Course Overview

Introduction to Computer

Yu-Ting Wu

Course Information

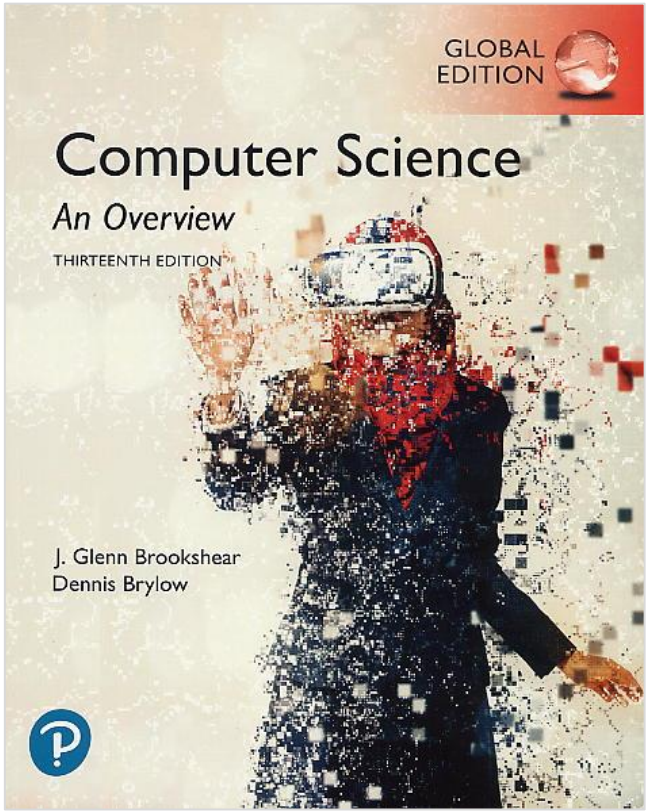
- **Meeting time:** 09:10 - 12:00, Tuesday
- **Classroom:** 電1F-06
- **Instructor:** 吳昱霆 (Yu-Ting Wu)
- **Teaching assistants:** 曾念馨
- **Course webpage:**
  - *https://kevincosner.github.io/courses/IC2022/*
- **Grading:**
  - Assignment: 25%
  - Participation: 5%
  - Midterm: 35%
  - Final exam: 35%

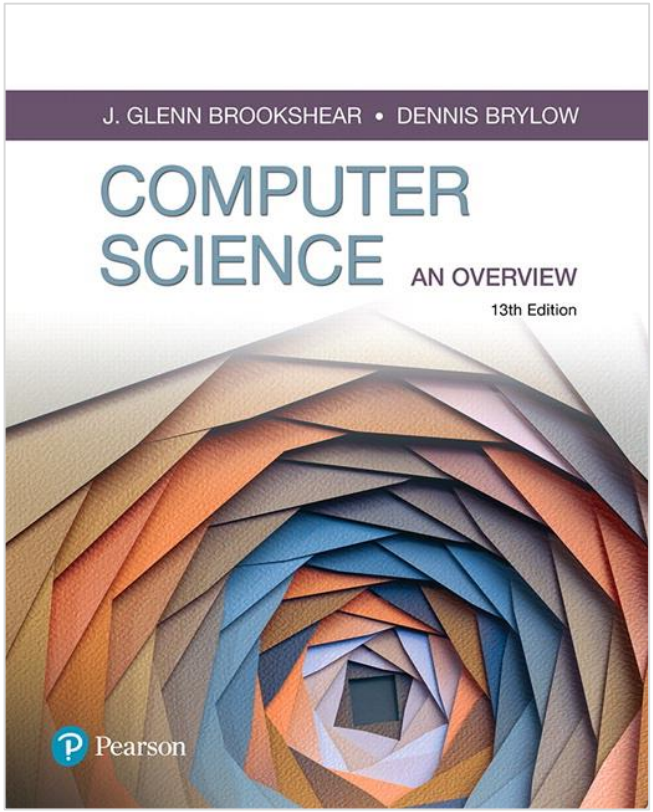
HW Late Policy

- One day 90%
- Two days 80%
- Three days 70%
- Four days 60%
- Five days+ 50%
- E.g., assume the deadline for the HW is 12/24 23:59 and you submit your HW on 12/25, you will get a 10% penalty
- You should **NOT** share your homework with any **living creatures (if caught, you will get zero)**

Textbook

- ***Computer Science: An Overview (13th edition)***
  - *Glenn Brookshear and Dennis Brylow*





Introduction

Algorithms

- A set of steps that defines how a task is performed

Algorithms (cont.)

- A set of steps that defines how a task is performed
  - Example: recipes for cooking

10 Ingredients

- 40g butter
- 3 green shallots, thinly sliced
- 2 garlic cloves, crushed
- 400g can cherry tomatoes
- 500ml (2 cups) Massel Stock Chicken Style
- 1 tbsp sweet chilli sauce
- 350g dried spaghetti pasta
- 300g peeled green prawns, deveined, tails removed
- Extra virgin olive oil, to drizzle
- Chopped fresh continental parsley leaves, to serve

Select all ingredients

3 Method Steps

Step 1

Melt the butter in a large, heavy-based saucepan over medium heat until foaming. Add the shallot and garlic. Cook, stirring, for 2 minutes or until softened.

Step 2

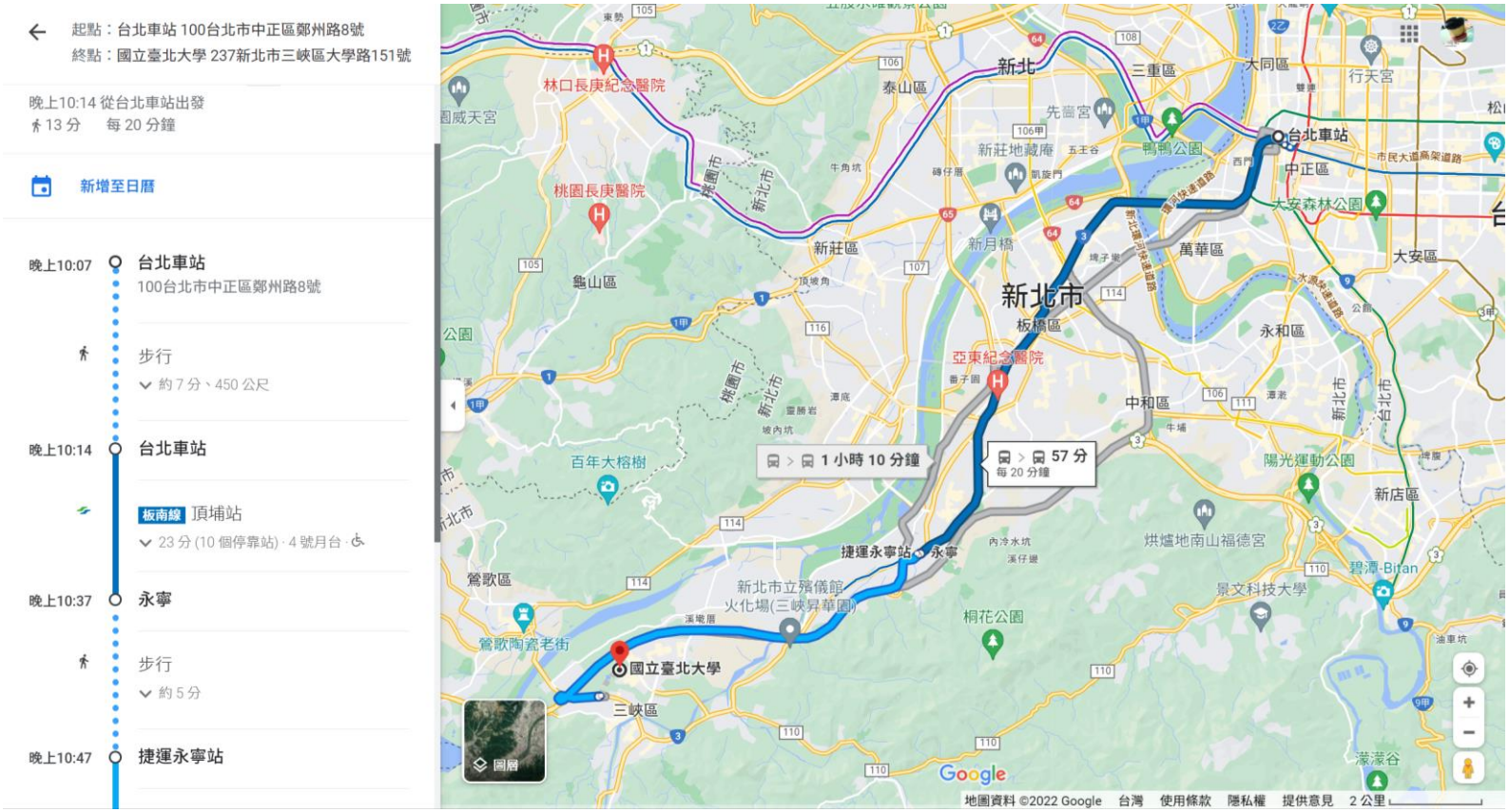
Add the tomatoes, stock, sweet chilli sauce and 250ml (1 cup) water to the pan. Season with salt. Add the spaghetti and increase heat to high. Cook, stirring often so the pasta cooks evenly, for 12 minutes or until the pasta is al dente.

