First Step to Practical Machine Learning

Knowledge Sharing for CPE/SKE students

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Before we start...

Make sure these are installed on your computer.

This page is a guide for installing on Windows

- Python 3.6: Download and install at `https://www.python.org`
- NumPy, Scipy, Matplotlib, Scikit-learn, MLxtend:
  Run `pip install numpy scipy matplotlib sklearn mlxtend`

Outline

Introduction to Machine Learning

What is Machine Learning?

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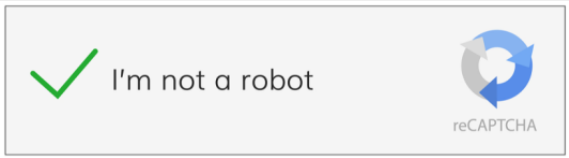

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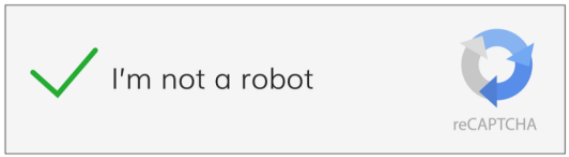

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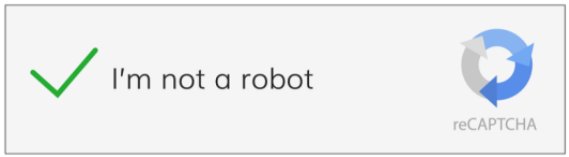

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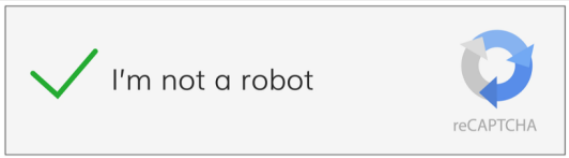

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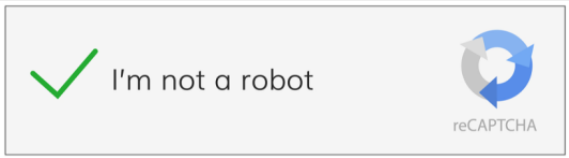

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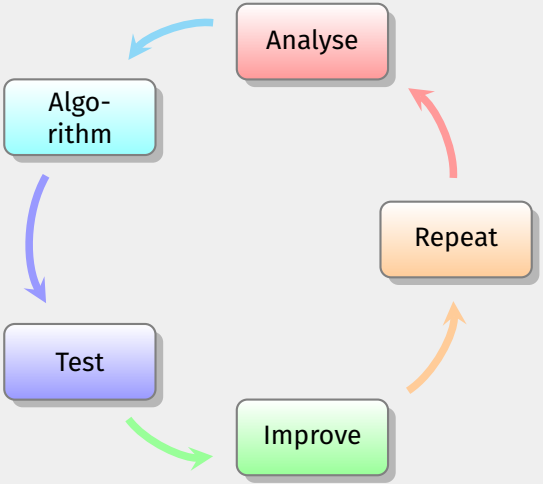
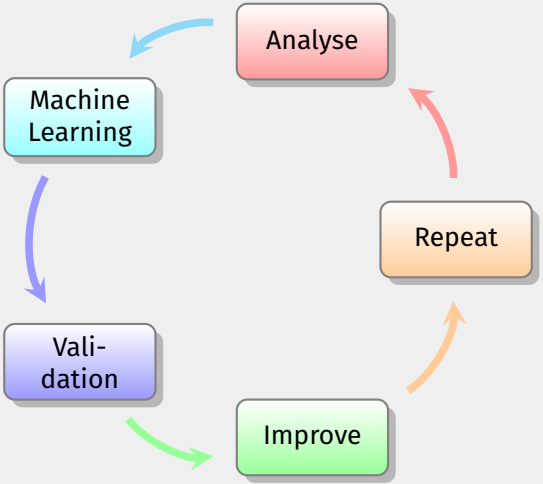
  - Recaptcha helps stop millions of spam a day.
  - In some old days, we have to type Captcha texts to distinguish ourself from bots.
  - How is it possible that with a single click, an automated system can distinguish bots from humans?

