



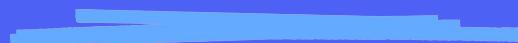


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Introduction to Data Science

Data Science Unit 1





Before we start...

- Make sure you are comfortable
- Have water and maybe a strong coffee handy
- If you need a break... take it!
- If you need a stretch – please go ahead!
- Please mute yourselves if you are not talking
- Have your video on at all times

...and let's get started!





In this session we will...

- **Understand** what data science is and who a data scientist is
- **Understand** the differences between classical programming and machine learning
- **Discuss** the types of machine learning
- **Understand** algorithms and algorithm training
- **Familiarise** yourself with machine learning terms and definitions



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What is a Data Scientist?





Patrick Dougherty @cpdough · 19 Jan 2016

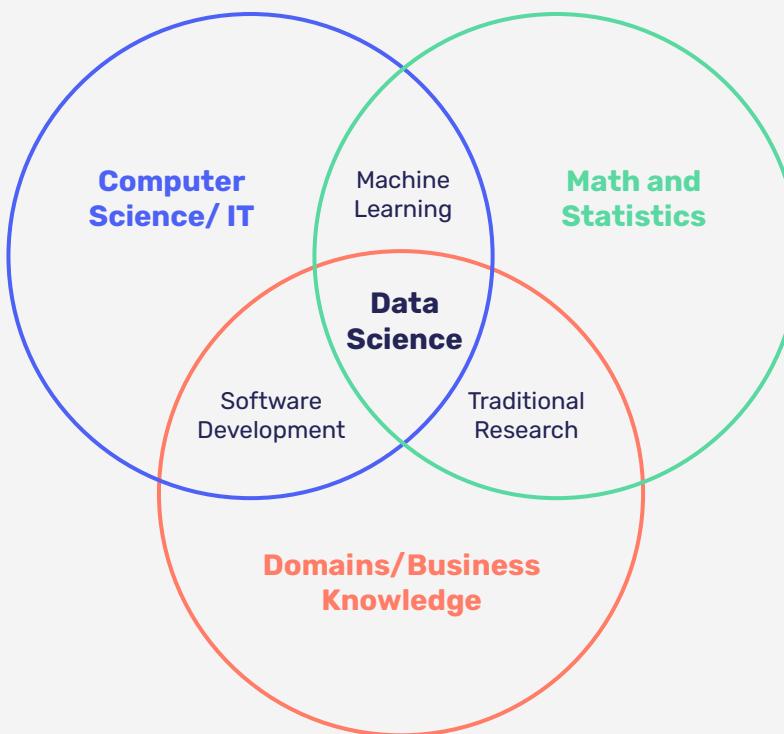
My favorite description of a data scientist. "specialization is for engineers"... so true! from @joelgrus

**a data scientist should be able to
run a regression, write a sql query, scrape a web
site, design an experiment, factor matrices, use a
data frame, pretend to understand deep learning,
steal from the d3 gallery, argue r versus python,
think in mapreduce, update a prior, build a
dashboard, clean up messy data, test a hypothesis,
talk to a businessperson, script a shell, code on a
whiteboard, hack a p-value, machine-learn a model.
specialization is for engineers.**

JOEL GRUS



Intro to Data Science





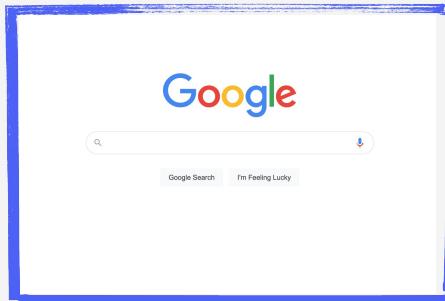
Activity

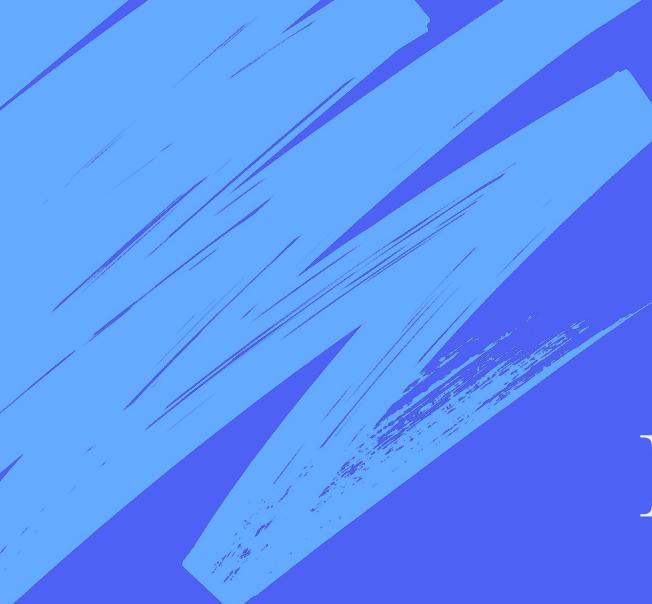
Give an example of a product or service you think utilises data science





Intro to Data Science



The background features abstract blue brushstrokes on the left side, consisting of several thick, diagonal strokes of varying lengths and saturation.

