

AWS Academy Machine Learning Foundations

# Module 2: Introduction to Machine Learning



## Sections

1. What is machine learning?
2. Business problems solved with machine learning
3. Machine learning process
4. Machine learning tools overview
5. Machine learning challenges



**Knowledge  
check**

## Demonstration

Introducing Amazon SageMaker

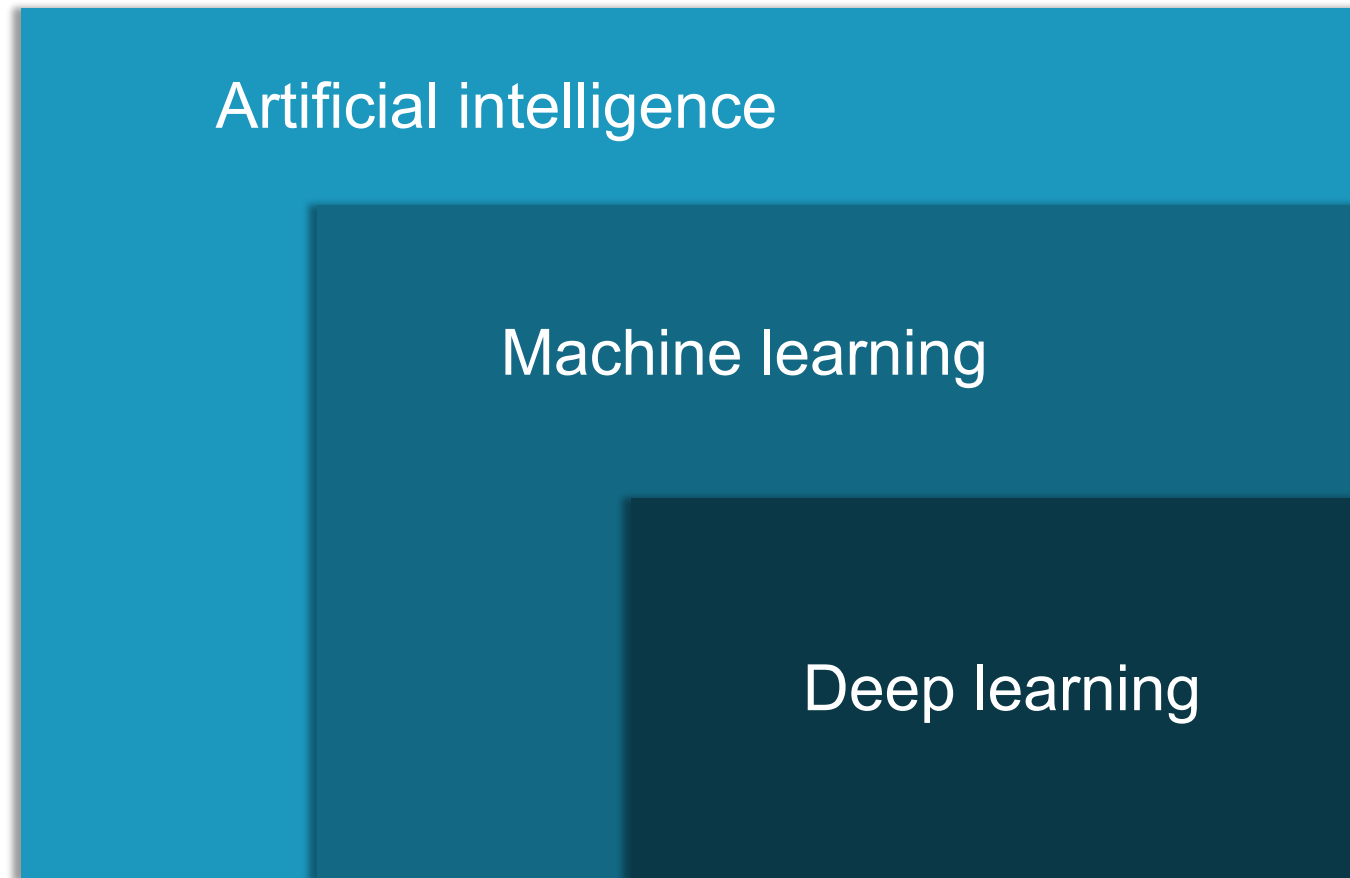
At the end of this module, you should be able to:

- Recognize how machine learning and deep learning are part of artificial intelligence
- Describe artificial intelligence and machine learning terminology
- Identify how machine learning can be used to solve a business problem
- Describe the machine learning process
- List the tools available to data scientists
- Identify when to use machine learning instead of traditional software development methods

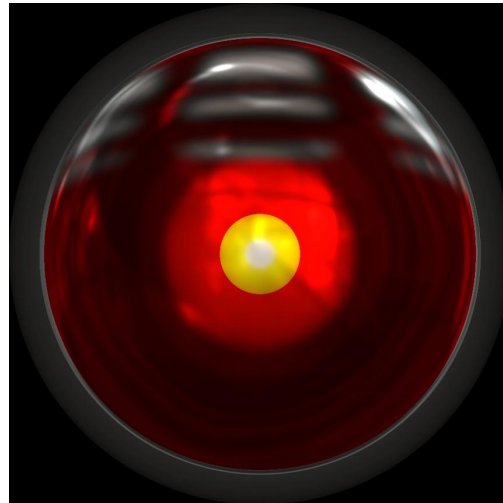
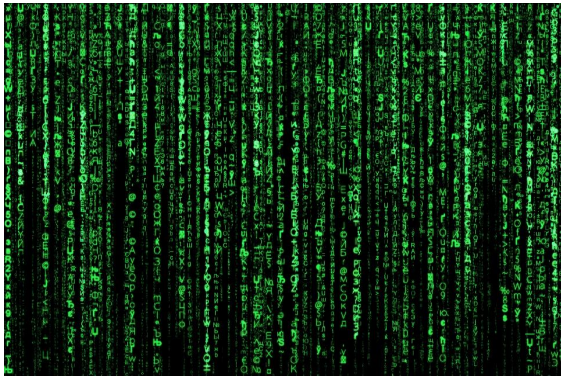
## Module 2: Introduction to Machine Learning

# Section 1: What is machine learning ?

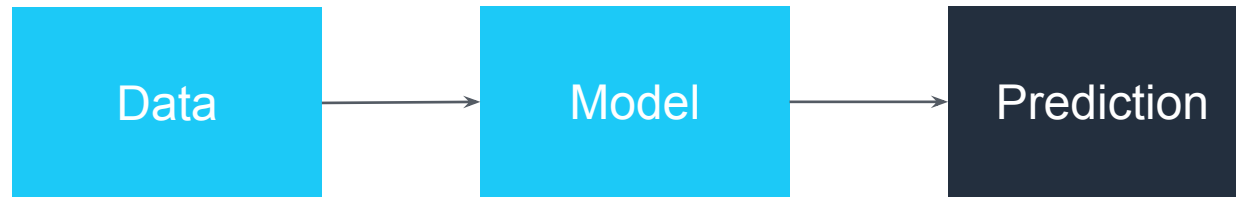
# Artificial intelligence, machine learning, and deep learning



# Artificial intelligence



Machine learning is the scientific study of algorithms and statistical models to perform a task using inference instead of instructions.

