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INFORMATION
TECHNOLOGY

A peak into…
Artificial Intelligence (AI) and Machine Learning (ML)

Ian Wern Han Lim
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Referencing materials by
Chern Hong LIM

GROUP OF EIGHT AUSTRALIA

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Ready?

Agenda

- What is?
  - Artificial Intelligence
  - Machine learning

Agenda

- What is?
  - Artificial Intelligence
  - Machine learning
    - Supervised learning
    - Unsupervised learning
    - Semi-supervised
    - Reinforced learning
    - Deep learning

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Let us begin…

About me…

- Wern Han LIM (Ian)

About me…

- Wern Han LIM (Ian)
  - B. Comp Science graduate 2009
  - PhD Comp Science graduate 2018

About me…

- Wern Han LIM (Ian)
  - B. Comp Science graduate 2009
  - PhD Comp Science graduate 2018

- Teaching since 2014
  - FIT1008 Introduction to Comp Science
  - FIT2004 Algorithms and Data Structures
  - FIT3155 Advanced Algorithms and Data Structures

  - FIT3152 Data Science/ Analytics
  - FIT2014 Theory of Computation
  - And a number of supervisions (FYP and Honours)

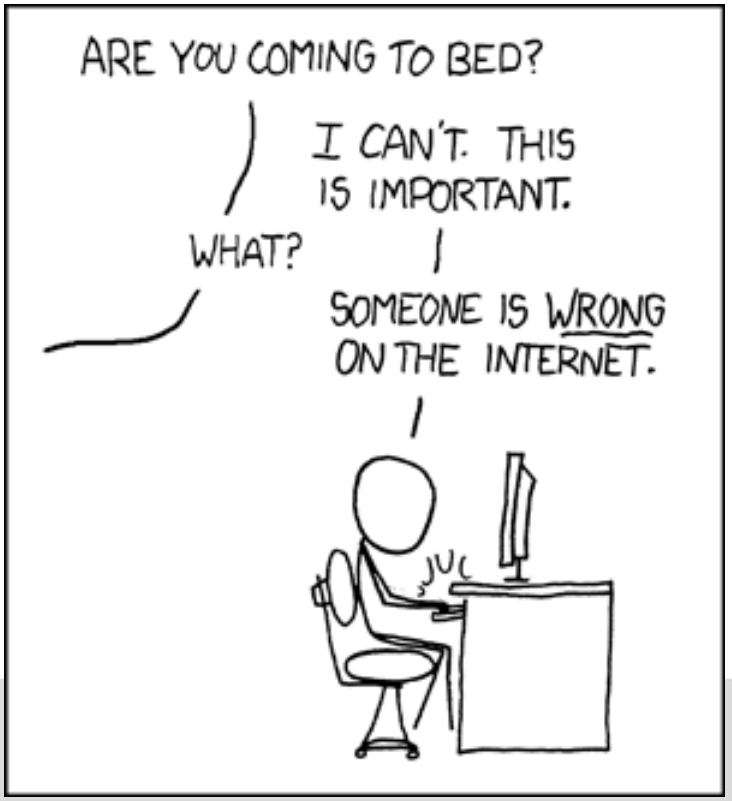
About me…

- My main area?
  - Information retrieval (IR)
  - User Generated Content (UGC)

About me…

- My main area?
  - Information retrieval (IR)
  - User Generated Content (UGC)

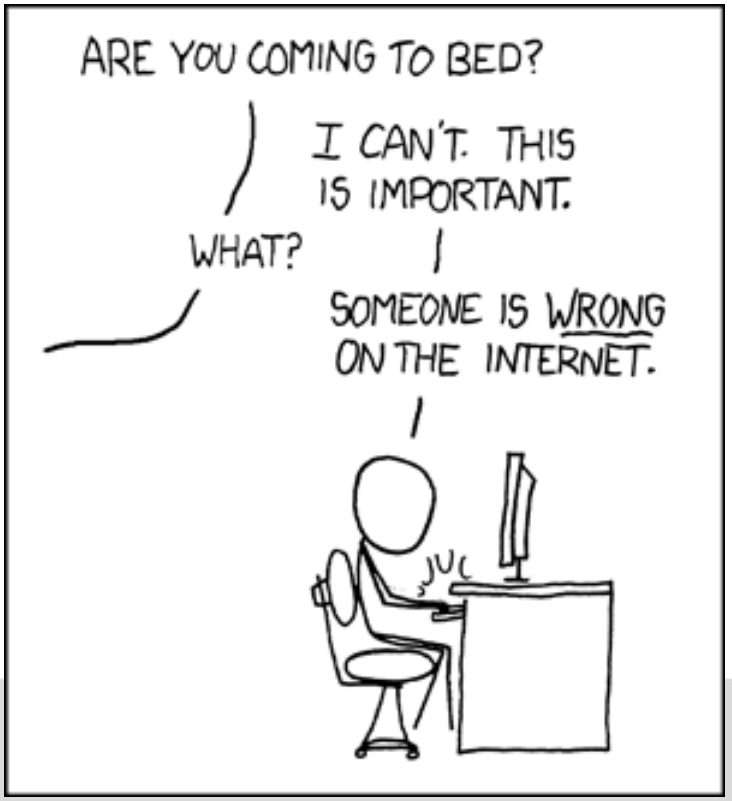
- My PhD Research?



About me…

- My main area?
  - Information retrieval (IR)
  - User Generated Content (UGC)

- My PhD Research?
  - Finding good #tags that describe documents, images etc.
  - Predict the best answer on QnA platforms (StackOverflow)
  - Organizing comments on Reddit
  - Profiling users on all 3 platforms
    - Expertise
    - Reliability



About me…

- I do have speech impairment
  - Pronunciation can be GG at times
    - Ask me to repeat
    - Ask me to spell
    - Ask me to write

About me…

- I do have speech impairment
  - Pronunciation can be GG at times
    - Ask me to repeat
    - Ask me to spell
    - Ask me to write
  - Feel free to interrupt me anytime
  - Keep it casual =)

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Questions?

Artificial Intelligence (AI)

What is it?

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Artificial Intelligence (AI)

What is it?

- Mimic the cognitive functions of human

Artificial Intelligence (AI)

What is it?

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- Mimic the cognitive functions of human
  - Perception
  - Reasoning
  - Learning and knowledge organization

Artificial Intelligence (AI)

What is it?

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- Mimic the cognitive functions of human
  - Perception
    - Natural language
    - Vision
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  - Learning and knowledge organization

Artificial Intelligence (AI)

What is it?

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- Mimic the cognitive functions of human
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    - Natural language
    - Vision
  - Reasoning
    - Cause-and-effect
    - Xs affecting the Y
  - Learning and knowledge organization

Artificial Intelligence (AI)

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- Mimic the cognitive functions of human
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  - Learning and knowledge organization
    - Using observations/ empirical data
    - Make a set of rules
    - Generalize what is learnt

Artificial Intelligence (AI)

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- Mimic the cognitive functions of human
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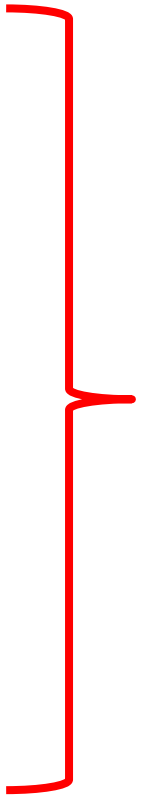
    - Using observations/ empirical data
    - Make a set of rules
    - Generalize what is learnt
    - Make the best decisions



General AI
(strong AI)

Artificial Intelligence (AI)

What is it?

Artificial Intelligence (AI)

What is it?

"AI is a fundamental risk to the existence of human civilization."

- Elon Musk

Artificial Intelligence (AI)

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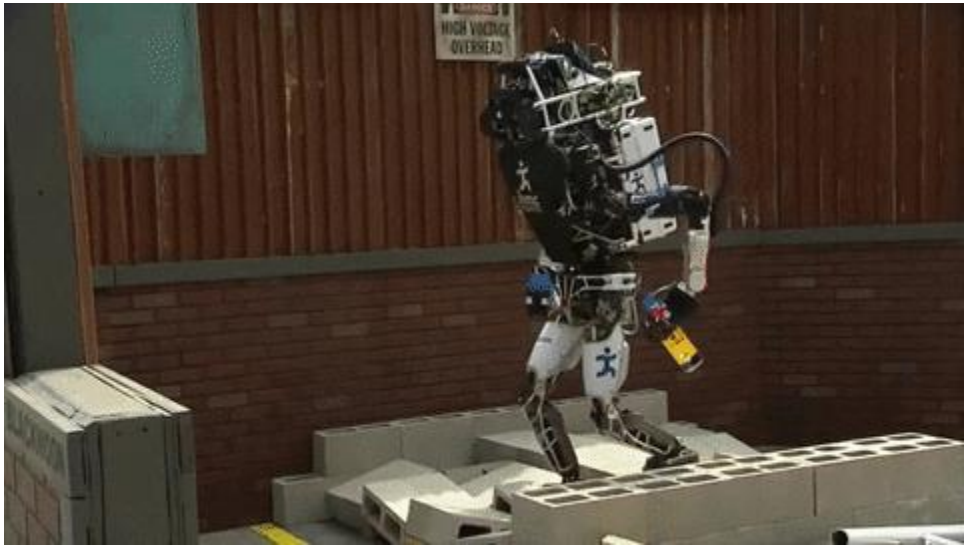

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Artificial Intelligence (AI)

Dangerous?

