認識演算法

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認識演算法(Algorithm)

- Before there were computers, there were algorithm. But now that there are computers, there are even more algorithms, and algorithms lie at the heart of computing.
- 演算法舉例：厄拉托西尼篩法、輾轉相除法

- Algorithms -- The **Design** and **Analysis** of Computer Algorithms
- 演算法精確的說就是 -- 計算機方法「設計」與「分析」

認識演算法(Algorithm)

- In formally, an **algorithm** is any well-defined computational procedure that takes some value, or set of values, as **input** and produces some value, or set of values, as **output**.

- An algorithm is thus a sequence of computational steps that transform the input into the output.
- input→**algorithm**→output

- 例如：輾轉相除法

認識演算法(Algorithm)

- We can also view an **algorithm** as a tool for solving a well-specified computational problem. The statement of the problem specifies the desired input/output relationship. The algorithm describes a specific computational procedure for achieving that input/output relationship.

- Algorithms as a technology 演算法比硬體設備來得重要

For example, The sorting problem

- **Input**: A sequence of *n* numbers $< a_1, a_2, \cdots, a_n >$
- **Output**: A permutation (reordering) $< a_1', a_2', \cdots, a_n' >$ of the input sequence such that $a_1' \leq a_2' \leq \cdots \leq a_n'$.

- For example, given the input sequence ⟨31, 41, 59, 26, 41, 58⟩, a sorting algorithm returns the output sequence ⟨26, 31, 41, 41, 58, 59⟩.

- Such an input sequence is called an instance of the sorting problem.

演算法(Algorithm)的三部曲

- 1. Design

  設計演算法
- 2. Proof of Correctness

  證明你所設計的演算法是正確的
- 3. Analysis

  分析你所設計的演算法要用掉多少 resources -- 主要是指 time

- 這門課著重介紹已知的演算法，正確性證明較少，分析偶爾提到

Appendix:Mathematical Background

- A Summations
  - A.1 Summation formulas and properties
  - A.2 Bounding summations
- B Sets, Etc.
  - B.1 Sets
  - B.2 Relations
  - B.3 Functions
  - B.4 Graphs
  - B.5 Trees

Appendix:Mathematical Background

- C Counting and Probability
  - C.1 Counting
  - C.2 Probability
  - C.3 Discrete random variables
  - C.4 The geometric and binomial distributions
  - C.5 The tails of the binomial distribution
- D Matrices
  - D.1 Matrices and matrix operations
  - D.2 Basic matrix properties