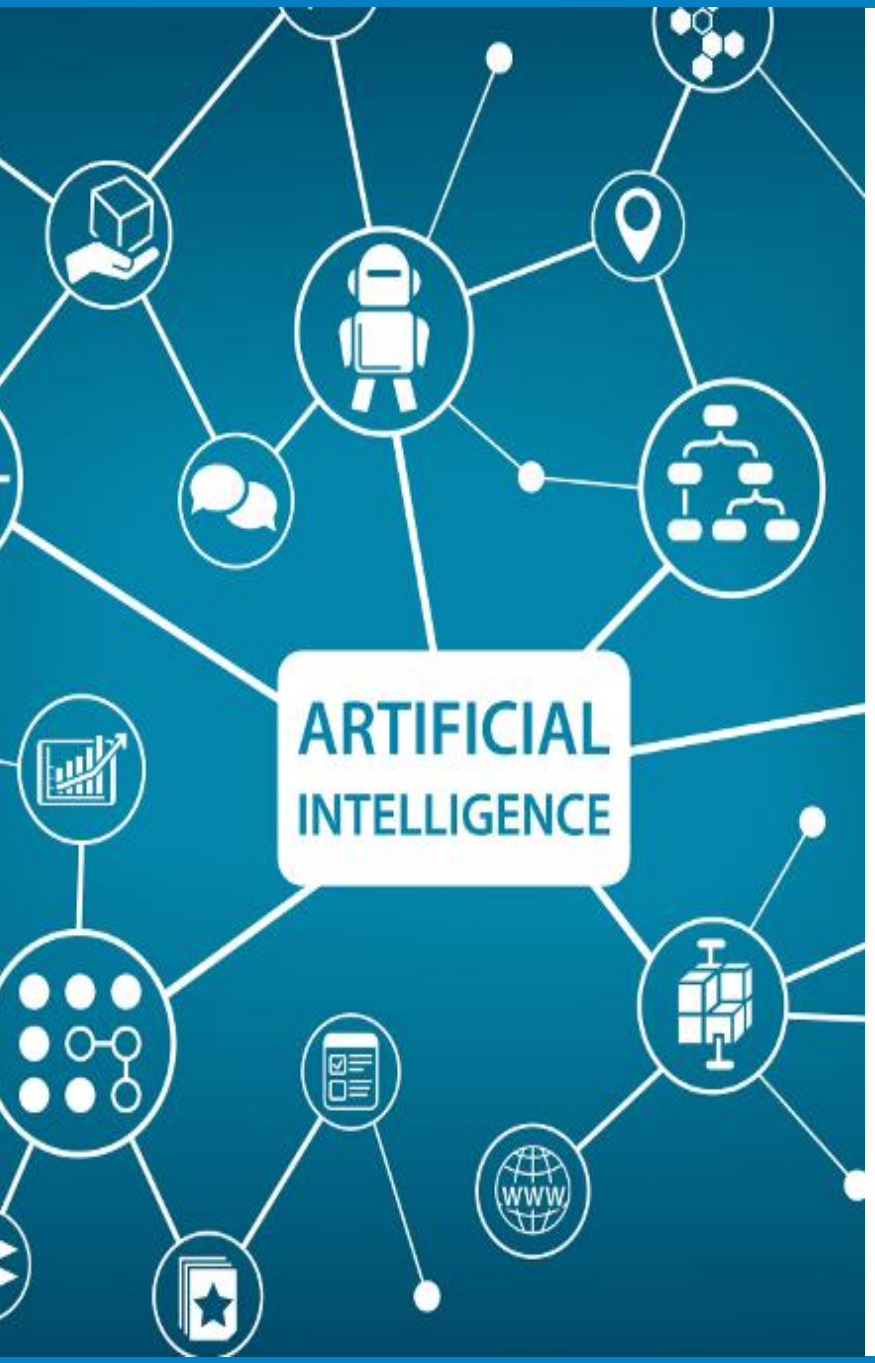
Introduction to Artificial Intelligence

David P Hutasoit



Outline

01 What is AI?

- Hype vs reality
- General Intelligence vs Narrow Intelligence
- What AI can and cannot do
- Machine Learning & Deep Learning
- How does it work?

02 AI Transformation

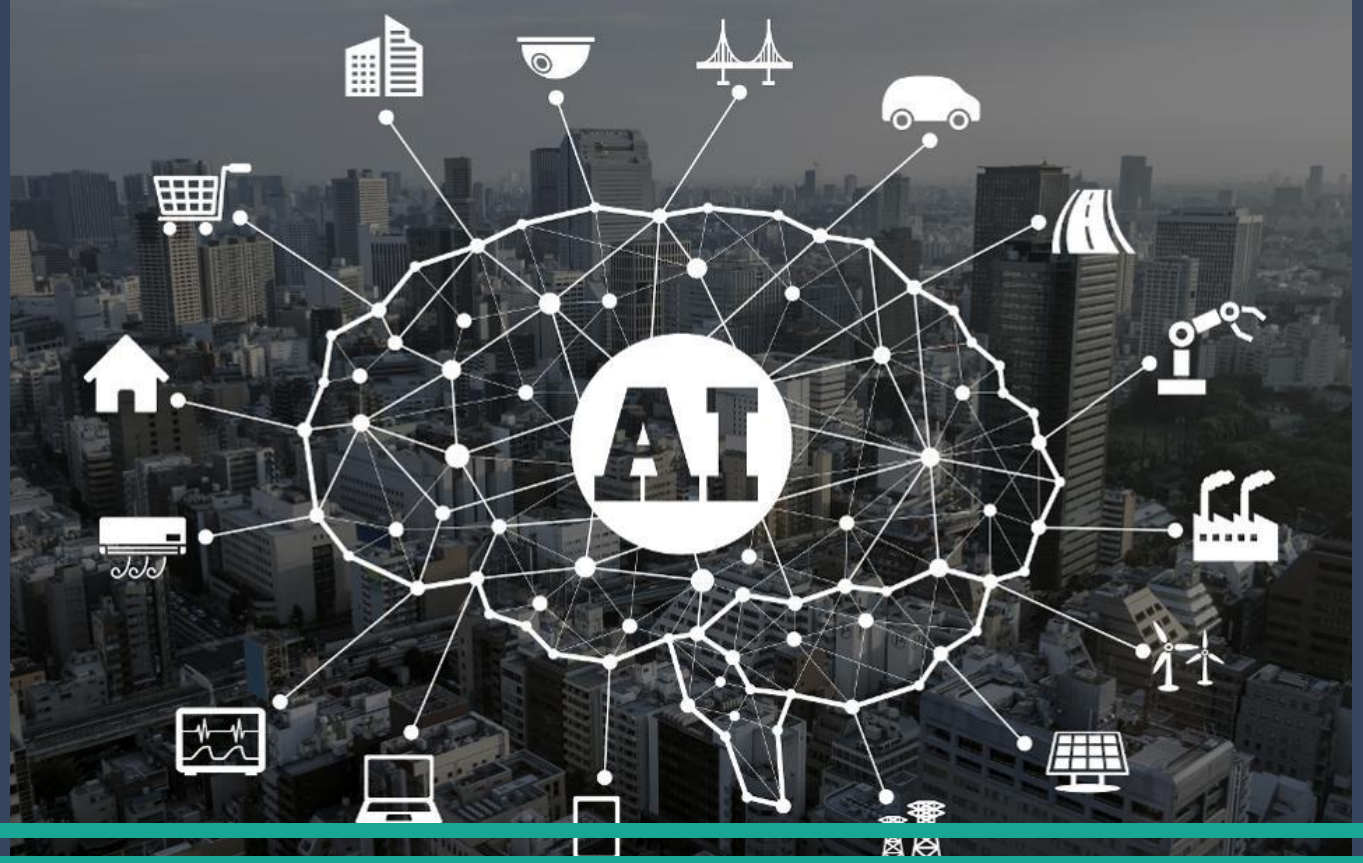
- What makes an AI company
- Virtuous cycle of AI
- Data Maturity
- Five steps of AI transformation

03 AI in Marketing

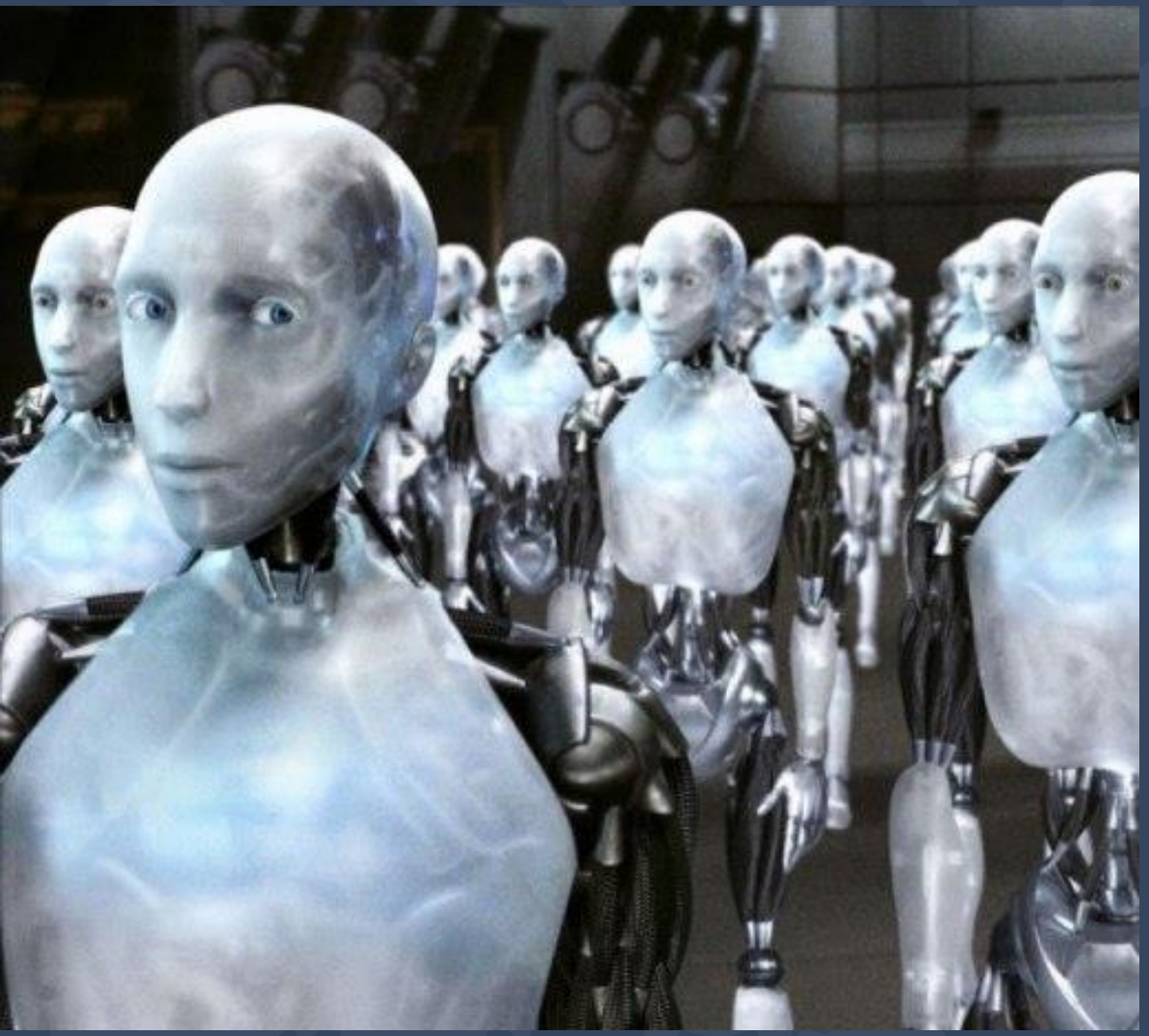
- Marketing Analytics
- Automation
- Personalization
- CDP

04 AI and Society

- Ethical Issues
- Explainability
- Economical impact
- Limitation



What is AI?



“I visualize a time when we will be to robots what dogs are to humans, and I’m rooting for the machines.”
- Claude Shannon

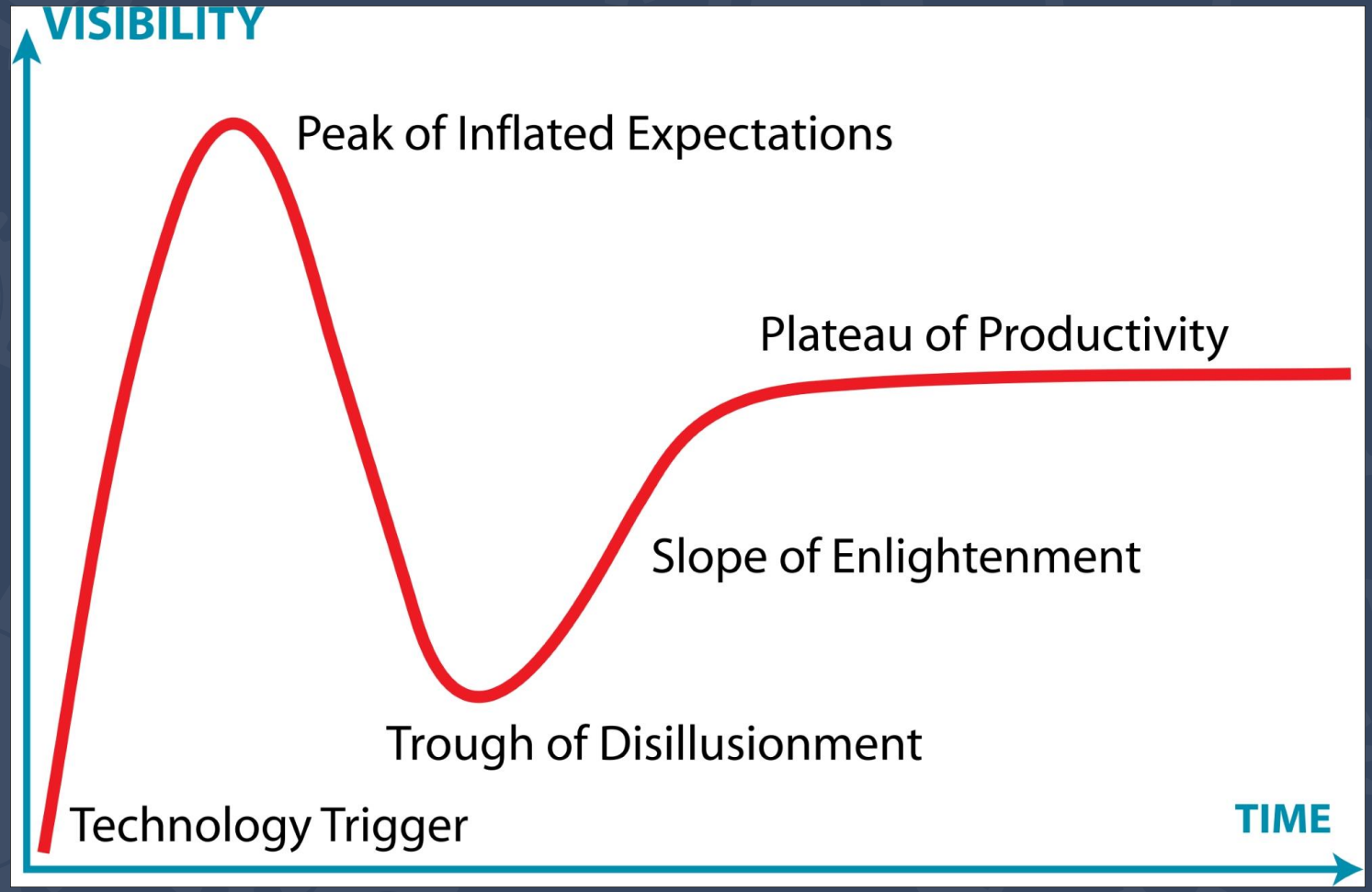
"Success in creating AI would be the biggest event in human history [...] Unfortunately; it might also be the last."
- Stephen Hawking

"I think we should be very careful about artificial intelligence. If I were to guess at what our biggest existential threat is, it's probably that."
- Elon Musk

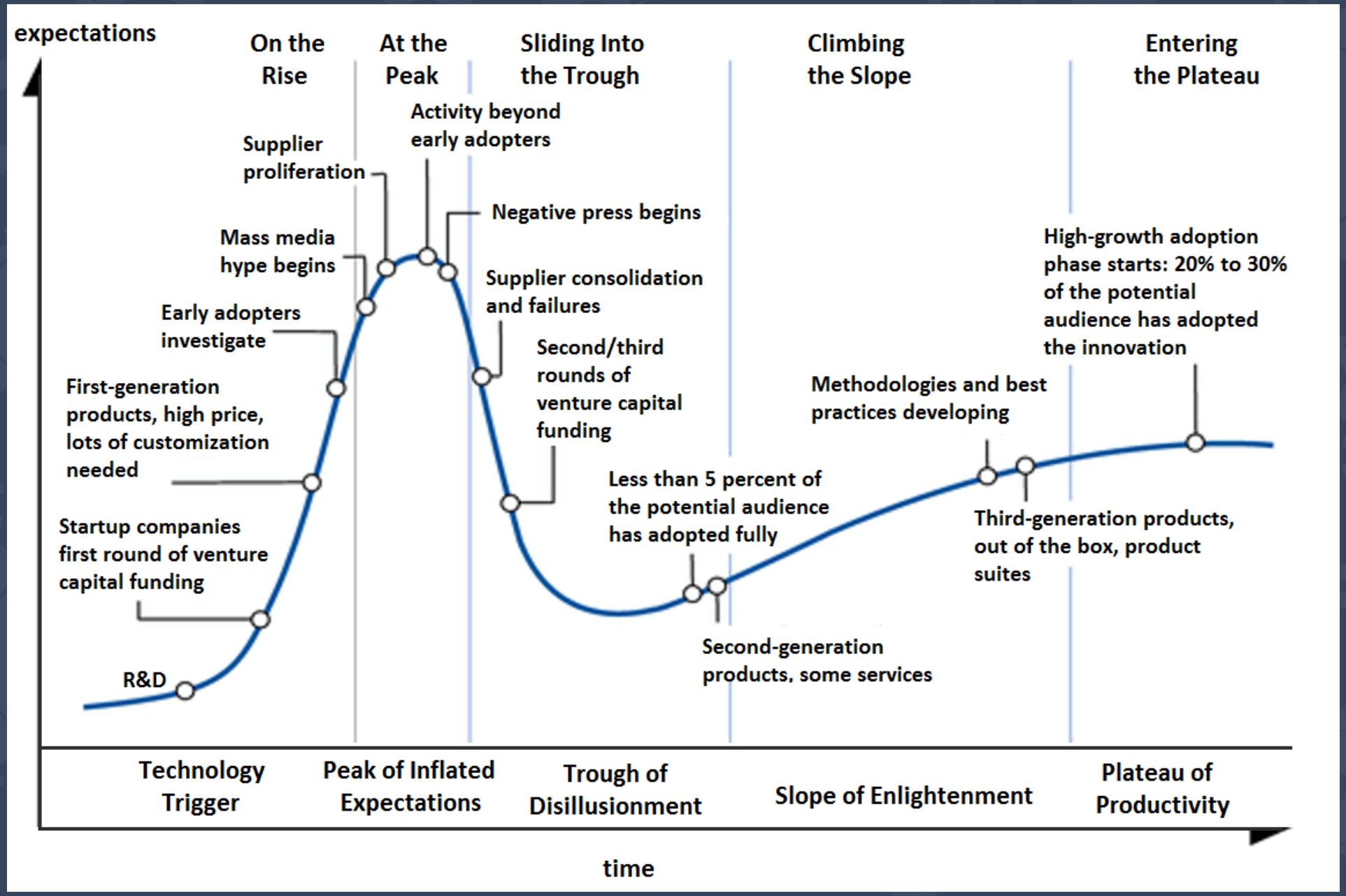
"First the machines will do a lot of jobs for us and not be super intelligent. That should be positive if we manage it well. A few decades after that though the intelligence is strong enough to be a concern. I agree with Elon Musk and some others on this and don't understand why some people are not concerned."
- Bill Gates

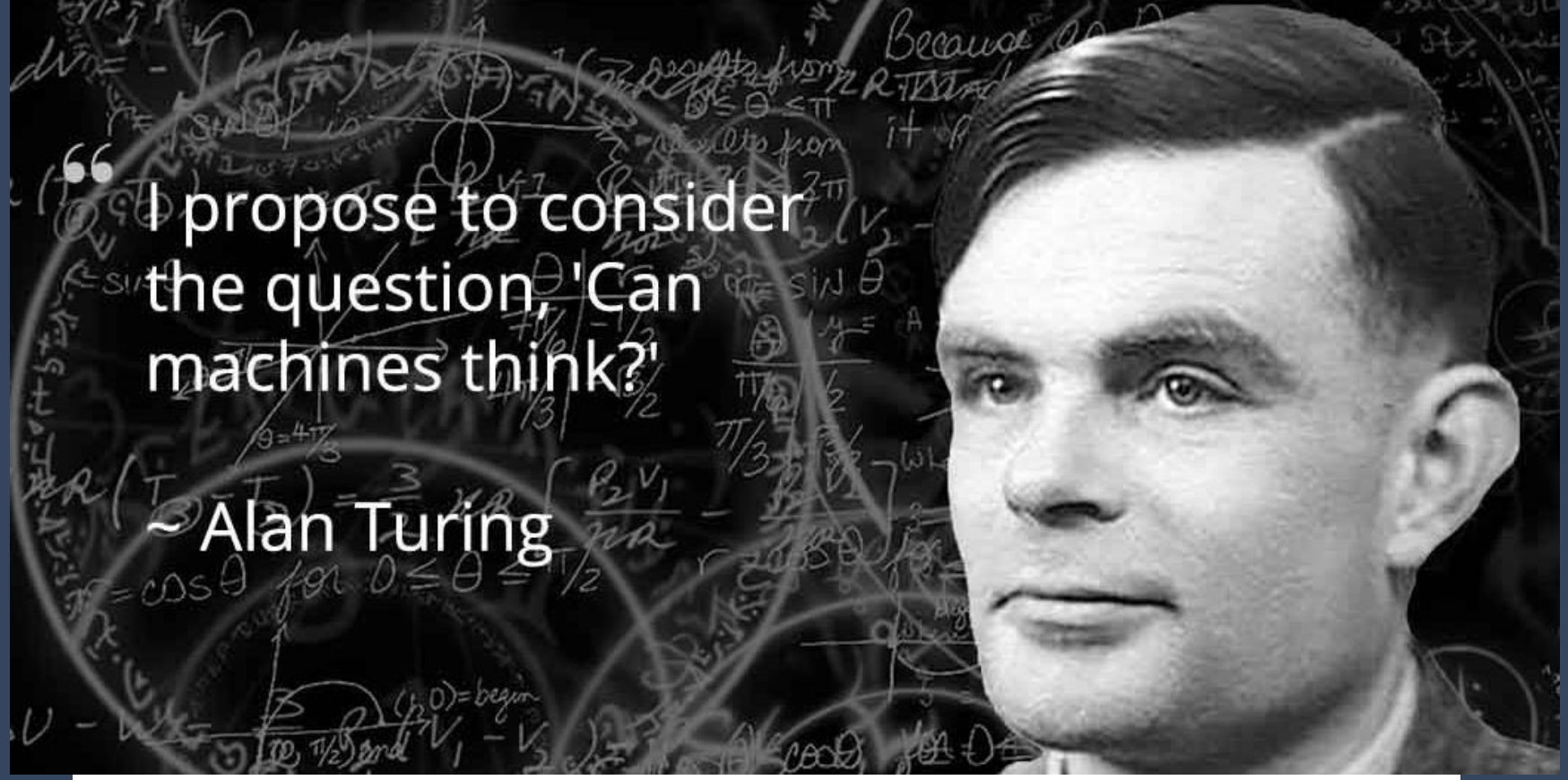
1. http://theconversation.com/rise-of-the-machines-how-computers-could-control-our-lives-5838
2. https://futurism.com/hawking-creating-ai-could-be-the-biggest-event-in-the-history-of-our-civilization/
3. https://www.theguardian.com/technology/2014/oct/27/elon-musk-artificial-intelligence-ai-biggest-existential-threat
4. https://www.reddit.com/r/IAmA/comments/2tzjp7/hi_reddit_im_bill_gates_and_im_back_for_my_third/co3r3g8/