Traditional programming approach



Machine learning approach



In other words...

Machine Learning

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= Data + Data analysis algorithm

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Machine Learning

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= Adapt to change

Machine Learning Problems

Types of Machine Learning problems

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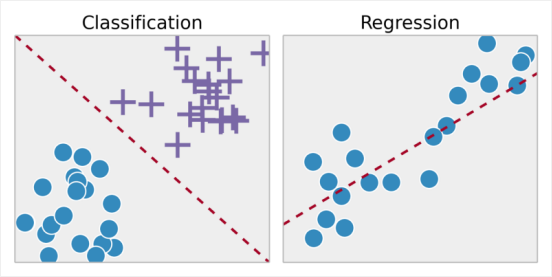
2. Unsupervised learning
3. Reinforcement learning

Supervised learning



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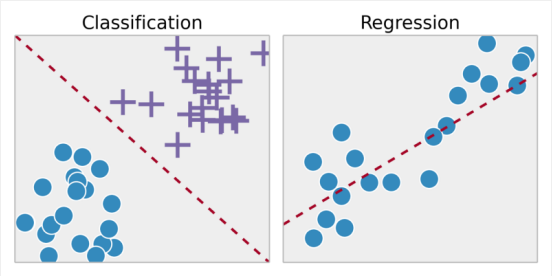

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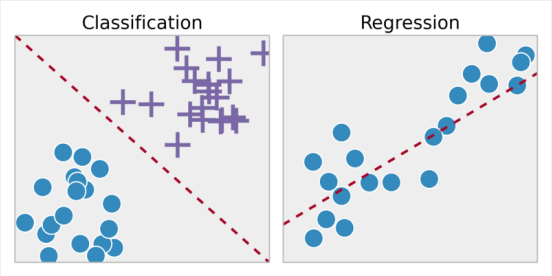
Supervised learning



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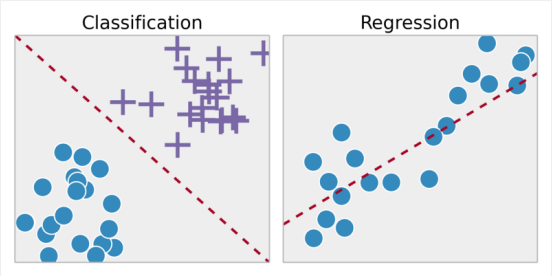

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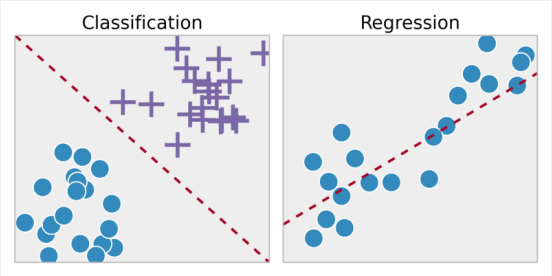

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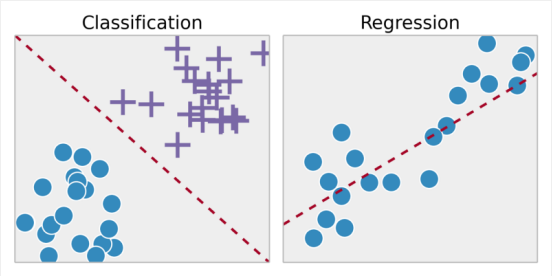

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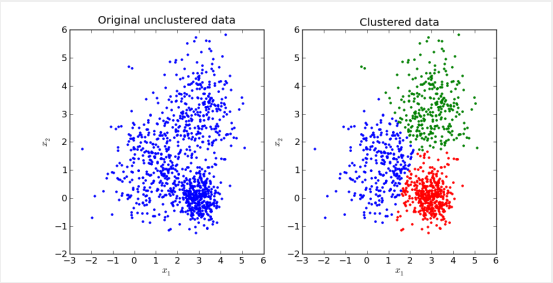
- Example problems: Spam E-mail detection, Facial recognition