Step 3

Add prawns to pan and use tongs to toss until combined. Cover and cook for 3 minutes or until prawns change colour. Drizzle over oil and sprinkle

Algorithms (cont.)

- A set of steps that defines how a task is performed
  - Example: route planning



Algorithms (cont.)

- A set of steps that defines how a task is performed
  - Example: finding the greatest common divisor of two positive integers

Description: This algorithm assumes that its input consists of two positive integers and proceeds to compute the greatest common divisor of these two values.

Procedure:

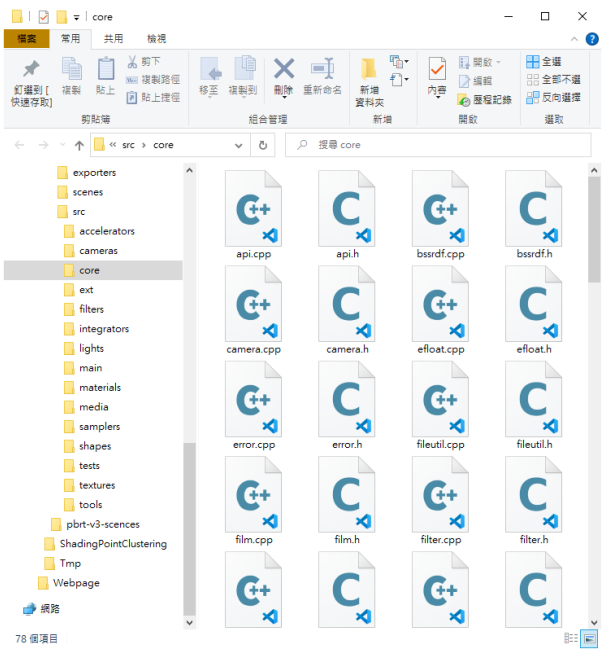
Step 1. Assign M and N the value of the larger and smaller of the two input values, respectively.

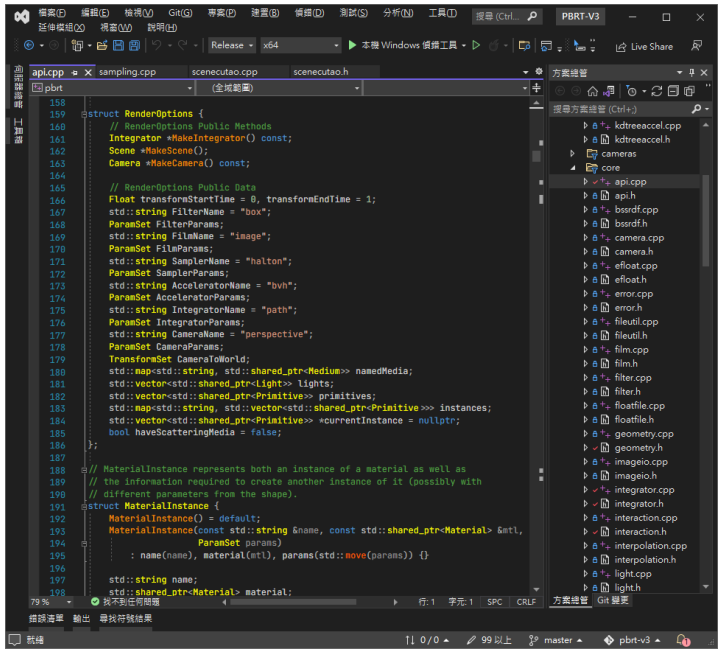
Step 2. Divide M by N, and call the remainder R.

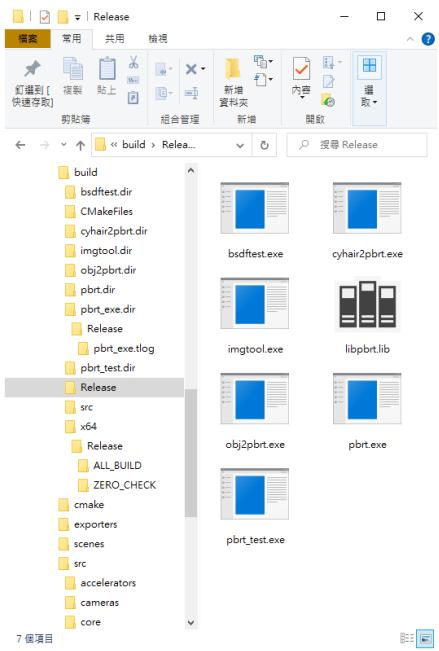
Step 3. If R is not 0, then assign M the value of N, assign N the value of R, and return to step 2; otherwise, the greatest common divisor is the value currently assigned to N.

Programs

- A **representation** of an algorithm
  - Usually displayed on computer screens for the convenience of humans
  - Usually **encoded** in a manner compatible with the technology of the machine



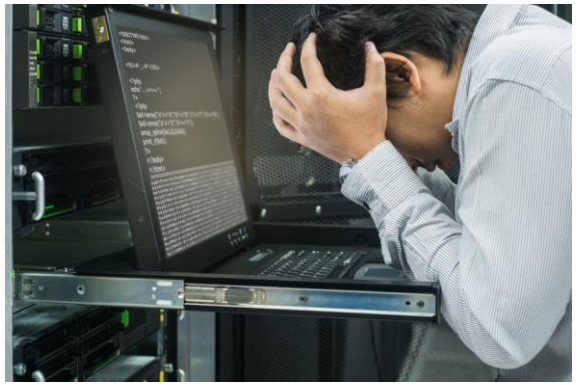




Programming

- The process of developing a program and encoding it into a machine

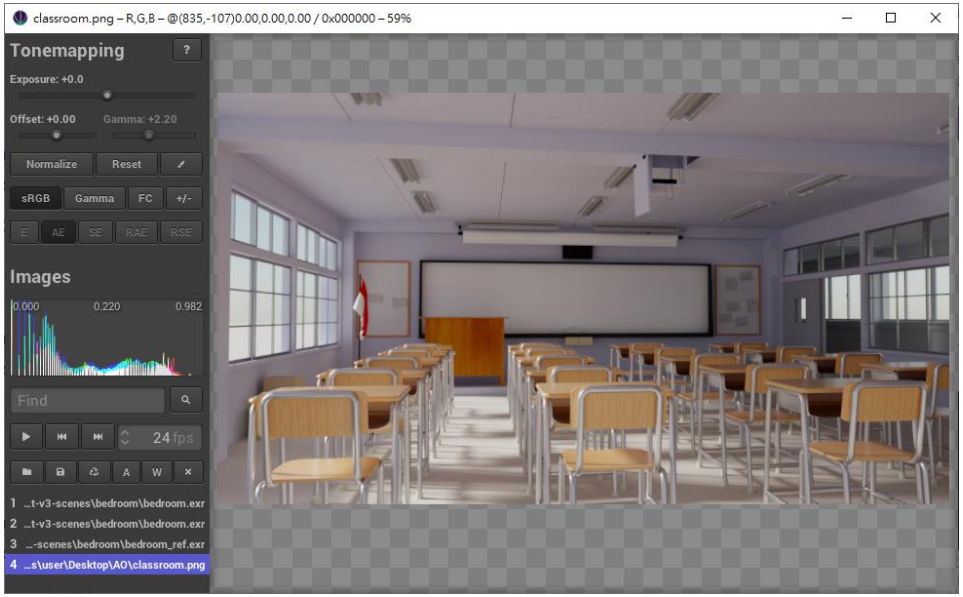
what others think you do



what you actually do

Software

- Programs (and their algorithms)
  - Examples: image viewers, video players, editors, browsers, communication software … etc.



Hardware

- Machinery (equipment)

Terminology Review

- **Algorithm**
  - A set of steps that defines how a task is performed
- **Program**
  - A representation of an algorithm
- **Programming**
  - The process of developing a program
- **Software**
  - Programs (and their algorithms)
- **Hardware**
  - Machinery (equipment)

Gödel's Incompleteness Theorems

"Some problems cannot be solved by algorithms"

Kurt Friedrich Gödel (1906 – 1978)

The History of Computing

Early Computing Devices

- **Abacus**
  - Use positions of beads to represent numbers
  - Used in ancient China, early Greek and Roman

Early Computing Devices (cont.)