Hype Cycle



"We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run." (Amara)


expectations
On the Rise
At the Peak
Sliding Into the Trough
Climbing the Slope
Entering the Plateau
Activity beyond early adopters
Supplier proliferation
Negative press begins
Mass media hype begins
Supplier consolidation and failures
High-growth adoption phase starts: 20% to 30% of the potential audience has adopted the innovation
Early adopters investigate
Second/third rounds of venture capital funding
Methodologies and best practices developing
First-generation products, high price, lots of customization needed
Less than 5 percent of the potential audience has adopted fully
Third-generation products, out of the box, product suites
Startup companies first round of venture capital funding
Second-generation products, some services
R&D
Technology Trigger
Peak of Inflated Expectations
Trough of Disillusionment
Slope of Enlightenment
Plateau of Productivity
time



A. M. Turing (1950) Computing Machinery and Intelligence. *Mind 49:* 433-460.

COMPUTING MACHINERY AND INTELLIGENCE

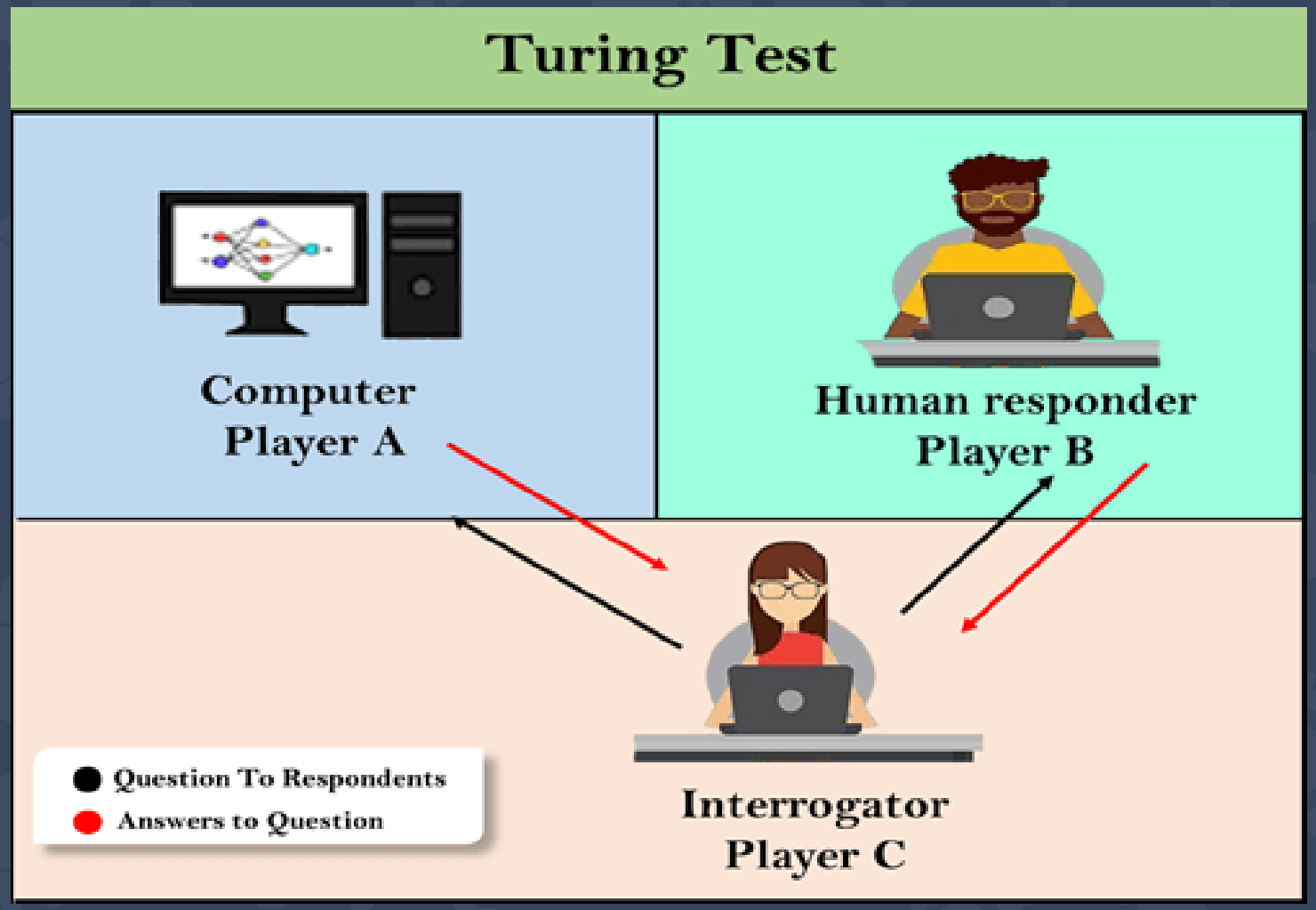
By A. M. Turing

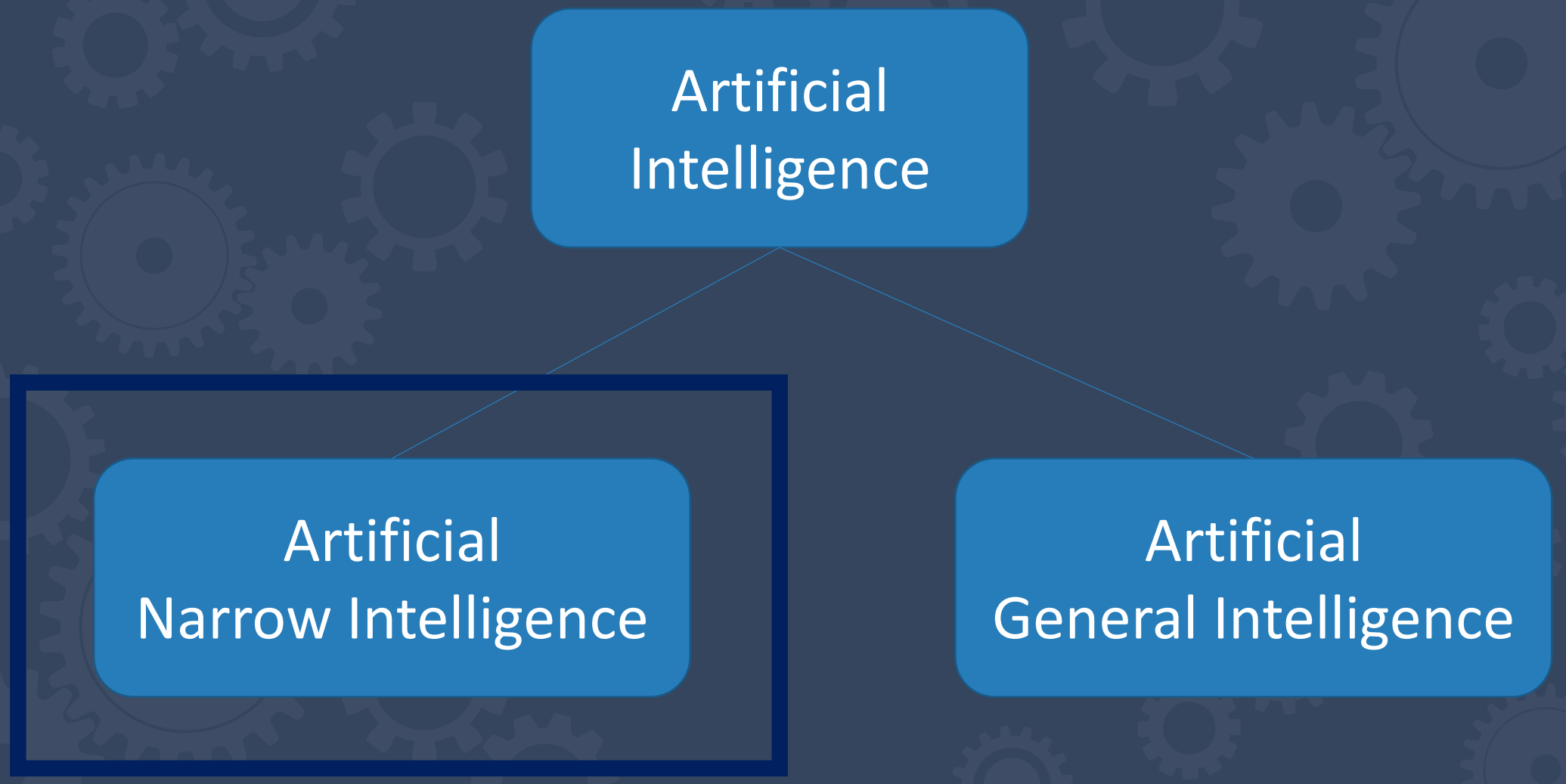
1. The Imitation Game

I propose to consider the question, "Can machines think?" This should begin with definitions of the meaning of the terms "machine" and "think." The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous, If the meaning of the words "machine" and "think" are to be found by examining how they are commonly used it is difficult to escape the conclusion that the

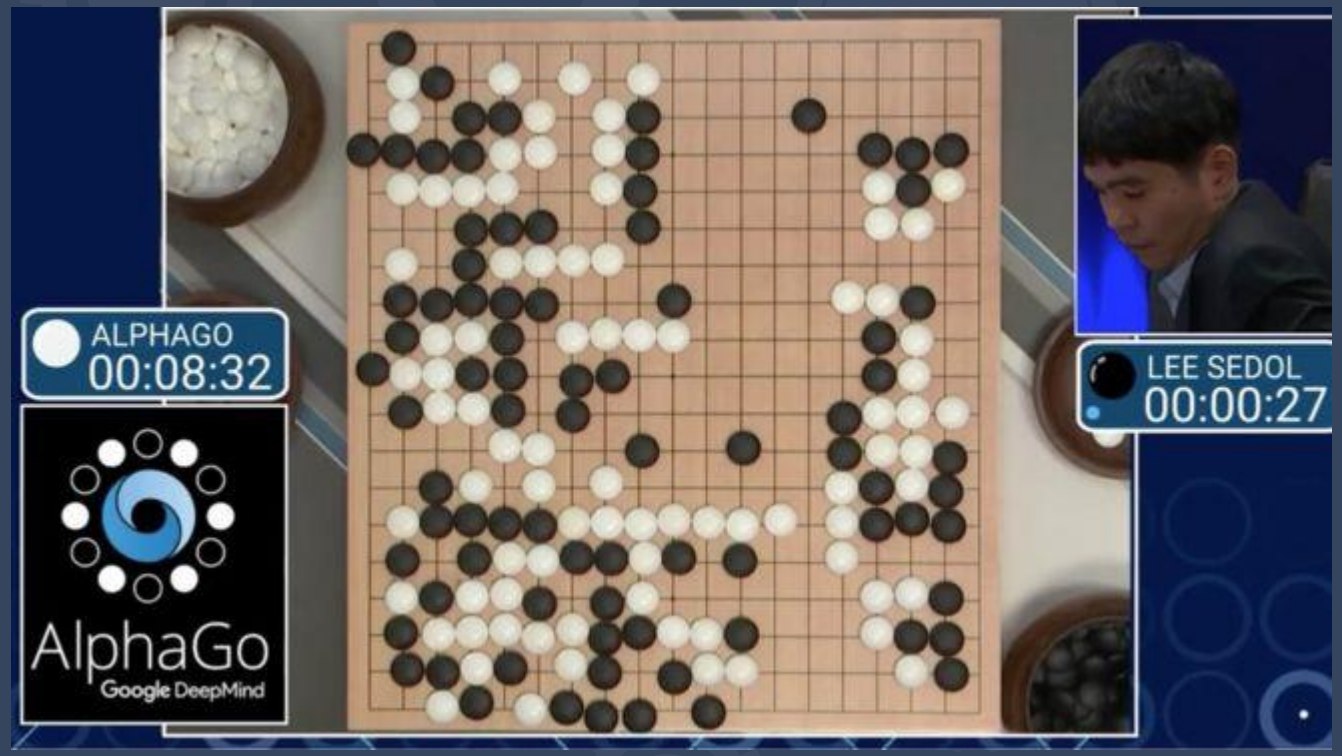
Can machines think?

Of course machines can't think as people do. A machine is different from a person. Hence, they think differently.
The interesting question is, just because something, thinks differently from you, does that mean it's not thinking?
- *The Immitation Game* (2014)

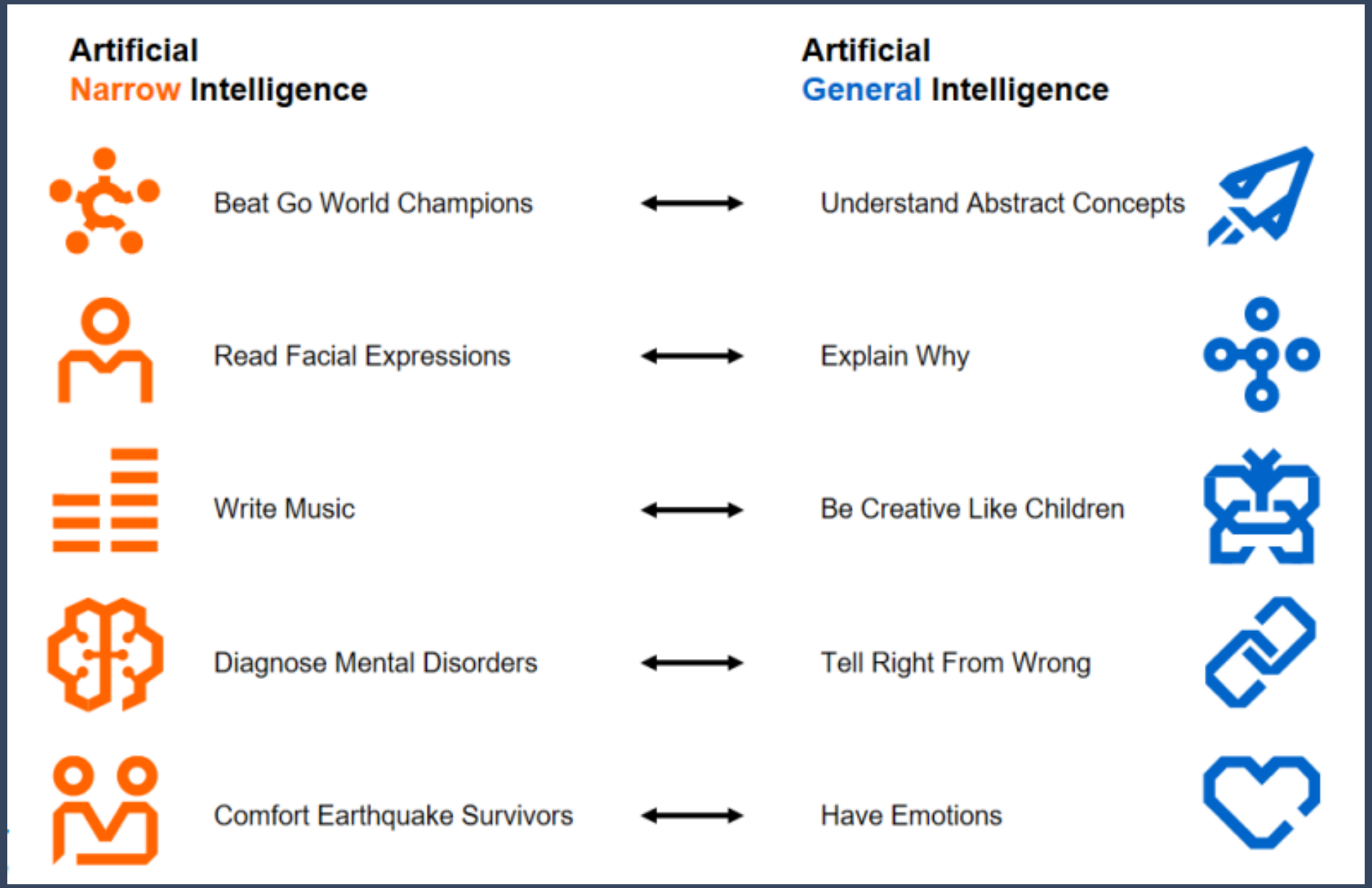

Turing Test
Computer
Player A
Human responder
Player B
Interrogator
Player C
Question To Respondents
Answers to Question


Artificial Intelligence
Artificial Narrow Intelligence
Artificial General Intelligence

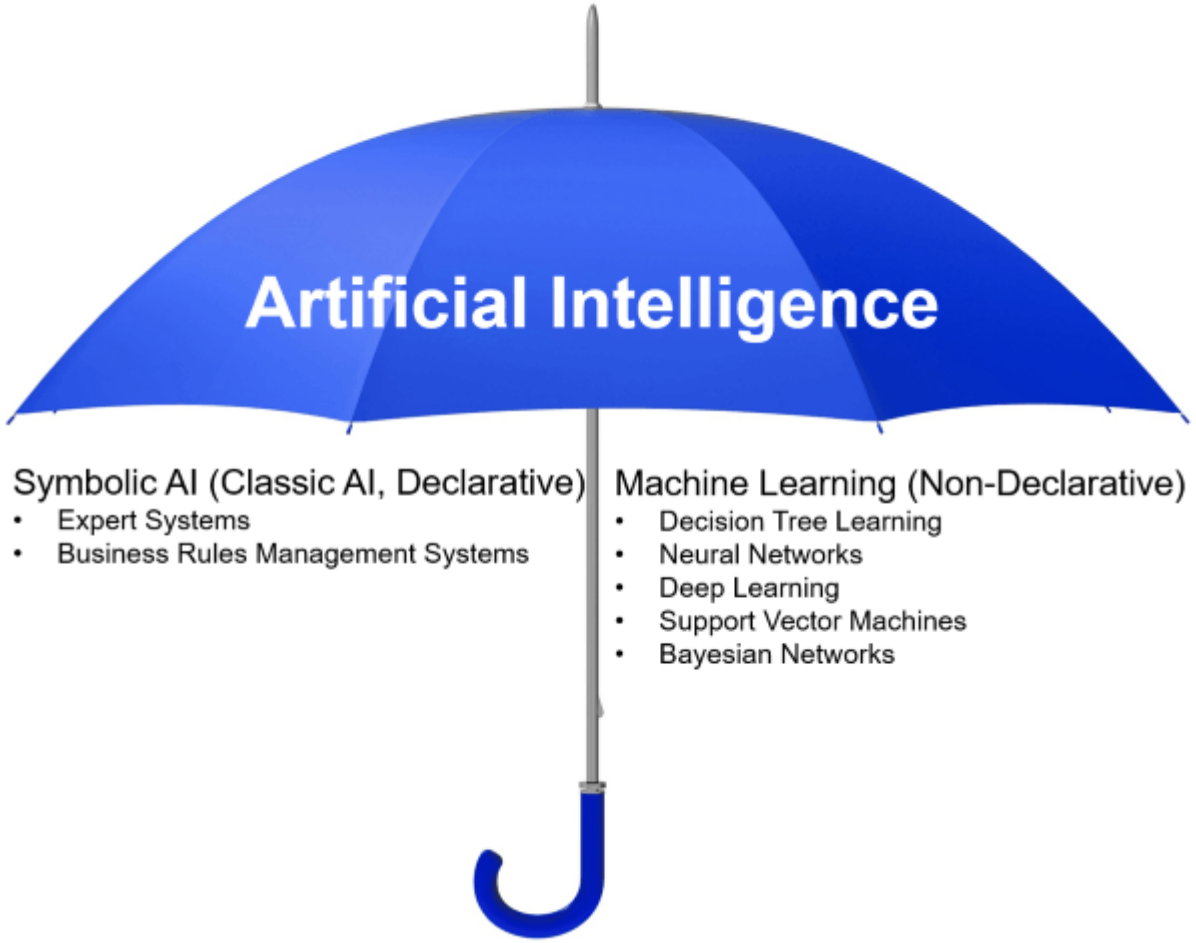
Deep Blue vs Garry Kasparov
(1997)



Alpha Go vs Lee Sedol
(2016)



Source: Accenture



Symbolic AI (Classic AI, Declarative)

- Expert Systems
- Business Rules Management Systems

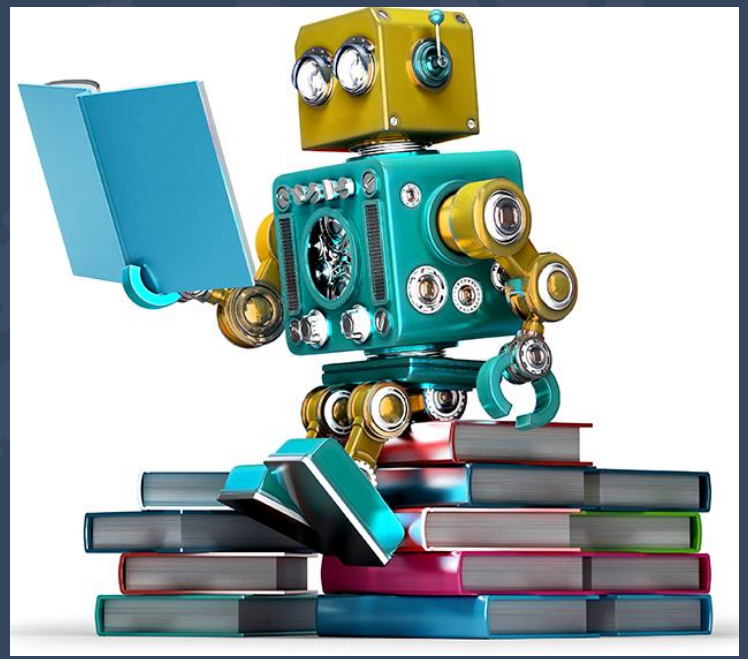
Machine Learning (Non-Declarative)