- Thing is, we are still very far…

Artificial Intelligence (AI)

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- Thing is, we are still very far…

BUSINESS \ TECH \ ARTIFICIAL INTELLIGENCE

This AI startup claims to automate app making but actually just uses humans

11

Who could have seen that coming?

By Nick Statt | @nickstatt | Aug 14, 2019, 1:58pm EDT

Artificial Intelligence (AI)

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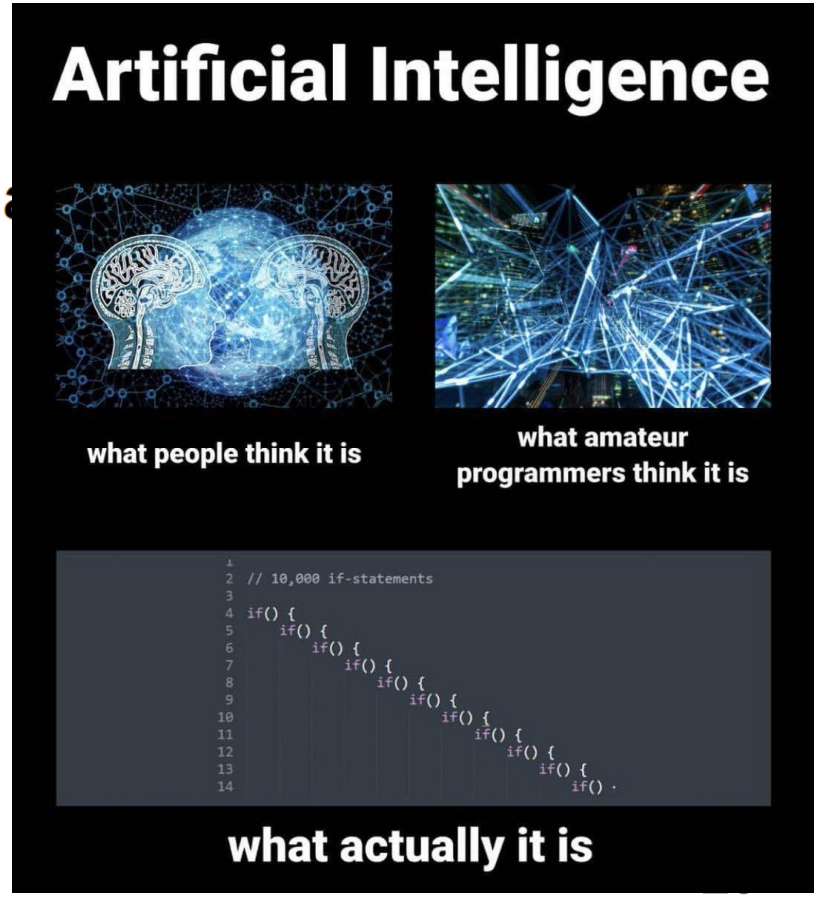

Artificial Intelligence (AI)

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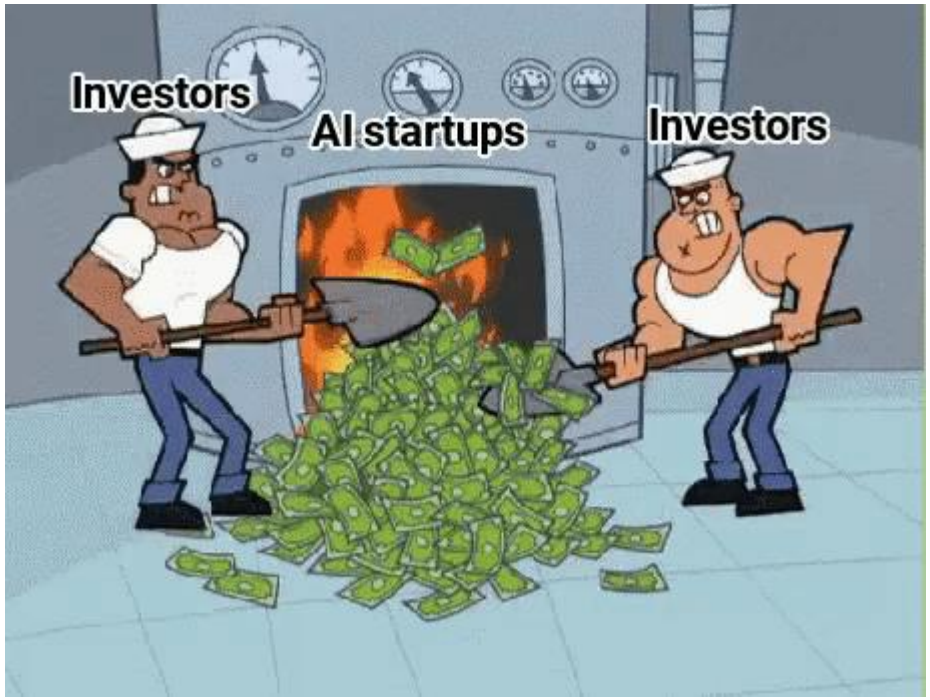

Artificial Intelligence (AI)

Dangerous?

- Thing is, we are still very far…

- AI can do many things better than us
- AI can't do many things better than us

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  - Mundane task
  - Identify patterns
  - Anomaly detection
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Artificial Intelligence (AI)

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  - … and many more
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Machine Learning (ML)

What is it?

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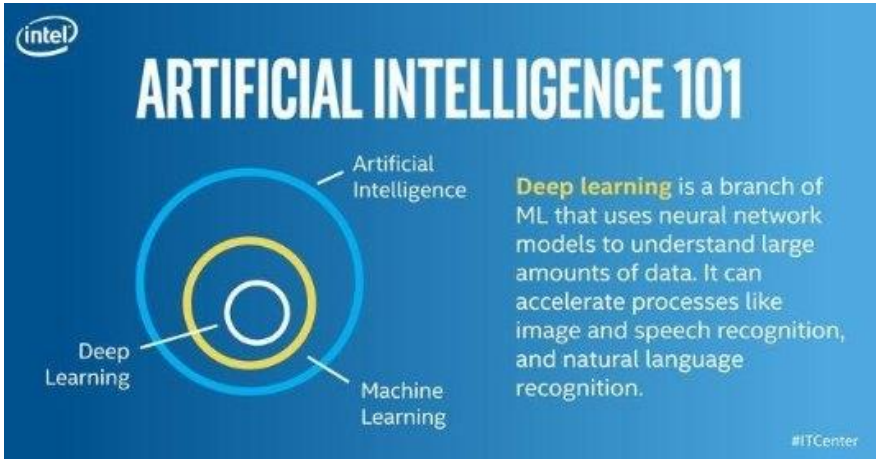
Machine Learning (ML)

What is it?

- Subset of AI



Machine Learning (ML)

What is it?

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- Subset of AI
  - Focus on the brain of the machine
  - Enable machine to evolve based on empirical data

Machine Learning (ML)

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    - Variety
    - Velocity

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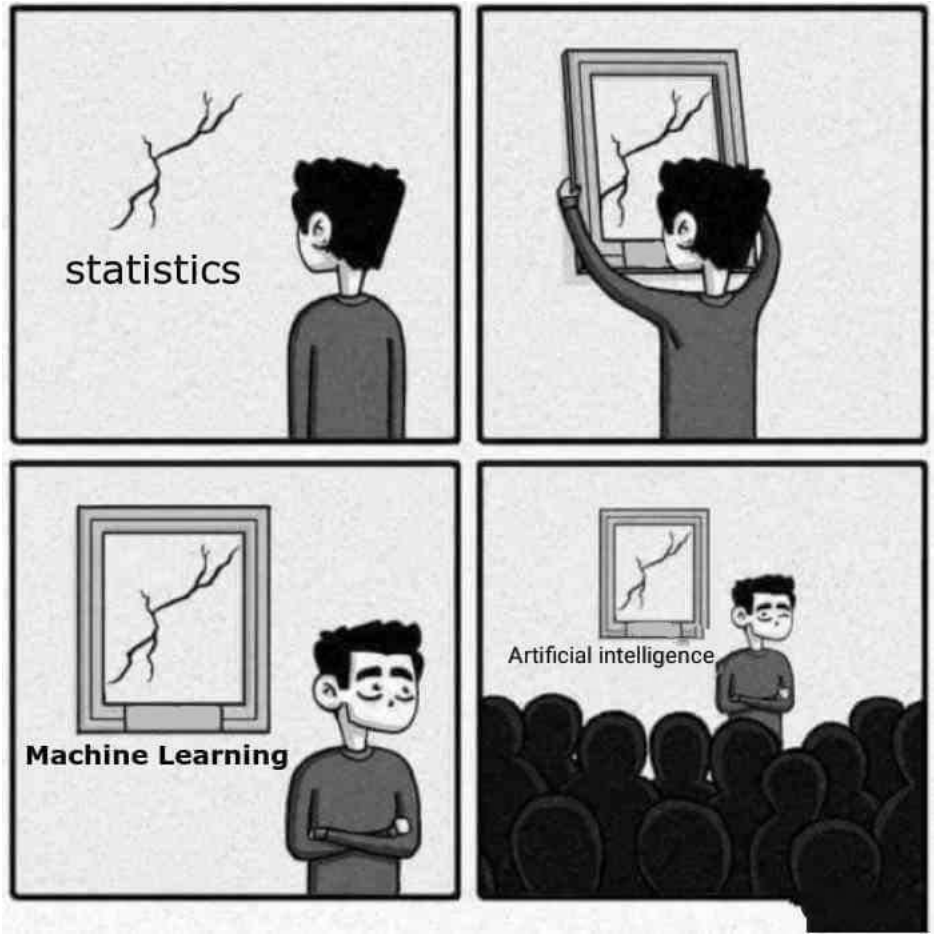

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Questions?

