

Machine Learning (ML)

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Outline

Outline of
Topics

Introduction

Linear Regression

Classification

Naive Bayes
Classifier

Decision Tree

Logistic Regression

Neural Network

Support Vector
Machine

Clustering

K-means Clustering

Hierarchical
Clustering

Summary

1 Introduction

- Linear Regression
- Classification
 - Naive Bayes Classifier
 - Decision Tree
 - Logistic Regression
 - Neural Network
 - Support Vector Machine
- Clustering
 - K-means Clustering
 - Hierarchical Clustering
- Summary

Machine Learning

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Figure 1: ML

- Human: Learn from past experiences
- Computer: Need to be programmed about what to do
- Can we get computers to learn from experiences?
 - Yes, Machine learning
 - Past experience: Data
 - How to make the computer to learn from the previous data?

Price of a House

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Figure 2: Regression

- Predict price(dollars) of the house given its size(Sq.ft).
- What is the price of this medium sized house?

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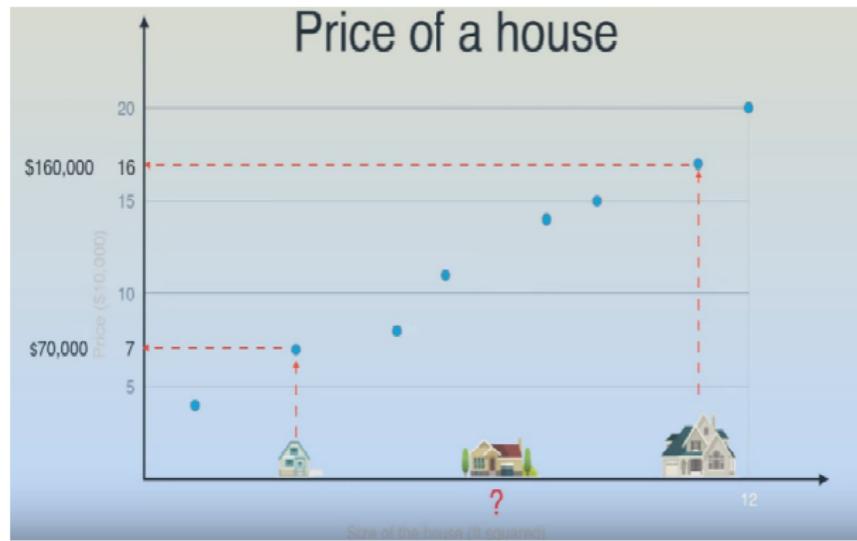


Figure 3: Regression

- What is the best estimate for the price of the house?

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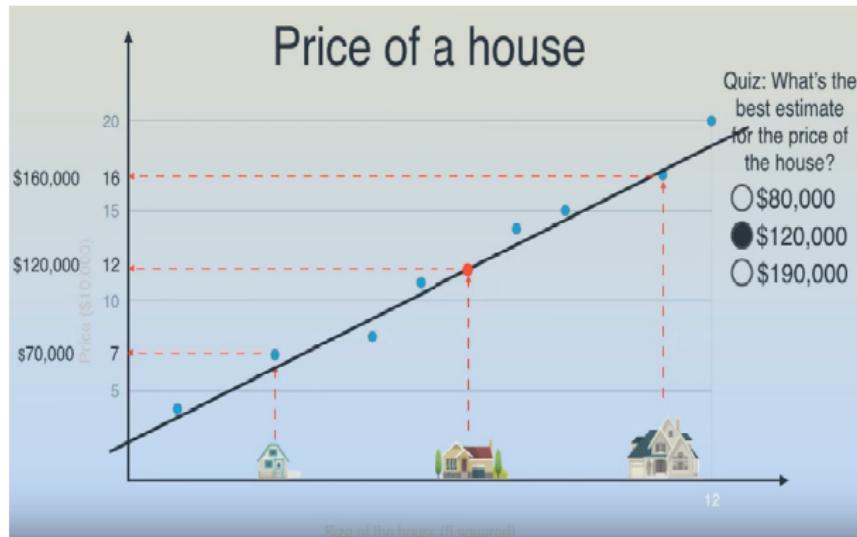


Figure 4: Linear Regression

- How to find this line?

How to fit the line?

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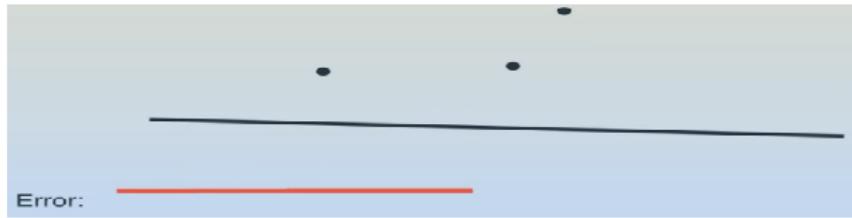
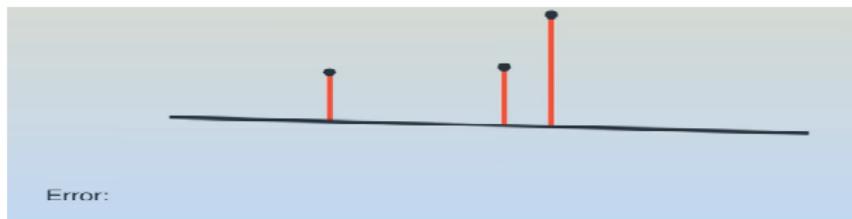
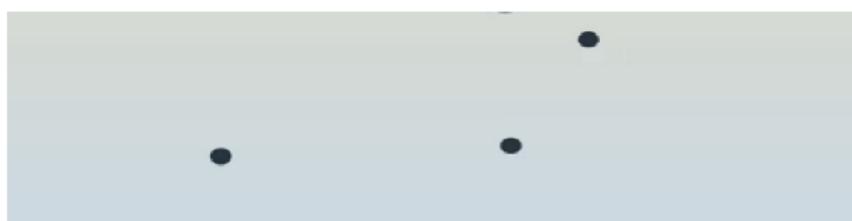


Figure 5: Example

Contd ...

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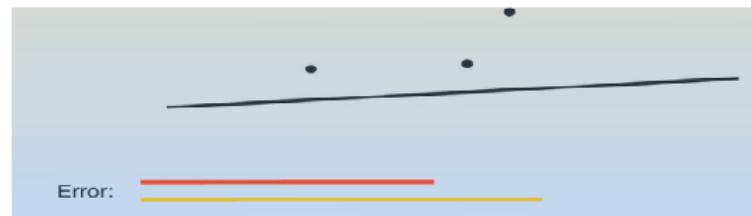
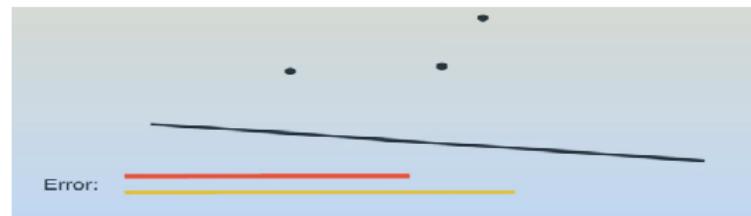
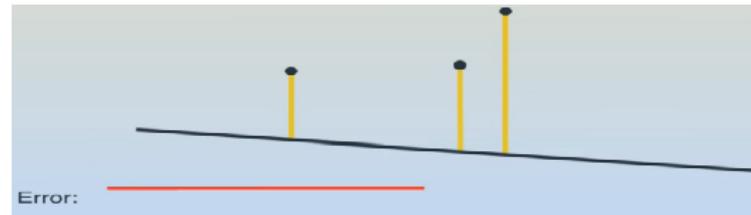


Figure 6: Example

Contd ...