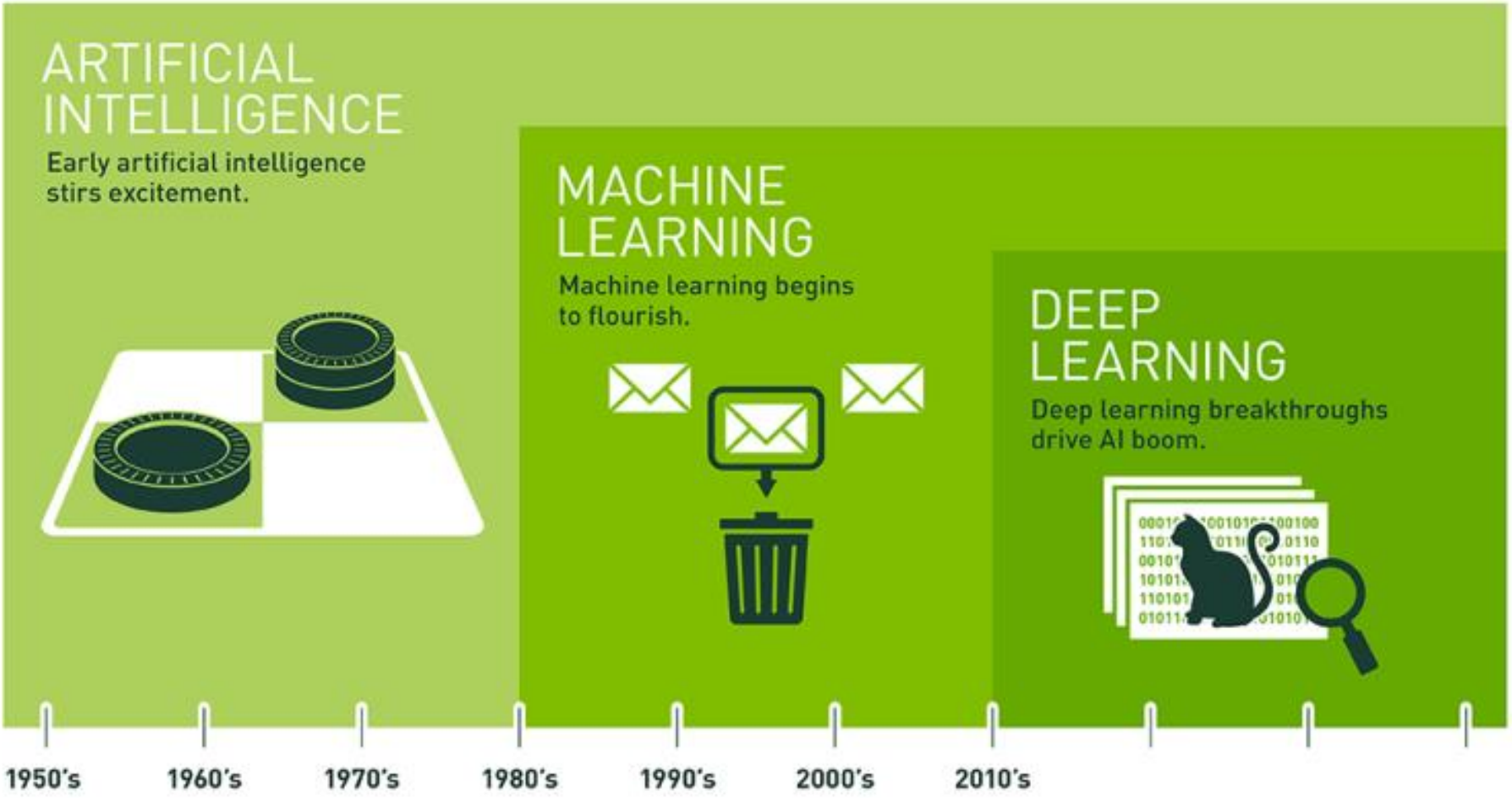
- Decision Tree Learning
- Neural Networks
- Deep Learning
- Support Vector Machines
- Bayesian Networks

Definition of Machine Learning

"A computer program is said to **learn** from experience ***E*** with respect to some class of tasks ***T*** and performance measure ***P***, if its performance at tasks in ***T***, as measured by ***P***, improves with experience ***E***." - (*Mitchell*)

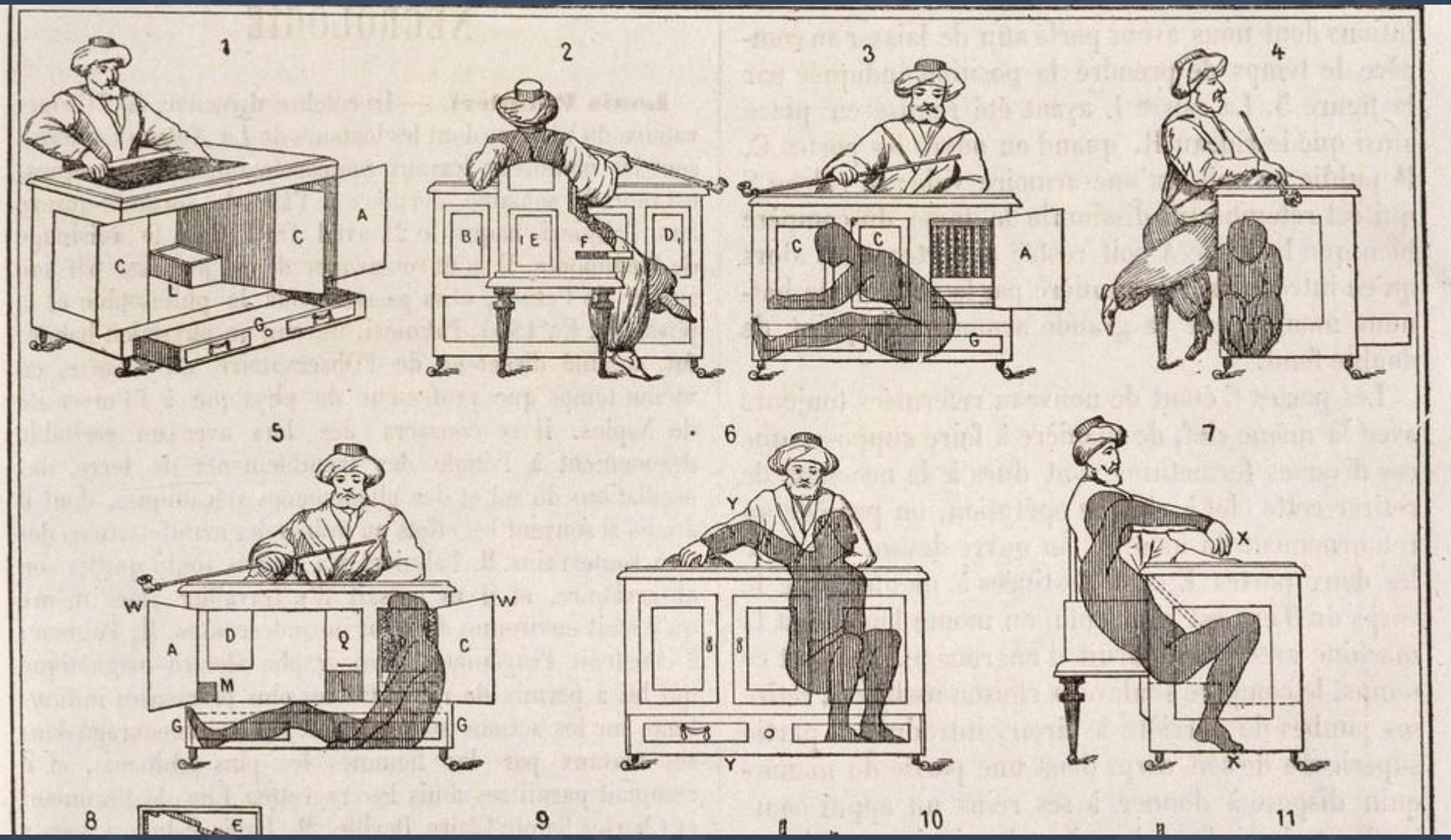
$$P(T) \sim E$$





Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

Source: NVIDIA


1
2
3
4
5
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7
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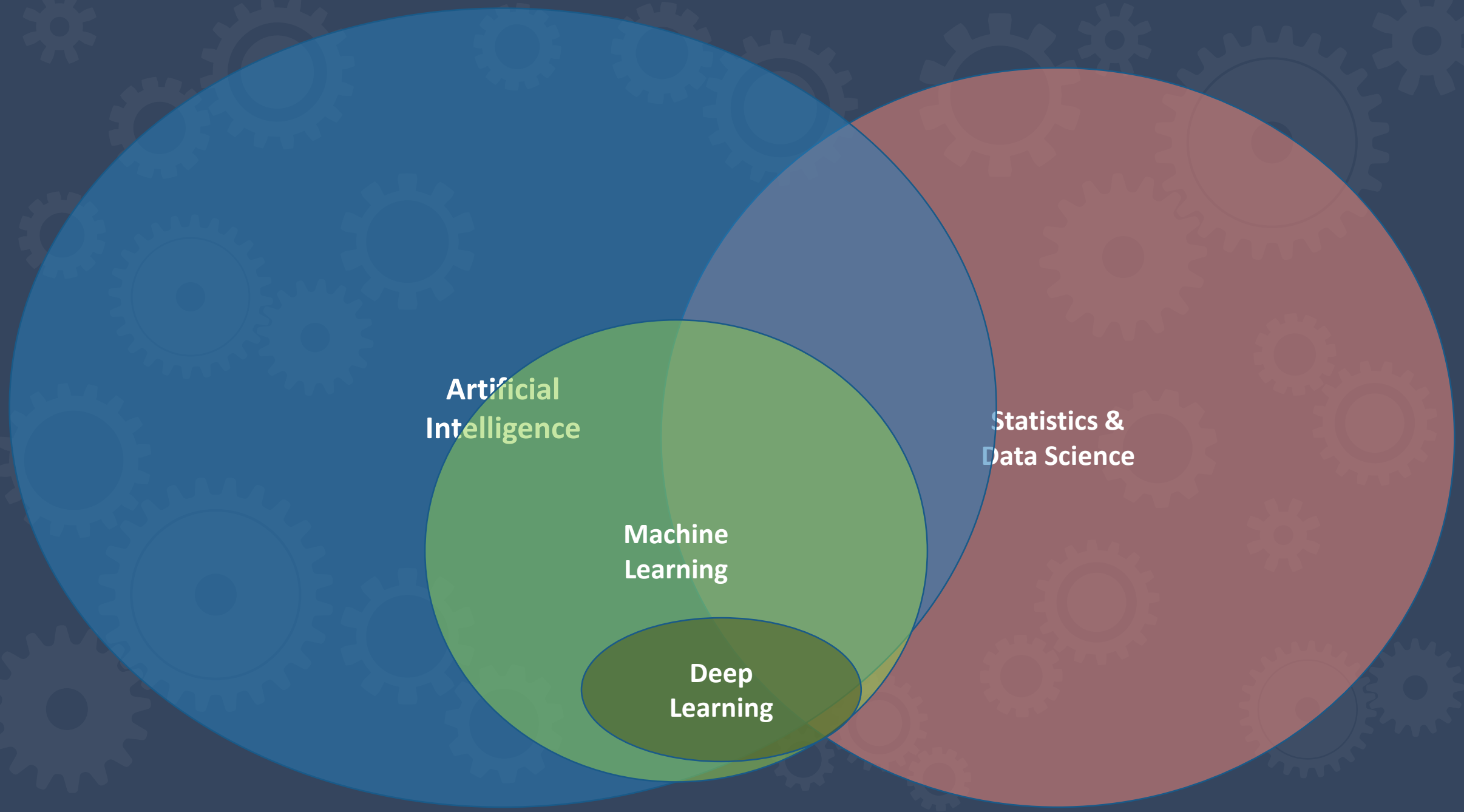
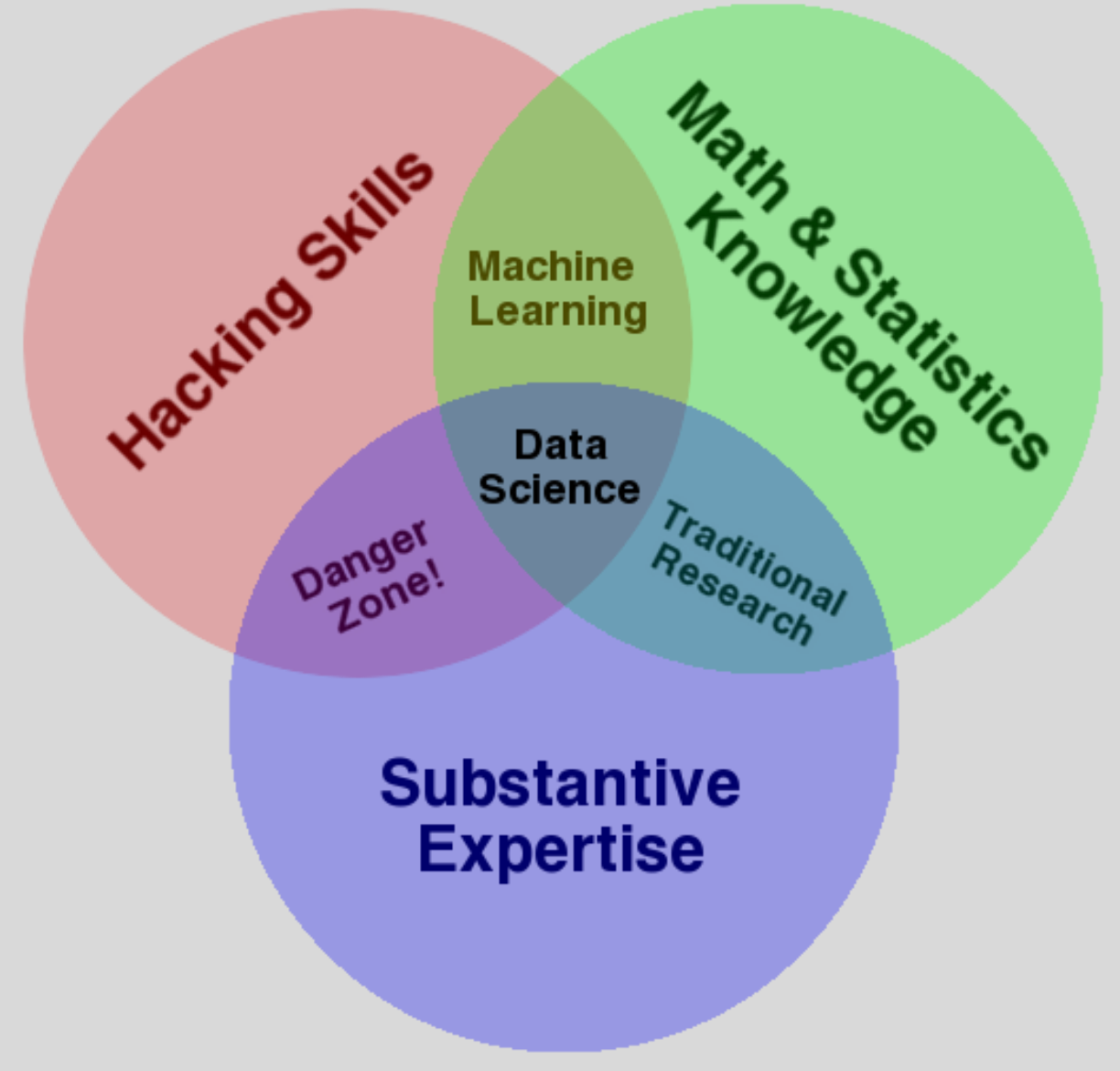
9
10
11


Artificial Intelligence
Statistics & Data Science
Machine Learning
Deep Learning



http://drewconway.com/zia/2013/3/26/the-data-science-venn-diagram

Machine Learning vs Data Science

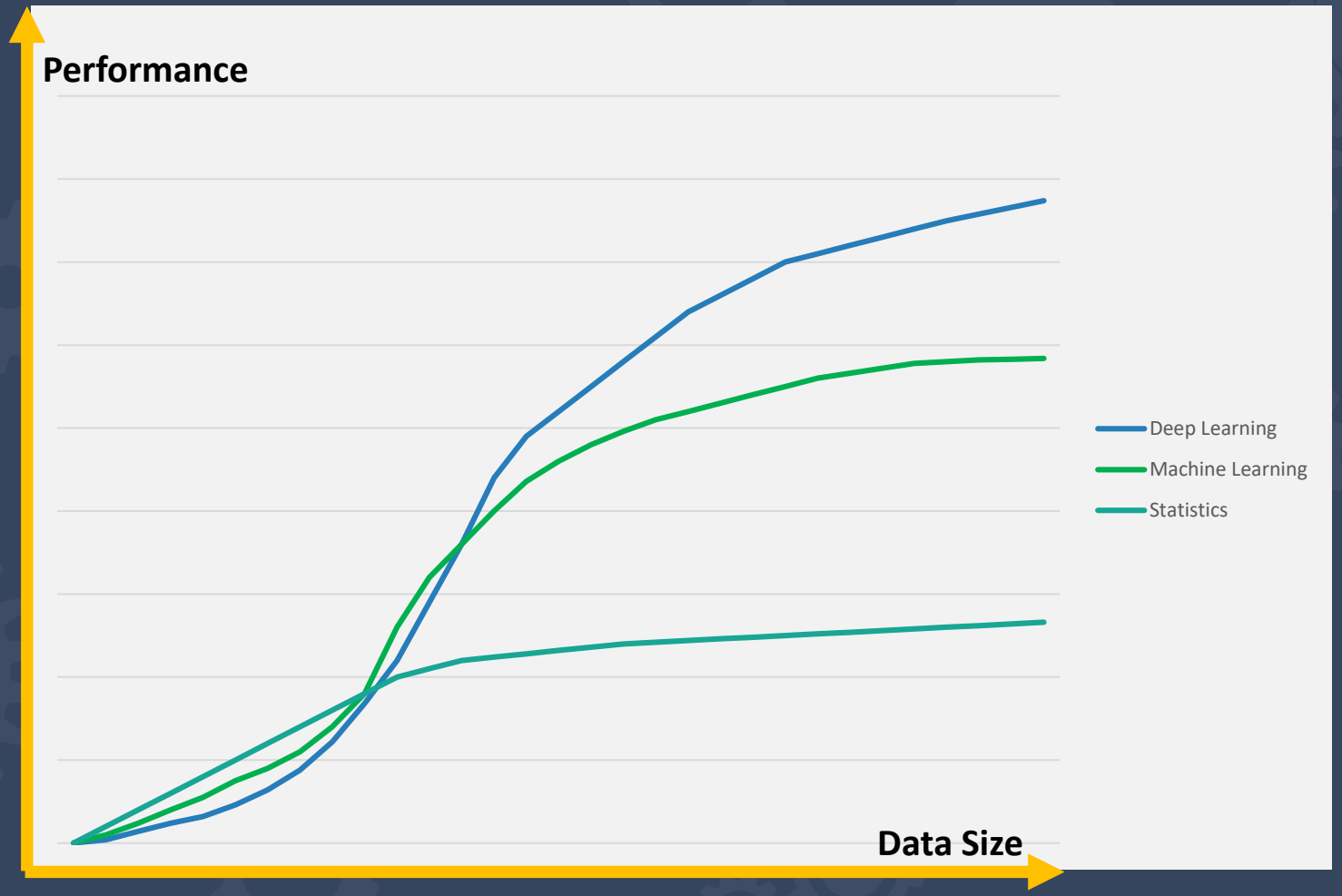
Key Steps in Machine Learning

1. Collect data
2. Train model
   - Iterate many times
3. Deploy model
   - Get data back
   - Update/maintain model

Key Steps in Data Science

1. Collect data
2. Analyze Data
3. Suggestion

Data Size and Machine Learning Performance



Data

Structured Data

Size	#bedrooms	···	Price (1000$s)
2104	3		400
1600	3		330
2400	3		369
⋮	⋮		⋮
3000	4		540

