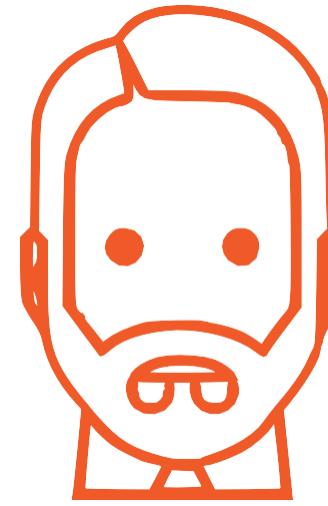
# Artificial Super Intelligence



Skynet



Ultron



The Architect

# Types of A.I.

**Artificial  
narrow  
intelligence**

**Artificial  
general  
intelligence**

**Artificial  
super  
intelligence**

# Components of A.I.

---

# Components of Artificial Intelligence



Perception



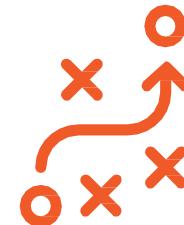
Learning



Knowledge



Reasoning



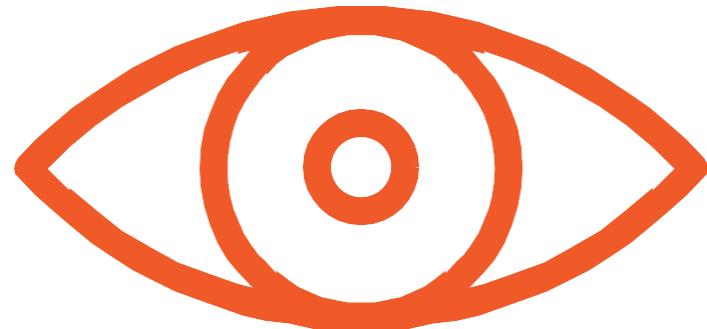
Planning

# 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

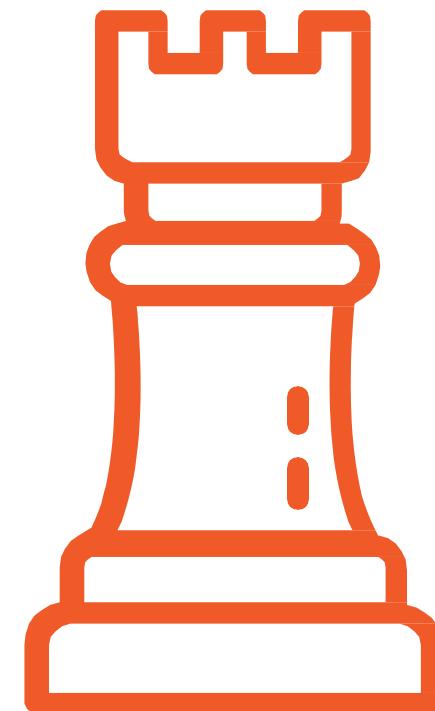


# Reasoning

Infer conclusions

Deduction

Induction

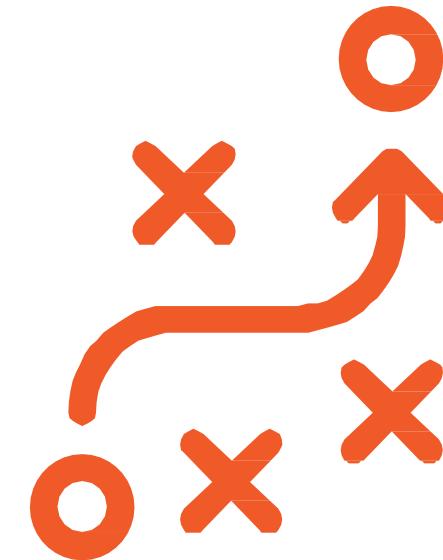


# Planning

**Set and achieve goals**

**Visualize future states**

**Predict actions**



# Components of Artificial Intelligence



Perception



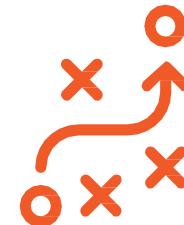
Learning



Knowledge



Reasoning

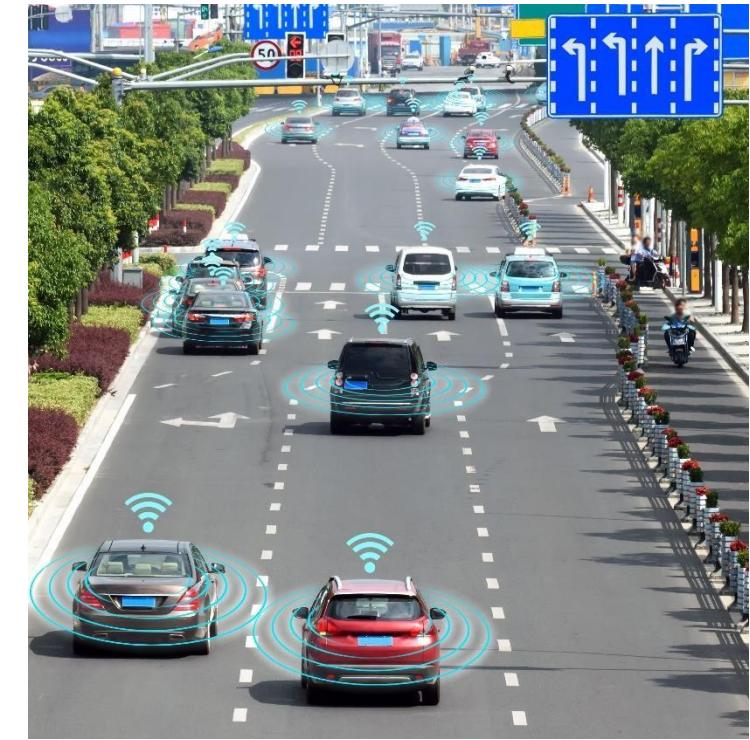


Planning

# Applications of A.I.

---

# 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.

---

# 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.

---



# 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

---

# 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.

---



ACCESS

# 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

---

# Limitations of Knowledge-based A.I.

**Expensive  
to maintain**

**Rigid and  
inflexible**

**Not very  
efficient**

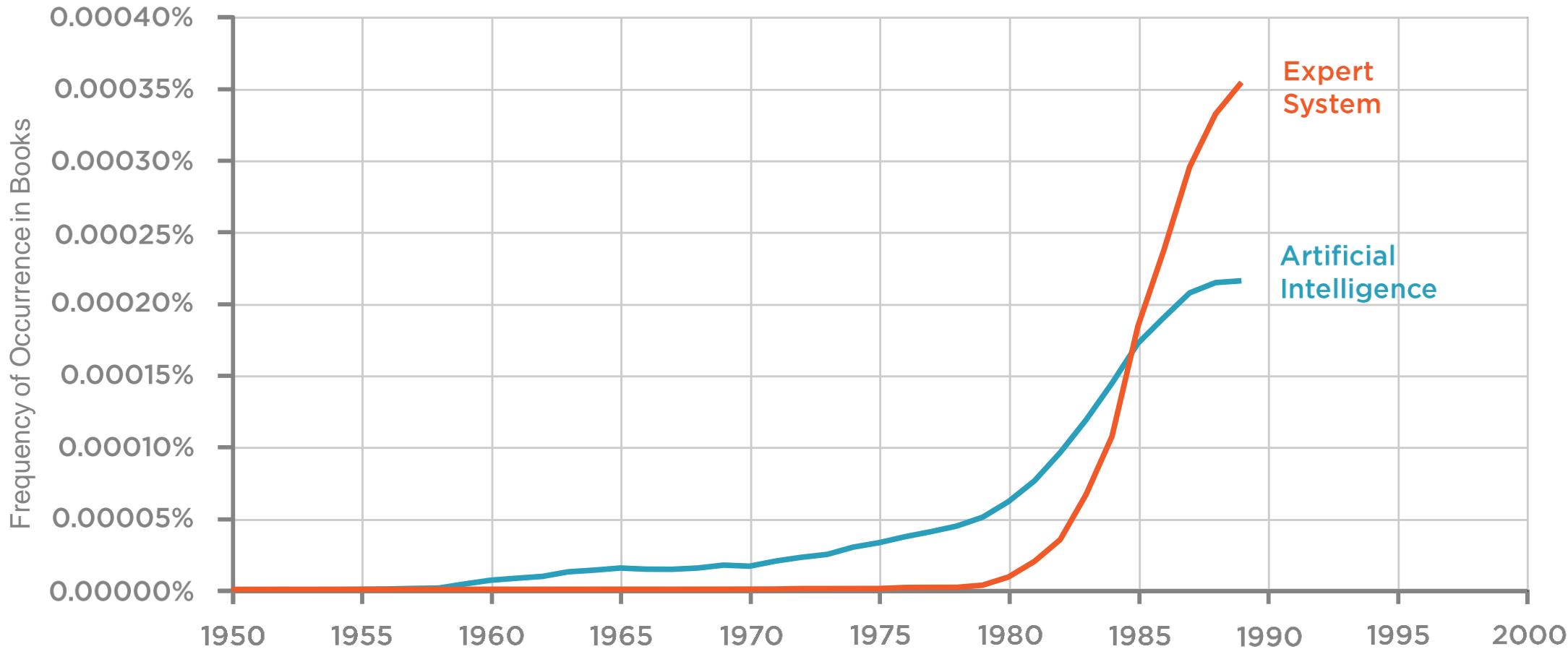
# Failures of Knowledge-based A.I.

**MYCIN  
never reaches  
production**

**Collapse of the  
LISP machine  
market**

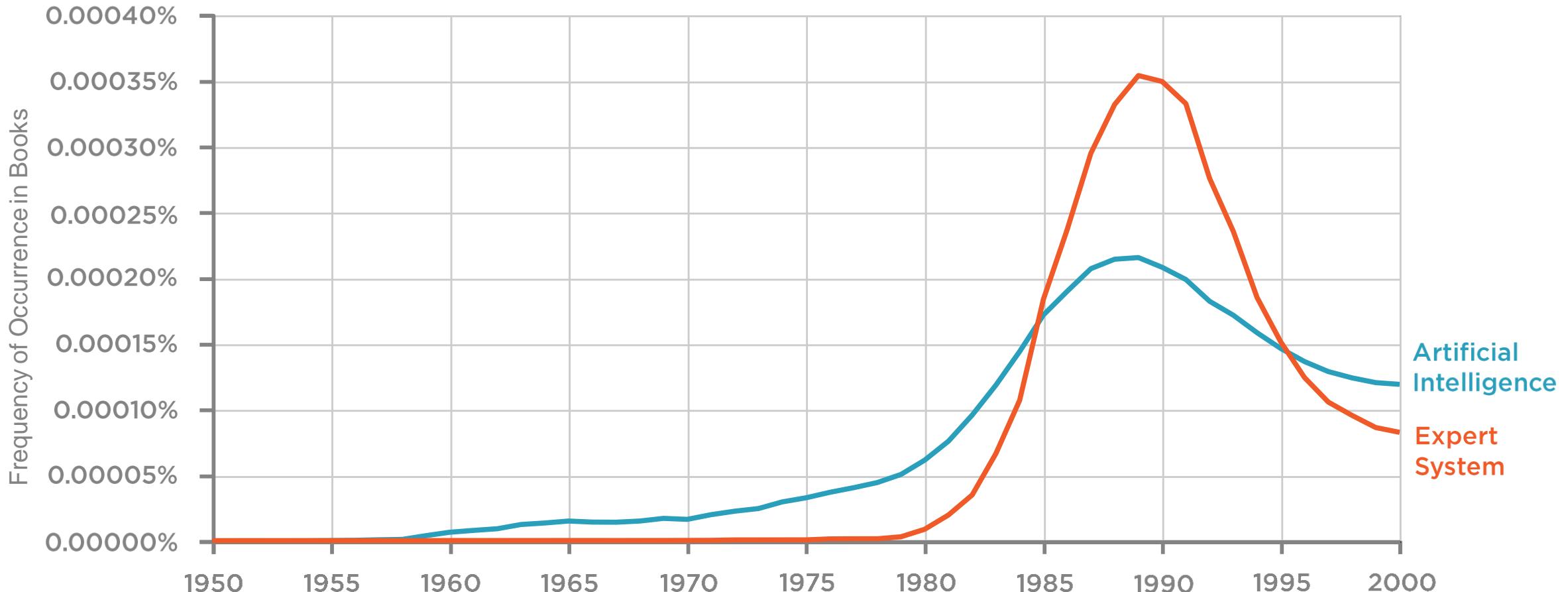
**5<sup>th</sup> Generation  
Computer  
Systems Project**

# Second A.I. Winter



Source: Google Books Ngram Viewer

# Second A.I. Winter



Source: Google Books Ngram Viewer



A black and white photograph of a person from behind, wearing a long, dark, hooded cloak. They are standing in a dense, misty forest. The background is filled with thick fog and silhouettes of trees, creating a mysterious and somber atmosphere.

Second A.I. Winter  
1988 - 2000s

# Data-driven A.I.

---



# 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

---

# 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**

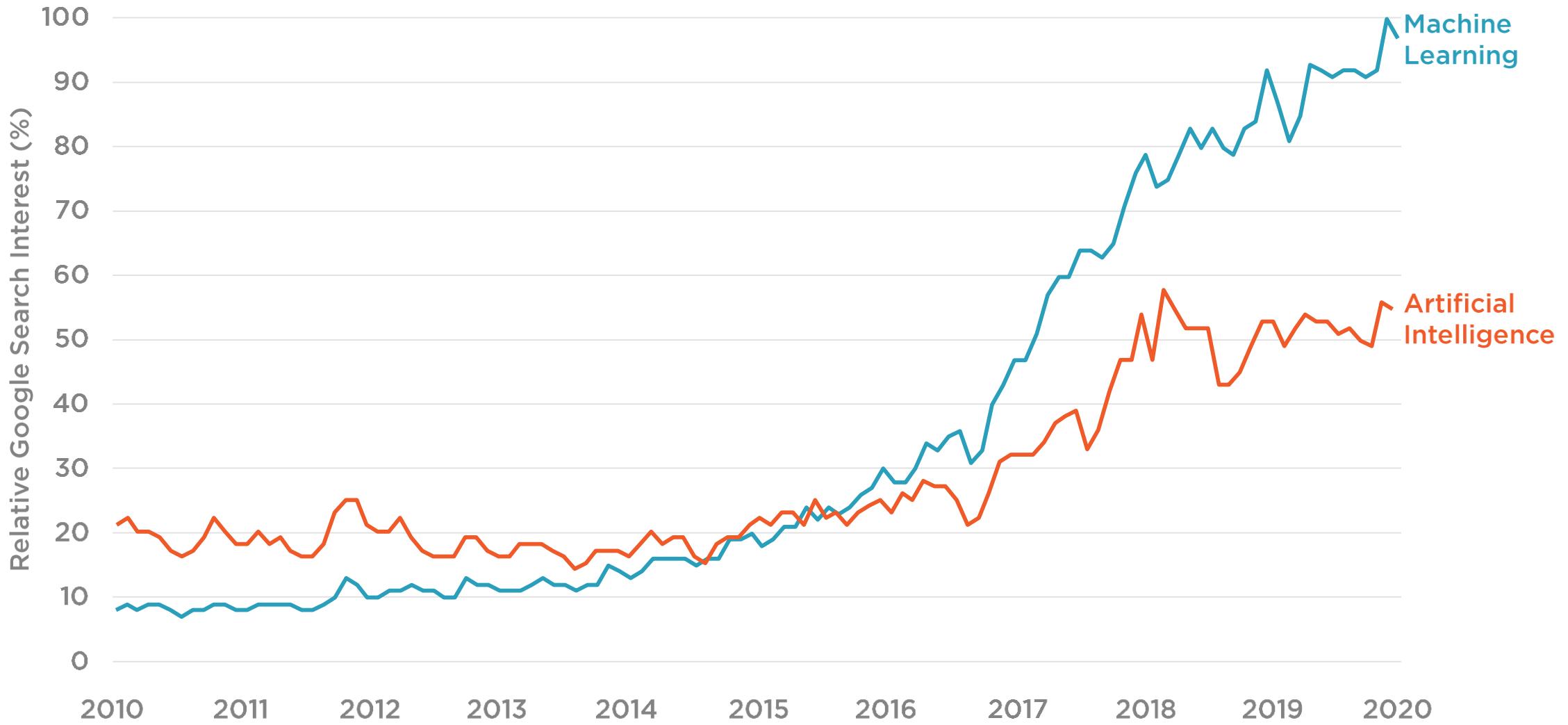
**Chat bot  
learns  
racism**

**Watson  
fails as  
a doctor**

A blurry, overexposed black and white photograph showing a person's lower body from behind, walking through a field of tall grass. The person is wearing dark trousers and light-colored shoes. The background is a soft-focus landscape.

# 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.**

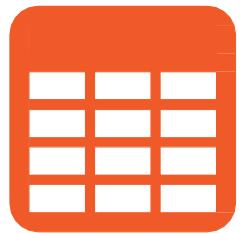
# Machine Learning

---

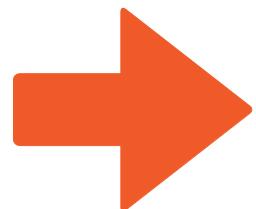
# Machine Learning

- 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.

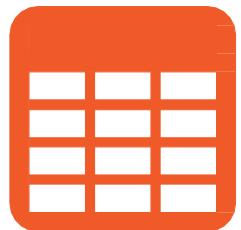
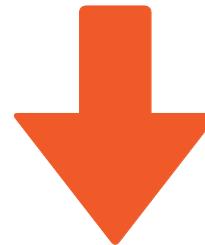
# Machine Learning



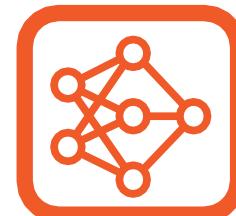
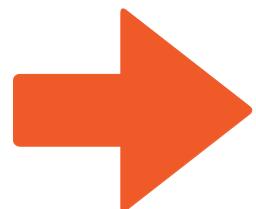
Data



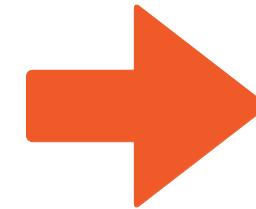
Algorithm



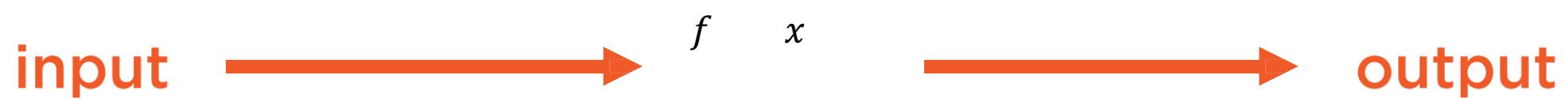
New data

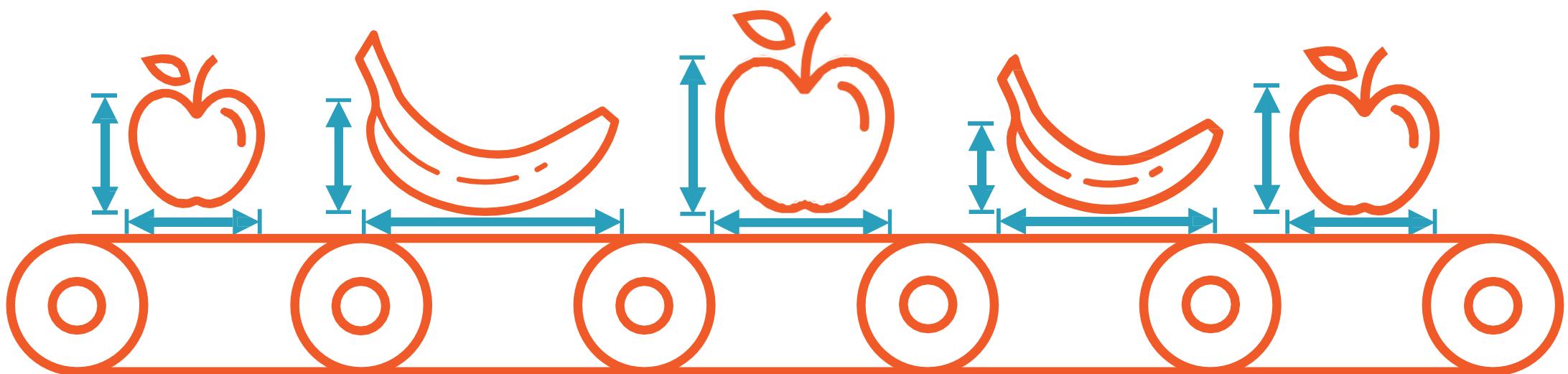


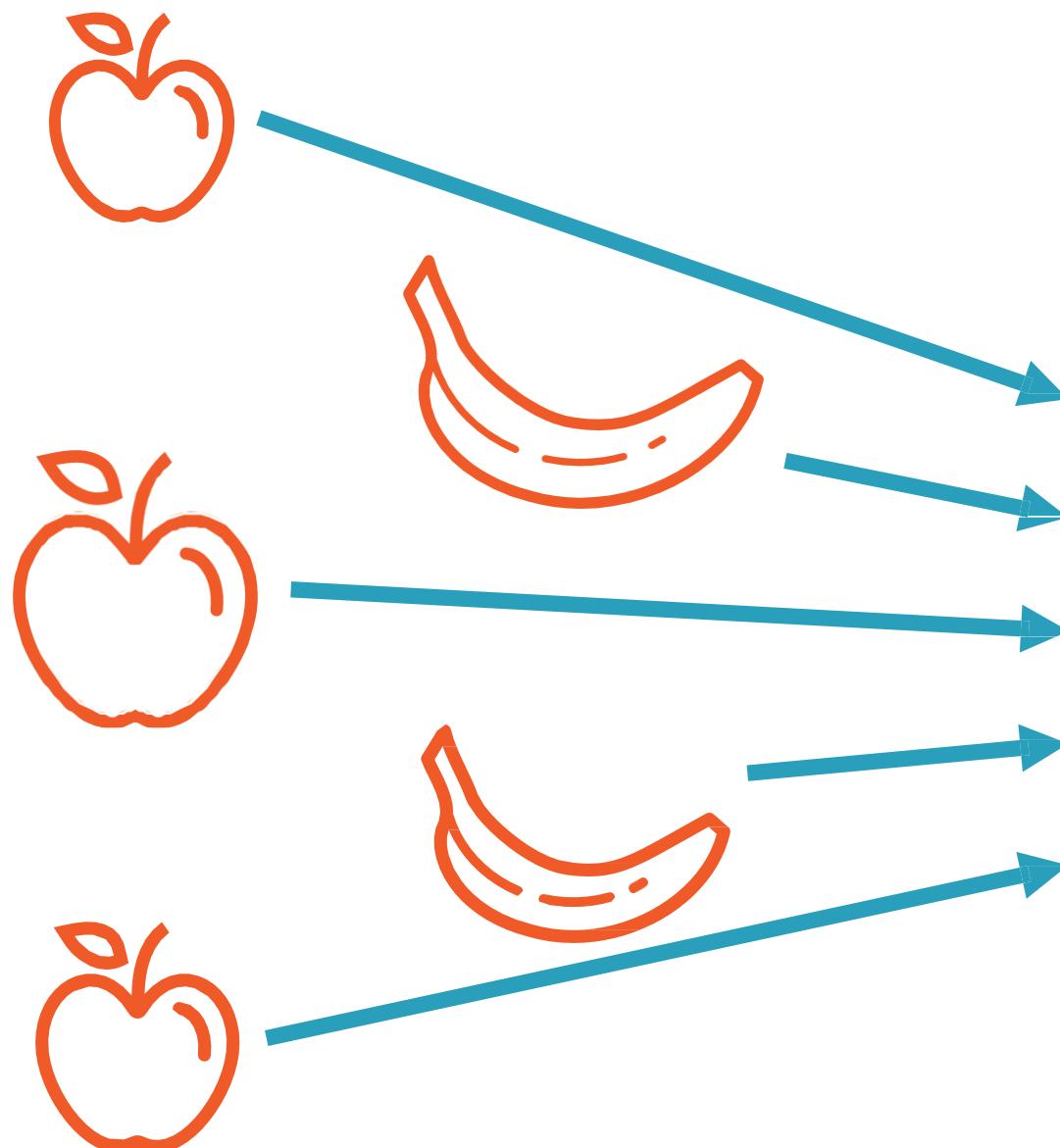
Model



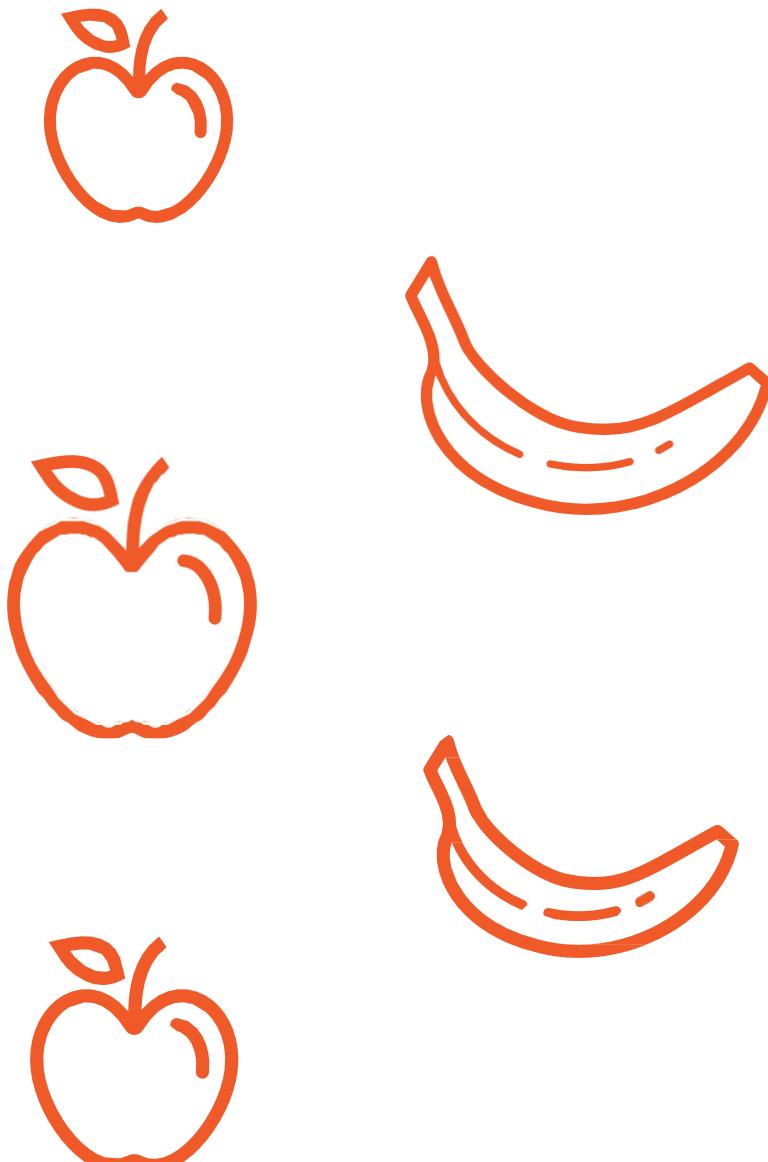
Prediction





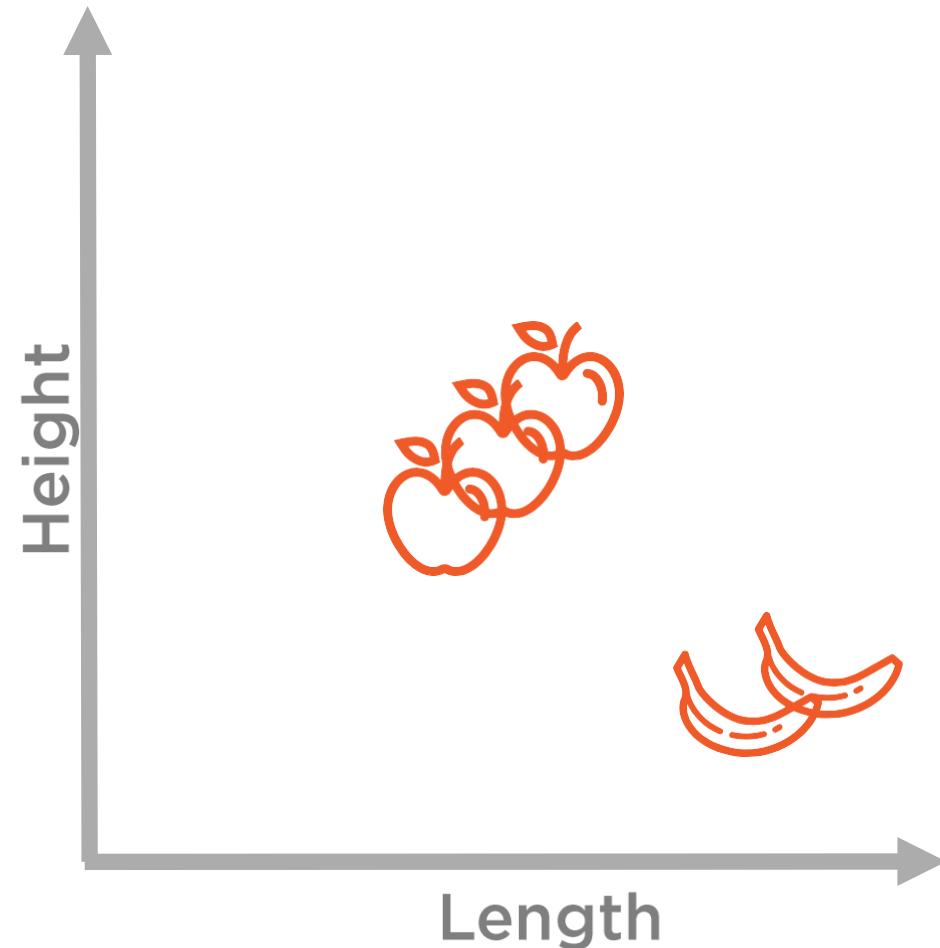


Length	Height	Type
6.8	7.0	Apple
19.0	3.6	Banana
8.0	8.3	Apple
15.2	3.1	Banana
7.3	7.5	Apple