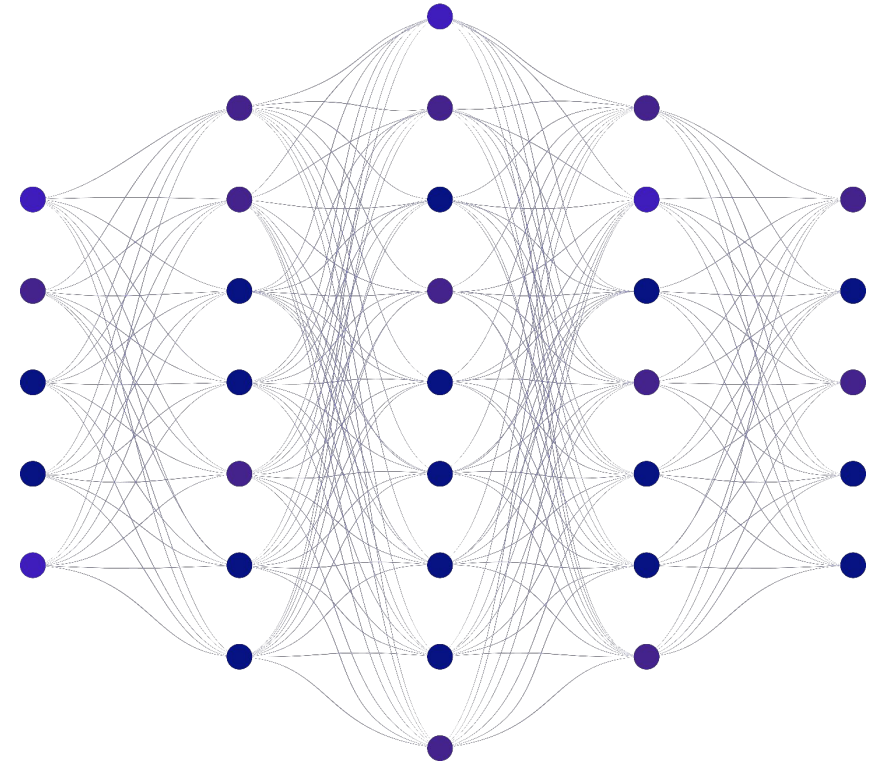


Machine learning flow

# Deep learning



## Artificial Neural Network



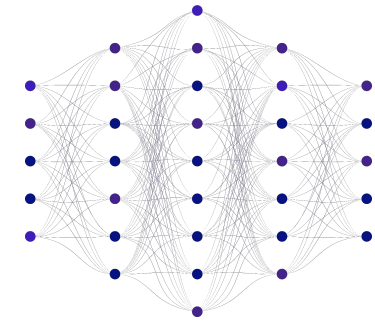


# ML and technology advancements



LOWERING GRAPH  
VECTOR ICON

Artificial Neural Network



Traditional  
computing

Cloud computing  
and  
Moore's law

Modern machine  
learning

# Section 1 key takeaways



- Artificial intelligence
  - Machines performing human tasks
- Machine learning
  - Training models to make predictions
- Deep learning
  - Neural networks
- Technology and economic advancements have made machine learning more accessible to individuals and organizations