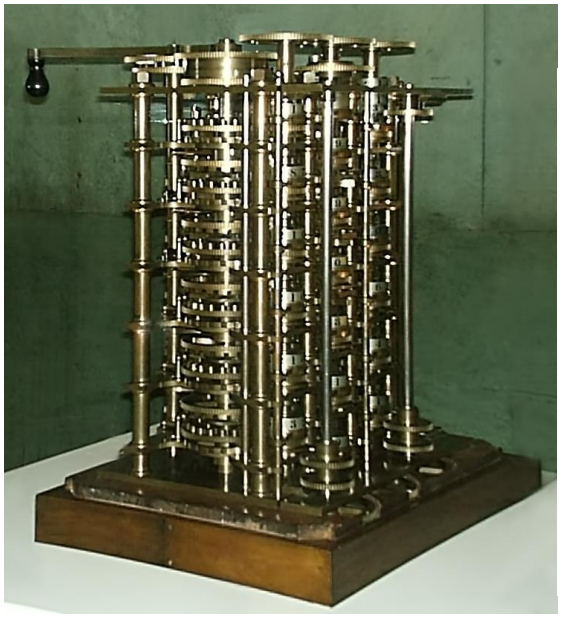
- **Gear-based machines** (1600s – 1800s)
  - Use positions of gears to represent numbers
    - Blaise Pascal (1642)
    - Thomas Morland (1666)
    - Wilhelm Leibniz (1673)

Pascal's calculator

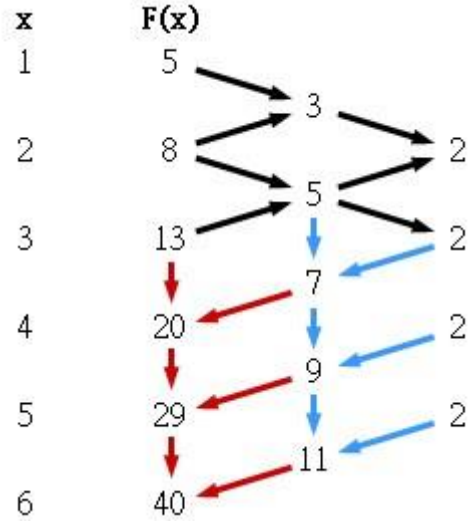
Leibniz's calculator

Early Computing Devices (cont.)

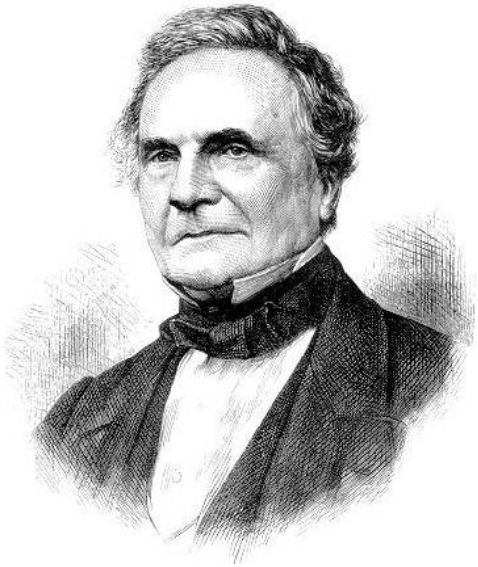
- **Gear-based machines** (1600s – 1800s)
  - Use positions of gears to represent numbers
    - Difference engine: Charles Babbage (1820)



Difference engine



$F(x) = x^2+4$



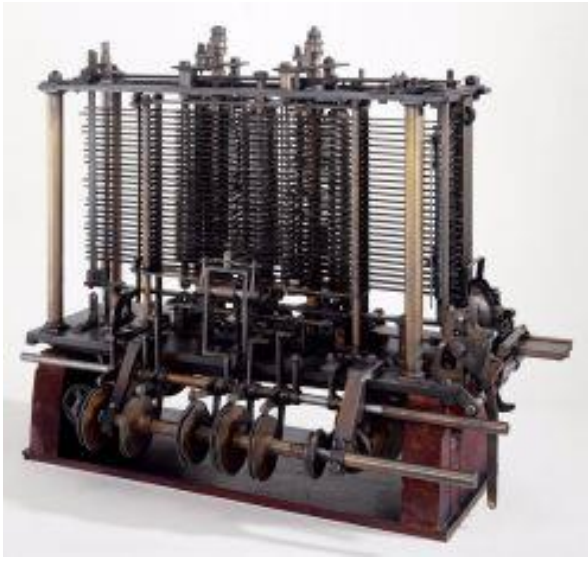
Charles Babbage

Early Computing Devices (cont.)

- **Gear-based machines** (1600s – 1800s)
  - Use positions of gears to represent numbers
    - Analytical engine: Charles Babbage (1834)

- The idea of a general-purpose computer comprises of
  - Input (punch card)
  - Processor
  - Control unit
  - Storage
  - Output

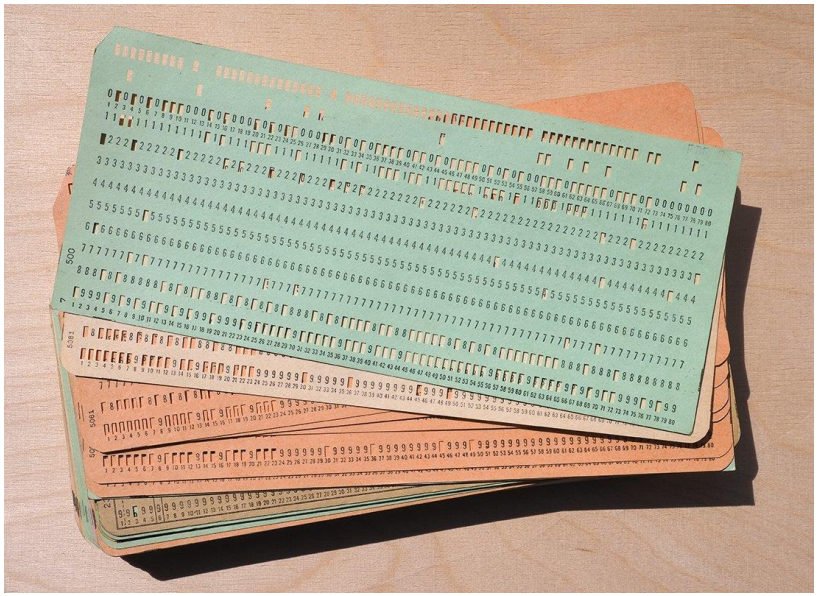
Ada Lovelace



Analytical Engine

Early Data Storage

- **Punched cards**
  - Popular from 1720s to 1970s



Early Data Storage (cont.)

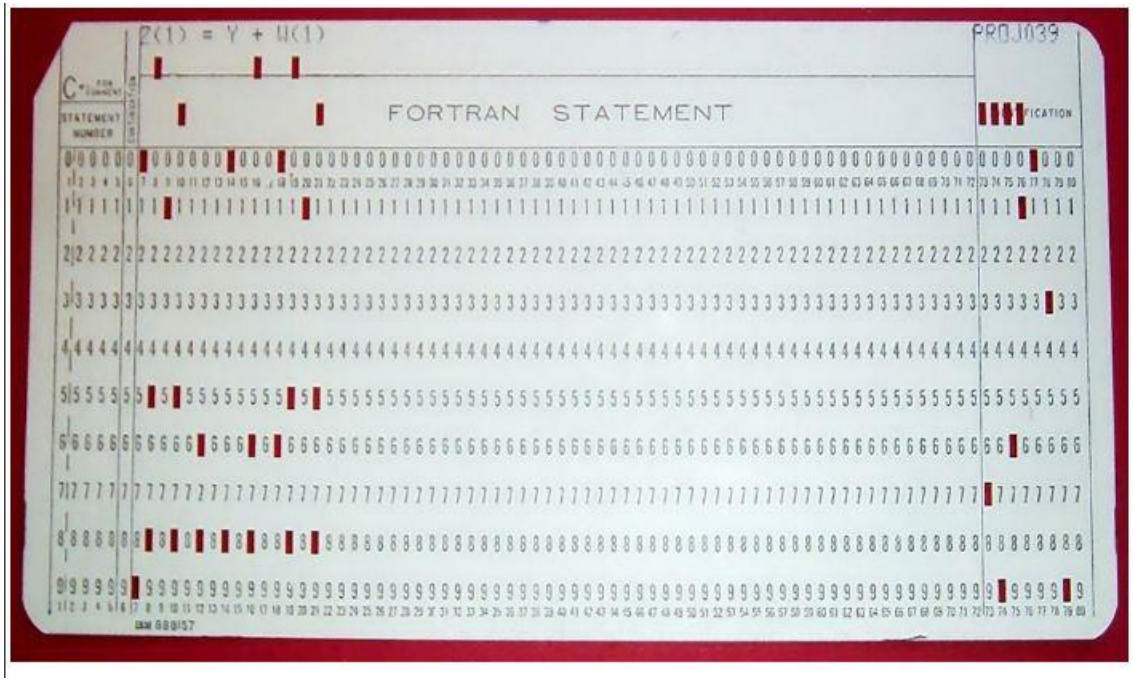
- **Punched cards**
  - First used in Jacquard Loom (1801) to store patterns for weaving cloth
  - Storage of programs in Babbage's Analytical Engine

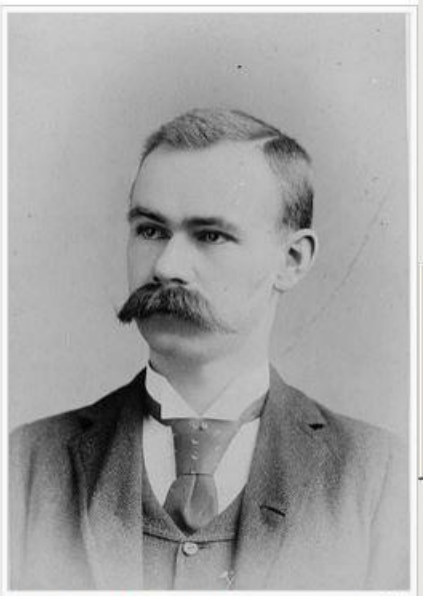
Jacquard Loom

Analytical Engine

Early Data Storage (cont.)

