

EE2211 Pre-Tutorial 1

Dr Feng LIN

Instructor

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Location:

- E1A-04-01
- Level 6, #06-02, T-Lab Building



Attendance of Today's Tutorial

About Me

Undergraduate: Control Engineering at Beihang University

Master: System Engineering at Beihang University

Doctorate: Electrical and Computer Engineering at National University of Singapore

Research Interests

- Flight Control Systems and Robust Control
- Vision-aided Control and Vision-aided Inertial Navigation
- Autonomous Unmanned Aerial Vehicles





Agenda

- Recap
- Self-learning
- Tutorial 1



Recap

- Definition of Machine Learning
- Three types of Machine Learning
 - ❖ Supervised
 - ❖ Unsupervised
 - ❖ Reinforcement
- Inductive and Deductive Reasoning

Machine Learning

What is machine learning

Machine Learning: field of study that gives computers the ability to learn without being explicitly programmed.

- Arthur Samuel

A computer program is said to learn

- from ***experience E***
- with respect to some class of ***tasks T***
- and ***performance measure P*** ,

if its performance at tasks in **T** , as measured by **P** , improves with experience **E** .

- Tom Mitchell



Type of Machine Learning

- Supervised Learning

- ❖ Classification

- ❖ Regression

Supervised Learning

Classification

- Given a **dataset** D (**training set**) which consists of a certain number N of data examples $(\mathbf{x}_i, y_i), i = 1 \dots N$.
- \mathbf{x}_i is training sample / training example / feature vector

$$\mathbf{x}_i = \begin{bmatrix} x_{i1} \\ x_{i2} \\ \vdots \\ x_{id} \end{bmatrix} \in \mathbb{R}^d, \text{ } d\text{-dimensional Euclidean Space}$$

Feature space

Label space

- The label y_i belongs to a **finitely values**, so $y_i \in \{1, 2, \dots, c\}$, where c is the number of class.
- Learn a function to predict **categorical** y given x



Classification

$$y_i \in \{cat, dog, frog, \dots, horse\}$$

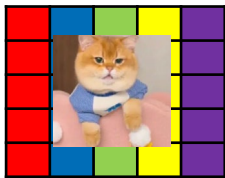
Size of label space = 10

Example 1

Dataset

$y_1 = 'cat'$

x_1



5×5

$y_2 = 'dog'$

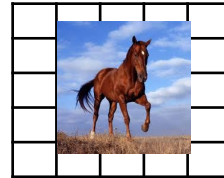
x_2



.....

$y_{100} = 'horse'$

x_{100}



Learn an image classifier $f(x)$ to predicts which animal is given a new image.

x_1

$\in \mathbb{R}^{25}$

$$f(x_{new}) = y_{new}$$

'cat'

Testing
image



Predicted
label

Supervised Learning

Regression

- Given a dataset D (training set) which consists of a certain number N of data examples $(x_i, y_i), i = 1 \dots N$.
- x_i is training sample / training example / feature vector
- But y_i is continuous number, which is normally called target variable or outcome variable.
- Learn a function to predict real-valued y given x