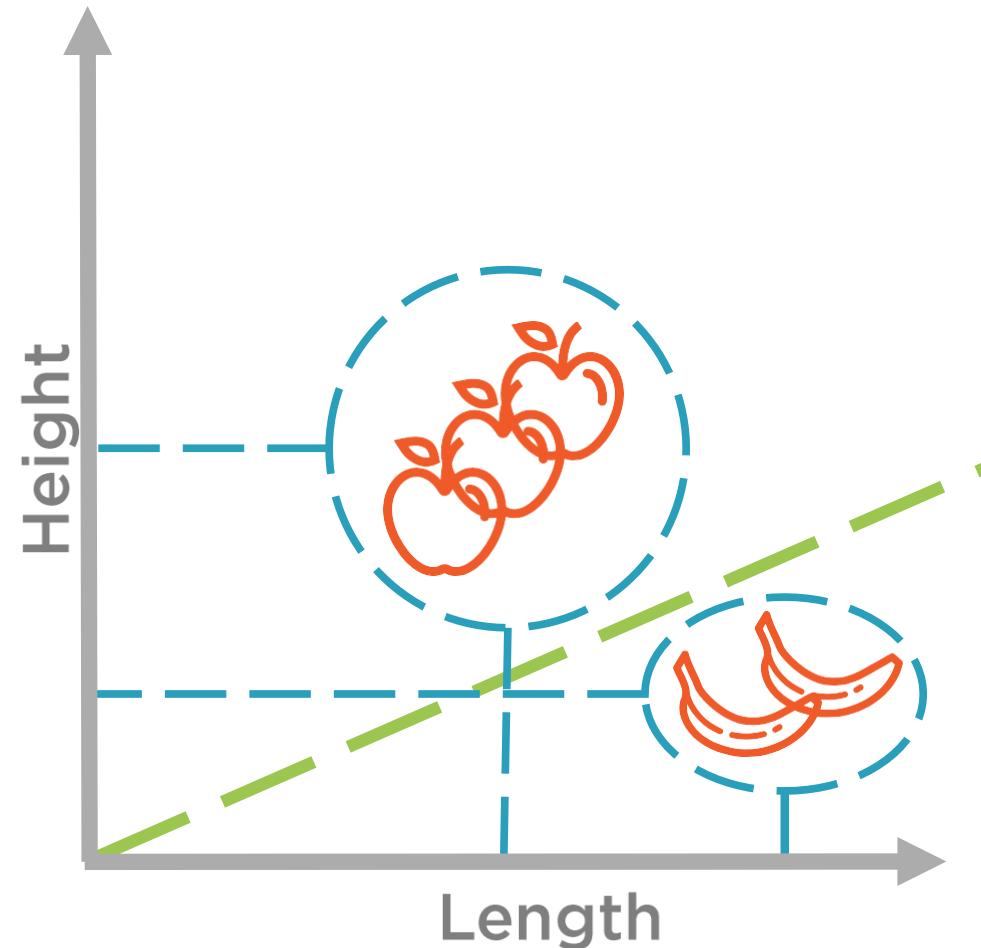


Length	Height	Type
6.8	7.0	Apple
19.0	3.6	Banana
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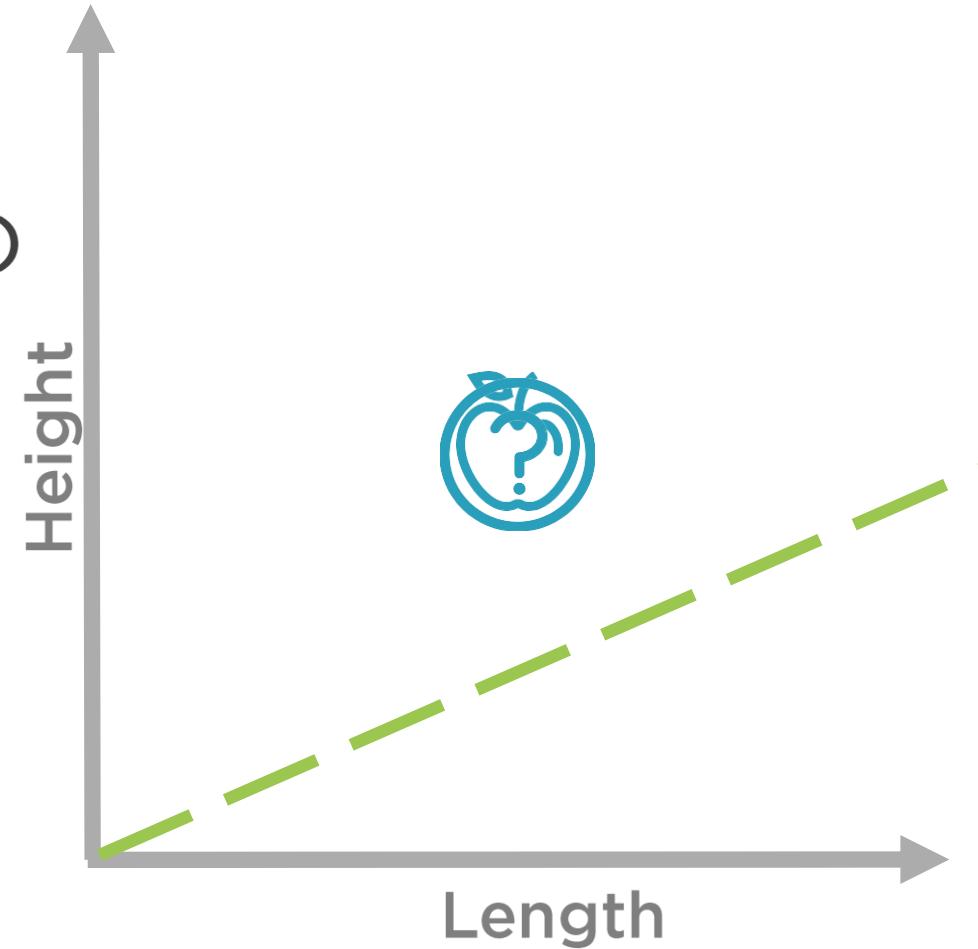
Length	Height	Type
6.8	7.0	Apple
19.0	3.6	Banana
8.0	8.3	Apple
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7.3	7.5	Apple



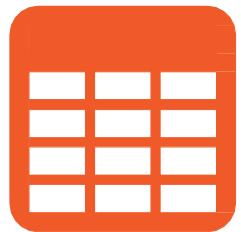
Length	Height	Type
6.8	7.0	Apple
19.0	3.6	Banana
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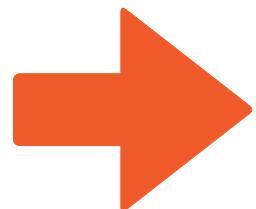
Length	Height	Type
7.5	7.7	Apple (99%)



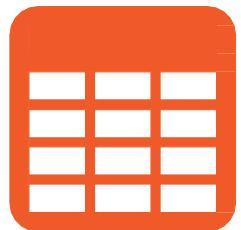
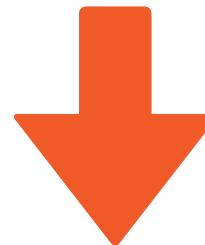
# Machine Learning



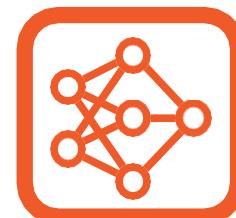
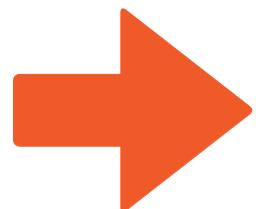
Data



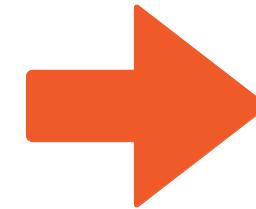
Algorithm



New data

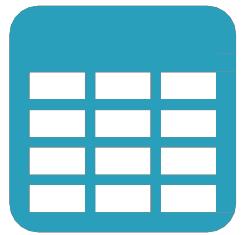


Model

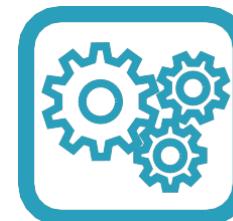
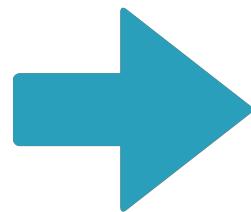


Prediction

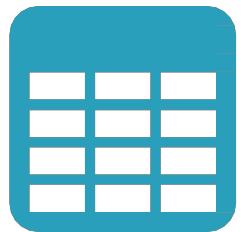
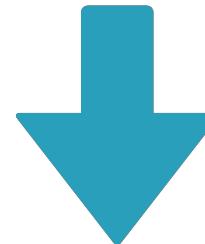
# Machine Learning



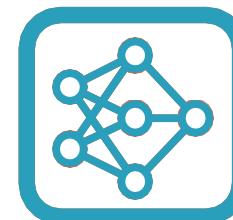
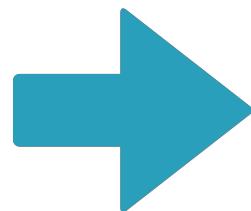
Data



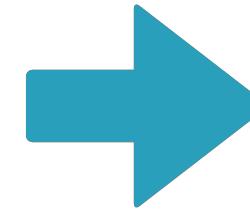
Algorithm



New data

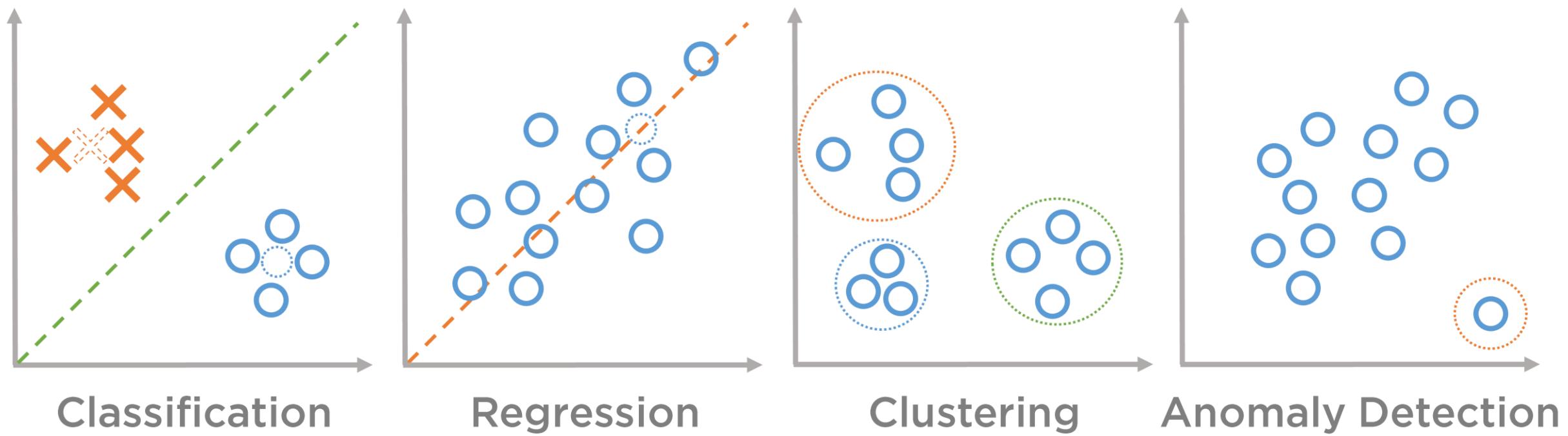


Model

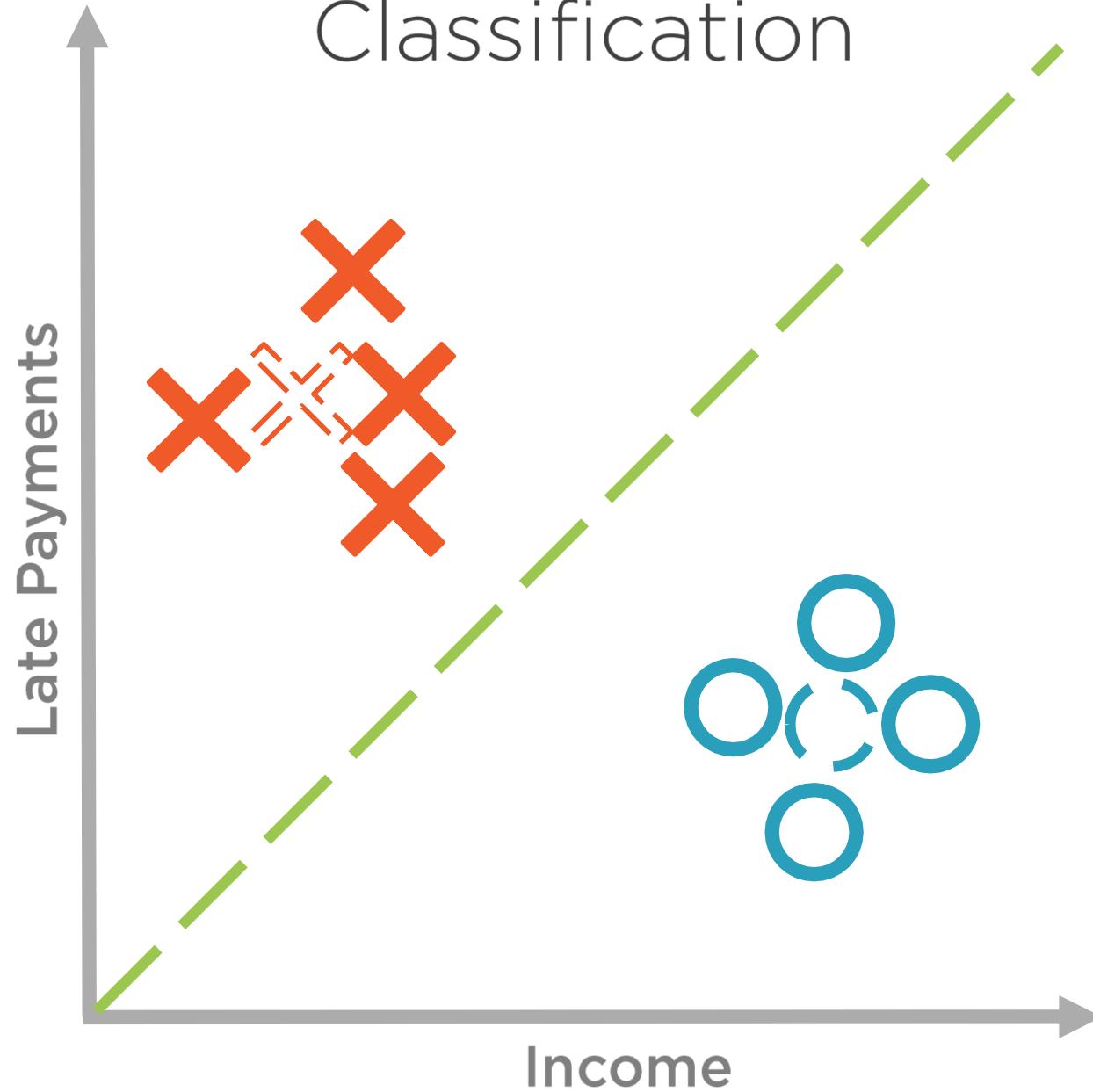


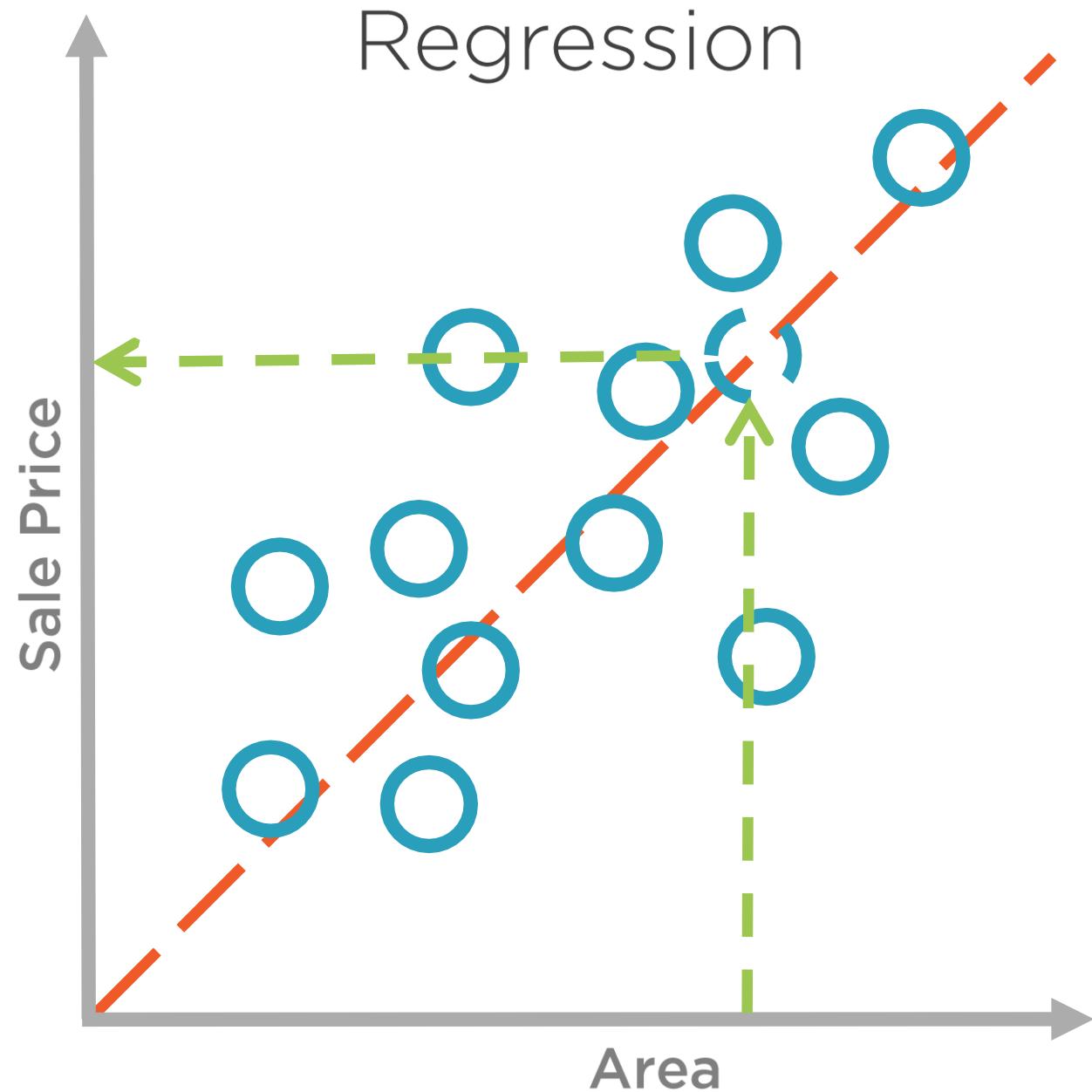
Prediction

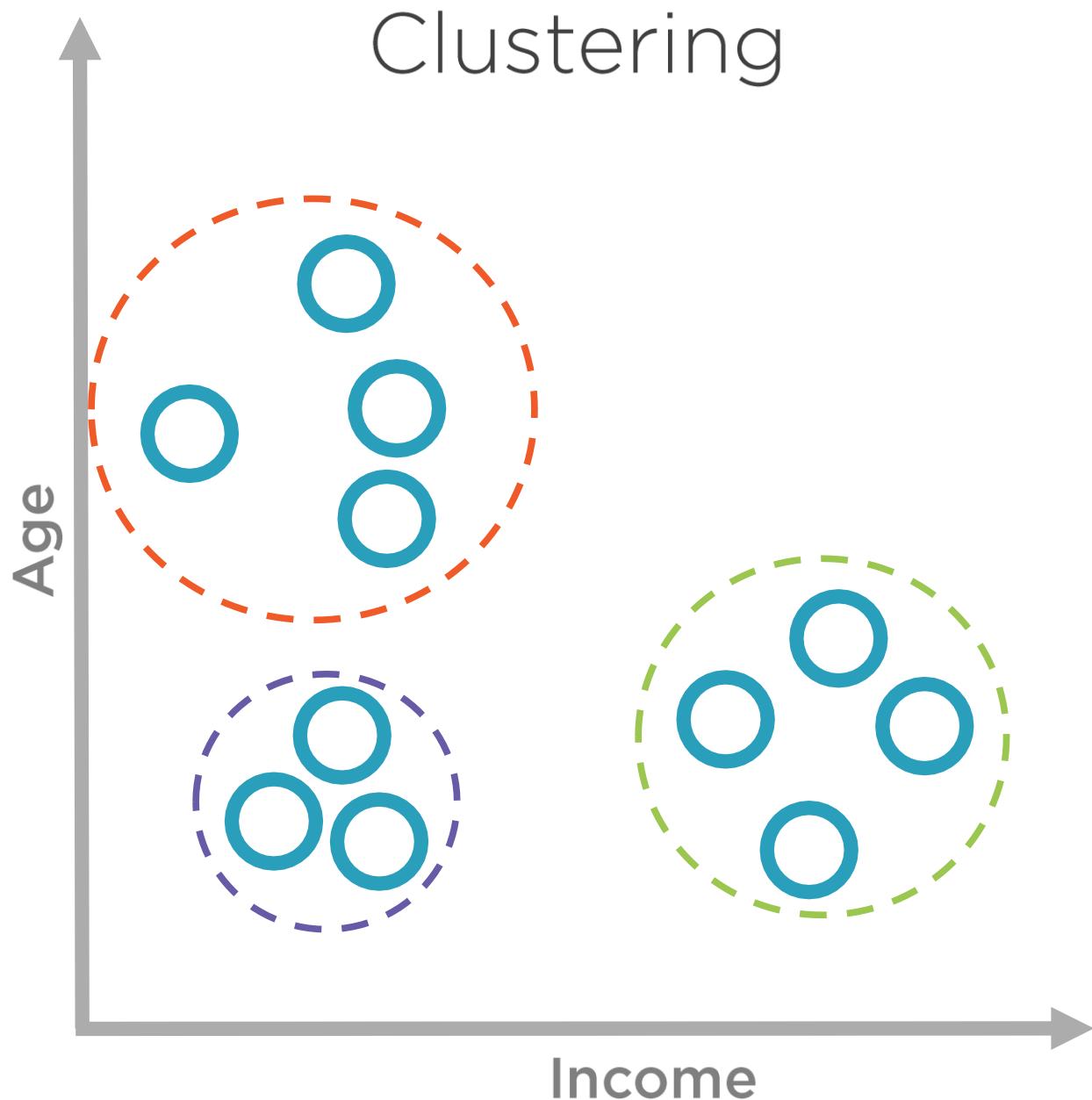
# Machine Learning Tasks



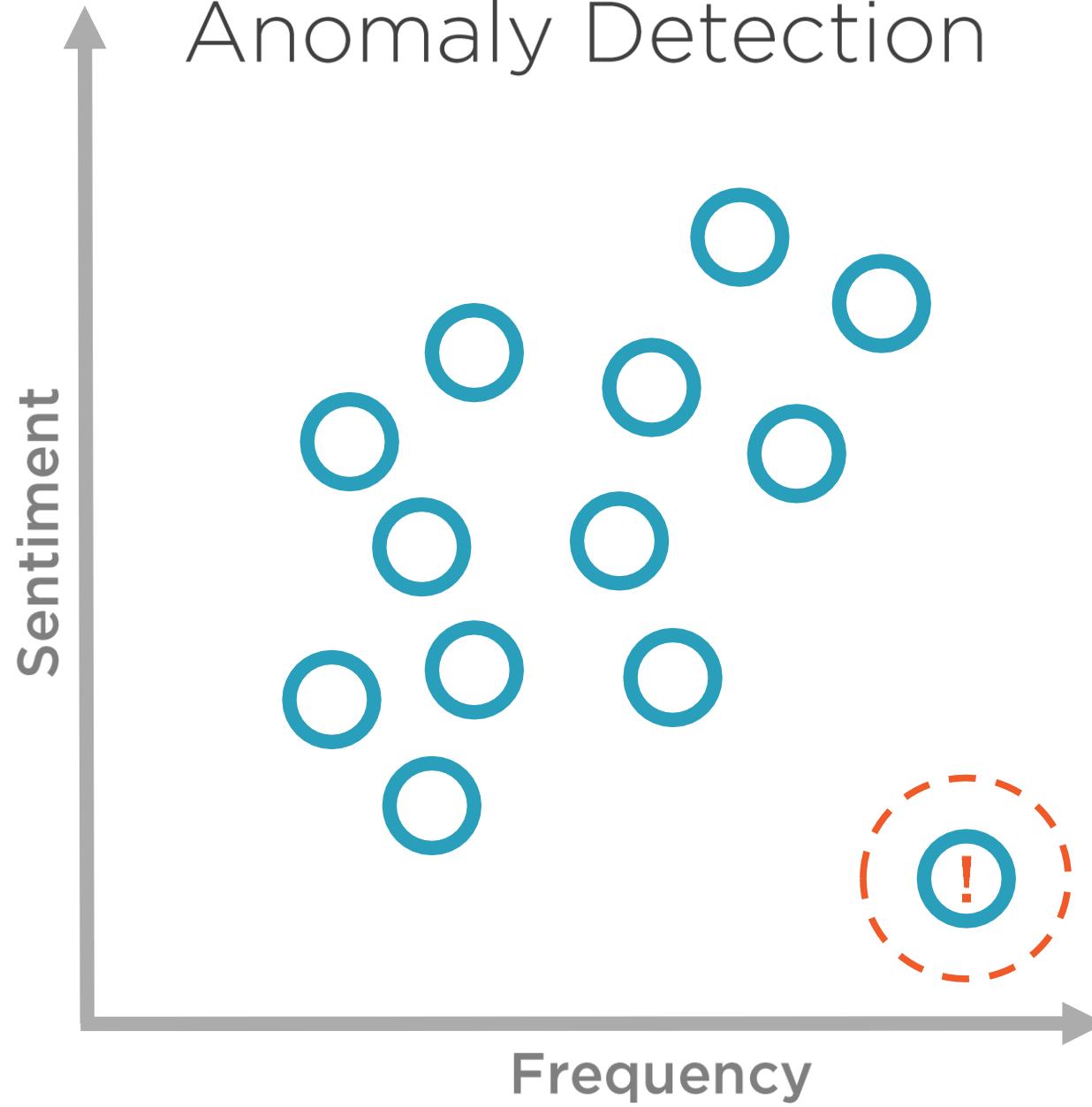
# Classification







## Anomaly Detection



# Machine Learning

Make  
better  
decisions

Create  
smarter  
products

Automate  
manual  
labor

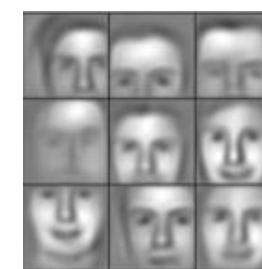
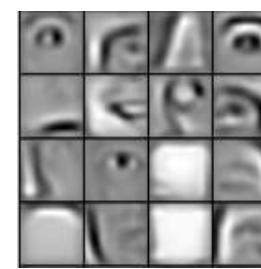
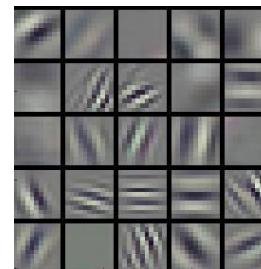
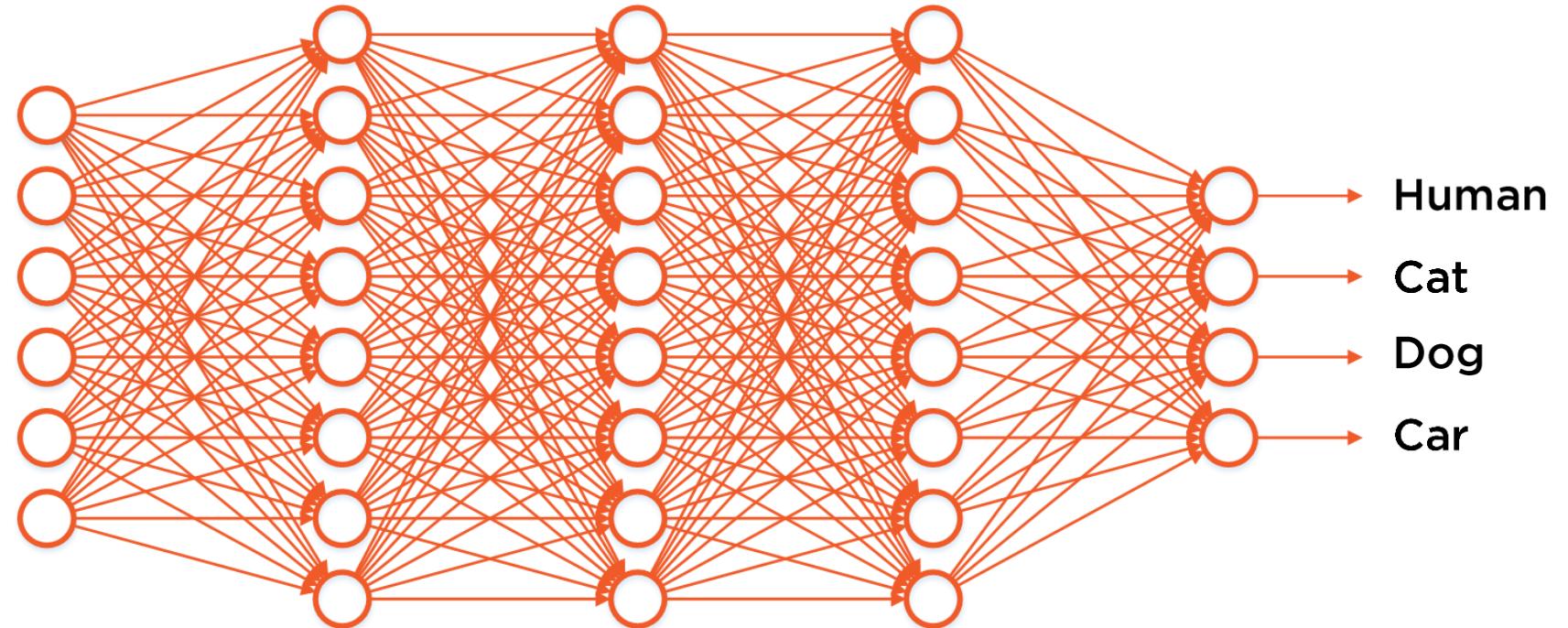
# Deep Learning