- **Punched cards**
  - Used by Herman Hollerith (1890) to speed up the tabulation process in the 1890 U.S. census
  - Shorten the time from 8 years to 3 years





Herman Hollerith

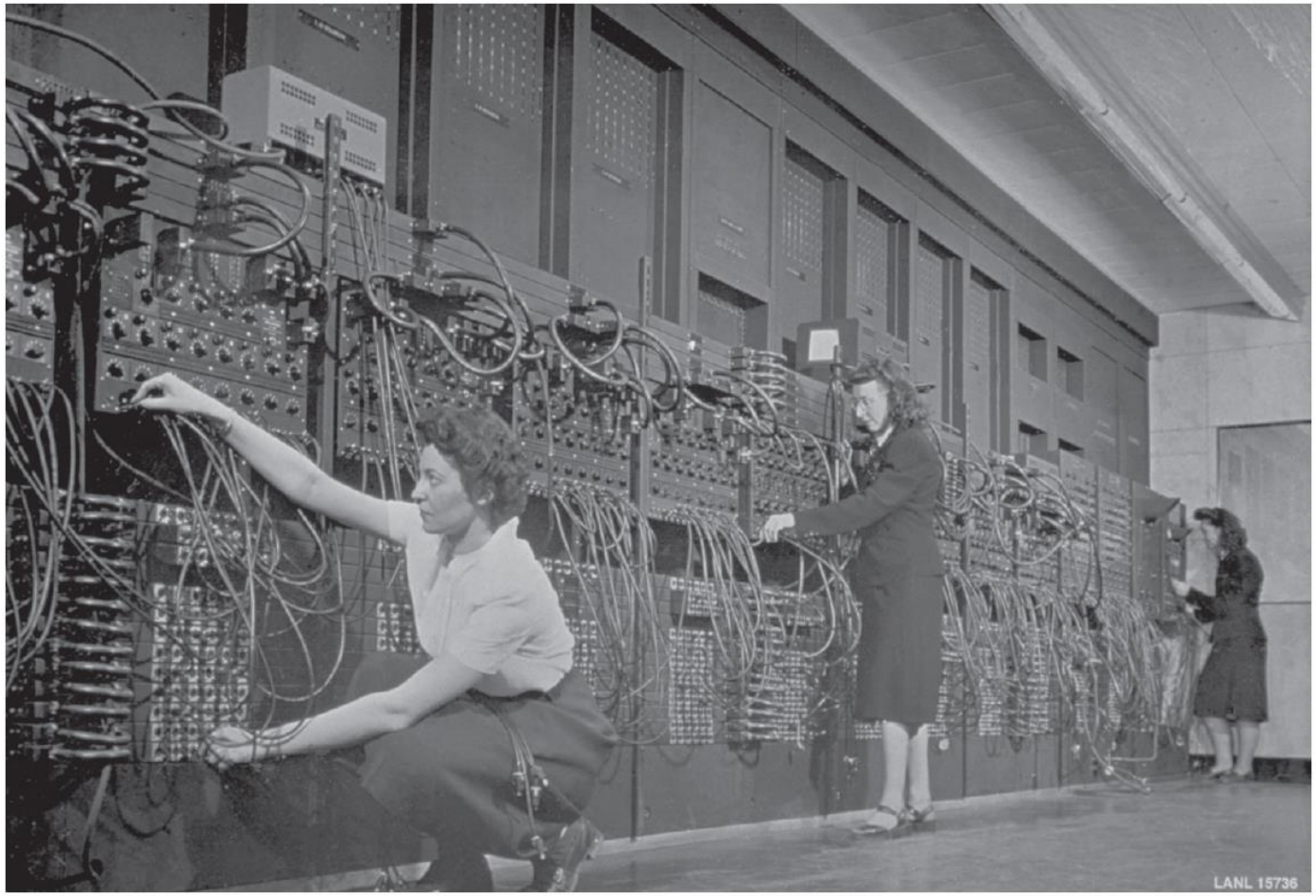
1st Generation Computer

- **1940 – 1958**
- **Mechanical relays**
  - 1940: George Stibitz at Bell Laboratories
  - 1944: Mark I: Howard Aiken and IBM at Harvard
- **Vacuum tubes (totally electronics)**
  - 1937 – 1941: Atanasoff-Berry at Iowa State
  - 1940s: Colossus: secret German code-breaker
  - 1940s: ENIAC: Mauchly & Eckert at U. of Penn.

1st Generation Computer (cont.)

Mark I

1st Generation Computer (cont.)



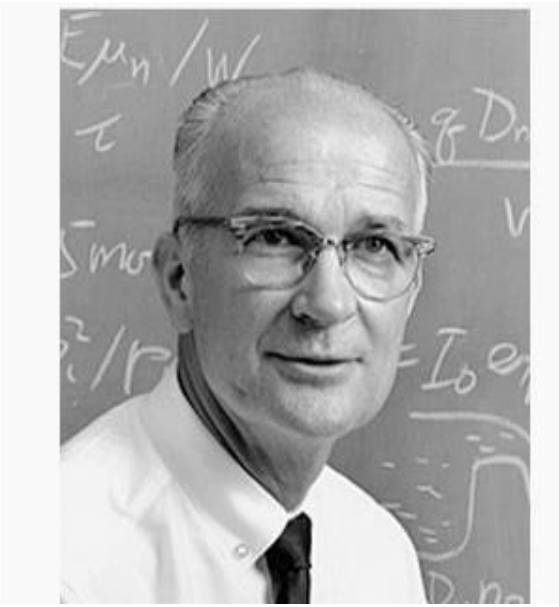
Electronic Numerical Integrator And Computer (ENIAC)

2nd Generation Computer

- **1959 – 1963**
- **Transistor**
  - Developed by J. Bardeen, H. W. Brattain, and W. Shockley

John Bardeen

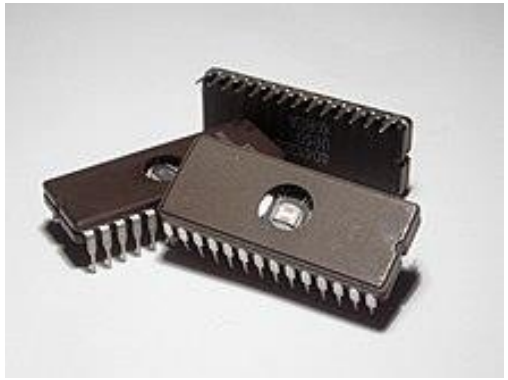
Walter Brattain

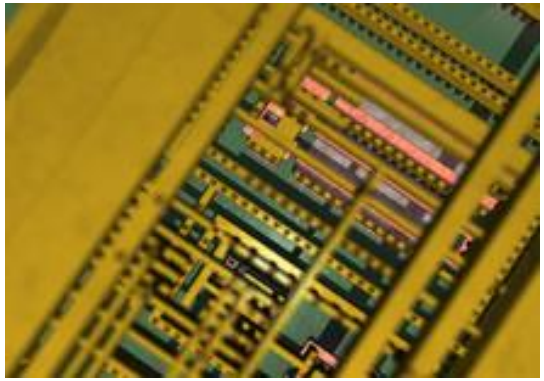


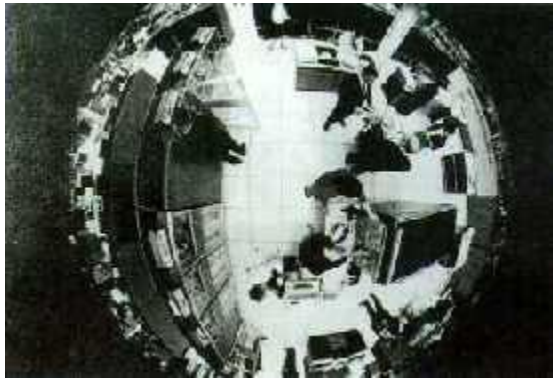
William Shockley

3rd Generation Computer

- **1965 – 1970**
- **Integrated Circuit (IC)**
  - Complete circuits constructed as single units
  - 1964: IBM SYSTEM-360
  - Decrease the size of computers, make desktop and mobile computers possible