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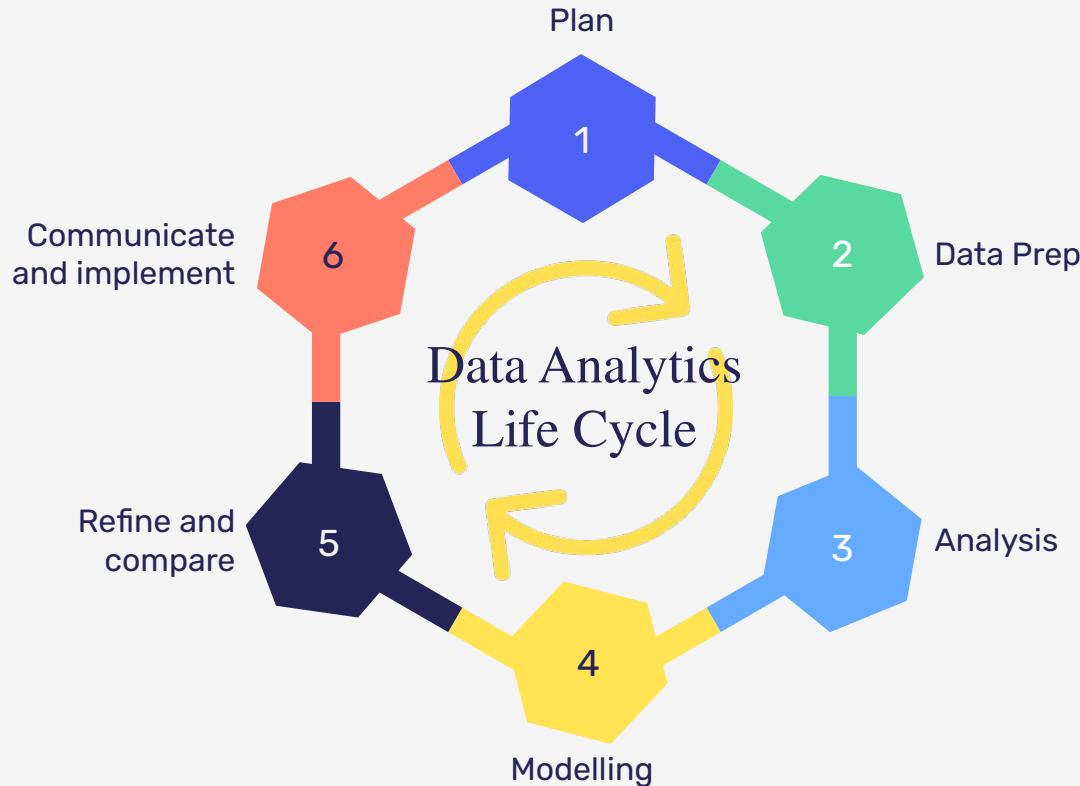
Data Science Workflow

A horizontal row of thin, overlapping blue brushstrokes located near the bottom center of the slide.



Data Science Workflow

Recall the
Data Analytics
Lifecycle





Example

Business Scenario

You work for a real estate company interested in using data science to determine the best properties to buy and resell. Specifically, your company would like to identify the characteristics of residential houses that estimate their sale price and the cost-effectiveness of doing renovations. Using the analytics life cycle, describe the activities that you would carry out in each stage.





Plan

Identify the business/
product objectives.

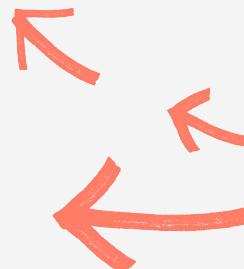
- The customer tells us their business goals are to accurately predict prices for houses (so that they can sell them for as large a profit as possible) and to identify which kinds of features in the housing market would be more likely to lead to foreclosure and other abnormal sales (which could represent more profitable sales for the company).

Identify and hypothesise
goals and criteria for
success.

- Deliver a presentation to the real estate team.
- Write a business report discussing results, procedures used, and rationales.
- Build an API that provides estimated returns.

Create a set of questions
to help you identify the
correct data set.

- Can you think of questions that would help this customer deliver on their business goals?
- What sort of features or columns would you want to see in the data?