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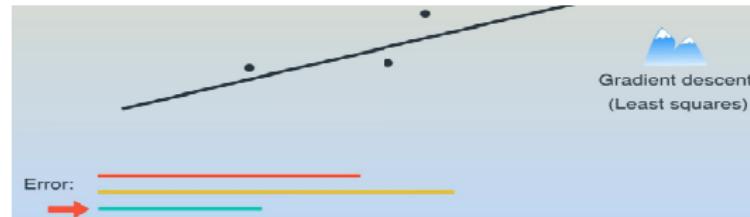
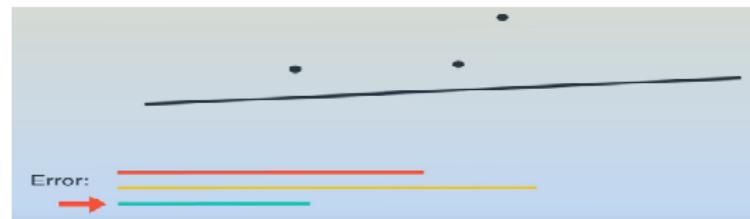
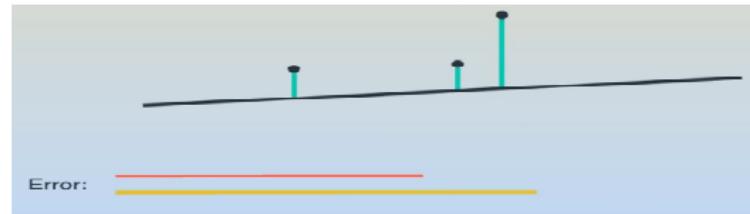


Figure 7: Example

Gradient Descent

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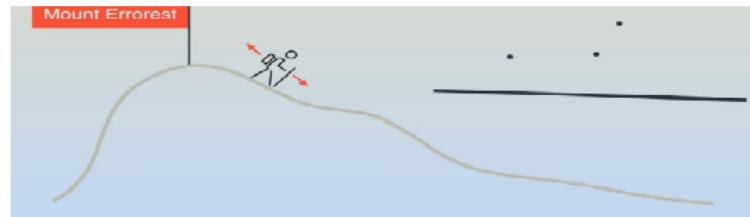
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- Descent: Reducing the error
- Identify direction that descent more



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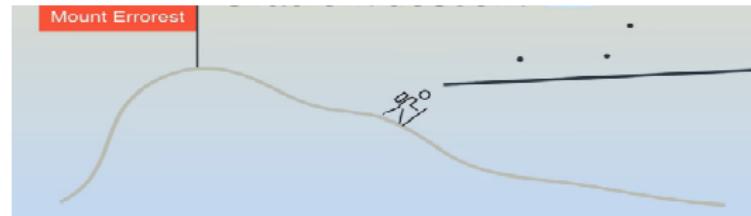
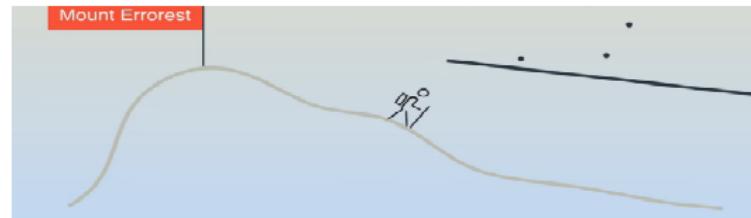
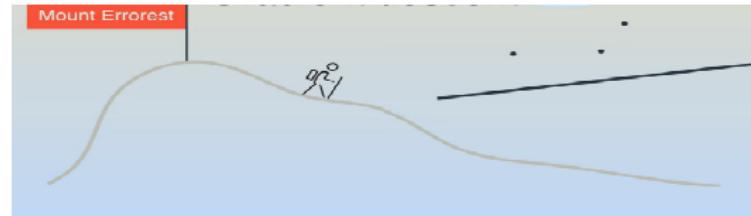


Figure 8: Example

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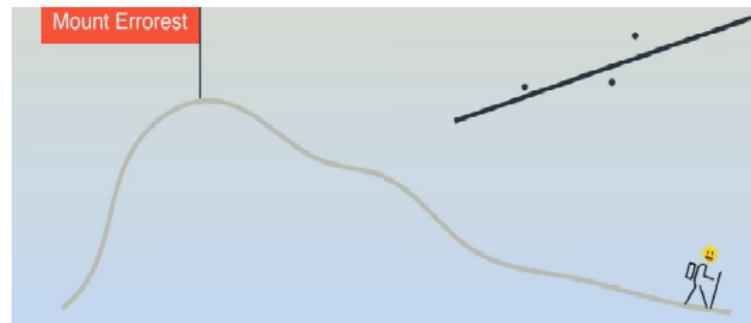
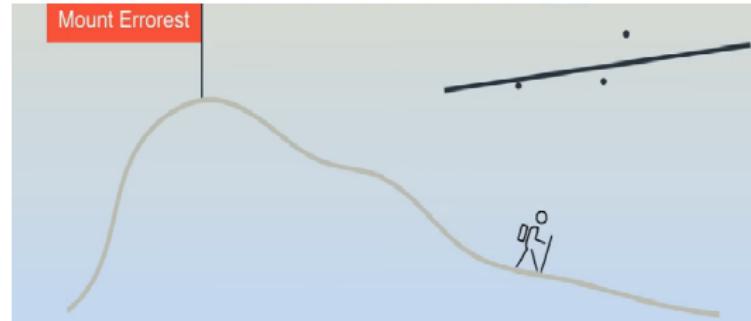


Figure 9: Example

Linear and Polynomial Regression

Outline of
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- Summary

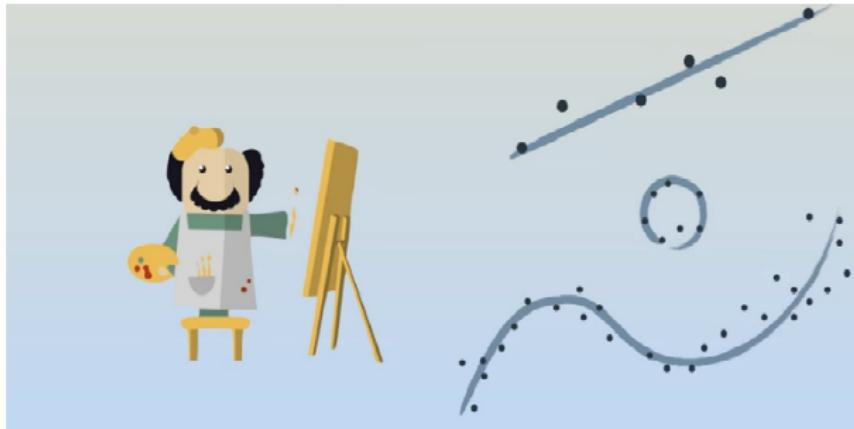


Figure 10: Example

Detecting Spam E-mails

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Hierarchical
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Summary

- 100 emails
 - 25: Spam
 - 75: Non-Spam

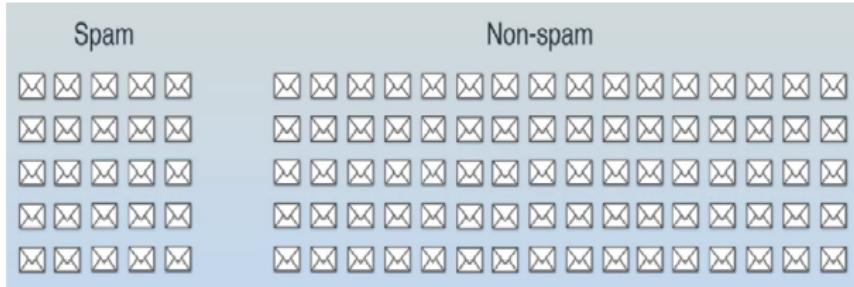
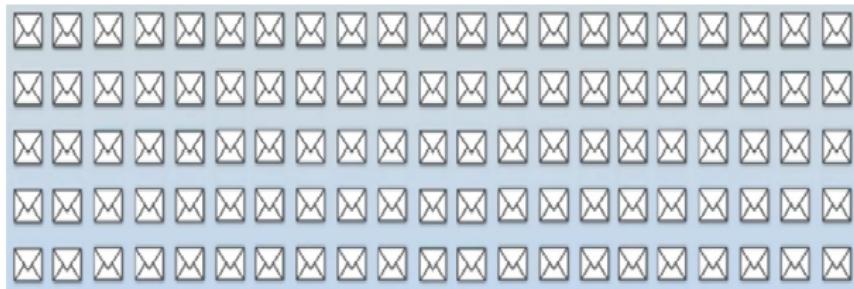