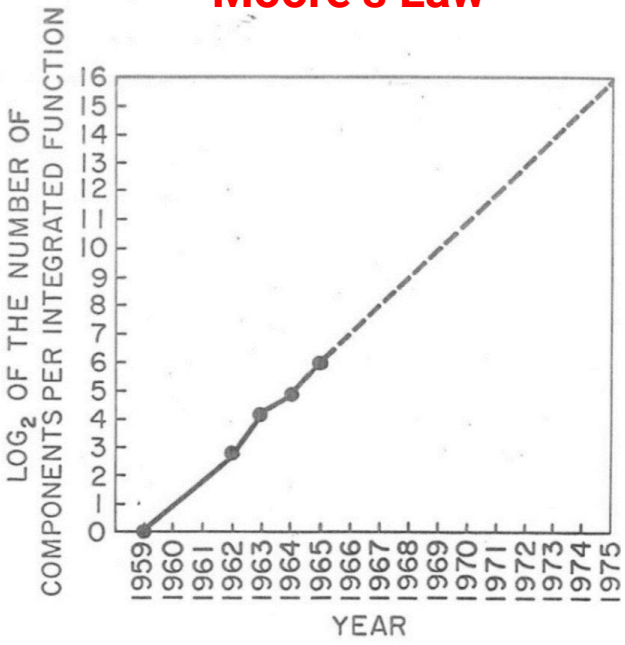


IBM SYSTEM-360

4th Generation Computer

- **From 1971**
- **Very-Large-Scale Integration (VLSI)**
  - IC can be encased in toy-sized blocks of plastic called **chips**
  - **Moore's Law**

Moore's Law



Personal (Desktop) Computers

- Origins: hobbyists built homemade computers from a combination of chips
- Steve Jobs and Stephen Wozniak built ***Apple Computer*** in 1976 for manufacturing and marketing their products
- **IBM** introduced the PC in 1981
  - The underlying software was developed by a newly formed company known as ***Microsoft***
  - Accepted by the business community
  - Became the standard hardware design for most desktop computers

Internet

- The ability to connect individual computers in a world-wide system
- **World Wide Web (**or shortened to **Web)**
  - First proposed by Tim Berners-Lee
  - Documents stored on computers throughout the Internet can be linked together producing a maze of linked information
- **Search engines** make the information on the Web accessible
  - Sift through the Web, categorize the findings, assist users to find particular topics

Miniaturization of Computing Machines

- Tiny computers are embedded within a wide variety of electronic appliances and devices
  - **Global Positioning Systems (GPS)**
  - Engine monitors
  - Voice command system

- **Smartphones**

Topics We Plan to Cover

Topics We Plan to Cover

- Chap01: Data storage
- Chap02: Data manipulation
- Chap03: Operating systems
- Chap04: Networking and the internet
- Chap05: Algorithms
- Chap06: Programming language
- Chap08: Data abstractions
- Chap09: Database systems
- Chap10: Computer graphics
- Chap11: Artificial intelligence
- Chap12: Theory of computation

Chap 1: Data Storage

Basics of Data Encoding and Storage

Data Storage and Representation

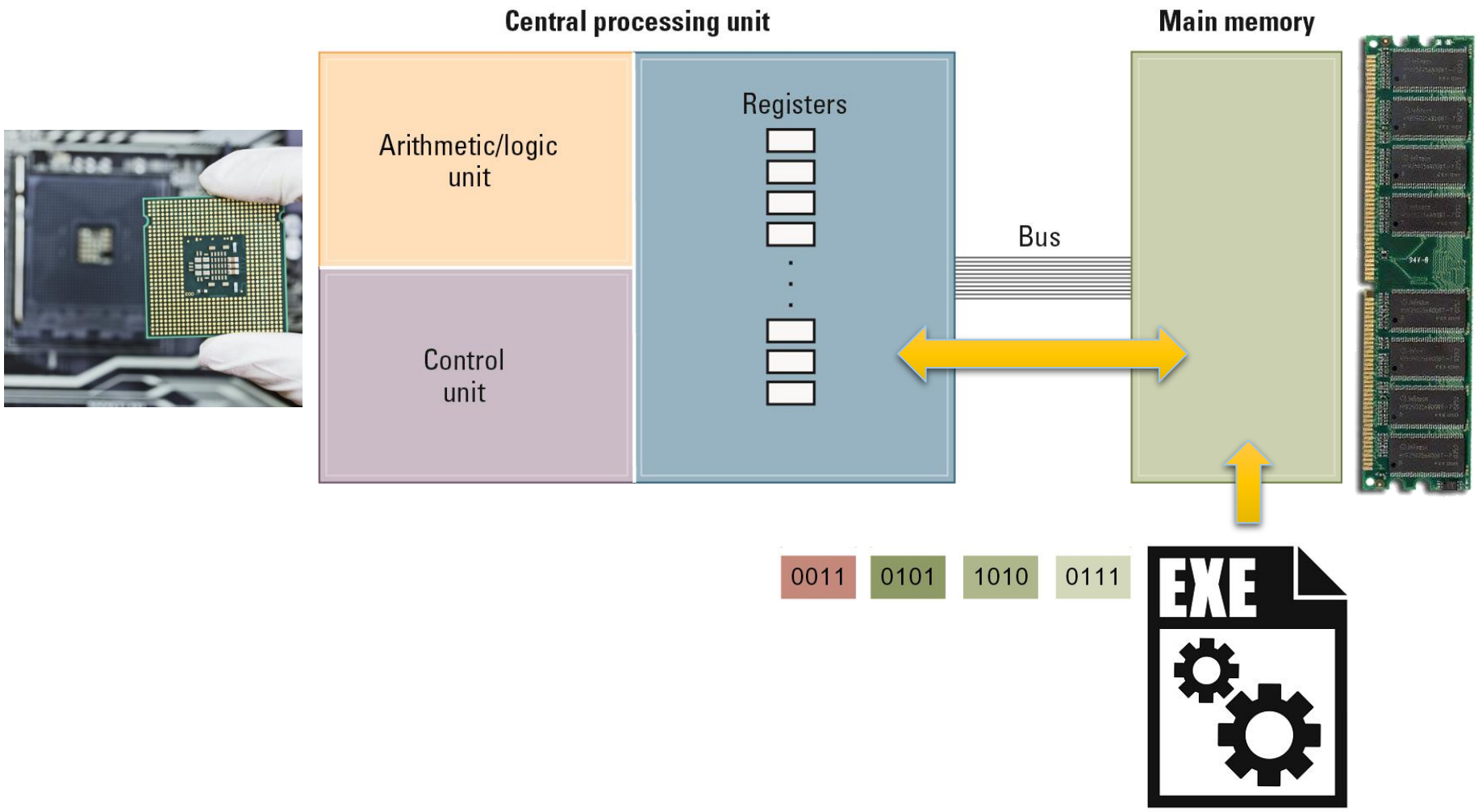
Related Courses in NTPU

- 數位電子電路 (1st year)
- 數位訊號處理 (江振宇老師, 4th year)
- 數位系統設計 (陳永源老師, 1st year)

