

## EECS 204002

### Data Structures 資料結構

Prof. Ren-Song Tsay

蔡仁松 教授

2019/8/30 Data Structures © Prof. Ren-Song Tsay 1

---

---

---

---

---

---

---

---

## What People Said About Me

- 理論與實務平衡
- “人好但不苟且”有原則
- “點石成金”



2

---

---

---

---

---

---

---

---

## What do you want to be?

- Introduce yourself in 15 seconds
- Your name
- Use a picture to describe what you would like to be in ten years?

2019/8/30 Data Structures © Prof. Ren-Song Tsay 3

---

---

---

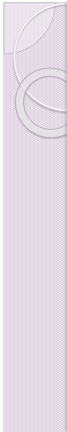
---

---

---

---

---



## 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
- Alternate lecture review and online test
- Course Web Site:
  - Login to [lms.nthu.edu.tw](http://lms.nthu.edu.tw)
- Office Hours:
  - Every Thursday 13:20~15:10
  - Office: 台達館#616

2019/8/30 Data Structures © Prof. Ren-Song Tsay 4

---

---

---

---

---

---

---

---



## 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 9 hours each week off class
- Suggest at least 4-hour preview and preparation time each week.

2019/8/30 Data Structures © Prof. Ren-Song Tsay 5

---

---

---

---

---

---

---

---



## Prerequisite Course

- C and C++ Programming

2019/8/30 Data Structures © Prof. Ren-Song Tsay 6

---

---

---

---

---

---

---

---

## Teaching Assistants Office Hours

- [Check out LMS.](#)

2019/8/30 Data Structures © Prof. Ren-Song Tsay 7

---

---

---

---

---

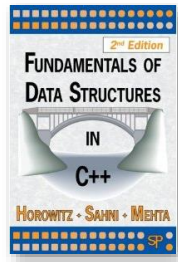
---

---

---

## Textbook

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



2019/8/30 Data Structures © Prof. Ren-Song Tsay 8

---

---

---

---

---

---

---

---

## 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

2019/8/30 Data Structures © Prof. Ren-Song Tsay 9

---

---

---

---

---

---

---

---



## Class Rules

- Be honest
  - Forced out if cheating
- No missing classes
  - Dismissed if miss classes more than two times
  - Fixed seating
- Be on time
  - No late project/homework submission

2019/8/30 Data Structures © Prof. Ren-Song Tsay 10

---

---

---

---

---

---

---

---



## Grading

- In-class exercises: 25%
- Online tests: 25%
- Term Projects: 50% (15+15+20)
  
- For fairness, graduate students will be evaluated in a higher standard.
  
- Final grade may subject to adjustment

2019/8/30 Data Structures © Prof. Ren-Song Tsay 11

---

---

---

---

---

---

---

---



## Tuesday Group Exercises

- The semester is divided into three sessions.
- During each session, we will form groups of 5–6 students.
- Students should review teaching videos before class
- TAs will issue 10 exercises each week.
- In each class, we will randomly pick students to teach the class how to do these exercises.
- Each selected student will be graded for correctness and clarity, and his/her group members receive the same grade.
- All group members are encouraged to help each other.

2019/8/30 Data Structures © Prof. Ren-Song Tsay 12

---

---

---

---

---

---

---

---



### Thursday Online Tests

- Every Thursday, we will have an online test which will cover topics from previous week.

2019/8/30 Data Structures © Prof. Ren-Song Tsay 13

---

---

---

---

---

---

---

---



### Why Study Data Structures?



2019/8/30 Data Structures © Prof. Ren-Song Tsay 14

---

---

---

---

---

---

---

---



### 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

2019/8/30 Data Structures © Prof. Ren-Song Tsay 15

---

---

---

---

---

---

---

---

### 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
---	---	---	---	---	----	----	----

- 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.

2019/8/30 Data Structures © Prof. Ren-Song Tsay 16

---

---

---

---

---

---

---

---

### 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!



2019/8/30 Data Structures © Prof. Ren-Song Tsay 22

---

---

---

---

---

---

---

---

### 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?

2019/8/30 Data Structures © Prof. Ren-Song Tsay 23

---

---

---

---

---

---

---

---



### 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?**

2019/8/30 Data Structures © Prof. Ren-Song Tsay 24

---

---

---

---

---

---

---

---



### 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

2019/8/30 Data Structures © Prof. Ren-Song Tsay 25

---

---

---

---

---

---

---

---



### 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.

2019/8/30 Data Structures © Prof. Ren-Song Tsay 26

---

---

---

---

---

---

---

---



## 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.

2019/8/30 Data Structures © Prof. Ren-Song Tsay 27

---

---

---

---

---

---

---

---