User Age	Ad Id	···	Click
41	93242		1
80	93287		0
18	87312		1
⋮	⋮		⋮
27	71244		1

Unstructured Data

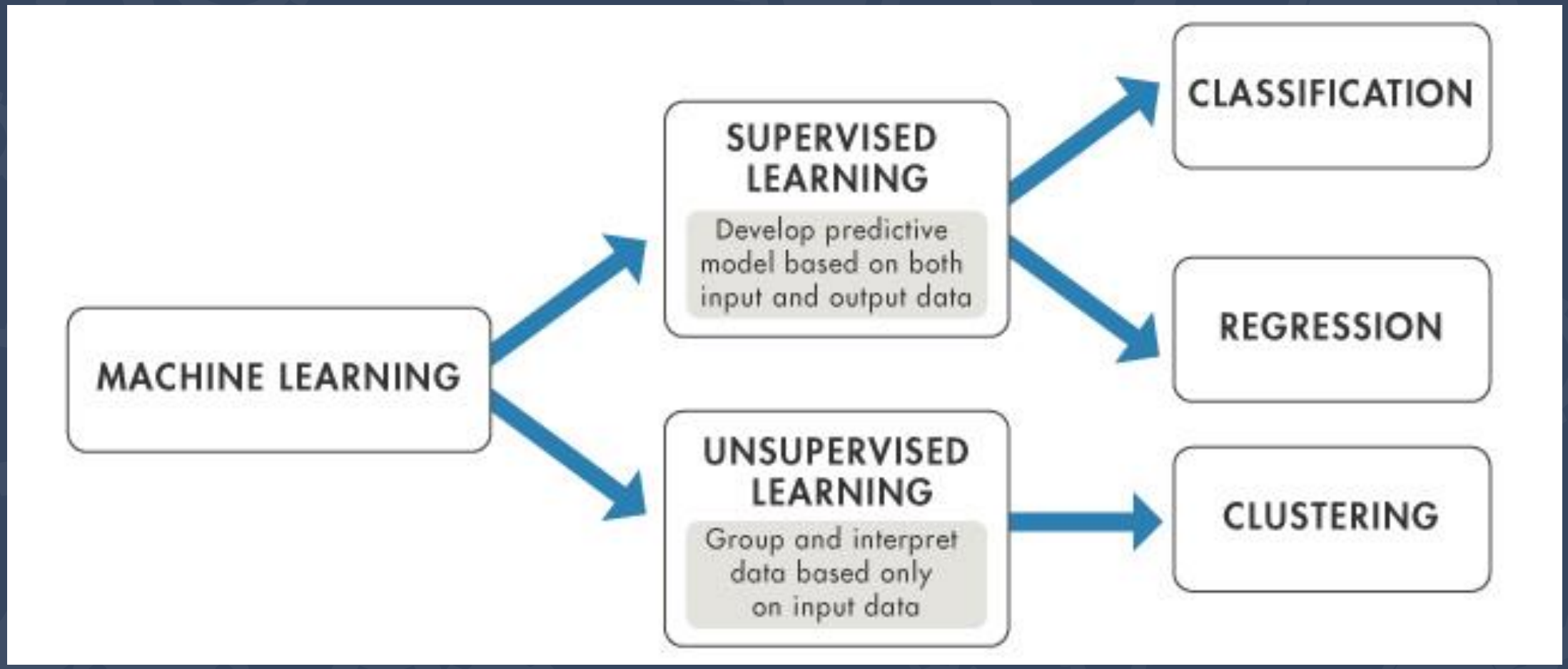
Audio

Image

Four scores and seven years ago…

Text

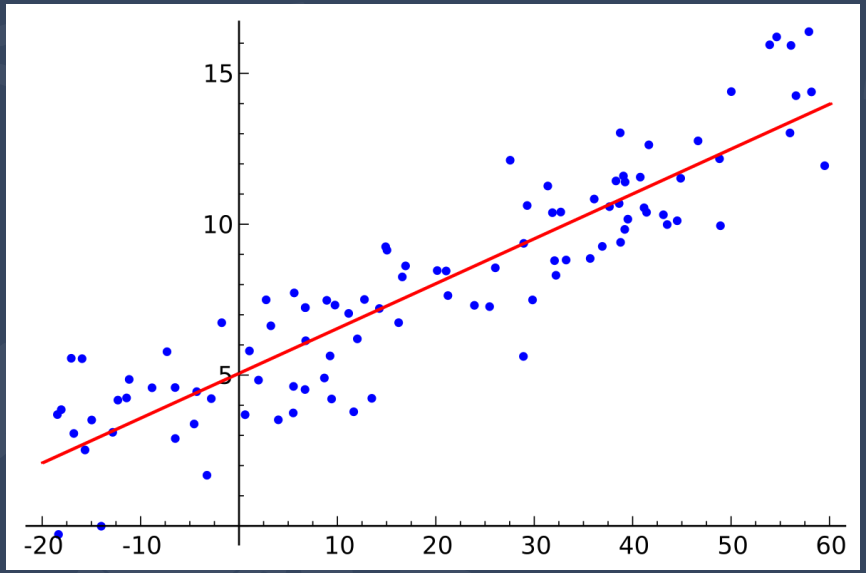
Machine Learning

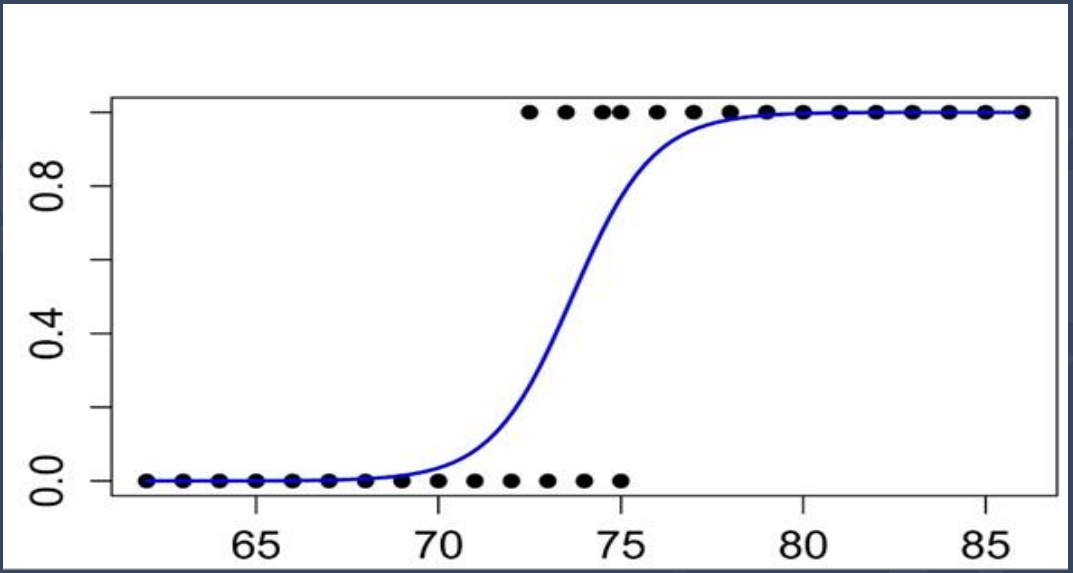


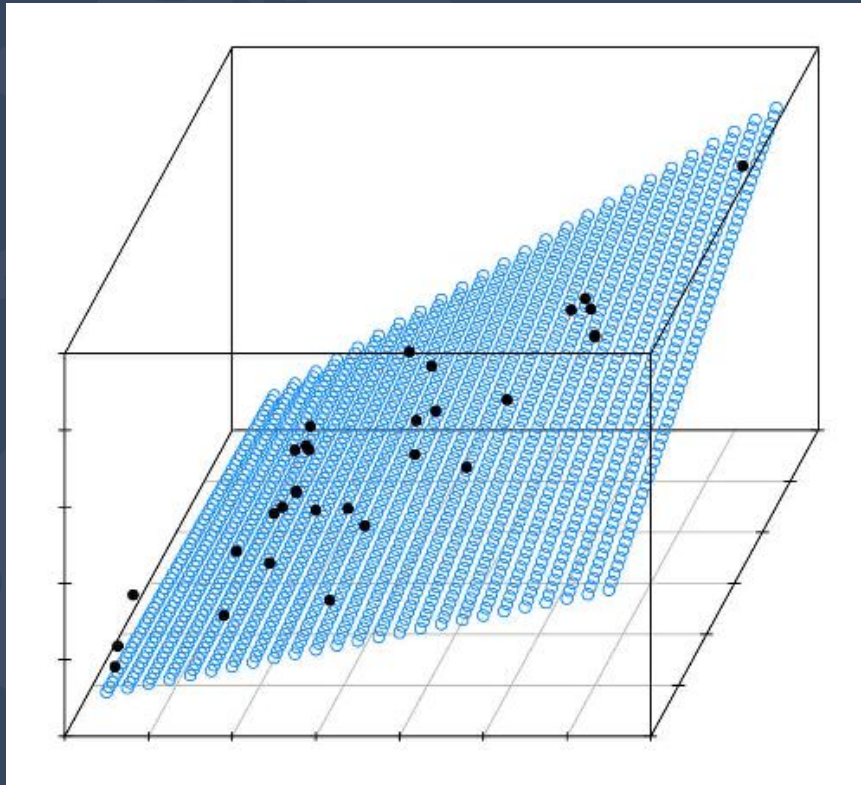
Source: wikipedia

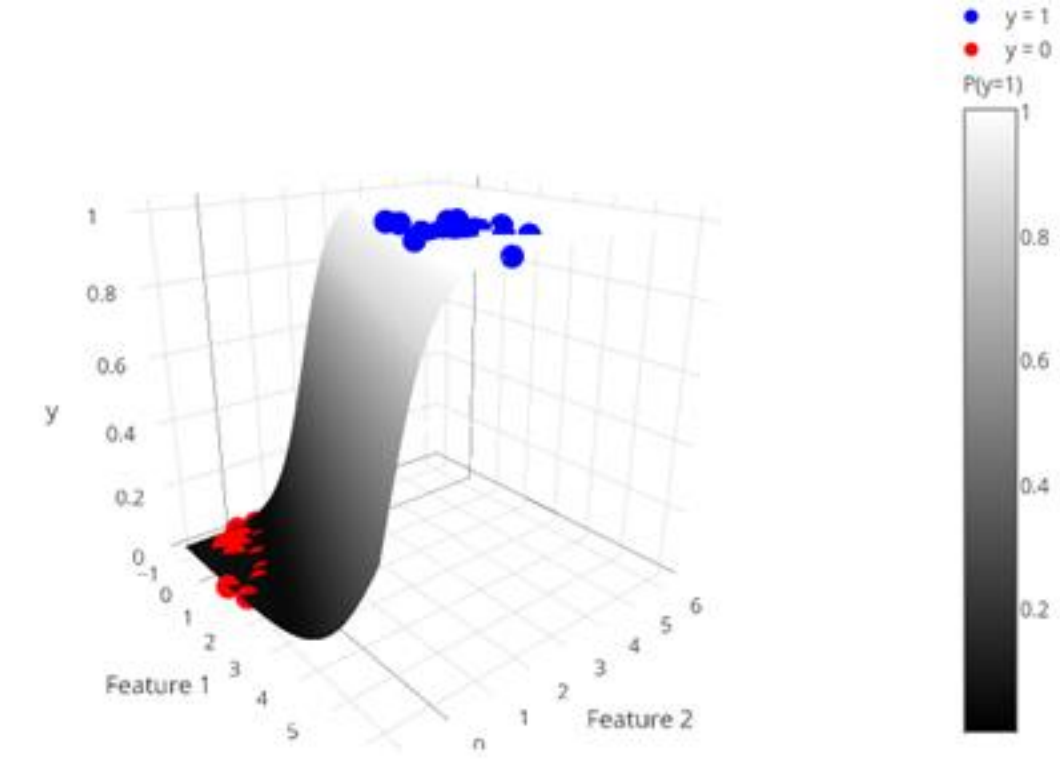
Supervised Machine Learning

Input (A)	Output (B)	Application
Email	Spam? (0/1)	Spam filtering
Audio file	Text transcripts	Speech recognition
English	Indonesian	Machine translation
Ad, user info	Click? (0/1)	Online advertising
House features	House price	Real estate
Image, radar info	Position of other cars/objects	Self-driving car
Image of product	Defect? (0/1)	Visual inspection


15
10
5
-20
-10
10
20
30
40
50
60

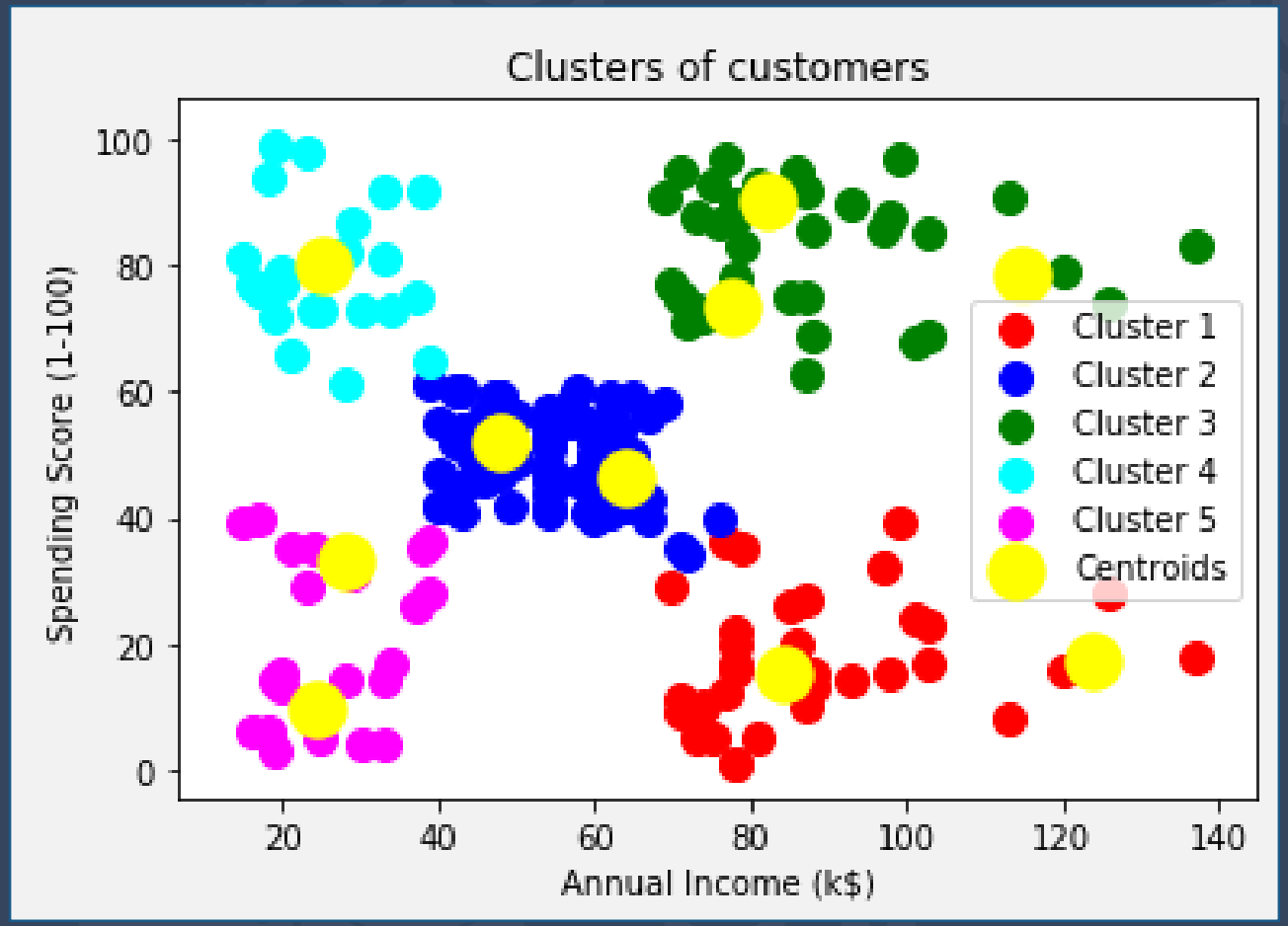

0.0
0.4
0.8
65
70
75
80
85

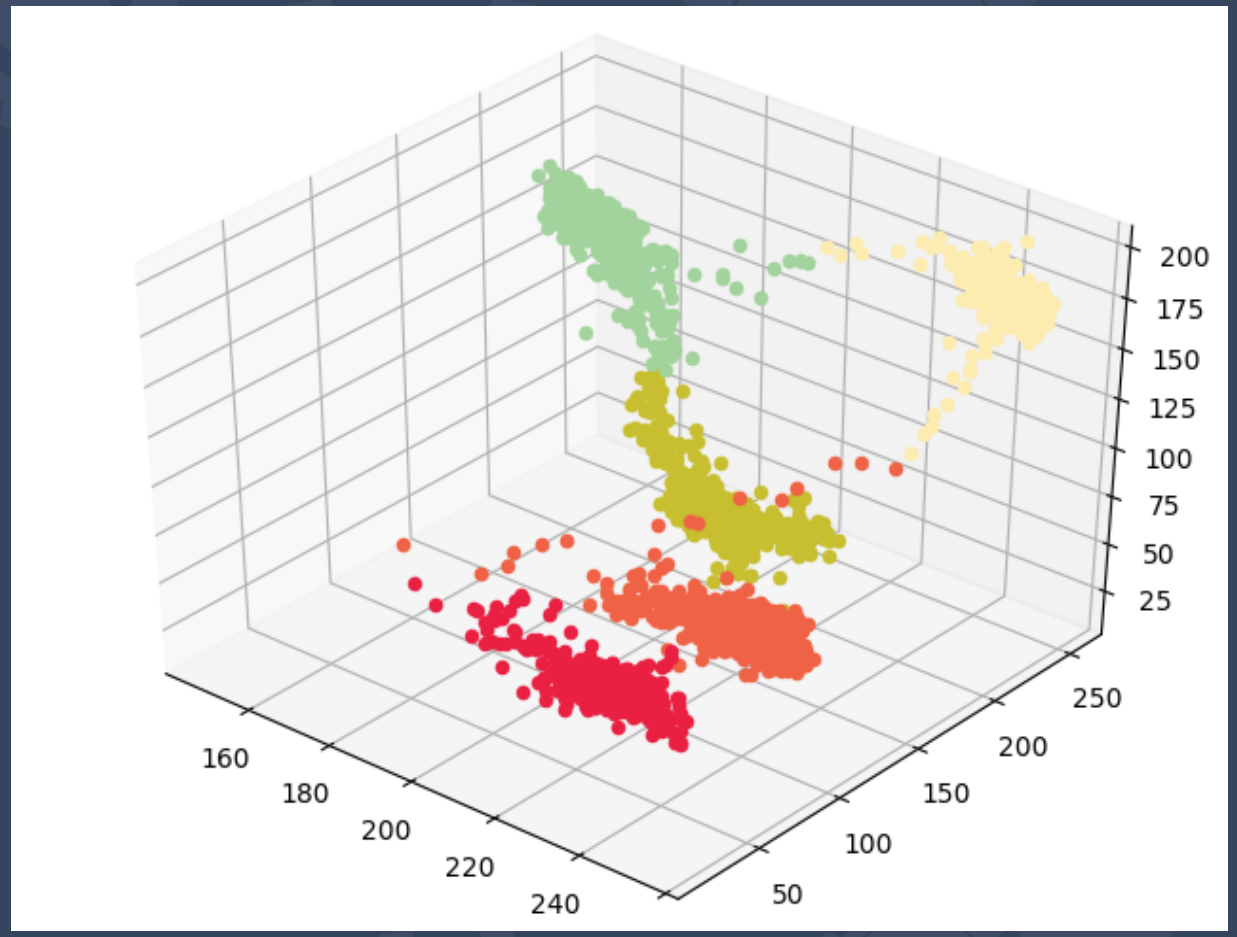



y = 1
y = 0
P(y=1)
1
0.8
0.6
0.4
0.2
y
Feature 1
Feature 2

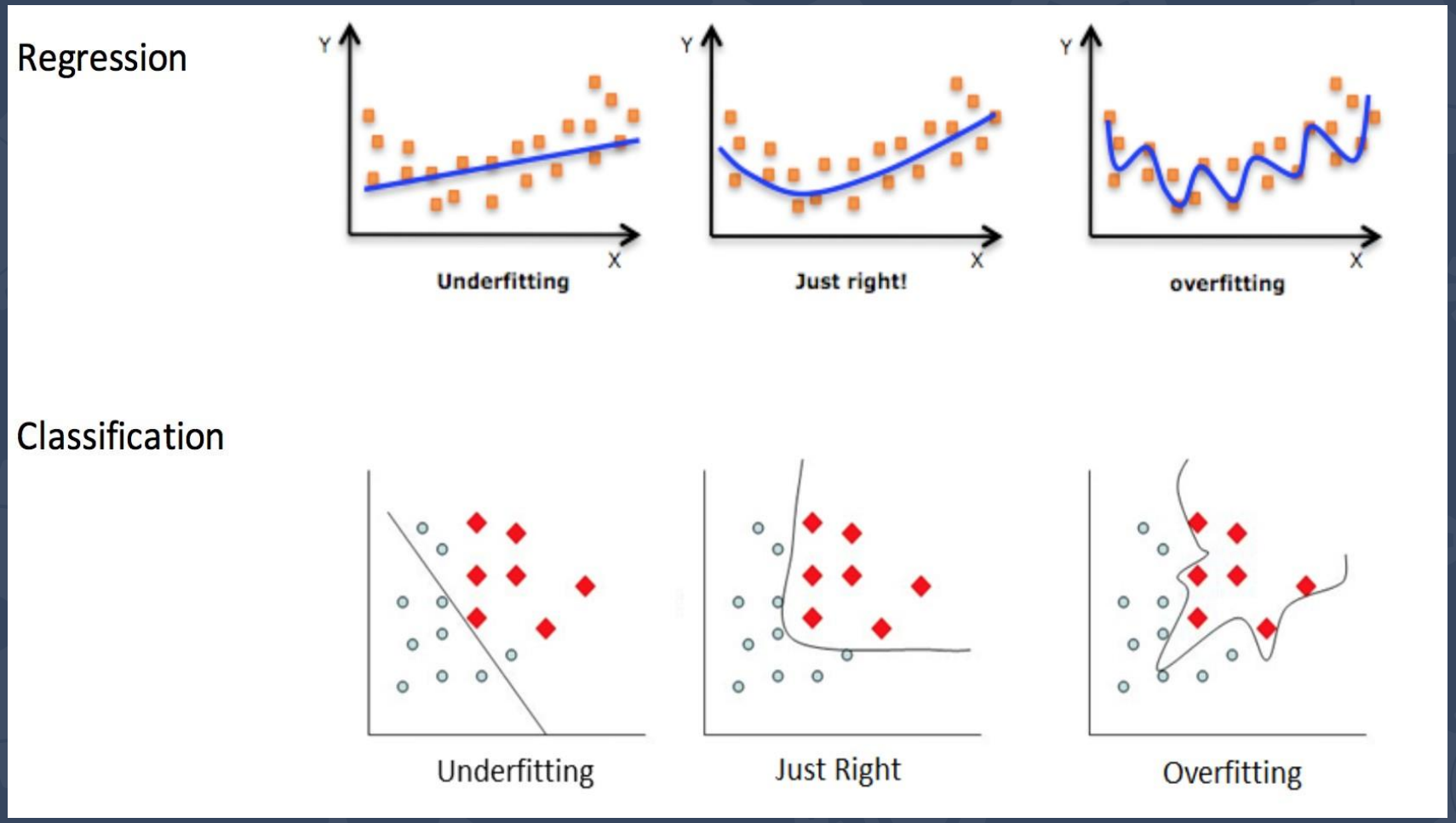
Unsupervised Machine Learning

- Clustering
- Anomaly Detection
- Association
- Dimensionality Reduction

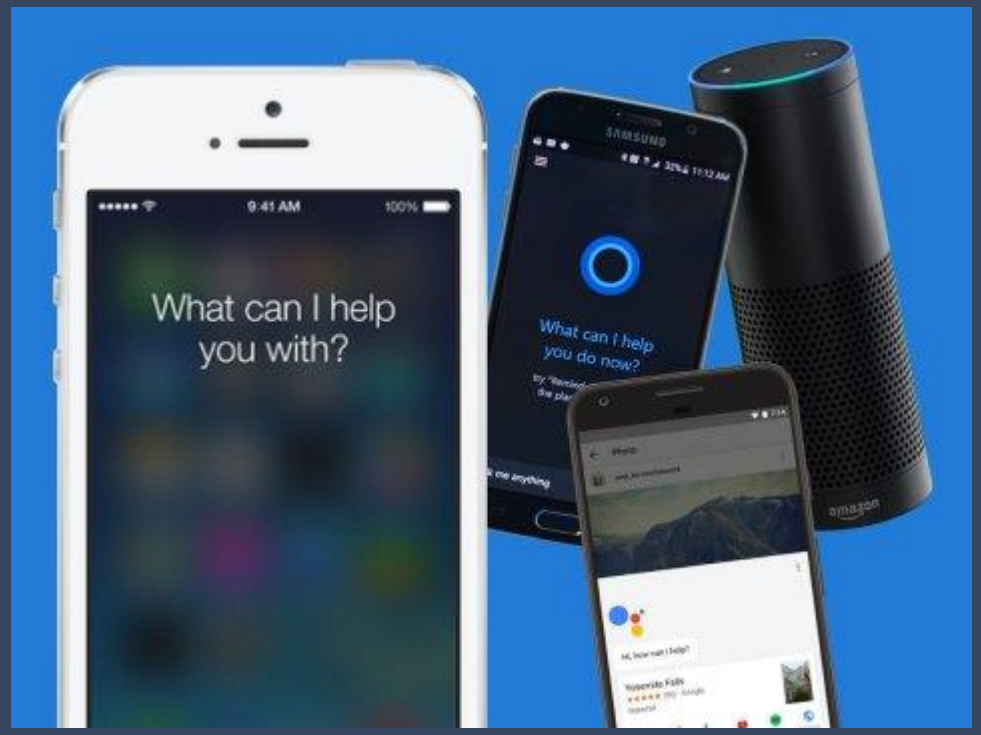

Clusters of customers
Spending Score (1-100)
Annual Income (k$)
0
20
40
60
80
100
20
40
60
80
100
120
140
Cluster 1
Cluster 2
Cluster 3
Cluster 4
Cluster 5
Centroids


