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# ②國玄東華大學

## 教學計劃表 Syllabus

課程名稱(中文) Course Name in Chinese	資料結構			學年/學期 Academic Year/Semester		114/1	
課程名稱(英文) Course Name in English	Data Structures						
科目代碼 Course Code	DS10090	系級 Department & Year	學二	,	開課單位 Course-Offering Department	大數據	[科學國際學士班
修別 Type	學程 Program	學分數/時 Credit(s)/Hou			3	.0/3.0	
授課教師 Instructor	/張紘睿						
先修課程 Prerequisite							

#### 課程描述 Course Description

#### Introduction

A data structure is a way of organizing and storing data so that it can be processed efficiently by a computer program. The CSIEB0100 Data Structures course is therefore about the organization, storage and effective processing of data for computer programs. The objectives of this course can be summarized as follows.

- . Understand the concept of abstract data types(ADT) for data modeling.
- . Study different types of data structures and the algorithms that operate on them.
- . Learn how to choose appropriate data structures and algorithms for problem solving.
- . Learn to evaluate the cost/performance of data structures and algorithms.
- . Learn how to design new data structures and algorithms if necessary.

This is a lecture-oriented course with associated lab course CSIE@0700. It is strongly recommended that you take both courses at the same time. The sample code will be presented in C++. It is therefore a prerequisite of this class to be familiar with the C++ programming language. We will use the free Code::Blocks IDE in class. You may choose any C++ compiler/IDE you like. Regular Topics

The topics to be covered in the lecture are listed as follows (\*\*: topics to be covered depending on the time and progress):

- . Data structures and abstract data types
- . C++ review and algorithms
- . Arrays and strings
- . Stacks and queues
- . Linked lists (single and doubly linked)
- . Trees (basic facts, binary trees, search, heap)
- . Graphs (basic facts, representations, shortest paths, spanning trees)
- . Internal sorting (insertion sort, quick sort, merge sort, heap sort, radix sort)
- . External sorting
- . Hashing and maps (dictionary structures)
- . Priority queues\*\*
- . Efficient search structures\*\*
- . Advanced data structures\*\*

#### 課程目標 Course Objectives

A data structure is a way of organizing and storing data so that it can be processed efficiently by a computer program. The objectives of this course can be summarized as follows.

- ●Understand the concept of abstract data types(ADT) for data modeling.
- •Study different types of data structures and the algorithms that operate on them.
- •Learn how to choose appropriate data structures and algorithms for problem solving.
- Learn to evaluate the benefits, costs and effectiveness of different data structures on a program.
- ●Learn how to design new data structures and algorithms if necessary. This is a lecture-oriented course with associated lab course. It is strongly recommended that you take both courses at the same time.

The sample code will be presented in C++. It is therefore a prerequisite of this class to be familiar with the C++ programming language.

		課程目標與系專業能
		力相關性
	系專業能力	Correlation between
		Course Objectives
	Basic Learning Outcomes	and Dept.'s
		Education
		Objectives
A	具備基本資料科學知識及邏輯推理能力。have well-founded background in data science and	
Λ	logical reasoning,	
	具備機率、統計、資料科學及相關領域的知識與應用能力。have the knowledge of	_
В	probability, statistics, data science and the related fields, and their	•
	applications,	
C	具備資料科學應用技能與團隊合作,解決問題能力。be able to utilize data scientific	
	skills for problem solving through cooperation and teamworking.	

圖示說明Illustration : ● 高度相關 Highly correlated ○中度相關 Moderately correlated

### 授課進度表 Teaching Schedule & Content

週次Week	內容 Subject/Topics	備註Remarks
1	Course Introduction . Course description . Regular topics . Special topic(s) . Syllabus . Textbook and references . Assignments . Exams	
2	Basic Concepts and Abstract Data Types . What are data structures? . Why do we study data structures? . What is an abstract data type(ADT)? . Relationship between data structures and ADTs . Classification of data structures . Algorithms and performance analysis . Complexity and asymptotic notations	
3	00 and C++ Review . Object orientation . Object-oriented programming(00P) . C++ review . C++ templates . Data structures in C++ . 00P with C++	
4	Arrays and strings: . Array ADT . Polynomial ADT . Sparse matrices . String ADT	