Unsupervised learning



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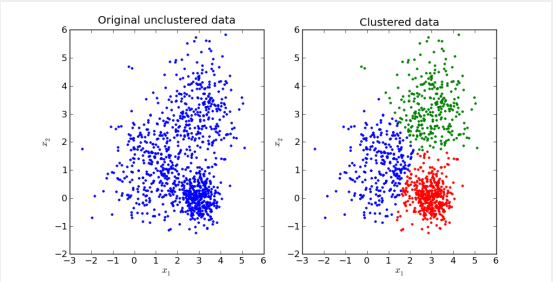

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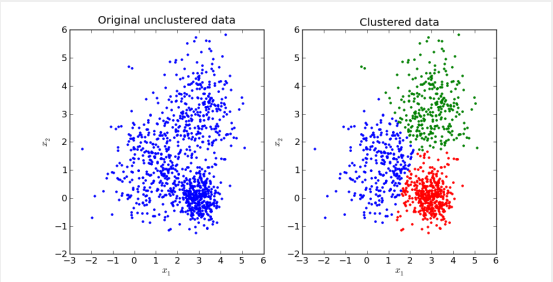

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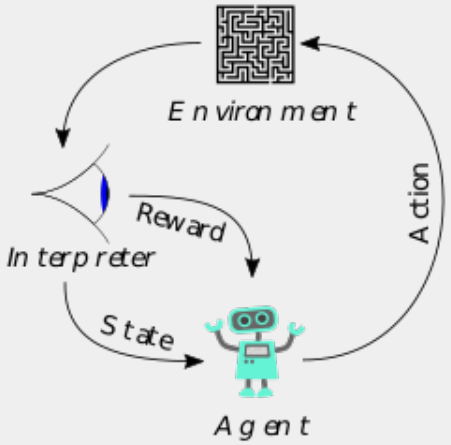
- Example: Clustering, Generative models

Reinforcement learning



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Data

Determine which group should the purple dot be in (red/green/blue) by **checking the colour of its nearest dot.**

Method

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_k_-NN algorithm

To classify label of a data point, get *k* nearest data points to the data point, and select the major label among those data points.

Coding time!

Machine Learning Process

Machine Learning Process

- Train
- Test

(There'll be more of this, trust me.)

Choosing the parameter for k-NN algorithm

What is the bad way to choose k?

- What if we choose k = # of all points?
  - What will happen if our dataset's got 3 labels of A, B, C with 10, 20, and 30 data points of each?
  - Answer: Our model will always answer the labels with the highest data point count.
- What if we choose k = 1?
  - Let's try!

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    - **Cheating!** Like letting the model *remembers* the answer instead of **generalising** the data pattern.
  - In other words, **don't test and train model on the same set of data.**

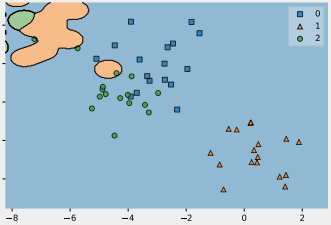
Choosing the best k

- **Train** with the training set, to let our model know how will the data looks like.
- **Test** with the testing set, to see on how our model performs.

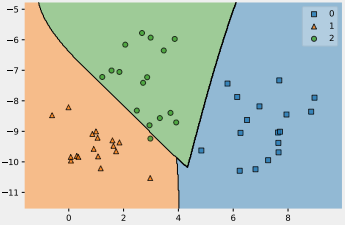
Warning! This is a simplified Machine Learning model training process, there are more to concerns!

Overfitting and underfitting

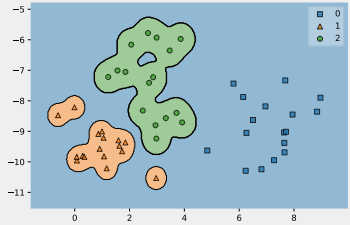
Which decision region is good?



Underfit: The model fails to recognise data pattern



Good fit: The model recognises data pattern **generally**



Overfit: The model **remembers** data pattern instead of generalising.

Good model must **generalise**