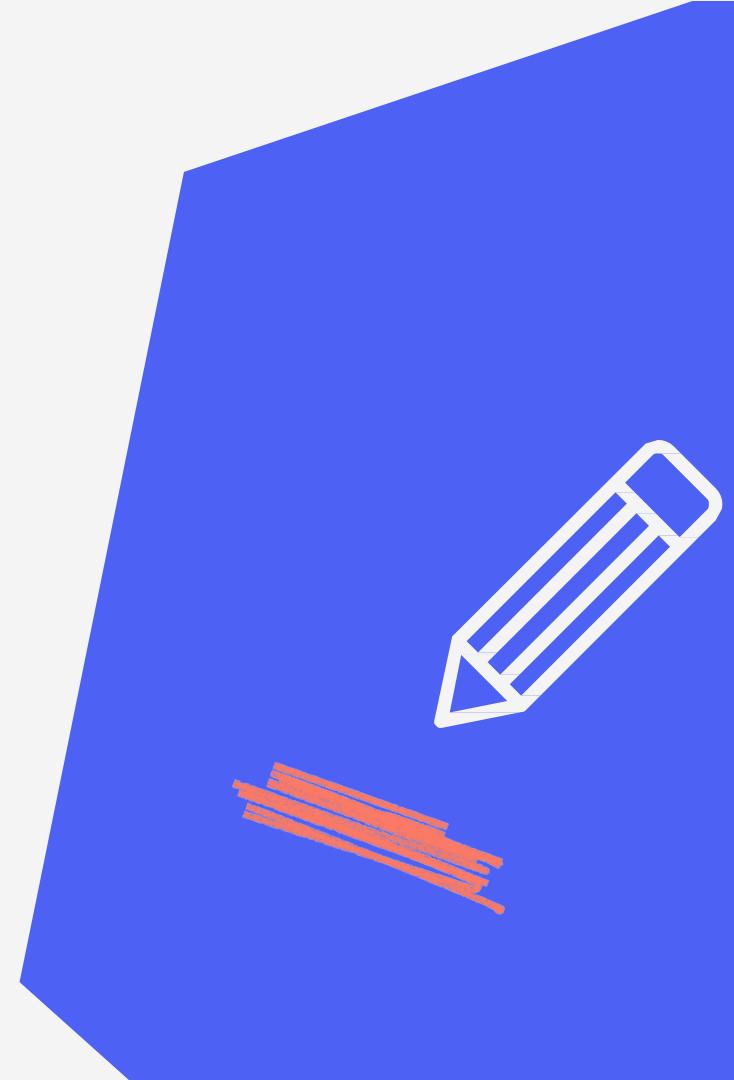


Data Prep

Common considerations when preparing our data include:

- Ensuring data is clearly defined and structured
- Check and clean data formatting as needed

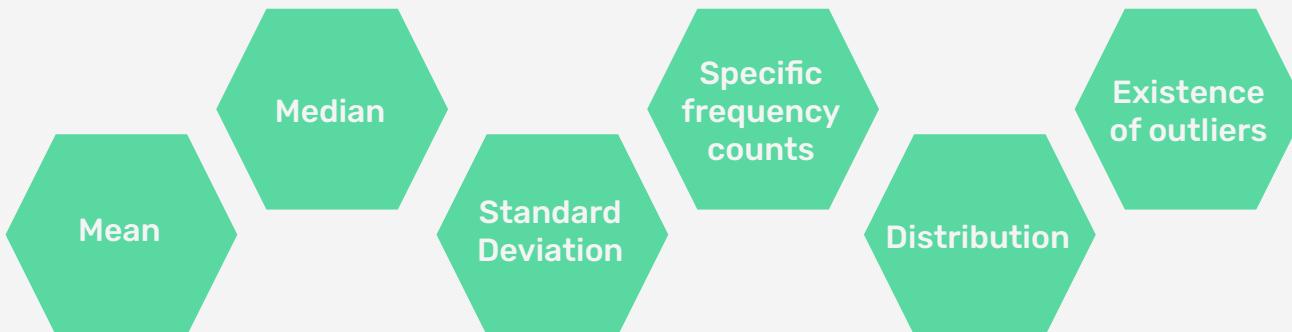
Most data will not come perfectly clean and ready to use. Cleaning data is normally the most time-consuming task a data scientist faces.