Figure 11: Example

Outline of
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Summary

■ Feature: Word "Cheap"

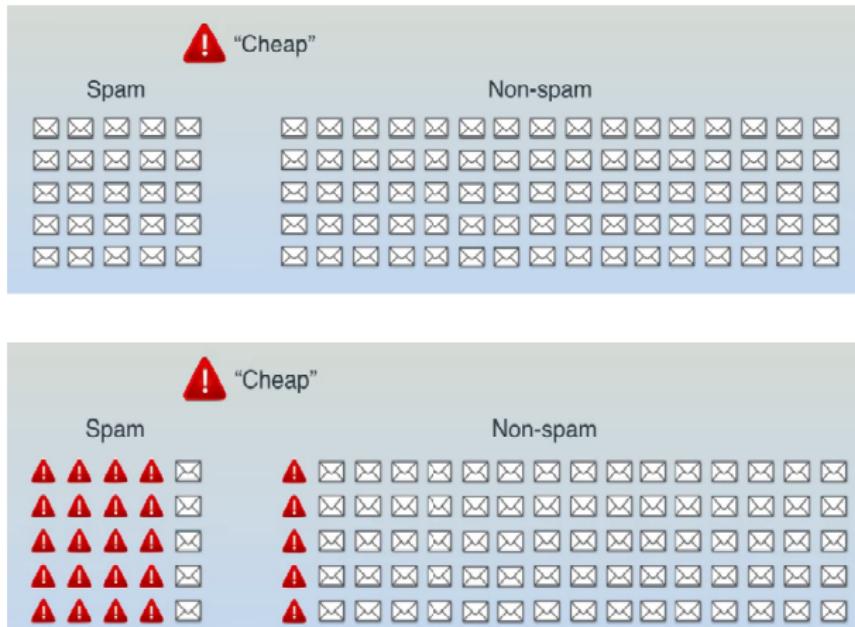


Figure 12: Example

Contd ...

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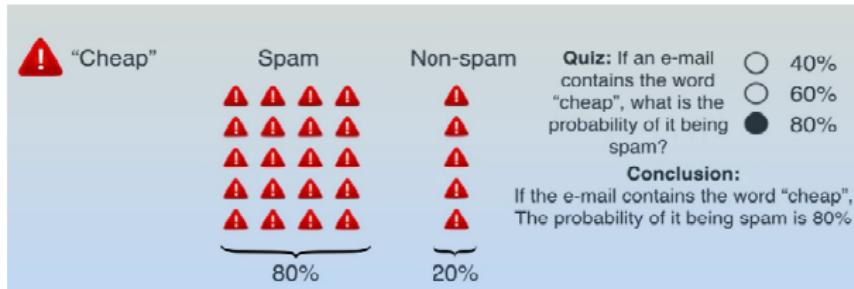


Figure 13: Example

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Summary

The slide contains four items, each preceded by a warning icon (yellow triangle with exclamation mark):

- "Cheap" → 80%
- Spelling mistake → 70%
- Missing title → 95%
- etc...

Quiz: If an e-mail contains the word "cheap", what is the probability of it being spam?

Conclusion: If the e-mail contains the word "cheap", The probability of it being spam is 80%

Figure 14: Example

Naive Bayes Classifier

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Summary

The slide features a light blue background with a white central area. On the left, there's a vertical list of topics. In the center, four red exclamation mark icons are aligned vertically, each followed by a statement and an arrow pointing right, indicating a probability:

- ! "Cheap" → 80%
- ! Spelling mistake → 70%
- ! Missing title → 95%
- ! etc...

To the right of these statements is a quiz:

Quiz: If an e-mail contains the word "cheap", what is the probability of it being spam?

Three radio buttons are shown:

- 40%
- 60%
- 80%

Below the quiz is a **Conclusion:**

If the e-mail contains the word "cheap",
The probability of it being spam is 80%

Figure 15: Example

App Recommendation

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Summary

- User's downloaded app

- Pokemon Go
- SnapChat
- Whatsapp

Gender	Age	App
F	15	
F	25	
M	32	
F	40	
M	12	
M	14	

Figure 16: Example

Contd ...

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Summary

Gender	Age	App
F	15	Pokémon Go
F	25	WhatsApp
M	32	Snapchat
F	40	WhatsApp
M	12	Pokémon Go
M	14	Pokémon Go

Quiz: Between Gender and Age, which one seems more decisive for predicting what app will the users download?

- Gender
- Age

Gender	Age	App
F	15	Pokémon Go
F	25	WhatsApp
M	32	Snapchat
F	40	WhatsApp
M	12	Pokémon Go
M	14	Pokémon Go

Quiz: Between Gender and Age, which one seems more decisive for predicting what app will the users download?

- Gender
- Age

Figure 17: Example

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Summary

Gender	Age	App
F	15	
F	25	
M	32	
F	40	
M	12	
M	14	

Quiz: Between Gender and Age, which one seems more decisive for predicting what app will the users download?

- Gender
- Age

Gender	Age	App
F	15	
F	25	
M	32	
F	40	
M	12	
M	14	

Quiz: Between Gender and Age, which one seems more decisive for predicting what app will the users download?

- Gender
- Age

Figure 18: Example

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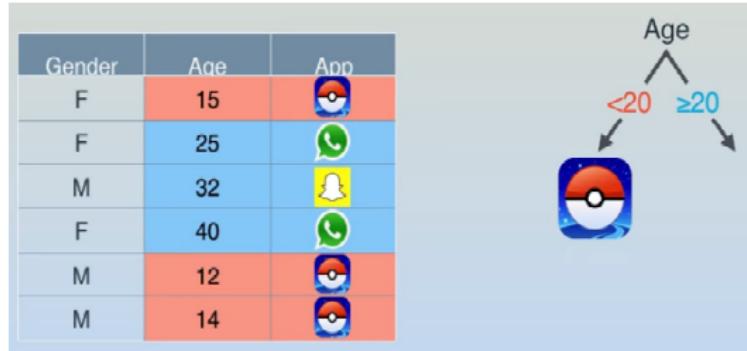


Figure 19: Example

Decision Tree

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Figure 20: Example

Acceptance at the University

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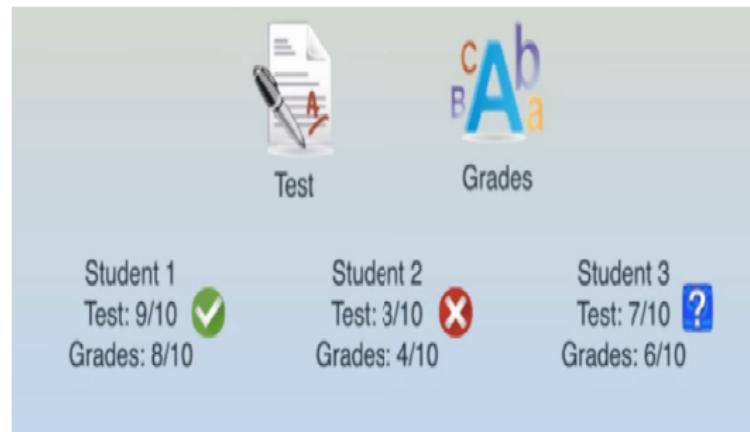


Figure 21: Example

Contd ...

