	Universitas Negeri Surabaya Faculty of Engineering, Undergraduate Study Program in Informatics Engineering	Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Data Structures	5520204095	Compulsory Study Program Subjects	T=4	P=0	ECTS=6.36	2	July 17, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	.....	.....	Aditya Prapanca, S.T., M.Kom.

Learning model: Project Based Learning

Program Learning Outcomes (PLO)

PLO study program that is charged to the course

PLO-5	Able to communicate the results of studies on the implications of developing or implementing information technology science (SKI-02)
PLO-8	Able to implement computing needs by considering various appropriate methods/algorithms (COM-03)

Program Objectives (PO)

PO - 1	Students have the ability to solve problems into an algorithm (steps) that will be executed by a computer, then implement it into a computer program
PO - 2	Students have the ability to solve programming problems that must be solved using material in advanced programming such as pointers, structs, etc.
PO - 3	Students have the ability to implement data used in programming (either input data or output data) with the right data structure
PO - 4	Students have the knowledge to compare various algorithms in the sorting and searching process and can determine the algorithm used in the programming problem they solve.

PLO-PO Matrix

P.O	PLO-5	PLO-8
PO-1		
PO-2		
PO-3		
PO-4		

PO Matrix at the end of each learning stage (Sub-PO)

P.O	Week															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PO-1																
PO-2																
PO-3																
PO-4																

Short Course Description: Advanced programming material such as pointers, structs, etc. Apart from that, there are also several data structures used in programming, both static and dynamic. And also algorithms in the sorting process and search process. Lectures contain theory, where programming assignments will be given.

References

Main :

1. Ekohariadi, Anita Qoiriah, Pemrograman Dasar Komputer, Unipress, , 2007
2. Malik, D.S., C++ Programming: From Problem Analysis to Program Design, Fifth Edition, Course Technology, Cengage Learning, 2011
3. Malik,D.S., Data Structures Using C++, Second Edition, Course Technology, Cengage Learning, 2010
4. Shaffer, Clifford A. A, Practical Introduction to Data Structures and Algorithm Analysis Edition 3.1 (C++ Version), Prentice Hall International Inc, 2011
5. Yatini B, Indra, Erliansyah Nasution, Algortima dan Struktur Data dengan C++, Graha Ilmu, 2005
6. Zakaria, Teddy Marcus, Agus Prijono. Konsep dan Implementasi Struktur Data, Informatika Bandung, 2006

Supporters:

Supporting lecturer	Anita Qoiriah, S.Kom., M.Kom. Dr. Ricky Eka Putra, S.Kom., M.Kom.

Week-	Final abilities of each learning stage (Sub-PO)	Evaluation		Help Learning, Learning methods, Student Assignments, [Estimated time]		Learning materials [References]	Assessment Weight (%)
		Indicator	Criteria & Form	Offline (*offline*)	Online (*online*)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Understand the concepts of arrays, pointers and structures	1.Explain the concept of one and two dimensional arrays 2.Explain the concept of pointers 3.Explain the difference between memory allocation in arrays and pointers 4.Explain the concept of structure 5.Create programs with structure and array declarations on structure data types	**Criteria:** Students respond to the lecture material, each response is worth 5 **Form of Assessment** : Participatory Activities	Approach: Scientific Model: Cooperative Method: Discussion, Presentation and 4 X 50 practicum		**Material:** Arrays **Bibliography:** *Ekohariadi, Anita Qoiriah, Basic Computer Programming, Unipress, , 2007*	2%
2	Understand the concept of single linked list	1. Explain the Single Linked List declaration2. Explain how to search in a Linked List3. Explain the operation of inserting nodes in a single Linked List (at the beginning, at the end, in the middle) 4. Explain the node deletion operation in a single Linked List (at the beginning, in the middle, at the end) 5. Implementing a single linked list in a case	**Criteria:** Students respond to the lecture material, each response is worth 5 **Form of Assessment** : Participatory Activities	Approach: Scientific Model: Cooperative Method: Discussion, Presentation and 4 X 50 practicum		**Material:** linkedlist **Bibliography:** *Malik, DS, Data Structures Using C, Second Edition, Course Technology, Cengage Learning, 2010* **Material:** linkedlist **Bibliography:** *Shaffer, Clifford A. A, Practical Introduction to Data Structures and Algorithm Analysis Edition 3.1 (C Version), Prentice Hall International Inc, 2011* **Material:** linkedlist **Bibliography:** *Yatini B, Indra, Erliansyah Nasution, Algorithms and Data Structures with C, Graha Ilmu, 2005* **Material:** linkedlist **Bibliography:** *Zakaria, Teddy Marcus, Agus Prijono. Concept and Implementation of Data Structures, Informatics Bandung, 2006*	2%