Machine Learning (ML)

Types?

Machine Learning (ML)

Types?

- Supervised learning
- Unsupervised learning
- Semi-supervised learning
- Reinforced learning
- Deep learning?

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Questions?

Supervised Learning
What is it?

- Given a set of observations

Supervised Learning
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- Given a set of observations
  - Features/ variables
  - Values/ measures

Supervised Learning
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- … that is labelled
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- Are we able to map the observations to their label?

Supervised Learning
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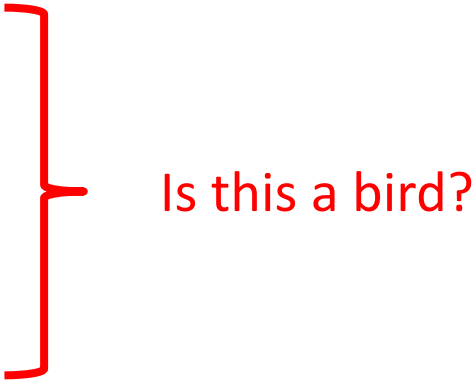

Supervised Learning
What is it?

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- Given a set of observations
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} We want useful features only

- … that is labelled
  - Predefined classes
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  - 2 legs
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  - ~~Breathes~~
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  - 700 square feet
  - 2 bed room
  - 2 bath room
  - LRT in 100 meter

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RM 500,000.00?

Supervised Learning
What is it?

- Can you think of some applications?

Supervised Learning
What is it?

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- Can you think of some applications?
  - Organizing email

Supervised Learning
What is it?

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- Can you think of some applications?
  - Organizing email
    - What is important
    - What is spam

Supervised Learning
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  - Classifying document
    - News
    - Sports
    - Social media

Supervised Learning
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  - High risk transactions
    - Credit card
    - Loan application

Supervised Learning
What is it?

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    - What is important
    - What is spam
  - Classifying document
    - News
    - Sports
    - Social media
  - High risk transactions
    - Credit card
    - Loan application
  - High potential clients
    - Based on their spending
    - Based on their income etc.

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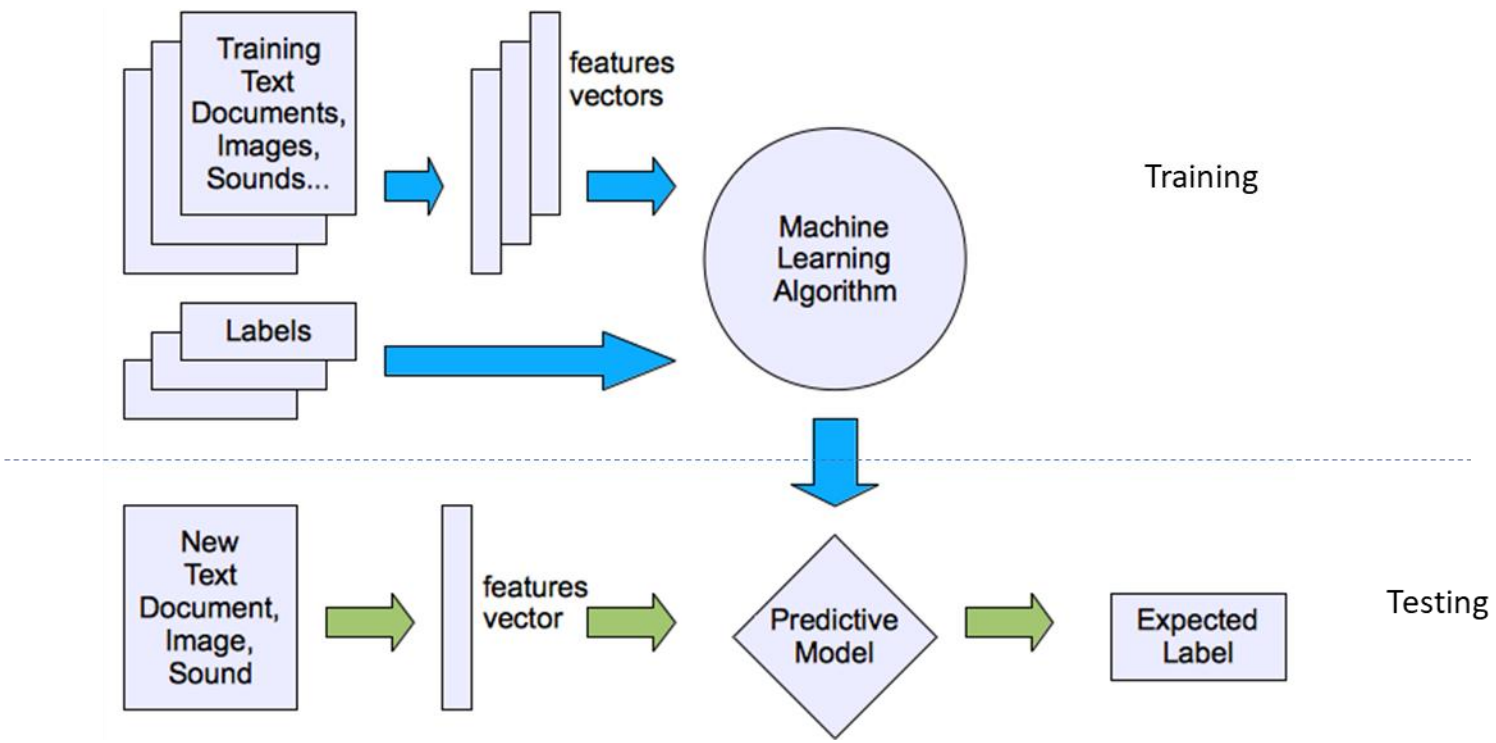
Questions?

Supervised Learning

What is it?



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Questions?

Supervised Learning
Algorithms

- Decision Tree
- Regression
- Naïve Bayes (NB)
- K-nearest Neighbour (kNN)
- Support Vector Machine (SVM)
- Artificial Neural Network (ANN)

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- Decision Tree

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- Decision Tree

age	income	student	credit_rating	buys_computer
<=30	high	no	fair	no
<=30	high	no	excellent	no
31…40	high	no	fair	yes
>40	medium	no	fair	yes
>40	low	yes	fair	yes
>40	low	yes	excellent	no
31…40	low	yes	excellent	yes
<=30	medium	no	fair	no
<=30	low	yes	fair	yes
>40	medium	yes	fair	yes
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- Decision Tree

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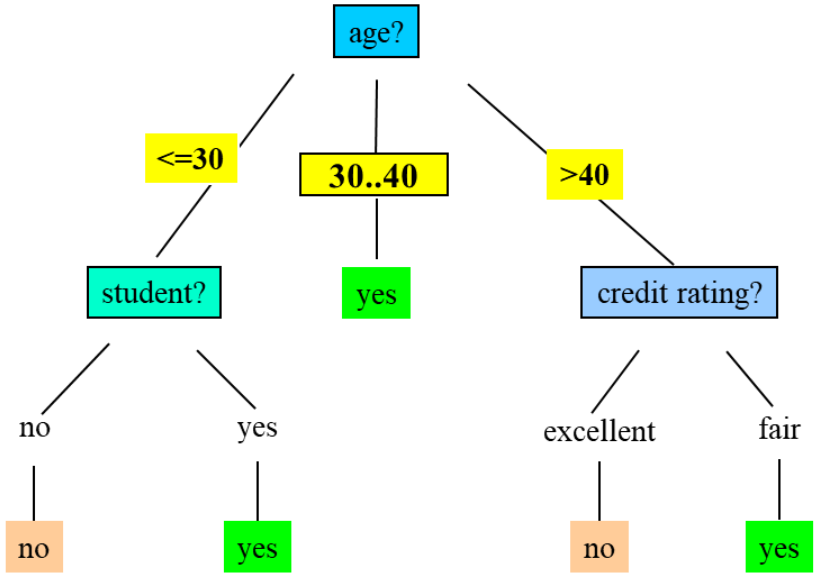

