MA8510: Introduction to Data Mining

Collaborate Session 1

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JCU Masters of Data Science

2019-22-10 (updated: 2020-10-29)

Housekeeping

- Collaborate 1 = Wednesdays 6-7pm (Martha)
- Collaborate 2 = Thursdays 7-8pm (Hongbin)

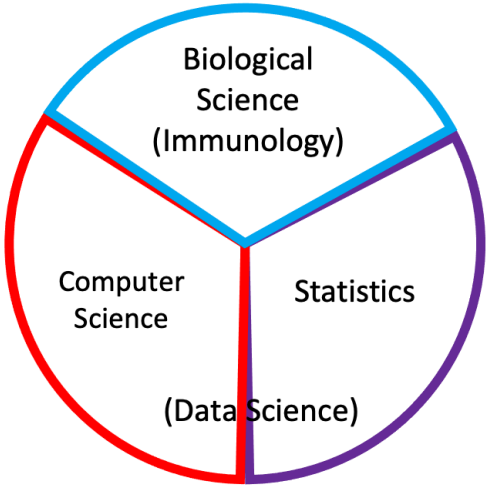
For my Collaborate Sessions, you can get the slides & R code for each week here:

https://github.com/MarthaCooper/MA8510

Introduction

Dr. Martha Cooper

- I'm a research scientist at the Australian Institute of Tropical Health and Medicine, JCU
- Immunology & Bioinformatics
- I use Data Science to understand how people's immune systems respond to parasite infections.



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MA8510 Discussion board: Saturday & Sunday

Subject: MA8510 Intro to Data Mining

MA8510 Learning Outcomes

1. Overview of Data Mining and Examples (Today)
2. Unsupervised data mining methods e.g. clustering and outlier detection;
3. Unsupervised and supervised techniques for dimensionality reduction;
4. Supervised data mining methods for pattern classification;
5. Apply these concepts to real data sets using R.

Assignments

Time management is important!

Assignment 1 due Sunday Week 3 (30%)

Assignment 2 due Sunday Week 5 (30%)

Assignment 3 (Capstone) due Wednesday Week 7 (40%)

The Extension Policy has been updated. Check the course outline for more information.

Today's Goals

- Understand the major roles of data mining within the broader scope of data science
- Classify the most common problems involved in data mining as:

  predictive *vs* descriptive

  unsupervised *vs* supervised tasks
- Understand the main challenges for data mining in the context of Big Data analytics

What is Data Mining?

The process of discovering useful...

Patterns

Information

Knowledge

Predictive models

...from large-scale data.

Data Mining Methods

Supervised Learning

What?

Find patterns in our data that explain a dependent variable, Y

Why?

Predict future values of the dependent variable, Y, using a set of independent variables, $X = X_1, \ldots, X_n$

How?

Regression, Classification

Unsupervised Learning

What?

Identify patterns in our data without defining a dependent variable, Y

Why?

Describe interesting patterns in the current set of independent variables, $X = X_1, \ldots, X_n$

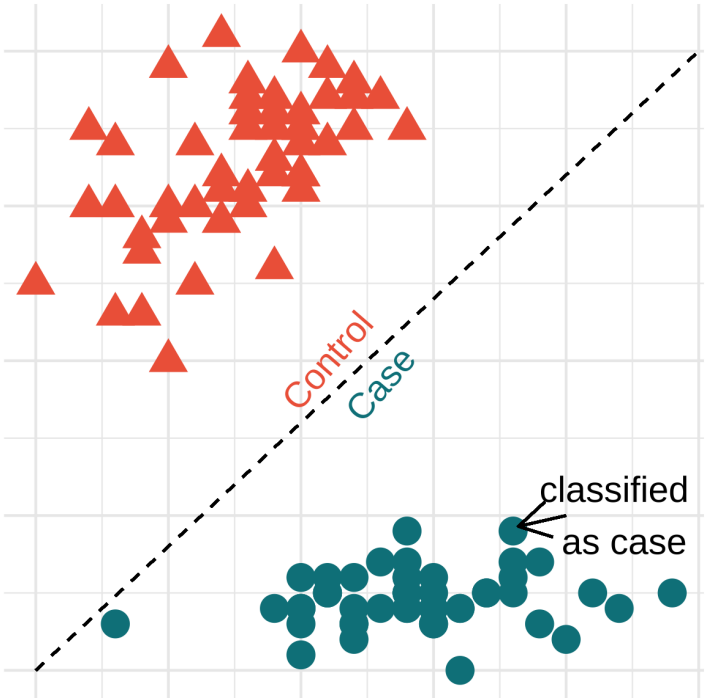
How?