3	Understand the concept of single linked list	1. Explain the Single Linked List declaration2. Explain how to search in a Linked List3. Explain the operation of inserting nodes in a single Linked List (at the beginning, at the end, in the middle) 4. Explain the node deletion operation in a single Linked List (at the beginning, in the middle, at the end) 5. Implementing a single linked list in a case	**Criteria:** Implementation of correct methods 50, programs without errors 20, running correctly 30 **Form of Assessment** : Practical Assessment	Approach: Scientific Model: Cooperative Method: Discussion, Presentation and practicum 84X 50		**Material:** linkedlist **Bibliography:** *Malik, DS, Data Structures Using C, Second Edition, Course Technology, Cengage Learning, 2010* **Material:** linkedlist **Bibliography:** *Shaffer, Clifford A. A, Practical Introduction to Data Structures and Algorithm Analysis Edition 3.1 (C Version), Prentice Hall International Inc, 2011* **Material:** linkedlist **Bibliography:** *Yatini B, Indra, Erliansyah Nasution, Algorithms and Data Structures with C, Graha Ilmu, 2005* **Material:** linkedlist **Bibliography:** *Zakaria, Teddy Marcus, Agus Prijono. Concept and Implementation of Data Structures, Informatics Bandung, 2006*	2%

4	Understand the concept of double linked lists	1. Explain the double Linked List declaration2. Explain how to search in a double Linked List3. Explain the operation of inserting nodes in a double Linked List (at the beginning, at the end, in the middle) 4. Explain the node deletion operation in a double Linked List (at the beginning, in the middle, at the end) 5. Implementing a double linked list in a case	**Criteria:** Implementation of correct methods 50, programs without errors 20, running correctly 30 **Form of Assessment** : Practical Assessment	Approach: Scientific Model: Cooperative Method: Discussion, Presentation and practicum 4X 50		**Material:** linkedlist **Bibliography:** *Malik, DS, Data Structures Using C, Second Edition, Course Technology, Cengage Learning, 2010* **Material:** linkedlist **Bibliography:** *Shaffer, Clifford A. A, Practical Introduction to Data Structures and Algorithm Analysis Edition 3.1 (C Version), Prentice Hall International Inc, 2011* **Material:** linkedlist **Bibliography:** *Yatini B, Indra, Erliansyah Nasution, Algorithms and Data Structures with C, Graha Ilmu, 2005* **Material:** linkedlist **Bibliography:** *Zakaria, Teddy Marcus, Agus Prijono. Concept and Implementation of Data Structures, Informatics Bandung, 2006*	3%

5	Understand the concept of double linked lists	1. Explain the double Linked List declaration2. Explain how to search in a double Linked List3. Explain the operation of inserting nodes in a double Linked List (at the beginning, at the end, in the middle) 4. Explain the node deletion operation in a double Linked List (at the beginning, in the middle, at the end) 5. Implementing a double linked list in a case	**Criteria:** Implementation of correct methods 50, programs without errors 20, running correctly 30 **Forms of Assessment** : Project Results Assessment / Product Assessment, Practical Assessment	Approach: Scientific Model: Cooperative Method: Discussion, Presentation and practicum 4 X 50		**Material:** linkedlist **Bibliography:** *Malik, DS, Data Structures Using C, Second Edition, Course Technology, Cengage Learning, 2010* **Material:** linkedlist **Bibliography:** *Shaffer, Clifford A. A, Practical Introduction to Data Structures and Algorithm Analysis Edition 3.1 (C Version), Prentice Hall International Inc, 2011* **Material:** linkedlist **Bibliography:** *Yatini B, Indra, Erliansyah Nasution, Algorithms and Data Structures with C, Graha Ilmu, 2005* **Material:** linkedlist **Bibliography:** *Zakaria, Teddy Marcus, Agus Prijono. Concept and Implementation of Data Structures, Informatics Bandung, 2006*	10%