---

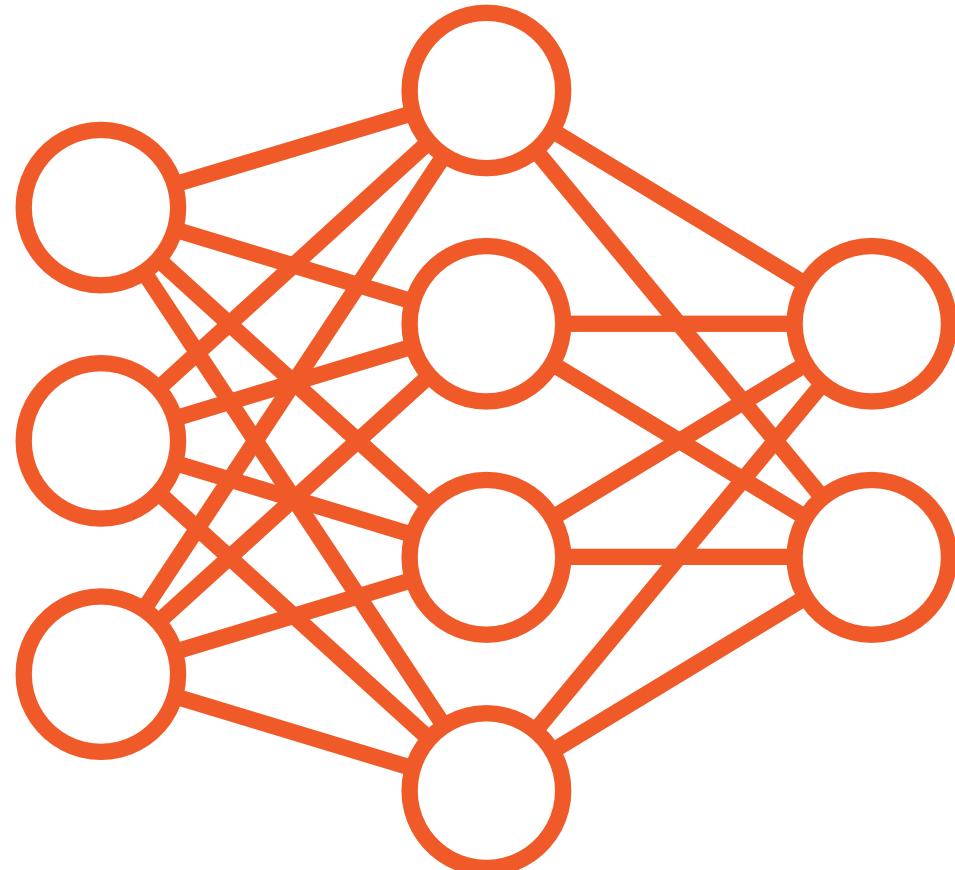
# Deep Learning

- 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

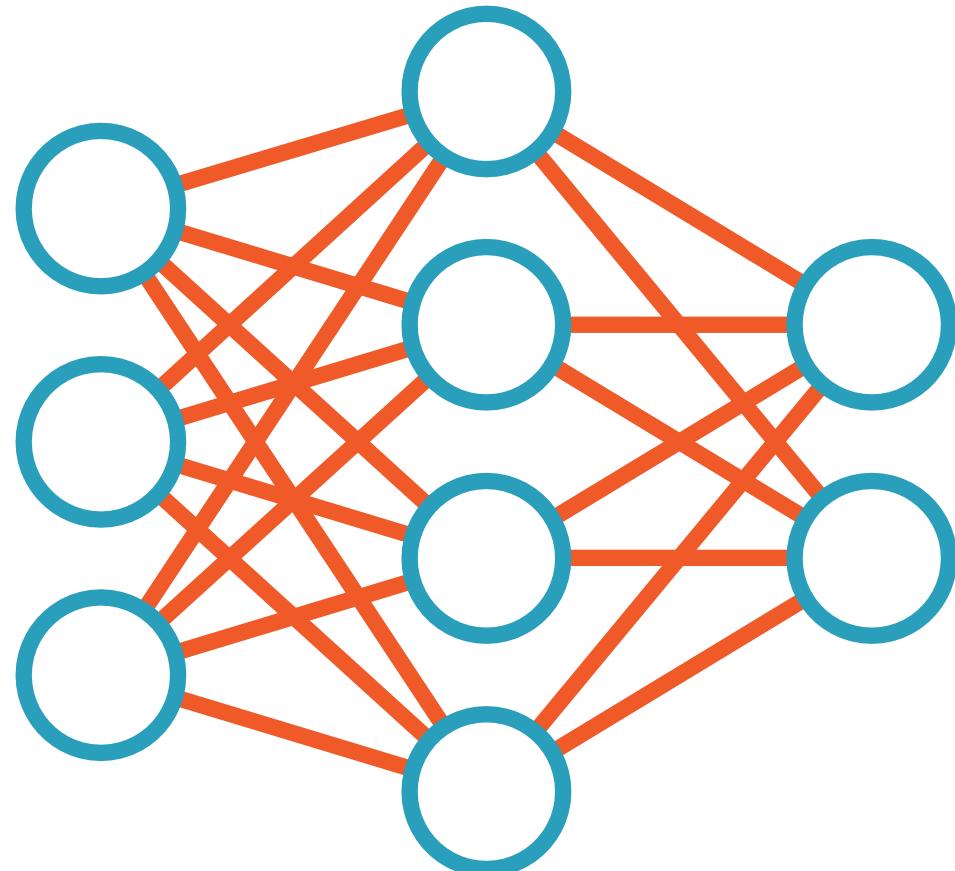


input

hidden

output

# Neural Network

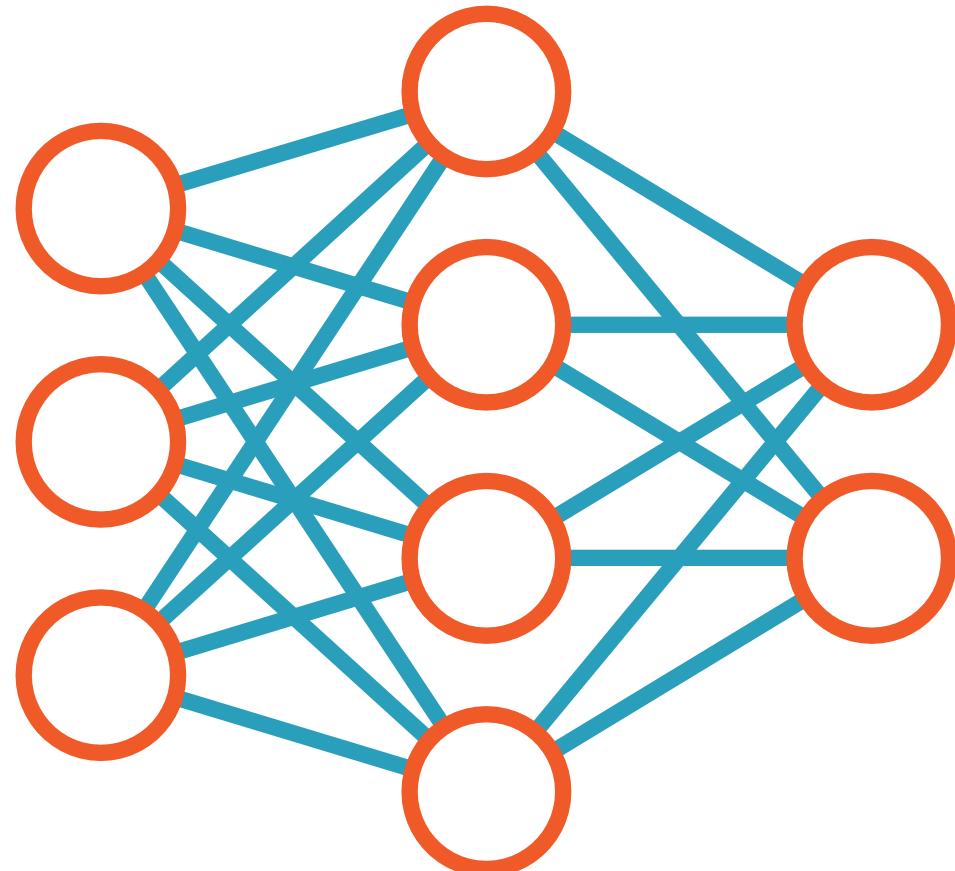


input

hidden

output

# Neural Network

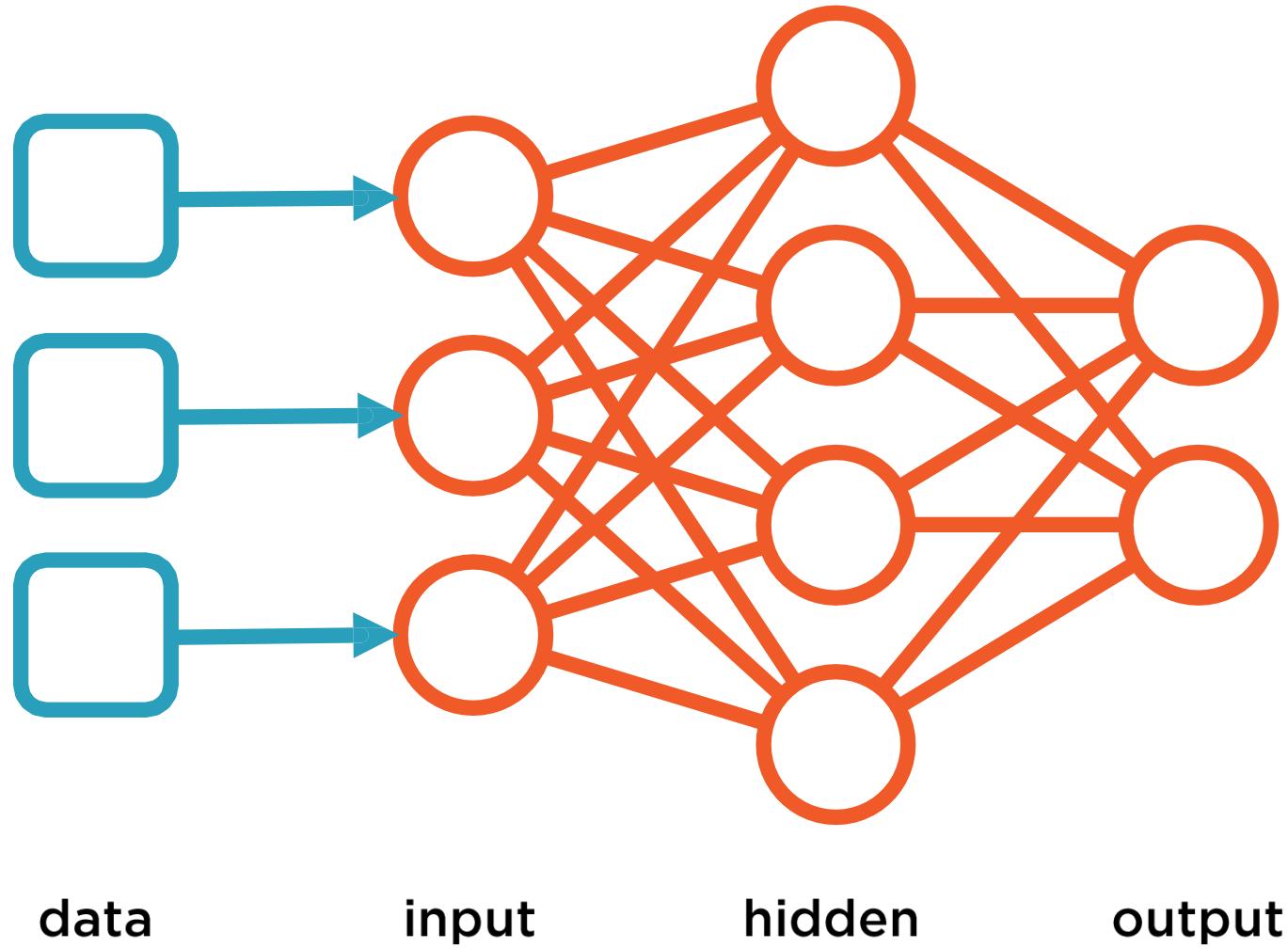


input

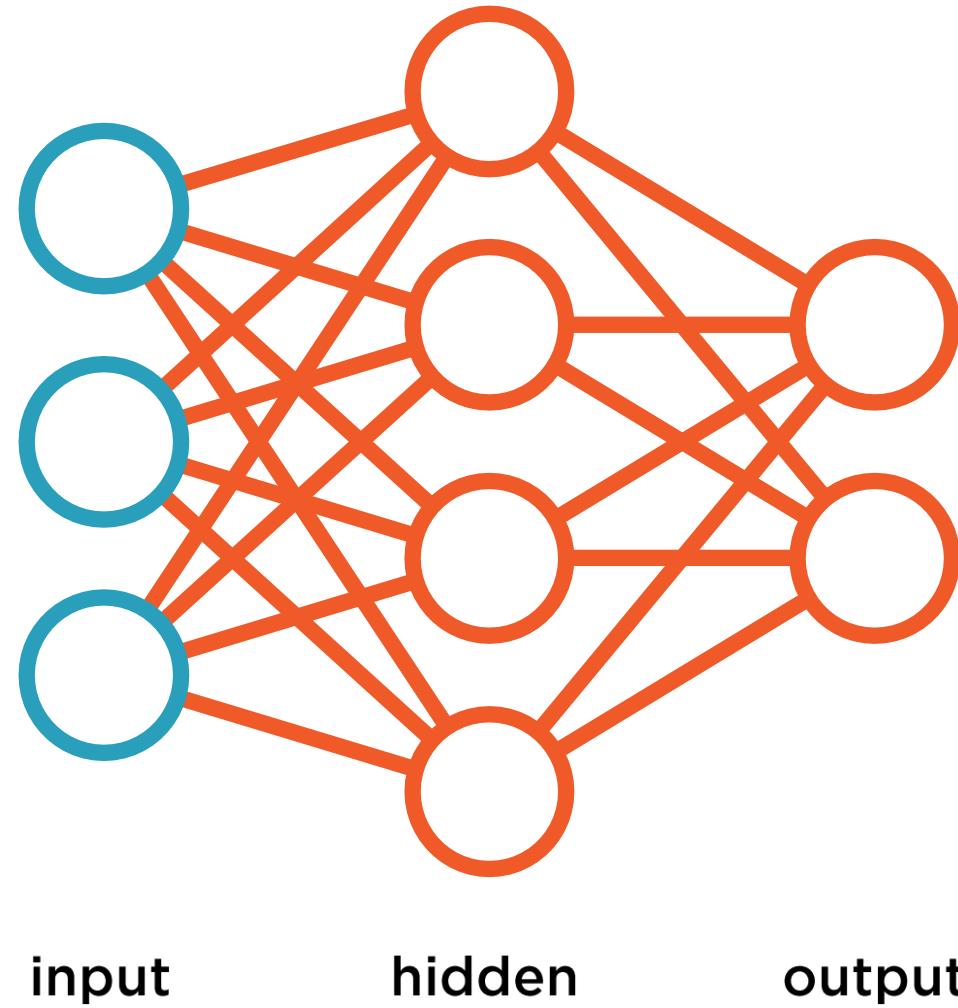
hidden

output

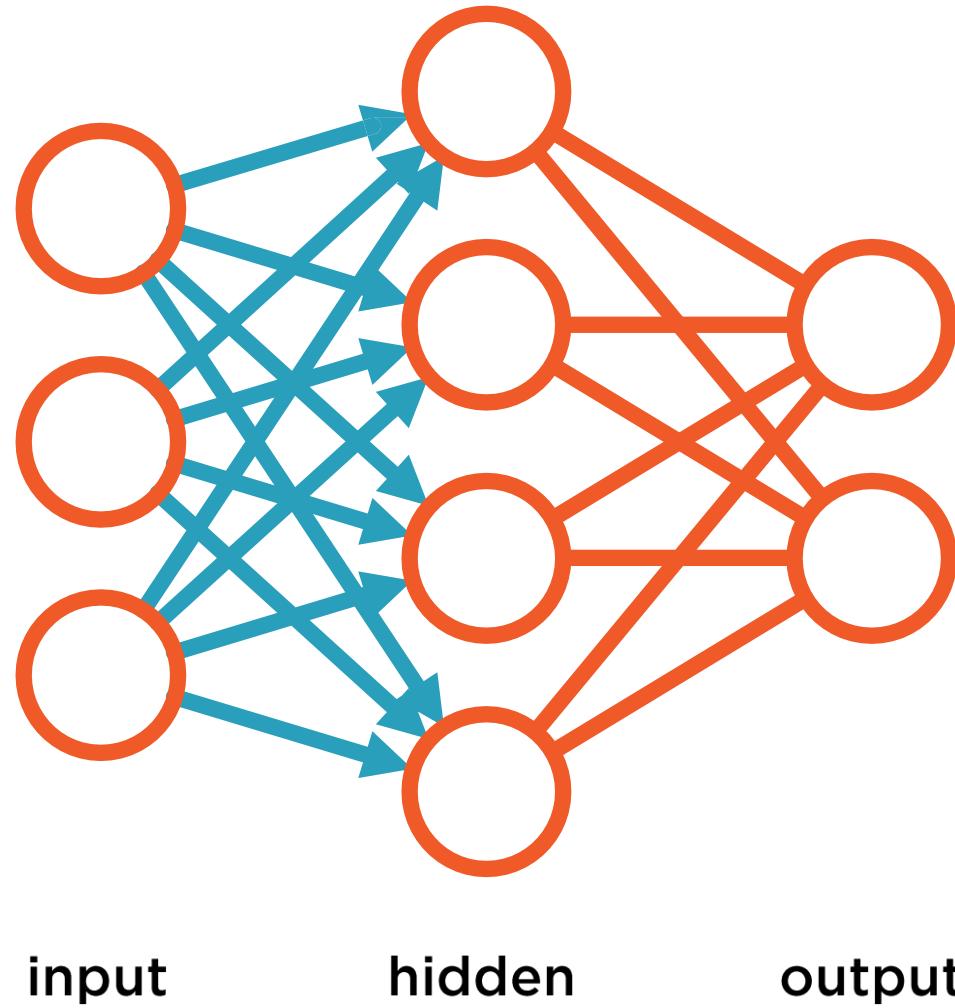
# Neural Network



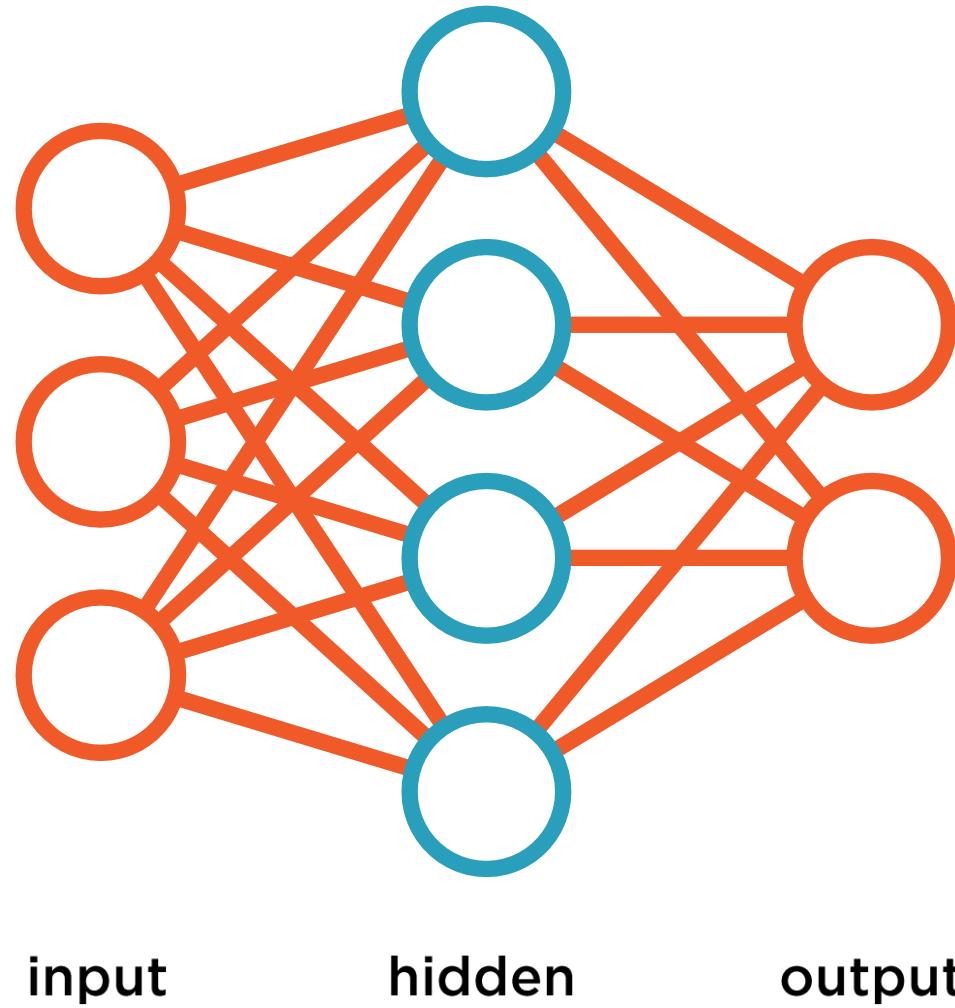
# Neural Network



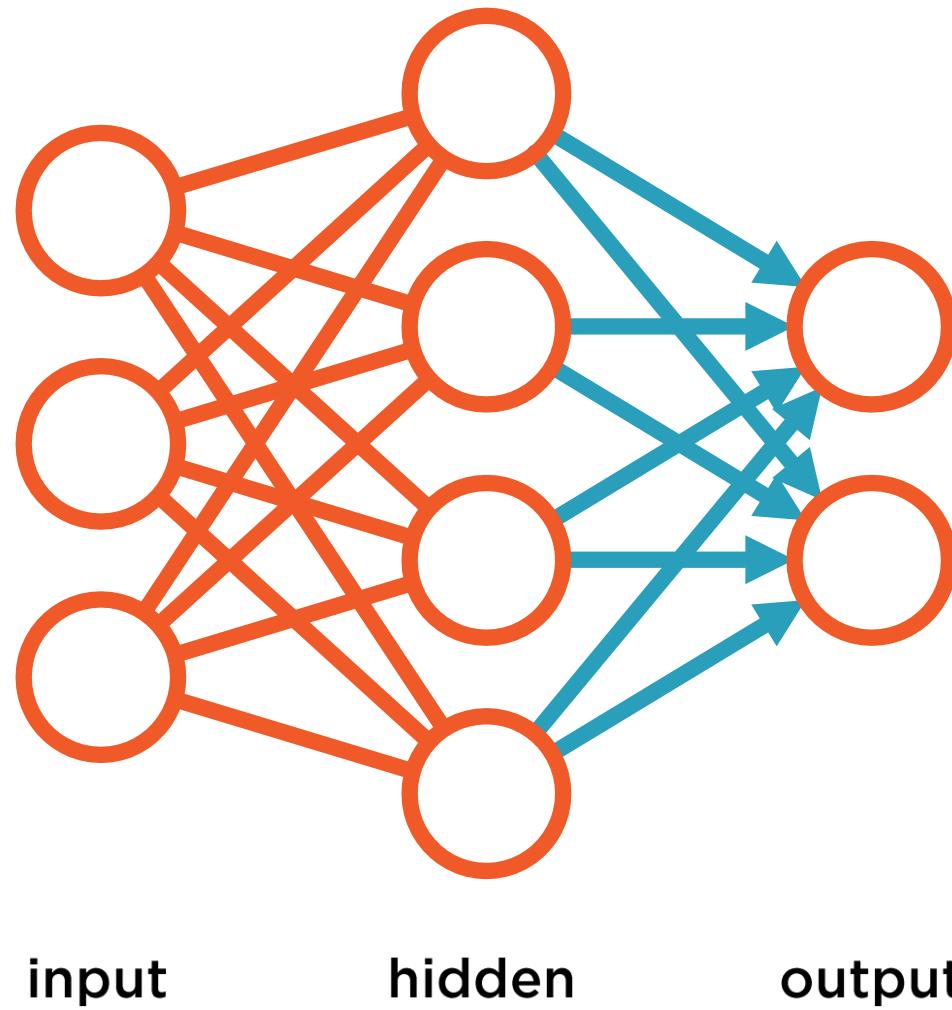
# Neural Network



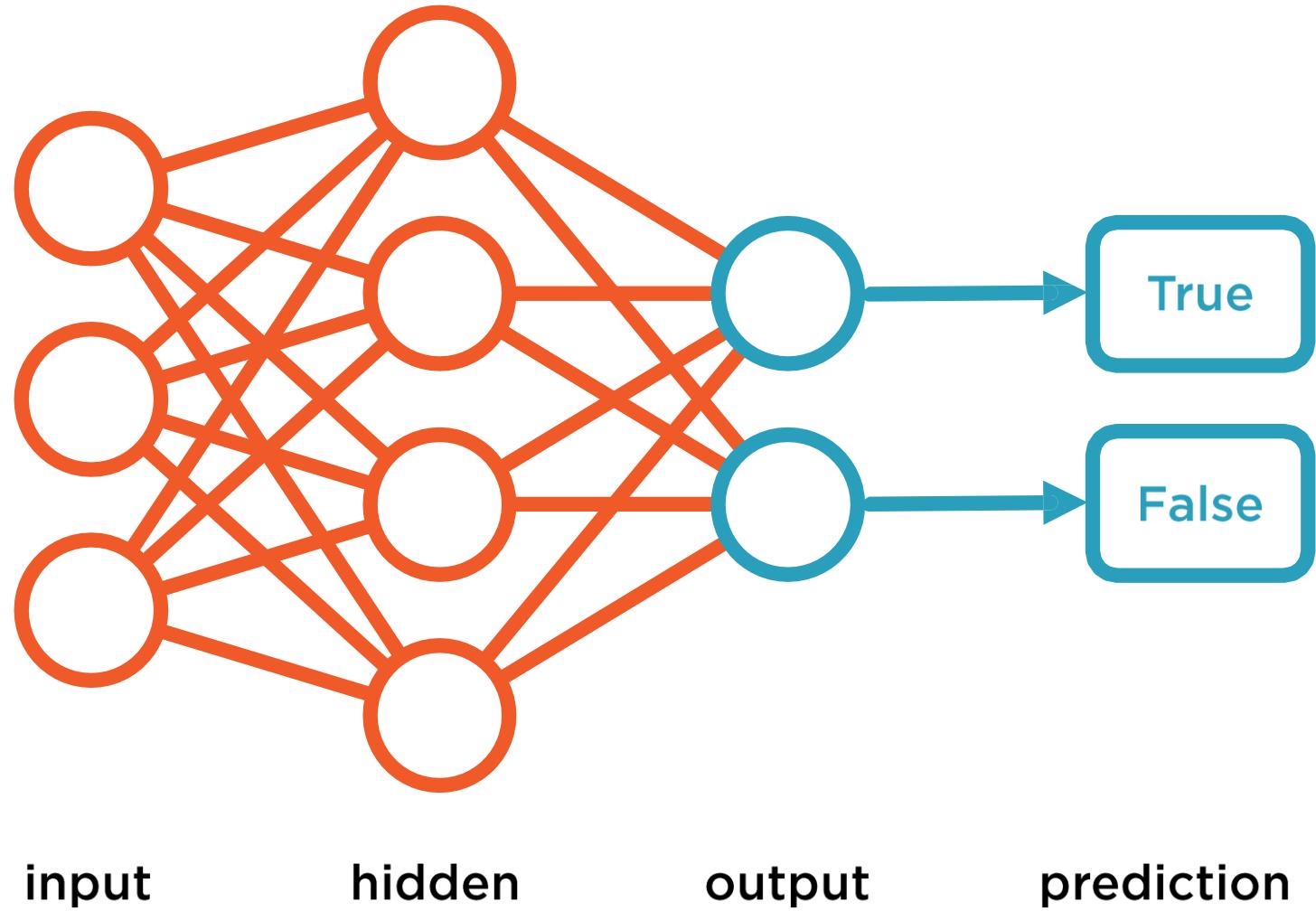
# Neural Network



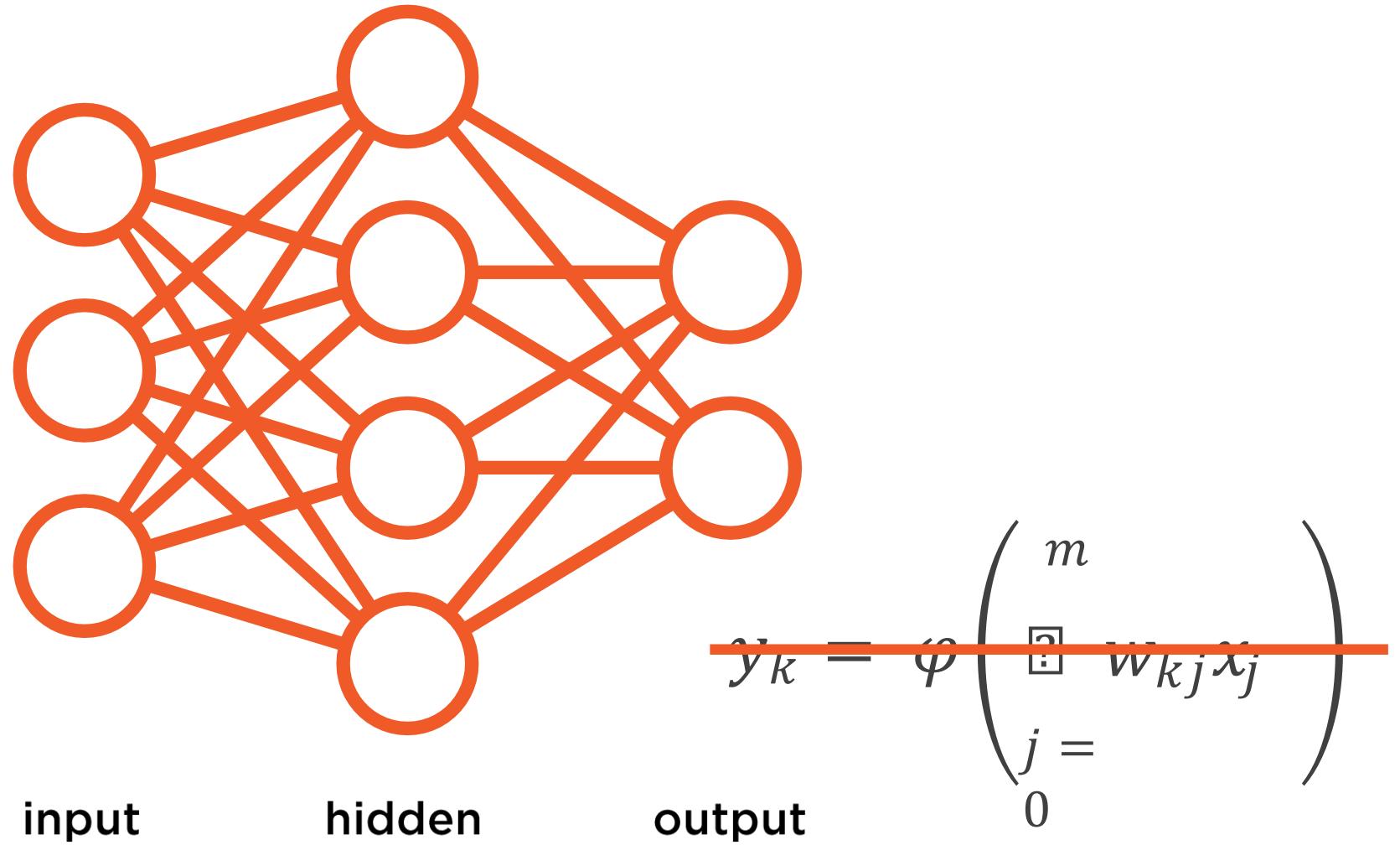
# Neural Network



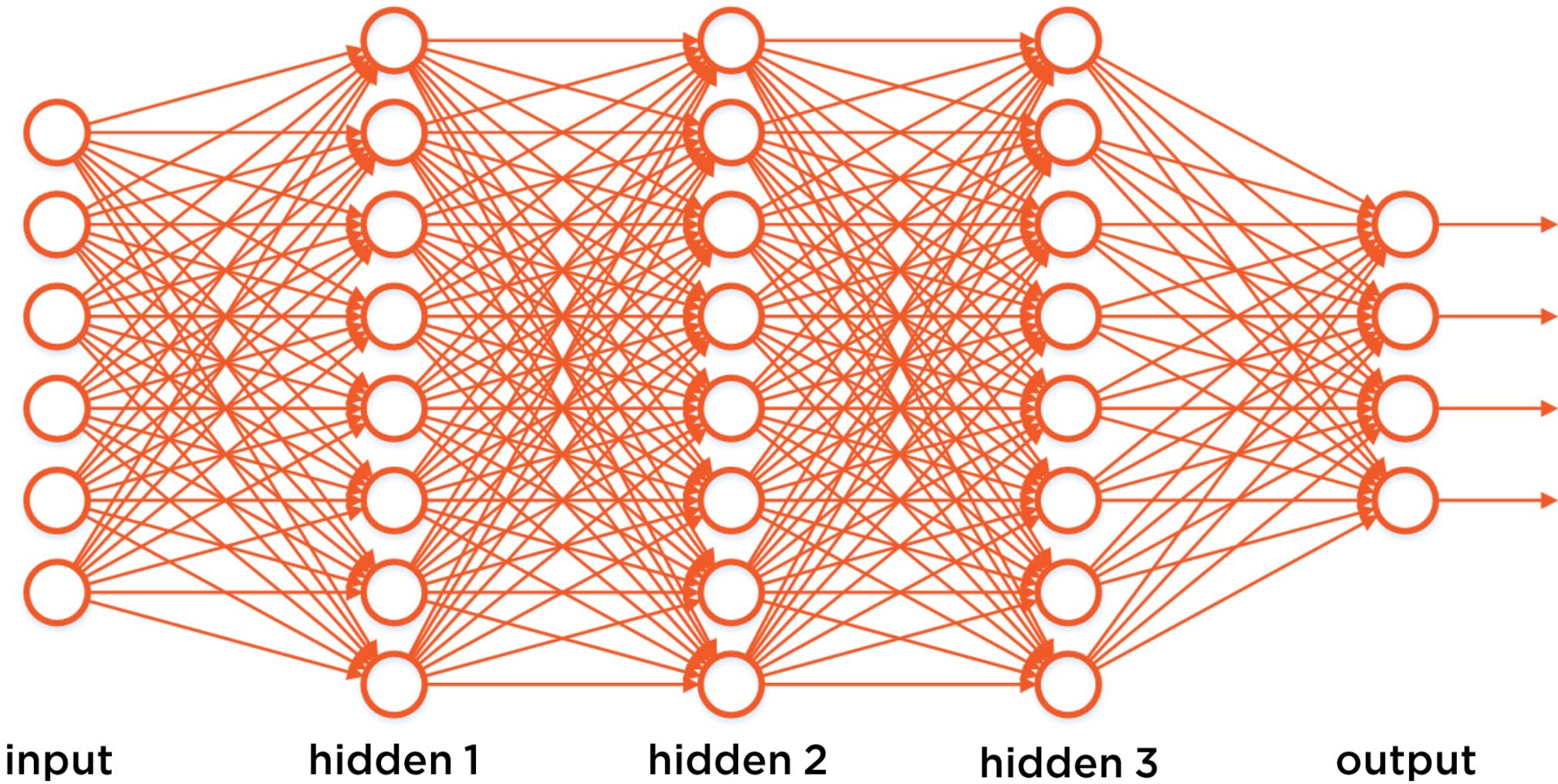