	Stacks and queues:	
	. Stack ADT	
5	. Queue ADT	
	. Maze	
	. Expression Evaluation	
	Linked lists:	
	. Singly linked lists	
6	. Circular lists	
	. Doubly linked lists	
	. Lists applications	
	Tree I:	
	. Tree ADT	
7	. Binary trees	
	. Threaded binary trees	
	. Heaps	
	. Binary search trees	
	Tree II:	
	. Selection trees	
8	. Heaps	
	. Binary search trees	
	. Selection trees	
9	期中考試週 Midterm Exam	
	777 T T T T T T T T T T T T T T T T T T	
10	NDHU Sports Day(no classes)	
	Graphs I:	
	. Graph ADT	
	. Graph operations	
	. Graph representation	
11	. Graph implementation	
	. Minimum cost spanning trees	
	. Shortest paths and transitive closure	
	. Graph search	
	Internal Sorting I:	
10	. Internal sorting concept	
12	. Insertion sort	
	. Quick sort	
	. Merge sort	
	Internal Sorting II:	
	. Heap sort	
13	. Radix sort	
	. How fast can we sort?	
	. Applying sorting algorithms (Which algorithm to use? Use	
	multiple algorithms?)	
	External sorting	
14	. External sorting concept	
	. External sort-merge algorithm	
	. External sorting applications	
	Hashing	
15	Associative arrays	
	Hash functions	
	Hash tables and dictionaries	
	Advanced topics: **	
	. Priority queues	
	. AVL trees	
1.0	. Red-black trees	
16	. B-trees, B+-trees	
	. Digital search structures	
	. Data structures for advanced applications: spatiotemporal, big	
	data, streaming, social network analysis,	
17	期末考試週 Final Exam	
1 /		

18	Special topic: data structures and AI (Artificial Intelligence) **  Relationship between DSA(Data Structures and Algorithms) and AIML(Artificial Intelligence and Machine Learning)  Commonly used DSA for AIML  What kind of data structures and algorithms does ChatGPT use?  How AIML can improve DSA
	教學策略 Teaching Strategies
✓ 課堂講	授 Lecture
其他Mis	scellaneous:
	教 學 創 新 自 評 Teaching Self-Evaluation
創新教學(	(Innovative Teaching)
問題導	一向學習(PBL)                                   解決導向學習(SBL)
翻轉教	室 Flipped Classroom
社會責任(	(Social Responsibility)
在地實	選Community Practice
跨域合作(	(Transdisciplinary Projects)
<b>一</b> 跨界教	學Transdisciplinary Teaching      跨院系教學Inter-collegiate Teaching
業師合:	授 Courses Co-taught with Industry Practitioners
其它 othe	er:

學期成績計算及多元評量方式 Grading & Assessments									
配分項目	配分比例		多元評量方式 Assessments						
Items	Percentage	測驗 會考	實作 觀察	口頭 發表	專題 研究	創作 展演	卷宗 評量	證照 檢定	其他
平時成績 General Performance									
期中考成績 Midterm Exam	35%	>							
期末考成績 Final Exam	35%	>							
作業成績 Homework and/or Assignments	30%		<b>~</b>						
其他 Miscellaneous									

評量方式補充說明

Grading & Assessments Supplemental instructions

Grading policy may change if necessary.

### 教科書與參考書目(書名、作者、書局、代理商、説明)

Textbook & Other References (Title, Author, Publisher, Agents, Remarks, etc.)

#### Textbook

Ellis Horowitz, Sartaj Sahni and Dinesh Mehta. Fundamentals of Data Structures in C++, 2nd Edition, Silicon Press, Summit, New Jersey, 2007. (Code: https://inside.mines.edu/~dmehta/FDS\_CPP/) Reference Books

- . Wikibooks. Fundamental Data Structures. The data structure Wikibook.
- . Open Content. Open Data Structures. An open content textbook.
- . Narasimha Karumanchi. Data Structures And Algorithms Made Easy, 5th Edition. CareerMonk Publications, 2017.
- . Clifford A. Shaffer. Data Structures and Algorithm Analysis, Edition 3.2.0.10, March 28, 2013. (Both C++ and Java versions are available on-line with source code.)

### 課程教材網址(含線上教學資訊,教師個人網址請列位於本校內之網址)

Teaching Aids & Teacher's Website(Including online teaching information.

Personal website can be listed here.)

https://elearn4.ndhu.edu.tw/

	其他補充說明	(Supplemental	instructions
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