6	Understand the stack concept	1. Represent Stack with array2. Explain Stack Operations (Push, Pop, empty, isfull etc.)3. Representing a Stack with a Single Linked List4. Representing a Stack with a Double Linked List Implementing a stack in several cases	**Criteria:** Students respond to the lecture material, each response is worth 5 **Form of Assessment** : Participatory Activities, Practical Assessment	Approach: Scientific Model: Cooperative Method: Discussion, Presentation, Assignment and practicum exercises 4 X 50		**Material:** stack **Reference:** *Malik, DS, Data Structures Using C, Second Edition, Course Technology, Cengage Learning, 2010* **Material:** stack **References:** *Shaffer, Clifford A. A, Practical Introduction to Data Structures and Algorithm Analysis Edition 3.1 (C Version), Prentice Hall International Inc, 2011* **Material:** stack **Bibliography:** *Yatini B, Indra, Erliansyah Nasution, Algorithms and Data Structures with C, Graha Ilmu, 2005* **Material:** stack **Readers:** *Zakaria, Teddy Marcus, Agus Prijono. Concept and Implementation of Data Structures, Informatics Bandung, 2006*	2%

7	Understand the concept of queue	1. Represent the queue with an array2. Explain queue operations (enqueue, dequeue, is empty, is full, etc.)3. Representing a queue with a Single Linked List4. Representing a queue with a Double Linked List Implementing a queue in several cases	**Criteria:** Implementation of correct methods 50, programs without errors 20, running correctly 30 **Form of Assessment** : Practical Assessment	Approach: Scientific Model: Cooperative Method: Discussion, Presentation, Assignment and practicum exercises 4 X 50		**Material:** queue **Reference:** *Malik, DS, Data Structures Using C, Second Edition, Course Technology, Cengage Learning, 2010* **Material:** queue **References:** *Shaffer, Clifford A. A, Practical Introduction to Data Structures and Algorithm Analysis Edition 3.1 (C Version), Prentice Hall International Inc, 2011* **Material:** queue **Bibliography:** *Yatini B, Indra, Erliansyah Nasution, Algorithms and Data Structures with C, Graha Ilmu, 2005* **Material:** queue **Readers:** *Zakaria, Teddy Marcus, Agus Prijono. Concept and Implementation of Data Structures, Informatics Bandung, 2006*	3%
8	Can understand and apply data structures and operations	Can apply data structures and operations to a problem	**Criteria:** uts value = (project theory test)/2 **Form of Assessment** : Project Results Assessment / Product Assessment, Test	Written test and practical 4 x 50 minutes		**Material:** Array, linkedlist, queue, stack, struct, pointer **Reference:** *Malik, DS, Data Structures Using C, Second Edition, Course Technology, Cengage Learning, 2010* **Material:** Array, linkedlist, queue, stack, struct, pointer **Reference:** *Shaffer, Clifford A. A, Practical Introduction to Data Structures and Algorithm Analysis Edition 3.1 (C Version), Prentice Hall International Inc, 2011*	20%