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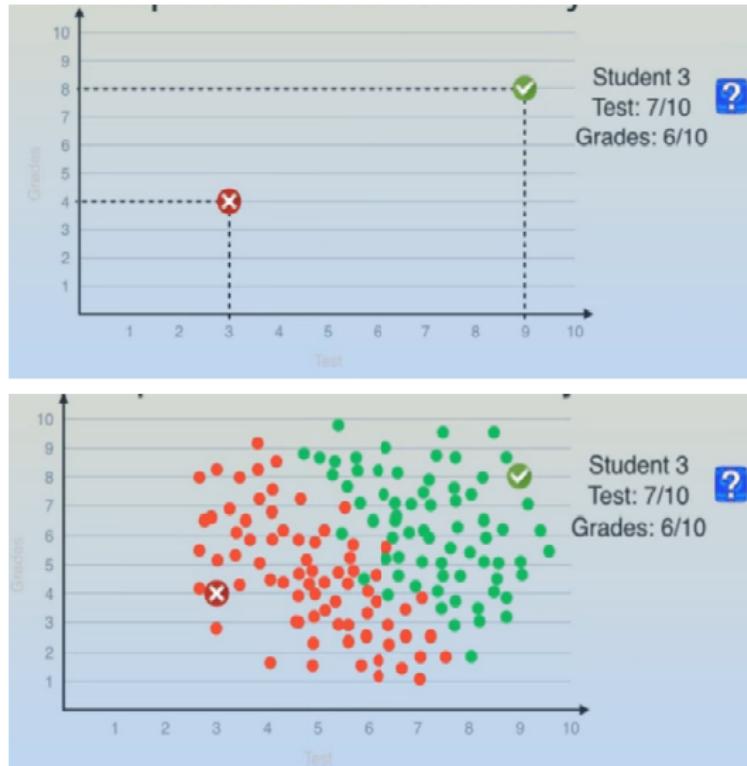


Figure 22: Example

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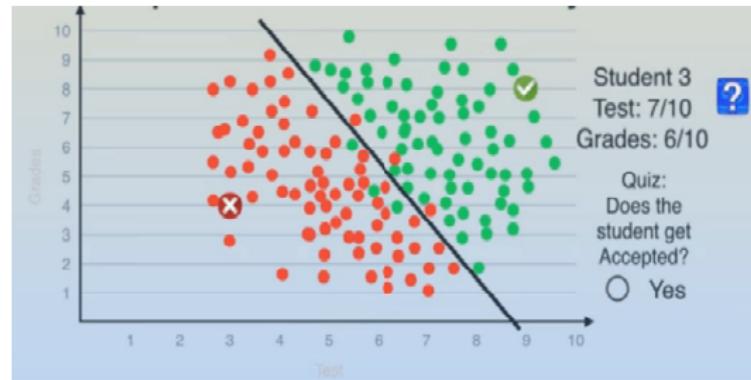
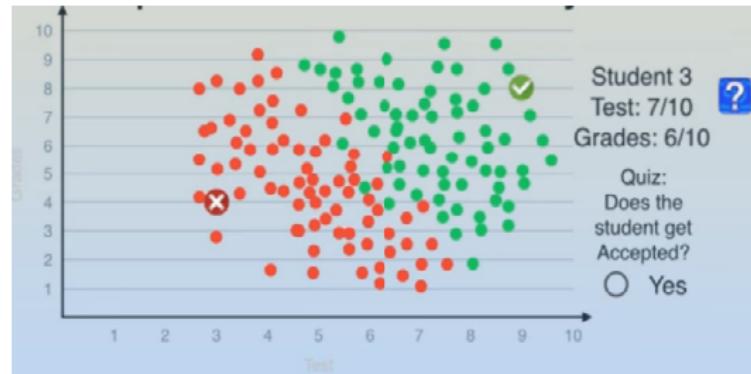


Figure 23: Example

Logistic Regression

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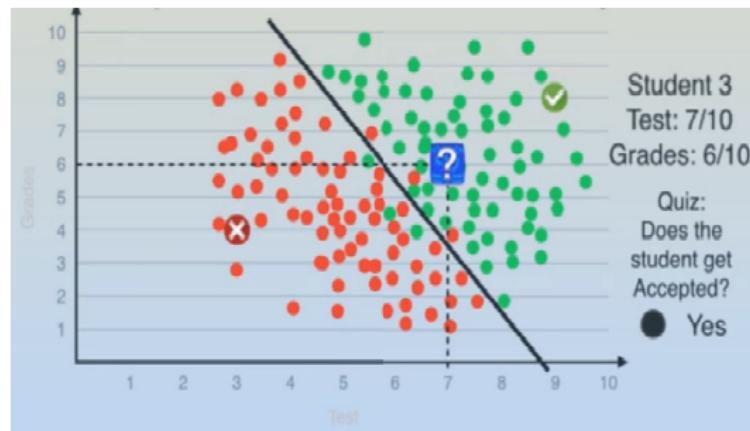


Figure 24: Example

- How to find the line that best cuts the data points into two?

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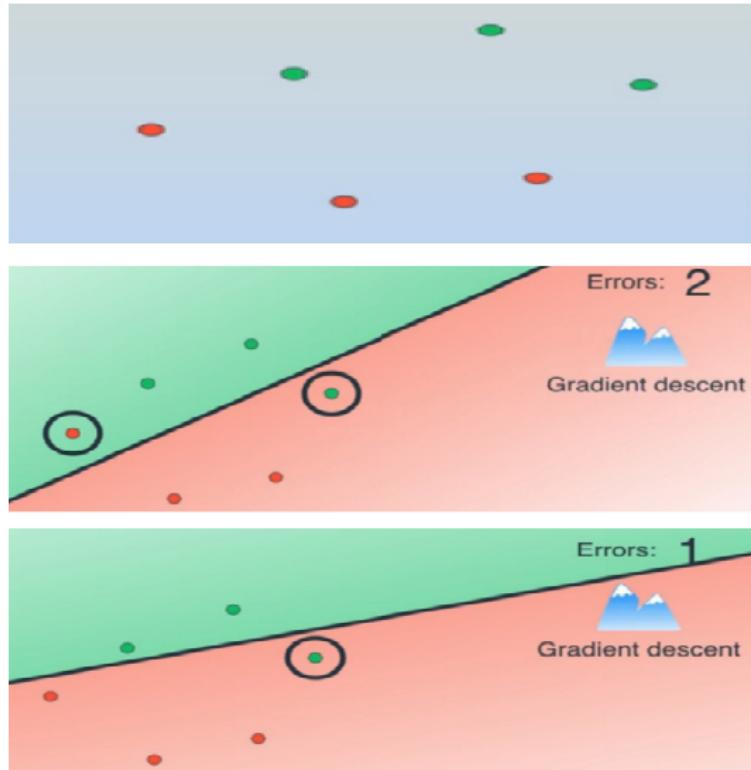


Figure 25: Example

Contd ...