Analyse

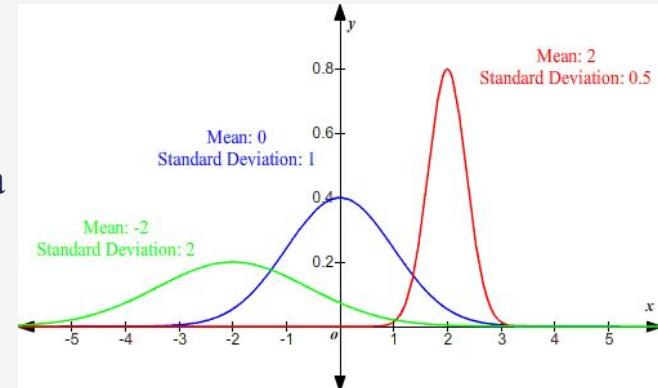
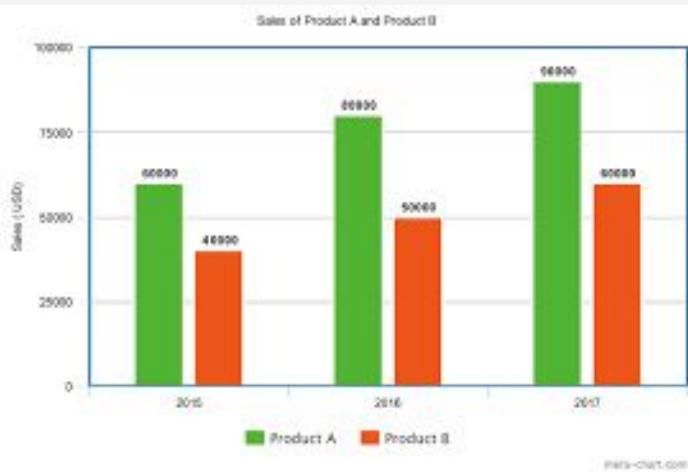
Data scientists often check for their data the:





Analyse

This is also where you can undertake some Exploratory Data Analysis (EDA); plot everything!





Model

Look to predict a value we are interested in, for example:

Outcome of prediction is:





Refine and Compare

Develop Recommendations and Decisions



Did you reject or fail to reject your hypothesis?

- What does this mean for your project?
- What does this mean for your client?



Were your questions answered?

- Which ones?
- What do you need to do to answer the ones that weren't?
- Did any new questions arise?



Do your findings support any business recommendations, actions, or decisions?

- Is there further supportive analysis?
- How do your data support these recommendations?

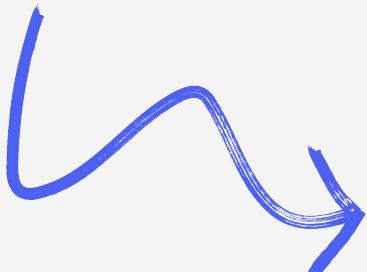


Communicate and Implement

Share the Results of Your Analysis

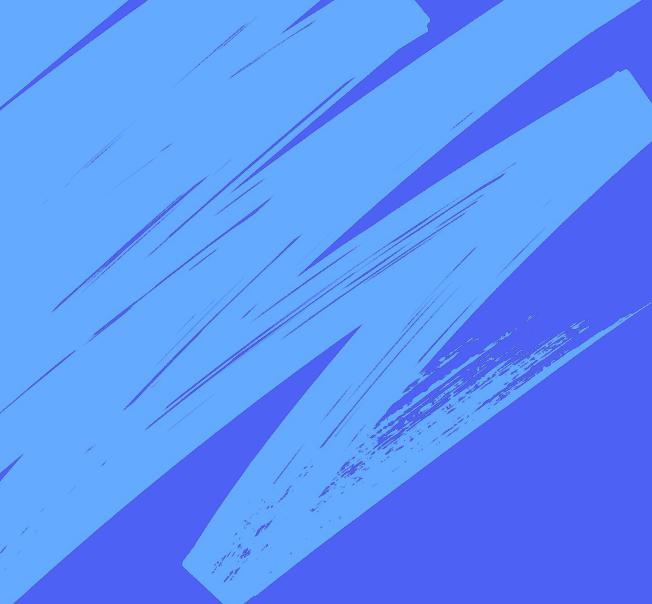
Reaching a conclusion:

- Seek guidance/interaction with subject matter experts (SMEs).
- If those are not available, check with the data – are you coming to reasonable conclusions and predictions given what you've seen?
- Do the next steps that you envision have any dependencies or corollary steps?



What are some conclusions you can draw?

- Conclusion: "Houses with large square footage from rural areas sold, on average, for twice their starting price within the first 5 years."
- Recommendation: "We should target more rural estates for our investments."
- Conclusion: "Other than location (rural vs urban vs suburban), and the size of the property, I found no significant evidence that any other feature led to anomalous appreciation of a property"



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Algorithms





Algorithms

“An **algorithm** is a sequence of steps (rules) to solve a problem. They must be finite and solve the problem”



Algorithm



Algorithm:

- Multiply data by 5
- Add 7



Equation:

- $\text{Answer} = 5 * \text{data} + 7$
- $y = mx + c$



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Activity





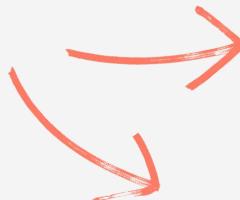
Activity

Let's say we are a real estate agent looking to price a house using only its **square footage**.