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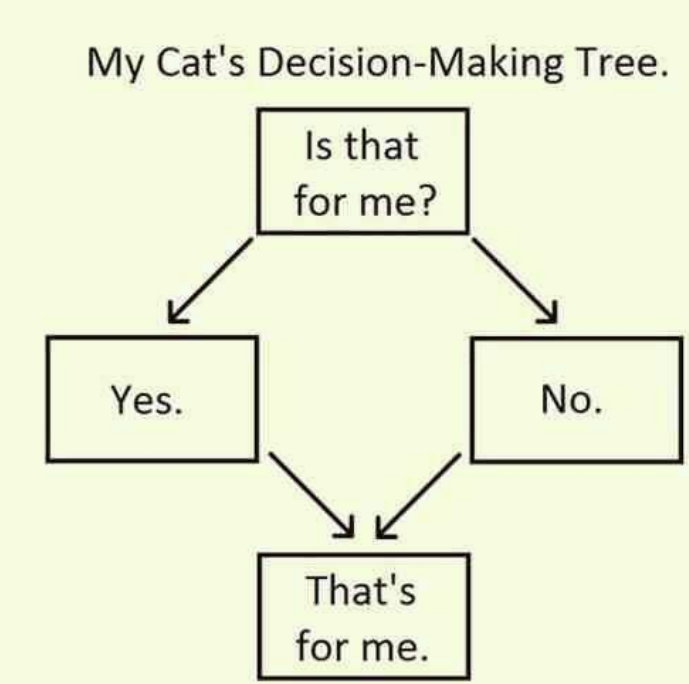

Supervised Learning
Algorithms

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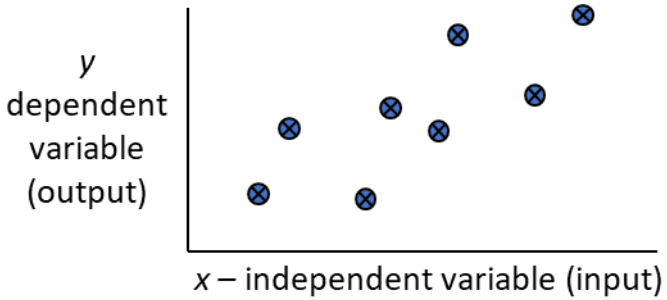
- Regression



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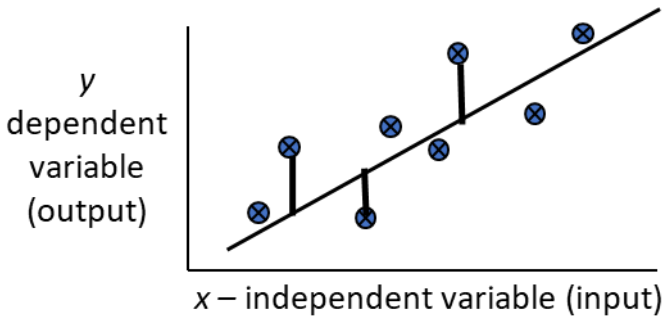

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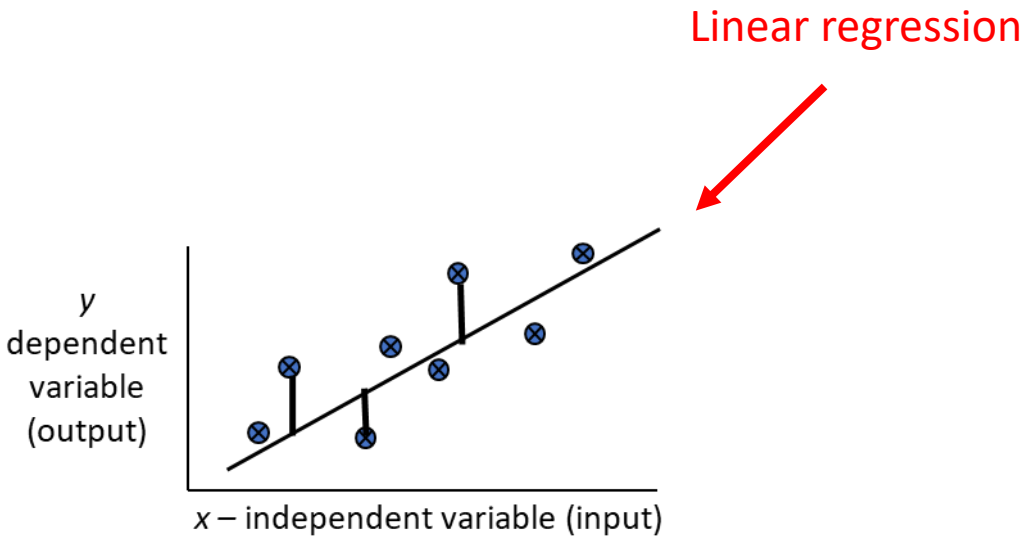

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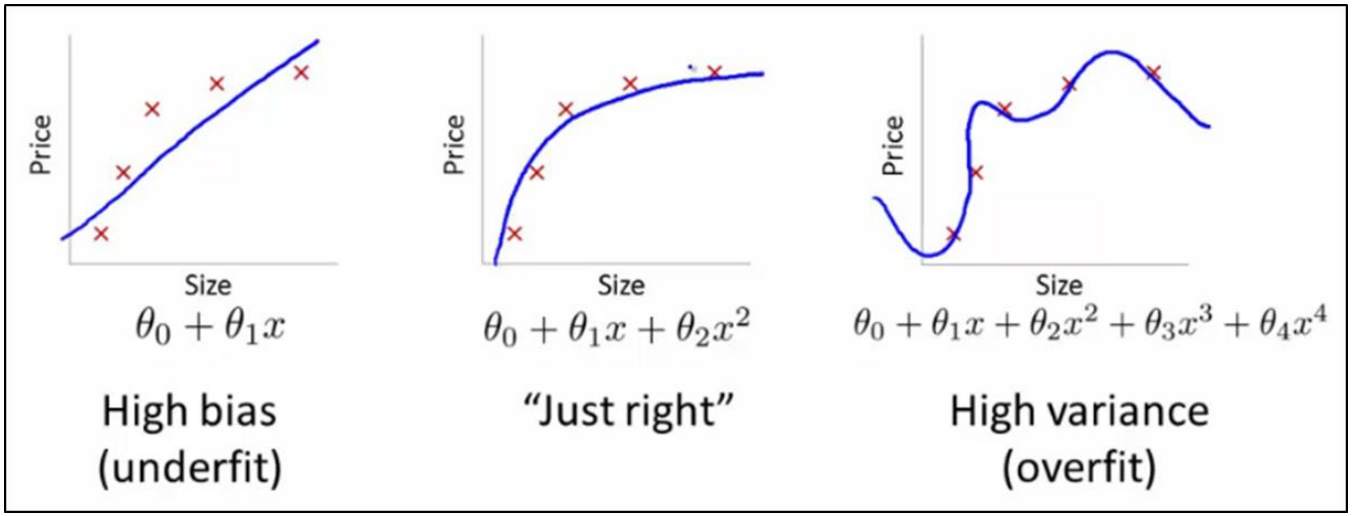
Price
Size
$\theta_0 + \theta_1 x$
High bias
(underfit)
Price
Size
$\theta_0 + \theta_1 x + \theta_2 x^2$
"Just right"
Price
Size
$\theta_0 + \theta_1 x + \theta_2 x^2 + \theta_3 x^3 + \theta_4 x^4$
High variance
(overfit)

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- Naïve Bayes (NB)

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- Naïve Bayes (NB)
  - Probability-based using the Bayesian Theorem

$$P(C_j|A_1 \cap A_2 \cap A_3 \dots \cap A_n) = \frac{P(C_j) \cdot P(A_1 \cap A_2 \cap A_3 \dots \cap A_n|C_j)}{P(A_1 \cap A_2 \cap A_3 \dots \cap A_n)}$$

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- Naïve Bayes (NB)
  - Probability-based using the Bayesian Theorem
  - Assuming variable independence

$$P(C_j | A_1 \cap A_2 \cap A_3 \dots \cap A_n) = \frac{P(C_j) \cdot P(A_1 \cap A_2 \cap A_3 \dots \cap A_n | C_j)}{P(A_1 \cap A_2 \cap A_3 \dots \cap A_n)}$$

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- K-nearest Neighbour (kNN)

