UFUG2602 (L01) - Data Structure and Algorithm Design

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The Hong Kong University of Science and Technology (Guangzhou)

UG Course Syllabus Template

[Course Title] Data Structures and Algorithm Design

[Course Code] UFUG 2602

[No. of Credits] 3

[Any pre-/co-requisites] UFUG 1601

1. **Name and Office Hour of Instructor**

Name: Jia LI

Email: Jialee@hkust-gz.edu.cn

Office Hours: Thursday 10:00 – 11:00 am., W2-605

2. **Lecture (Tutorial) Day, Time, and Venue**

Course Schedule (Jia LI)

Lecture: Tue, Thu 16:30AM - 17:50PM, Rm 149, E1

Lab: Fr 15:00PM - 15:50PM, Rm 102, W4

3. **Course Description**

This course introduces fundamental data structures and algorithms. Data structures include arrays, linked lists, stacks, priority queues, hash tables, trees, and Huffman coding. Algorithms include sorting, hashing, searching, recurrence, greedy methods, and string matching. Techniques for analyzing the performance of algorithms will also be discussed. Students will learn object-oriented implementations of these data structures and algorithms and solve programming problems with learned techniques.

4. **Intended Learning Outcomes (ILOs)**

By the end of this course, students should be able to:

1. Implement basic data structures and algorithms in Python
2. Solve problems using data structures such as lists, matrices, hash tables, and trees.
3. Design algorithms using methods such as greedy, divide and conquer, and backtrack search.
4. Choose and combine suitable data structures and algorithms for a given problem.

5. **Weekly schedule & Weekly ILOs**

Week	**Topics**	**Weekly ILOs**
1	Course intro, ADT and Arrays	ILO1,2,3
2	Asymptotic Complexity and Search	ILO1,2,3
3	Lists, Stacks and Queues	ILO1,2,3
4	Searching and Basic Sorting	ILO1,2,3
5	Recursion	ILO1,2,3
6	Advanced Sorting	ILO1,2,3
7	Hashing	ILO1,2,3
8	Midterm Exam and Trees Basics	ILO1,2,3,4
9	Tree Traversal	ILO1,2,3
10	Binary heaps	ILO1,2,3
11	Dynamic Binary Search Tree	ILO1,2,3
12	Huffman Coding	ILO1,2,3

13	Strings	ILO1,2,3
14	Final Exam	ILO1,2,3,4

6. **Assessment and Grading**

The assessment scheme employed in this course will be based on criterion-referencing, but not based on a

curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for scoring and

evaluation.

6.1 Assessments

Assessment Task	**Contribution to Overall Course grade (%)**	**Due date**
In-class test (Lecture)	10%	Two in-lecture tests*
Mid-Term	30%	3/29/2026 15:00-17:00 Lecture Hall A
Written assignments (programming)	30%	TBD*
Final examination	30%	TBD*

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

6.2 Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Lab Exercises	ILO1, ILO2, ILO3, ILO4	Lab exercises require students can solve real problems by writing programs and conducting analysis. This task evaluates students' understanding of the data structures and algorithms. Students should be able to apply and design data structures and algorithms to solve problems (ILOs 2-3) and choose suitable data structures to solve new problems (ILO 4). Students should be able to implement their solutions correctly and efficiently (ILO 1).
Mid-Term Examination	ILO1, ILO2, ILO3, ILO4	The mid-term exam is a comprehensive evaluation of students' understanding of data structures and algorithms, and their ability to apply data structures or create new ones to solve computational problems (ILOs 2-4). The exam will also include questions about the running process data structures and algorithms to assess their understanding of implementations of different data structures and algorithms (ILO 1).
Written assignments	ILO1, ILO2, ILO3, ILO4	Each student is required to complete a large-scale programming project individually. Students need to have a deep understanding of various data structures and algorithms, apply the methods to analyze the

		performance of the proposed solutions, and design solutions to solve computational problems (ILOs 2-4). In the project, students will be accessed by the correctness and efficiency of their implementations (ILO 1).
Final Examination	ILO1, ILO2, ILO3, ILO4	The final exam is a comprehensive evaluation of students' understanding of data structures and algorithms, and their ability to apply data structures or create new ones to solve computational problems (ILOs 2-4). The exam will also include questions about the running process data structures and algorithms to access their understanding of implementations of different data structures and algorithms (ILO 1).

6.3 Grading Rubrics

This course utilizes an absolute grading system as follows.

A: [100,85]; B: (85,70]; C: (70,55]; D: (55,40]; F: (40,0].

Subgrades (e.g., A-, B+, etc.) will be assigned for every 5 points within these ranges.

Lab Exercises Grading Rubrics

Criteria	Mapped ILOs	Expectation
Application of Algorithms in Programming	ILO 2, ILO 3, ILO 4	Demonstrate a comprehensive understanding of the data structures and have the ability to analyze the complexity of them. Effectively

		apply and combine appropriate data structures in programming task
Correctness and Efficiency of the Implementations	ILO 1	Implement various data structures and algorithms and solve the provided computation problems correctly within a time limit.