We know there are other features that can highly influence this outcome, but we are only focusing on square footage for now. **We know that, as square footage increases, so does price.**

Recently, we sold a house whose **square footage was 2,500** for about **£285,000** and an additional **£10,000** for stamp duties. Based on this information:

1. Generate an equation for house price using the square footage and stamp duties
2. Generate an algorithm for a computer to compute price of a house given this information



5 minutes



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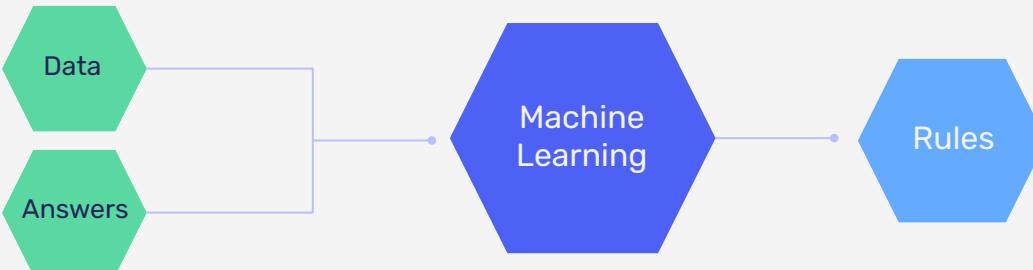
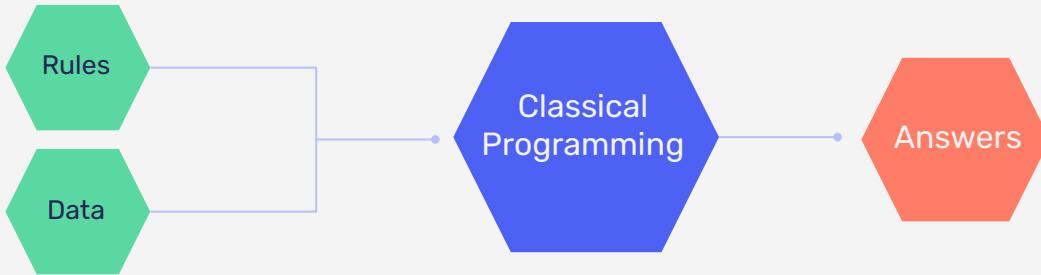


Introduction to Machine Learning





Classical Programming vs ML





Classical Programming

Rules:

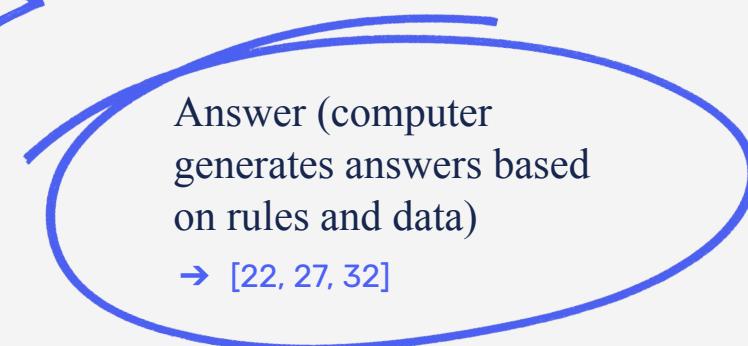
- Multiply data by 5
- Add 7

Data:
→ [3, 4, 5]



Answer (computer generates answers based on rules and data)

- [22, 27, 32]





ML

Answers:

→ [22, 27, 32]



Data:
→ [3, 4, 5]