Clustering, Outlier detection, Frequent Pattern Mining

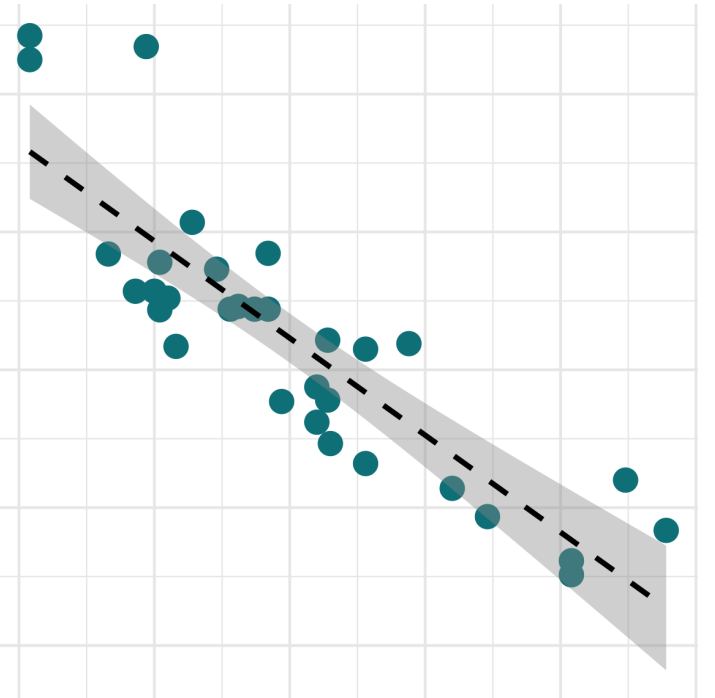
Supervised Learning

- The dependent variable, Y, is defined (data is "labelled")
- Used in predictive data mining tasks
- Training the model is called supervised learning