160
180
200
220
240
50
100
150
200
250
25
50
75
100
125
150
175
200

Underfitting and Overfitting



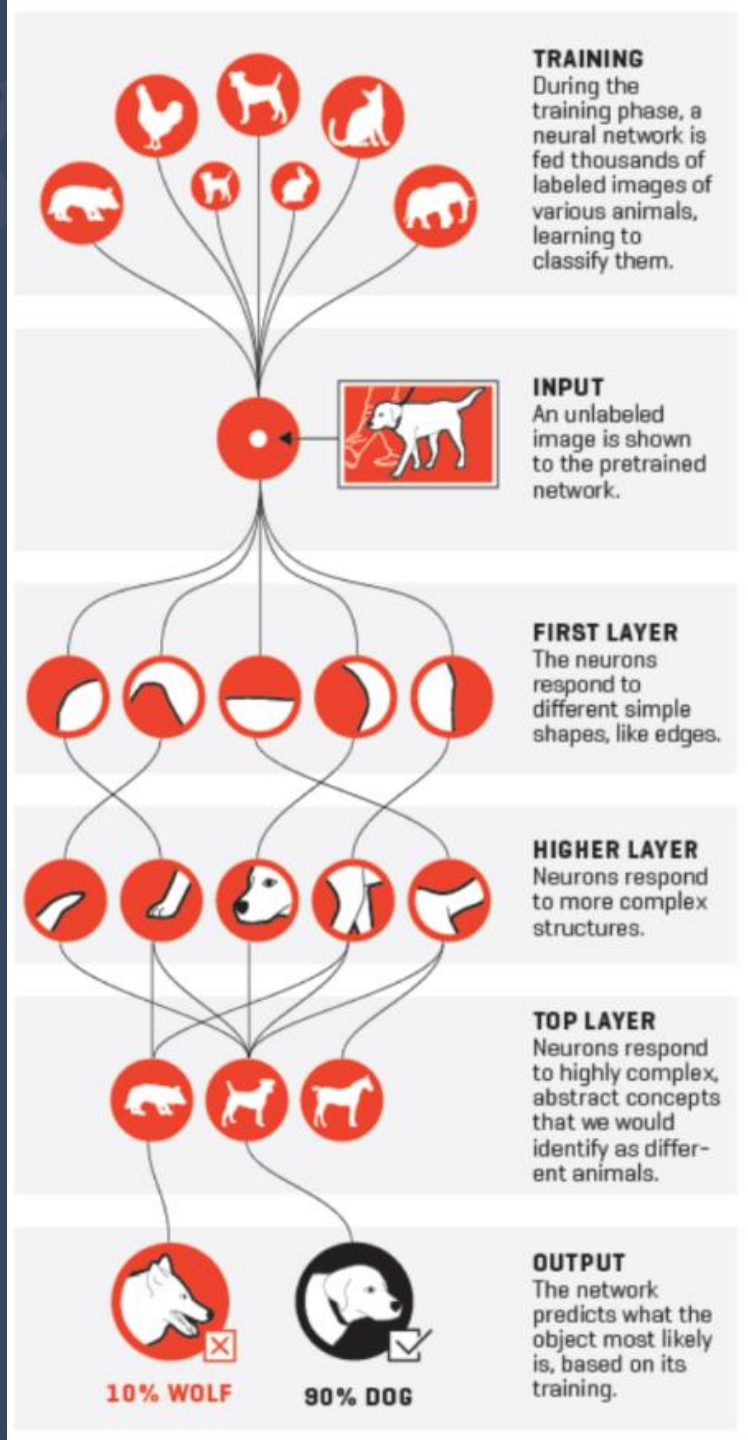
Use Case: Smart speaker



Steps to process the command:

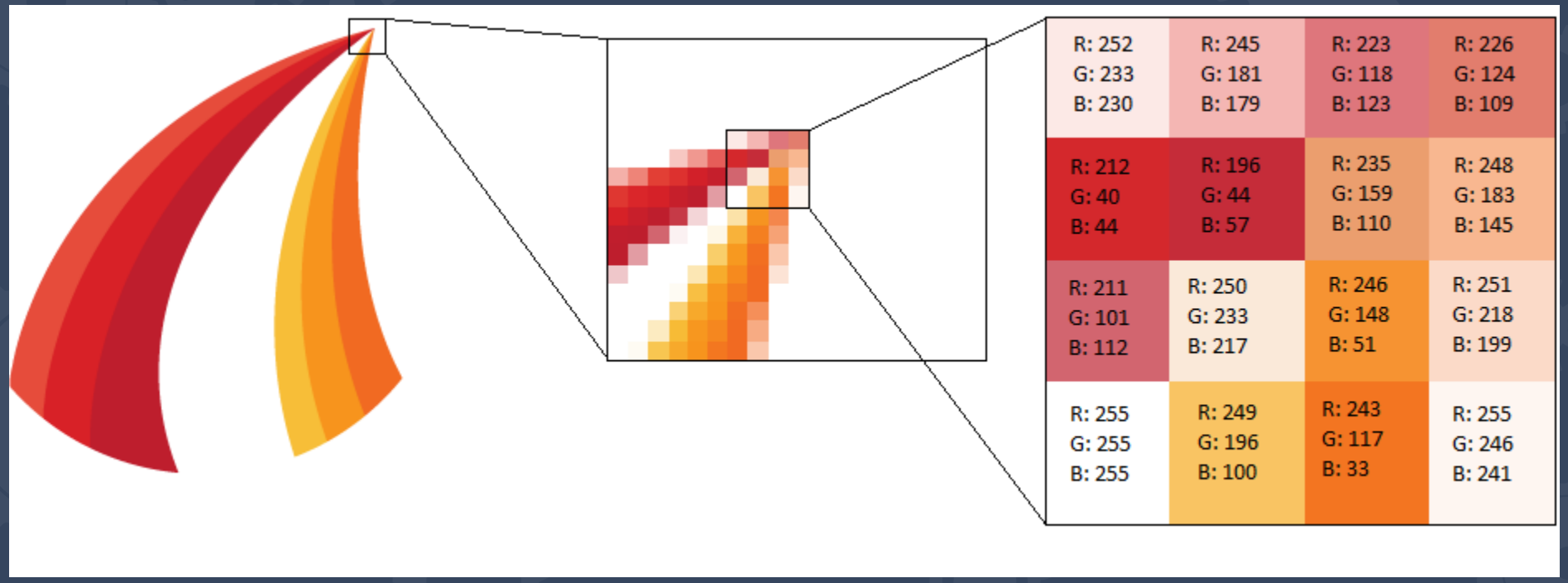
1. Trigger word detection
2. Speech recognition
3. Intent recognition
4. Execute

Use Case: Image Classification

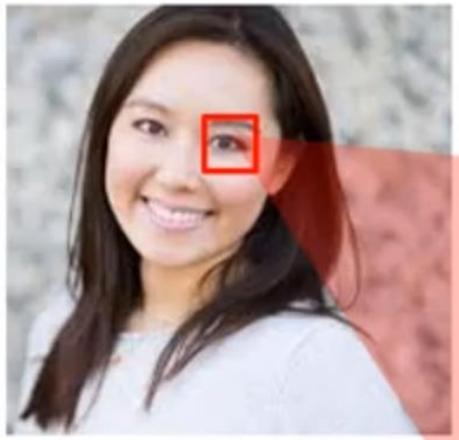


Source: Fortune.com

Computer vision

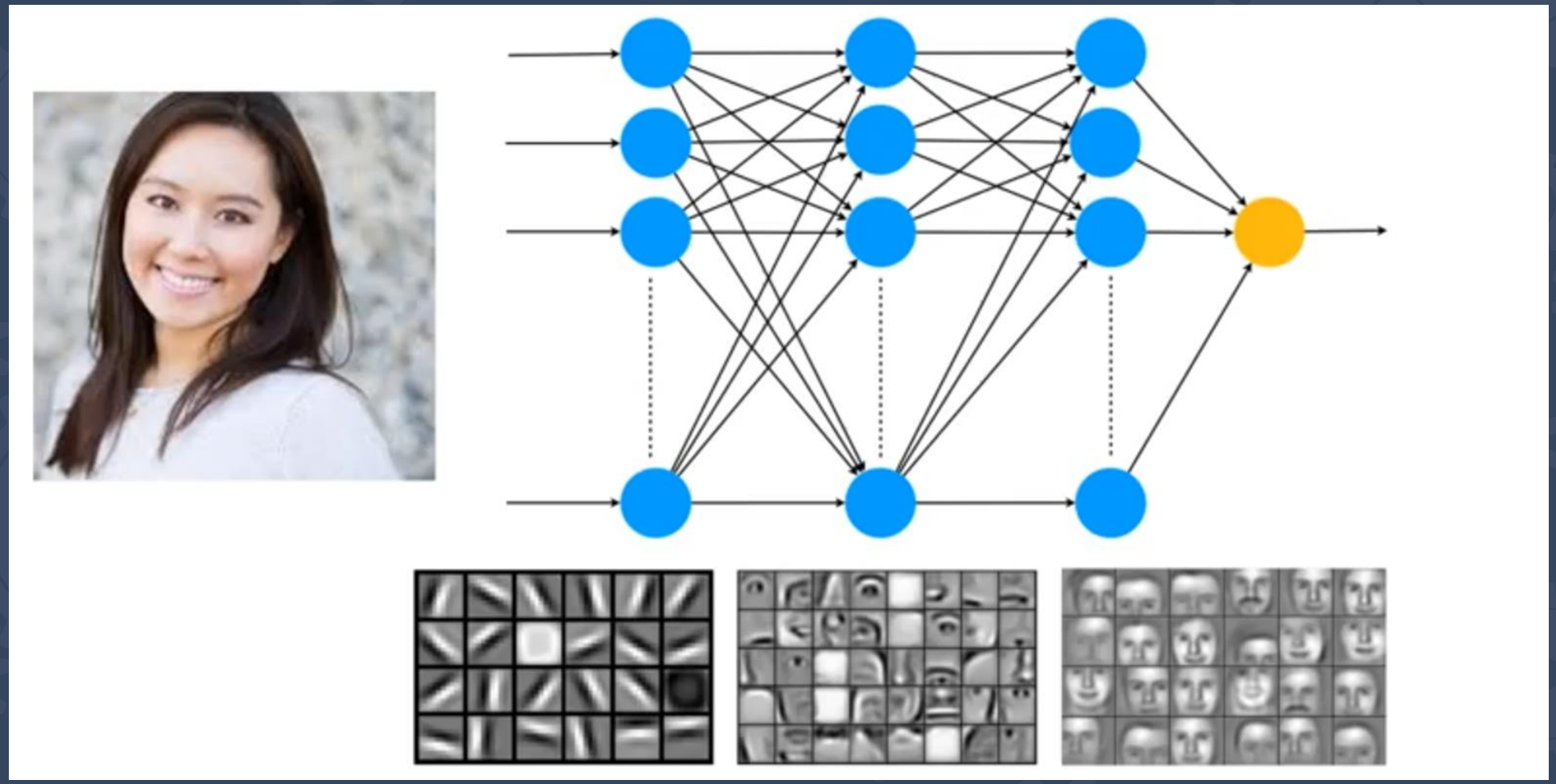


Use Case: Face Recognition

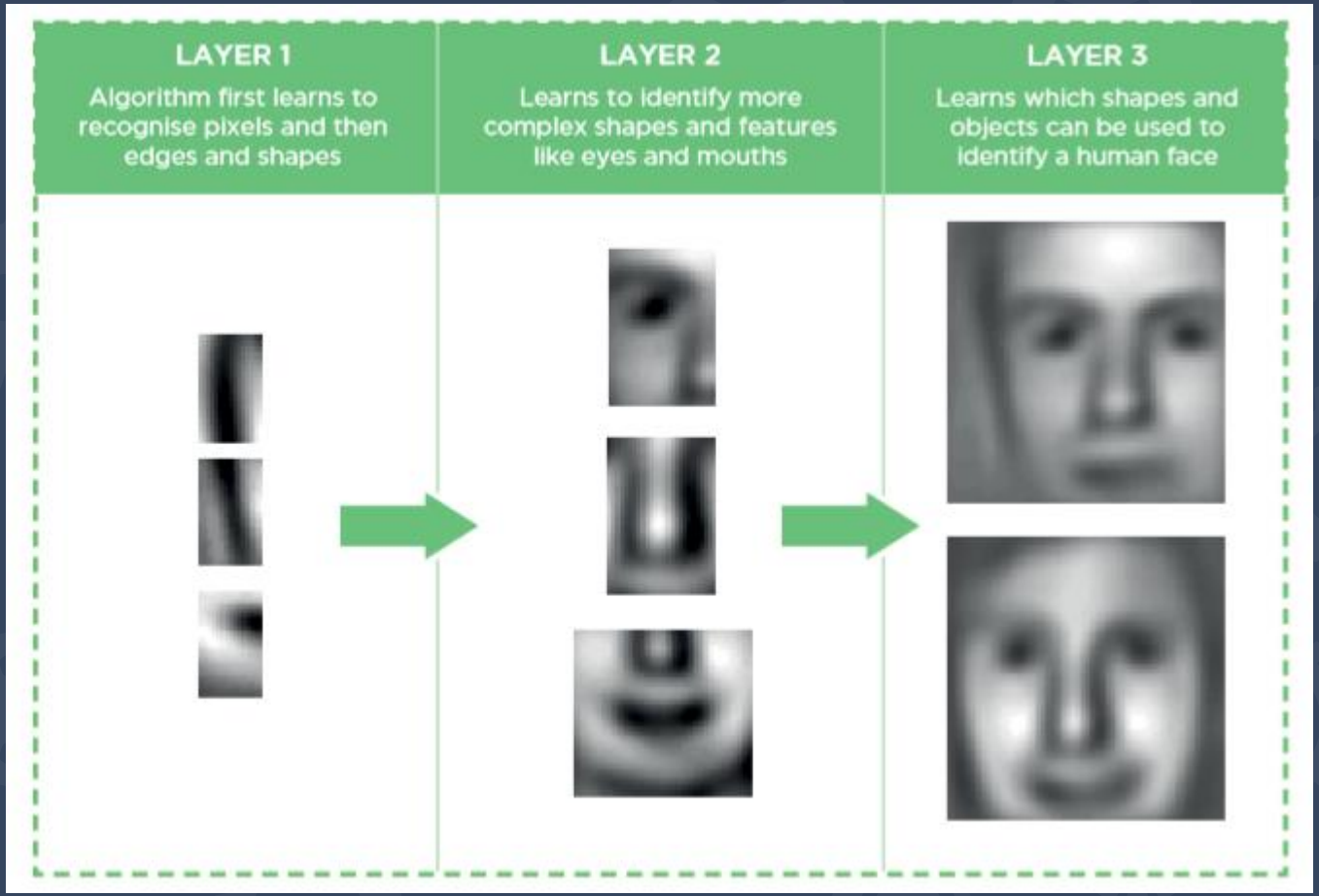


30	32	22	12	10	10	12	33	35	30
12	11	12	234	170	176	13	15	12	12
234	222	220	230	200	222	230	234	56	78
190	220	186	112	110	110	112	180	30	32
49	250	250	250	4	2	254	200	44	6
55	250	250	250	3	1	250	245	25	3
189	195	199	150	110	110	182	190	199	55
200	202	218	222	203	200	200	208	215	222
219	215	220	220	222	214	215	210	220	220
220	220	220	220	221	220	221	220	220	222