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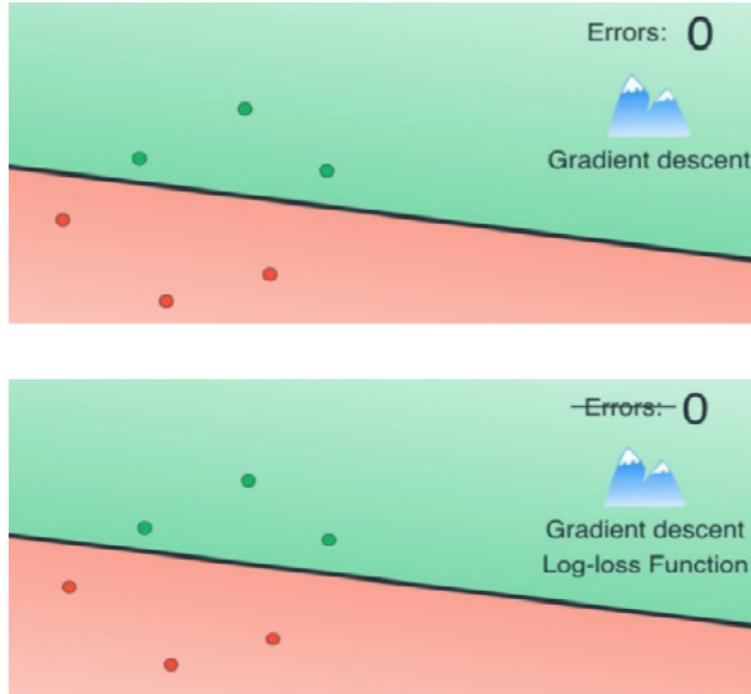


Figure 26: Example

Neural Network

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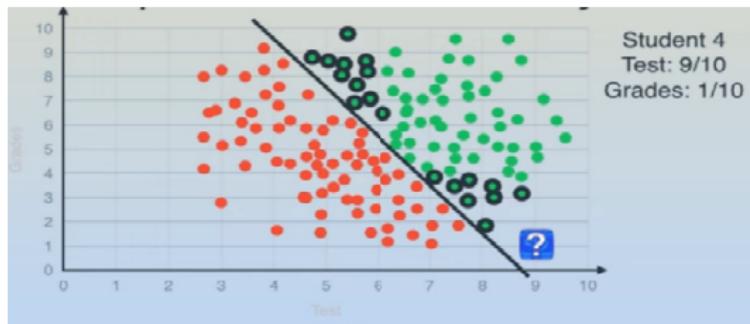
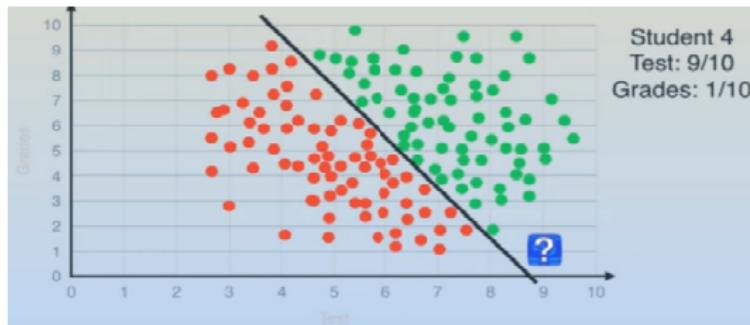


Figure 27: Example

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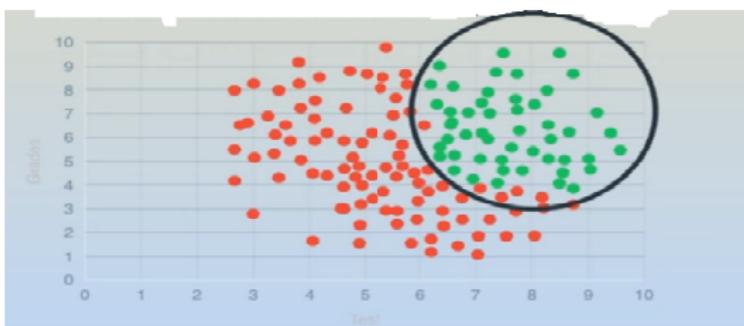


Figure 28: Example

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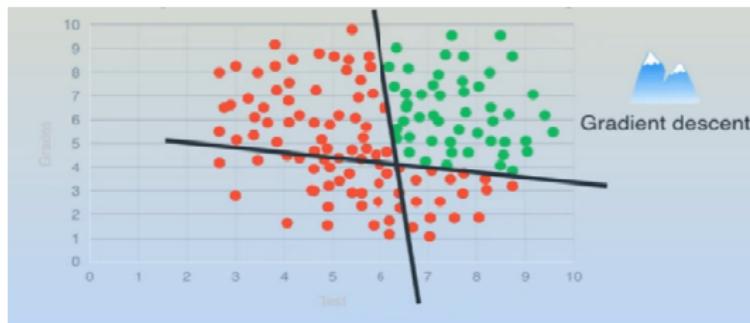
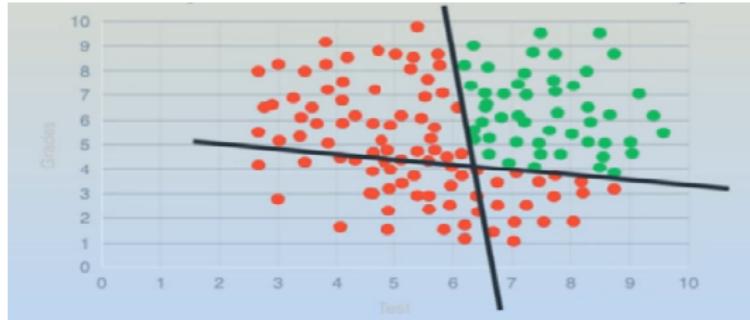


Figure 29: Example

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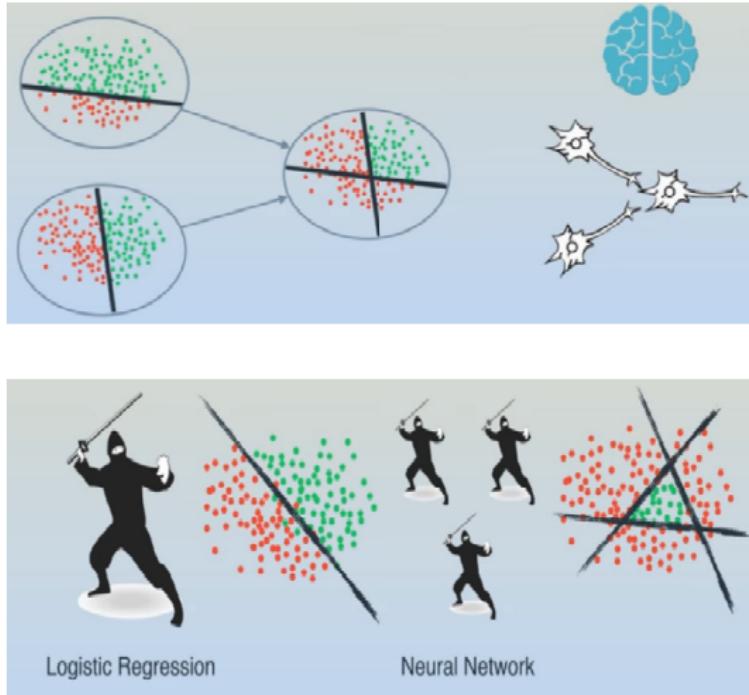


Figure 30: Example

Support Vector Machine

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Summary

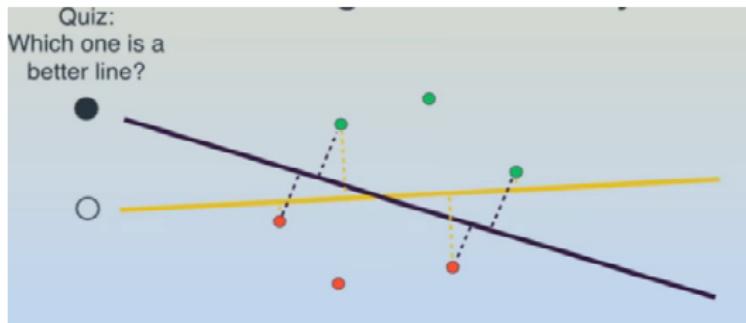
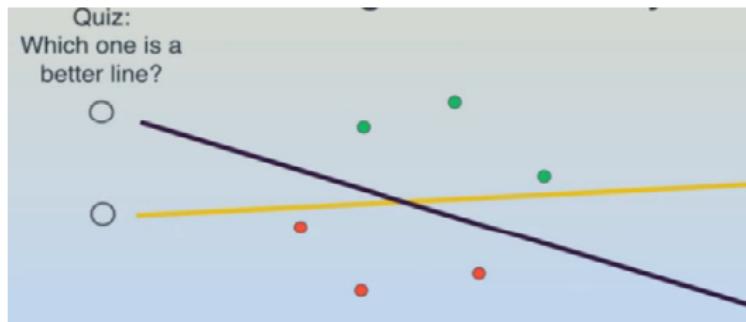