# Neural Network



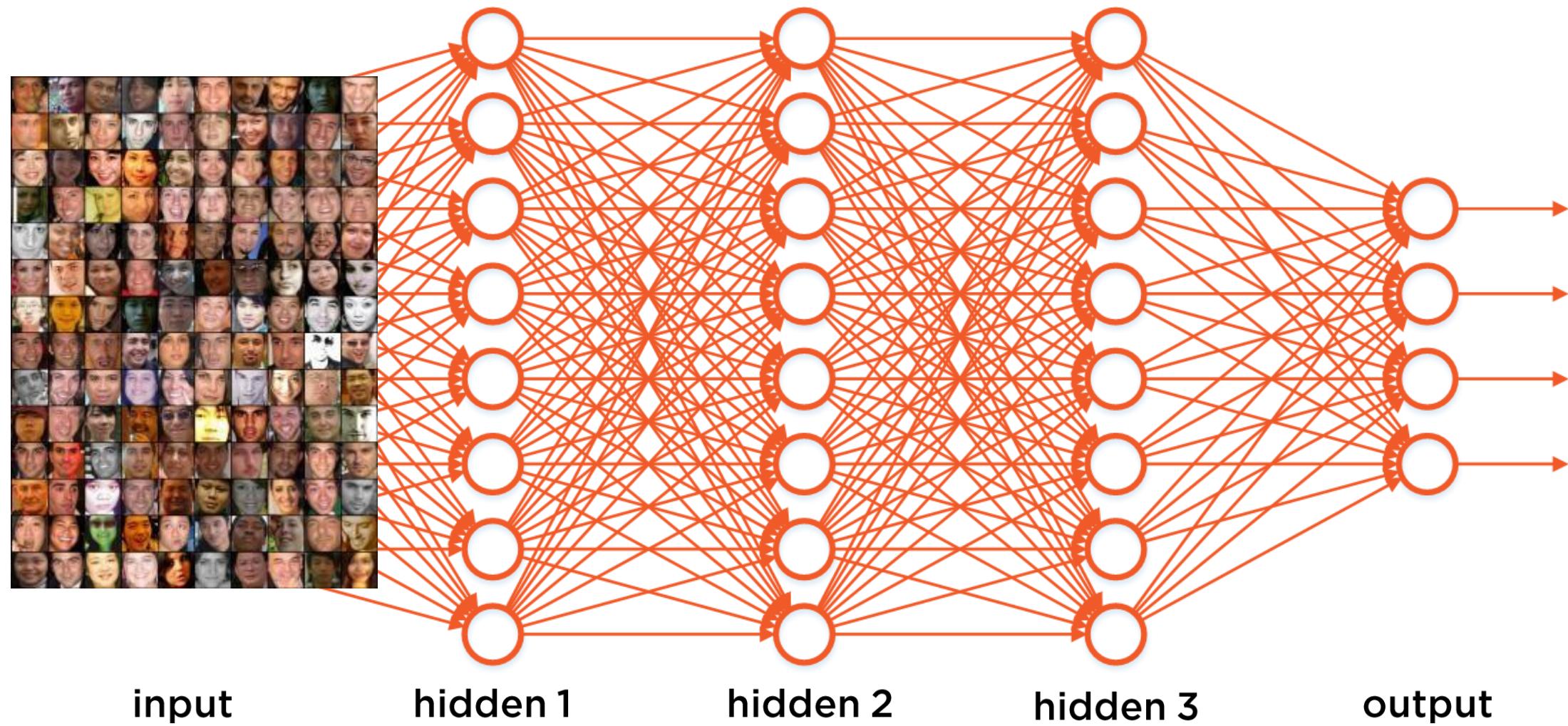
# Neural Network



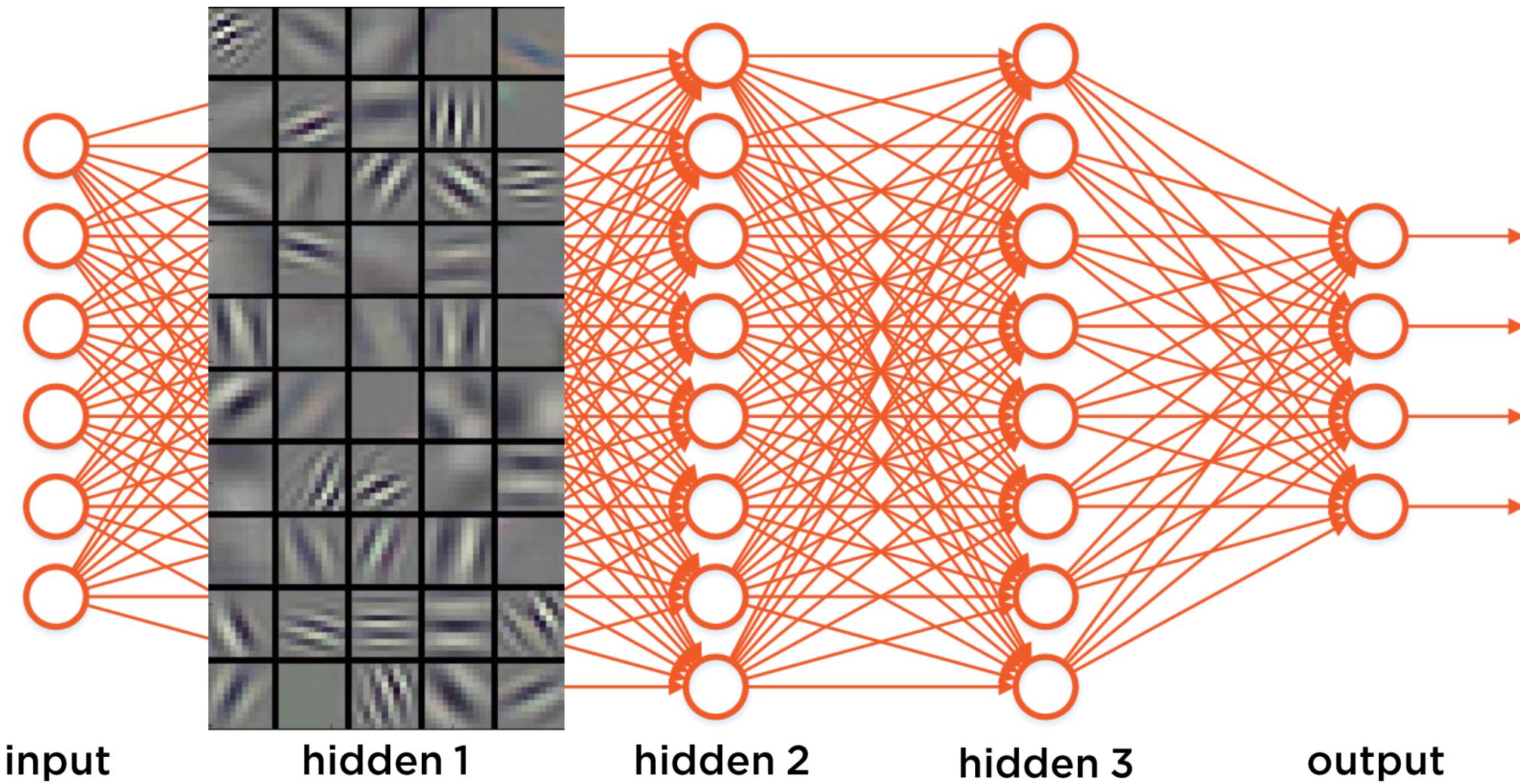
# Deep Neural Network



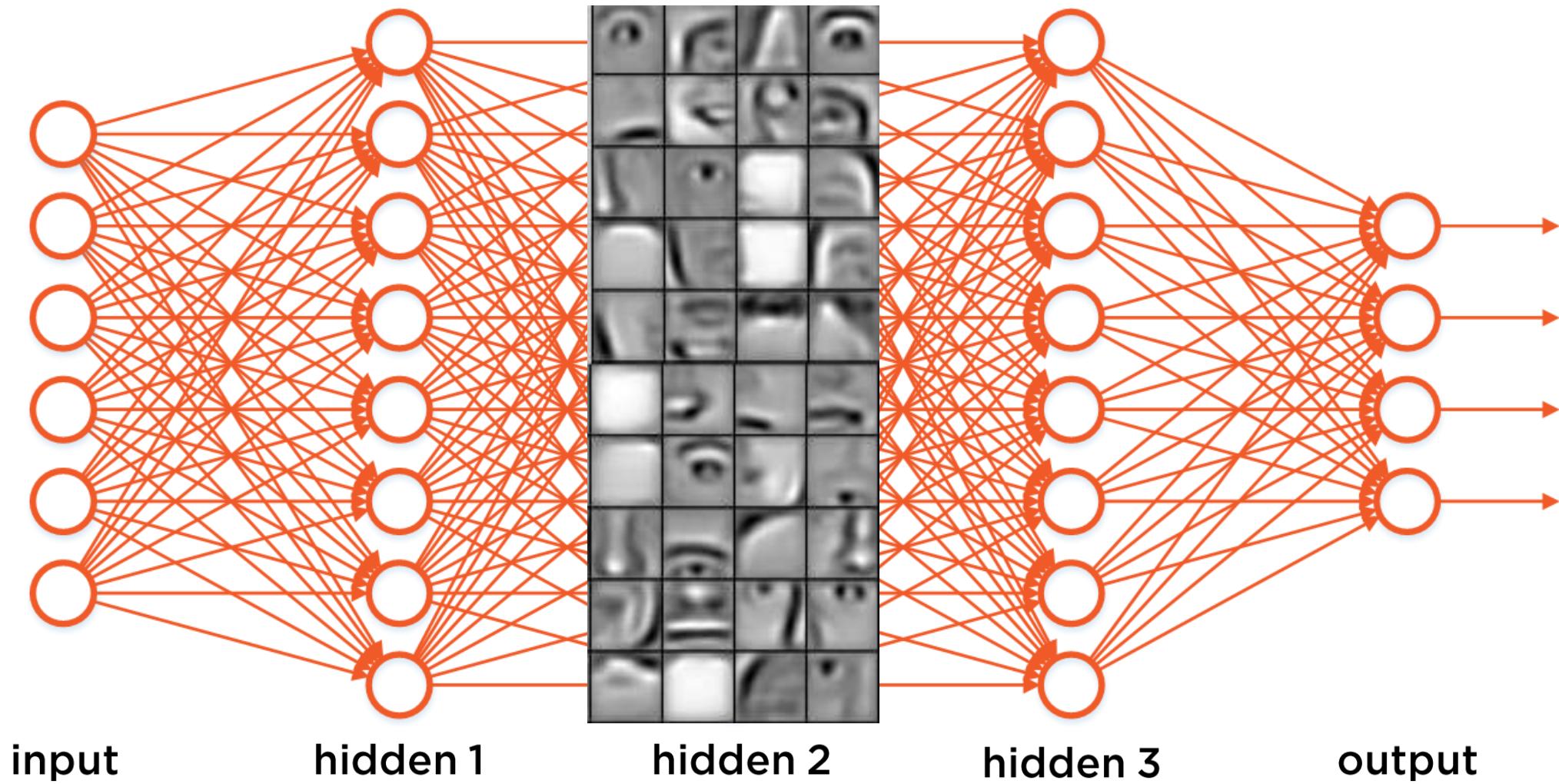
# Deep Neural Network



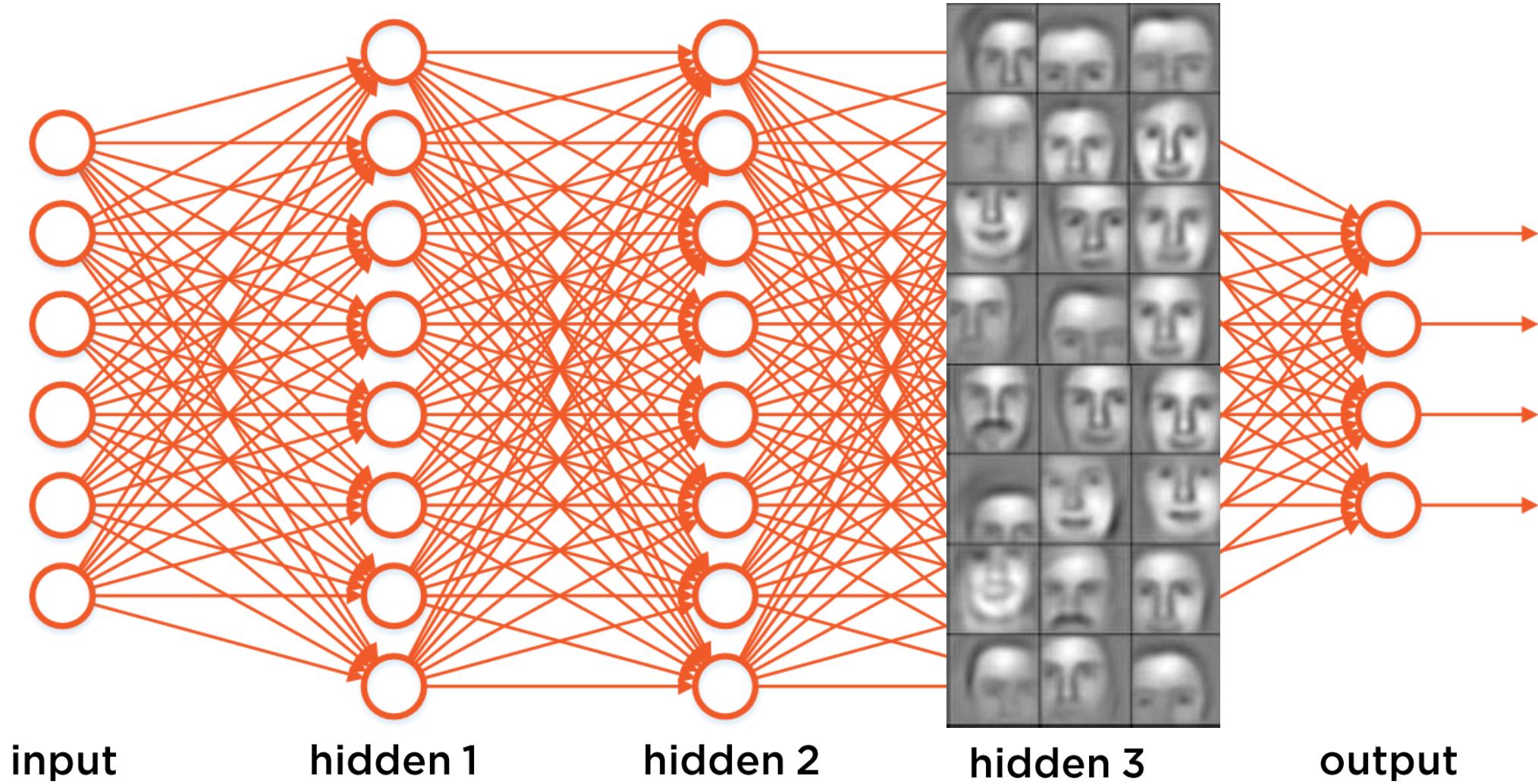
# Deep Neural Network



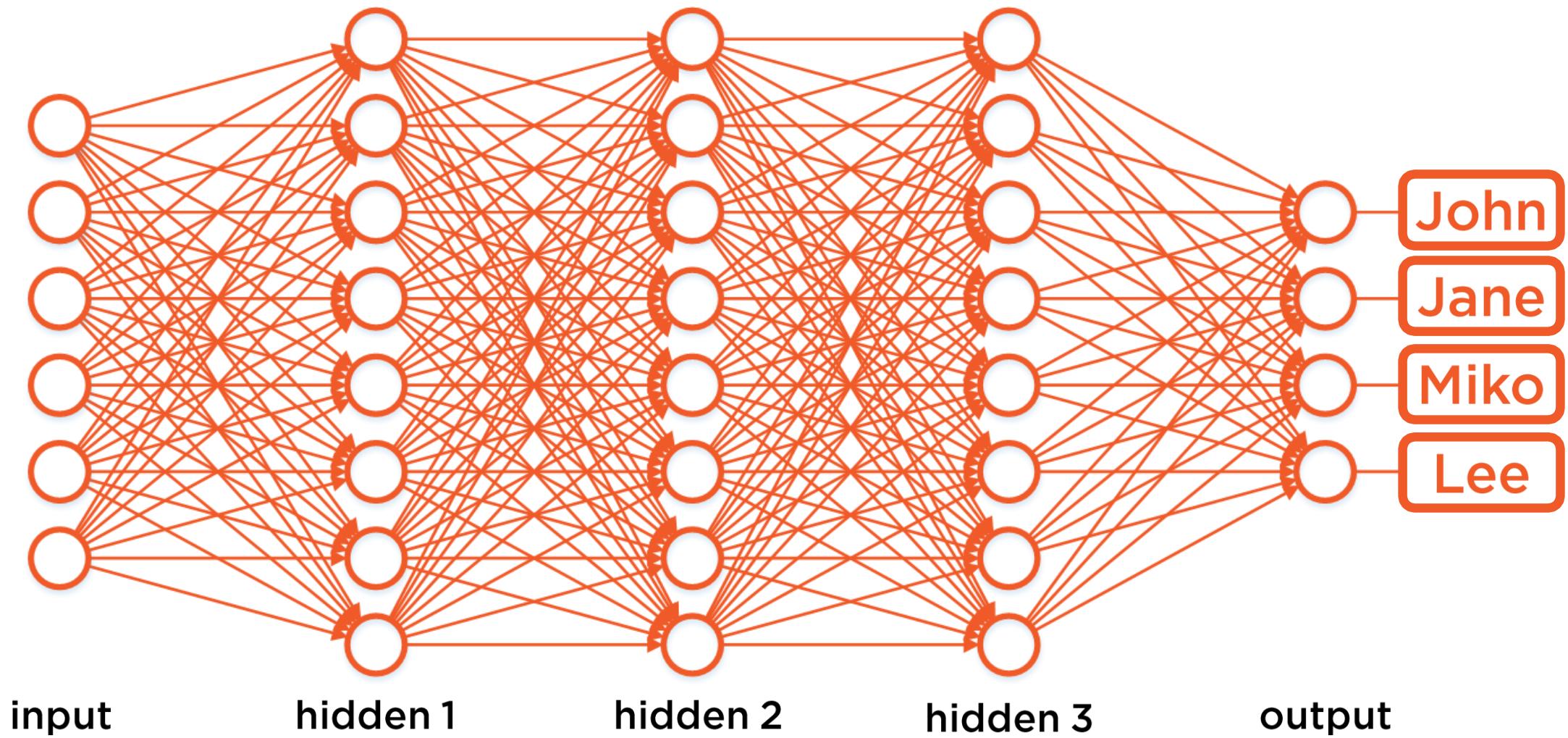
# Deep Neural Network



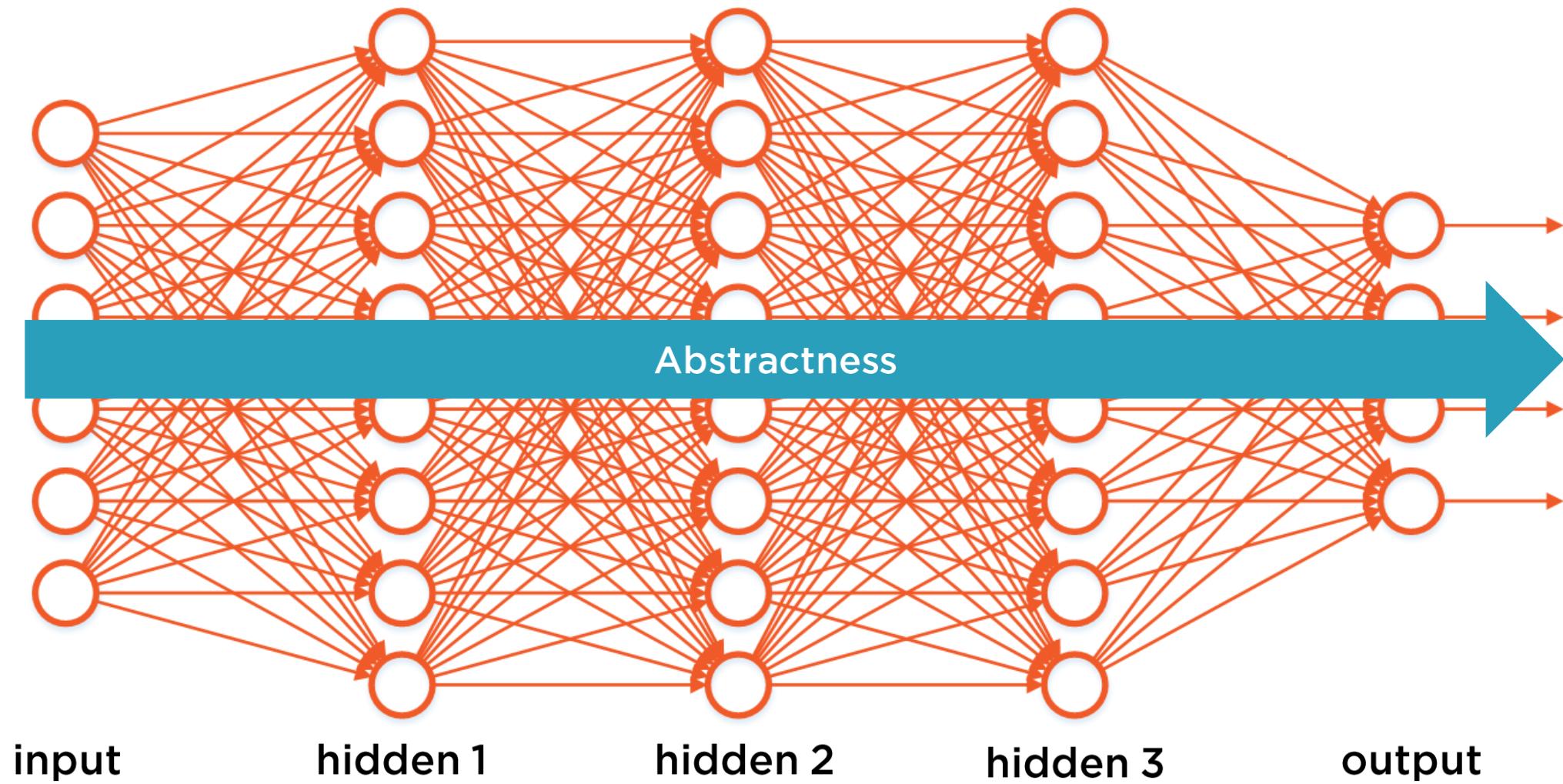
# Deep Neural Network



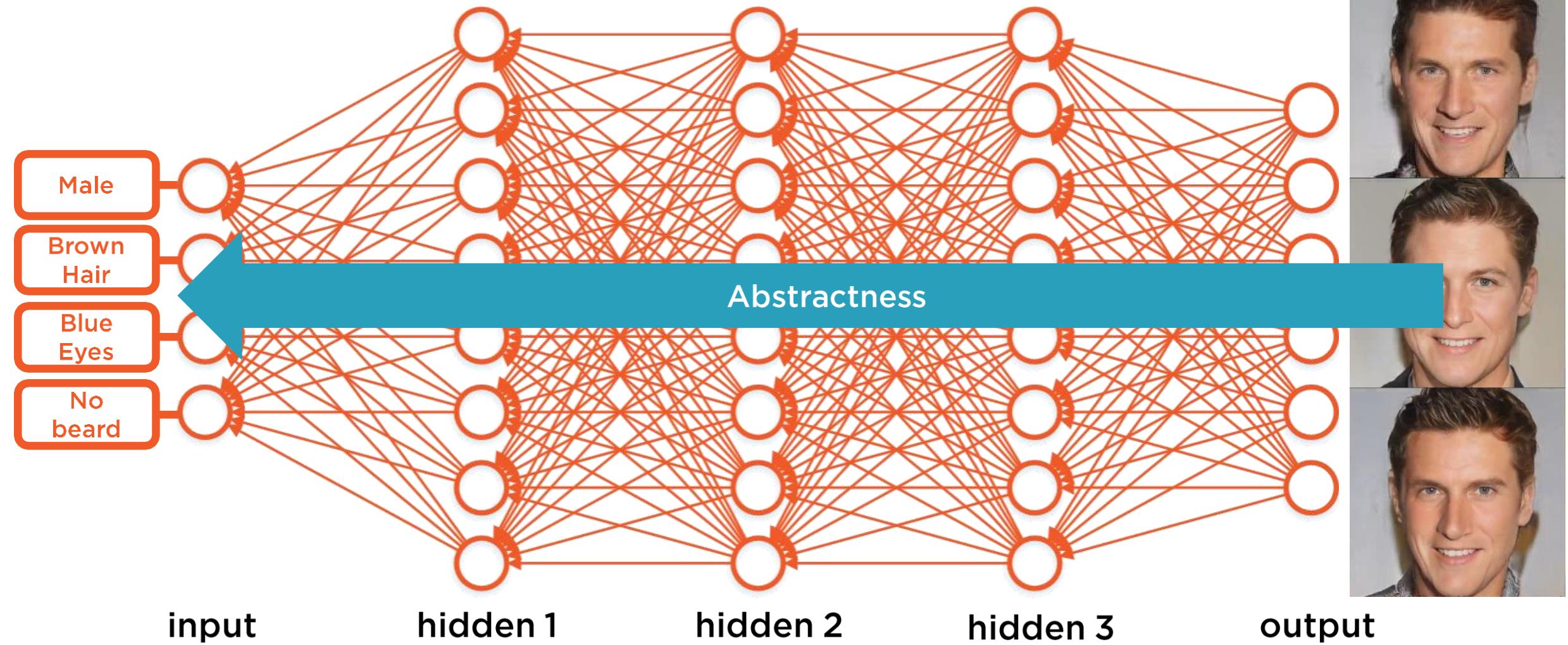
# Deep Neural Network



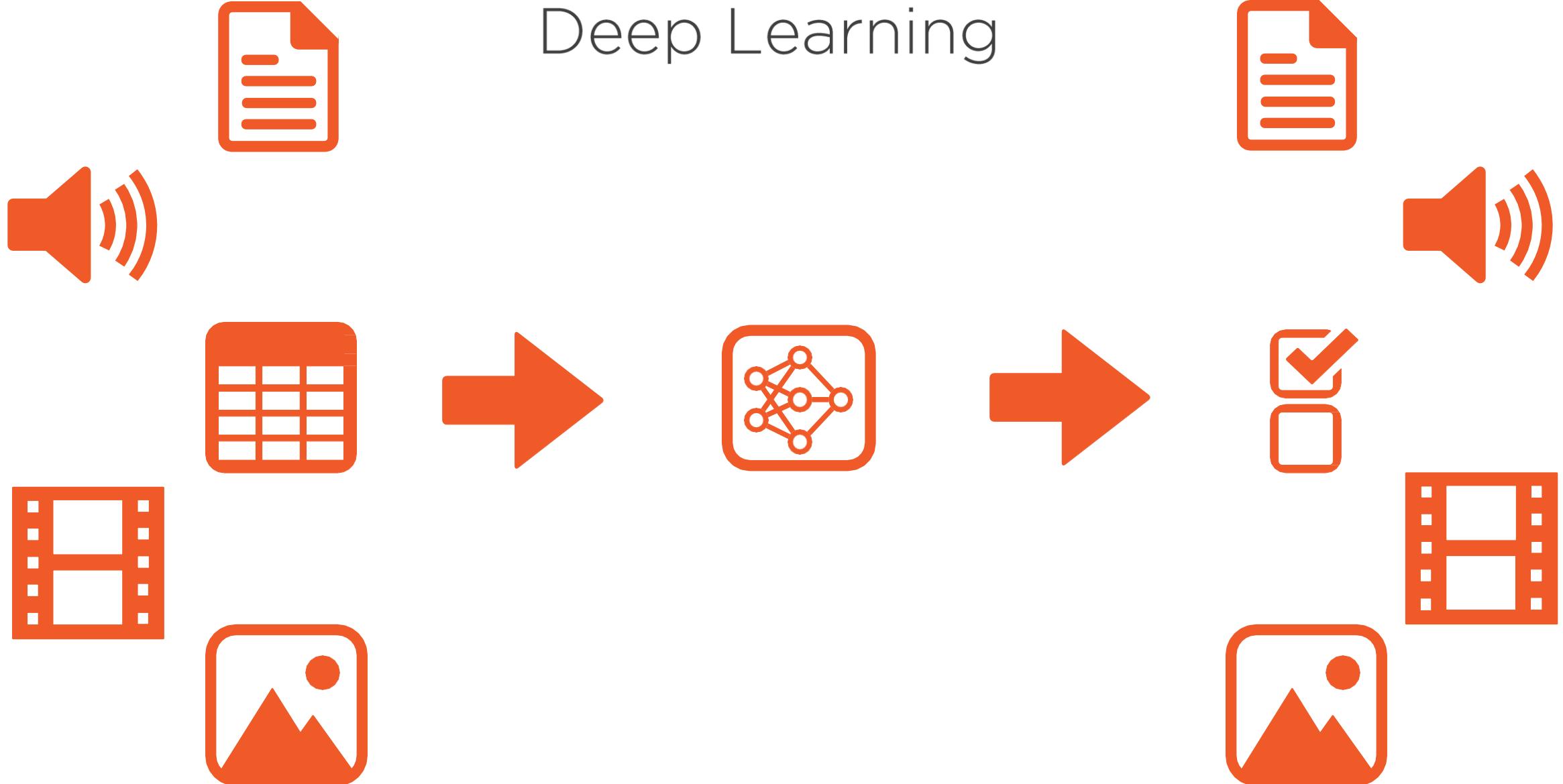
# Deep Neural Network



# DNN Generator



# Deep Learning



# Reinforcement Learning

---

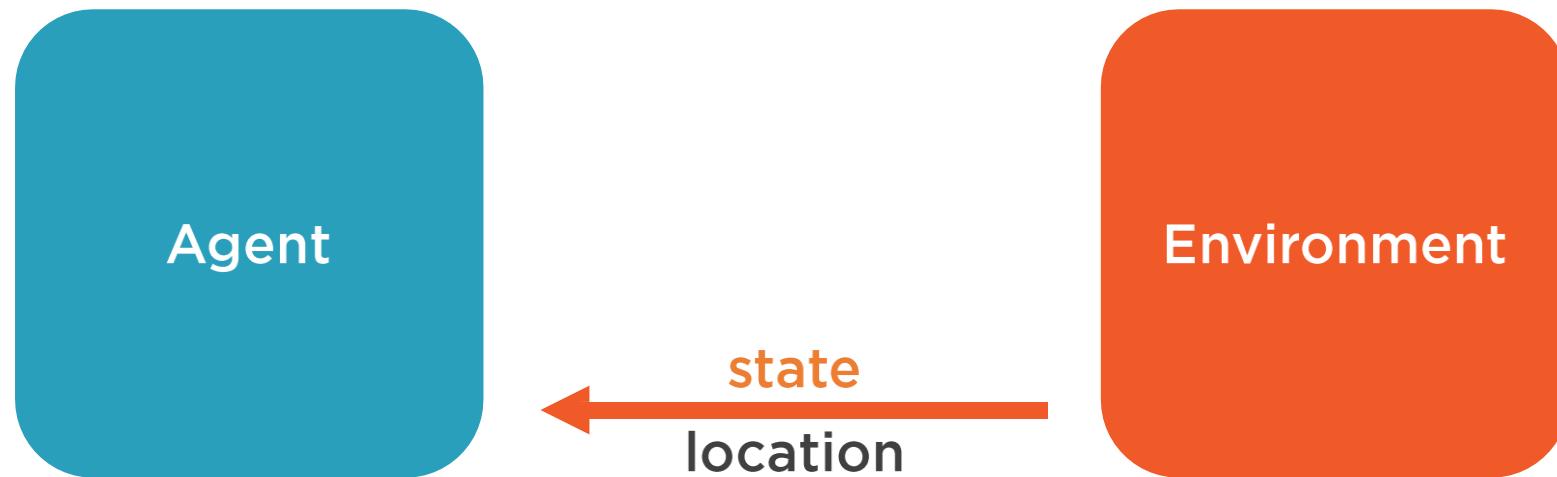
# Reinforcement Learning

- 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.