## Module 2: Introduction to Machine Learning

# Section 2: Business problems solved with machine learning

# Common business use cases



Spam versus  
regular email

Recommended items

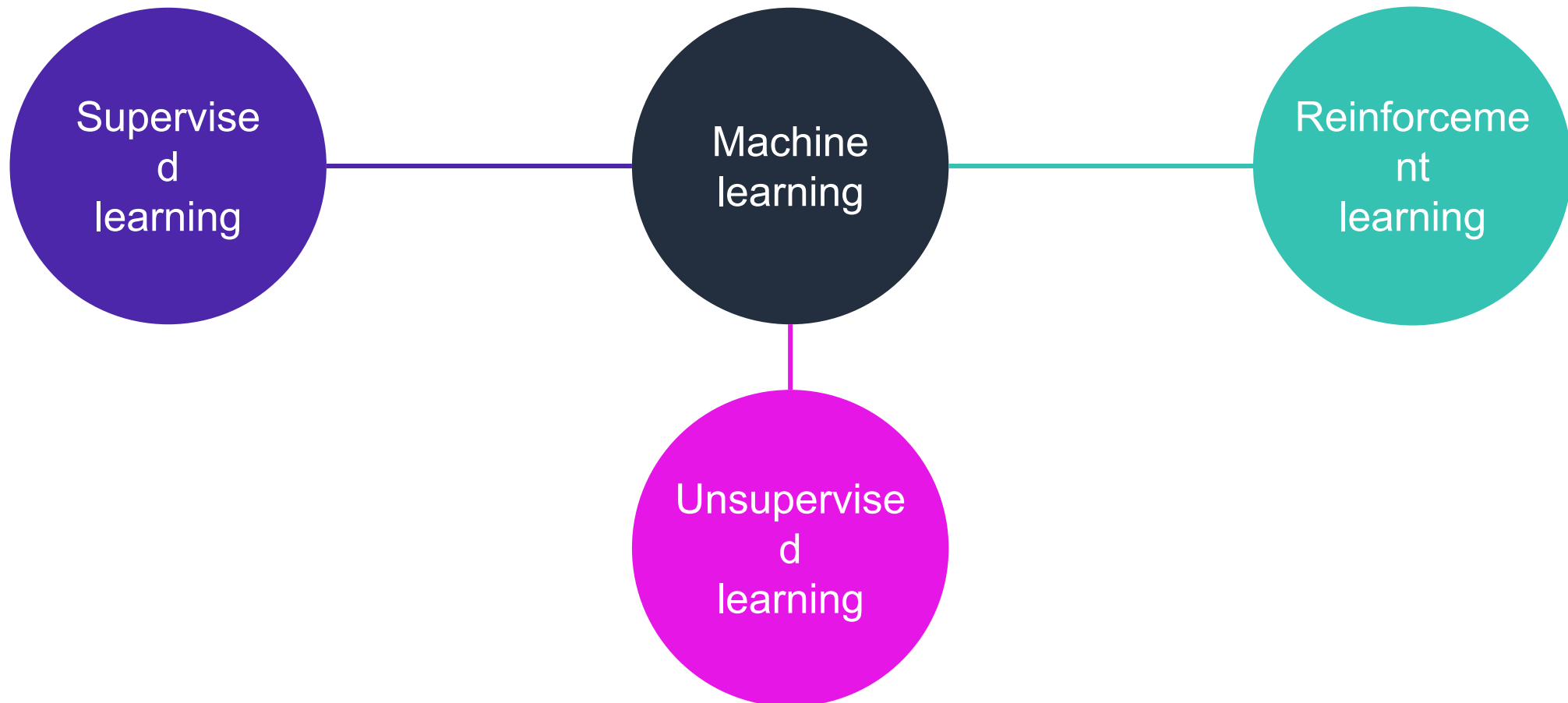


Recommendations



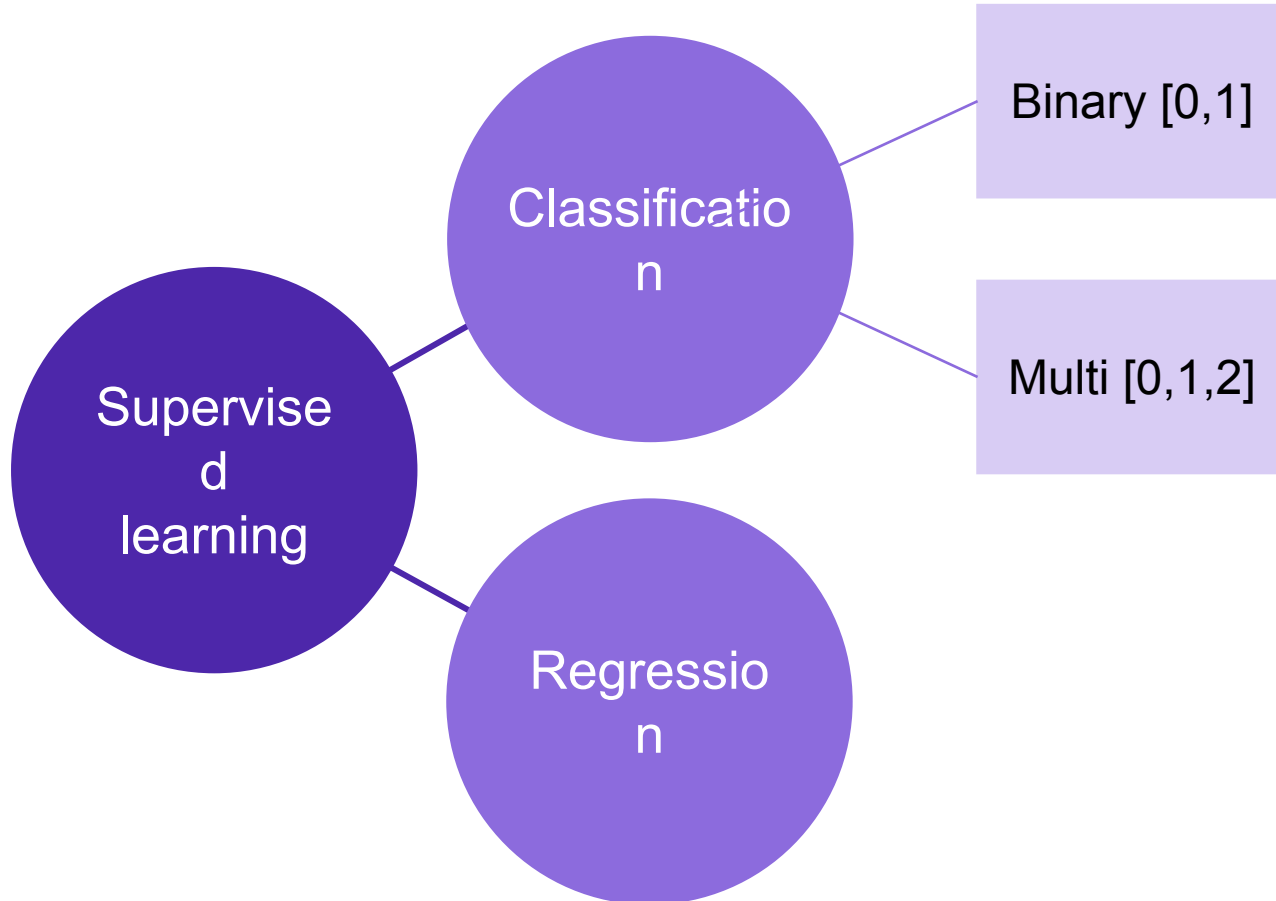
Fraud

# Types of machine learning



# Supervised learning

Learn by identifying patterns in data that is **already labeled**.