Figure 31: Example

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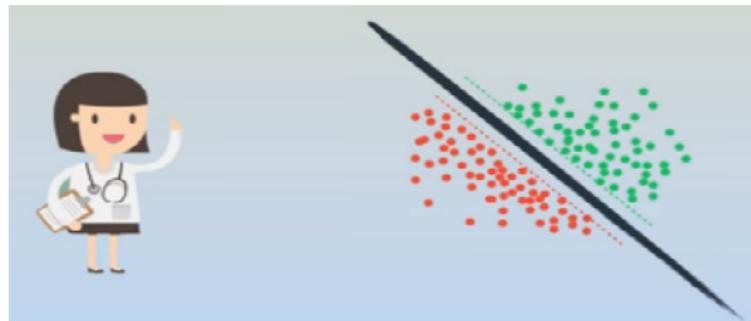
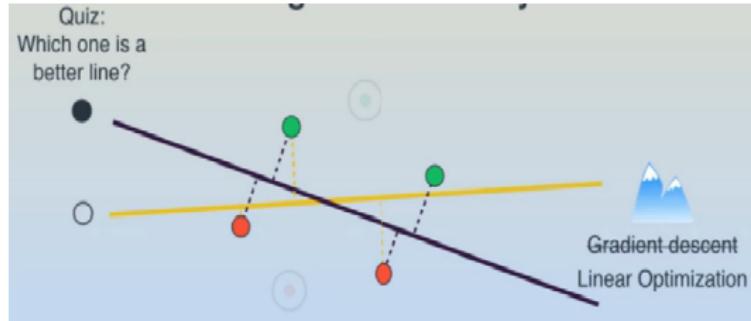


Figure 32: Example

When the line is not enough?

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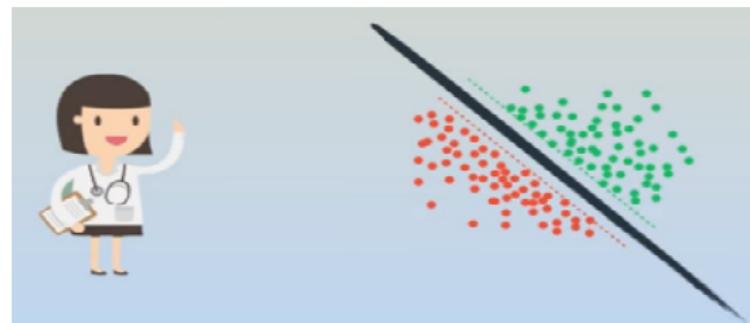
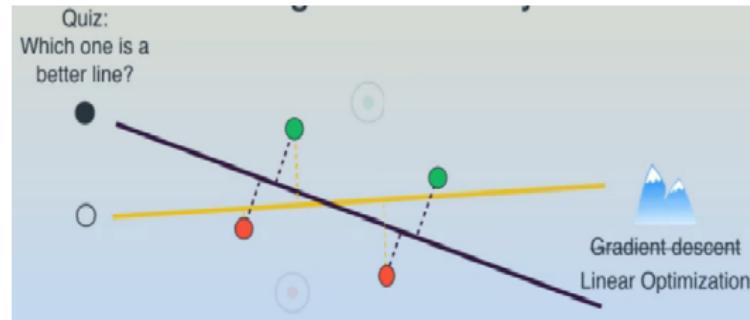


Figure 33: Example

Kernel Trick

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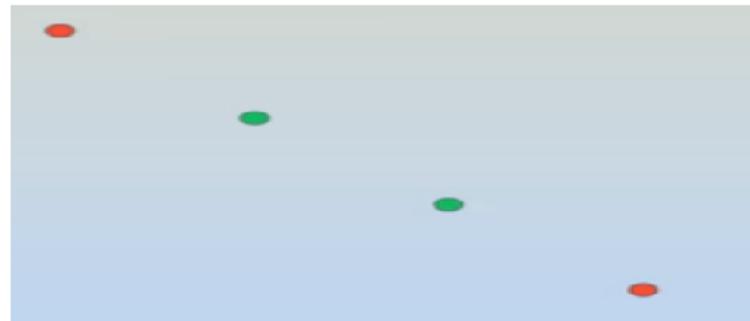
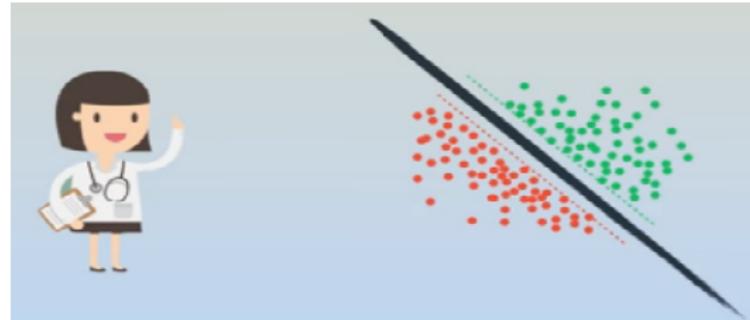


Figure 34: Example

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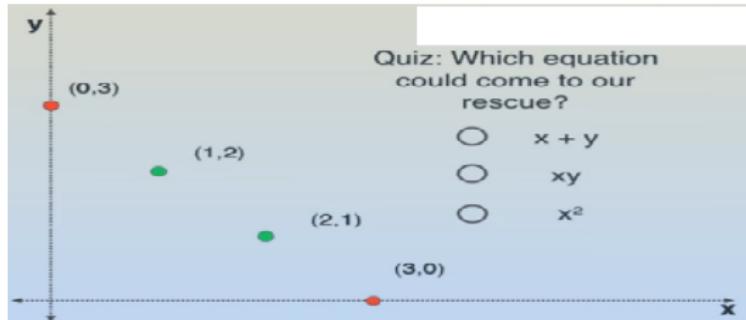
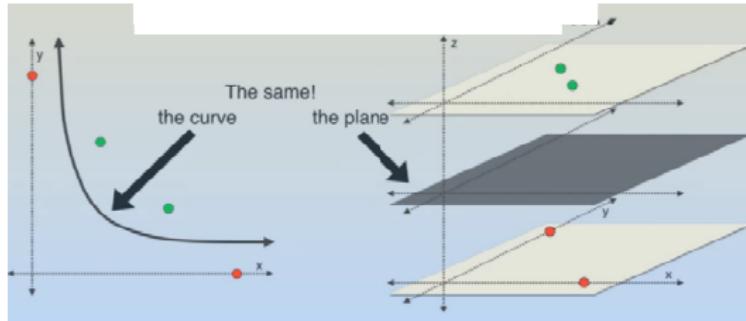
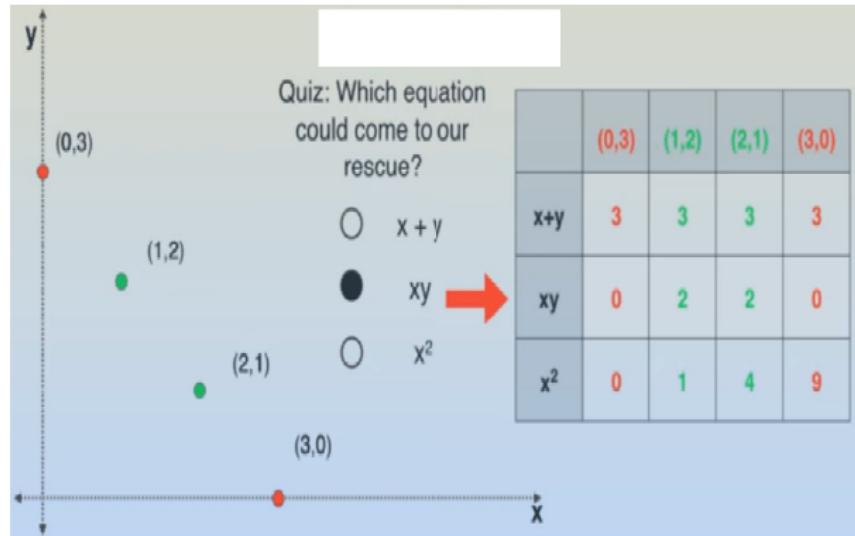