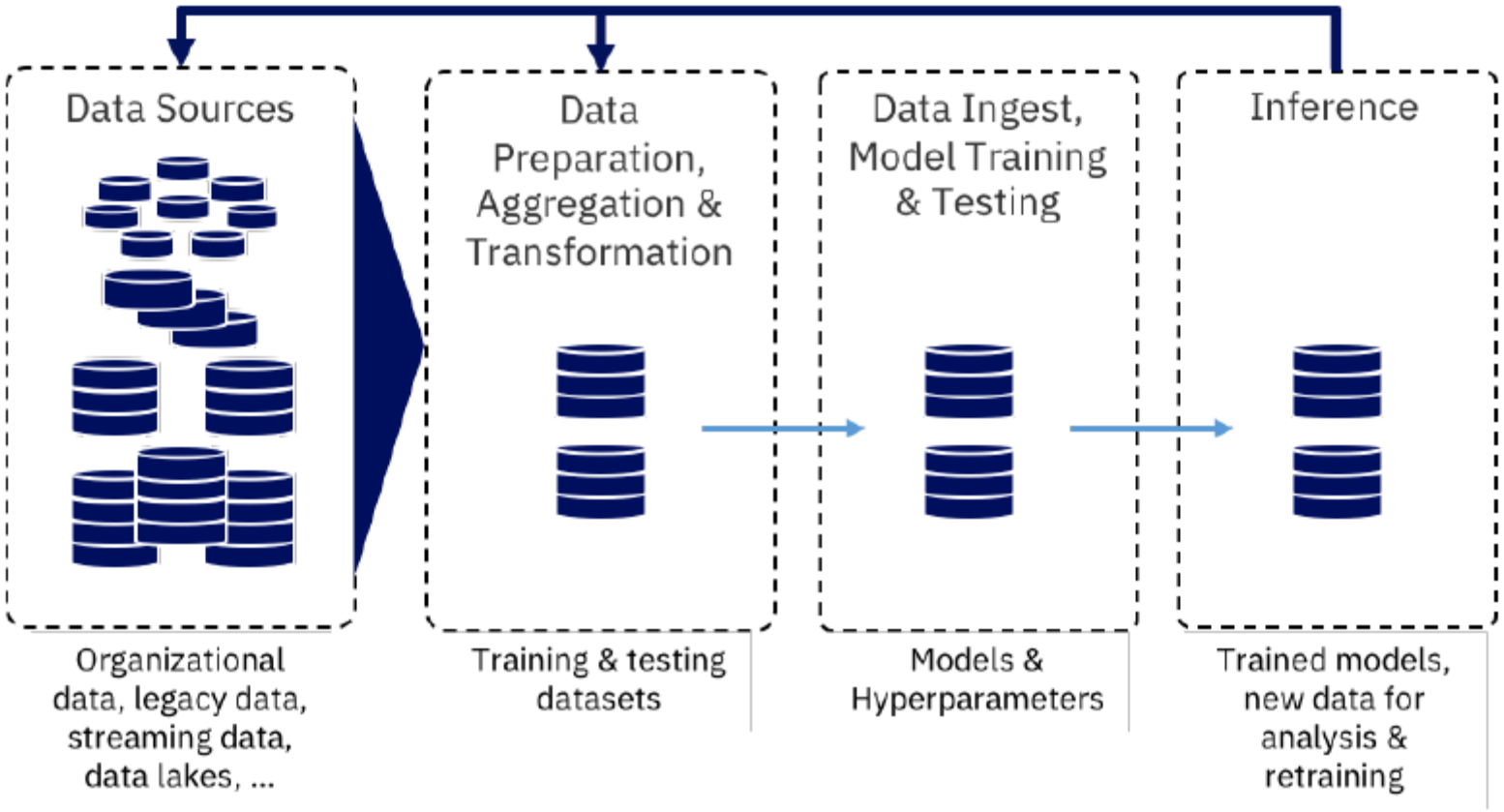
Use Case: Face Recognition



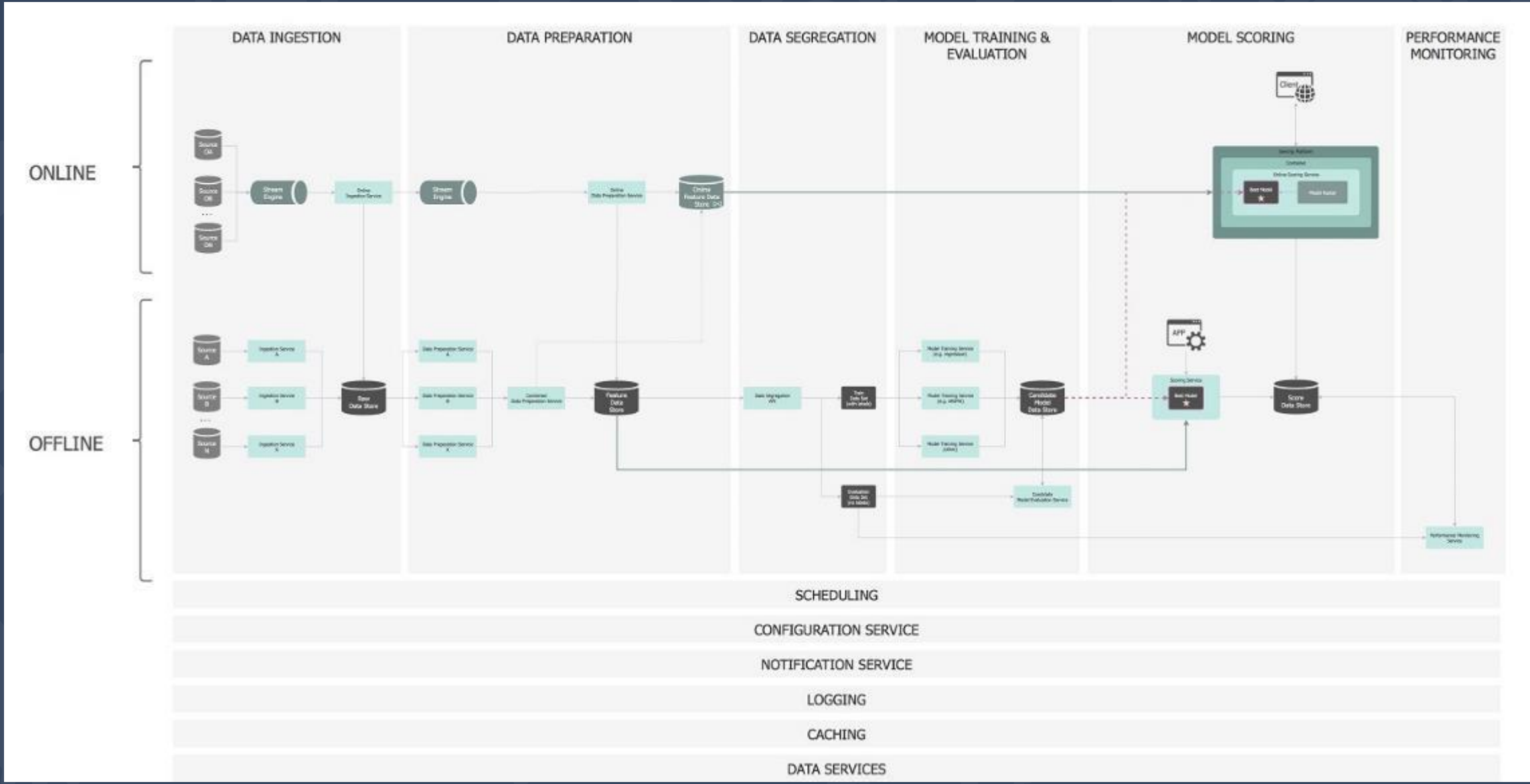
Use Case: Face Recognition



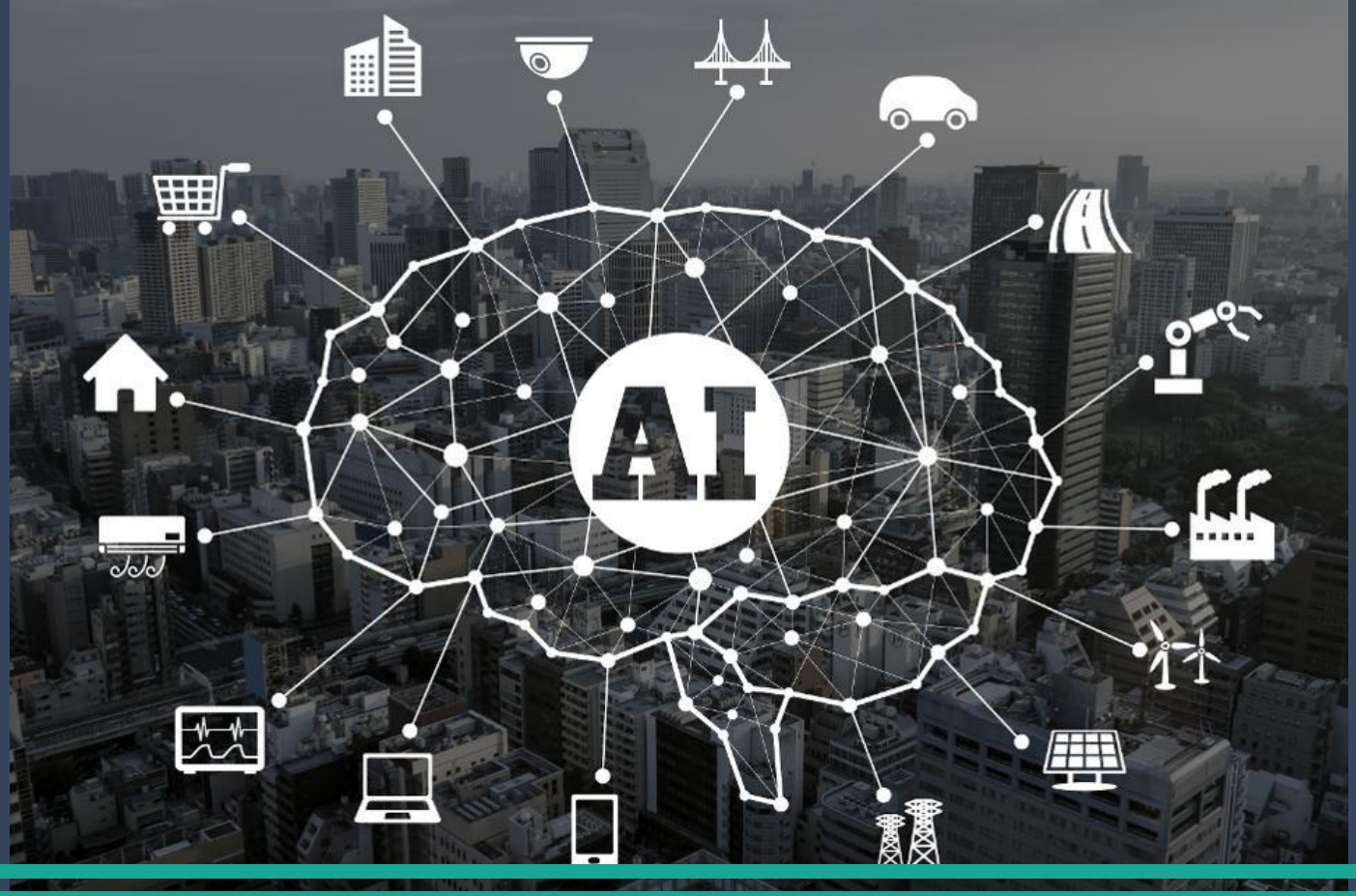
Machine Learning Lifecycle


Data Sources
Data Preparation, Aggregation & Transformation
Data Ingest, Model Training & Testing
Inference
Organizational data, legacy data, streaming data, data lakes, ...
Training & testing datasets
Models & Hyperparameters
Trained models, new data for analysis & retraining

Machine Learning Architecture



True Intelligence or just some smart algorithms?



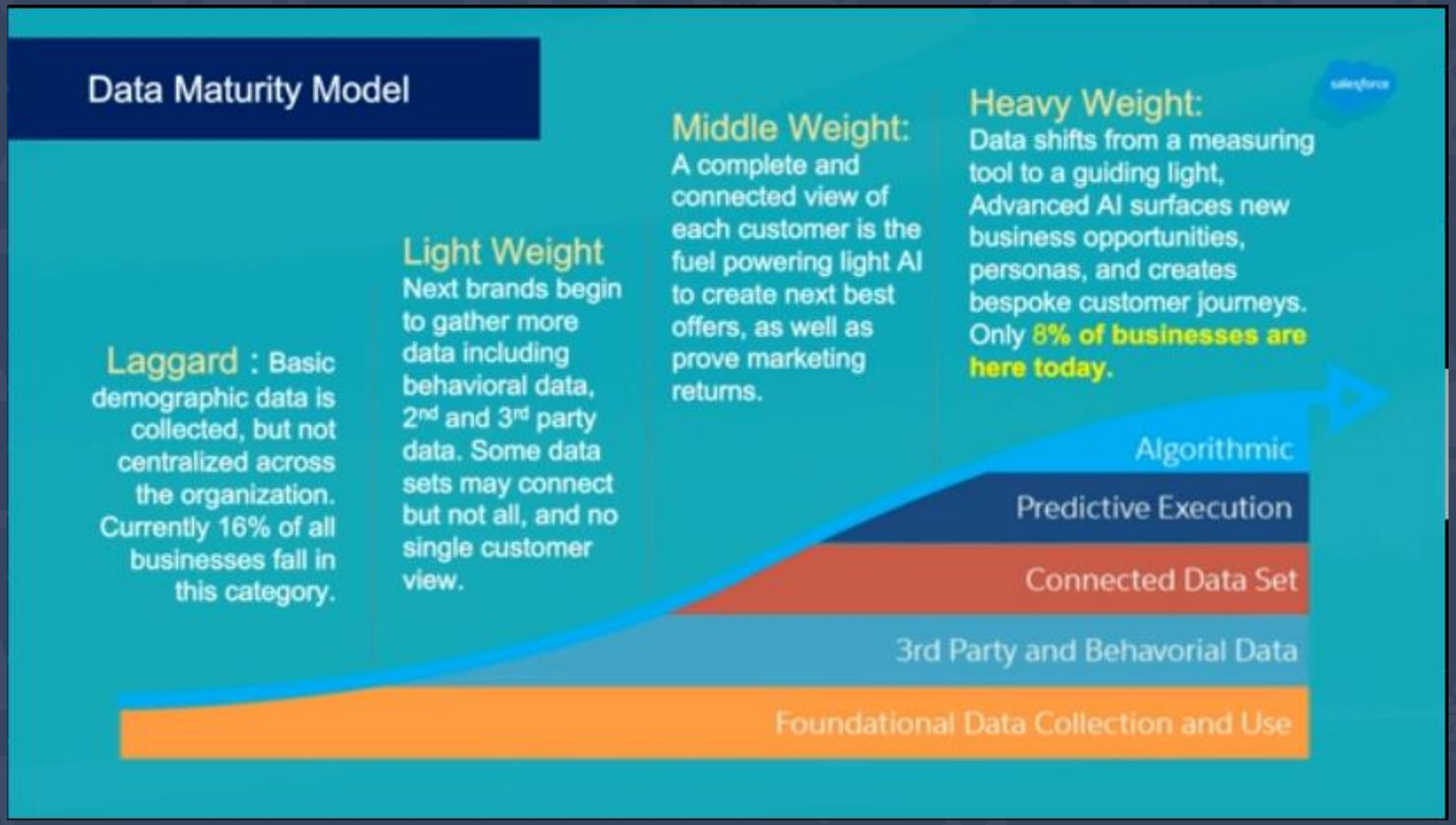
AI Transformation

What makes an AI company

- Strategic data acquisition
- Unified data warehouse
- Pervasive automation
- New roles, such as:
  - Software Engineer: write software code like a function/subroutine
  - Machine Learning Engineer: Responsible for creating models
  - Machine Learning Scientist: Responsible for extending state of the art
  - Applied ML Scientist: A role in between ML Engineer and Researcher
  - Data Scientist: Examine Data and provide insights to drive business decisions
  - Data Engineer: Make sure data is easily accessible in a secure and cost effective way
  - AI Product Manager: What to build, what is valuable and feasible
  - etc.

Source: deeplearning.ai

Data Maturity



*Source: Salesforce

5 Steps of AI Transformation

1. Execute pilot projects to gain momentum
2. Build an in-house AI team
3. Provide broad AI training
4. Develop an AI strategy
5. Develop internal and external communications

Source: https://landing.ai/ai-transformation-playbook/

AI Strategy

- Build several difficult AI assets that are broadly aligned with a coherent strategy.
- Leverage AI to create an advantage specific to your industry sector.
- Design strategies aligned with the “Virtuous circle of AI” positive-feedback loop.
- Create network effect and platform advantages.

Source: https://landing.ai/ai-transformation-playbook/

Data Strategy

Data is a key asset for AI systems. Thus, many great AI companies also have a sophisticated data strategy. Key elements of your data strategy may include:

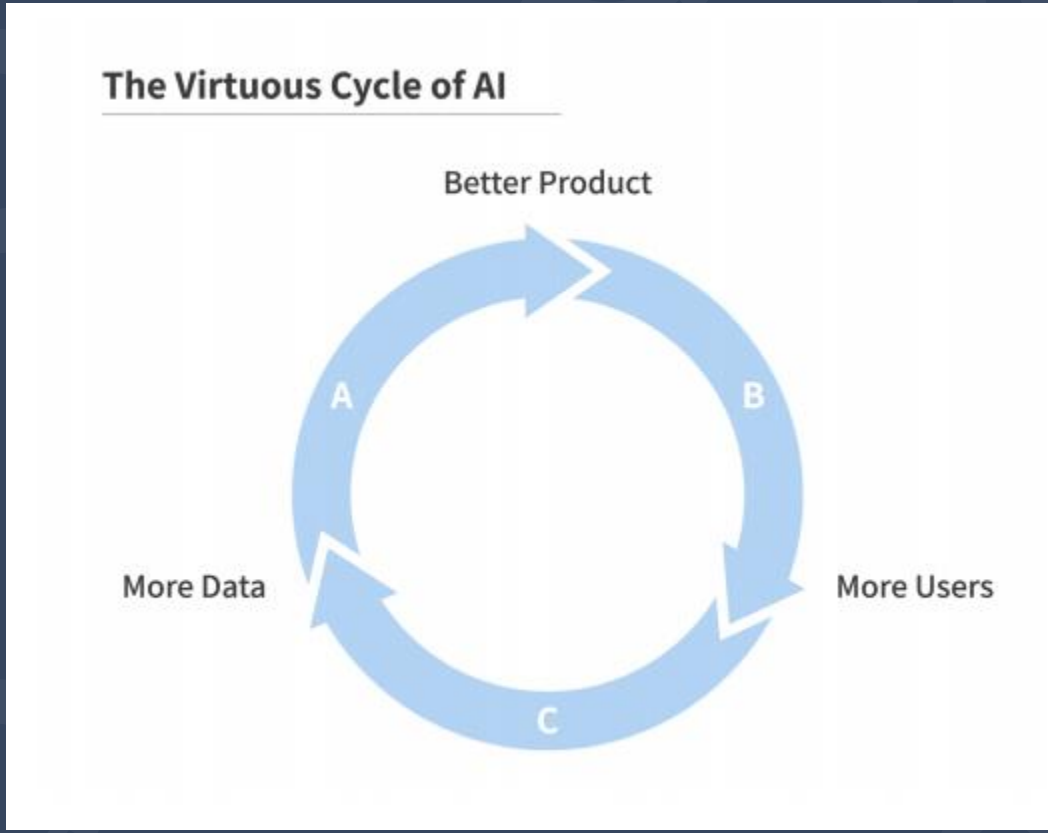
- **Strategic data acquisition**: Useful AI systems can be built with anywhere from 100 data points (“small data”) to 100,000,000 data points (“big data”). But having more data almost never hurts. AI teams are using very sophisticated, multi-year strategies to acquire data, and specific data acquisition strategies are industry- and situation-specific. For example, Google and Baidu both have numerous free products that do not monetize but allow them to acquire data that can be monetized elsewhere.

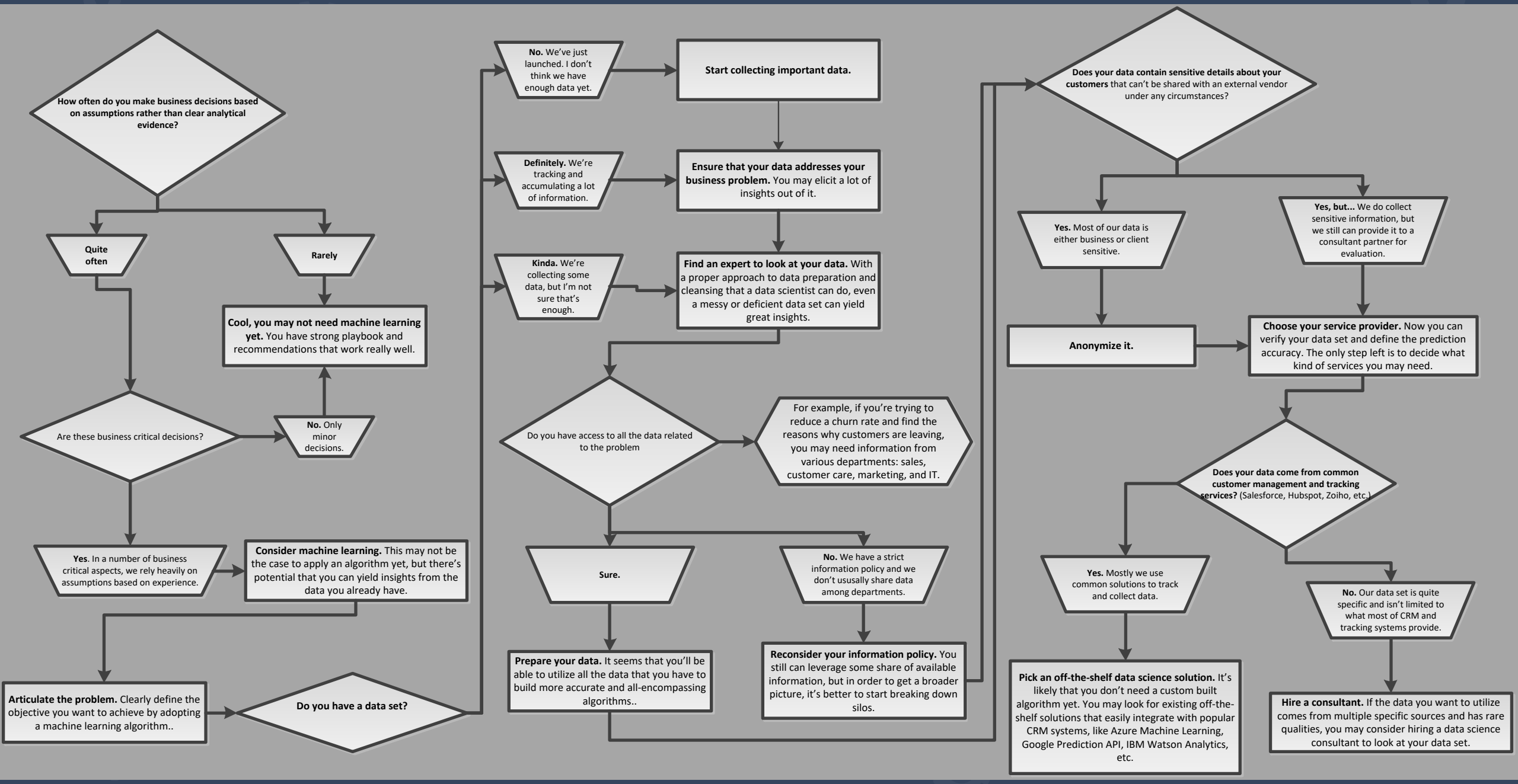
- **Unified data warehouses**: If you have 50 different databases siloed under the control of 50 different VPs or divisions, it will be nearly impossible for an engineer or for AI software to get access to this data and “connect the dots.” Instead, consider centralizing your data into one or at most a small number of data warehouses.

- **Recognize what data is valuable, and what is not**: It is not true that having many terabytes of data automatically means an AI team will be able to create value from that data. Expecting an AI team to magically create value from a large dataset is a formula that comes with a high chance of failure, and I have tragically seen CEOs over-invest in collecting low-value data, or even acquire a company for its data only to realize the target company’s many terabytes of data is not useful. Avoid this mistake by bringing an AI team in early during your process of data acquisition, and let them help you prioritize what types of data to acquire and save.

Source: https://landing.ai/ai-transformation-playbook/

Virtuous Cycle of AI:




How often do you make business decisions based on assumptions rather than clear analytical evidence?
Quite often
Rarely
Cool, you may not need machine learning yet. You have strong playbook and recommendations that work really well.
Are these business critical decisions?
No. Only minor decisions.
Yes. In a number of business critical aspects, we rely heavily on assumptions based on experience.
Consider machine learning. This may not be the case to apply an algorithm yet, but there's potential that you can yield insights from the data you already have.
Articulate the problem. Clearly define the objective you want to achieve by adopting a machine learning algorithm..
Do you have a data set?
No. We've just launched. I don't think we have enough data yet.
Start collecting important data.
Definitely. We're tracking and accumulating a lot of information.
Ensure that your data addresses your business problem. You may elicit a lot of insights out of it.
Kinda. We're collecting some data, but I'm not sure that's enough.
Find an expert to look at your data. With a proper approach to data preparation and cleansing that a data scientist can do, even a messy or deficient data set can yield great insights.
Do you have access to all the data related to the problem
For example, if you're trying to reduce a churn rate and find the reasons why customers are leaving, you may need information from various departments: sales, customer care, marketing, and IT.
Sure.
No. We have a strict information policy and we don't ususally share data among departments.
Prepare your data. It seems that you'll be able to utilize all the data that you have to build more accurate and all-encompassing algorithms..
Reconsider your information policy. You still can leverage some share of available information, but in order to get a broader picture, it's better to start breaking down silos.
Does your data contain sensitive details about your customers that can't be shared with an external vendor under any circumstances?
Yes. Most of our data is either business or client sensitive.
Yes, but... We do collect sensitive information, but we still can provide it to a consultant partner for evaluation.
Anonymize it.
Choose your service provider. Now you can verify your data set and define the prediction accuracy. The only step left is to decide what kind of services you may need.
Does your data come from common customer management and tracking services? (Salesforce, Hubspot, Zoiho, etc.)
Yes. Mostly we use common solutions to track and collect data.
No. Our data set is quite specific and isn't limited to what most of CRM and tracking systems provide.
Pick an off-the-shelf data science solution. It's likely that you don't need a custom built algorithm yet. You may look for existing off-the-shelf solutions that easily integrate with popular CRM systems, like Azure Machine Learning, Google Prediction API, IBM Watson Analytics, etc.
Hire a consultant. If the data you want to utilize comes from multiple specific sources and has rare qualities, you may consider hiring a data science consultant to look at your data set.