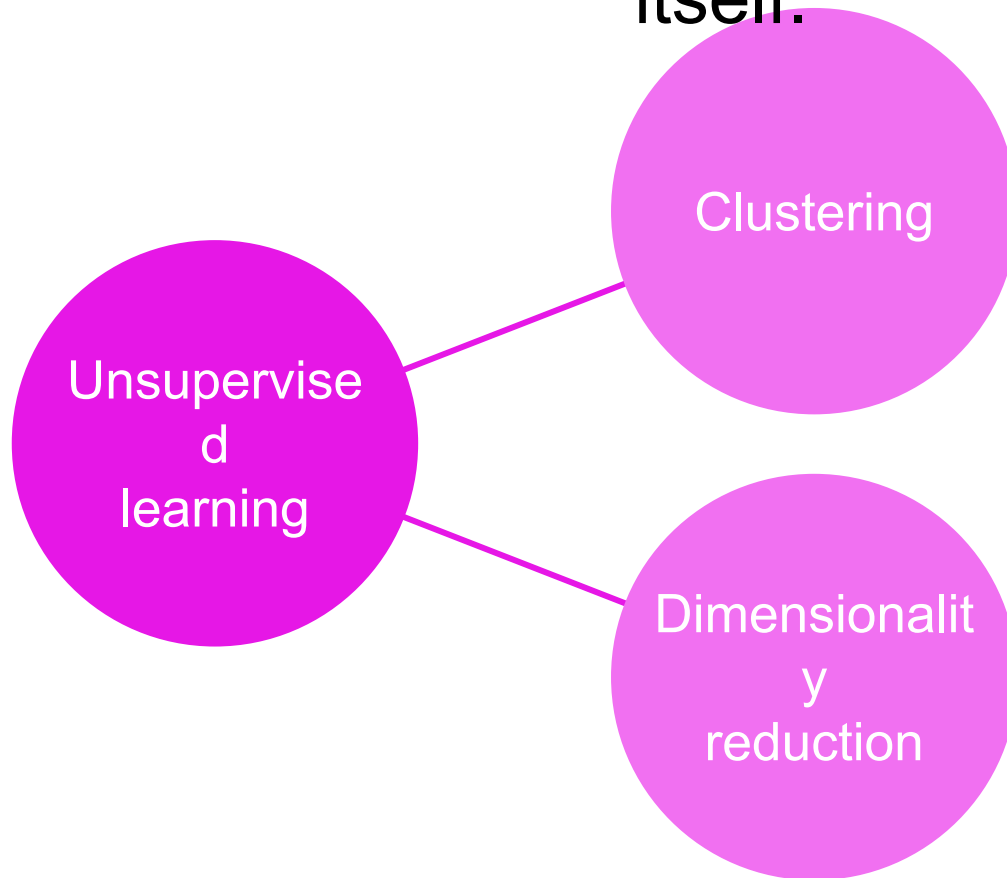
- Fraud detection
- Image recognition
- Customer retention
- Medical diagnostics
- Personalized advertising
- Product sales prediction
- Weather forecasting
- Market forecasting
- Population growth prediction



# Computer vision



The machine must uncover and **create the labels** itself.



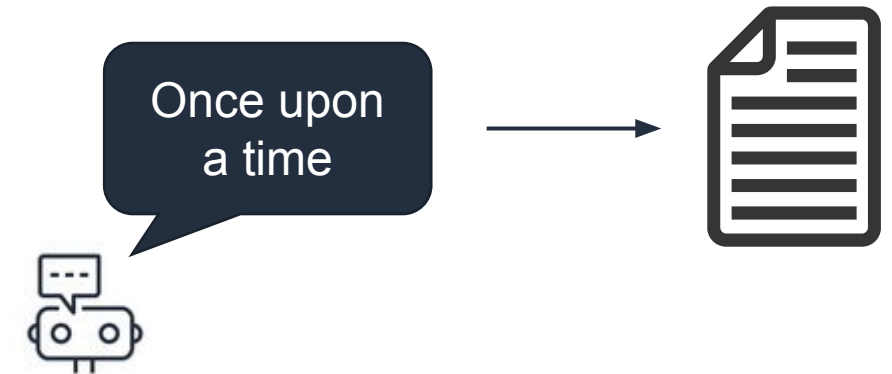
- Product recommendations
  - Customer segmentation
  - Targeted marketing
  - Medical diagnostics
- 
- Visualization
  - Natural language processing
  - Data structure discovery
  - Gene sequencing



# Natural language processing



gögn eru lykilatriði  $\longleftrightarrow$  los datos son clave



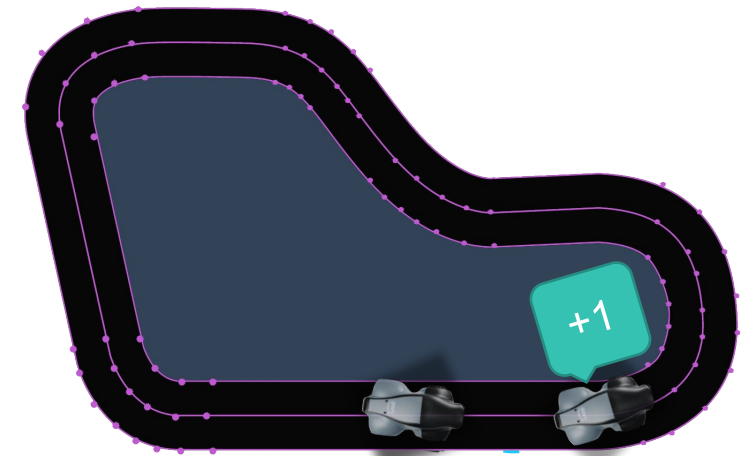
Poor story. Little character development. Jumps between scenes like you might get caught stealing. Unexplained bad guys appear with the thinnest of back story. Back to unlimited resources and lets not talk about the mechanics of building something so huge in such an inhospitable place...

# Reinforcement learning

Learning through trial and error.

Reinforcement  
learning

- Game AI
- Self-driving cars
- Robotics
- Customer service routing



AWS DeepRacer

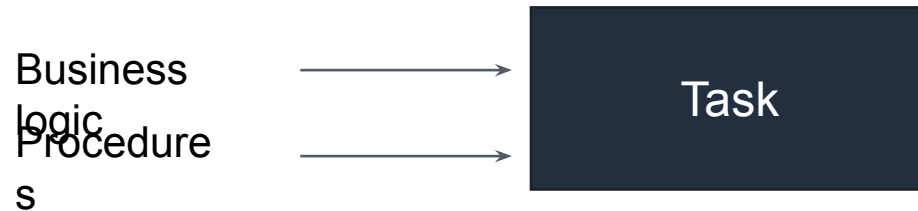
Best when the desired outcome is known but the exact path to achieving it is not known.