Figure 35: Example

Outline of
Topics

Introduction

- Linear Regression
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- Logistic Regression
- Neural Network
- Support Vector Machine
- Clustering
- K-means Clustering
- Hierarchical Clustering
- Summary



Contd ...

Outline of
Topics

Introduction

Linear Regression

Classification

Naive Bayes
Classifier

Decision Tree

Logistic Regression

Neural Network

Support Vector
Machine

Clustering

K-means Clustering

Hierarchical
Clustering

Summary

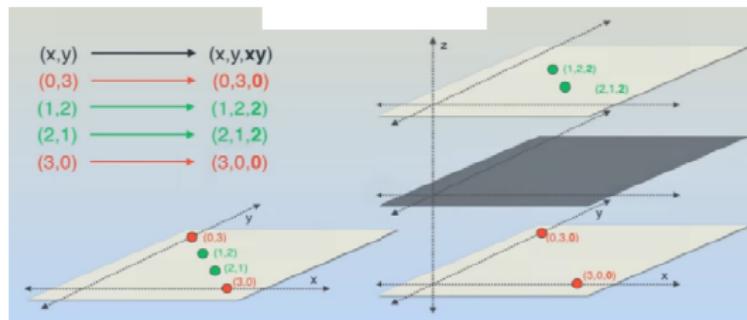
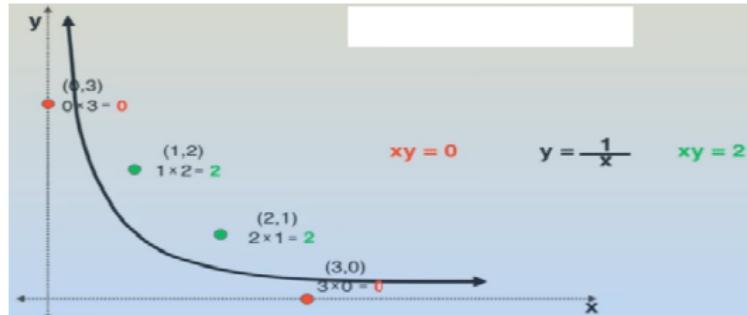


Figure 36: Example

Outline of
Topics

Introduction

Linear Regression
Classification
Naive Bayes
Classifier
Decision Tree
Logistic Regression
Neural Network
Support Vector
Machine

Clustering
K-means Clustering
Hierarchical
Clustering
Summary

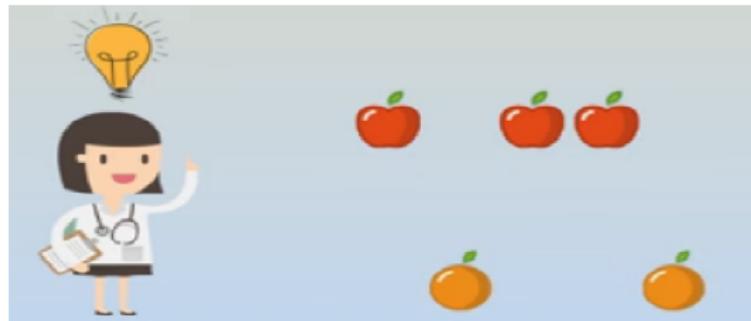


Figure 37: Example

K-means Clustering

Outline of Topics

Introduction

Linear Regression

Classification

Naive Bayes Classifier

Decision Tree

Logistic Regression

Neural Network

Support Vector Machine

Clustering

K-means Clustering

Hierarchical Clustering

Summary

- Chain of pizza parlors
- People eat pizza the most, is spotted the location
- Optimal places or best location to put three pizza parlors

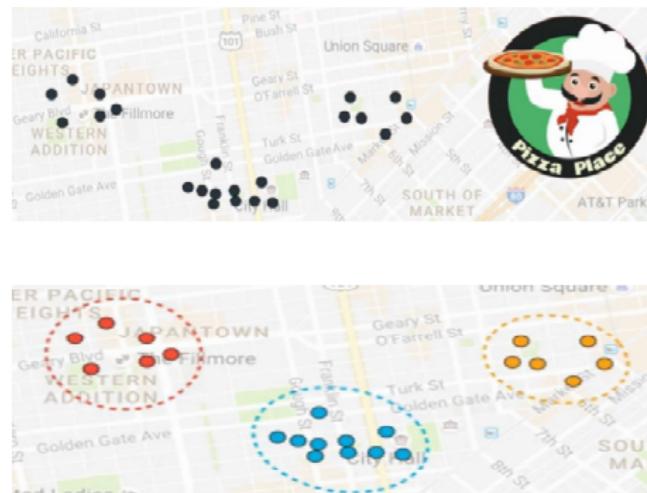


Figure 38: Example

Contd...

Outline of
Topics

Introduction

Linear Regression

Classification

Naive Bayes
Classifier

Decision Tree

Logistic Regression

Neural Network

Support Vector
Machine

Clustering

K-means Clustering

Hierarchical
Clustering

Summary

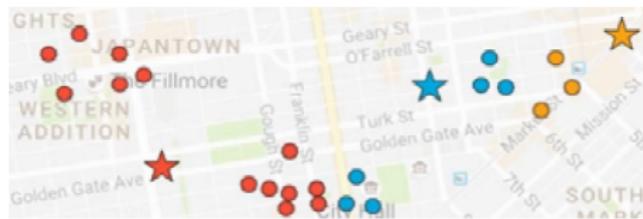
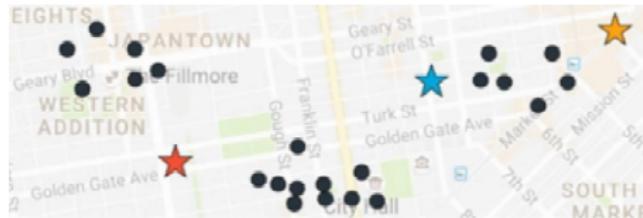


Figure 39: Example

Contd...

Outline of
Topics

Introduction

Linear Regression

Classification

Naive Bayes
Classifier

Decision Tree

Logistic Regression

Neural Network

Support Vector
Machine

Clustering

K-means Clustering

Hierarchical
Clustering

Summary



Figure 40: Example

Contd...