Google Cloud Platform

amazon web services

Azure

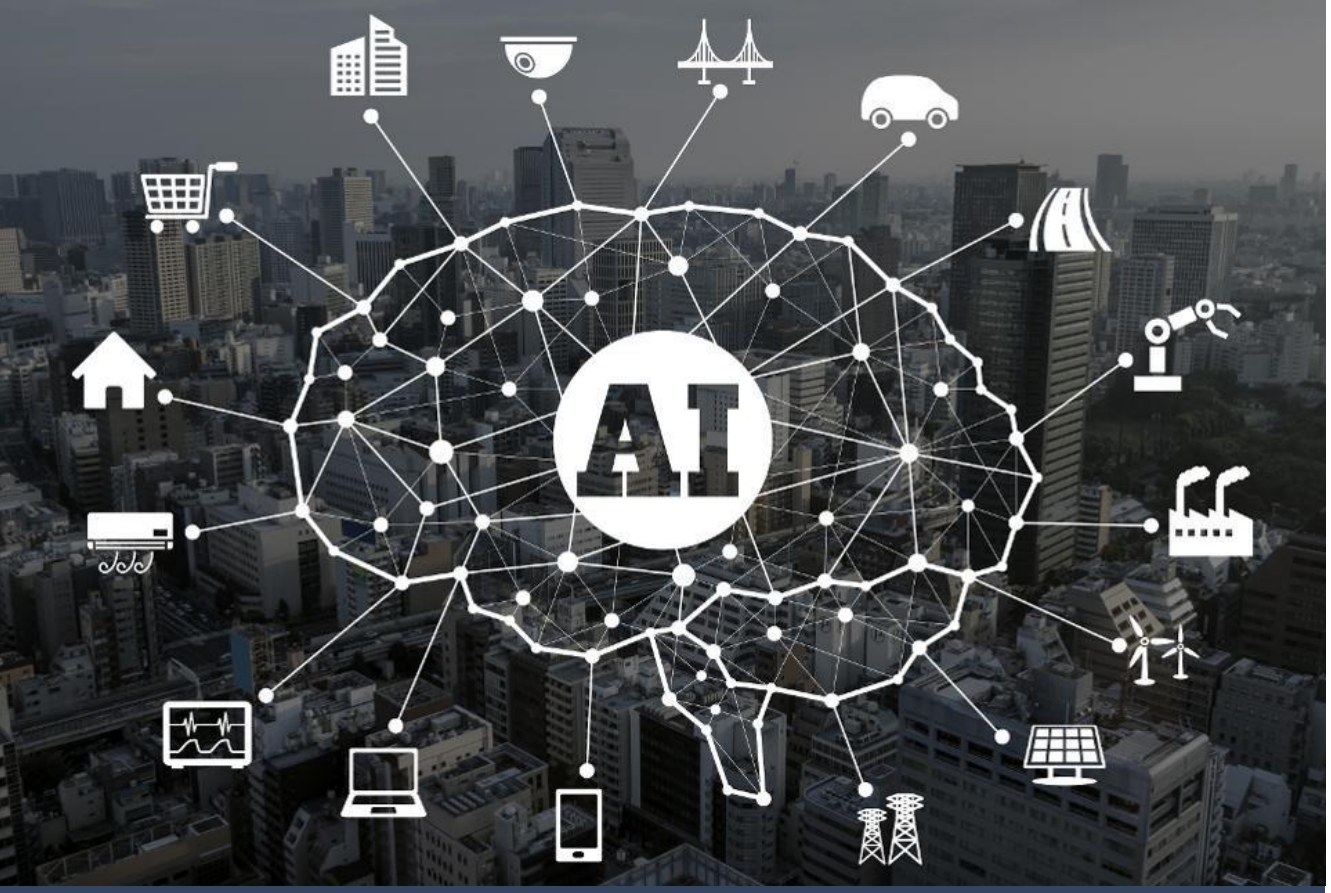
R

python

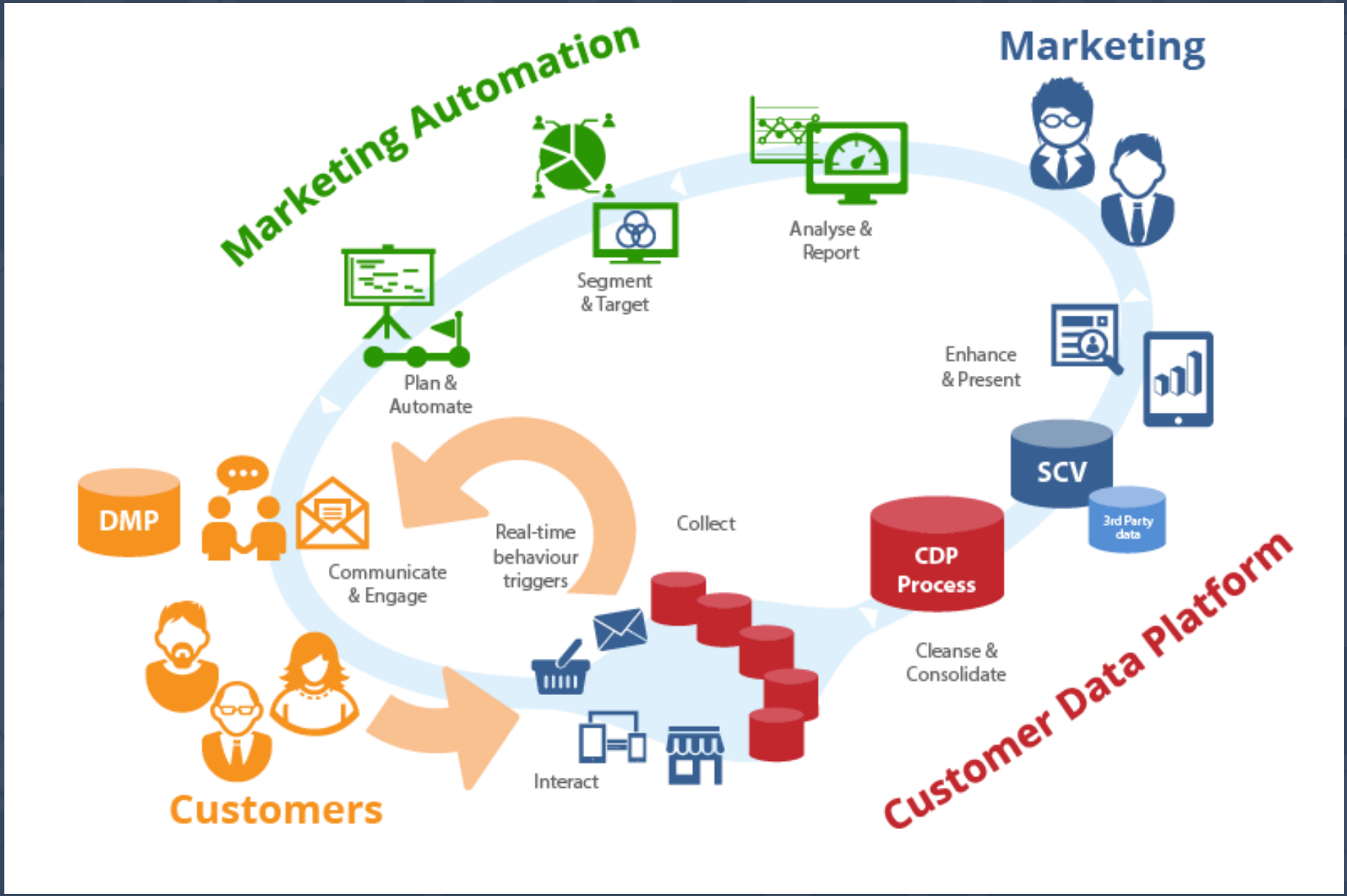
TensorFlow

Keras

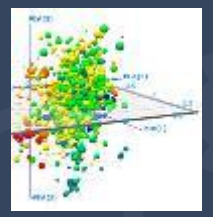
torch



AI in Marketing


Marketing Automation
Marketing
Analyse & Report
Segment & Target
Plan & Automate
Enhance & Present
SCV
3rd Party data
CDP Process
Cleanse & Consolidate
Customer Data Platform
DMP
Communicate & Engage
Real-time behaviour triggers
Collect
Interact
Customers

Marketing Analytics and Machine Learning



Hyper personalization and rapid experimentation

- Simulate and experiment with possible scenarios
- Hyper personalizing leveraging deep learning and neural networks (Next Best Offer)
- Leverage unstructured data and NLP to gain insights

Predictive modelling

- Leverage AI-ML techniques to predict future outcomes (CLTV, Churn, etc.)
- Connect AI-ML use cases to tangible measurable outcomes
- Leverage models to understand correlations and causalities

Segmentation

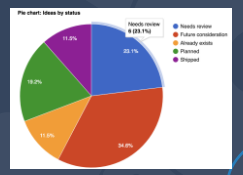
- Leverage algorithms to do segmentation to gain hidden insights
- Grouping and segmentation of customers, products, etc.
- Gain benefits from segmentation by doing targeted campaigns

Advanced data visualization

- Ability to do customer 360 by integrating data from all channels
- Advanced data visualizations with capability to do slicing and dicing to the customer level
- Unified customer view by having a single integrated data repository from CRM and other marketing stack

Performance-based reporting

- Integrated KPI-based performance reporting
- Interactive dashboards for providing the right level of insight
- Data integrated between CRM and few other marketing systems to gain insights



Operational reporting

- Standard reporting
- Custom segmentation and RFM calculation

Strategic Value

Analytical Sophistication

Customer Data Platform Definition

"A Customer Data Platform is packaged software that creates a persistent, unified customer database that is accessible to other systems".

This definition has three critical elements:

- "**packaged software**": the CDP is a prebuilt system that is configured to meet the needs of each client. Some technical resources will be required to set up and maintain the CDP, but it does not require the level of technical skill of a typical data warehouse project. This reduces the time, cost, and risk and gives business users more control over the system, even though they may still need some technical assistance.

- "**creates a persistent, unified customer database**": the CDP creates a comprehensive view of each customer by capturing data from multiple systems, linking information related to the same customer, and storing the information to track behavior over time. The CDP contains personal identifiers used to target marketing messages and track individual-level marketing results.

- "**accessible to other systems**": data stored in the CDP can be used by other systems for analysis and to manage customer interactions.

https://www.cdpinstitute.org/cdp-basics

CDP core features:

- Understand your customer: Single customer view to understand customer and deliver better, personalized services
- Sell better: Improve marketing through personalization and expanding reach and retain media effectiveness learning of what worked and what didn’t
- Data ownership: Collect, unify and retain data from various sources. Democratize customer intelligence across the enterprise

CDP technical features:

- Ability to consolidate data from multiple systems and formats
- Ability to match phone numbers & contact details to IFAs probabilistically
- Ability to automate marketing communications using APIs for mainstream media channels

LEVEL 1 CDP:

A Unified Database

Bring Data In from
Outside Data Sources

Customer Data Platform
with a Unified Profile for Each Individual

LEVEL 2 CDP:

A Unified Database that Passes Data to Other Systems

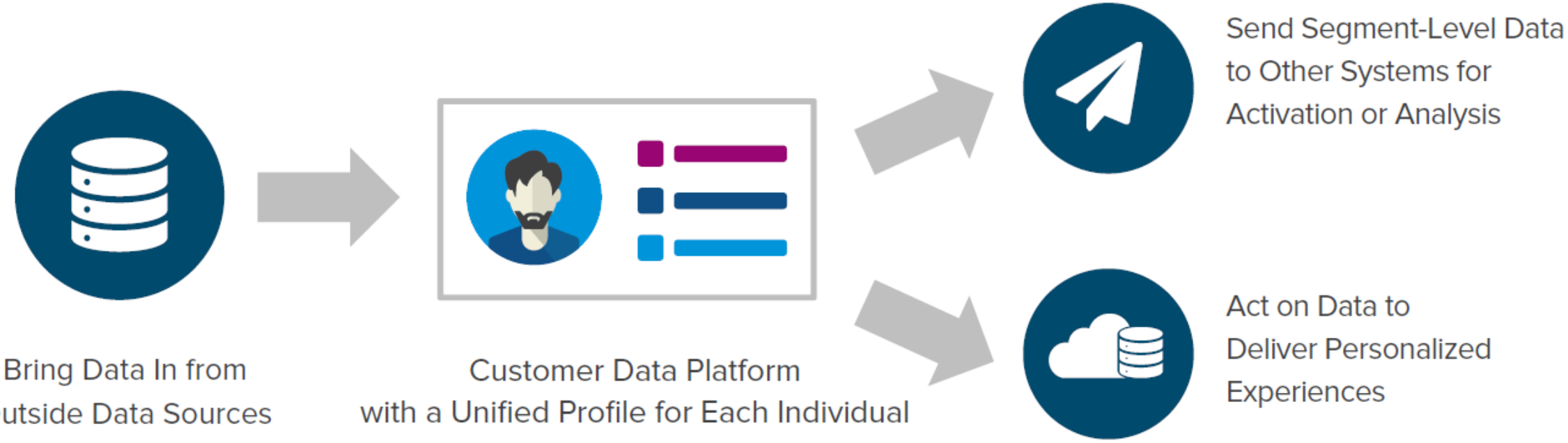
Bring Data In from
Outside Data Sources

Customer Data Platform
with a Unified Profile for Each Individual

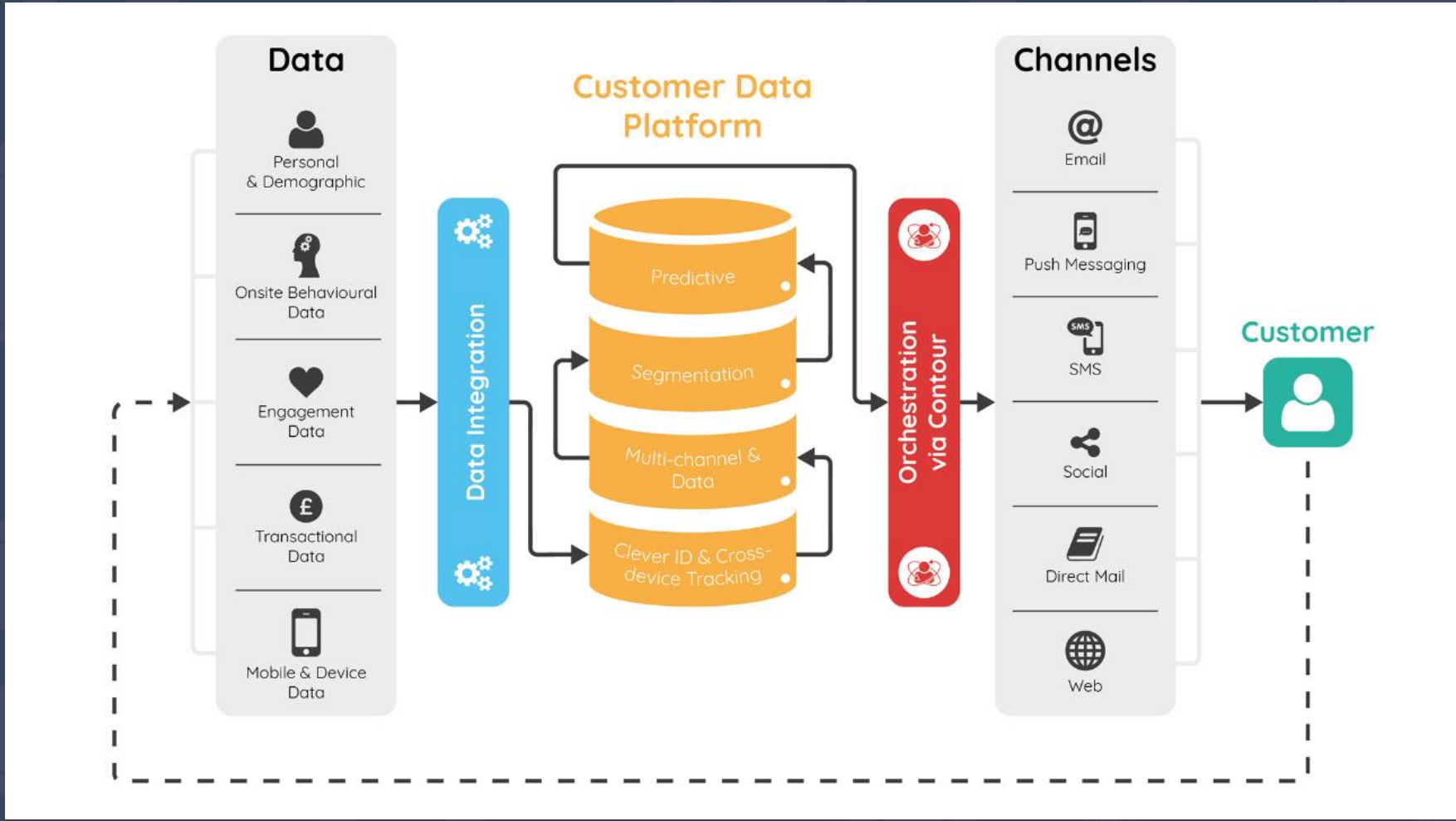
Send Segment-Level Data to
Other Systems for Activation
or Analysis

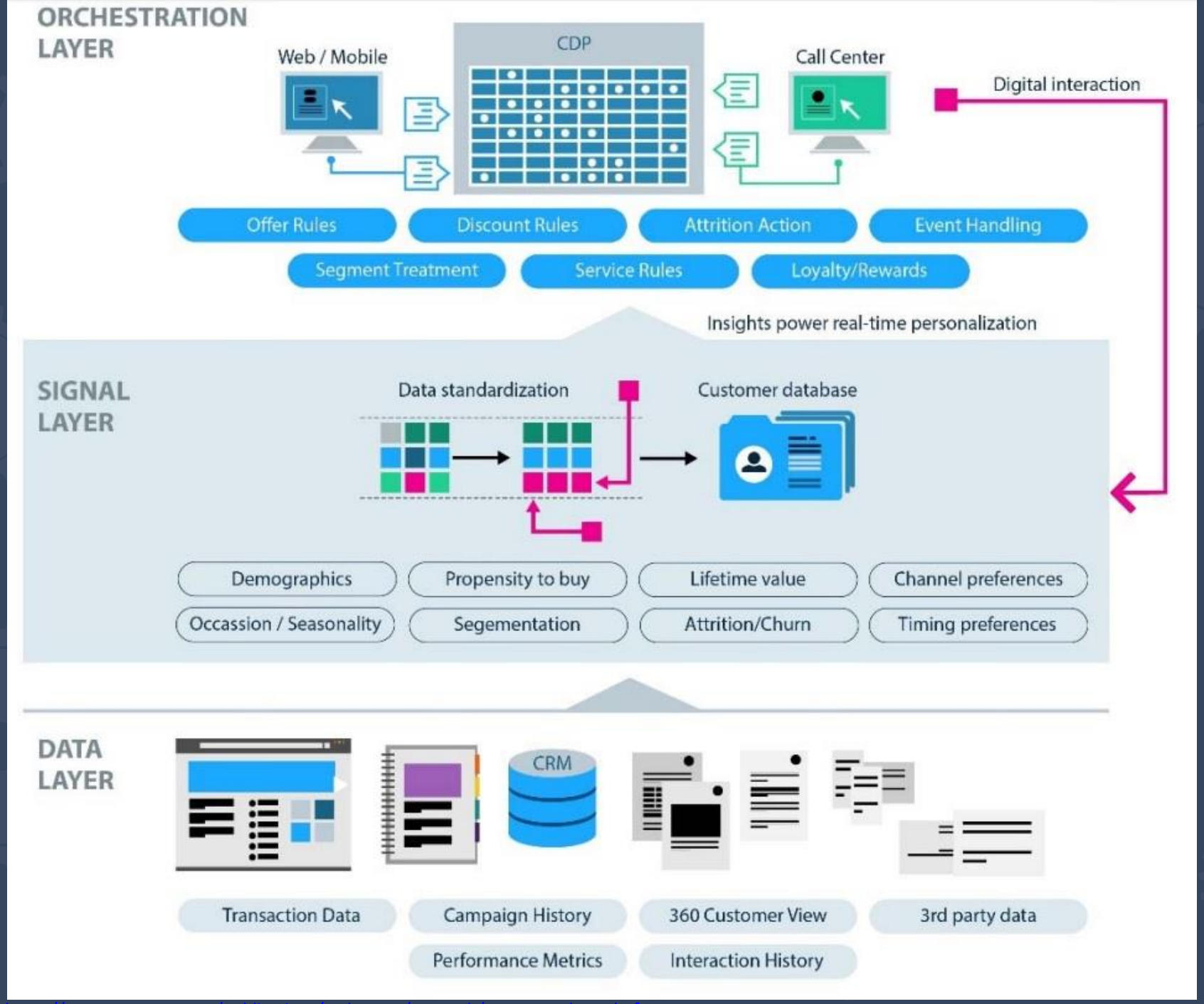
LEVEL 3 CDP:

A Unified Database that Passes Data to Other Systems AND Acts on Data to Deliver Personalized Experiences

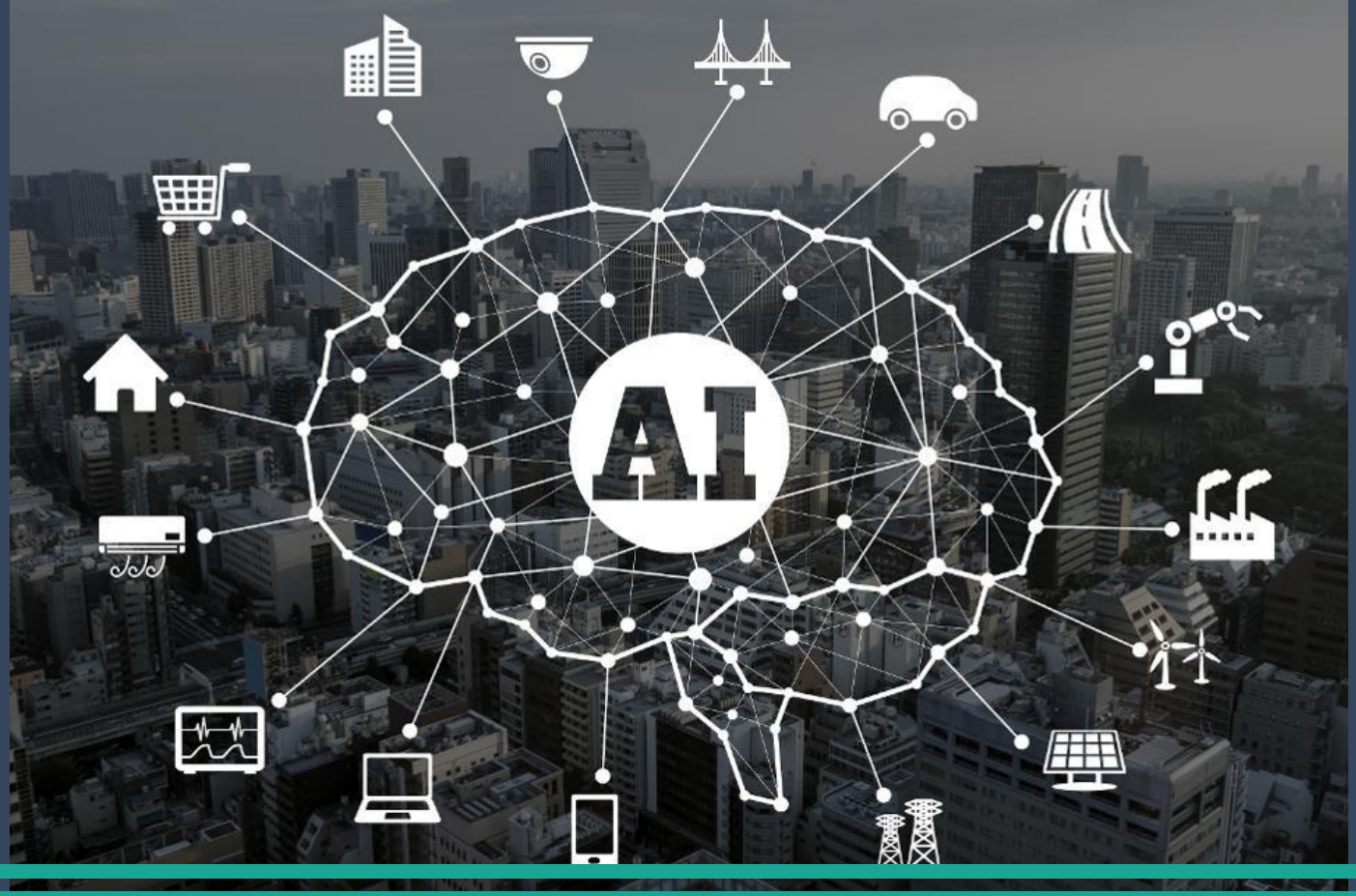


	Level 1 Differentiators	**Level 2** Differentiators	**Level 3** Differentiators
Collect in-depth, cross-channel behavioral data	●	●	●
Track data at account level	●	●	●
Understand business context	●	●	●
Interpret and analyze data with affinity modeling	●	●	●
Leverage a robust framework for exchanging data with outside systems		●	●
Pass data at the segment level based on deeper data		●	●
Use data to personalize at the segment and individual level, in true real time			●
Deliver 1-to-1 personalized experiences across channels			●
Build and A/B test your own personalization campaigns			●
Dive into algorithms and apply your own insights			●


Data
Personal & Demographic
Onsite Behavioural Data
Engagement Data
Transactional Data
Mobile & Device Data
Data Integration
Customer Data Platform
Predictive
Segmentation
Multi-channel & Data
Clever ID & Cross-device Tracking
Orchestration via Contour
Channels
Email
Push Messaging
SMS
Social
Direct Mail
Web
Customer



https://www.computer.org/publications/tech-news/research/customer-data-platform



AI and Society

Some notes on AI

- Explainability of AI is hard.
- Ethical issues.
- Privacy compliance.
- AI can become biased with biased data.
- AI systems are open to Adversarial Attacks. In future companies might be at war with the adversarial attackers.
- US and China are leading in AI but this technology is still immature giving other nations an equal advantage to compete.
- AI to create 13 Trillion Value by 2030 mostly to be used in Retail followed by Travel and Automotive sector. (McKinsey)
- By 2030 (McKinsey):
    - Jobs displaced by AI : 400–800 Million
    - Jobs created by AI : 555–890 Million

Privacy Compliance: Challenges and Opportunities

Trust Maturity Model

Explain: Explaining how you plan to use personal data, showcase experiences you can create with It, and explain how you plan to protect it. This is the foundation of trust to gain consumer data.