9	Understand the concept of recursion functions and their implementation	1. Explain the basic concept of recursion 2. Implementing recursion in some cases	**Criteria:** Students respond to the lecture material, each response is worth 5 **Form of Assessment** : Participatory Activities	Approach: Scientific Model: Cooperative Method: Discussion, presentation, Presentation/Assignment and practicum 4 X 50		**Material:** recursive **References:** *Malik, DS, Data Structures Using C, Second Edition, Course Technology, Cengage Learning, 2010* **Material:** recursive **References:** *Shaffer, Clifford A. A, Practical Introduction to Data Structures and Algorithm Analysis Edition 3.1 (C Version), Prentice Hall International Inc, 2011*	2%
10	Understand various methods in sequencing and their implementation	. Explaining the Insertion Method2. Explain the Selection Method3. Explaining the Bubble Method4. Explaining Shell Method5. Explaining the Quick6 Method. Explain the Merge Method7. Examples of simple cases that require sorting to solve, create algorithms and flow charts8. Implementing with C language	**Criteria:** Implementation of correct methods 50, programs without errors 20, running correctly 30 **Form of Assessment** : Practical Assessment	Approach: Scientific Model: Cooperative Method: Discussion, Presentation/Assignment and practicum 8 X 50		**Material:** sorting **Bibliography:** *Malik, DS, Data Structures Using C, Second Edition, Course Technology, Cengage Learning, 2010* **Material:** sorting **Bibliography:** *Shaffer, Clifford A. A, Practical Introduction to Data Structures and Algorithm Analysis Edition 3.1 (C Version), Prentice Hall International Inc, 2011*	2%
11	Understand various methods in sequencing and their implementation	. Explaining the Insertion Method2. Explain the Selection Method3. Explaining the Bubble Method4. Explaining Shell Method5. Explaining the Quick6 Method. Explain the Merge Method7. Examples of simple cases that require sorting to solve, create algorithms and flow charts8. Implementing with C language	**Criteria:** Implementation of correct methods 50, programs without errors 20, running correctly 30 **Form of Assessment** : Practical Assessment	Approach: Scientific Model: Cooperative Method: Discussion, Presentation/Assignment and practicum 4 X 50		**Material:** sorting **Bibliography:** *Malik, DS, Data Structures Using C, Second Edition, Course Technology, Cengage Learning, 2010* **Material:** sorting **Bibliography:** *Shaffer, Clifford A. A, Practical Introduction to Data Structures and Algorithm Analysis Edition 3.1 (C Version), Prentice Hall International Inc, 2011*	2%

12	Understand the concept of searching and its implementation	1. Explain searching using the sequential method2. Explaining Search using the binary method3. Comparing the performance of sequential with binary search4. Implement search methods for simple cases that require an understanding of searching to solve them	**Criteria:** Implementation of correct methods 50, programs without errors 20, running correctly 30 **Form of Assessment** : Project Results Assessment / Product Assessment	Approach: Scientific Model: Cooperative Method: Discussion, Presentation/Assignment and practicum 4 x 50 minutes		**Material:** searching **References:** *Malik, DS, Data Structures Using C, Second Edition, Course Technology, Cengage Learning, 2010* **Material:** searching **References:** *Shaffer, Clifford A. A, Practical Introduction to Data Structures and Algorithm Analysis Edition 3.1 (C Version), Prentice Hall International Inc, 2011*	10%
13	Understand the concept of trees and problems that use tree implementations to solve them	1. Explaining the concept of a tree 2. Explaining the introduction of terms in a tree 3. Explaining forming a binary tree 4. Explaining visits to a tree in preorder, inorder, or postorder 5. Representing a tree with a linked list Explaining the implementation of polish notation using a tree	**Criteria:** Students respond to the lecture material, each response is worth 5 **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Practical Assessment	Approach: Scientific Model: Cooperative Method: Discussion, Presentation/Assignment and practicum 4 X 50		**Material:** tree **Reference:** *Malik, DS, Data Structures Using C, Second Edition, Course Technology, Cengage Learning, 2010* **Material:** tree **Bibliography:** *Shaffer, Clifford A. A, Practical Introduction to Data Structures and Algorithm Analysis Edition 3.1 (C Version), Prentice Hall International Inc, 2011*	2%
14	Understand graph concepts and graph implementation in path finding algorithms	1. Explain the concept of graphs 2. Explain types of graphs: directed and undirected graphs 3. Represent graphs with arrays 4. Represent with linked lists 5. Explain the application of graphs in implementing directed and undirected path finding algorithms	**Criteria:** Students respond to the lecture material, each response is worth 5 **Form of Assessment** : Participatory Activities	Approach: Scientific Model: Cooperative Method: Discussion, Presentation/Assignment and practicum 4 X 50		**Material:** graph **Reference:** *Malik, DS, Data Structures Using C, Second Edition, Course Technology, Cengage Learning, 2010* **Material:** graph **Reference:** *Shaffer, Clifford A. A, Practical Introduction to Data Structures and Algorithm Analysis Edition 3.1 (C Version), Prentice Hall International Inc, 2011*	2%