Mid-term Examination Grading Rubrics

Criteria	Mapped ILOs	Expectation
Ability to design data structures and algorithms to solve computation problems	ILO 2, ILO 3, ILO 4	Demonstrate a comprehensive understanding of the data structures including the complexity analysis; Be able to explain the differences and advantages/limitations of different algorithms in different situations. Apply and combine appropriate data structures and algorithms to create innovative solutions to new problems with required performance guarantees.
Understanding how to implement the data structures and algorithms	ILO 1	Understand the running process of the data structures and algorithms on running examples and how to implement them correctly and effectively.

Individual Projects (Written assignments) Grading Rubrics

Criteria	Mapped ILOs	Expectation
Application of Algorithms in Programming and problem-solving skills	ILO 2, ILO 3, ILO 4	Demonstrate a comprehensive understanding of the data structures and have the ability to analyze the complexity of them. Effectively apply and combine appropriate data structures to solve complex computational problems in real scenarios.

Correctness and Efficiency of the Implementations	ILO 1	Implement various data structures and algorithms with outstanding skills and solve the provided computational problems correctly with attractable performance.

Final Examination Grading Rubrics

Criteria	Mapped ILOs	Expectation
Ability to design data structures and algorithms to solve computation problems	ILO 2, ILO 3, ILO 4	Demonstrate a comprehensive understanding of the data structures including the complexity analysis; Be able to explain the differences and advantages/limitations of different algorithms in different situations. Apply and combine appropriate data structures and algorithms to create innovative solutions to new problems with required performance guarantees.
Understanding how to implement the data structures and algorithms	ILO 1	Understand the running process of the data structures and algorithms on running examples and how to implement them correctly and effectively.

6.4 Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	The student exhibits a mastery of data structures and algorithms, applying them expertly in lab exercises with insightful analysis. Their understanding of algorithmic complexity is profound, and their programming solutions are both efficient and innovative. Code implementation is top-notch, with a focus on best practices and performance optimization.

B	Good Performance	The student demonstrates a solid understanding of data structures and algorithms, applying them effectively in the lab with mostly accurate analysis. Their comprehension of algorithmic complexity is clear, and programming solutions are generally efficient. The implementation of data structures and algorithms is proficient, with minor issues in documentation or optimization.
C	Satisfactory Performance	Shows a basic understanding of data structures and algorithms, capable of completing lab tasks with some errors in analysis. Their grasp of algorithmic complexity is adequate, and programming solutions are functional but may lack efficiency. Implementation is competent, though with notable inefficiencies or lack of documentation.
D	Marginal Pass	Exhibits a limited understanding of data structures and algorithms, with significant errors in lab analysis and implementation. Their approach to algorithmic complexity is shaky, and programming solutions are inconsistent, often inefficient. Code may be incomplete or contain substantial errors, indicating a need for greater proficiency.
F	Fail	Demonstrates a lack of understanding of data structures and algorithms, with frequent and fundamental errors in lab exercises and written analysis. Their grasp of algorithmic complexity is inadequate, and programming solutions are either incorrect or non-existent. Implementation of data structures and algorithms is ineffective, showing a clear deficiency in skills.

7. **Course AI Policy**

Generative AI can be used to aid you in your learning. However, its use in all the assessment of this course is prohibited, as early reliance on AIGC code will deprive you of the opportunity to lay a solid foundation.

1. In exams, calculators will possibly be allowed. On the other hand, use of any other tool (including, but not limited to, AI tools, internet, mathematical software, etc.) is strictly prohibited.

2. In all the other parts of the course, use of tools is not prohibited.

8. **Communication and Feedback**
9. Assessment marks for individual assessed tasks (for example, homework) will be communicated within two weeks of submission in most cases.
10. Feedback on assignments will include, for instance, strength and weakness, suggestion for further thoughts, and areas for improvement.
11. Students who have further questions about the feedback including marks are expected to contact the instructor or the TA within five working days after the feedback is received.
12. Before the grade is finalized after the final exam, tentative grades will be posted. If a student has any concern regarding the tentative grade, the student is expected to contact the instructor within the time interval posted together with the tentative grades.

9. **Resubmission Policy**

If a student has an unforeseen, uncontrollable, and unavoidable reason, resubmitting work or reassessment

opportunity will be considered. In such a case, the student is expected to contact the instructor immediately,

but no later than within five working days, for further details.

10. **Required Texts and Materials**

The Lecture Notes will be self-contained. For readers interested in exploring additional exercises or topics, we recommend the book "Introduction to Algorithms" by Cormen, Leiserson, Rivest, and Stein.

11. **Academic Integrity**

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST(GZ)'s Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Regulations for Academic Integrity and Student Conduct for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

[Optional] Additional Resources

- **Introduction to Algorithms (https://mitpress.mit.edu/9780262533058/introduction-to-algorithms/)** . Cormen, Leiserson, Rivest, and Stein

- MIT 6.006 - **Introduction to Algorithms (https://ocw.mit.edu/courses/6-006-introduction-to-algorithms-spring-2020)**
- Stanford CS161 - **Design and Analysis of Algorithms (https://stanford-cs161.github.io/winter2024/)**

Course Summary:

Date	Details	Due