# Self-driving vehicles

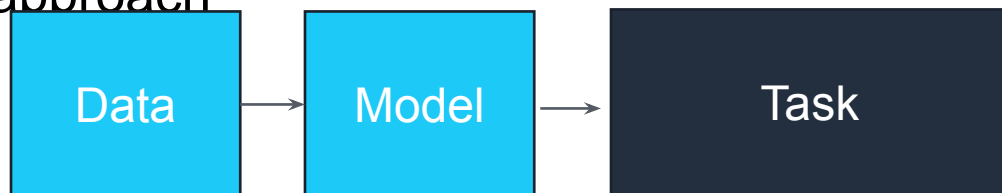


# When to use machine learning?

## Classical programming approach



## Machine learning approach



## Use machine learning when you have:

- ✓ Large datasets, large number of variables
- ✓ Lack of clear procedures to obtain the solution
- ✓ Existing machine learning expertise
- ✓ Infrastructure already in place to support ML
- ✓ Management support for ML

# Section 2 key takeaways



- Machine learning applications affect everyday life
- Machine learning can be grouped into –
  - Supervised learning
  - Unsupervised learning
  - Reinforcement learning
- Most problems are supervised learning

## Module 2: Introduction to Machine Learning

# Section 3: Machine learning process

# ML pipeline: Business problem

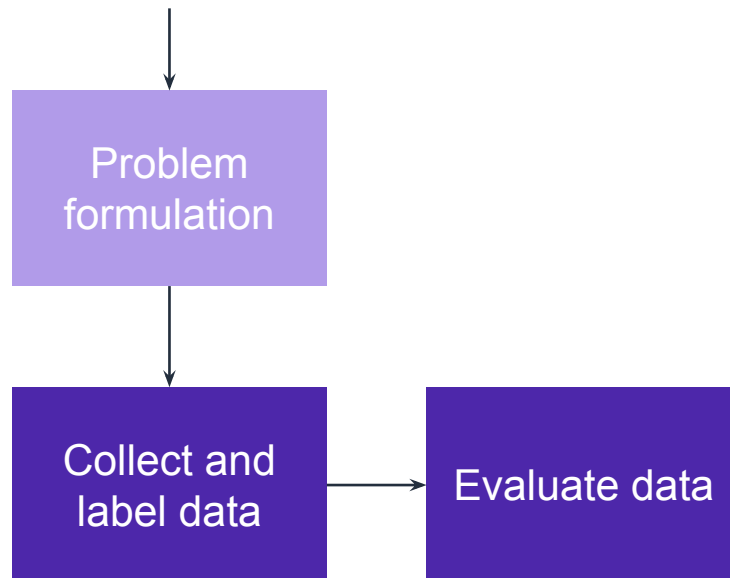
Business problem



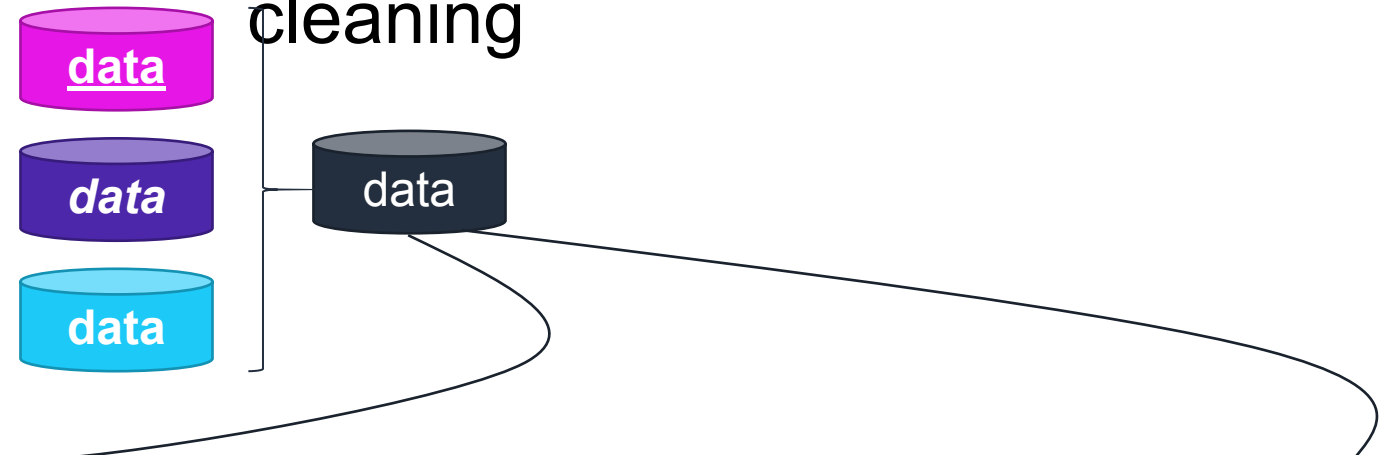
Problem  
formulation

# ML pipeline: Data preparation

Business problem



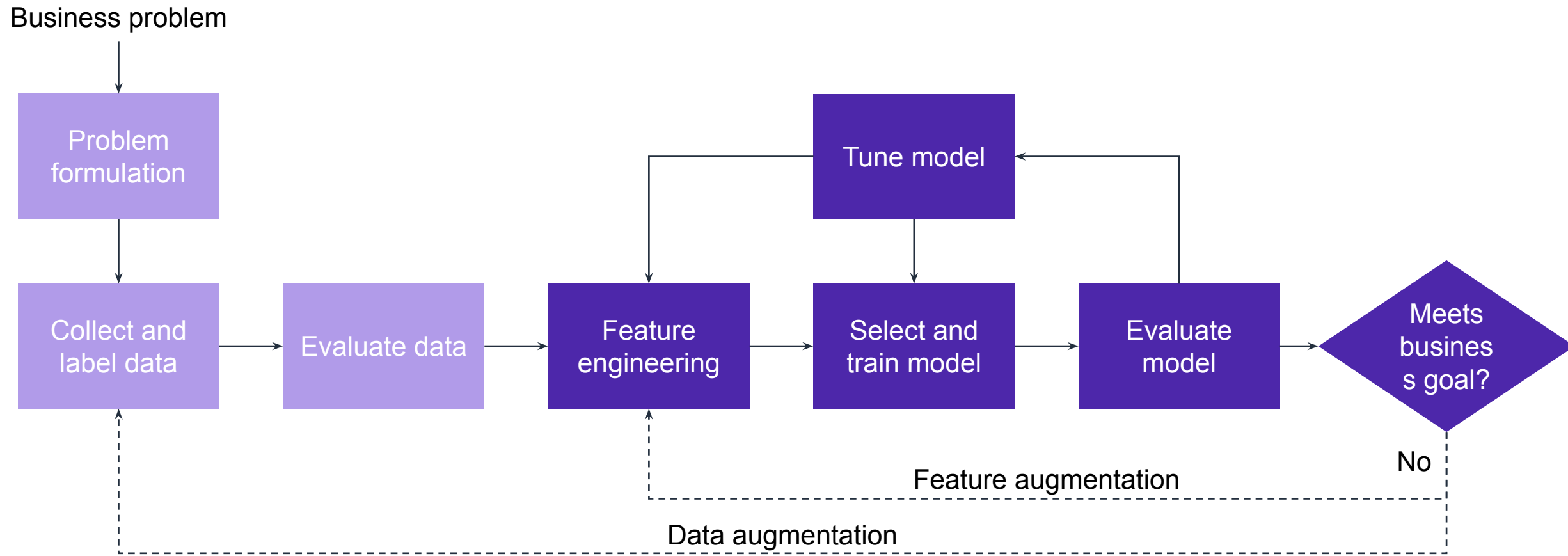
## Data handling and cleaning



Name	Country	Sex	dob
Richard Roe	UK	Male	18/2/1972
Paulo Santos	Male		11/2/1969
Mrs. Mary Major	Denver	F	37
Desai, Arnav	USA	M	2/22/1962