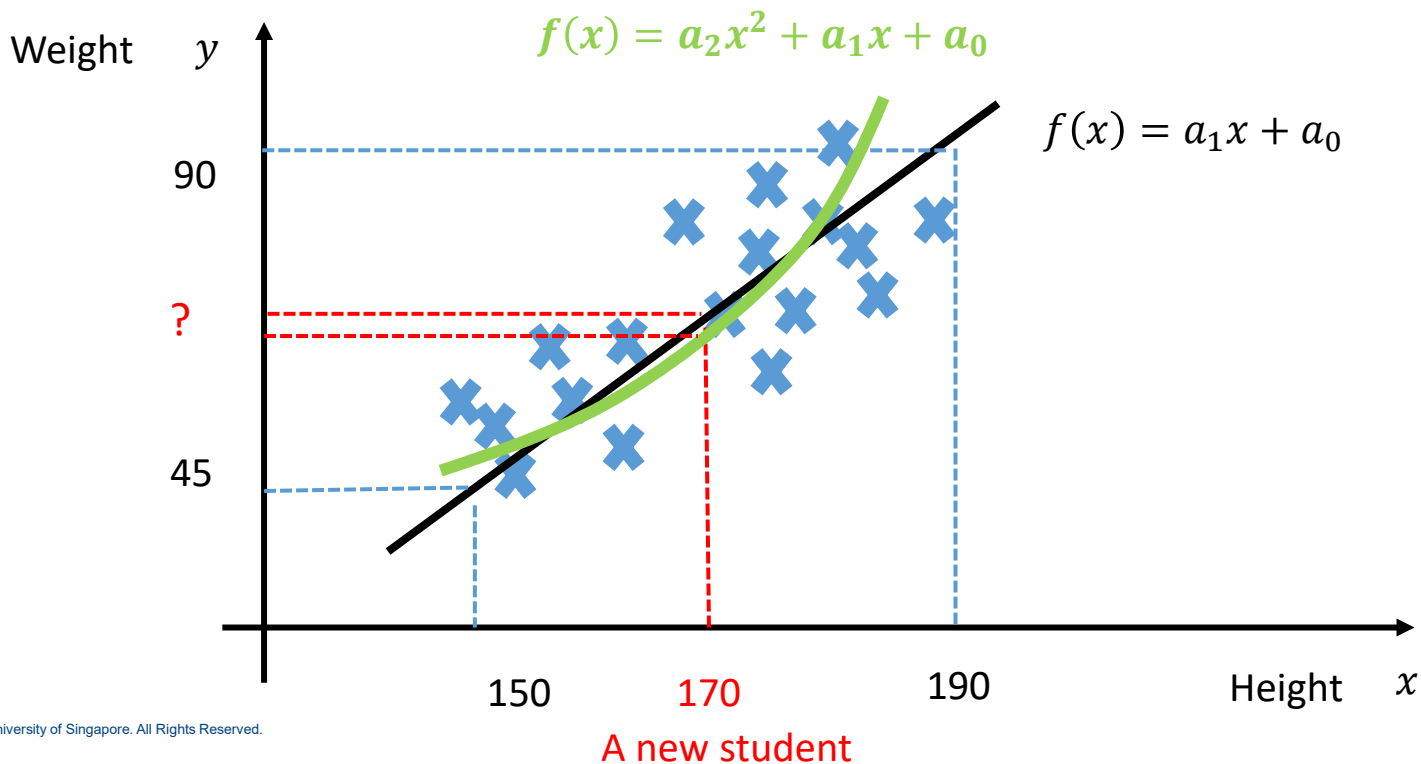


Regression

x_i : Height of i^{th} student in EE2211

y_i : Weight of i^{th} student in EE2211

Example:





Type of Machine Learning

- Unsupervised Learning

- ❖ Clustering



Clustering

- Given a dataset $D = \{x_i: 1 \leq i \leq N\}$, which only consists of a certain number N of feature vectors
- The label y_i is NOT available.
- Output hidden structure behind

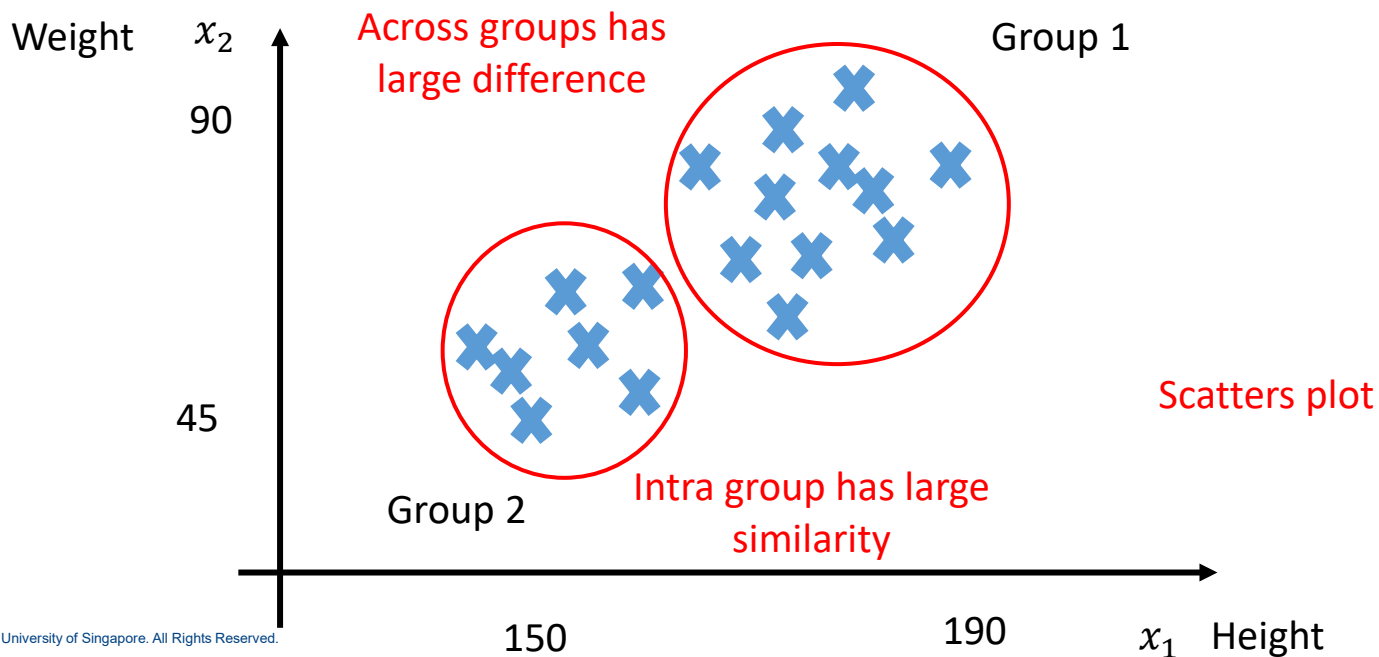
Clustering

Example:

$$x_i = \begin{bmatrix} x_{i1} \\ x_{i2} \end{bmatrix}$$

Height of i^{th} student in EE2211

Weight of i^{th} student in EE2211

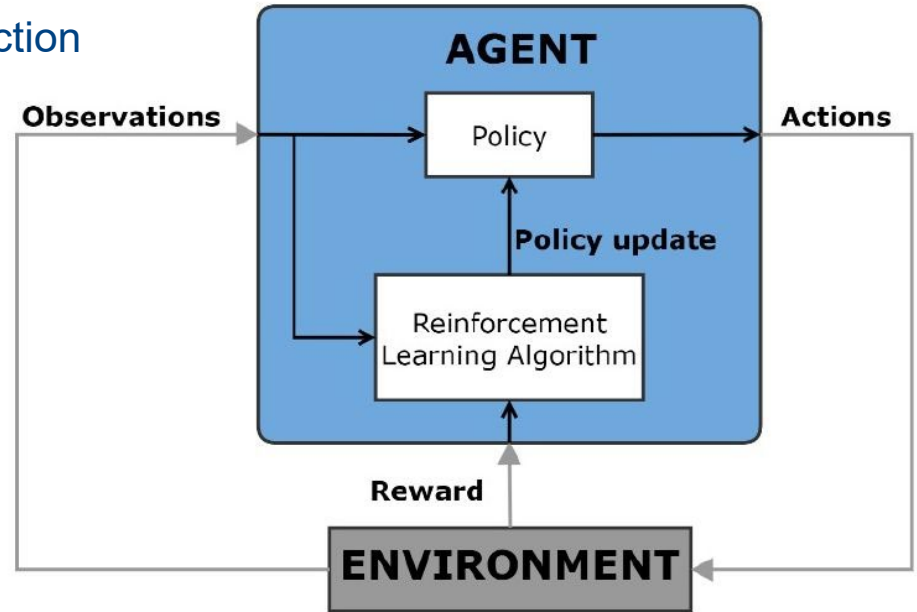


Comparison

	Supervised Learning		Unsupervised Learning
	Classification	Regression	Clustering
Purpose	Categorize data into predefined classes or labels	Predict continuous numeric values.	Group similar data points without predefined labels.
Input	<ul style="list-style-type: none">• Training samples• Discrete labels	<ul style="list-style-type: none">• Training samples• Continuous target values	Samples only
Output	A rule/function that maps inputs to discrete labels	A rule/function that maps inputs to continuous values	Underlying patterns in data

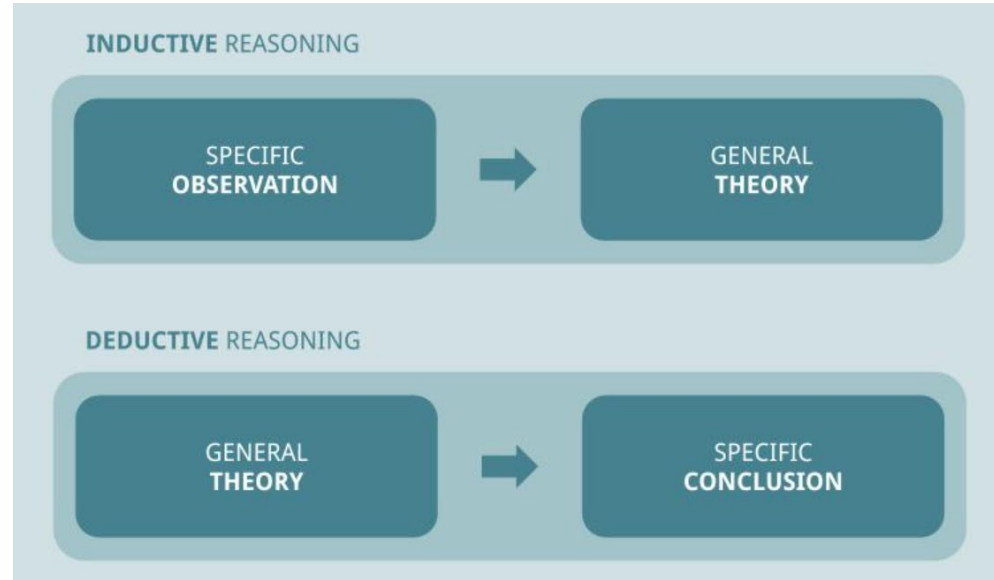
Type of Machine Learning

- Reinforcement Learning
 - ❖ Improve sequence of state or action
 - ❖ Get better delayed rewards



Inductive and Deductive Reasoning

- Inductive Reasoning
 - ❖ To reach probable conclusions
 - ❖ Not all information need, cause uncertainty
- Deductive Reasoning
 - ❖ To reach logical conclusions deterministically



<https://vitalflux.com/deductive-inductive-reasoning-examples-differences/>



THANK YOU