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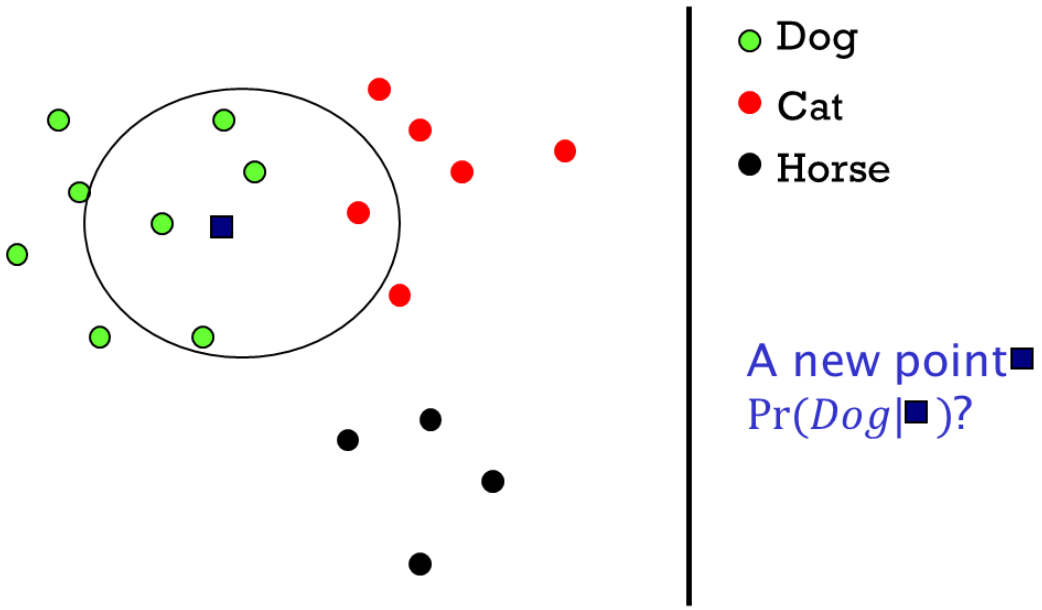
- K-nearest Neighbour (kNN)
  - When k=5, we look for the 5 closest points



Supervised Learning
Algorithms

- Support Vector Machine (SVM)
- Artificial Neural Network (ANN)

- We will skip these 2…

Supervised Learning
Algorithms

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- Support Vector Machine (SVM)
- Artificial Neural Network (ANN)

- We will skip these 2…
- And even more complex ones
  - Ensemble methods for example

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Questions?

Supervised Learning
Algorithms

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- Let us try out a few simple examples
  - Decision tree
  - Regression

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Questions?

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- In the real world, it is more complex on how we do things… for example sentiment analysis

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- Given a text, we pre-process it:

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- Given a text, we pre-process it:
  - Convert case
  - Tokenization
  - Stop words removal
  - Stemming and Lemmatization
  - N-gram

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- Given a text, we pre-process it:
  - “My dog eat my HomeWorK”
  - Convert case
  - Tokenization
  - Stop words removal
  - Stemming and Lemmatization
  - N-gram

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- Given a text, we pre-process it:
  - "My dogs eated a HomeWorK"
  - Convert case = my dogs eated a homework
  - Tokenization = {my, dogs, eated, a, homework}
  - Stop words removal = {my, dogs, eated, homework}
  - Stemming and Lemmatization = {my, dog, eat, homework}
  - N-gram

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  - N-gram
    - 2-gram = {my dog} {dog eat} {eat homework}
    - 3-gram = {my dog eat} {dog eat homework}

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- These are used as features…
  - Can we weighted such as TF-iDF

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- Then we do the same with supervised learning

Supervised Learning
Sentiment Analysis

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- Then we do the same with supervised learning
  - Positive sentiment sentences
  - Neutral sentences
  - Negative sentiment sentences

Supervised Learning
Sentiment Analysis

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- Then we do the same with supervised learning
  - Positive sentiment sentences
  - Neutral sentences
  - Negative sentiment sentences
- Build a model which we can use!

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- Let us try it out now!

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- Let us try it out now!
- Of course real world is more complex
  - We bring in concepts as well

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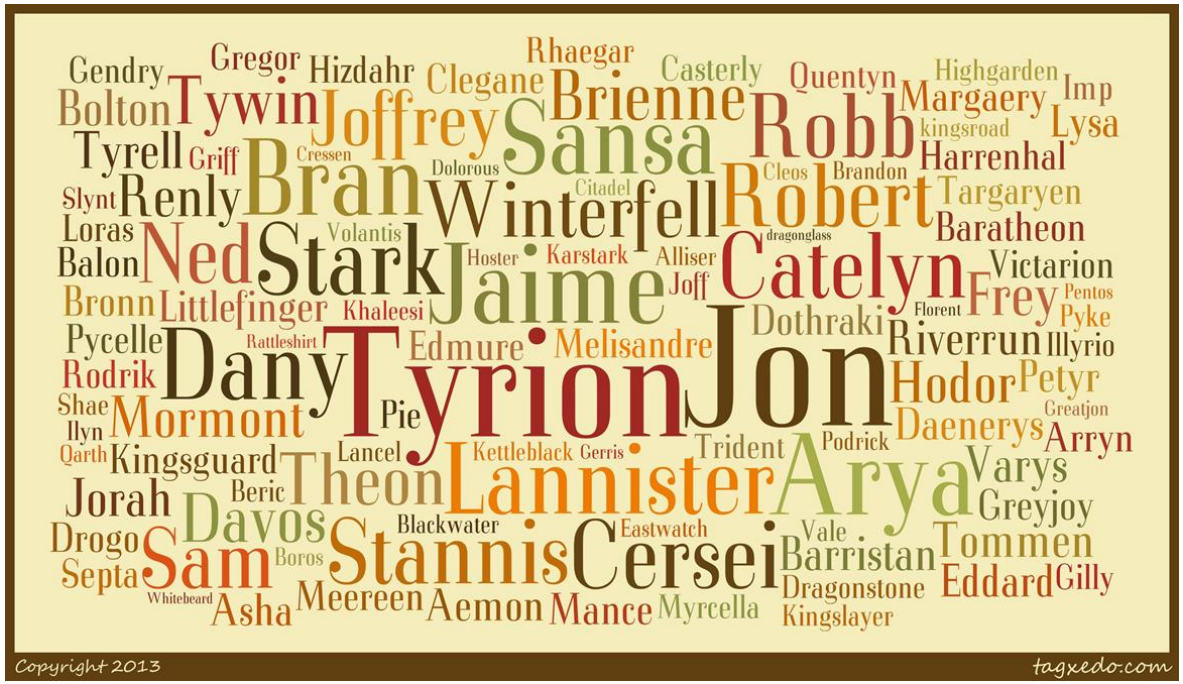
- Let us try it out now!

- Of course real world is more complex
  - We bring in concepts as well
  - For a hotel review
    - Food?
    - Location?
    - Room?
    - Price?

Supervised Learning

Sentiment Analysis

- Another usage is to understand important concepts in text such as word cloud



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Questions?

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Have a break

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Questions?

Unsupervised Learning
What is it?

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- Very similar with supervised learning…

Unsupervised Learning
What is it?

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- Except we are not giving
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  - Predefined values

Unsupervised Learning
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Unsupervised Learning
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    - Features
    - Observations
  - Dimension reduction

Unsupervised Learning
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} Can you think of applications?

Unsupervised Learning

What is it?

- Given a collection of food, how would you group it?

Unsupervised Learning

What is it?

- Given a collection of food, how would you group it?

Unsupervised Learning

What is it?

- Given a collection of human, how would you group it?

Unsupervised Learning
What is it?

- Given a collection of human, how would you group it?

Unsupervised Learning
What is it?

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- Do be careful, it isn’t always predefined…

Unsupervised Learning
What is it?

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Unsupervised Learning
What is it?

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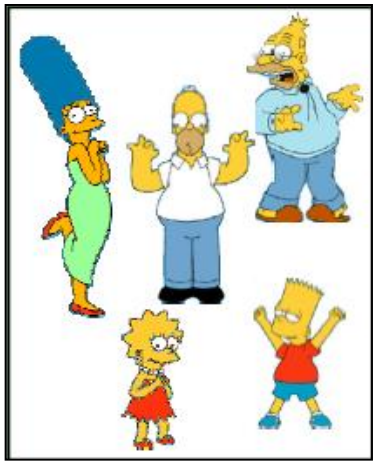
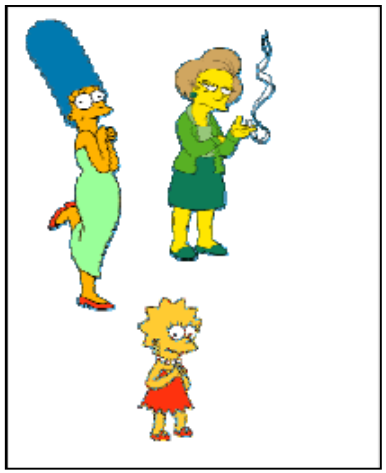
Family