Value and Transparency: To gain their explicit permission you must ask, and to make that exchange provide them with value. Brands able to show over time how they have used personal data are able to build more trust and gain more access.

Ownership: It is the consumers data. Brands who easily allow their customers to access their data, and control it are able to reach the peak of consumer trust with their data.

Source: salesforce

Consumers trust brands with their data more when they....

Explain how data improves their experience

86%

Ask for permission to use the data

88%

Be **transparent** on what data you are using and when

91%

Give **control** over the collected data and how it is used

92%

Source: State of the Connected Customer 2018

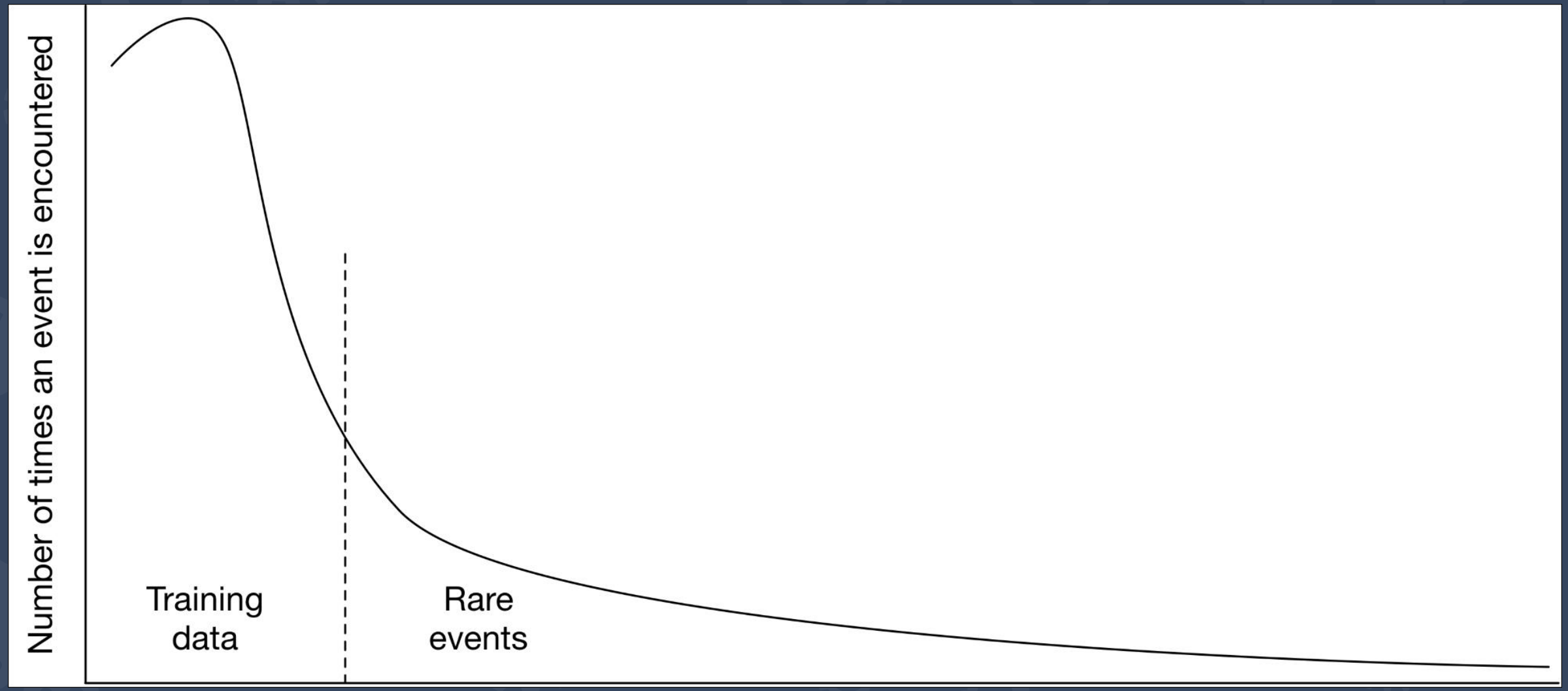
GDPR: 3 Important Points

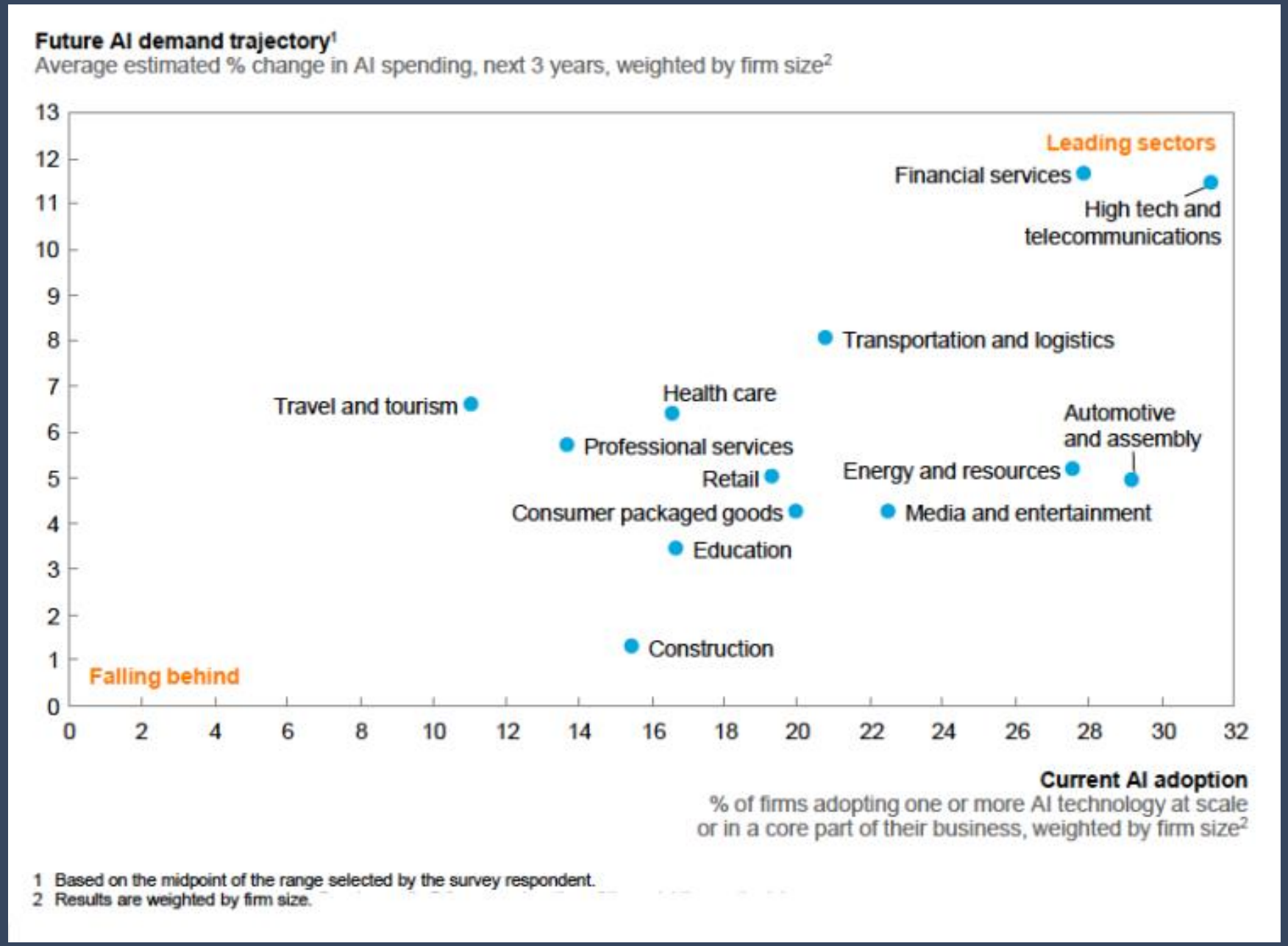
1. **Expanded Definition of Personal Data** : The GDPR explicitly defines online identifiers (in Recital 30) such as IP addresses, cookie identifiers, GPS locations as PII. In the UK, a postal code may be so granular that it identifies one person or ten people. Name, email, phone, etc are of course still PII. Further, GDPR recognizes the concept of “pseudonymization” which is a practice that may include User IDs and/or encryption/hashing of data to make identification of an individual less likely without combining it with another data source.

2. **Explicit Consent & Transparency** : No more pre-checked boxes or inactivity to assume consent; your customers must explicitly opt-in. They must also be able to easily change their decision afterwards (opt-out).

3. **Right to be Forgotten** : Personal data must be erased upon the request.

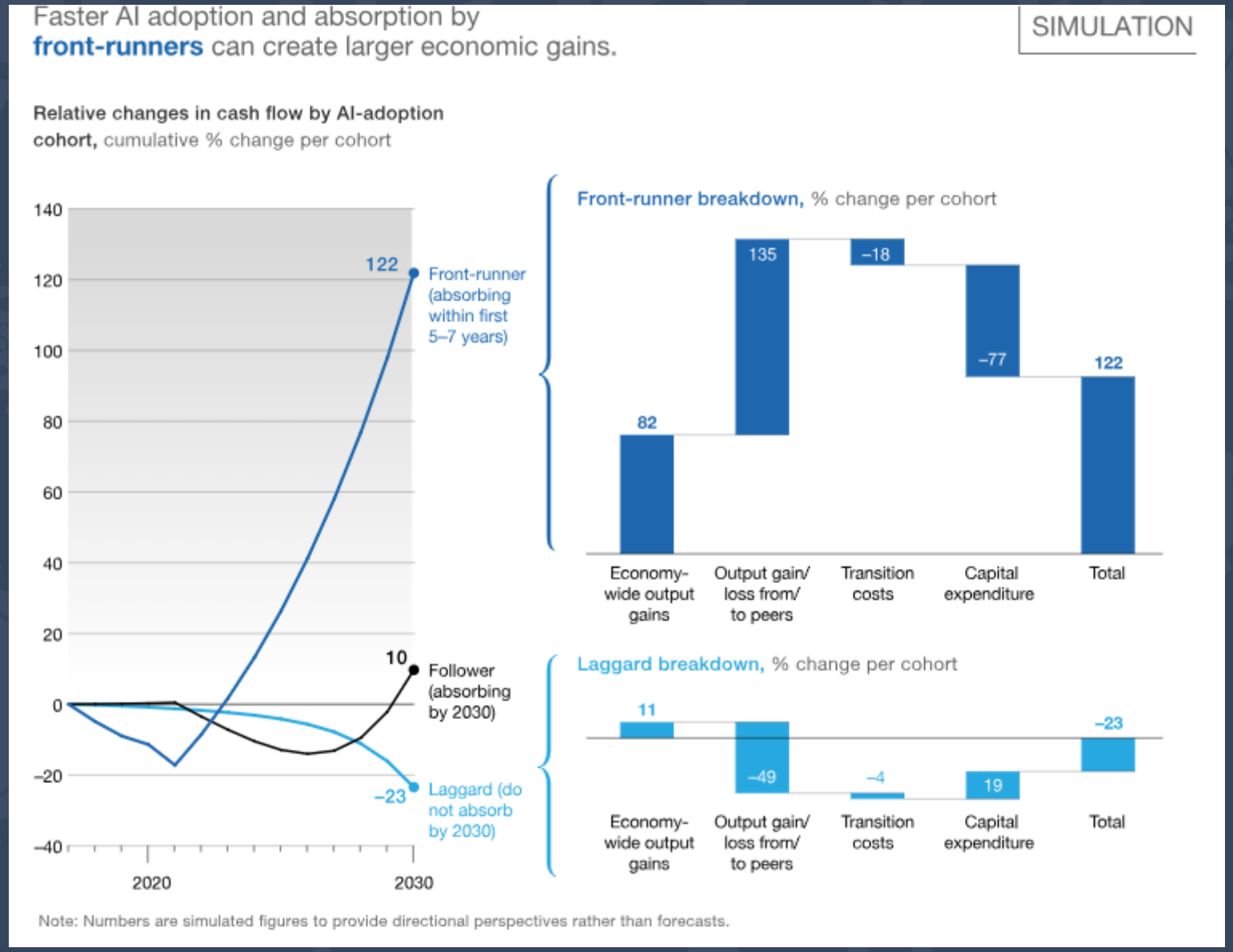
Bias


Number of times an event is encountered
Training data
Rare events



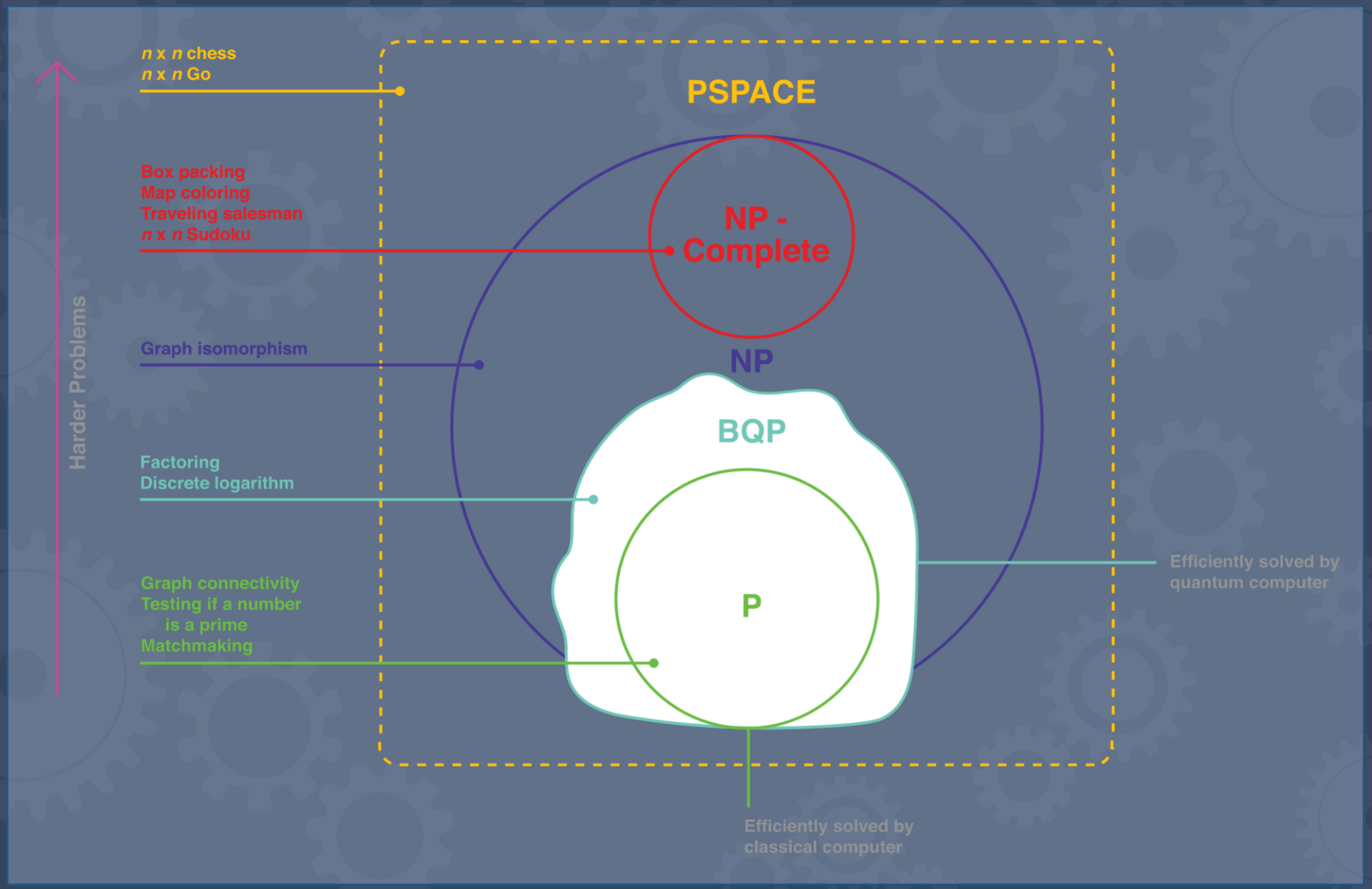
Source: McKinsey Global Institute AI adoption and use survey 2018

Economic advantage

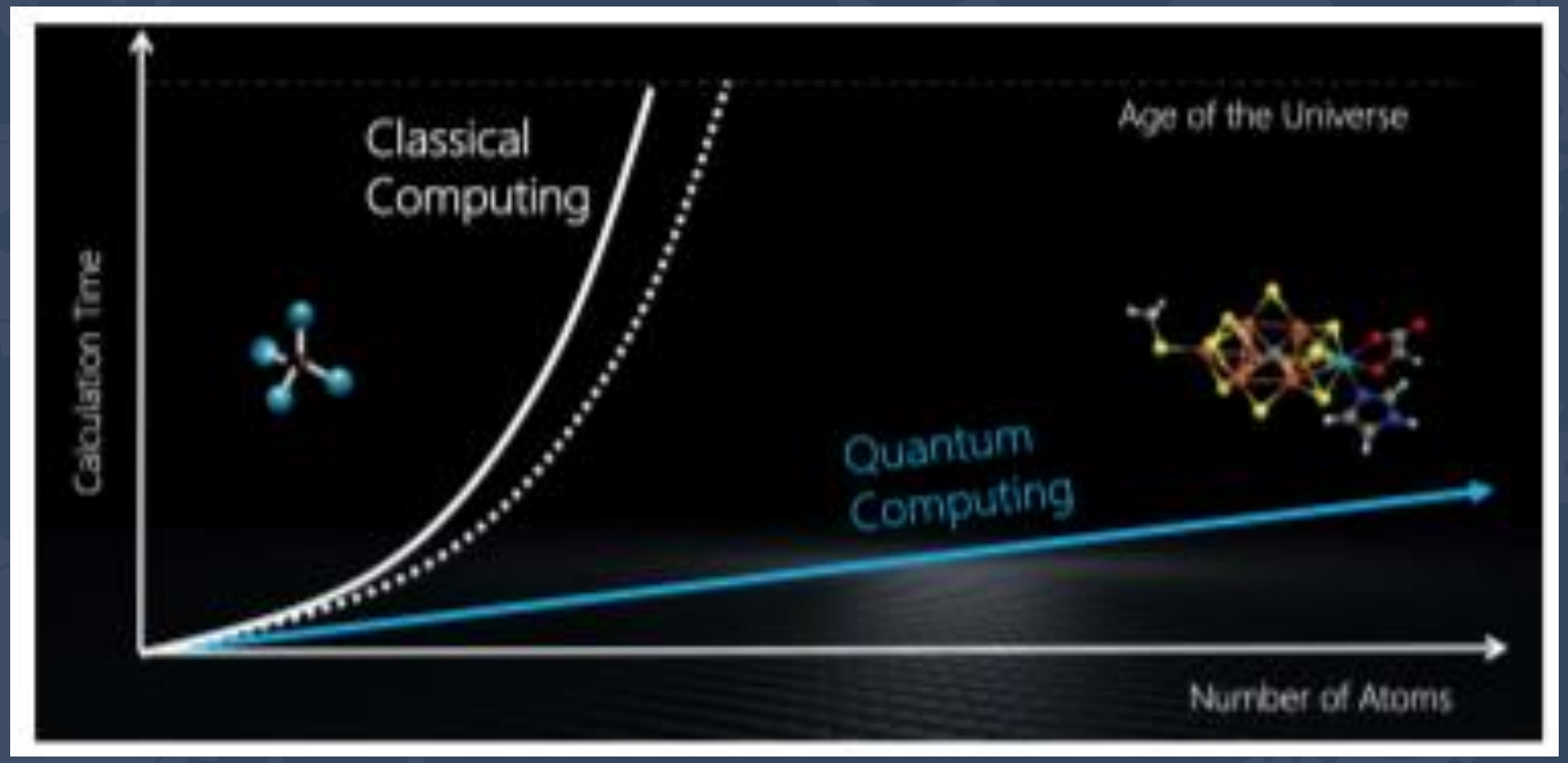


Source: McKinsey Global Institute AI-frontier-modeling-the-impact-of-ai-on-the-world-economy

Computation limits



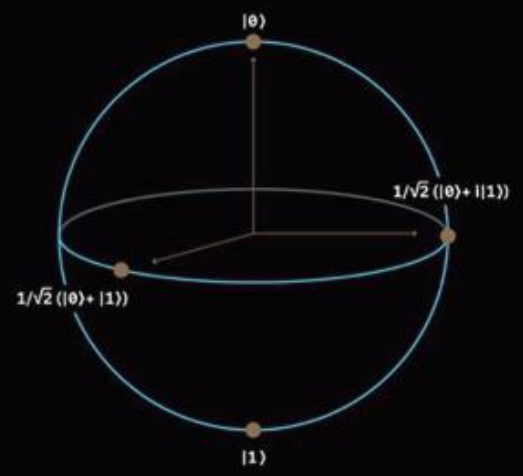
* Scott Aronson, “The limit of quantum computers”, Scientific American, March 2008

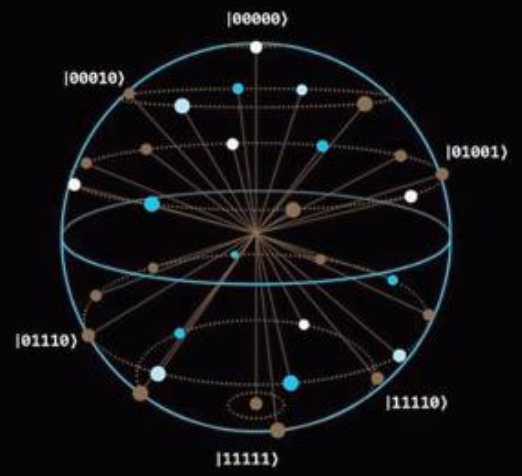

Classical
Computing
Age of the Universe
Calculation Time
Quantum
Computing
Number of Atoms

Why is quantum different?

1. Superposition

N qubits
2^N paths





Classical states

Quantum states

IBM Research

“The best time to plant a tree was 20 years ago.
The second best time is now.”

– a proverb

Thank You