# ML pipeline: Iterative model training



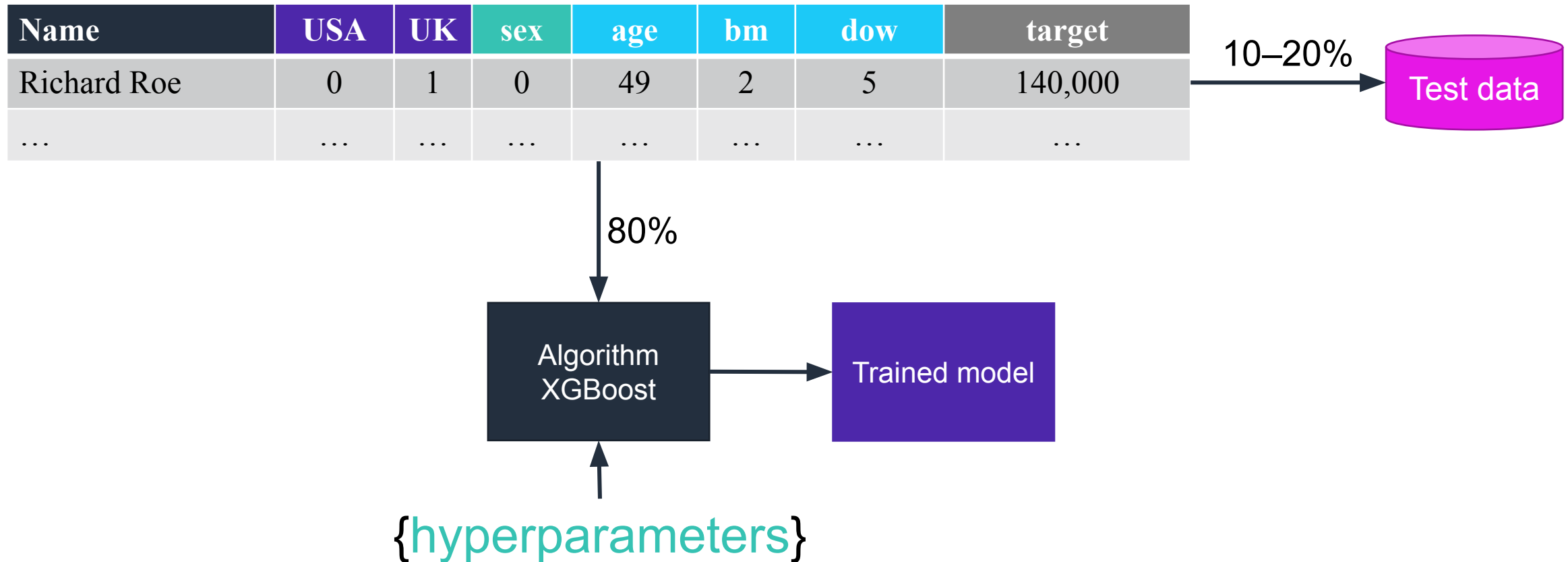
# ML pipeline: Feature engineering

Name	Country	Sex	dob
Richard Roe	UK	Male	18/2/1972
Paulo Santos	Male		11/2/1969
Mrs. Mary Major	Denver	F	37
Desai, Arnav	USA	M	2/22/1962

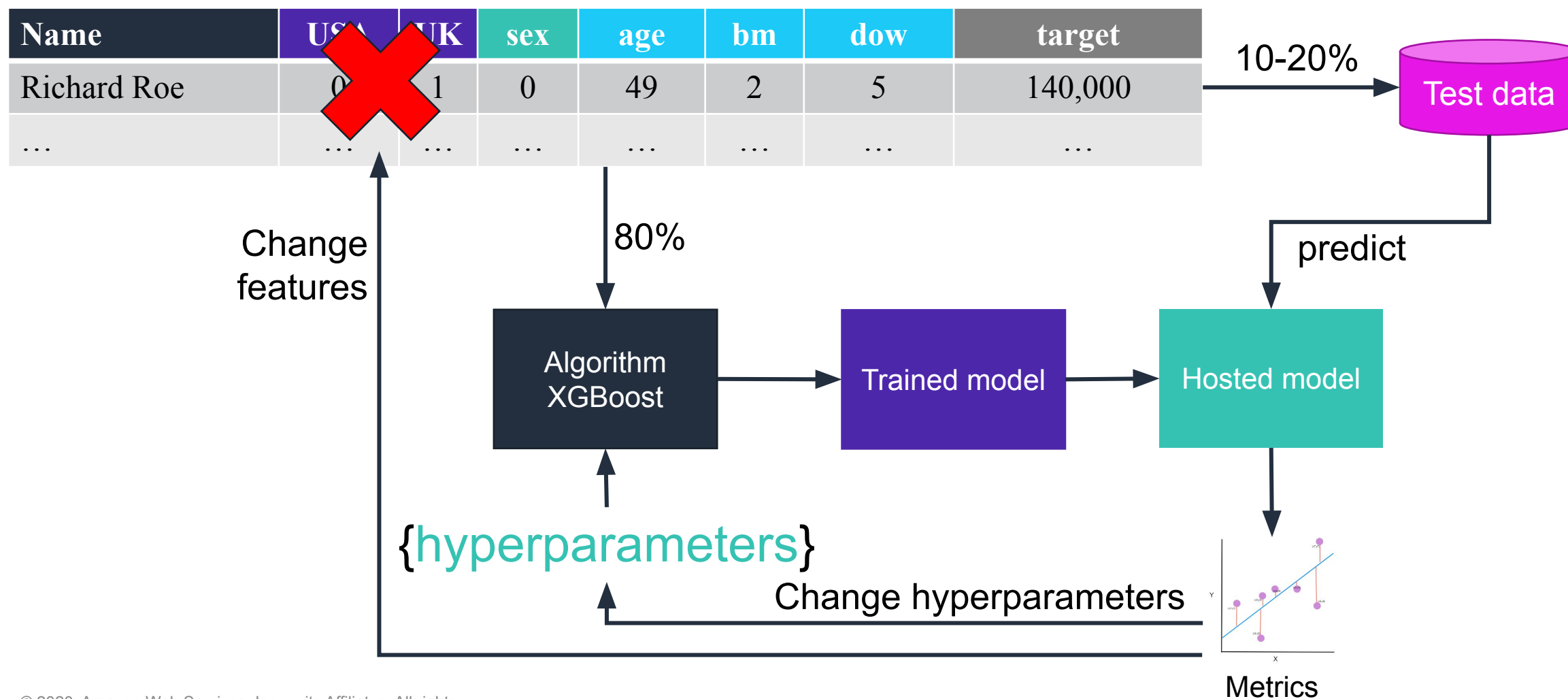
Name	USA	UK	sex	age	bm	dow	target
Richard Roe	0	1	0	49	2	5	140,000
Paulo Santos	1	0	0	51	11	7	78,000
Mary Major	1	0	1	37	NAN	0	167,000
Arnav Desai	1	0	0	58	2	4	100,000

