DATA STRUCTURES & ALGORITHMS
Course Syllabus

1. General Information

Course name: Data Structures & Algorithms

Course code: INT1306_CLC

Number of credits: 3

2. Objectives

Knowledge:

The aim of this course is to provide learners the important knowledge of algorithms and data structures, including:

- Knowledge of algorithm analysis, design and evaluation.
- Knowledge of traditional algorithmic models.
- Knowledge of abstract data structures.

Skills:

The aim of this course is to equip learners in solving specific problems of computer science with skills in:

- Proficiency in selecting and implementing appropriate data structures for object representation.
- Apply traditional algorithmic models on the selected data structures to solve specific problems of computer science.
- Enhance analytical thinking, algorithm design, and evaluation skills based on theory of complexity analysis of algorithms.

Attitude:

Learners are required to attend the classes and complete assignments/projects.

3. Abstracts

This course introduces students to the basic knowledge of algorithms and data structures. For each algorithm, the course provides learners with knowledge of representation, complexity evaluation, implementation, evaluation and applications. For each data structure, the course provides learners with concepts, definitions, representations, operations, implementation and applications. Learners can use the knowledge learned in solving specific problems of computer science.

4. Teaching and learning methods

Lectures: 30h

Exercises: 08h

Projects: 0h

Lab: 06h
Individual reading: 01h

5. **Prerequisites**:

6. **Learning outcomes**

After studying this course, the learner could:

[LO1]: Understand the general concepts of data structures and algorithms. Enhance analytical thinking and evaluation skills based on theory of complexity analysis of algorithms.

[LO2]: Understand and implement traditional algorithmic models (Sorting and searching techniques, algorithm design techniques) to solve specific problems of computer science.

[LO3]: Proficiency in selecting and implementing appropriate data structures for object representation.

7. Assignment criteria

Learning outcomes	Assignment criteria
[LO1]: Understand the general concepts of data structures and algorithms. Enhance analytical thinking and evaluation skills based on theory of complexity analysis of algorithms.	- General concepts of data structures and algorithms - Complexity analysis of algorithms
[LO2]: Understand and implement traditional algorithmic models (Sorting and searching techniques, algorithm design techniques) to solve specific problems of computer science.	- Sorting and searching techniques - Algorithm design techniques
[LO3]: Proficiency in selecting and implementing appropriate data structures for object representation.	- Abstract data structures

8. Outlines

Chapter 1. Introduction to data structures and algorithms

1.1. Introduction to data structures
- 1.1.1. Data structure definition
- 1.1.2. Classification of data structures
- 1.1.3. Application of data structures

1.2. Introduction to algorithms
- 1.2.1. Algorithm definition
- 1.2.2. Algorithm specification
- 1.2.3. Algorithm representation
  - 1.2.3.1. Using a natural language

4.5.6.1. Dijkstra algorithm
4.5.6.2. Bellman-Ford algorithm
4.5.6.3. Floyd-Warshall algorithm
4.5.7. Minimum spanning tree
4.5.7.1. Kruskal algorithm
4.5.7.2. Prim algorithm
4.5.7.3. Boruvka algorithm
4.5.8. Graph applications
4.6. Summarization of chapter 4

9. Required Textbooks

[1]. M. Main, W. Savitch, Data Structures and Other Objects Using C++, 4th Edition, 2010.

[2]. Donald E. Knuth, The Art of Programming, Vol 1, 2, 3, 4, the 4th Edition, Addison-Wesley Publishing Company, 2005.

10. Suggested Textbooks

[1]. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, 3rd Edition, the MIT Press, 2009.

[2]. Bradley N. Miller, Problem Solving with Algorithms and Data Structures Using Python, 2nd Edition, 2011

11. Schedule

Main contents	Duration	Specific contents
Chapter 1. Introduction to data structures and algorithms	4h lecture	1.1. Introduction to data structures 1.2. Introduction to algorithms 1.3. Summarization of chapter 1
Chapter 2. Sorting and searching techniques	4h lecture 2h exercise 2h lab	2.1. Sorting techniques 2.2. Searching techniques 2.3. Summarization of chapter 2
Chapter 3. Algorithm design techniques	12h lecture 3h exercise 2h lab	3.1. Next generation algorithm 3.2. Recursion algorithm 3.3. Back-track algorithm 3.4. Branch and bound algorithm 3.5. Greedy algorithm 3.6. Divide and conquer algorithm 3.7. Dynamic programming algorithm 3.8. Summarization of chapter 3
Chapter 4. Abstract data structures	10h lecture 3h exercise 2h lab	4.1. Linked list data structure 4.2. Stack data structure 4.3. Queue data structure

		4.4. Binary tree data structure 4.5. Graph data structure 4.6. Summarization of chapter 4

12. Grading Policy

Attendance:	10%
Exercises:	20%
Mid-term projects/exams:	20%
Final examination:	50%