Classification

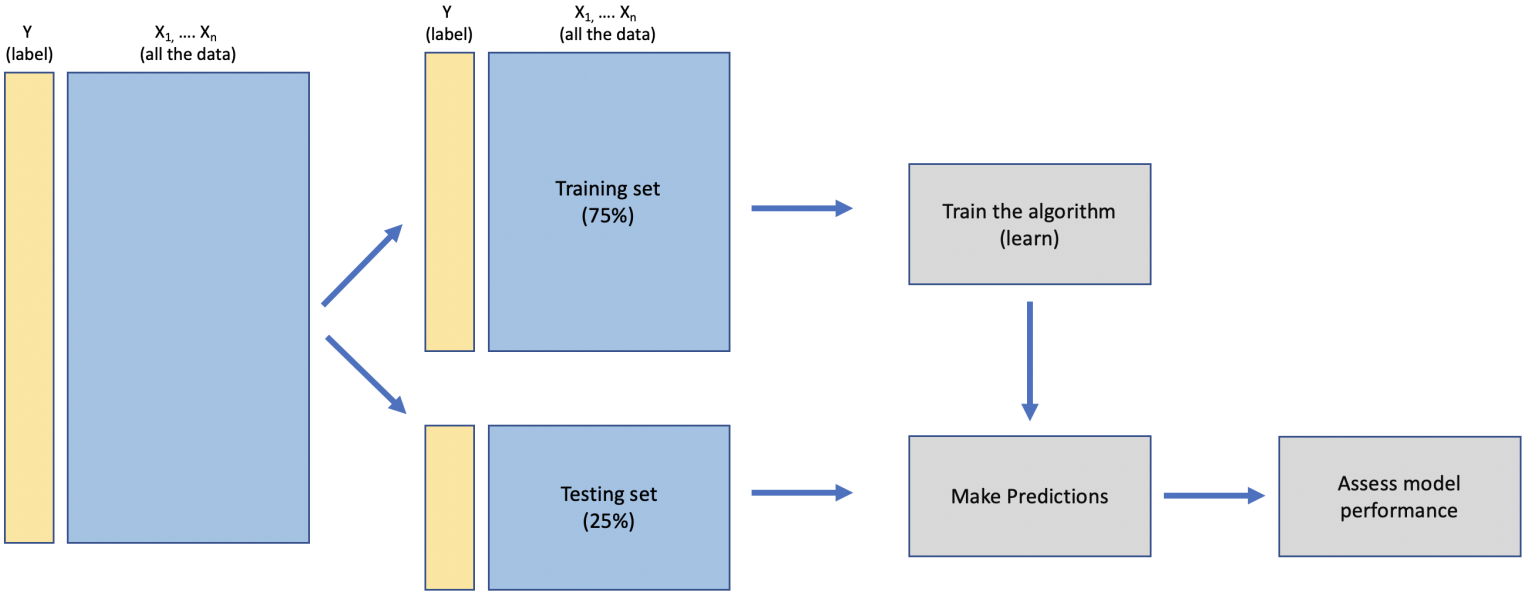


Regression



Supervised Learning

A supervised learning workflow:

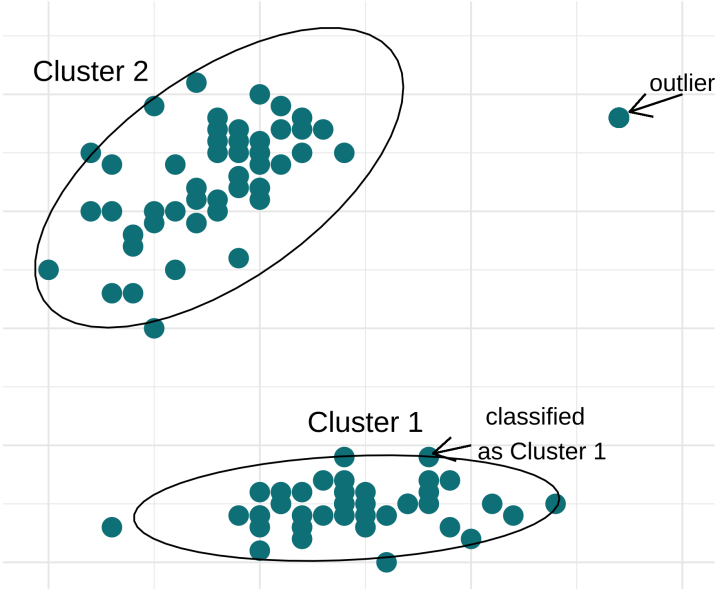


e.g. Naive Bayes Classifiers, Logistic Regression

Unsupervised Learning

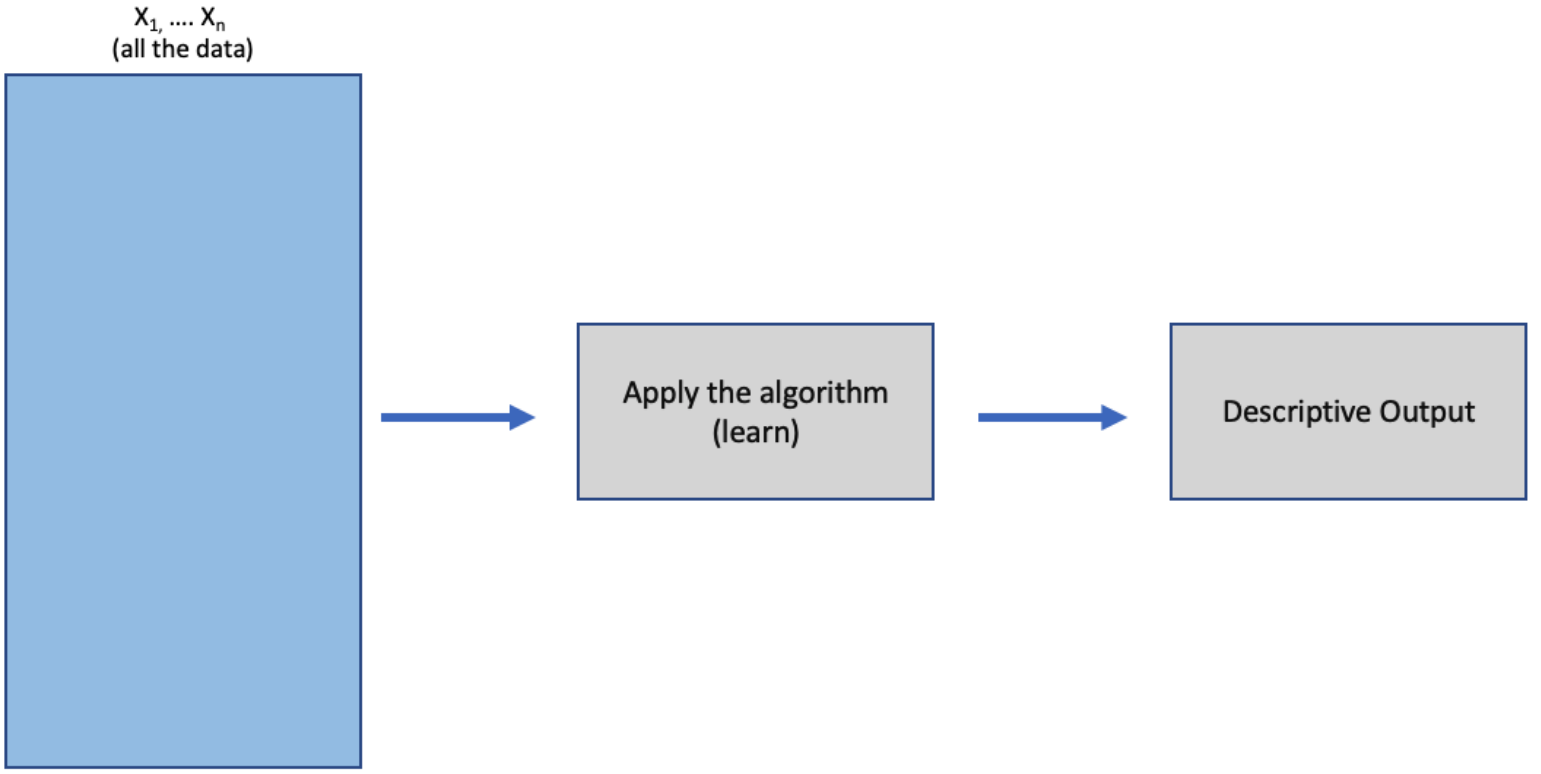
- We don't know (or define) a dependant variable (data is "unlabeled")
- Used in descriptive data mining tasks
- Training the model is called unsupervised learning

Clustering, Outlier Detection



Unsupervised Learning

An unsupervised learning workflow:



e.g. Principal Components Analysis (PCA), k-means clustering, hierarcical clustering

Task 1: Supervised *vs* Unsupervised?

1. Predictive Policing - forecasting when and where a crime will happen
2. Identifying subtypes of ovarian cancer based on genetic data
3. Automatic grading of students papers in some Chinese schools
4. A facial recognition system to identify gender
5. Dividing a set of photographs of people into piles containing each individual

Task 2: Challenges for data mining in the context of Big Data

Any ideas?

Task 2: Challenges for data mining in the context of Big Data

- Heterogeneity
- Complexity
- Data Privacy and Security
- Storage
- Computation Issues

Extra reading/listening

Get used to using stackoverflow:

- This stackoverflow thread

Still stuck? Go here:

- This Guru99 tutorial

Want a challenge? Go here:

- Big Data Bioinformatics

Just for fun:

- This Data Learner's podcast

References

Slides

- xaringhan, xaringanthemer, remark.js, knitr, R Markdown