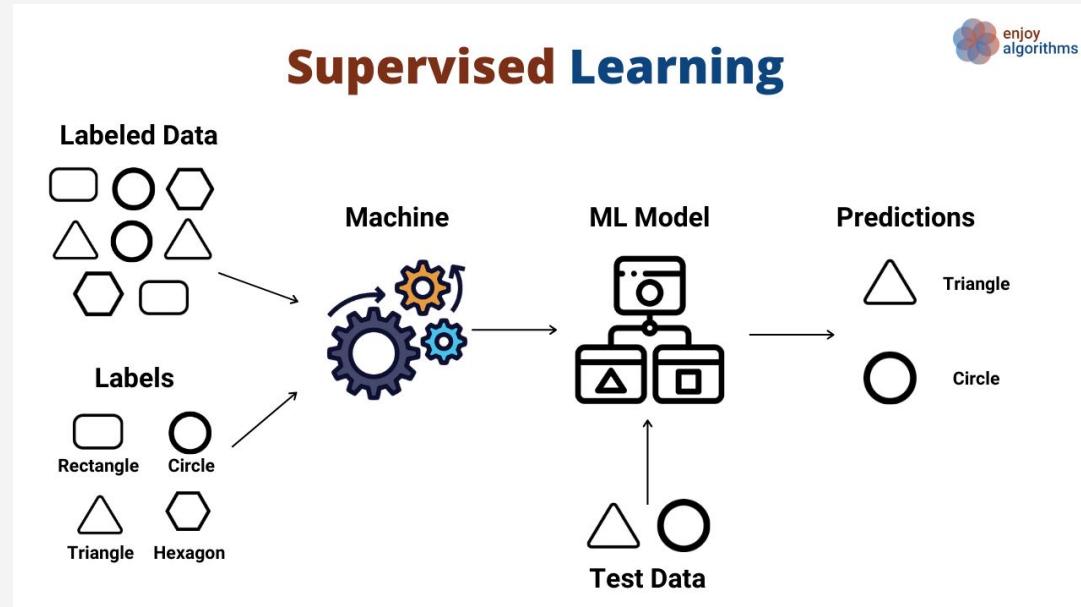


Answer (computer
generates rules based on
data and answers)
→ Data * 5 + 7



Categories of ML

- Supervised Learning
- Unsupervised Learning
- (Reinforcement Learning)





Supervised Learning

“The model is provided with both data (**features**) and the answers (**target**). To put it simply, train the model using **labelled data**.’



Types of Supervised ML

Regression:

The outcome to predict is a continuous value.

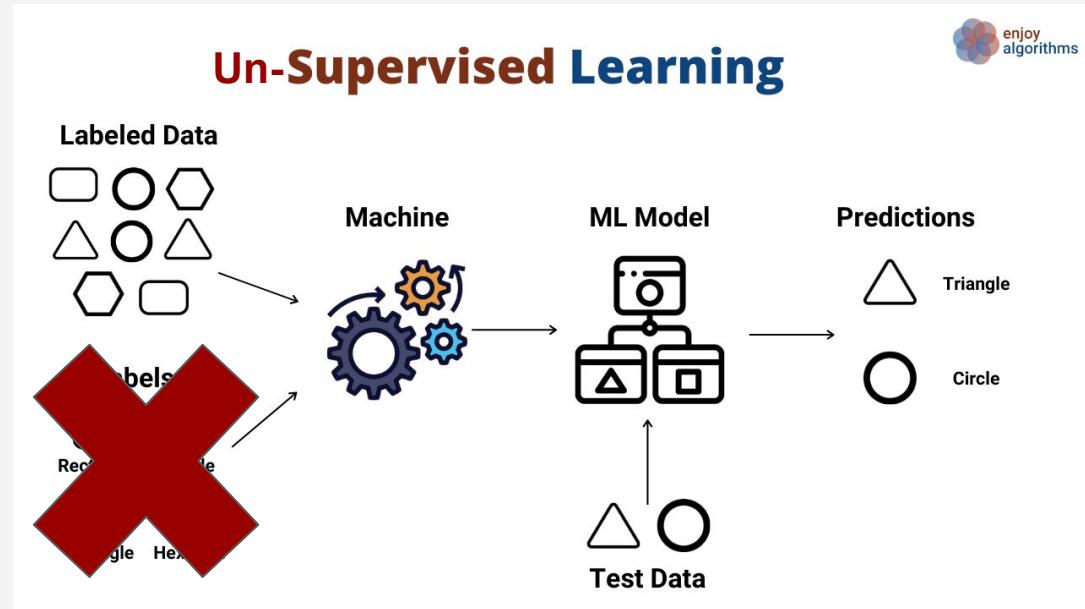
Classification:

The outcome we are trying to predict is categorical.



Categories of ML

- Supervised Learning
- Unsupervised Learning
- (Reinforcement Learning)