Chap 2: Data Manipulation

Basic Internal Operation of a Computer

Data Manipulation



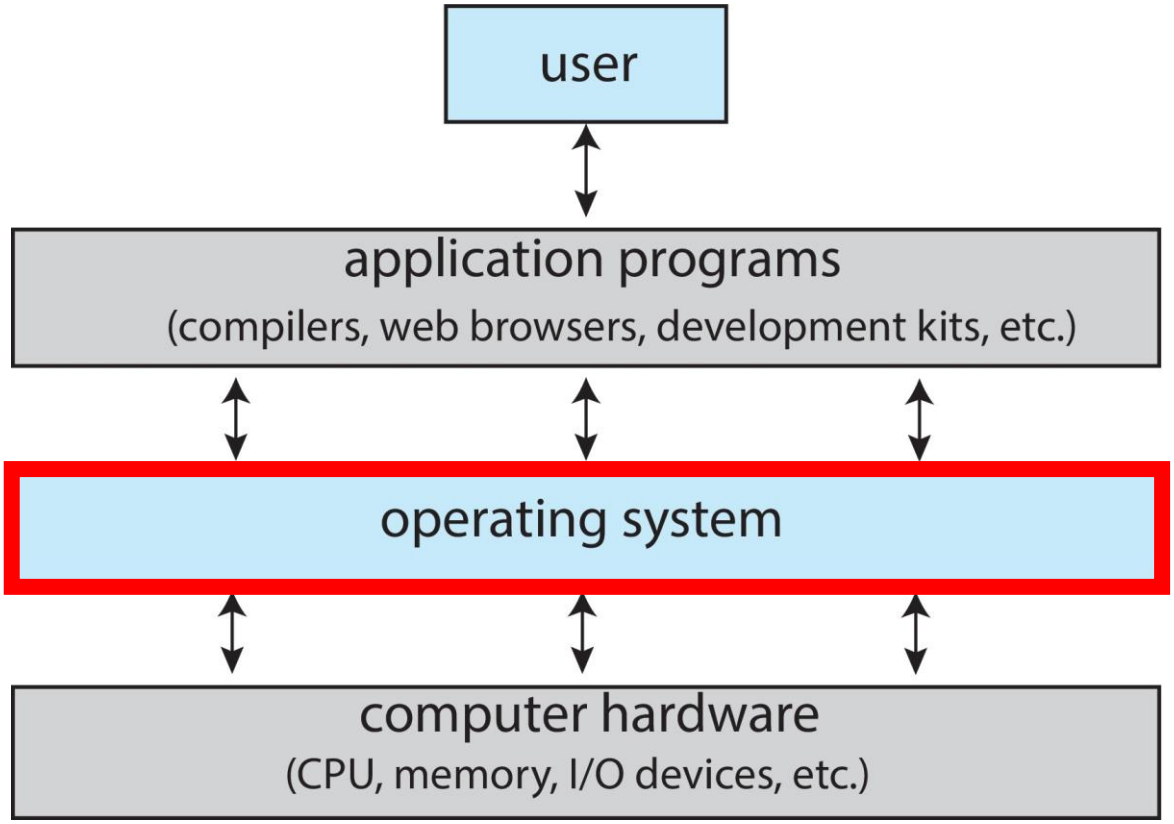
Related Courses in NPTU

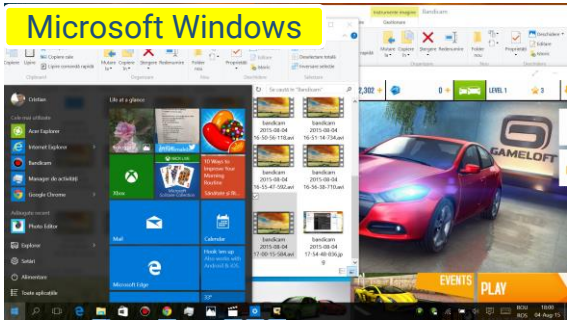
- 計算機結構 (陳志昌老師, 3rd year)

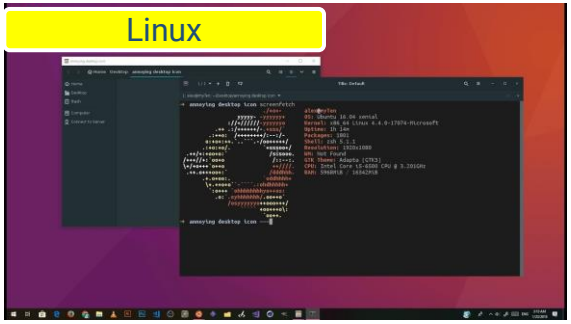
Chap 3: Operating Systems

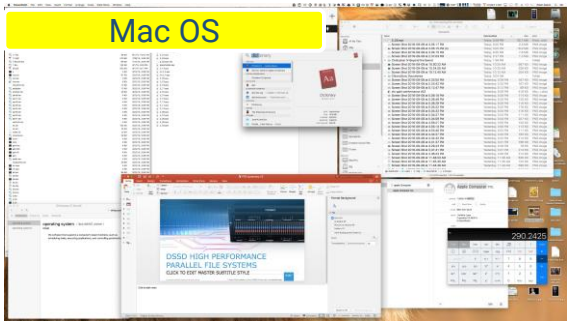
A Special Software that Controls the Overall Operations of a Computer

Operating Systems









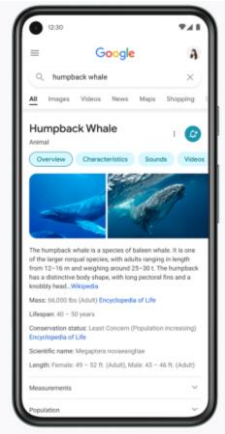
Related Courses in NPTU

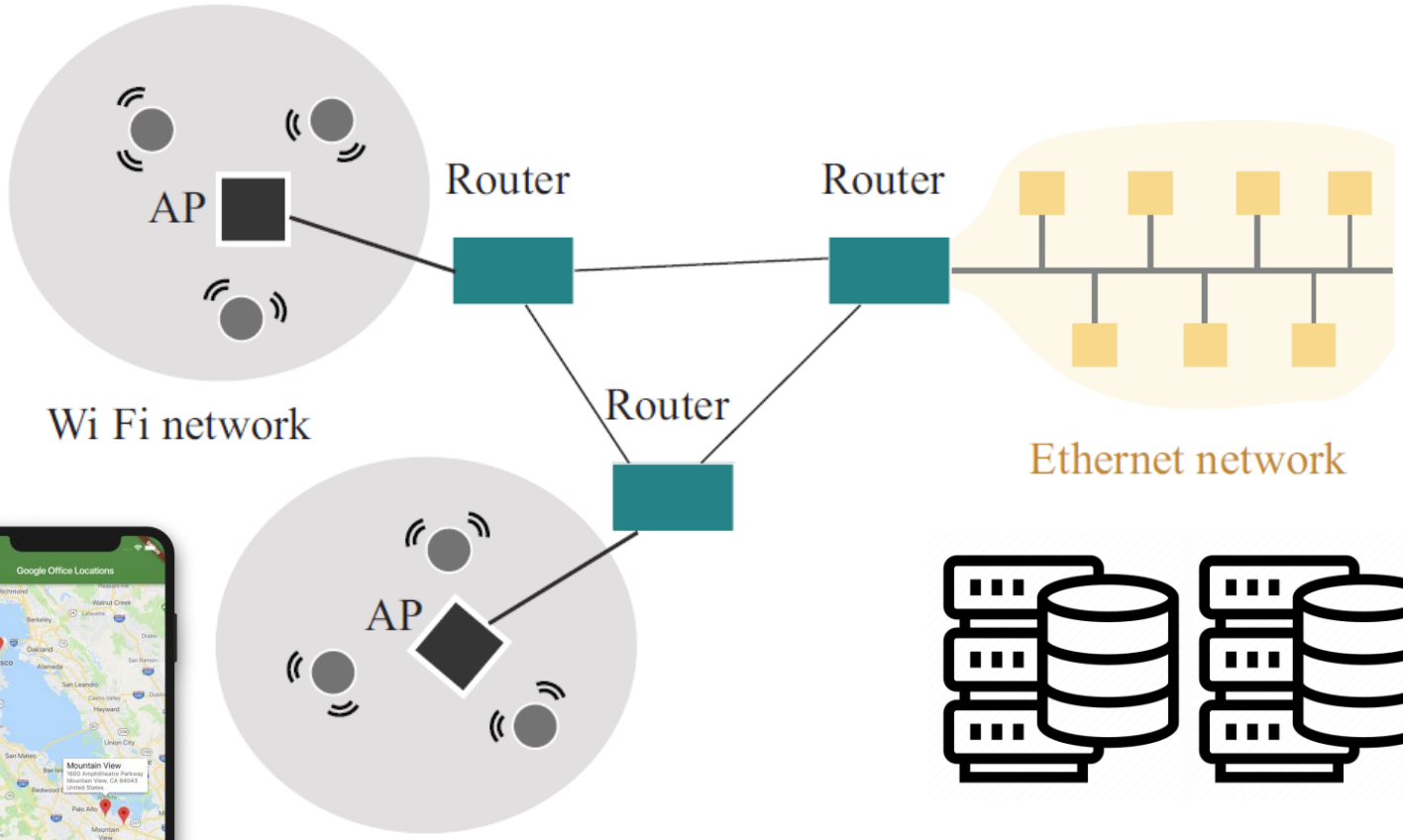
- 作業系統 (我, 3rd year)
- 嵌入式系統導論 (林伯星老師, 3rd year)
- 系統韌體開發與實作 (張仁俊老師, 4th year)

Chap 4: Networking and the Internet

How Computers are Connected to Each Other

Networking and the Internet





Related Courses in NPTU

- 電腦網路 (陳裕賢老師, 2nd year)
- 無線網路導論 (陳裕賢老師, 3rd year)
- 網路程式設計 (曾俊元老師, 3rd year)
- 網路安全與深度學習 (曾俊元老師, 3rd year)
- 高等電腦網路 (曾俊元老師, graduated)