?

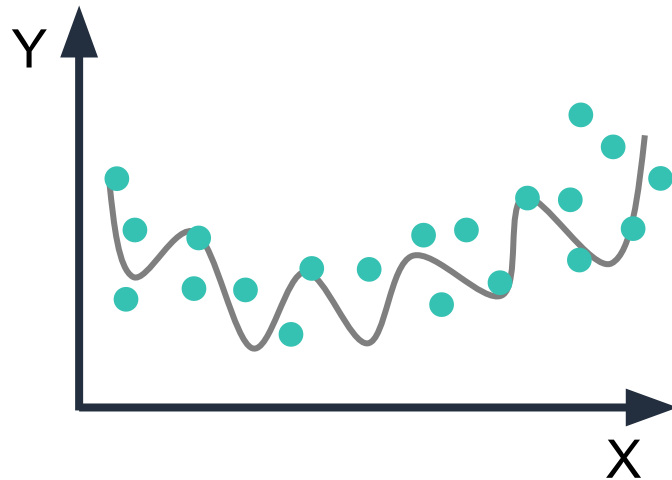
# ML pipeline: Model training



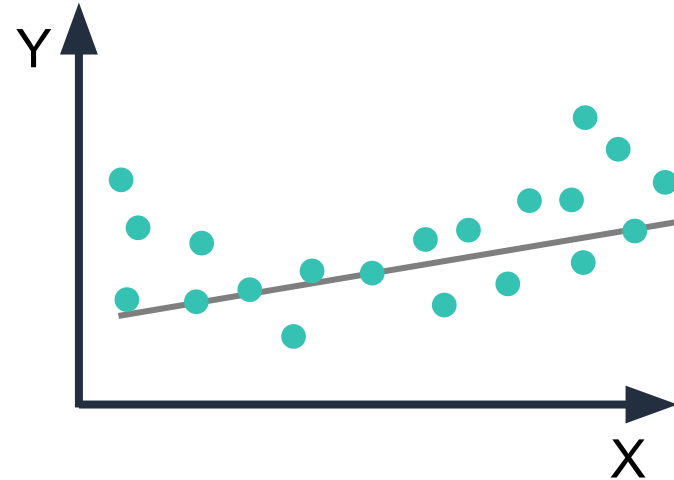
# ML pipeline: Evaluating and tuning the model



