

# EECS 204002

## Data Structures 資料結構

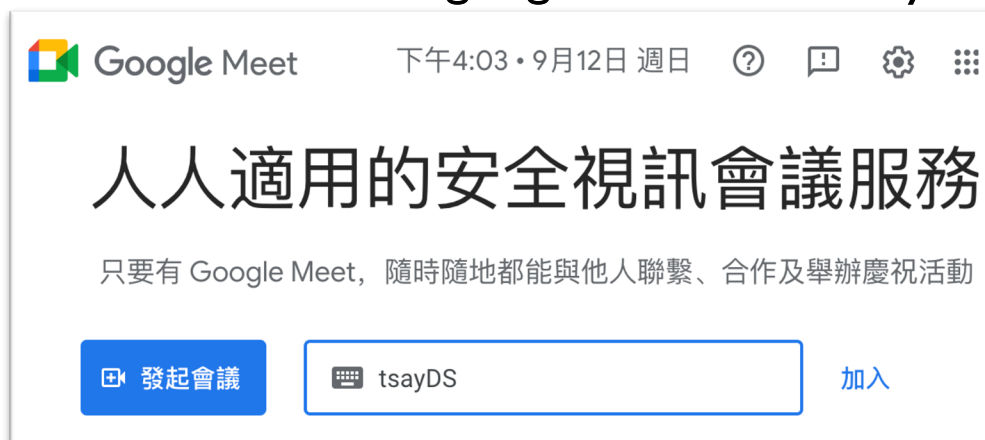
Prof. Ren-Song Tsay

蔡仁松 教授



# 新冠病毒流行期間上課注意事項

- 課堂內維持1.5m社交距離
    - 基本上需跳位坐
    - 如無法維持社交距離，即應佩戴口罩。
  - 每人固定坐位，上課需點名
  - 多利用廁所內洗手台的洗手乳勤洗手
  - 進出課堂大樓，用入口處的自動酒精釋出器消毒手及身體。
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- 若因疫情要求需線上遠距教學時
    - 用 [gapp.nthu.edu.tw](http://gapp.nthu.edu.tw) 帳號用 google meet 加入 tsayDS 會議室



# Prof. Ren-Song Tsay 蔡仁松教授

- Class Room (Delta) 台達館 #104
- Tuesday 10:10~12:00 and Thursday 10:10~11:00
- Weekly lecture review and Online Judge
- Course Web Site:
  - Login to [eeclclass.nthu.edu.tw](http://eeclclass.nthu.edu.tw)
  - Office Hours:
    - Every Thursday 13:20~15:10
    - Office: 台達館#616

# Course Objective

- Students can analyze and design basic data structures and implement a few basic algorithms for practical problem solving.
- Estimated work load: in average 6 hours each week off class
- Suggest at least 3-hour preview and preparation time each week.

# Prerequisite Course

- C and C++ Programming

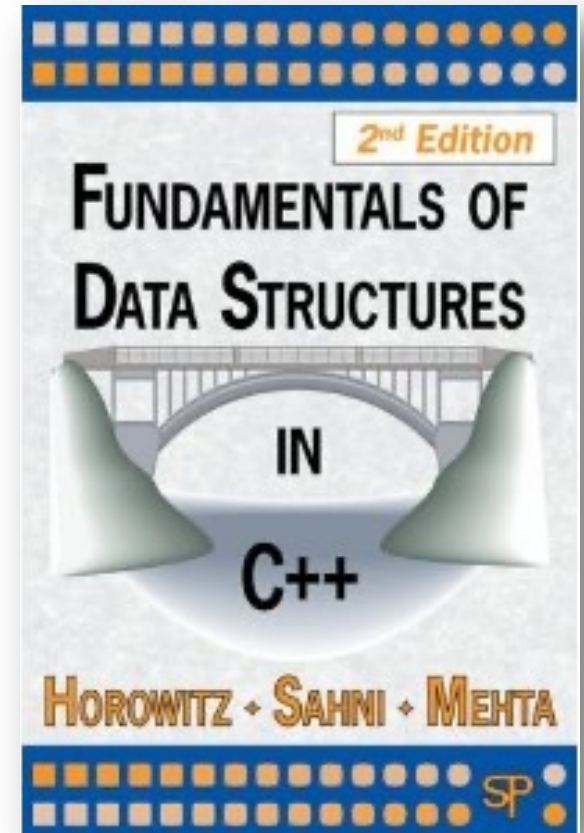
# Teaching Assistants Office Hours

- Check out eeClass announcements.



# Textbook

Fundamentals of Data Structures in C++, E. Horowitz, S. Sahni, and D. Mehta, 2nd ed., 2006.