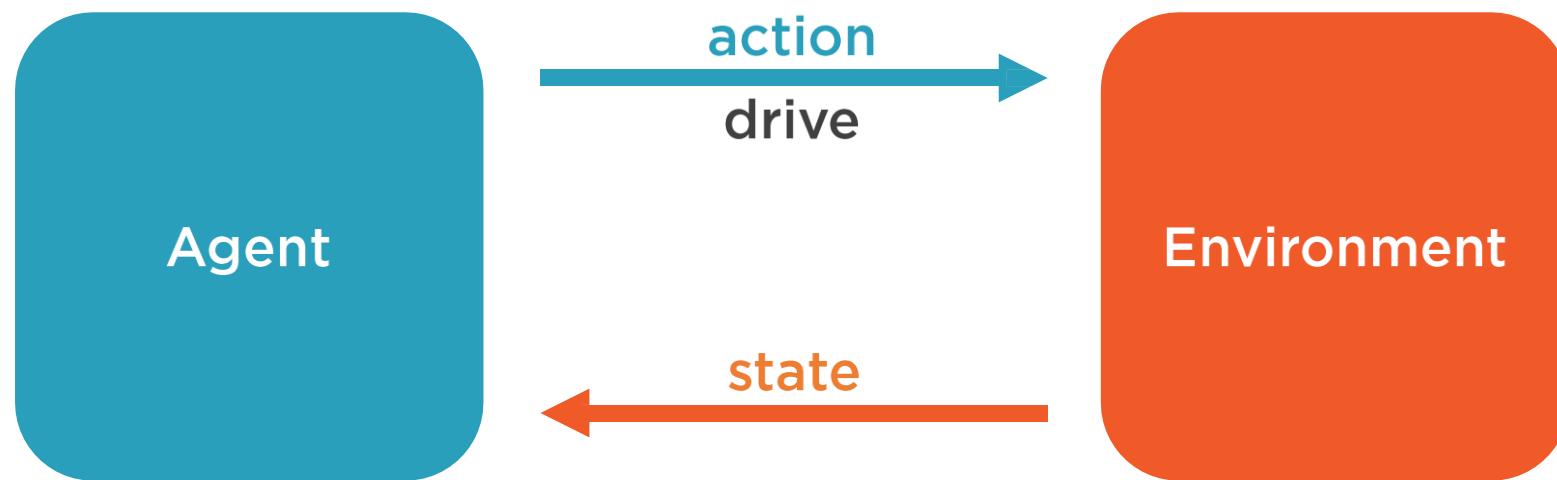
# Reinforcement Learning



# Reinforcement Learning



# Reinforcement Learning



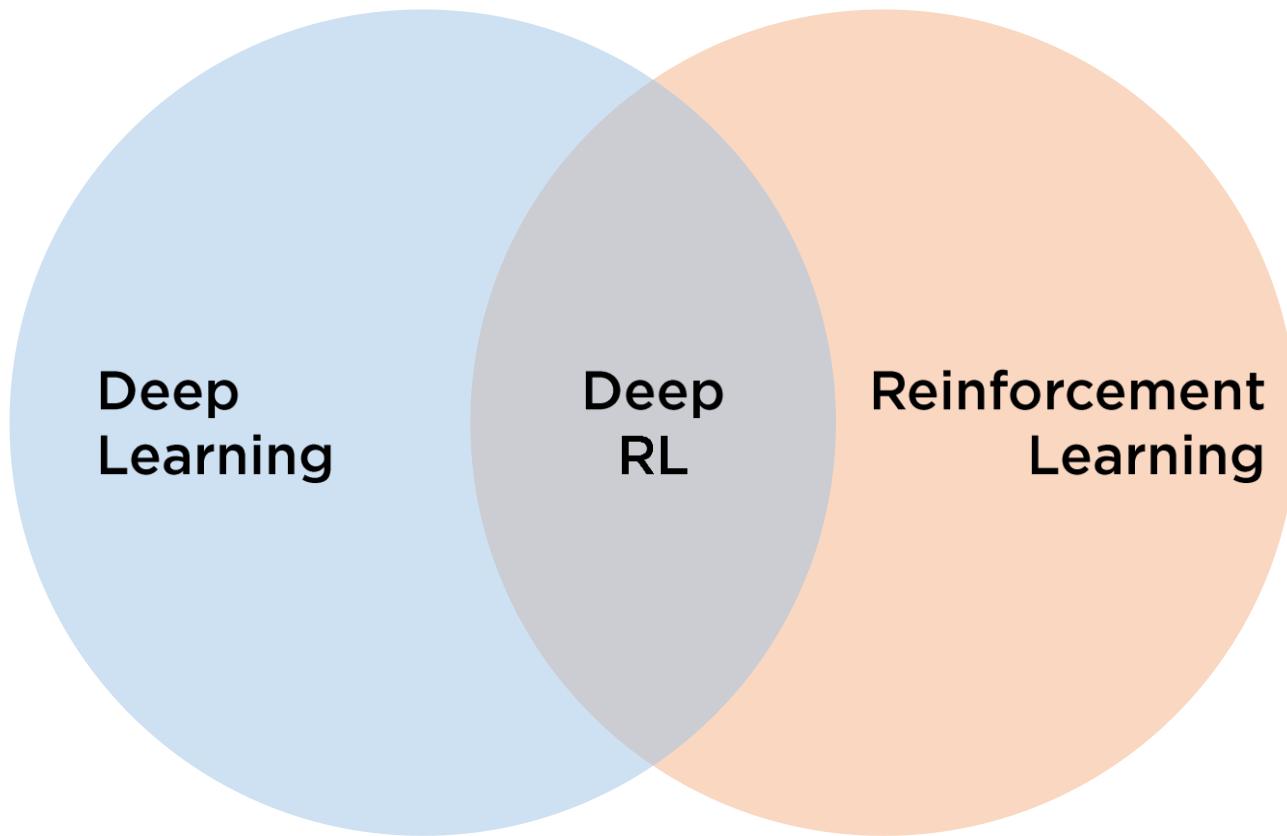
# Reinforcement Learning



# Reinforcement Learning



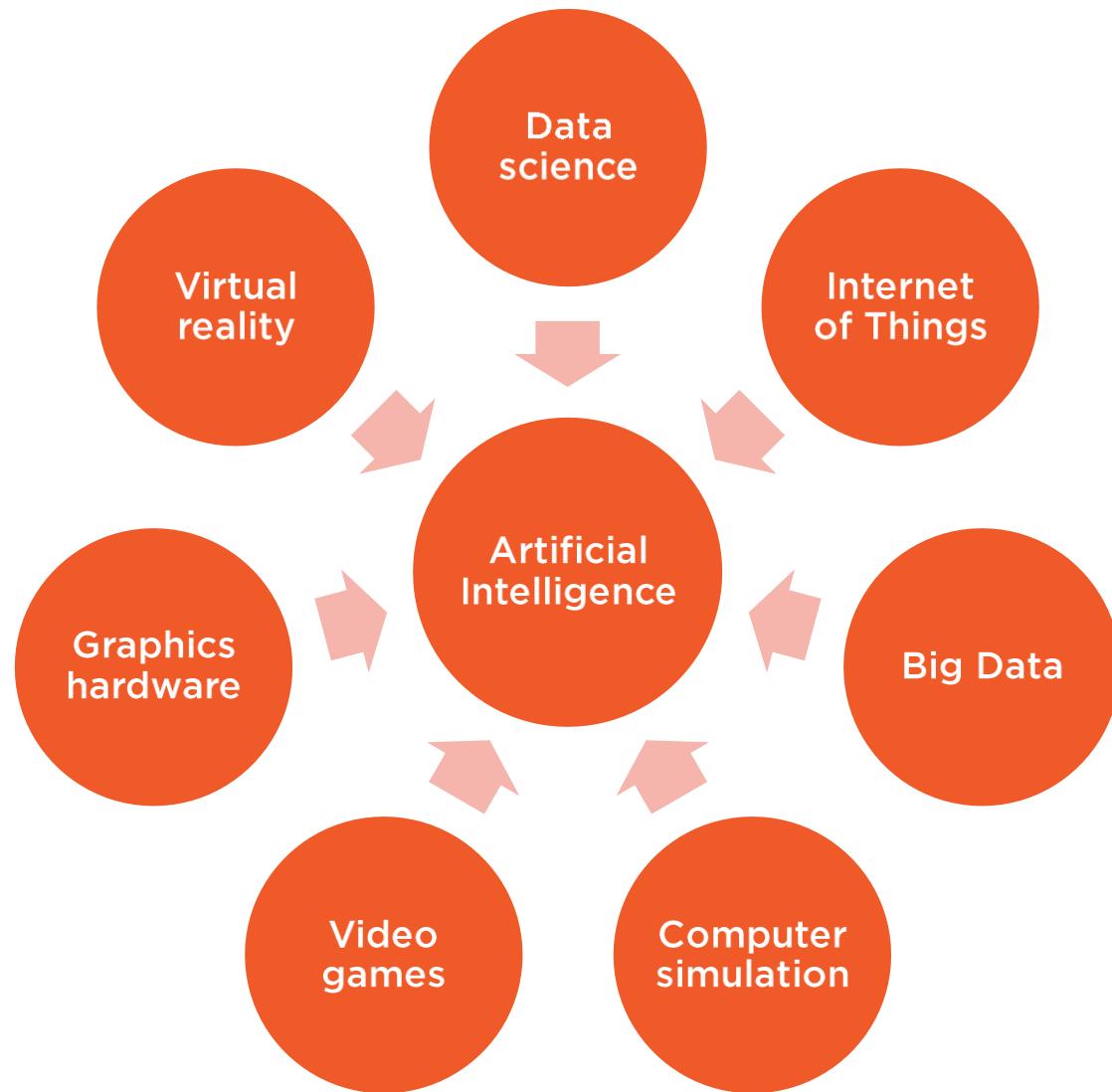
# Deep Reinforcement Learning



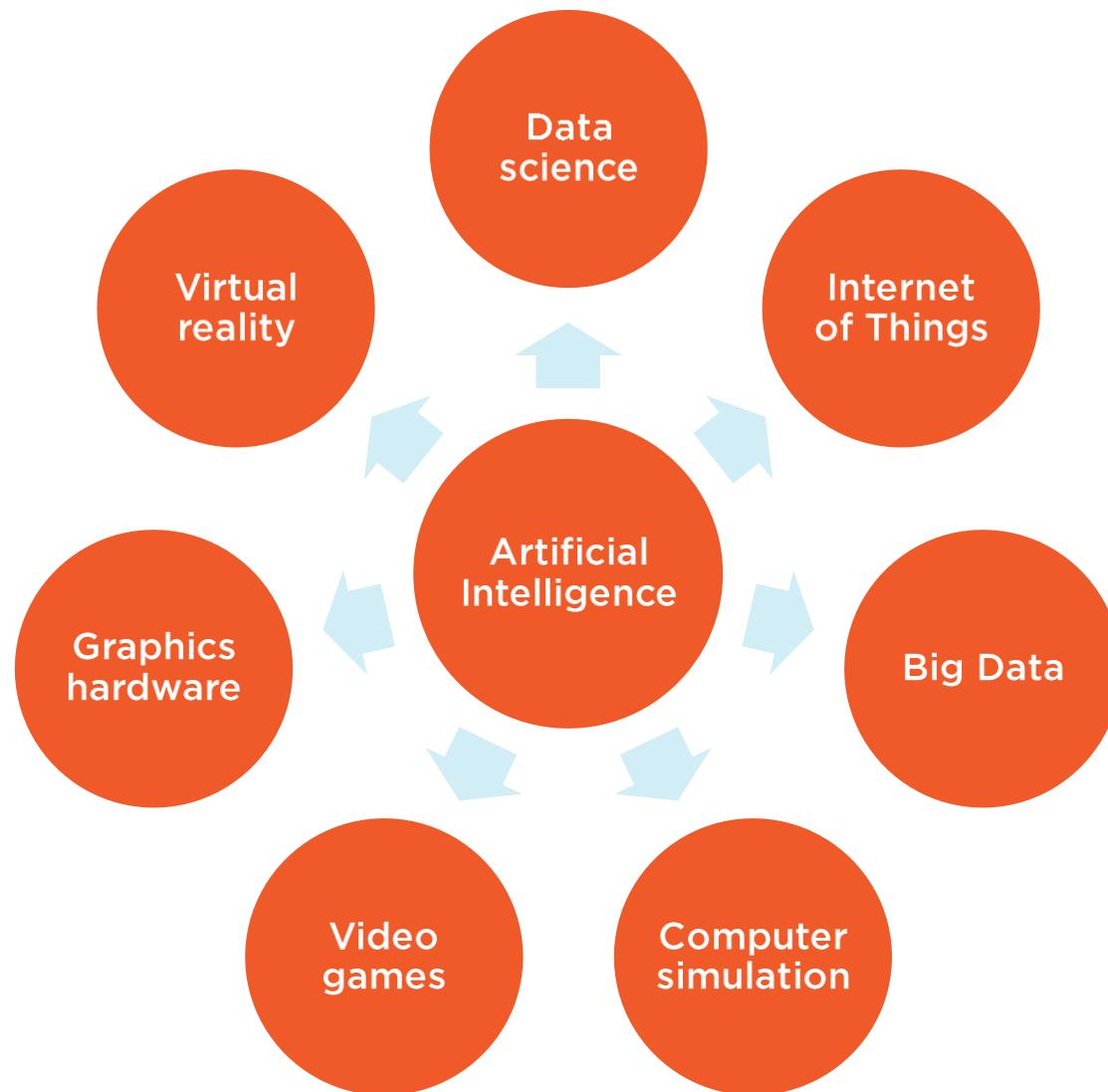
## Other A.I. Trends

---

# Other Trends

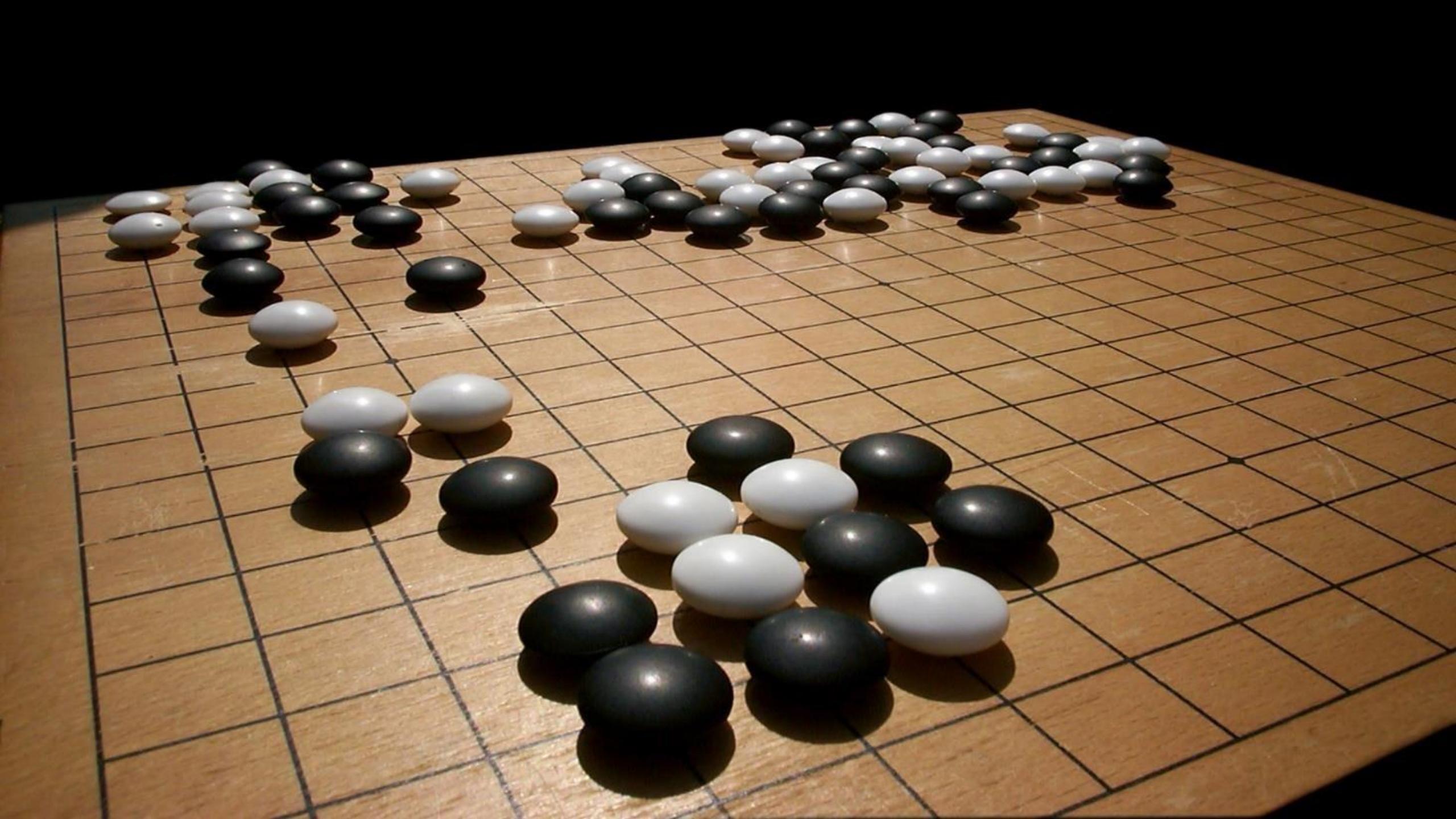


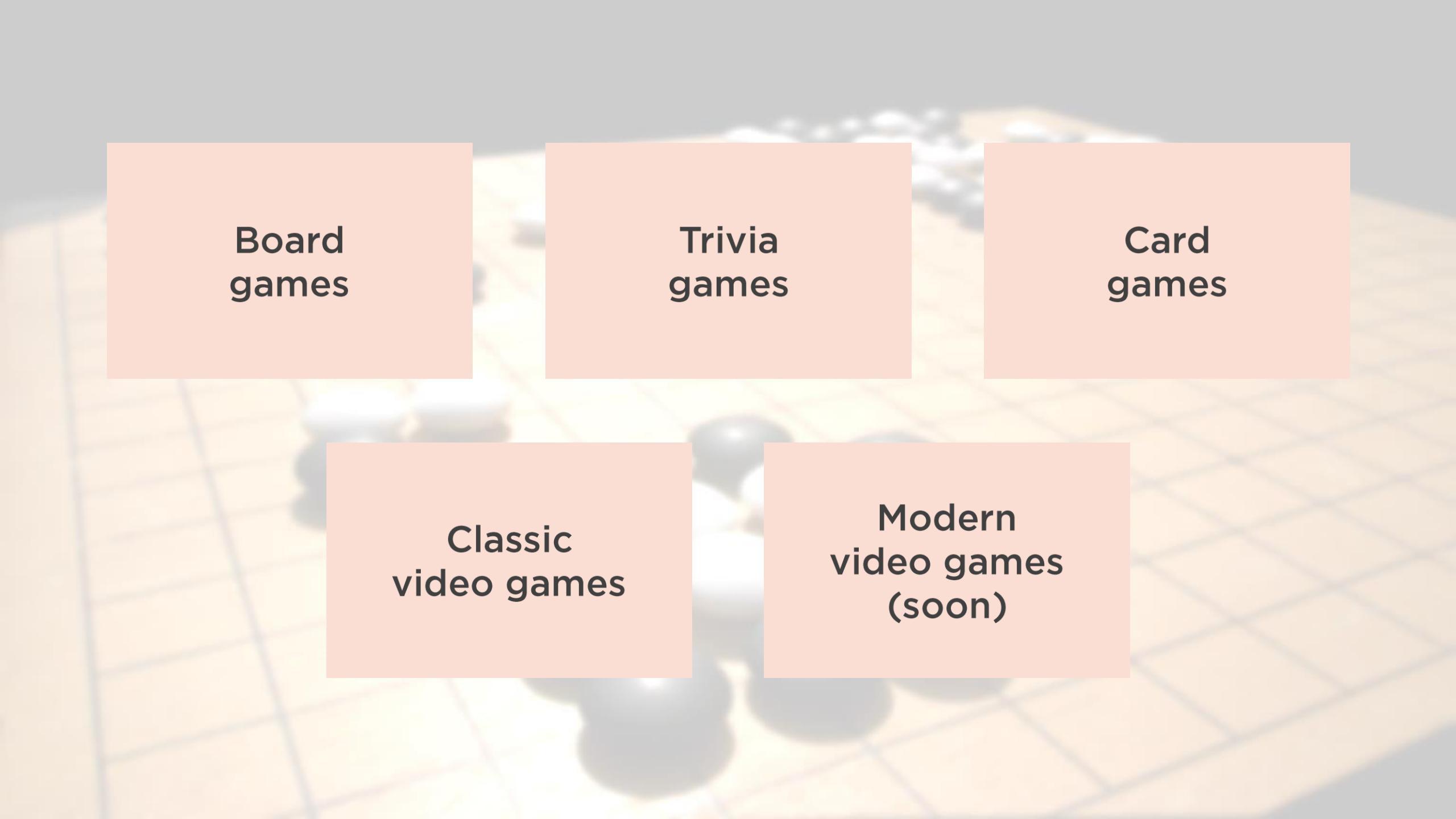
# Other Trends



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

---





A faint background image of a board game is visible, featuring a light-colored board with a grid pattern, several dark circular game pieces, and a single white die showing a six.

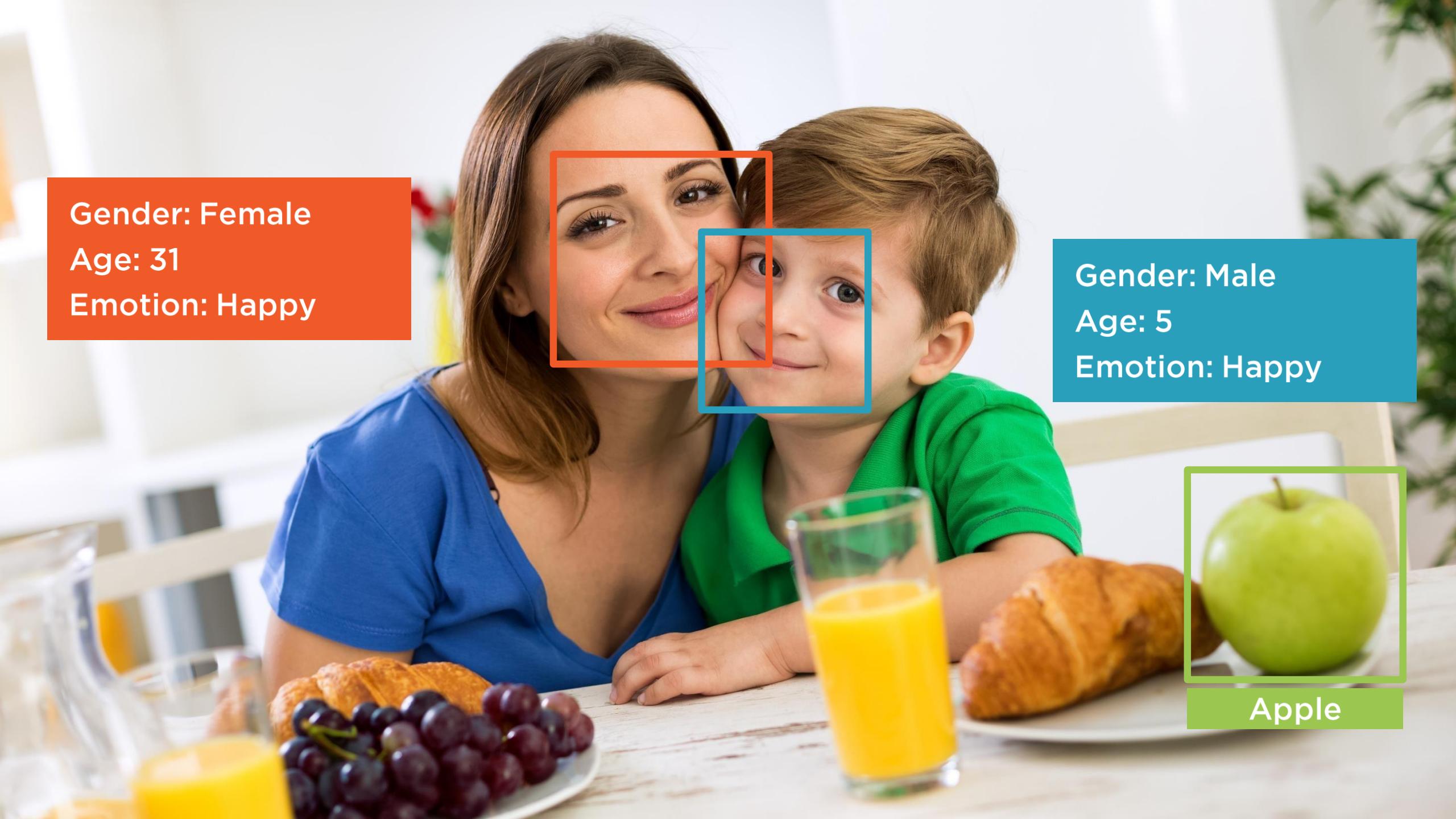
Board  
games

Trivia  
games

Card  
games

Classic  
video games

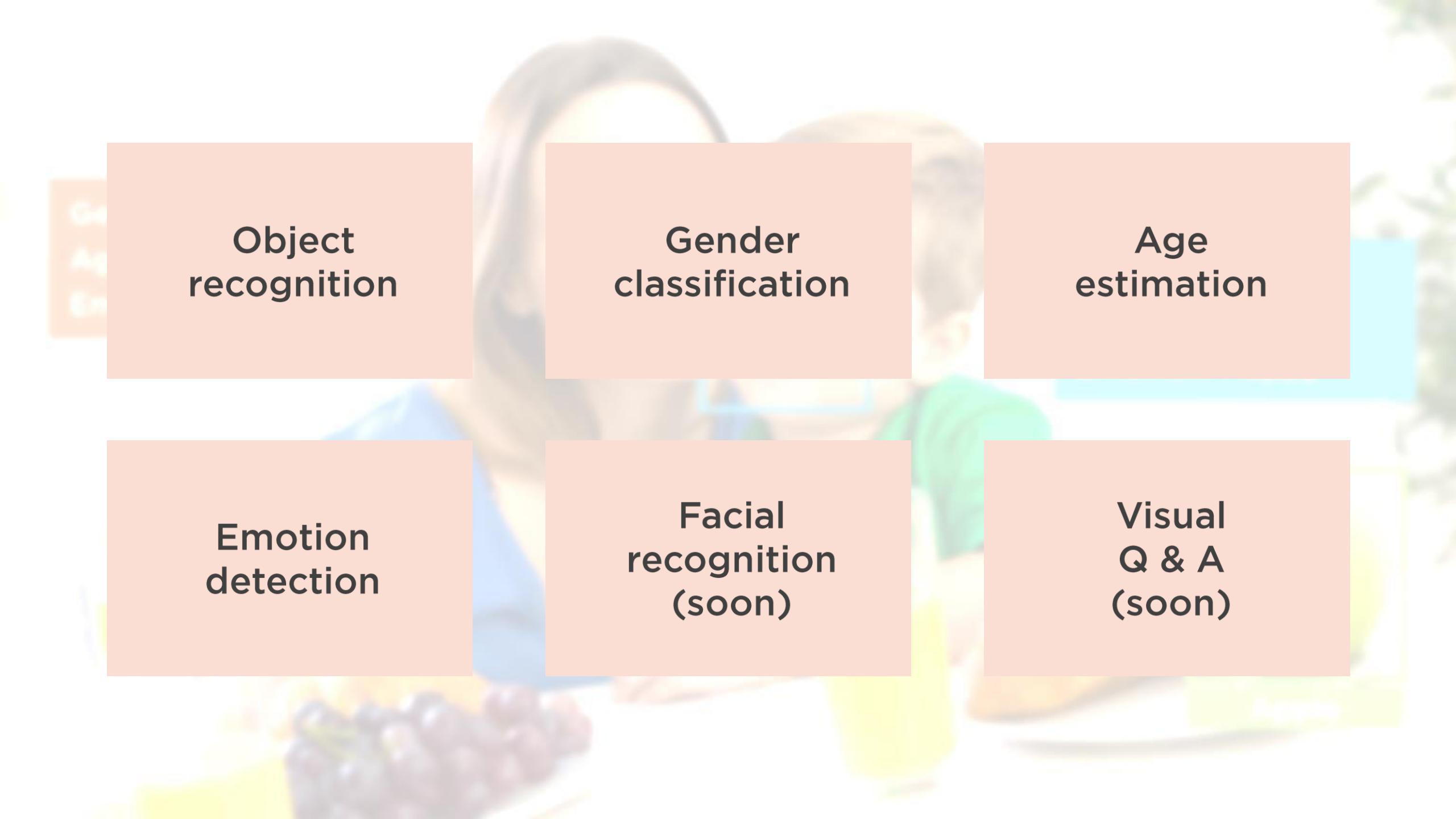
Modern  
video games  
(soon)



Gender: Female  
Age: 31  
Emotion: Happy

Gender: Male  
Age: 5  
Emotion: Happy



The background of the image shows a group of people sitting around a table, engaged in a meal. On the table, there are several items including a bunch of purple grapes, some bread rolls, and a green cloth. The scene is set outdoors with trees visible in the background.