15	Understand graph concepts and graph implementation in path finding algorithms	1. Explain the concept of graphs 2. Explain types of graphs: directed and undirected graphs 3. Represent graphs with arrays 4. Represent with linked lists 5. Explain the application of graphs in implementing directed and undirected path finding algorithms	**Criteria:** Implementation of correct methods 50, programs without errors 20, running correctly 30 **Form of Assessment** : Project Results Assessment / Product Assessment	Approach: Scientific Model: Cooperative Method: Discussion, Presentation/Assignment and practicum 4 X 50		**Material:** graph **Reference:** *Malik, DS, Data Structures Using C, Second Edition, Course Technology, Cengage Learning, 2010* **Material:** graph **Reference:** *Shaffer, Clifford A. A, Practical Introduction to Data Structures and Algorithm Analysis Edition 3.1 (C Version), Prentice Hall International Inc, 2011*	15%

16	Students are able to understand and apply data structures and operations	Can apply data structures and operations to a problem	**Criteria:** final score = (project theory test)/2 **Form of Assessment** : Project Results Assessment / Product Assessment, Test	Final exam		**Material:** Arrays **Bibliography:** *Ekohariadi, Anita Qoiriah, Basic Computer Programming, Unipress, , 2007* **Material:** Array, linkedlist, queue, stack, struct, pointer **References:** *Malik, DS, C Programming: From Problem Analysis to Program Design, Fifth Edition, Course Technology, Cengage Learning, 2011* **Material:** Array, linkedlist, queue, stack, struct, pointer **Reference:** *Yatini B, Indra, Erliansyah Nasution, Algorithms and Data Structures with C, Graha Ilmu, 2005* **Material:** Array, linkedlist, queue, stack, struct, pointer **Reader:** *Zakaria, Teddy Marcus, Agus Prijono. Concept and Implementation of Data Structures, Informatics Bandung, 2006* **Material:** Array, linkedlist, queue, stack, struct, pointer, recursive, graph, tree **Reference:** *Malik, DS, Data Structures Using C, Second Edition, Course Technology, Cengage Learning, 2010* **Material:** Array, linkedlist, queue, stack, struct, pointer, tree, graph, recursive **Reference:** *Shaffer, Clifford A. A, Practical Introduction to Data Structures and Algorithm Analysis Edition 3.1 (C Version), Prentice Hall International Inc, 2011*	20%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	9.67%
2.	Project Results Assessment / Product Assessment	50.67%
3.	Practical Assessment	18.67%
4.	Test	20%
		99.01%

Notes

1. **Learning Outcomes of Study Program Graduates (PLO - Study Program)** are the abilities possessed by each Study Program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the level of their study program obtained through the learning process.
2. **The PLO imposed on courses** are several learning outcomes of study program graduates (CPL-Study Program) which are used for the formation/development of a course consisting of aspects of attitude, general skills, special skills and knowledge.
3. **Program Objectives (PO)** are abilities that are specifically described from the PLO assigned to a course, and are specific to the study material or learning materials for that course.
4. **Subject Sub-PO (Sub-PO)** is a capability that is specifically described from the PO that can be measured or observed and is the final ability that is planned at each learning stage, and is specific to the learning material of the course.
5. **Indicators for assessing** ability in the process and student learning outcomes are specific and measurable statements that identify the ability or performance of student learning outcomes accompanied by evidence.
6. **Assessment Criteria** are benchmarks used as a measure or measure of learning achievement in assessments based on predetermined indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
7. **Forms of assessment:** test and non-test.
8. **Forms of learning:** Lecture, Response, Tutorial, Seminar or equivalent, Practicum, Studio Practice, Workshop Practice, Field Practice, Research, Community Service and/or other equivalent forms of learning.
9. **Learning Methods:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, and other equivalent methods.
10. **Learning materials** are details or descriptions of study materials which can be presented in the form of several main points and sub-topics.
11. **The assessment weight** is the percentage of assessment of each sub-PO achievement whose size is proportional to the level of difficulty of achieving that sub-PO, and the total is 100%.
12. TM=Face to face, PT=Structured assignments, BM=Independent study.