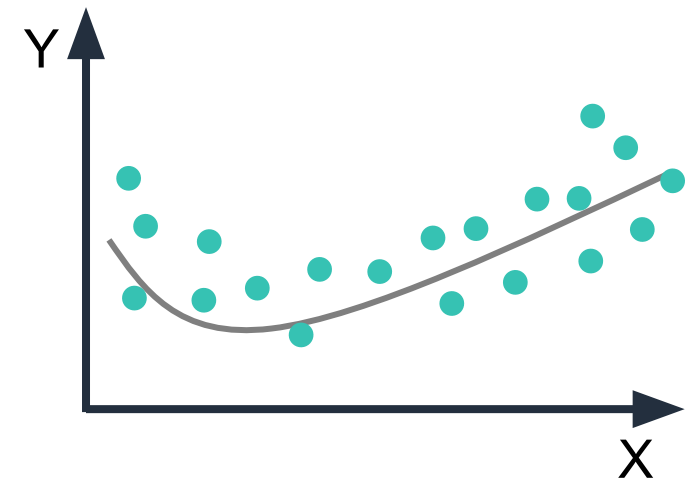
# Overfitting and underfitting



Overfitting

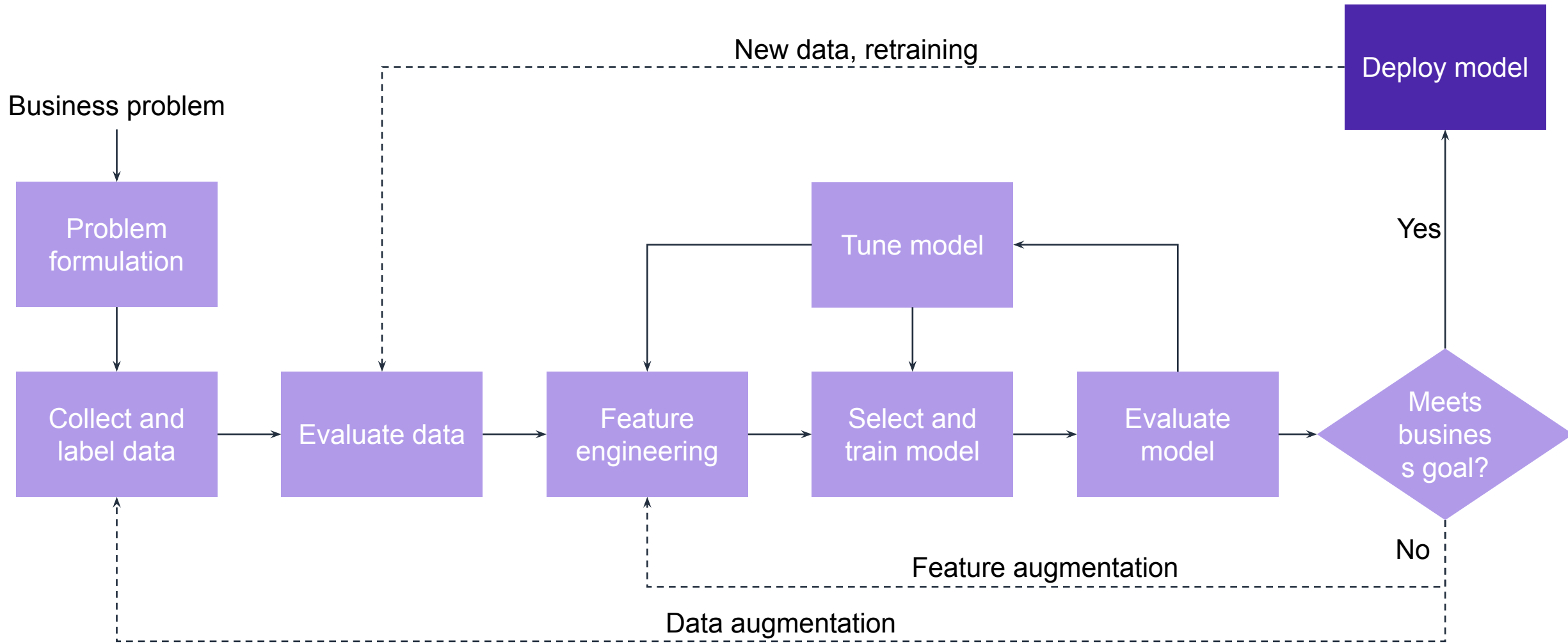


Underfitting



Balanced

# ML pipeline: Deployment



# Section 3 key takeaways



- Machine learning pipeline guides you through the process of evaluating and training a model
- Iterative process of –
  - Data processing
  - Training
  - Evaluation

## Module 2: Introduction to Machine Learning

# Section 4: Machine learning tools overview



# Python tools and libraries

- Jupyter Notebook
- JupyterLab
- pandas
- Matplotlib
- Seaborn
- NumPy
- scikit-learn

# Machine learning frameworks and infrastructure

Machine learning **frameworks** provide tools and code libraries:

- Customized scripting
- Integration with AWS services
- Community of developers

PyTorch	Caffe2	Torch
TensorFlow	Gluon	Chainer
Keras	CNTK	Apache MXNet

Amazon **instances** that are designed for machine learning applications:

- AWS IoT Greengrass provides an infrastructure for building machine learning for IoT devices
- Amazon Elastic Inference reduces costs for running machine learning applications

			
EC2 P3 instances	EC2 C5 and C5n instances	AWS IoT Greengrass	Amazon Elastic Inference

# Amazon SageMaker



## Ground Truth

Set up and manage labeling jobs for highly accurate training datasets by using active learning and human labeling.



## Notebook

Provide AWS and SageMaker SDKs and sample notebooks to create training jobs and deploy models.



## Training

Train and tune models at any scale. Use high-performance AWS algorithms, or bring your own.



## Inference

Create models from training jobs, or import external models for hosting so you can run inferences on new data.



## AWS

**Marketplace**  
Find, buy, and deploy ready-to-use model packages, algorithms, and data products in AWS Marketplace.

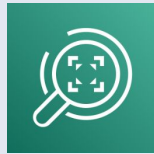
# Demonstration: Introducing Amazon SageMaker



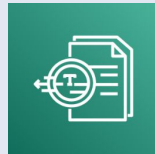
# Machine learning managed services

These managed services don't require ML experience.

Computer  
vision

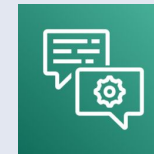


Amazon Rekognition



Amazon Textract

Chatbots

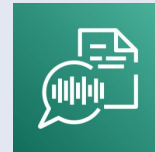


Amazon  
Lex

Speech



Amazon Polly



Amazon  
Transcribe

Forecastin  
g

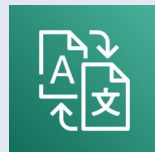


Amazon  
Forecast

Languag  
e

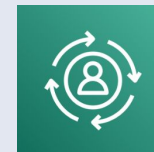


Amazon Comprehend



Amazon  
Translate

Recommendations



Amazon  
Personalize



# Section 4 key takeaways



- Python is the most popular ML language
- Jupyter Notebooks
- Many open-source tools
- Frameworks and services for all requirements
  - Low-level frameworks
  - Amazon SageMaker
  - Managed ML services

## Module 2: Introduction to Machine Learning

# Section 5: Machine learning challenges

# Machine learning challenges



Data

- Poor quality
- Non-representative
- Insufficient
- Overfitting and underfitting



Users

- Lack of data science expertise
- Cost of staffing with data scientists
- Lack of management support



Business

- Complexity in formulating questions
- Explaining models to the business
- Cost of building systems



Technology

- Data privacy issues
- Tool selection can be complicated
- Integration with other systems



# Using existing models and services



Amazon ML  
managed services

- Amazon ML managed services
- No ML experience needed

You Only  
Look Once  
(YOLO)



AWS Marketplace

- Use existing trained and tuned models
- Enhance with domain-specific instances
- Over 250 ML model packages and algorithms
- Over 14 industry segments

# Section 5 key takeaways



- Machine learning challenges
  - Data
  - People
  - Business
  - Technology
- Managed services simplify machine learning

Module 2: Introduction to Machine Learning

# Module wrap-up

# Module takeaways



- Machine learning is a subset of artificial intelligence
  - Machine learning applies learning algorithms to develop models from large datasets
- The machine learning pipeline describes the different stages for developing a machine learning application
- The Amazon Machine Learning stack has three key layers
  - Managed services, machine learning services, machine learning frameworks
- Machine learning development is different from traditional development
  - Training algorithm is applied to data to create a model for making predictions

In summary, in this module, you learned how to:

- Recognize how machine learning and deep learning are part of artificial intelligence
- Describe artificial intelligence and machine learning terminology
- Identify how machine learning can be used to solve a business problem
- Describe the machine learning process
- List the tools available to data scientists
- Identify when to use machine learning instead of traditional software development methods



# Complete the knowledge check



# Additional resources

- [What is Machine Learning?](#)
- [Machine Learning on AWS](#)

# Thank you