**Object  
recognition**

**Gender  
classification**

**Age  
estimation**

**Emotion  
detection**

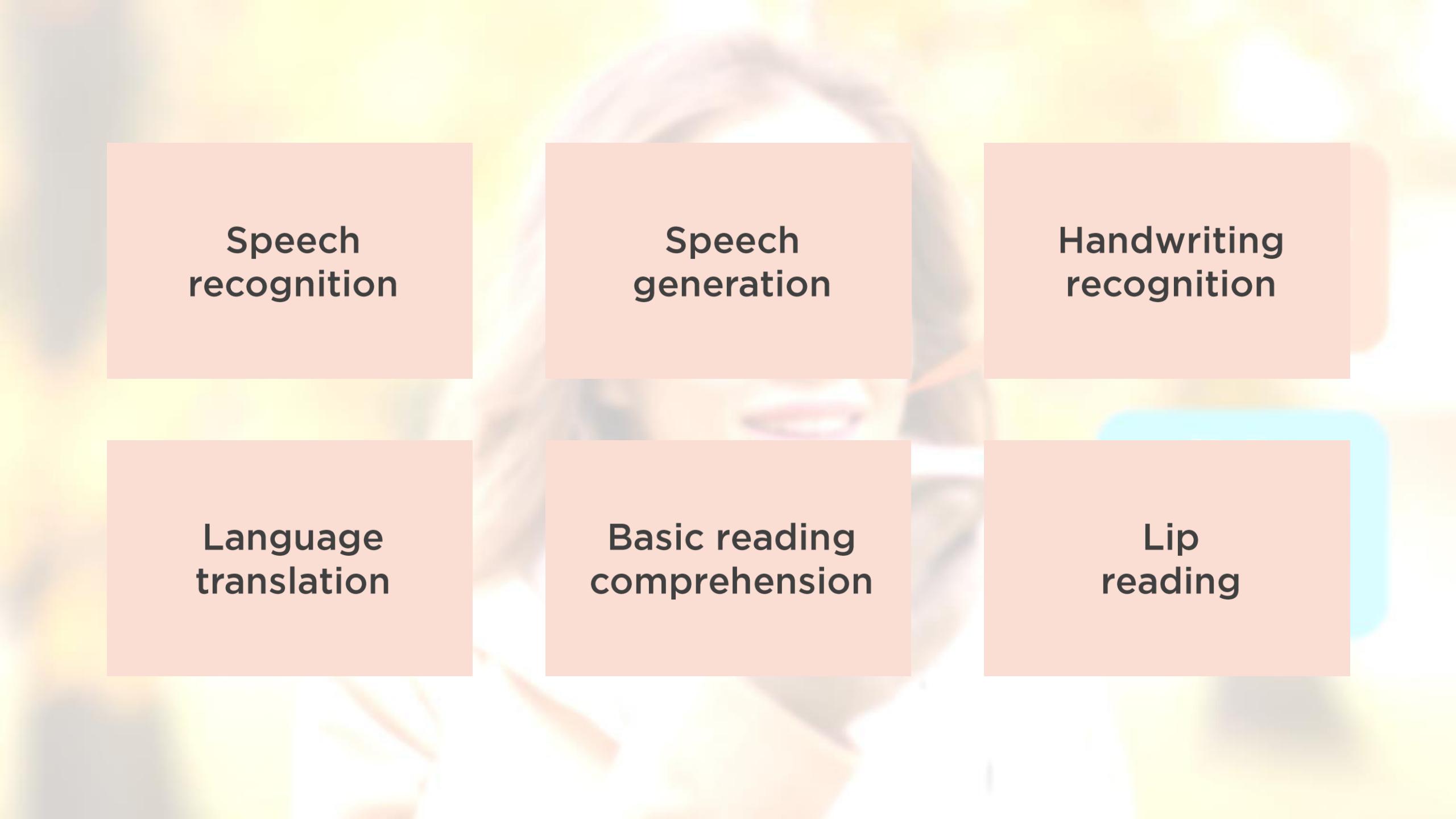
**Facial  
recognition  
(soon)**

**Visual  
Q & A  
(soon)**



Schedule a haircut for me for tomorrow around noon.

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

The background of the image shows a person's face with several colorful speech bubbles of different sizes and colors (pink, yellow, blue) floating around it, suggesting communication or language processing.

**Speech  
recognition**

**Speech  
generation**

**Handwriting  
recognition**

**Language  
translation**

**Basic reading  
comprehension**

**Lip  
reading**



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



A faint, circular watermark-like image of a person's face is visible in the background, with a soft, colorful, painterly effect applied over it.

**Image  
generation**

**Style  
transfer**

**Music  
composition**

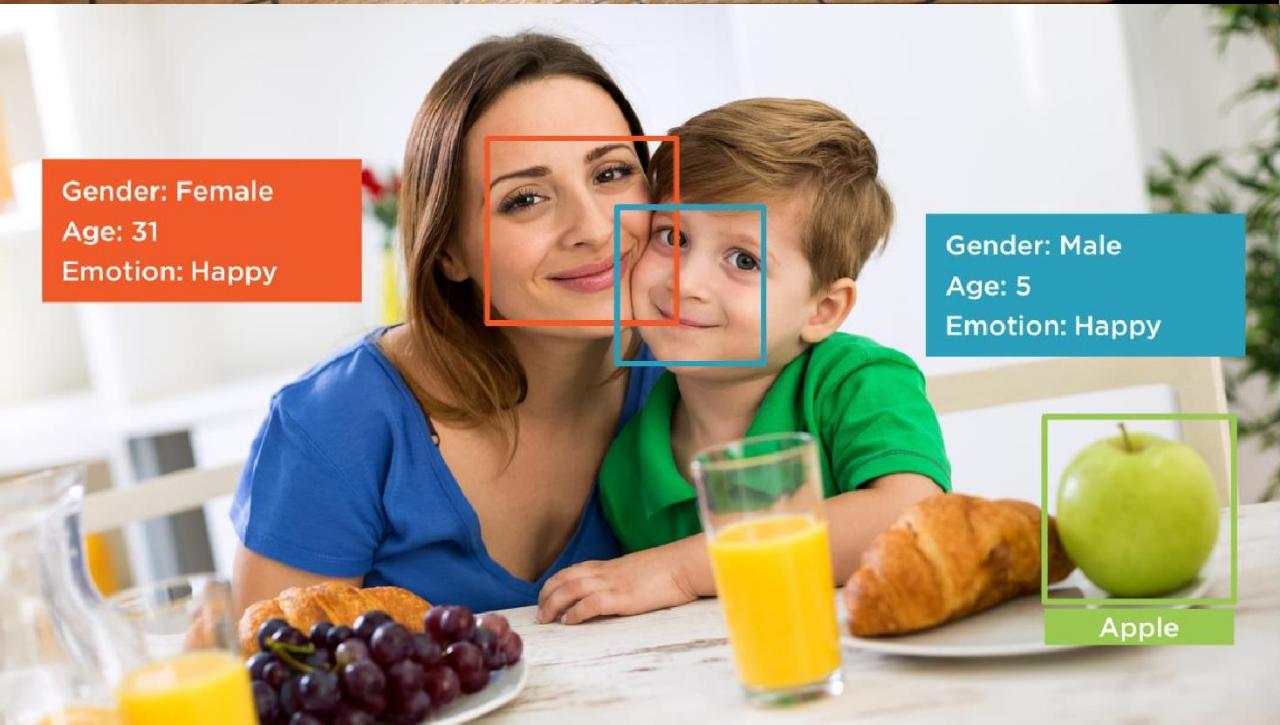
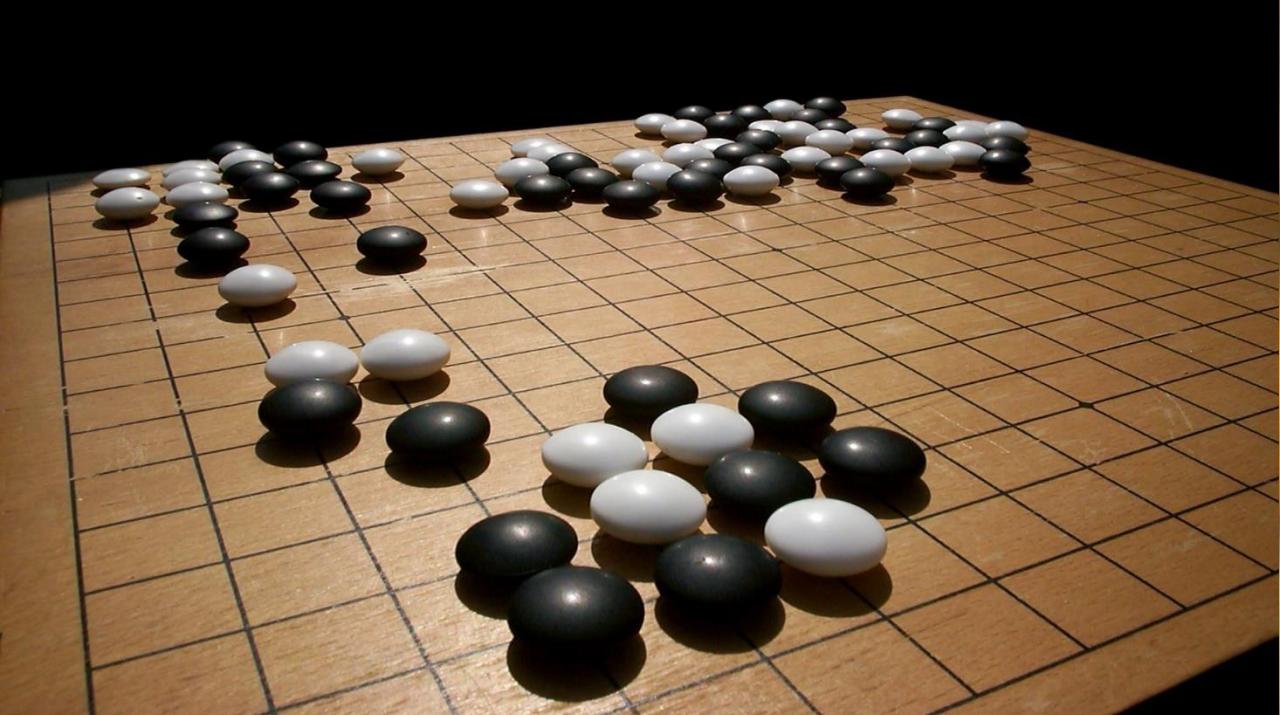