School

Female



Male

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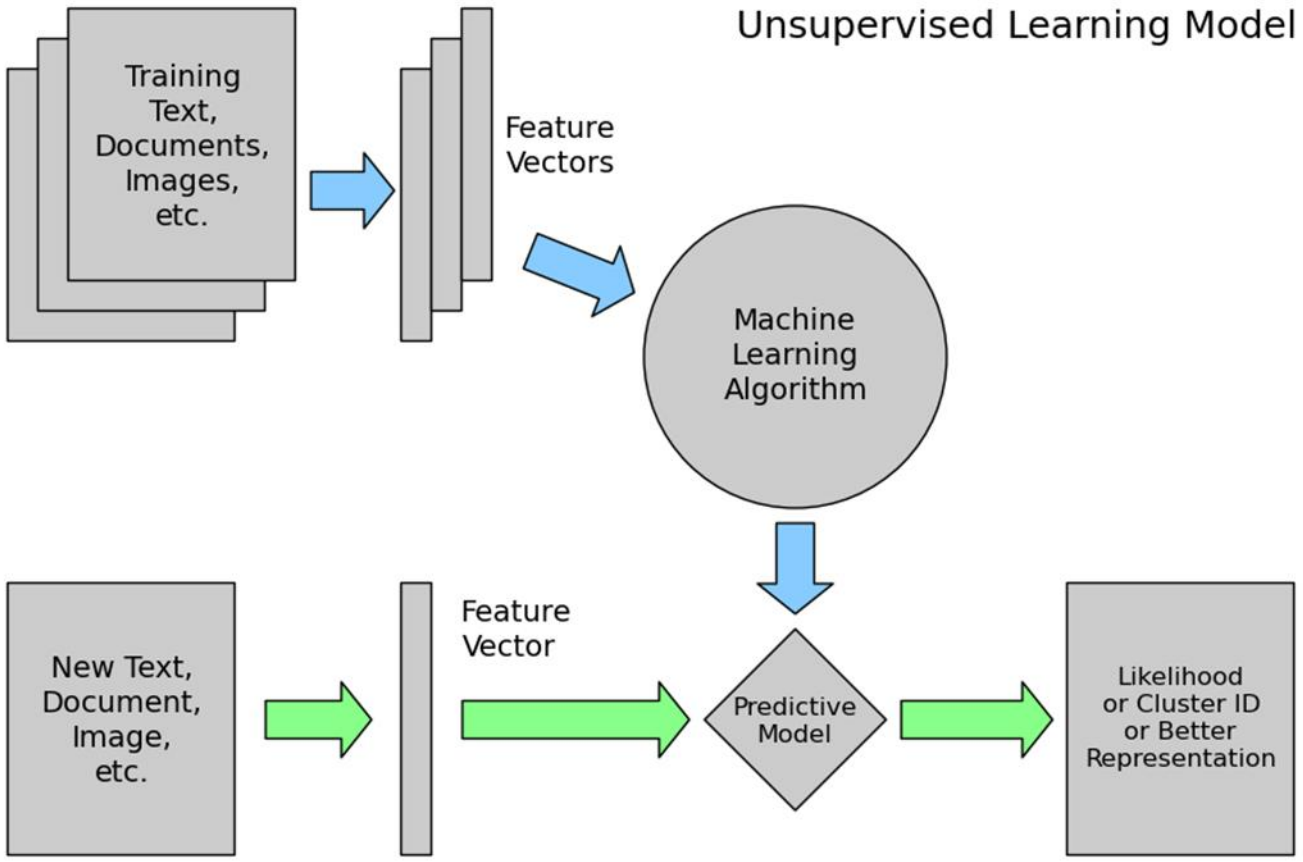
Questions?

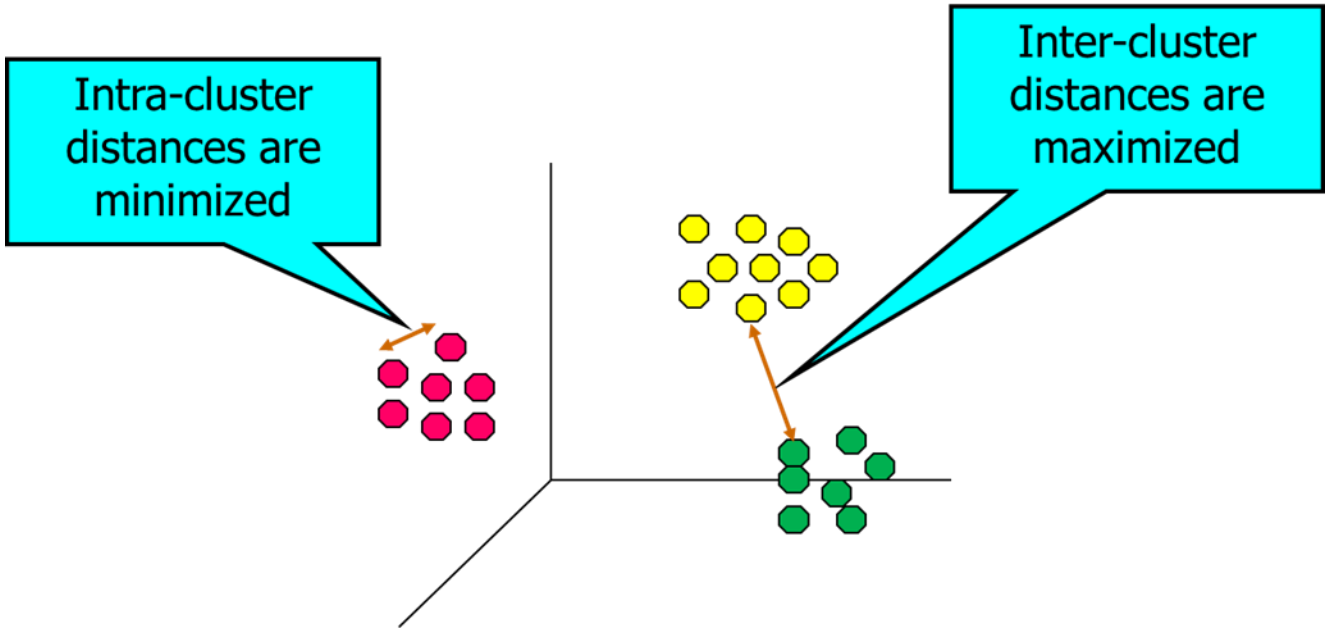
Unsupervised Learning

What is it?



Unsupervised Learning

What is it?



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Questions?

Unsupervised Learning
Algorithms

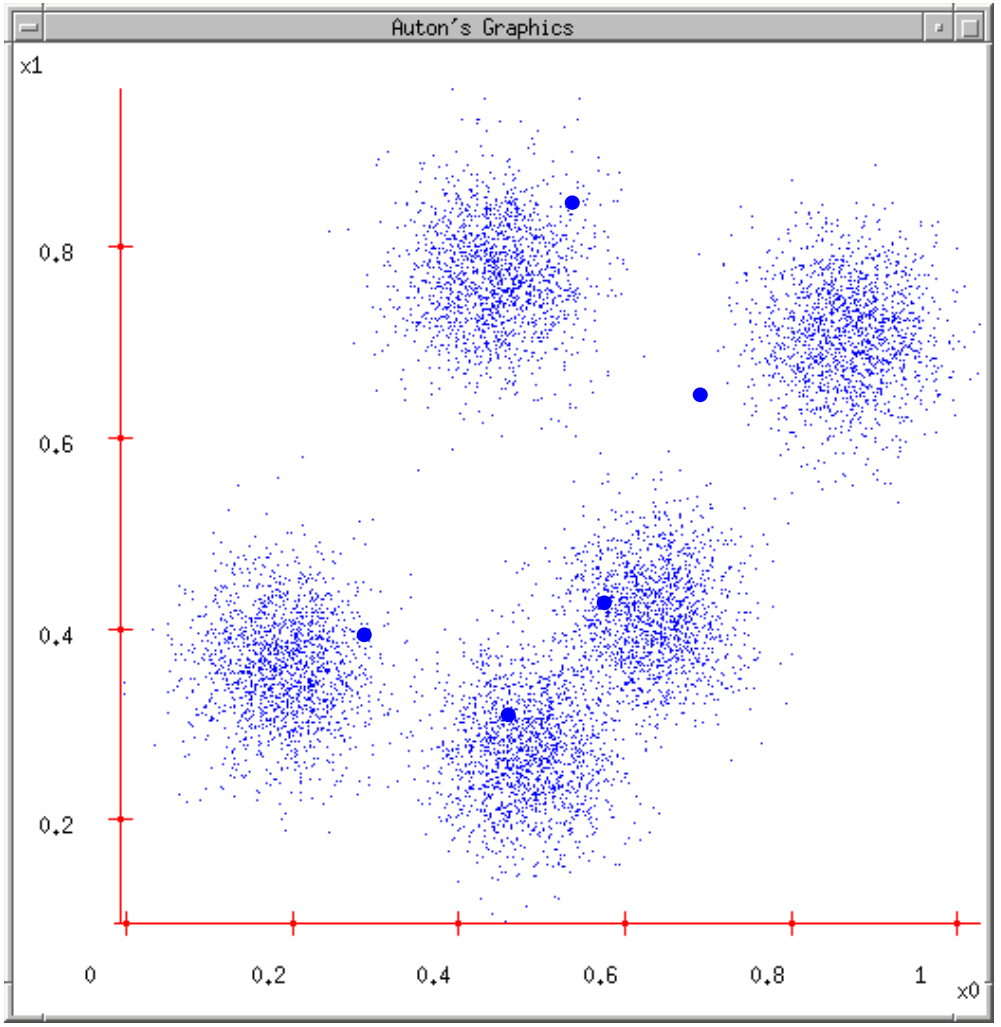
- K-means
- Gaussian Mixture Model (GMM)
- Mean Shift
- Hierarchical