# Topics Covered

Topics	Textbook
Intro. to C++ and Algorithm	Chapter 1
C++ and Arrays	Chapter 2
Stacks and Queues	Chapter 3
Linked Lists	Chapter 4
Trees	Chapter 5
Graphs	Chapter 6
Sorting	Chapter 7
Hashing	Chapter 8
Advanced Topics	Ch. 9~12



# Class Rules

- Be honest
  - Forced out if cheating
- No missing classes
  - Dismissed if miss classes more than two times
  - Fixed seating
  - Allow online attendance with teacher's permission – need to be live video.
- Be on time
  - No late project submission

# Grading

Online Quizzes	20%
Midterm I	20%
Midterm 2	20%
Final	20%
Final Project:	20%

- Final grade may subject to adjustment

# Tentative Schedule

1	9/14	0	9/16	1.2, 1.4, 1.5, 1.6
2	9/21	中秋節	9/23	1.7, 2.1, 3.1, 3.4
3	9/28	Ch. 2 array	9/30	上機考
4	10/5	Ch. 3 stack & queue	10/7	上機考
5	10/12	Ch 4 lists	10/14	上機考
6	10/19	期中考	10/21	
7	10/26	5.1~6 trees	10/28	上機考
8	11/2	5.7~ trees	11/4	上機考
9	11/9	6.1-3 graph	11/21	上機考
10	11/16	6.4-5 graph	11/18	上機考
11	11/23	期中考	11/25	
12	11/30	7.1-5 sorting	12/2	上機考
13	12/7	7.6-10 sorting	12/9	上機考
14	12/14	8 hasing	12/16	上機考
15	12/21	10 AVL	12/23	上機考
16	12/28		12/30	
17	1/4	期末考	1/6	
18	1/11		1/13	
	1/18		1/20	期末專題

# Online Quiz

- NTHU Online Judge System  
( <http://acm.cs.nthu.edu.tw/> )
- Thu. 10:00-11:00
- EECS Building, Room 326 and 328
- Clean hands: NO PCs, USBs, papers, books ...
- No stay after finishing the quiz.
- Cheaters will fail this course.

# Why Study Data Structures?



# What is Data Structure?

- A particular way of *storing* and *organizing* data in a computer so that it can be used *efficiently*.
- Different kinds of data structures are suited to different kinds of applications.
  - **B-Tree** for databases application
  - **Hash table** is used in compilers for looking up identifiers.

From wikipedia



# An Illustrative Example

- A set of 8 numbers stored in an array and organized in an ascending order

1	3	5	8	9	17	32	50
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- Want to know if “10” is in the data set
- Intuitive method: check one by one sequentially in  $n$  steps
- Smart method: binary search in less than  $\log(n)$  steps.

# What is Data Structure?

- Data structures is concerned with the **representation** and **manipulation** of data.
- **Representation:**
  - We organize data into a specialized structure such that it could be used **efficiently** and **effectively** later on.
- **Manipulation:**
  - Use **algorithms** to manipulate data!



# Why is Data Structure Important?

- Suppose you have to maintain a personal address book which contains 100 records of your friends
  - Each record stores a name and an address.
- What will you do if you want to lookup the record of a particular friend, say James?
- You can go through each record in sequence until the target name is found!
- But what if you maintain an address book of a city ( $\sim 10^6$ )?
- And each record needs to append more information, e.g., Gender, TEL, Job, etc?

# Why is Data Structure Important?

- Real problems occur when your problem size is getting **BIG!**
- You can divide the book into  $10^4$  parts, hiring  $10^4$  employees to do the lookup tasks!
- You can first **sort** the records in its name and gender, and then perform the lookup!
- How to **organize** the data such that it is suitable for **searching**?

# Why is Data Structure Important?

- Data structure is important because it dictates
  - The **types of operations** that can perform on the data
  - How **efficiently** these operations can be carried out
  - How **dynamic** we can be in dealing with the data
    - For example, whether we can add additional data on the fly or if we need to know about all of the data up front
- The way you **organize** the data determines how you solve a problem
- And, the way you solve a problem determines how **efficiently** the problem can be solved

# Why is Data Structure Important?

- Data structures is fundamental to Computer Science.
- Data structures play a key role in other courses:
  - Algorithms, Compilers, Image Processing, Computer Graphics, Blockchain,... etc.



# What Will We Learn?

- Techniques to design and implement large-scale computer programs
- Data abstraction and encapsulation, algorithm specification, performance analysis and measurement
- Basic **data structures** to represent data:
  - Arrays, Stacks, Queues, Linked lists, Trees, and Graphs, ... etc
- Basic **algorithms** to manipulate above data structures:
  - Sorting, String matching, Minimum spanning trees, Matrix multiplication, and Shortest paths, ... etc.