Disease  
diagnosis

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")
```

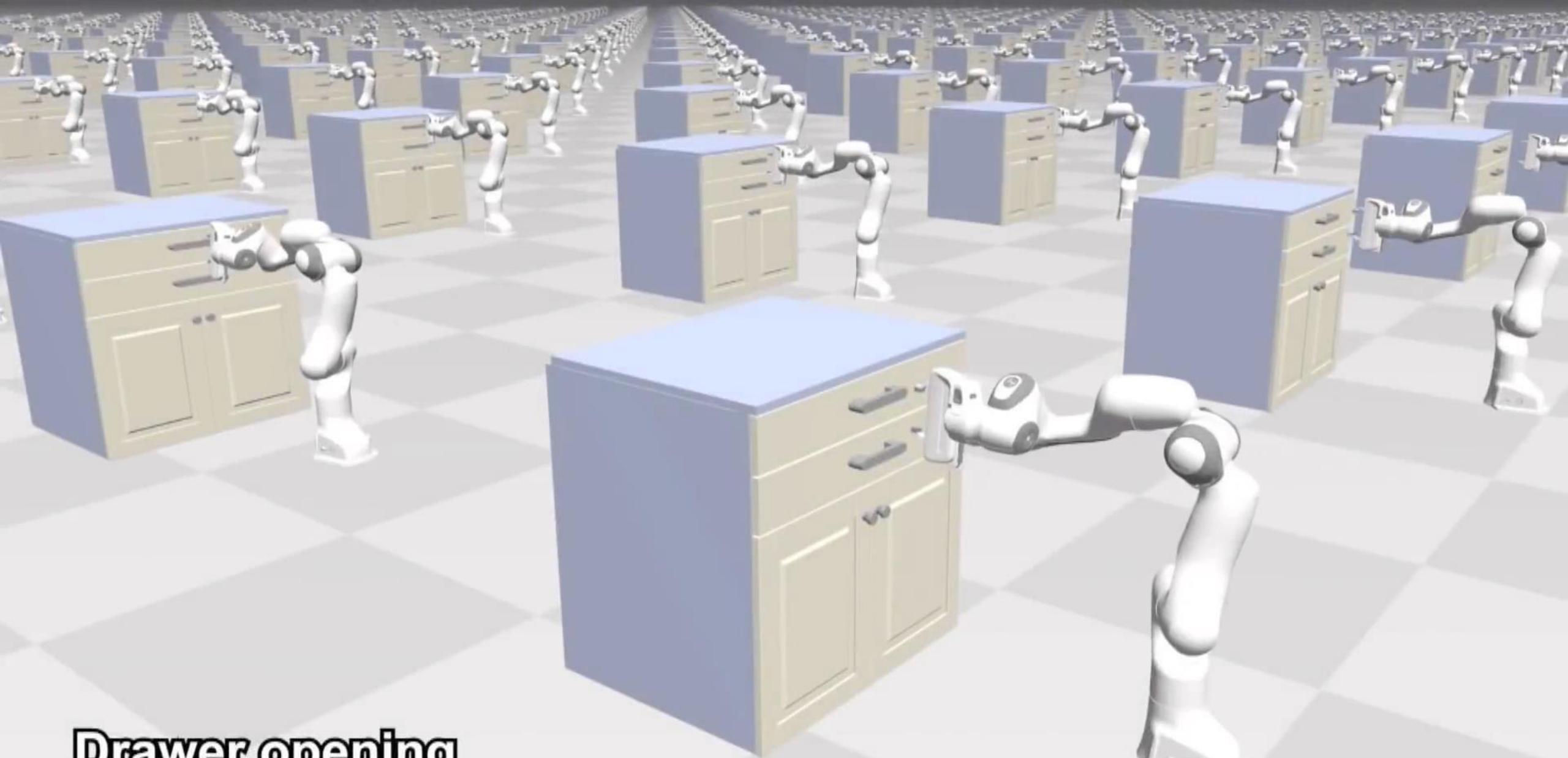
```
In [4]: policies = pd.read_csv("Risk.csv")
```

## 2. Transform the Data

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

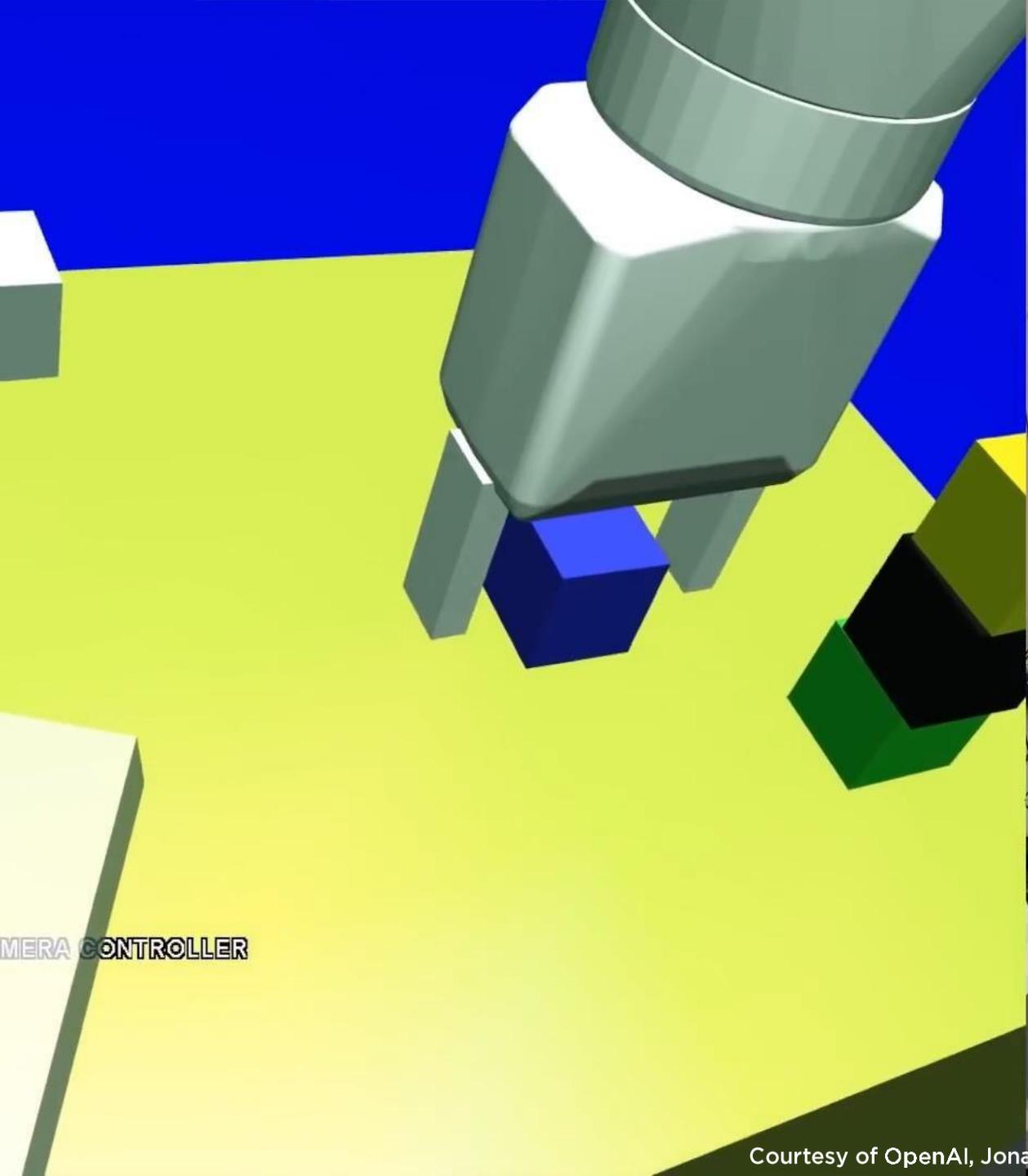
```
In [6]: X.Gender = X.Gender.replace(("Female", "Male"), (0, 1))
```





# Drawer opening Simulated environment

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



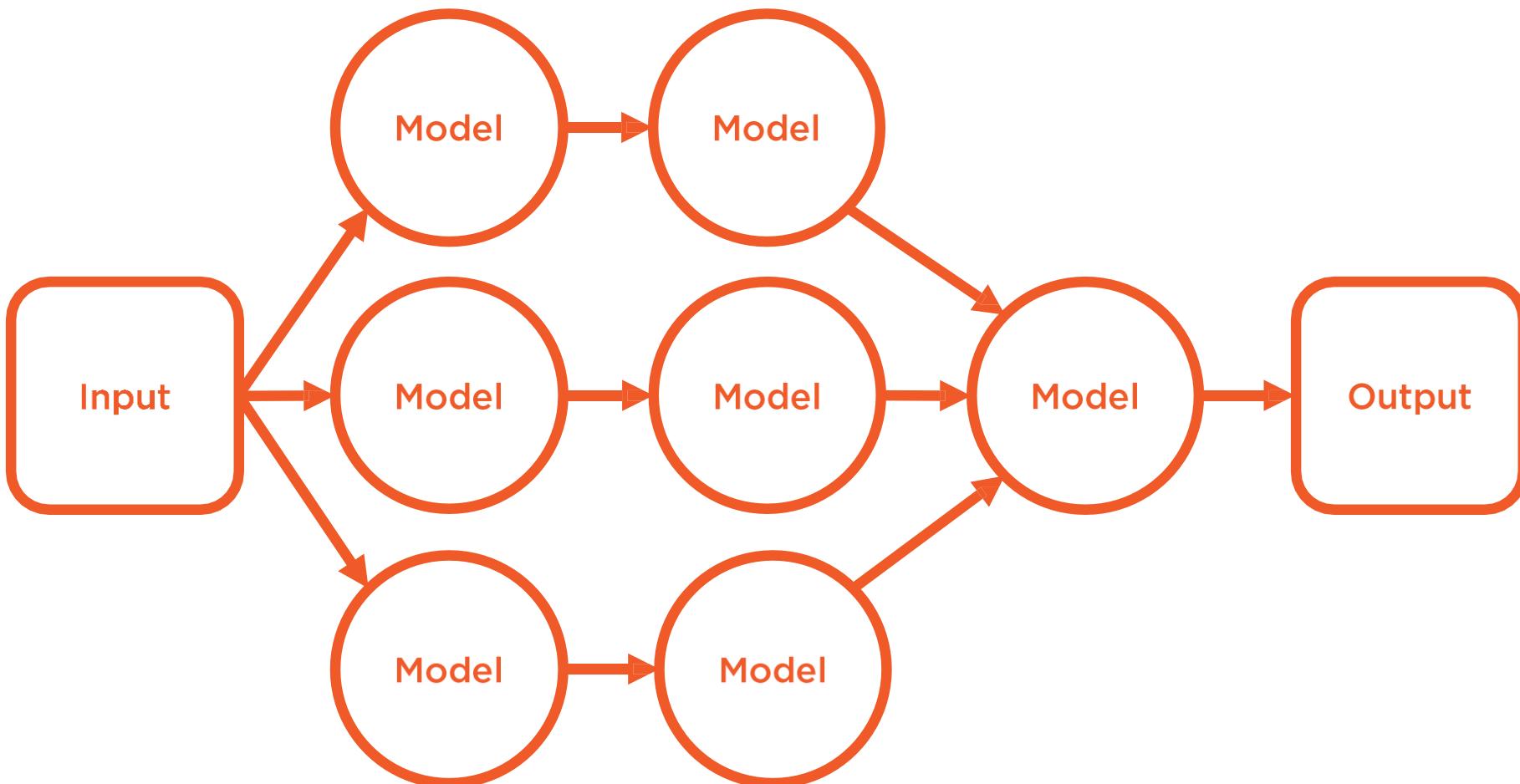


Courtesy of the HAHN Group

# Building A.I. Apps

---

# Modular A.I. Applications





John Doe

Follow

10 mins • 0



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

Like

Comment

Share



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! : )

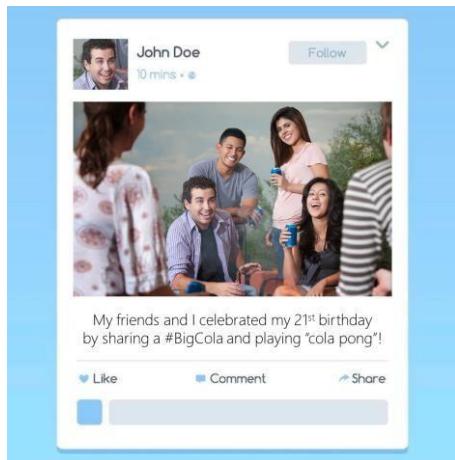
Here's a free big cola for your next party!



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)**

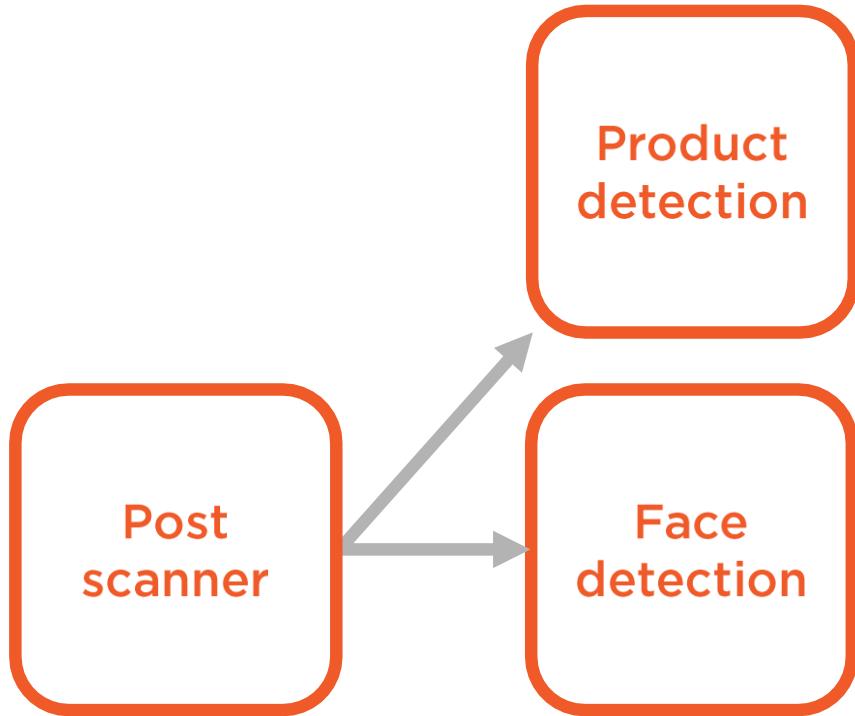


Post  
scanner

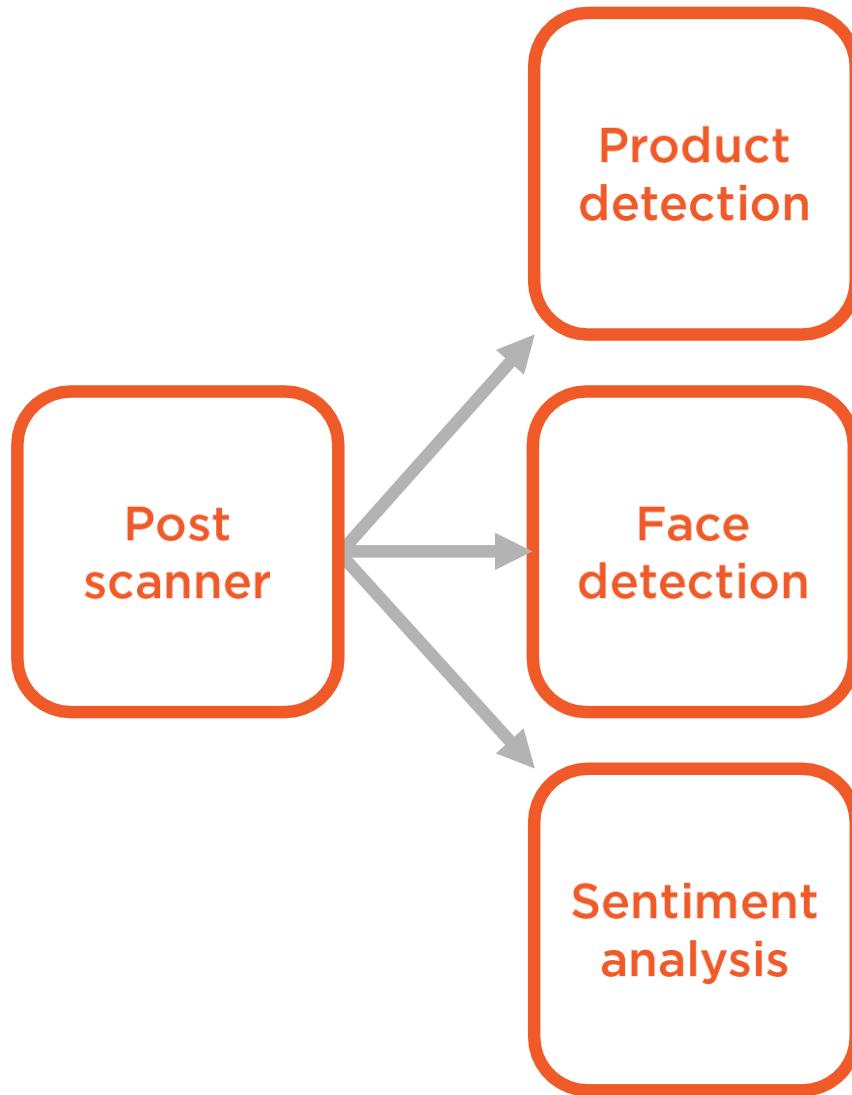
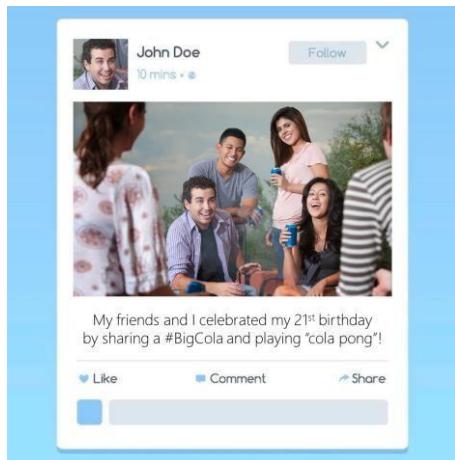
Product  
detection



Product detected  
(90% confidence)

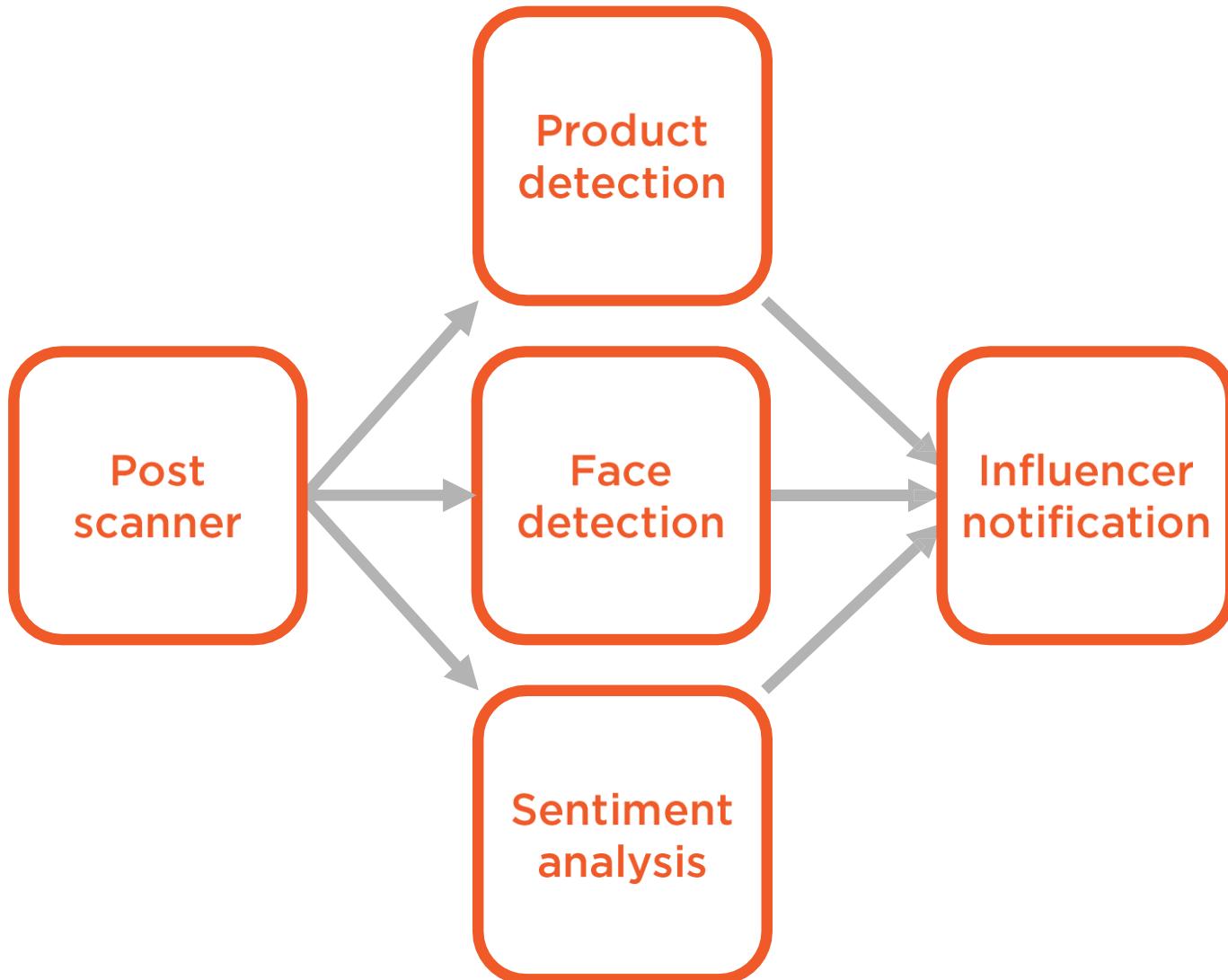


**Emotion: happiness  
(99% confidence)**



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

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



Big Cola, Inc  
Thanks for sharing your big day with us, John! : )  
Here's a free big cola for your next party!

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.

---

# Overview



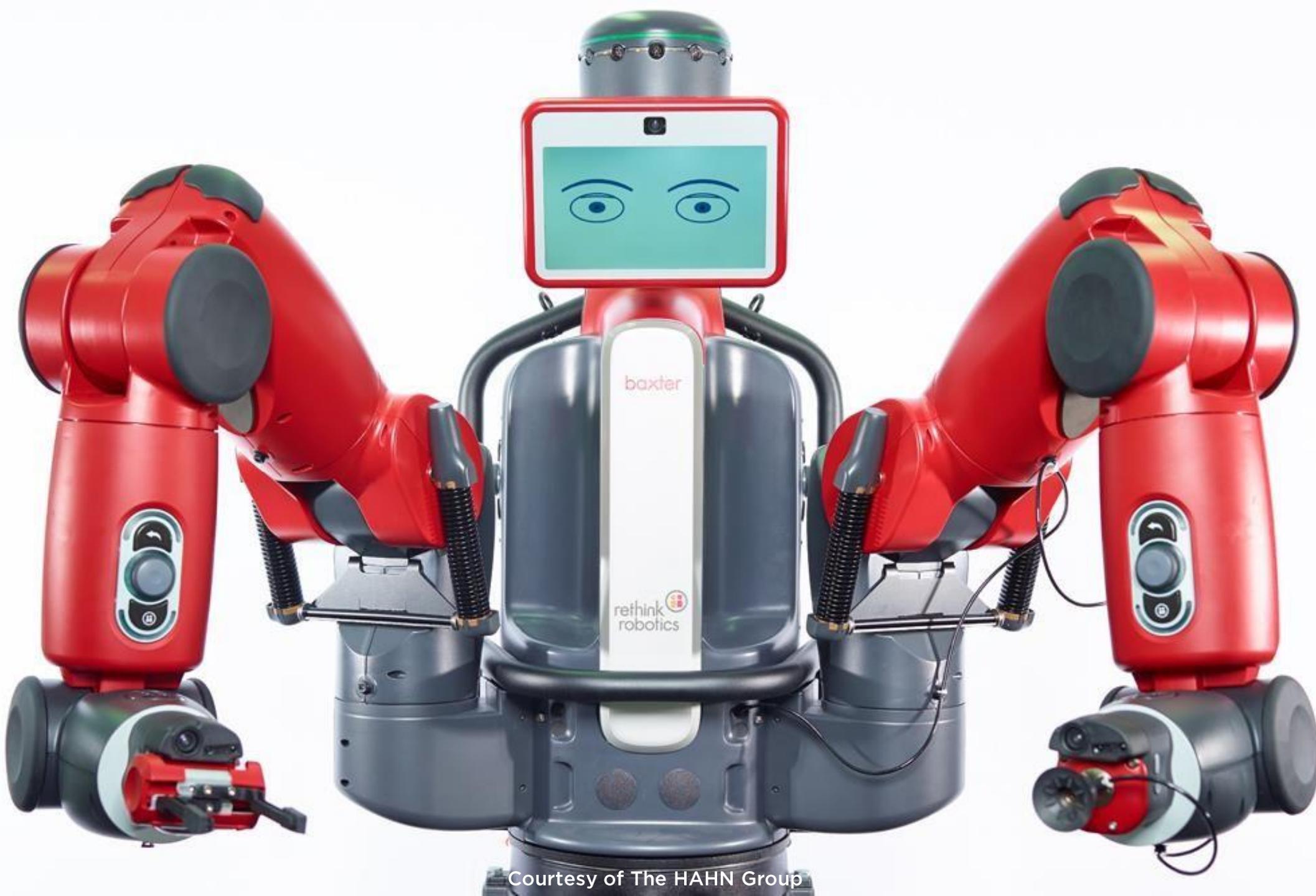
**A.I. and Society**

**A.I. and Labor**

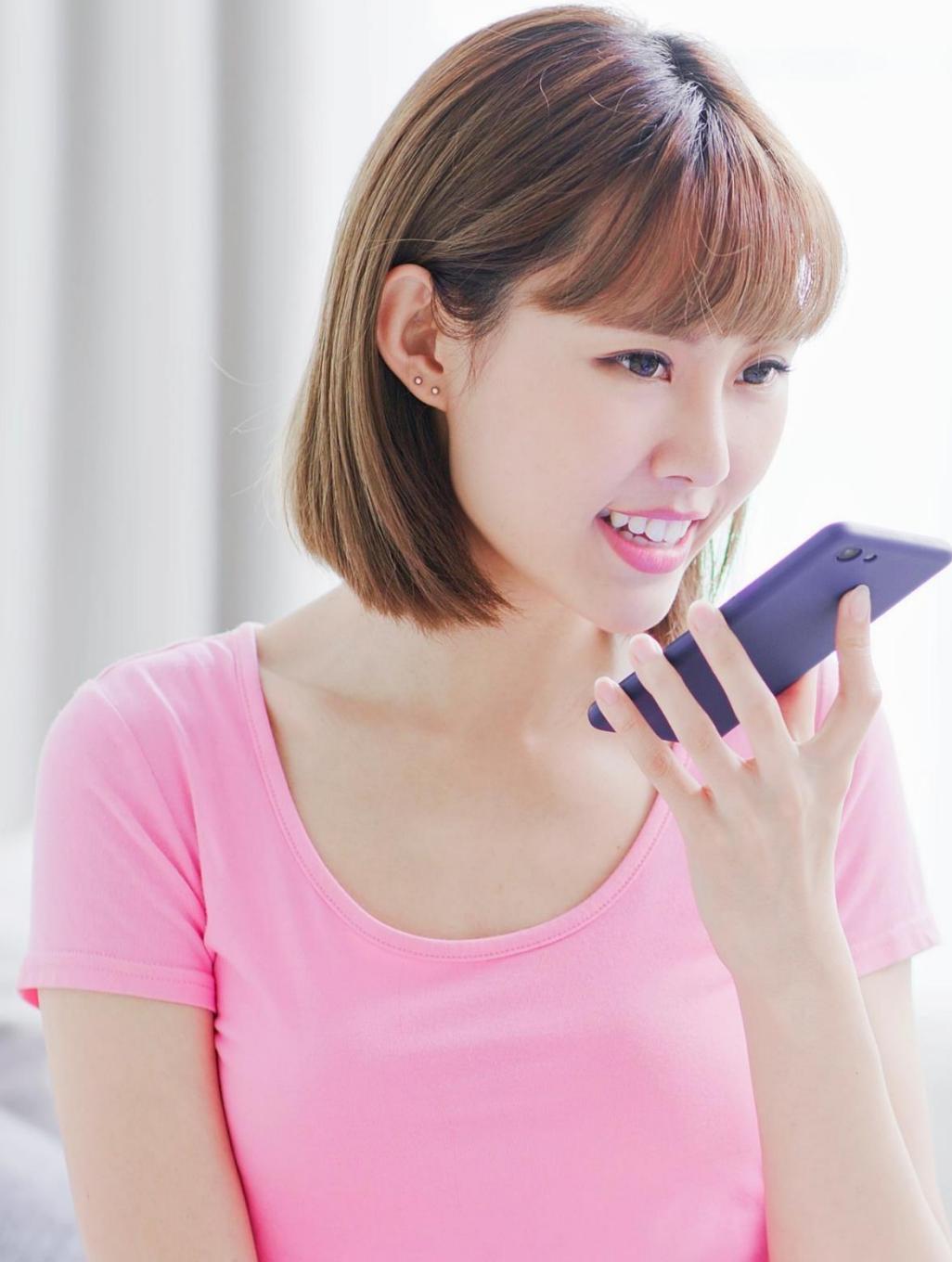
**A.I. and Ethics**

# A.I. and Society

---



Courtesy of The HAHN Group



# REMOTE HOME CONTROL

ONLINE HOME AUTOMATION



CLIMATE



LIGHTING



SECURITY



ENTERTAINMENT



ECO MODE

NORMAL

OFF





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