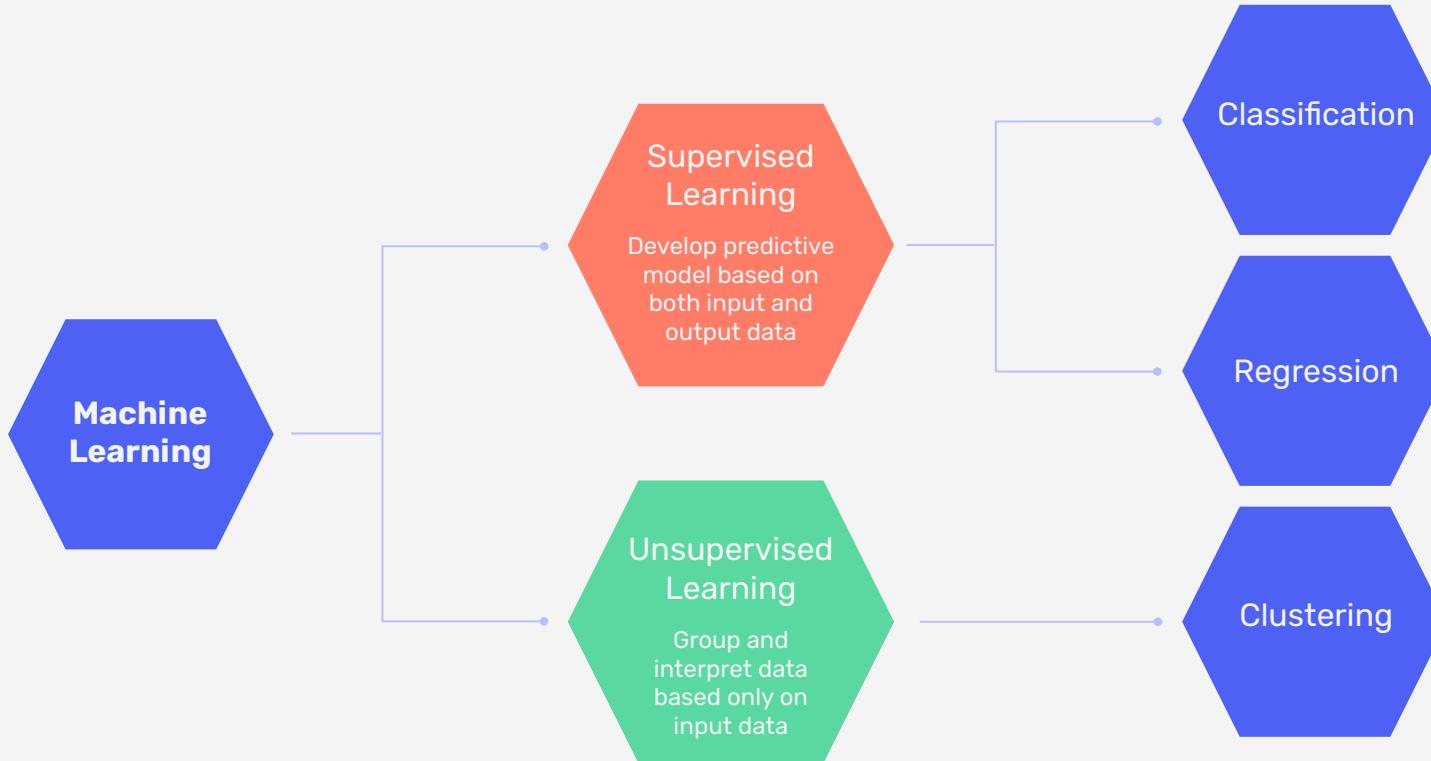


Unsupervised Learning

“The model is provided with only data (**features**) and it learns the interactions in the features, creating groups (**clusters**) in the process”