Outline of
Topics

Introduction

Linear Regression

Classification

Naive Bayes
Classifier

Decision Tree

Logistic Regression

Neural Network

Support Vector
Machine

Clustering

K-means Clustering

Hierarchical
Clustering

Summary

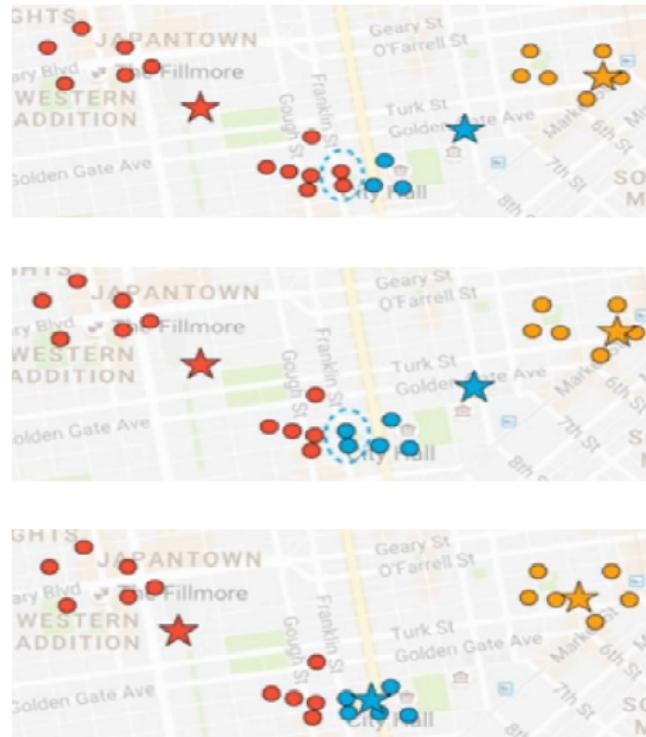


Figure 41: Example

Contd...

Outline of
Topics

Introduction

Linear Regression

Classification

Naive Bayes
Classifier

Decision Tree

Logistic Regression

Neural Network

Support Vector
Machine

Clustering

K-means Clustering

Hierarchical
Clustering

Summary

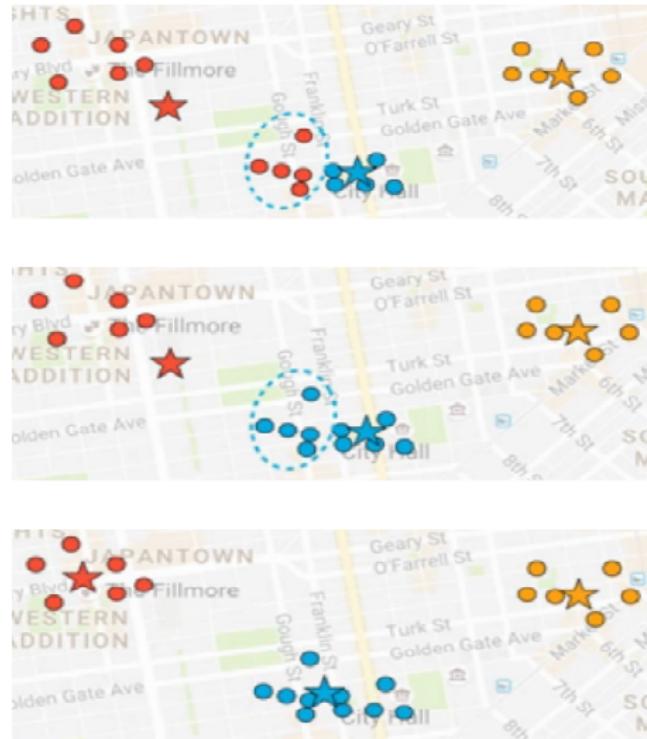


Figure 42: Example

Hierarchical Clustering

Outline of Topics

Introduction

Linear Regression

Classification

Naive Bayes Classifier

Decision Tree

Logistic Regression

Neural Network

Support Vector Machine

Clustering

K-means Clustering

Hierarchical Clustering

Summary



Figure 43: Example

Contd...

Outline of
Topics

Introduction

- Linear Regression
- Classification
- Naive Bayes Classifier
- Decision Tree
- Logistic Regression
- Neural Network
- Support Vector Machine
- Clustering
- K-means Clustering
- Hierarchical Clustering
- Summary

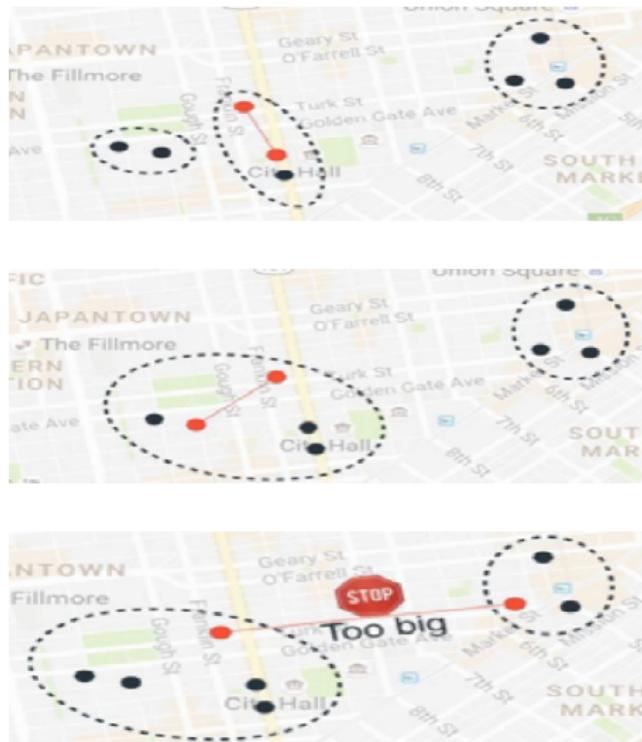


Figure 44: Example

Outline of Topics

Introduction

- Linear Regression
- Classification
- Naive Bayes Classifier
- Decision Tree
- Logistic Regression
- Neural Network
- Support Vector Machine
- Clustering
- K-means Clustering
- Hierarchical Clustering
- Summary

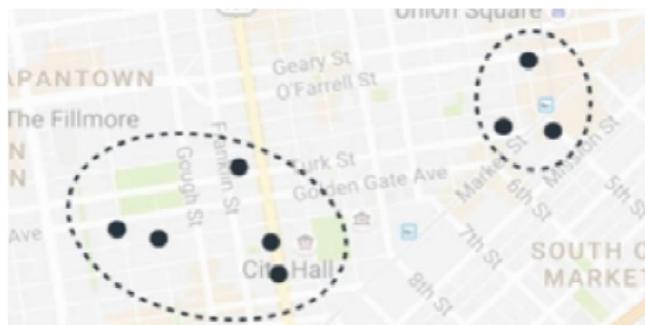


Figure 45: Example

Summary

Outline of
Topics

Introduction

Linear Regression
Classification
Naive Bayes
Classifier
Decision Tree
Logistic Regression
Neural Network
Support Vector
Machine
Clustering
K-means Clustering
Hierarchical
Clustering
Summary

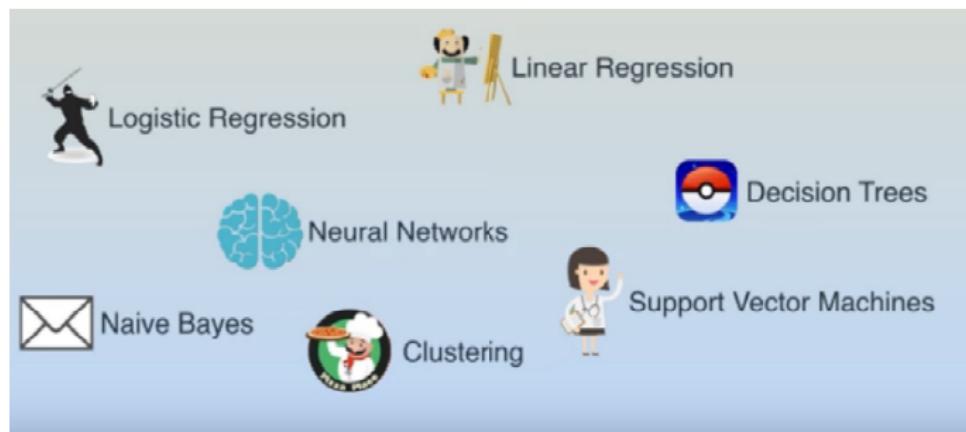


Figure 46: Example