# Impacts of A.I.

**Social**

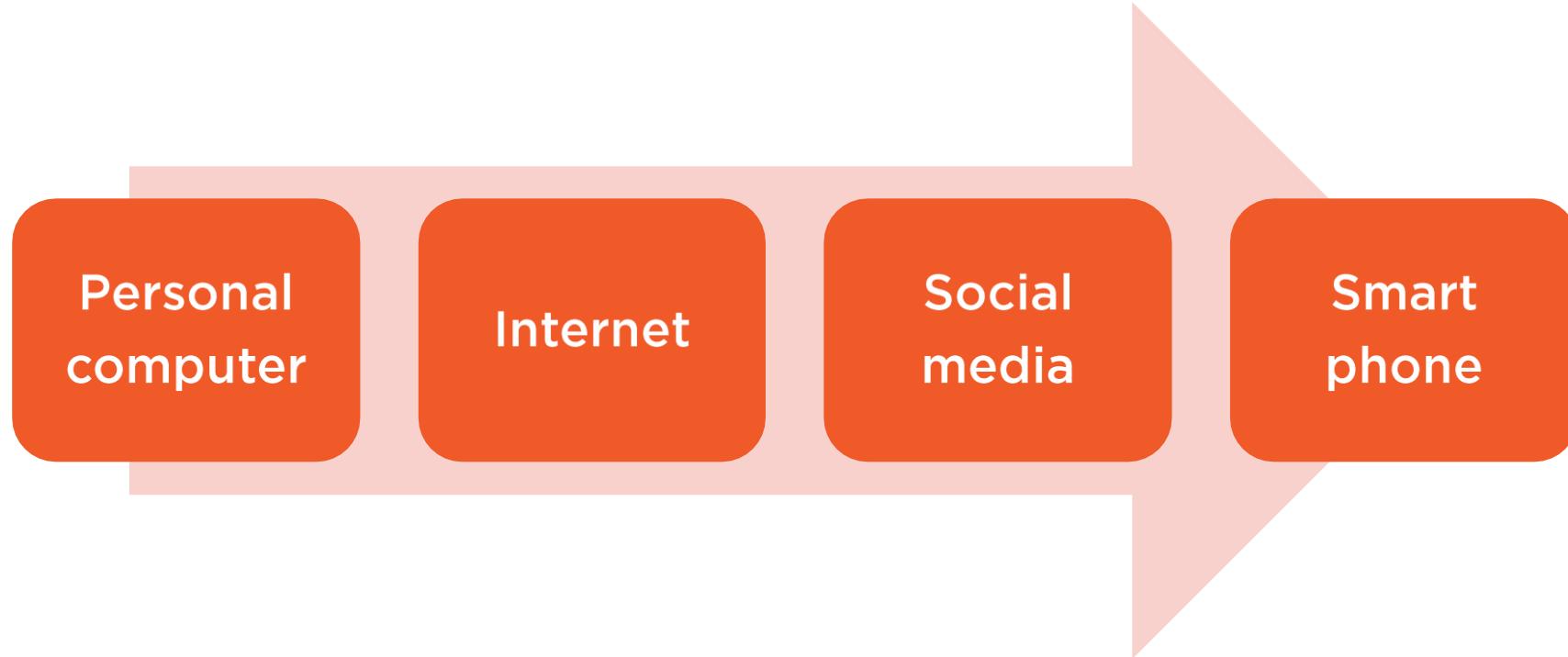
**Political**

**Economic**

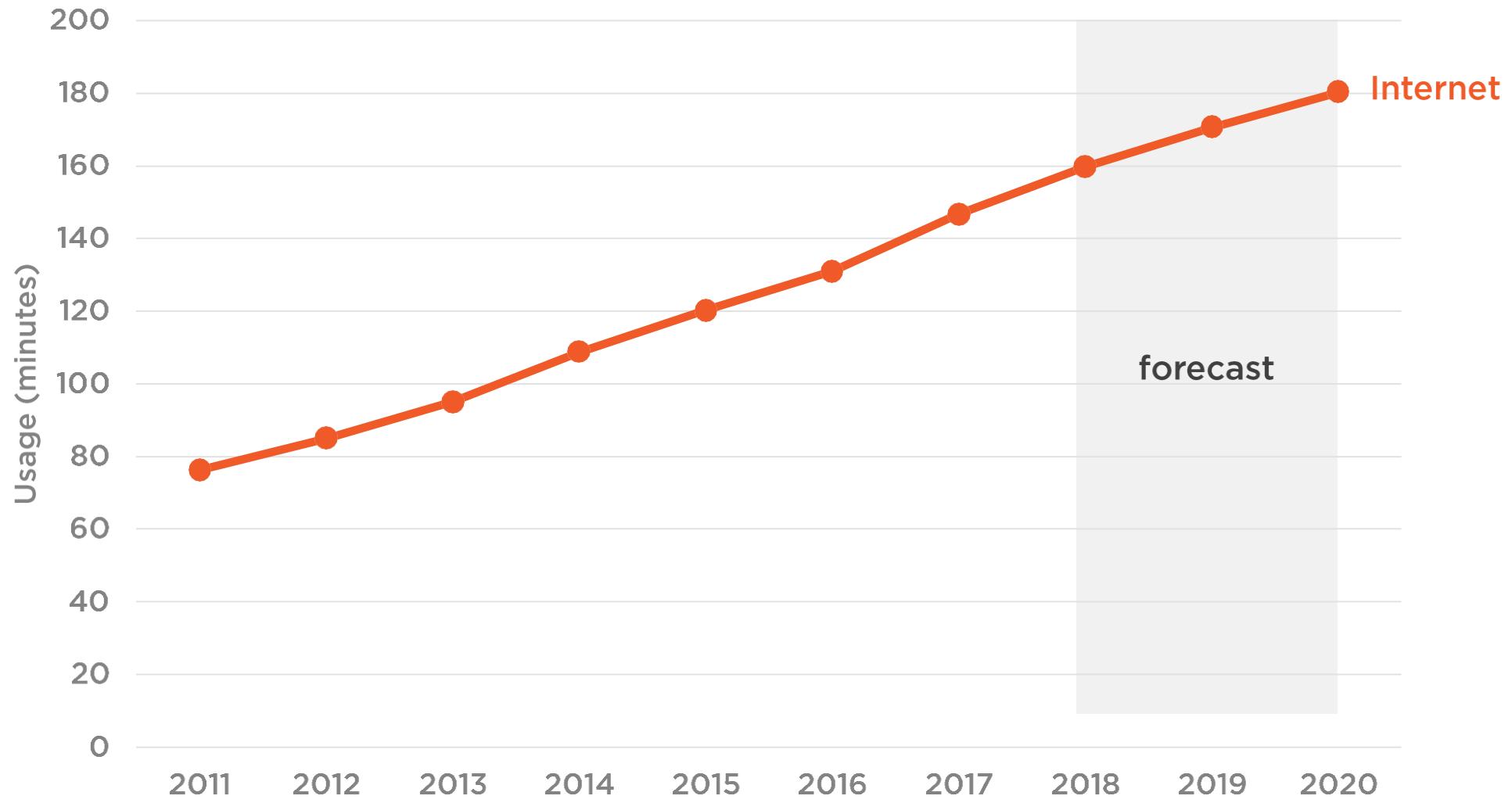
**Legal**

**Ethical**

# Information Revolution

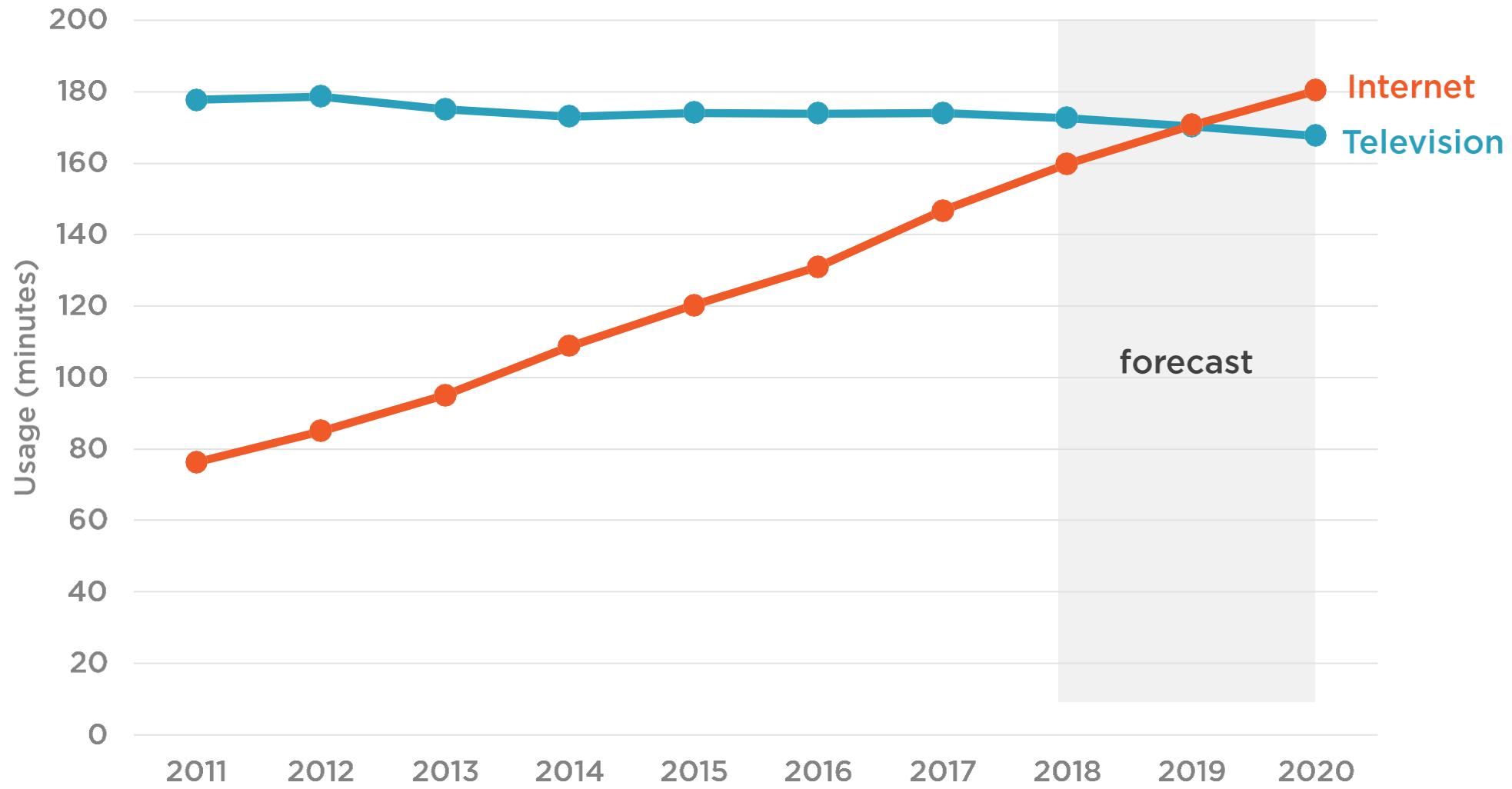


# Television vs. Internet Usage



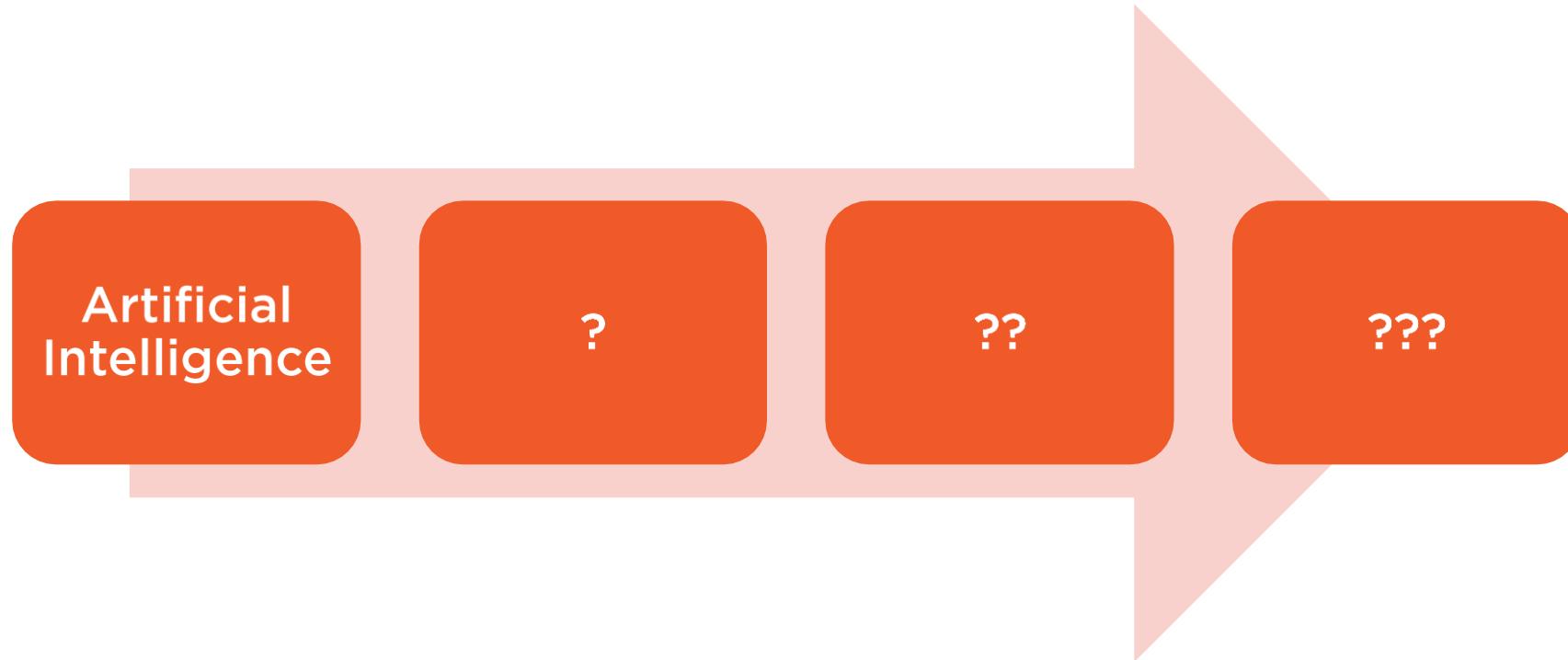
Source: Zenith - Media Consumption Forecasts 2018

# Television vs. Internet Usage



Source: Zenith - Media Consumption Forecasts 2018

# A.I. Revolution



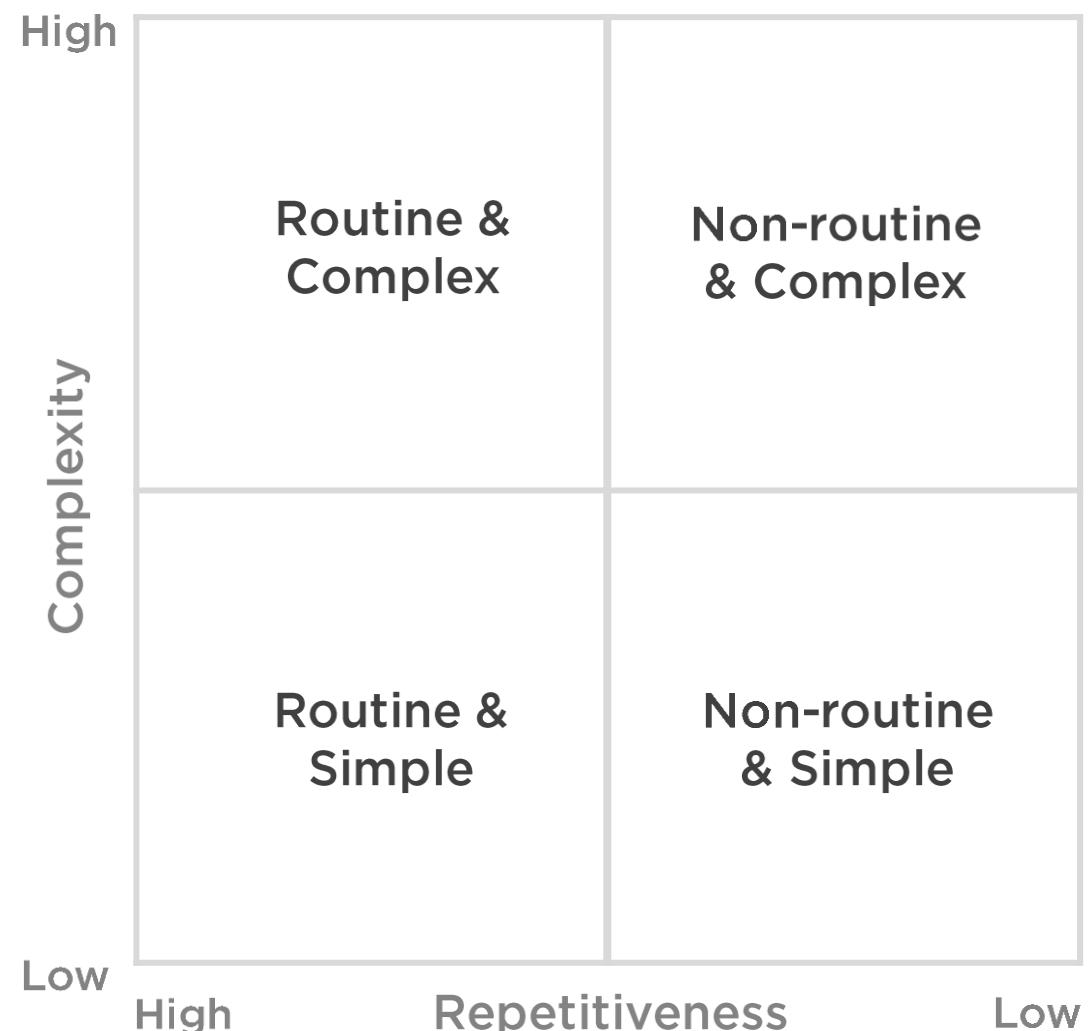
# A.I. and Labor

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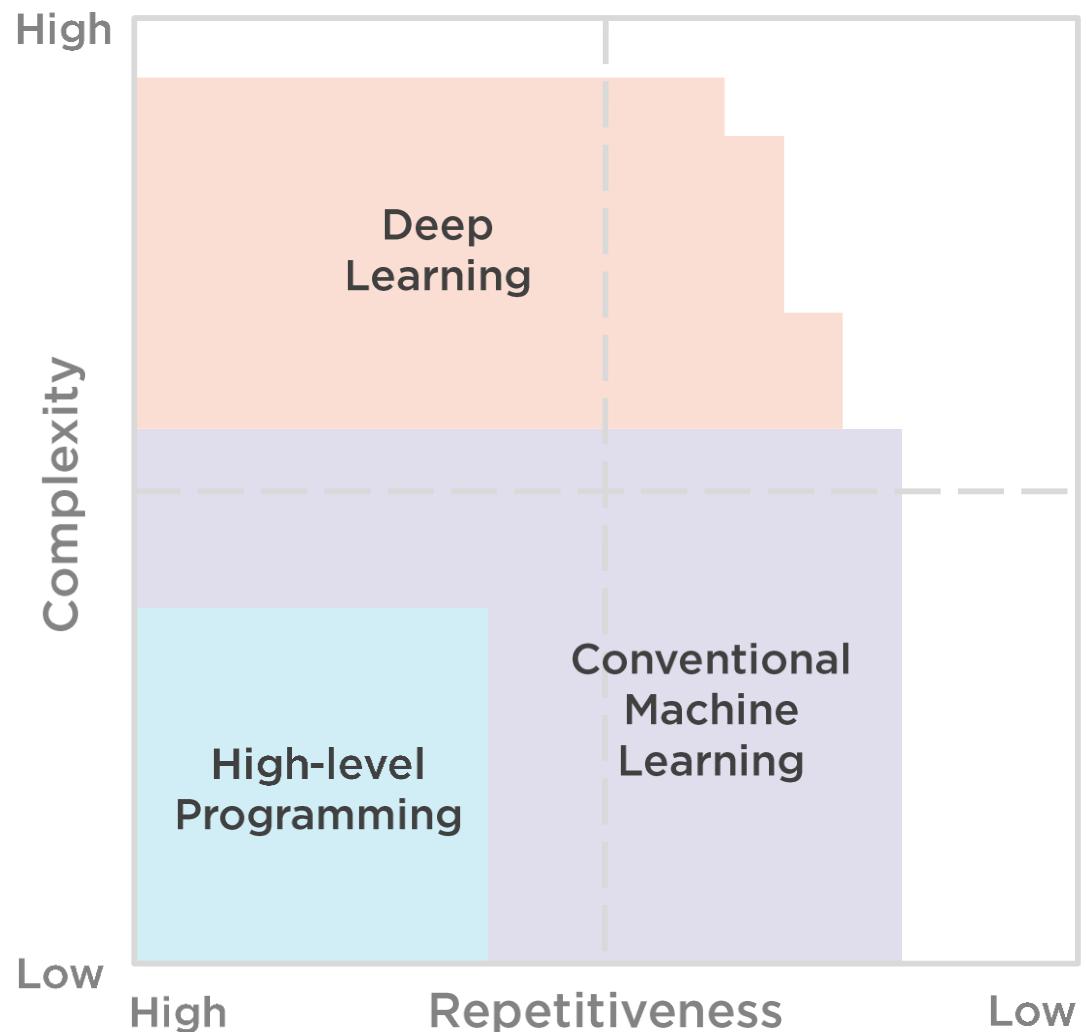


Courtesy of The HAHN Group

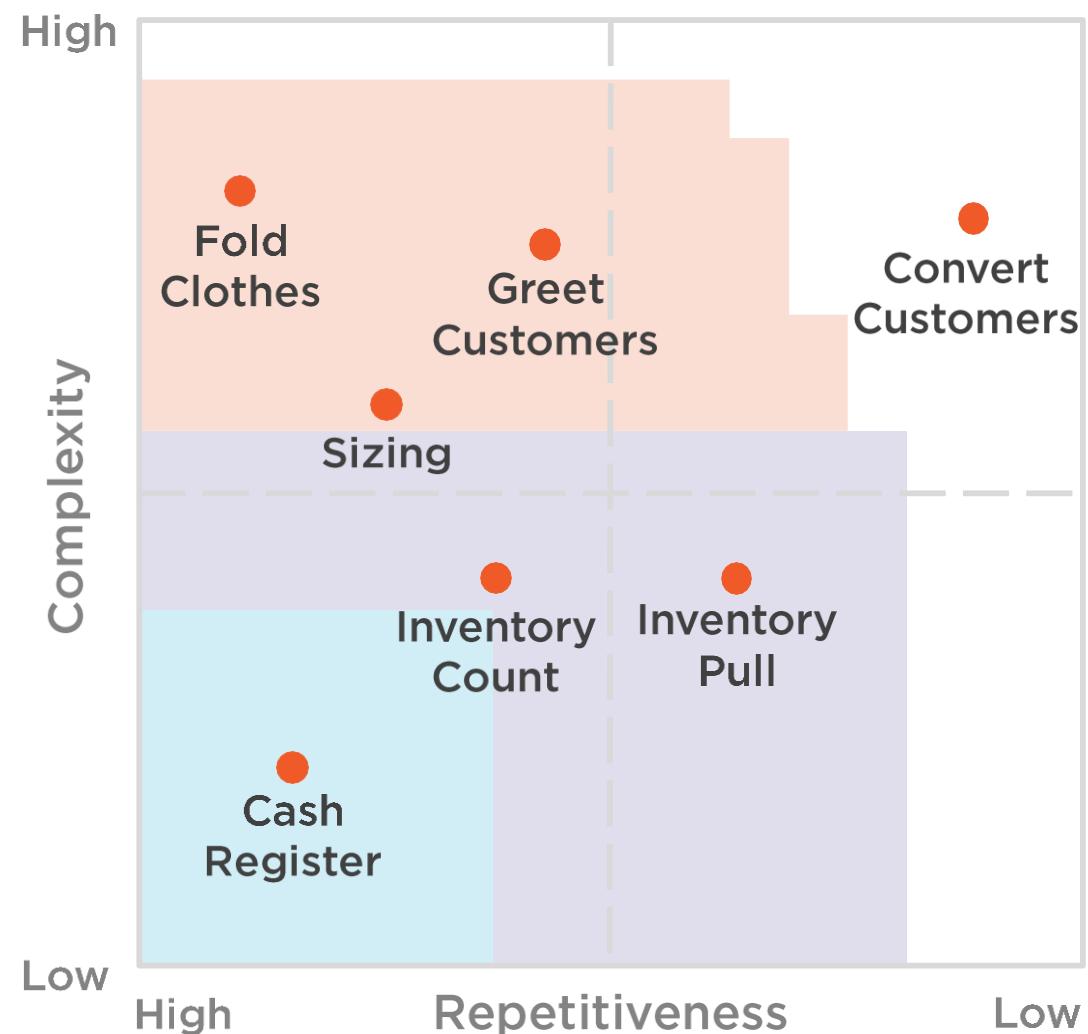
# Automation Framework



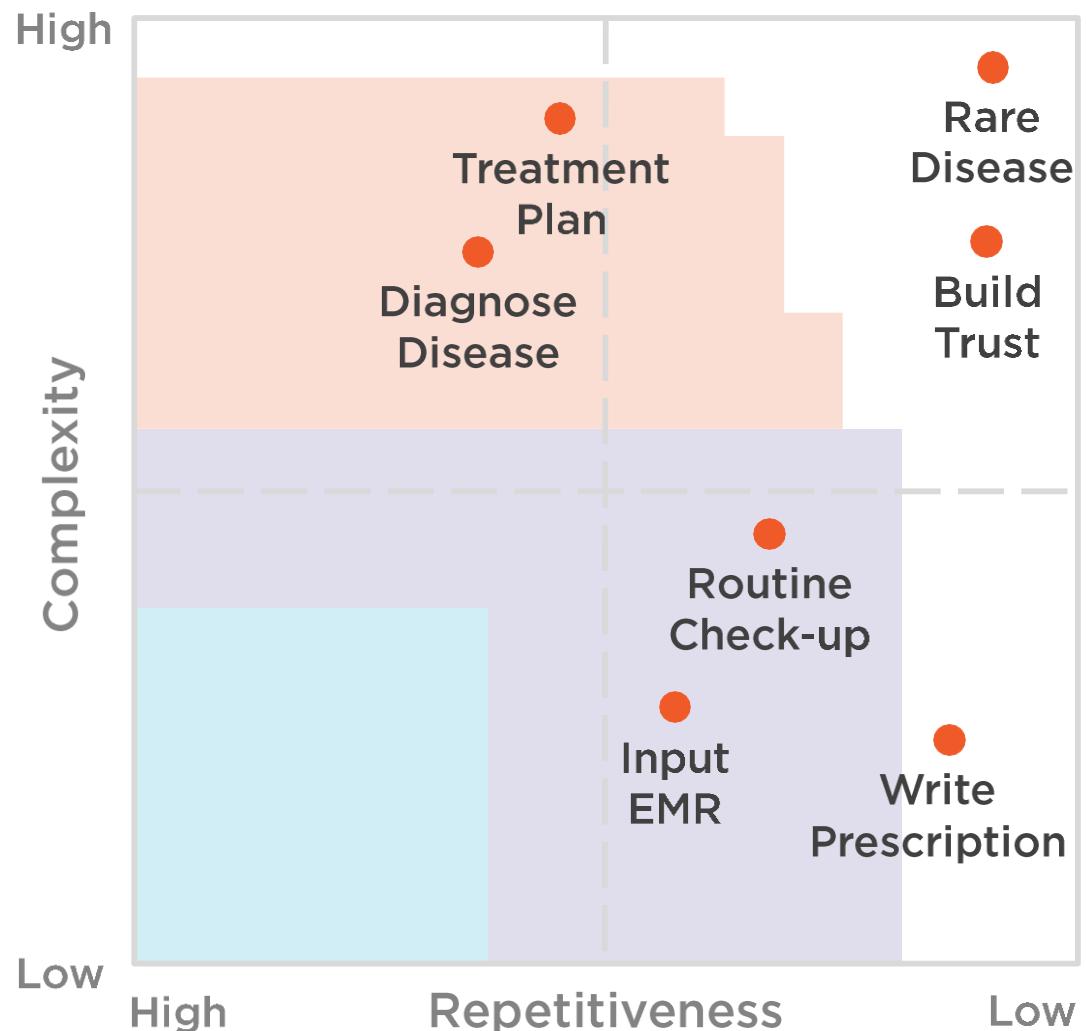
# Automation Technology



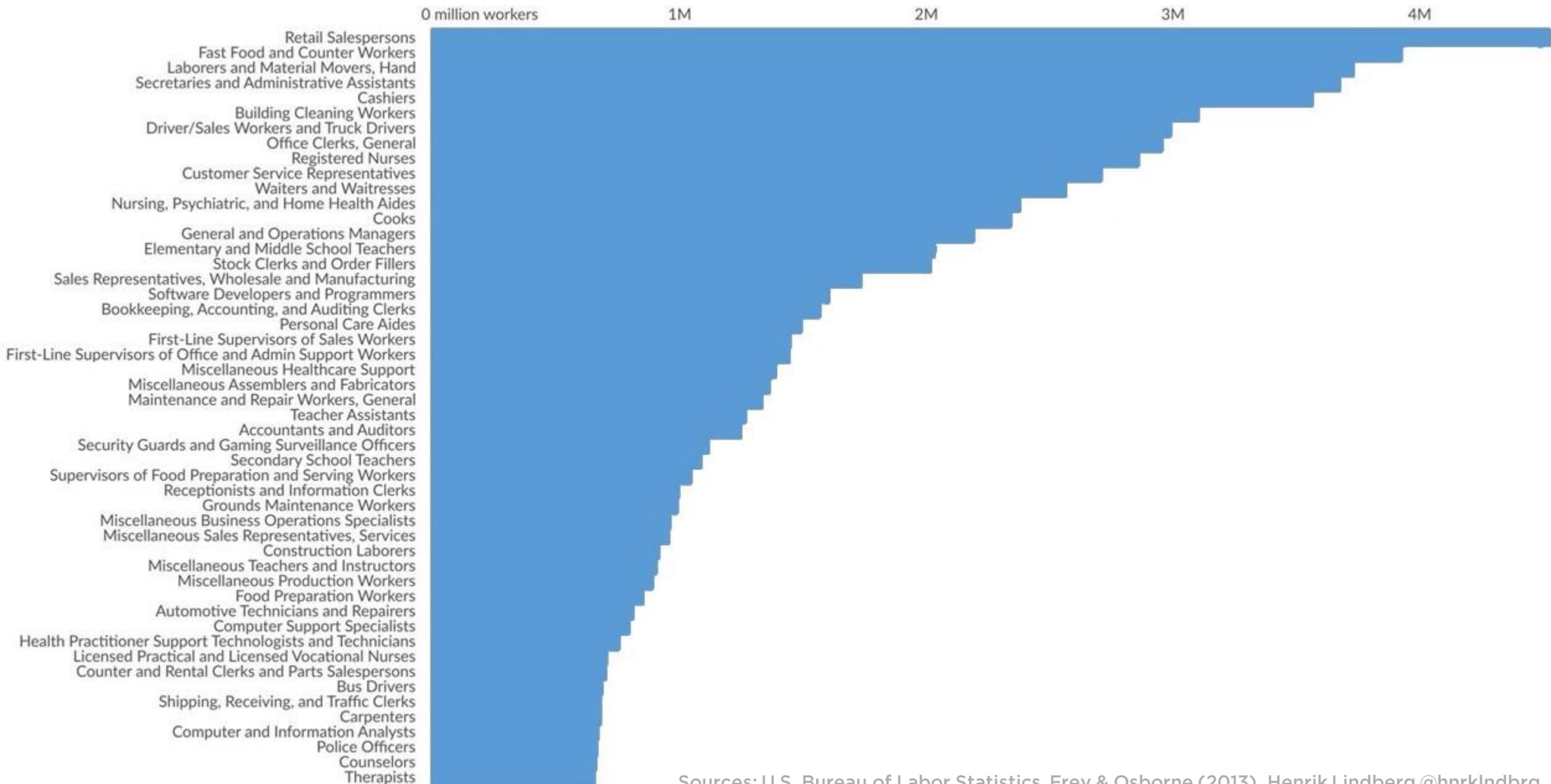
# Retail Salesperson



# Medical Doctor

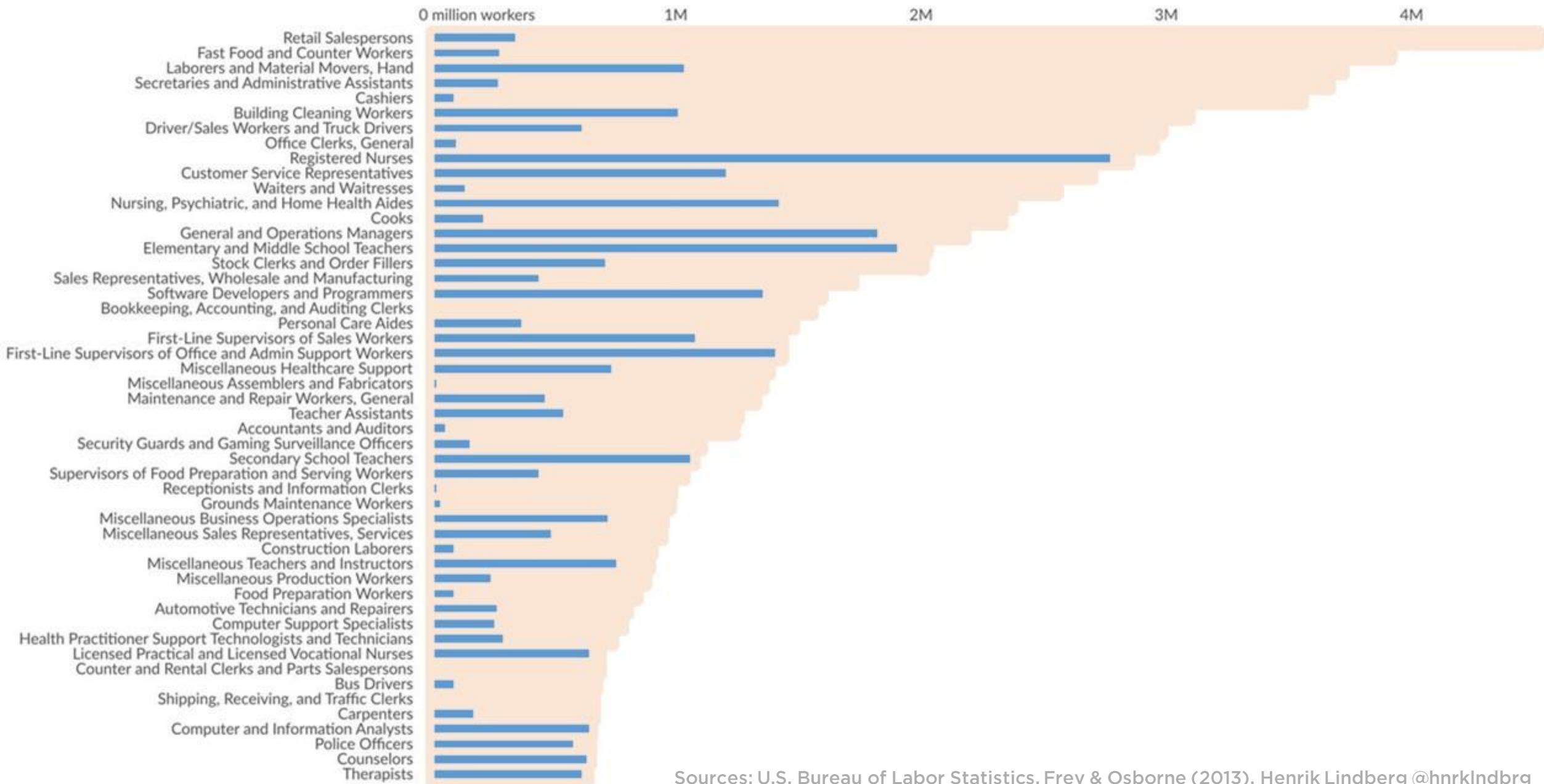


# The Future of Labor



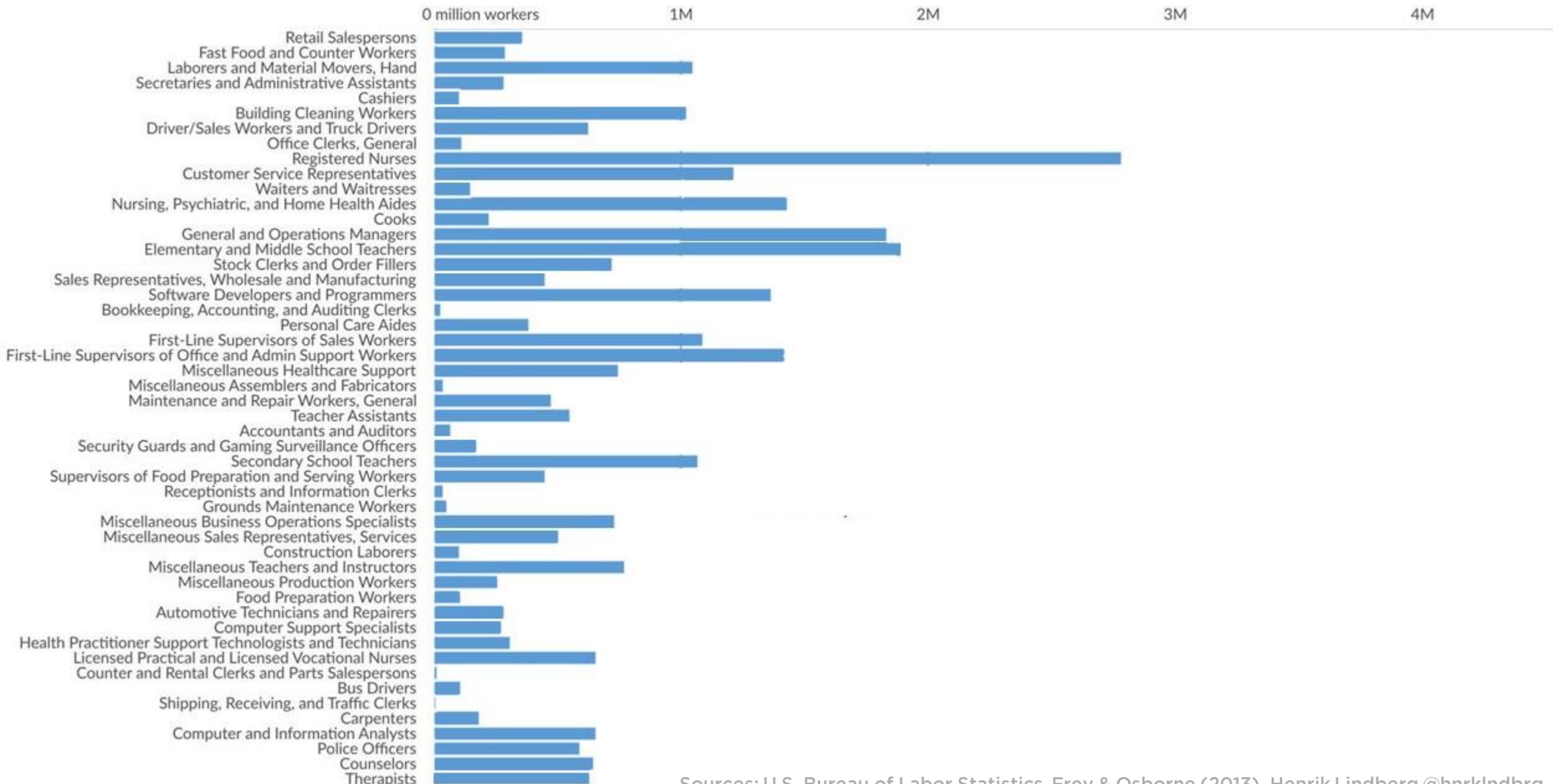
Sources: U.S. Bureau of Labor Statistics, Frey & Osborne (2013), Henrik Lindberg @hnrlndbрг

# The Future of Labor



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

# The Future of Labor



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



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

# 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%**

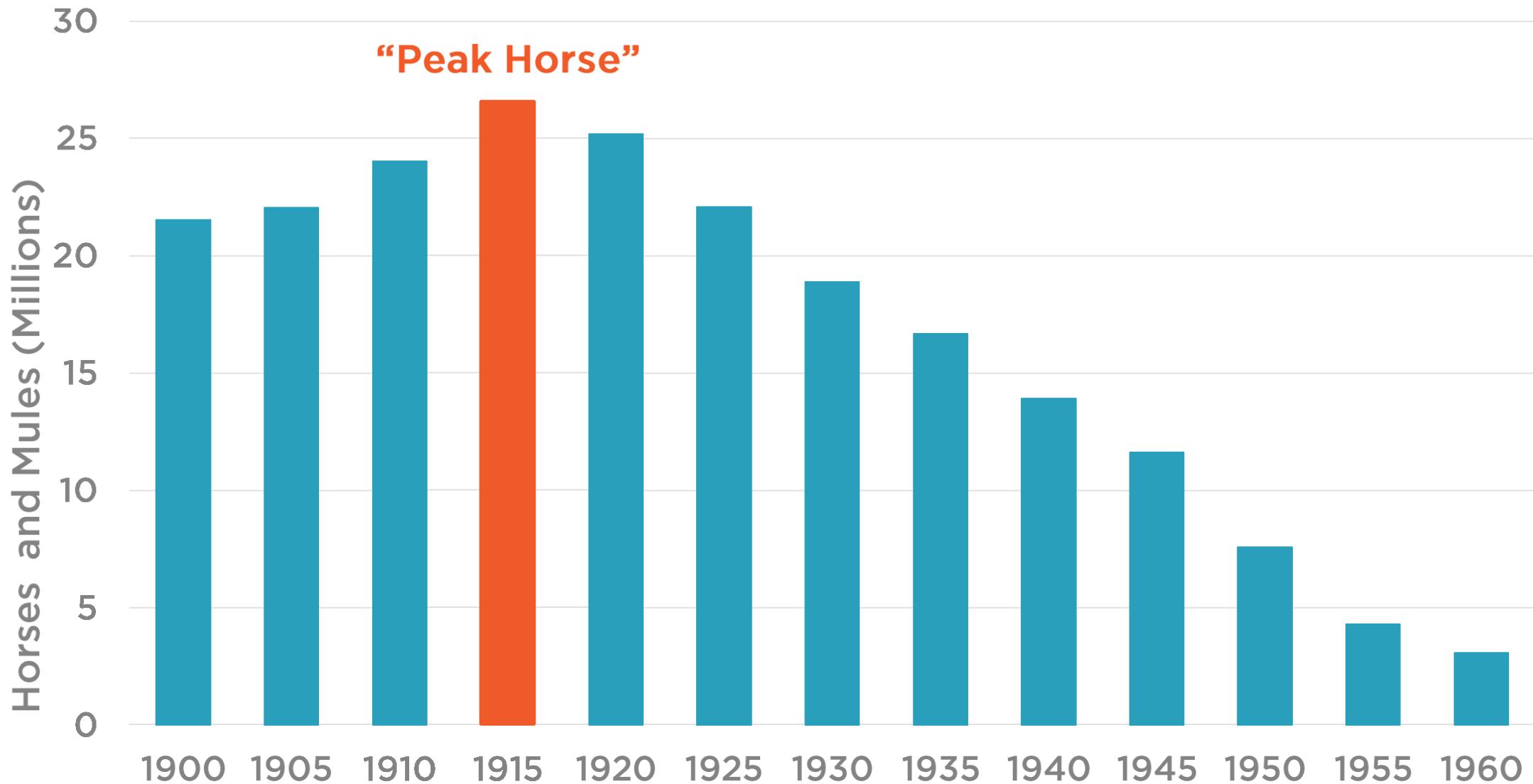
**Bartender - 77%**

**Archivist - 76%**

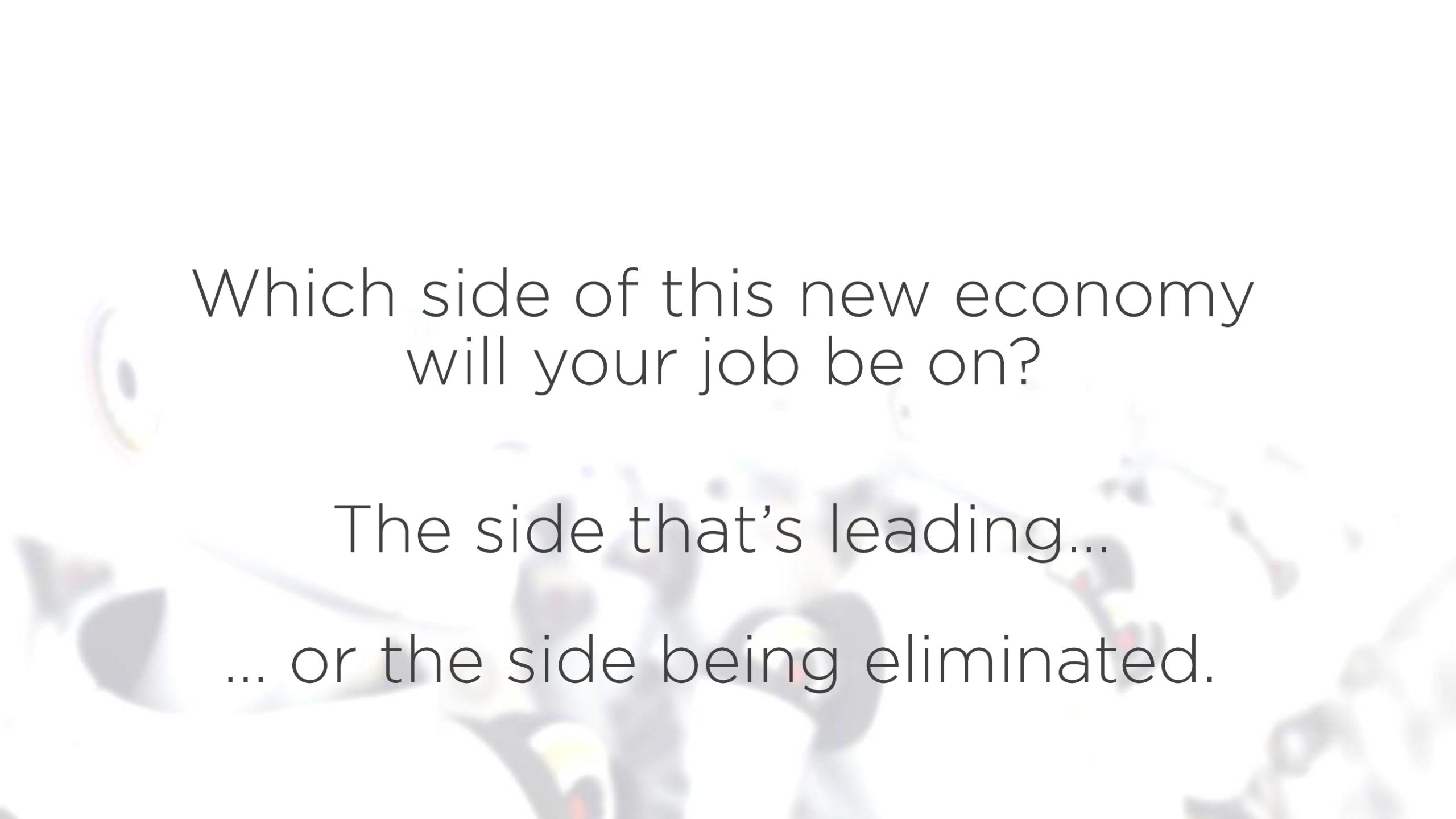
Will A.I. create more jobs  
than it eliminates?



# 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

---

# Current Ethical Issues

Privacy

Manipulation

Propaganda

Impersonation

Exploitation

A.I. weapons

What is privacy with A.I. surveillance?

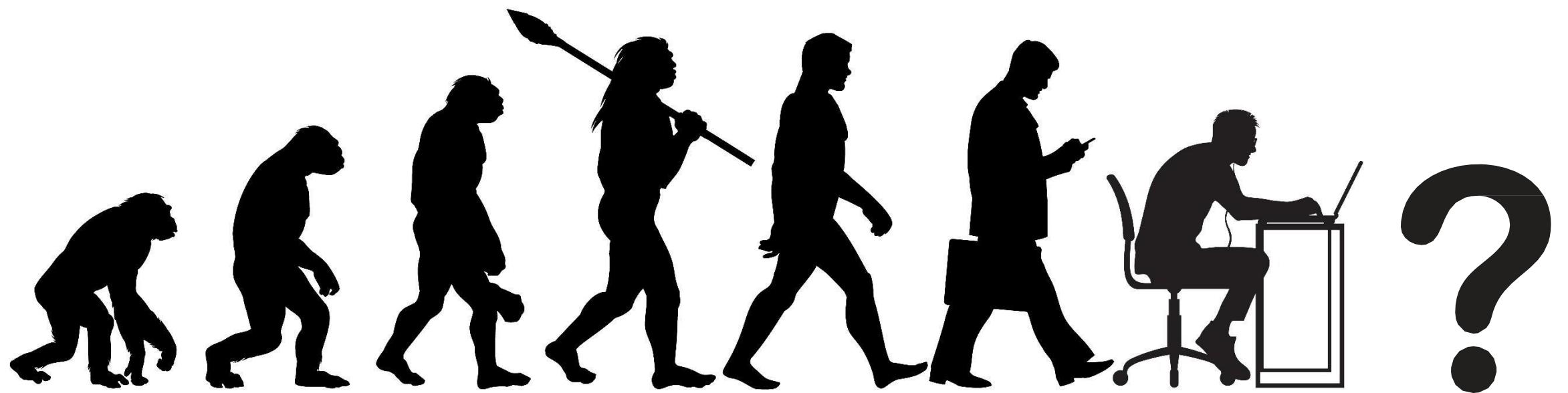
How do we avoid bias in A.I.?

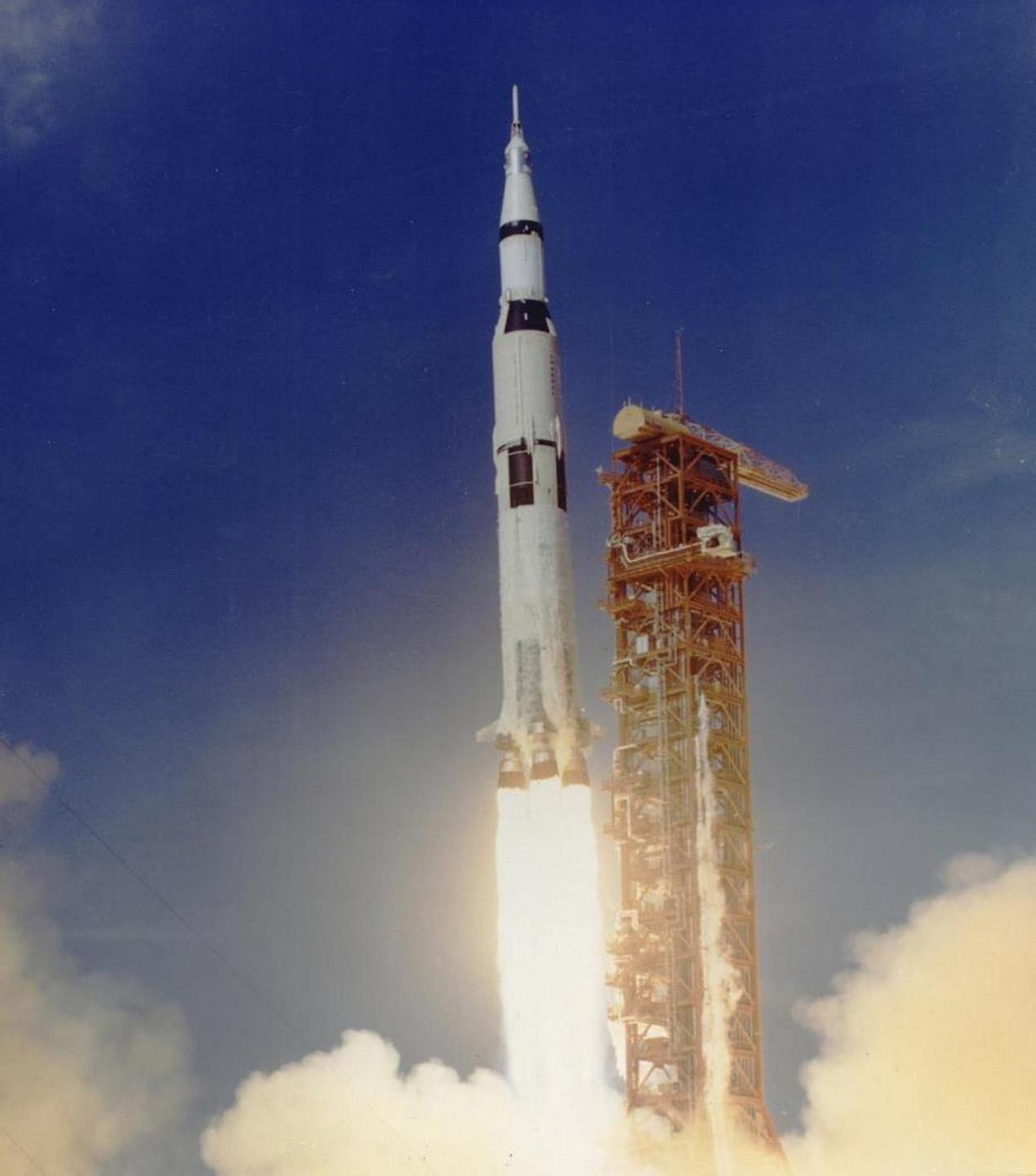
Should we weaponize A.I.?

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











What will you choose?