# CSCI2100C Data Structures
# Course Outline 2021/22

**1. Course code**
CSCI 2100

**2. English title**
Data Structures

**3. Chinese title**
數據結構

**4. Course description**
This course introduces the concept of abstract data types and the advantages of data abstraction. Various commonly used abstract data types including vector, list, stack, queue, tree, and set and their implementations using different data structures (array, pointer based structures, linked list, 2-3 tree, B-tree, etc.) will be discussed. Sample applications such as searching, sorting, etc., will also be used to illustrate the use of data abstraction in computer programming. Analysis of the performance of searching and sorting algorithms. Application of data structure principles.

Not for students who have taken ESTR2102 or CSCI2520;
Pre-requisite: CSCI1110 or 1120 or 1130 or 1510 or 1520 or 1530 or 1540 or ENGG1110 or ESTR1100 or ESTR1102 or ESTR1002 or its equivalent.
For senior-year entrants, the prerequisite will be waived.

**5. Learning outcomes**
1. To be able to implement the following data structures as abstract data types in a high level programming language: stack, queue, hash table, list, binary search tree (including AVL tree, red black tree and splay tree), B-tree, trie, disjoint set, graph (including minimum spanning tree and shortest path);
2. To be able to use appropriate data structures in different applications;
3. To be able to implement abstract data types;
4. To be able to analyse the complexity of simple algorithms (such as searching and sorting).

**Grade Descriptor:**

'A' and 'A-': EXCELLENT – exceptionally good performance and far exceeding expectation in all or most of the course learning outcomes; demonstration of superior understanding of the subject matter, the ability to analyze problems and apply extensive knowledge, and skillful use of concepts and materials to derive proper solutions.

'B+', 'B', and 'B-': GOOD – good performance in all course learning outcomes and exceeding expectation in some of them; demonstration of good understanding of the subject matter and the ability to use proper concepts and materials to solve most of the problems encountered.

'C+', 'C', and 'C-': FAIR – adequate performance and meeting expectation in all course learning outcomes; demonstration of adequate understanding of the subject matter and the ability to solve simple problems.

'D+' and 'D': MARGINAL – performance barely meets the expectation in the essential course learning outcomes; demonstration of partial understanding of the subject matter and the ability to solve simple problems.

'F': FAILURE – performance does not meet the expectation in the essential course learning outcomes; demonstration of serious deficiencies and the need to retake the course.

**6. Course syllabus**

| Topic | Contents/ fundamental concepts |
|---|---|
| Concept of abstract data types and the advantages of data abstraction. | Abstract data types and their implementation in C using header files and function prototypes. |
| Commonly used abstract data types including vector, list, stack, queue, tree, and set and their implementations using different data structures (array, pointer based structures, linked list, 2-3 tree, B-tree, etc.) | Implementation of different data structures (vector, list, stack, queue, tree, set, 2-3 tree, B-tree, etc.) as abstract data types |
| Sample applications such as searching, sorting, etc. to illustrate the use of data abstraction in computer programming. | Common sorting algorithms (e.g., bubble sort, merge sort, quicksort). Binary tree search. |
| Analysis of the performance of searching and sorting algorithms. | Big O notation. |
| Application of data structure principles. | Shortest paths, minimum spanning trees |

**7. Course components (Learning activities)**

Lectures: 3 hours per week
Tutorial: 1 hour per week
Others (homework, course material reviews): 10 hours per week

**8. Assessment type**

| Assessment type | Percentage |
|---|---|
| Assignments | 25% |
| Quizzes | 25% |
| Final examination | 50% |

**9. Required and recommended readings**

**Required readings:**

N/A

**Recommended readings:**

- Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed
  *Fundamentals of Data Structures in C*, 2nd edition
  Silicon Press. 2008.
- Eric S. Roberts
  *Programming Abstractions in C: A Second Course in Computer Science*
  Pearson. 1998.