Unsupervised Learning
Algorithms

- K-means

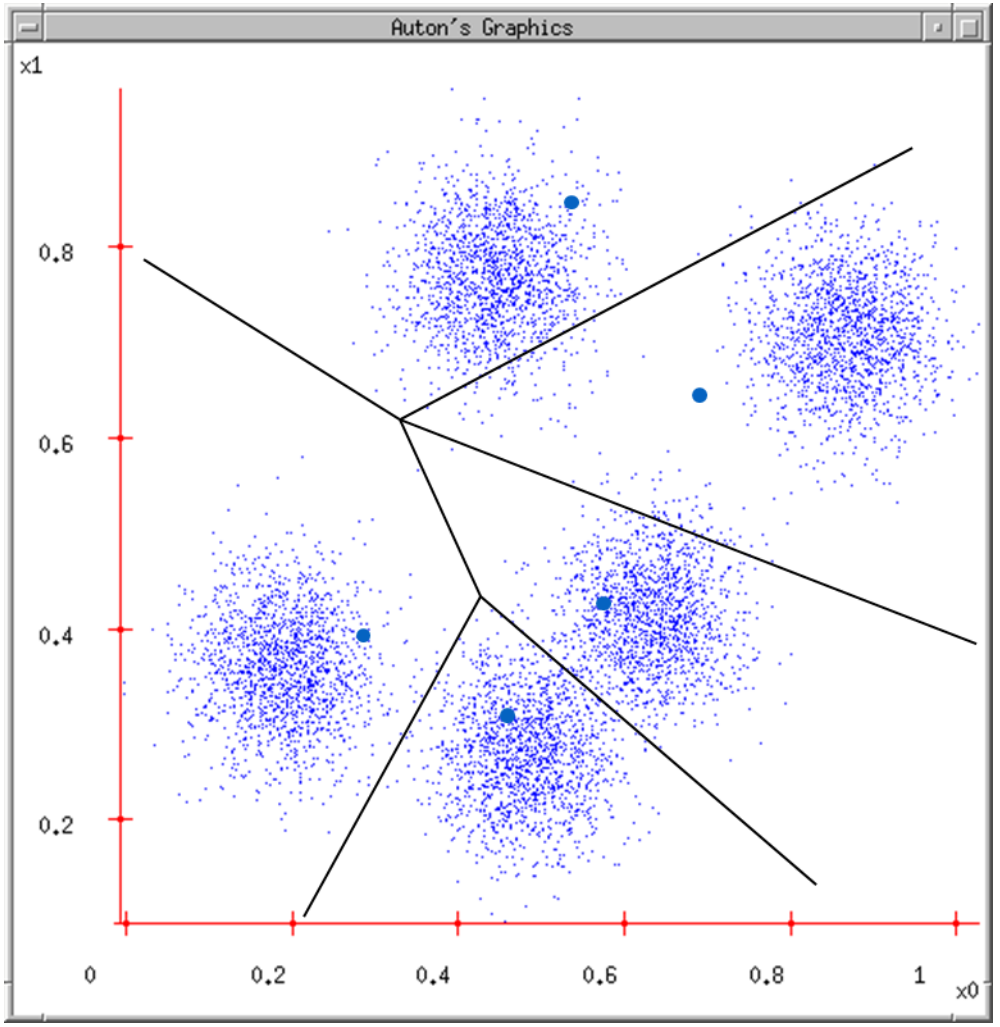
Unsupervised Learning
Algorithms

- K-means
  - We want 5 cluster



Unsupervised Learning
Algorithms

- K-means
  - We want 5 cluster
  - The process is more complex with calculations required



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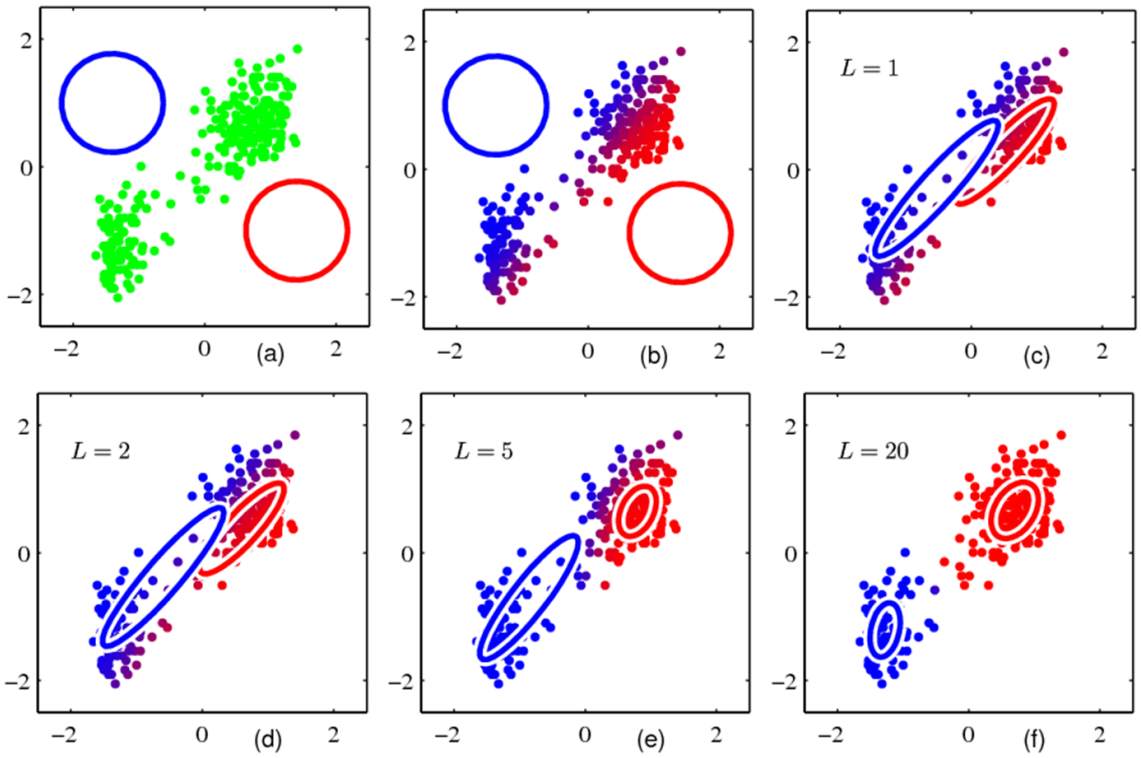
- Gaussian Mixture Model (GMM)

- Gaussian Mixture Model (GMM)
  - When it is more complex



60

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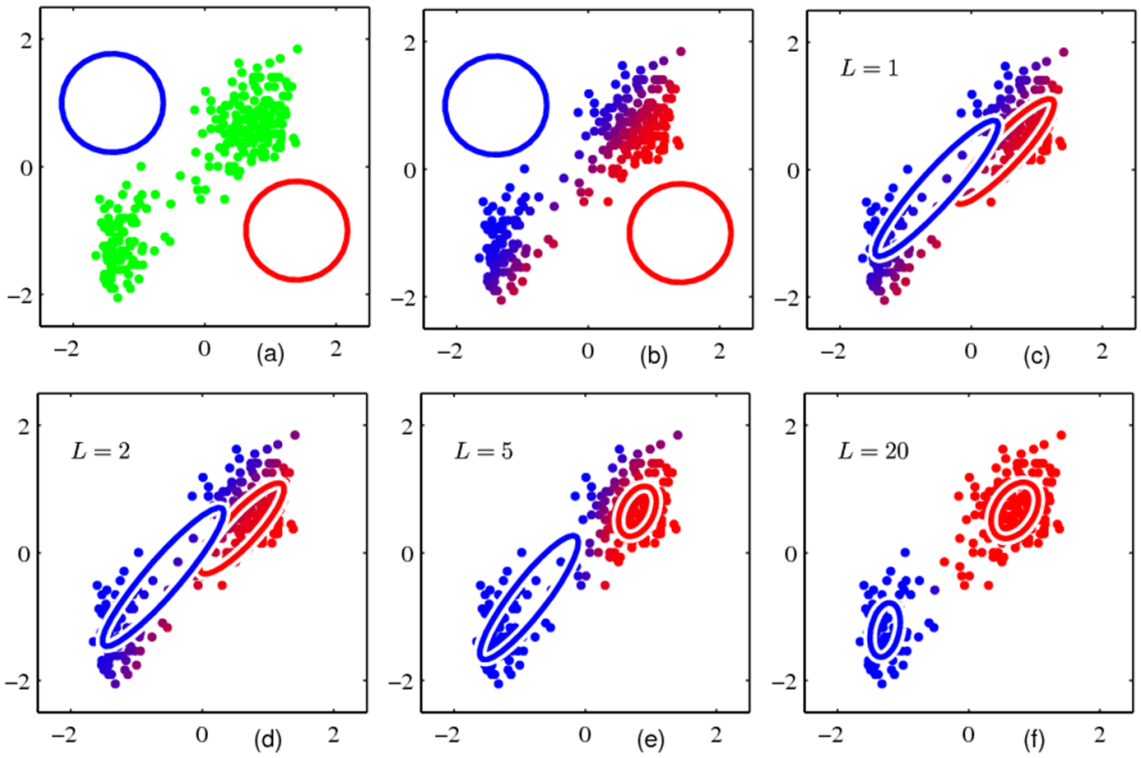