Machine Learning

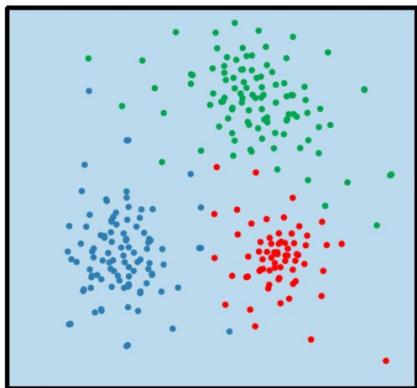




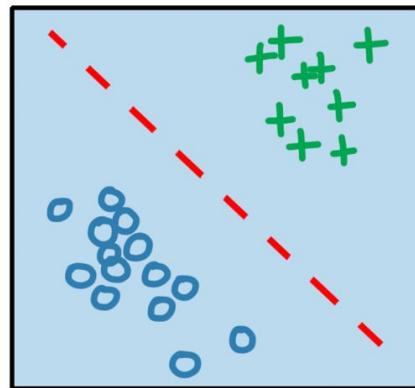
Machine Learning

machine learning

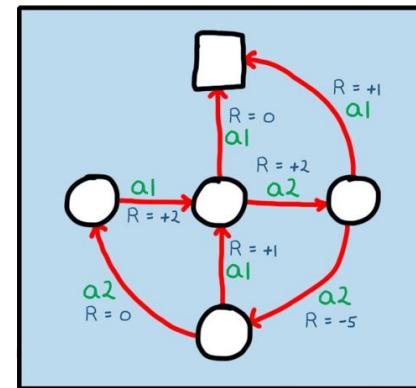
unsupervised
learning



supervised
learning

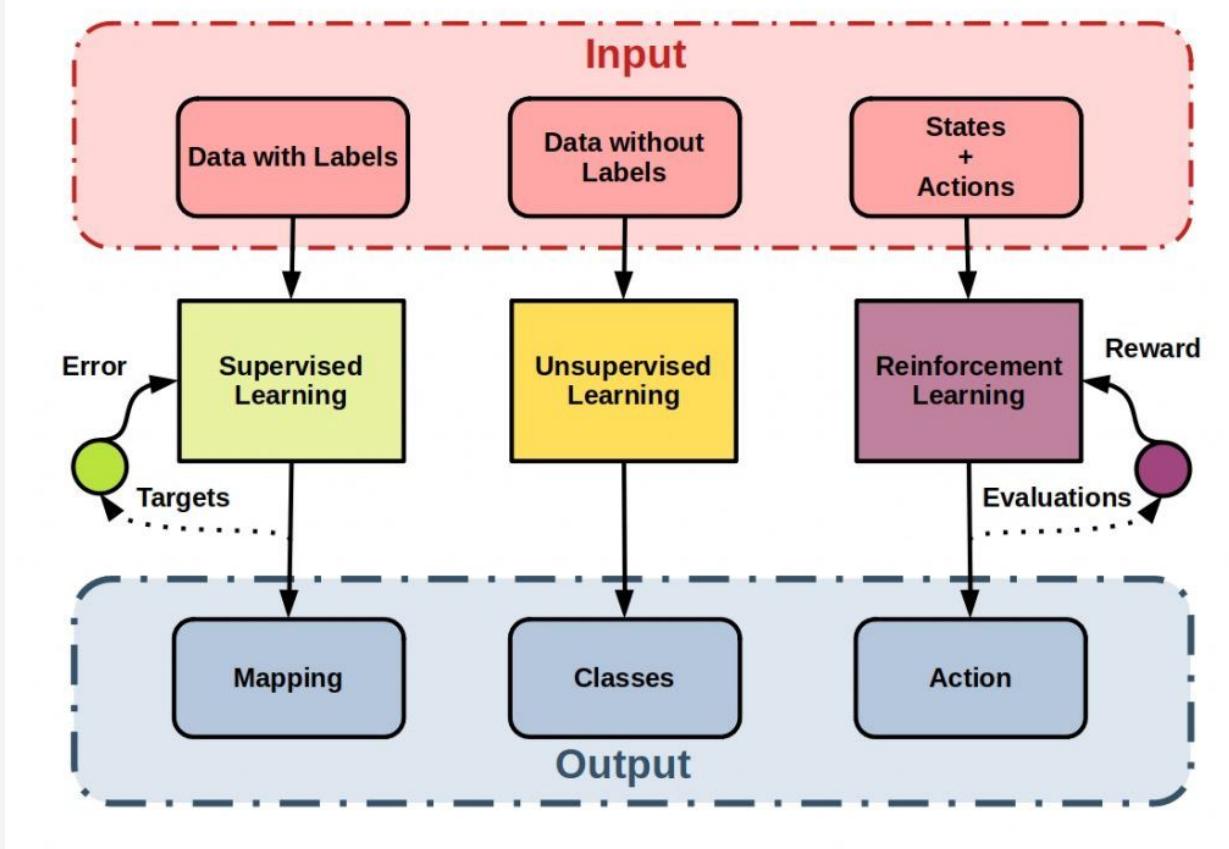


reinforcement
learning





Machine Learning





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Activity





Activity

- The next 2 slides have tables of tasks.
- Annotate in the following tables whether you think the tasks require supervised, unsupervised or reinforcement learning.
- We will discuss the answers after each table.



10 minutes



Supervised, Unsupervised or Reinforcement?

Scenario	Supervised	Unsupervised	Reinforcement
Riding a bicycle			
Driving a car			
Deciphering the Rosetta Stone			
Navigating into an unknown building			
Training a tiger to jump through a ring of fire			



Supervised, Unsupervised or Reinforcement?

Scenario	Supervised	Unsupervised	Reinforcement
Classifying musical pieces to different music genres			
After breaking the dominant hand, learn to use the other one for all tasks			
Proposing books to buyers according their previous choices (e.g. on-line bookshops)			
Developing social skills			
Building a classifier for handwritten digits (reading)			



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Activity





Activity

- In breakout rooms, think about a use case (if any) or potential use case of ML in your organization
- What type of ML would it be (supervised or unsupervised). If supervised, is it going to be regression or classification.
- What benefits does your organization gets with potential implementation of ML





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In

Activity





Activity

Open the folder ‘Ames_housing’- there is a dataset called “ames.csv” and a file called “description.txt”

Your task is to have look at the data and sketch out answers for the following

- What is a potential target in your data for a regression model?
- What is a potential target in your data for a classification model?
- (Extend) Could unsupervised learning be used within this data? How so?



5 minutes