Chap 5: Algorithms

A More Formal Perspective for Algorithms

Algorithms

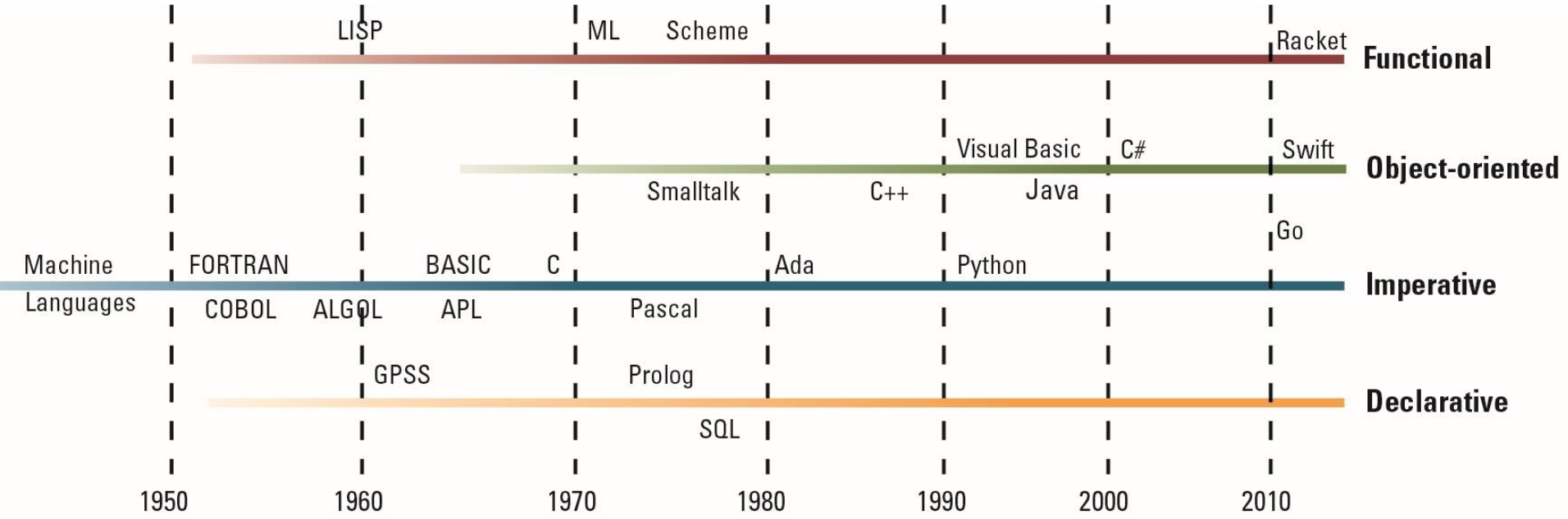
Related Courses in NPTU

- 演算法 (吳信龍老師, 3rd year)
- 高等演算法 (張仁俊老師, graduated)

Chap 6: Programming Languages

The Subject of Algorithm Representation and Development

Programming



Related Courses in NTPU

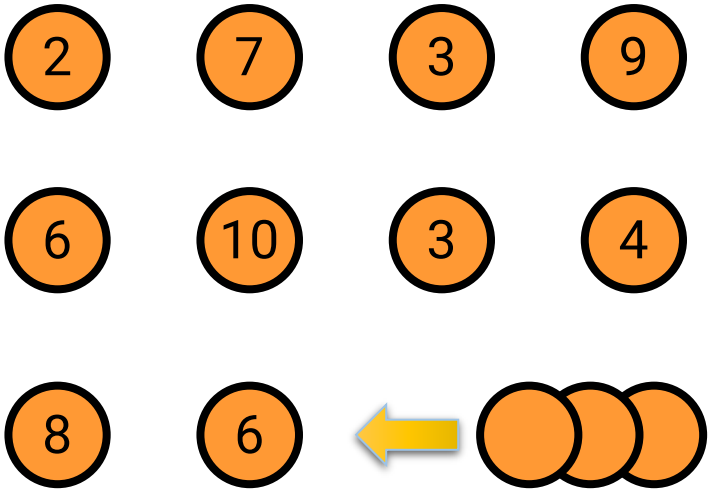
- 計算機程式設計 (陳志昌老師, 1st year)
- 物件導向程式設計 (戴志華老師, 1st year)
- 微算機與組合語言 (張玉山老師, 2nd year)
- 雲端計算與大數據程式設計 (張玉山老師, 3rd year)

Chap 8: Data Abstractions

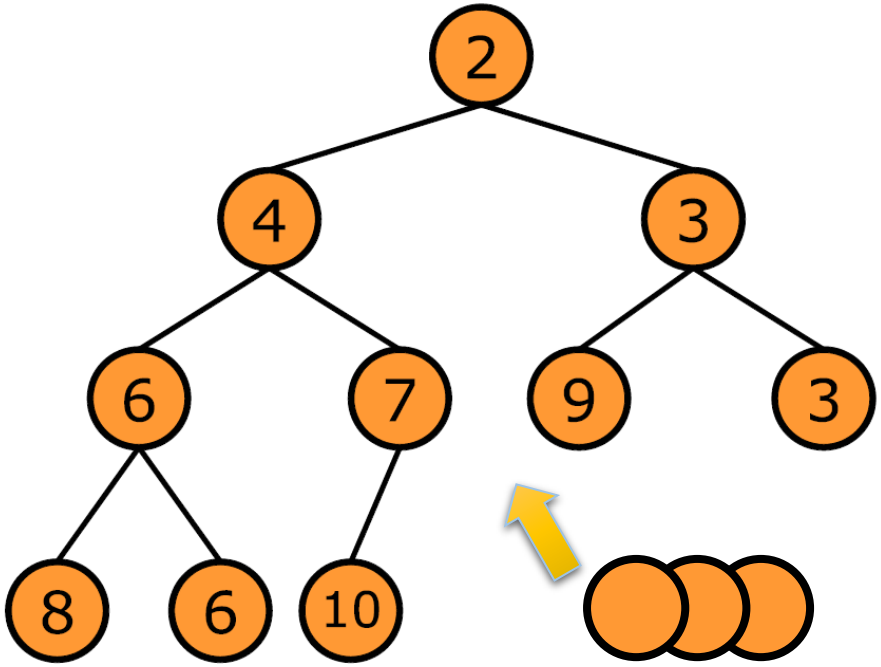
Ways of Data Organization in a Computer's Main Memory

Data Abstraction (Data Structures)

Problem: design an algorithm to pop the smallest number iteratively when new numbers are coming in



Naïve approach: compare n times in each iteration



Using a min heap: O(1) for finding the minimum, O(log(n)) to update

Related Courses in NTPU

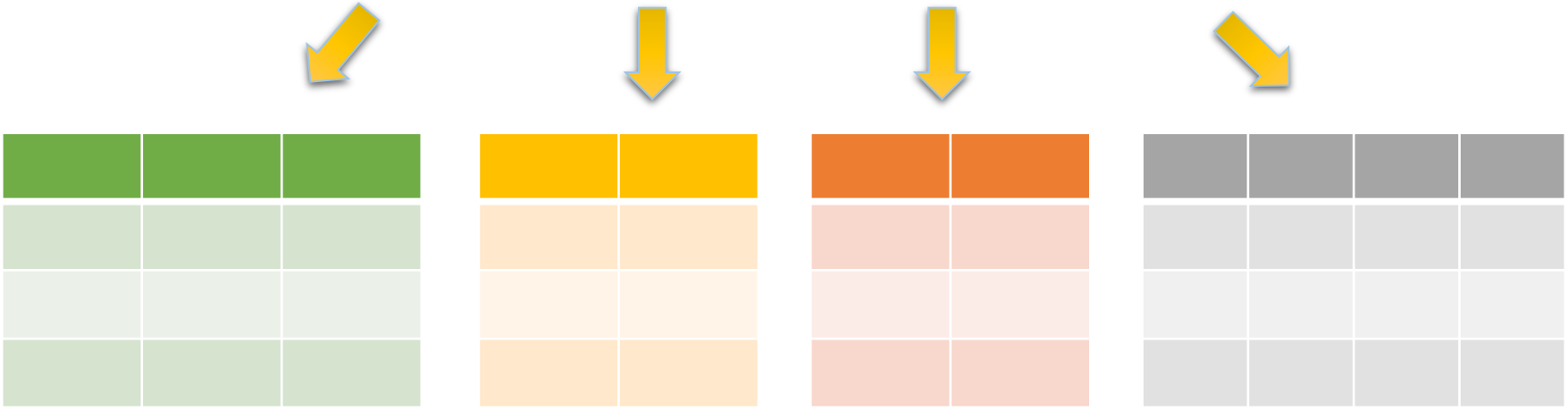
- 資料結構 (莊東穎老師, 2nd year)
- 進階資料結構 (莊東穎老師, 2nd year)

Chap 9: Database Systems

Ways of Data Organization in a Computer's Mass Storage

Database System

ID	Name	Birthday	BirthPlace	HealthStatus	CrimeHistory	...