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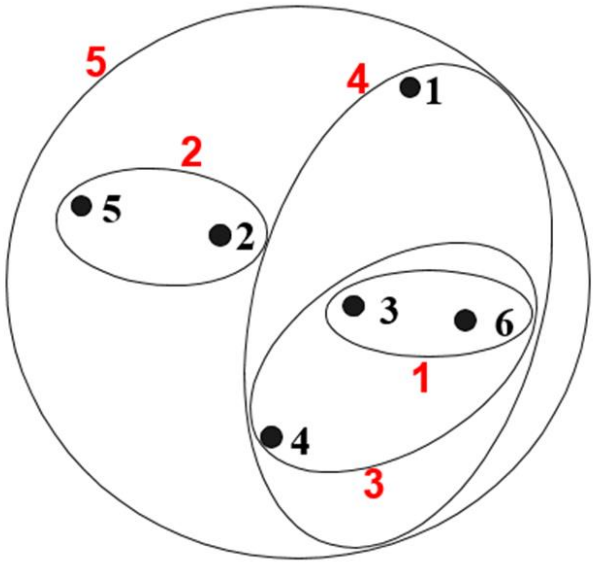
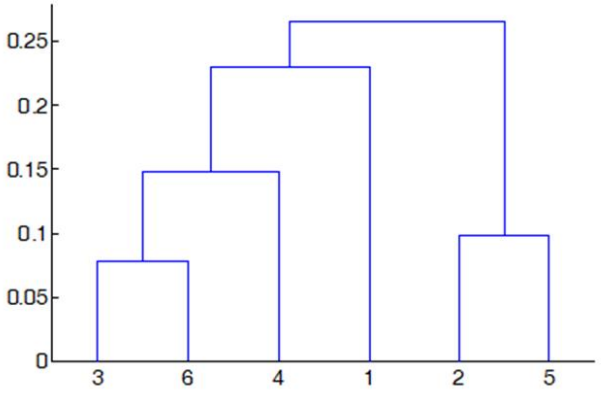
- Hierarchical





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- Mean Shift
  - We will skip this

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- And there are more clustering algorithms out there, all grouping data in different way

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- Mean Shift
  - We will skip this
- And there are more clustering algorithms out there, all grouping data in different way
  - For example the Latent Dirichlet Allocation (LDA) for topics

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Questions?

- Our last hands-on

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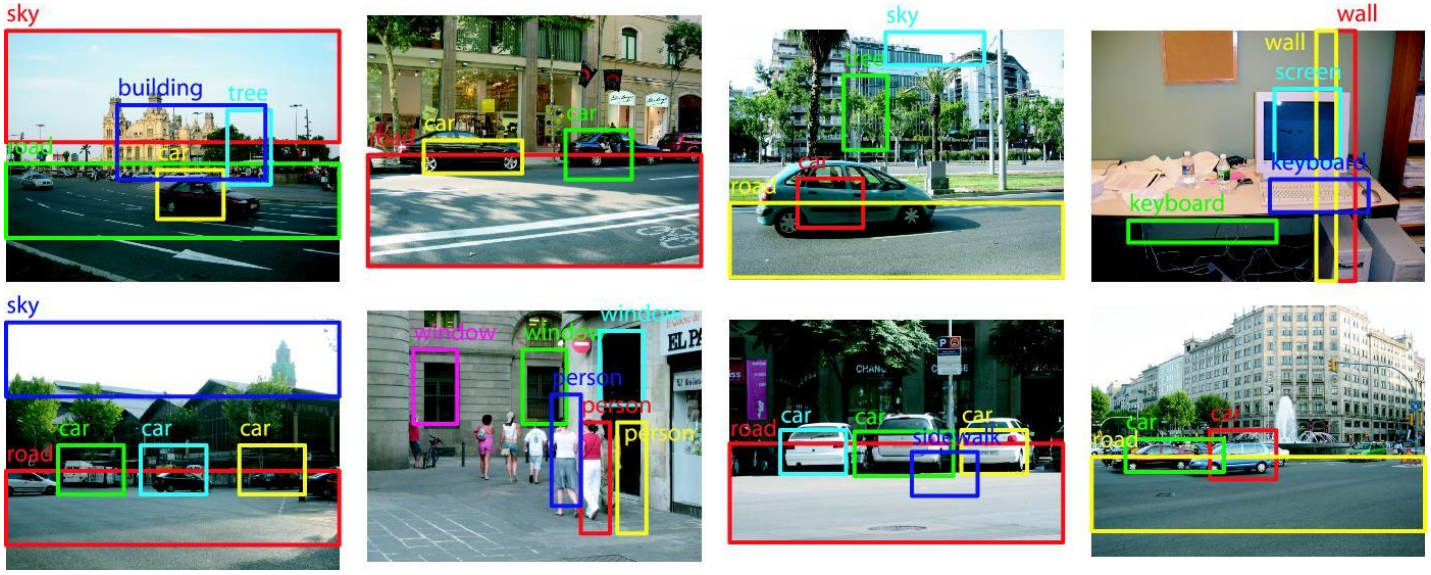
- Basically we are teaching the computer how to see things and recognize things

Computer Vision

Hands on…

- Our last hands-on

- Basically we are teaching the computer how to see things and recognize things



- Our last hands-on

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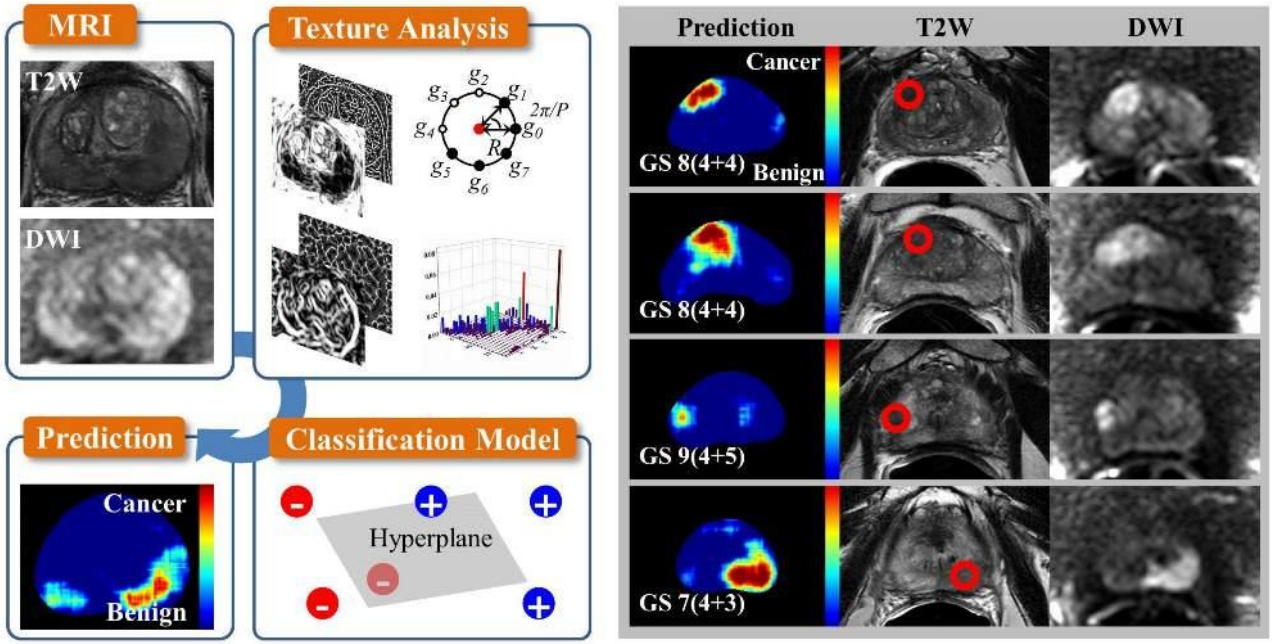

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- Let us try some simple ones
  - Face
  - Eye
  - Smile

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- Let us try some simple ones
  - Face
  - Eye
  - Smile

- But first, we need to learn how to extract features for the machine to recognize shapes
  - Edge detection as a simple example

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Questions?

- It is useful

- It is useful
- Still untap potential

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- It is useful
- Still untap potential
  - Good training?
  - Good features?
  - More features?

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  - Overfitting
  - Underfitting

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- It is useful
- Still untap potential
  - Good training?
  - Good features?
  - More features?
- Still a challenge
  - Overfitting
    - Imbalanced datasets
  - Underfitting

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Questions?

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Thank You