COMP2261 ARTIFICIAL INTELLIGENCE / MACHINE LEARNING

Introduction to Machine Learning

Dr SHI Lei

Durham University

learning lab

Learning Objectives

- Understand the Philosophy behind Machine Learning.
- Understand the definition of Machine Learning.
- Tell the differences between 3 types of Machine Learning.

“

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

”

-- Arthur Samuel, 1959

Machine learning arose from a simple question:

Can a computer learn on its own in order to perform a specified task, rather than relying on a programmer explicitly setting up the rules for it?

Classical Programming vs Machine Learning

- Rules rely on human understanding and manually coding.
- Not always work, as there are problems not possible to identify and explicitly write down rules.

- Human provides data and anticipated answer from the data.
- Computers outputs a set of rules, which can be applied to new data.

Machine Learning / Supervised Learning

- Machine learns mappings from input to output.
- When given input data, machine gives prediction of the output for that data.

Machine Learning / Supervised Learning

EXAMPLE.

savings — Credit Scoring — credit score

tumour size — Cancer Detection — is malignant or not

money transaction — Fraud Detection — is legitimate or not

… …

Machine Learning / Supervised Learning

EXAMPLE.

- The teacher knows the correct answers.
- The algorithm iteratively makes predictions on data, corrected by the teacher.
- The learning process stops at a certain acceptable level of performance.

Machine Learning / Supervised Learning

EXAMPLE.

Handwriting Recognition

Machine Learning / Supervised Learning

EXAMPLE.

Handwriting Recognition

一? 二? 三?

Machine Learning / Supervised Learning

EXAMPLE.

Handwriting Recognition

一? 二? 三?

feature

one

two

three

Machine Learning / Supervised Learning

EXAMPLE.

Handwriting Recognition

一? 二? 三?

一

二

三

one

two

three

Machine Learning / Supervised Learning

EXAMPLE.

Handwriting Recognition

Machine Learning / Supervised Learning

EXAMPLE. Handwriting Recognition

Machine Learning is the <u>process</u> of using a training set to <u>learn</u> features, continue modelling, and finally producing an efficient model.

Three types of Machine Learning

Supervised Learning

- To learn the mapping (rules) between inputs and outputs
- Labelled data is provided of past input & output pairs during the learning process to train the model how it should behave for previously unseen data.

EXAMPLE.

We have many photos of panda and raccoon, and we want our machine to learn to recognise them.

learning...

learnt

to recognise new photos

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Unsupervised Learning

- To learn hidden pattern (rules) from a set of inputs (no output).
- Unlabelled data is provided of past input (not a input & output pair) during the learning process.
- Instances in the same group are more similar to each other than to those in other groups.

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learning...

EXAMPLE.

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learnt

to group new photos

Group 1

Group 2

Three types of Machine Learning

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Reinforcement Learning

- Occasional positive and negative feedback is used to reinforce behaviours.
- Good behaviours are rewarded with a treat and become more common.
- Bad behaviours are punished and become less common.

Machine Learning: a Definition

“

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, 1997

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Machine learning is the study of algorithms that

- Improve their performance P ← To improve the accuracy
- At some task T ← of panda / raccoon recognition
- With experience E ← with learning from those photos (training data)

A well-defined learning task is given by <*P*, *T*, *E*>.

✓ Takeaway Points

- Definition of Machine Learning
  - First coined, by Arthur Samuel, 1959
  - More formal, by Tom Michell, 1997
- Classical Programming versus Machine Learning
- Supervised Machine Learning (mapping from input to output)
- Key terms: training set, feature, modelling/learning, model
- 3 types of Machine Learning (supervised, unsupervised, reinforcement)