**10. Feedback for evaluation**

- Examinations
- Course evaluation and questionnaire
- Reflection of teachers
- Question-and-answer sessions during class
- Student consultation during office hours or online

**11. Course schedule**

| Week | Date | Lecture Notes | Remarks |
|---|---|---|---|
| 1 | 11 January 2022 | Introduction. Stacks and Queues | |
| | 13 January 2022 | | |
| 2 | 18 January 2022 | | |
| | 20 January 2022 | | |
| 3 | 25 January 2022 | Tables, Hashing | |
| | 27 January 2022 | | Homework 1 |
| 4 | 1 February 2022 | **Lunar New Year Vacation** | |
| | 3 February 2022 | | |
| 5 | 8 February 2022 | Lists and Recursion | |
| | 10 February 2022 | | |
| 6 | 15 February 2022 | Sorting | |
| | 17 February 2022 | | |
| 7 | 22 February 2022 | **Quiz 1** | |
| | 24 February 2022 | Introduction to Complexity | |
| 8 | 1 March 2022 | Trees | |
| | 3 March 2022 | | Homework 2 |
| 9 | 8March 2022 | | |
| | 10 March 2022 | | |
| 10 | 15 March 2022 | | |
| | 17 March 2022 | | |
| 11 | 22 March 2022 | **Quiz 2** | |
| | 24 March 2022 | Trees | Homework 3 |
| 12 | 29 March 2022 | | |
| | 31 March 2022 | | |
| 13 | 5 April 2022 | **Ching Ming Festival** | |
| | 7 April 2022 | **Reading Week** | |
| 14 | 12 April 2022 | Graphs | |
| | 14 April 2022 | | |
| 15 | 19 April 2022 | | |
| | 21 April 2022 | | Homework 4 |

**12. Contact details for teacher(s) or TA(s)**

| **Professor/Lecturer/Instructor:** | |
|---|---|
| Name: | LEUNG Ho Fung |
| Office Location: | Room 1011, Ho Sin-hang Engineering Building |
| Telephone: | 3943 8428 |
| Email: | lhf@cuhk.edu.hk |
| Teaching Venue: | Sino Building LT2 (Tuesday); Lee Shau Kee Building LT1 (Thursday) |
| Website: | http://www.cse.cuhk.edu.hk/~lhf/ |
| Other information: | |

| **Teaching Assistant/Tutor:** | |
|---|---|
| Name: | LI Muzhi |
| Office Location: | Room 1013, Ho Sin-hang Engineering Building |
| Telephone: | |
| Email: | mzli@cse.cuhk.edu.hk |
| Teaching Venue: | William M W Mong Eng Bldg 803 (Wednesday); Esther Lee Bldg 405 (Thursday) |
| Website: | |
| Other information: | |

| **Teaching Assistant/Tutor:** | |
|---|---|
| Name: | ZHANG Xinyun |
| Office Location: | Room 122, Ho Sin-hang Engineering Building |
| Telephone: | |
| Email: | xyzhang21@cse.cuhk.edu.hk |
| Teaching Venue: | William M W Mong Eng Bldg 803 (Wednesday); Esther Lee Bldg 405 (Thursday) |

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|---|---|
| Website: | |
| Other information: | |

**13. Details of course website**

URL: http://course.cse.cuhk.edu.hk/~csci2100c/

The course website is assessible on the campus network, or from outside via the CUHK VPN.

**14. Academic honesty and plagiarism**

Attention is drawn to University policy and regulations on honesty in academic work, and to the disciplinary guidelines and procedures applicable to breaches of such policy and regulations. Details may be found at http://www.cuhk.edu.hk/policy/academichonesty/.

With each assignment, students will be required to submit a signed declaration that they are aware of these policies, regulations, guidelines and procedures.

- In the case of group projects, all members of the group should be asked to sign the declaration, each of whom is responsible and liable to disciplinary actions, irrespective of whether he/she has signed the declaration and whether he/she has contributed, directly or indirectly, to the problematic contents.
- For assignments in the form of a computer-generated document that is principally text-based and submitted via VeriGuide, the statement, in the form of a receipt, will be issued by the system upon students' uploading of the soft copy of the assignment.

Assignments without the properly signed declaration will not be graded by teachers.

Only the final version of the assignment should be submitted via VeriGuide.

The submission of a piece of work, or a part of a piece of work, for more than one purpose (e.g. to satisfy the requirements in two different courses) without declaration to this effect shall be regarded as having committed undeclared multiple submissions. It is common and acceptable to reuse a turn of phrase or a sentence or two from one's own work; but wholesale reuse is problematic. In any case, agreement from the course teacher(s) concerned should be obtained prior to the submission of the piece of work.