Related Courses in NTPU

- 資料庫系統 (戴志華老師, 3rd year)

Chap 10: Computer Graphics

The subject of Graphics and Animation

Computer Graphics

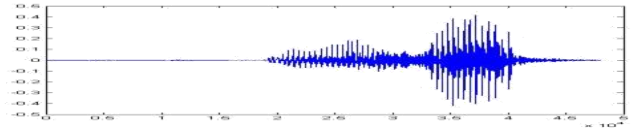
Related Courses in NTPU

- 多媒體技術與應用 (我, 2nd year)
- 計算機圖學導論 (我, 3rd year)

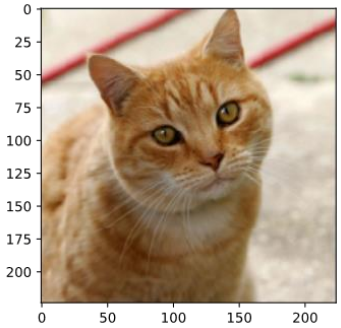
Chap 11: Artificial Intelligence

Develop More Intelligent (Useful) Machines

Artificial Intelligence

$f($  $)=$ “How are you”

$f($  $)=$ “Cat”



$f($  $)=$ “5-5”

(next move)

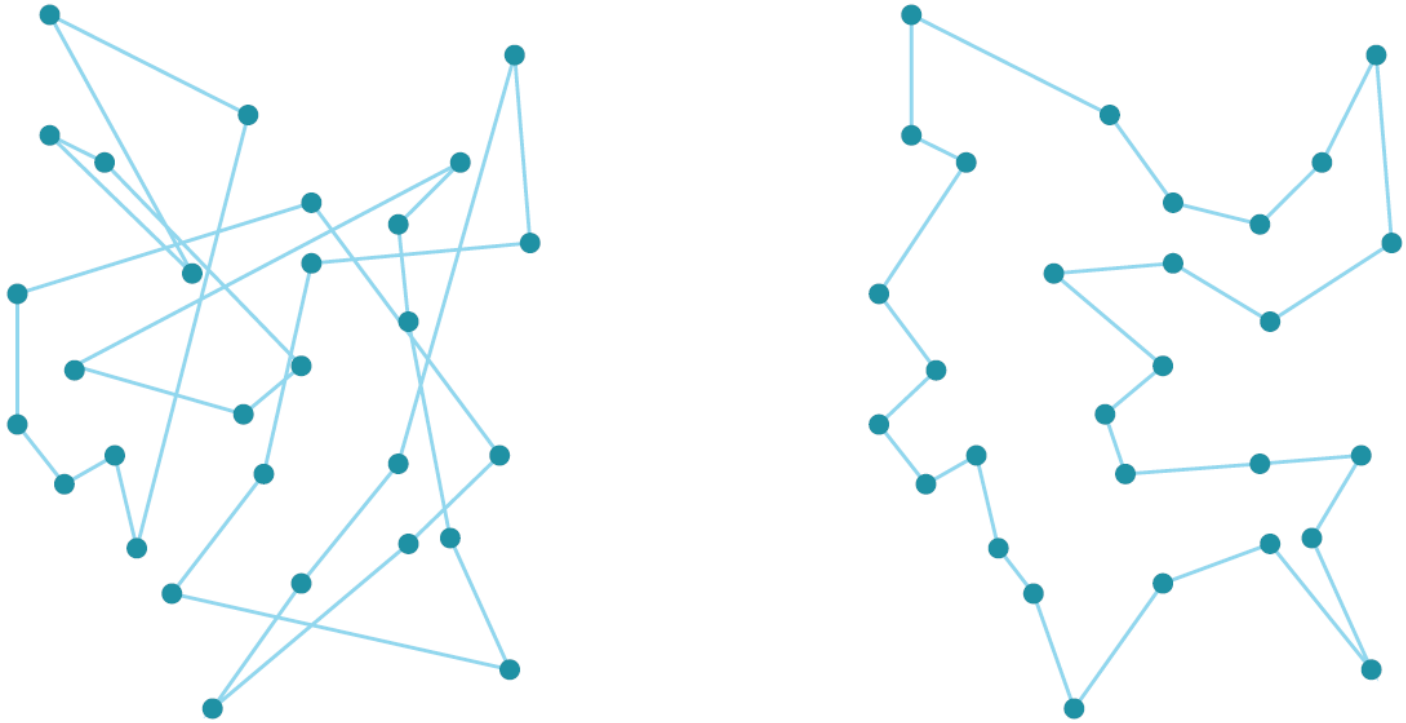
Related Courses in NTPU

- 人工神經網路與深度學習 (林道通老師, 3rd year)
- 機器學習導論 (吳信龍老師, 3rd year)

Chap 12: Theory of Computation

The Theoretical Foundations of Computer Science

Computation Theory



The travel salesman problem

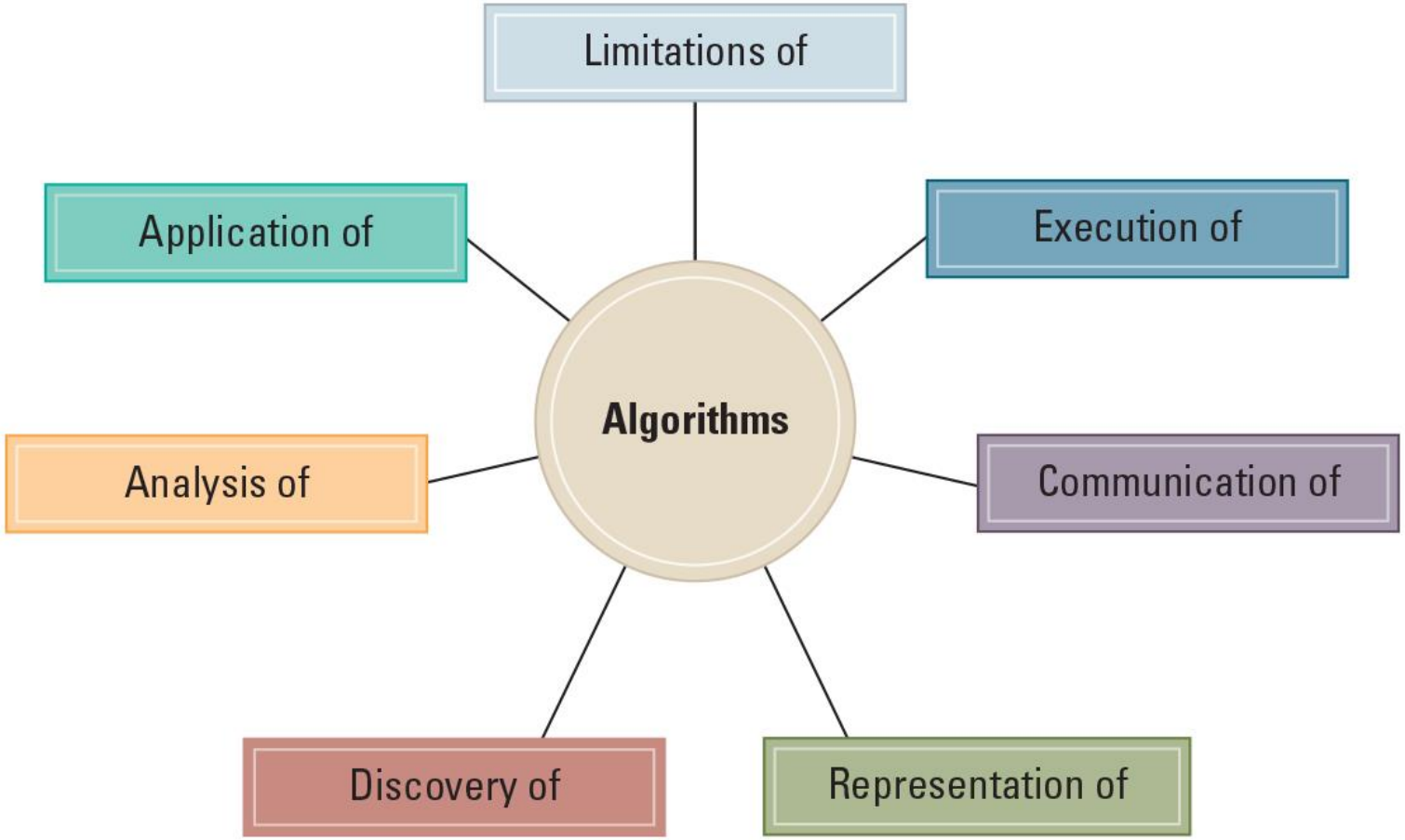
P = NP?

Related Courses in NTPU

- There are no related courses in NTPU
- But you can discuss with 吳信龍老師 if you are interested!

Summary: Computer Science and Algorithms

- Computer science is the science of algorithms



Any Questions?