COURSE SYLLABUS

1. COURSE TITLE

Data Structures and Algorithm Analysis

2. COURSE CODE

AI2003

3. PRE-REQUISITE

AI1013 Object-Oriented Programming

4. CO-REQUISITE

Nil

5. NO. OF UNITS

3

6. CONTACT HOURS

42

7. MEDIUM OF INSTRUCTION (MOI)

English

8. OFFERING UNIT

Artificial Intelligence Programme, Faculty of Science and Technology

9. SYLLABUS PREPARED & REVIEWED BY

Prepared by Dr. Zhiyuan Li

Reviewed by Prof. Haipeng Guo

10. AIMS & OBJECTIVES

This course aims to develop the students' knowledge in data structures and the associated algorithms. This course introduces the concepts and techniques of structuring and operating on abstract data types, commonly used algorithms, classic techniques to design algorithms, and efficiency of algorithms.

11. COURSE CONTENT

1. Review of Programming

2. Basic abstract data types
    a) Linked list
    b) Queue
    c) Stack

3. Recurrence relation and asymptotic analysis
    a) Time complexity
    b) Upper and lower bounds

4. Dictionary as an abstract data type
    a) Trees
    b) Binary search trees
    c) AVL tree

5. Sorting
    a) Insertion sort
    b) Merge sort
    c) Quick sort
    d) Heap sort

6. Graphs algorithms
    a) Searching
    b) Shortest path
    c) Minimum spanning tree

7. Algorithm design strategies
    a) Greedy algorithms
    b) Divide-and-conquer algorithms
    c) Dynamic Programming

12. COURSE INTENDED LEARNING OUTCOMES (CILOS) WITH MATCHING TO PILOS

Programme Intended Learning Outcomes (PILOs)

Programme Title: Bachelor of Science (Honours) in Artificial Intelligence	
PILO	**Upon successful completion of the Programme, students should be able to:**
PILO 1	Articulate and explain the principles, concepts and theories required across the field of artificial intelligence.
PILO 2	Develop appropriate artificial intelligence algorithms and systems, and enhance performance of them through comparisons and refinements of alternative approaches.
PILO 3	Identify problems solvable by artificial intelligence in real world applications and develop solutions using appropriate technology and systematic tools.
PILO 4	Collaborate and work effectively in teams using different communication formats in the context of AI technology.
PILO 5	Investigate contemporary issues in the field of artificial intelligence, and develop life-long effective learning skills.

CILOs-PILOs Mapping Matrix

Course Code & Title: AI2003 Data Structures and Algorithm Analysis		
CILO	**Upon successful completion, students should be able to:**	**PILO(s) Addressed**
CILO 1	**Describe** abstract data types and computational problem solving techniques;	PILO 1
CILO 2	**Design** efficient algorithms to solve real-world problems;	PILO 1, 3
CILO 3	**Implement** data types and algorithms in Programmes; and	PILO 2
CILO 4	**Evaluate** the efficiency of algorithms.	PILO 1

13. TEACHING & LEARNING ACTIVITIES (TLAS)

CILO No.	**TLAs**
CILO 1,2, 4	● **Lecture**: The instructor will explain the course material in detail. ● **Written Exercises**: Each student is given exercises to improve their understanding the principles of problem solving. ● **Online Discussion**: The instructor will setup an online discussion space

CILO No.	TLAs
	to interact with students ubiquitously.
CILO 3	● **Hands-on practice**: The instructor will arrange tutorials in the computer lab where each student can use and implement the data structures and algorithms introduced in the lectures. ● **Programming Exercises:** Each student is required to independently apply the data structures in algorithm implementations. ● **Online judge:** The instructor will setup an online judge system or select some problems from existing online judge systems. The students can further improve their algorithm design skills and implementation skills using the online system.

14. ASSESSMENT METHODS (AMS)

Type of Assessment Methods	Weighting	CILOs Addressed	Description of Assessment Tasks
Written Assignments	15%	1,2,4	Written assignments measure the students' understanding of the theory.
Programming Assignments	35%	3	Programming assignments measure the students' ability to solve practical problems.
In-class Exercise	10%	1,2,4	In-class Exercise assesses the major learning outcomes achieved by the students till half of the semester.
Final Examination	40%	1,2,4	This final examination aims to assess the major learning outcomes achieved by students upon completion of the course.

15. TEXTBOOKS / RECOMMENDED READINGS

Textbook:

Mark Allen Weiss. Data Structures and Algorithm Analysis in C++. Addison-Wesley, 2007.

Recommended Readings:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein. Introduction Algorithms (3rd Edition). The MIT Press, 2009.
2. Alfred V. Aho, John E. Hopcroft, and Jeffrey D. Ullman. The Design and Analysis of Computer Algorithms. Addison-Wesley, 1974.
3. Alfred V. Aho, John E. Hopcroft, and Jeffrey D. Ullman. Data Structures and Algorithms. Addison-Wesley, 1983.
4. Sara Baase. Computer Algorithms: Introduction to Design and Analysis. Second edition. Addison-Wesley, 1988.
5. Jon Bentley. Programming Pearls. Addison-Wesley, 1986.
6. Jon Bentley. More Programming Pearls. Addison-Wesley, 1988.
7. Jon Louis Bentley. Writing Efficient Programmes. Prentice-Hall, 1982.
8. Gilles Brassard and Paul Bratley. Algorithmics: Theory and Practice. Prentice-Hall, 1988.
9. Kai Lai Chung. Elementary Probability Theory with Stochastic Processes. Springer-Verlag, 1974.
10. Shimon Even.Graph Algorithms.Computer Science Press, 1979.
11. Dan Gusfield.Algorithms on Strings, Trees, and Sequences. Cambridge University Press, 1997.

Revised on: September 5, 2024