	Universitas Negeri Surabaya Faculty of Mathematics and Natural Sciences Data Science Undergraduate Study Program	Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Data Structures and Algorithms	4920203009	Compulsory Study Program Subjects	T=3	P=0	ECTS=4.77	2	January 22, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
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Learning model	**Project Based Learning**	
Program Learning Outcomes (PLO)	**PLO study program which is charged to the course**	
	PLO-8	Work together and have social sensitivity and bring change to the environment
	PLO-9	Able to apply data science principles to solve problems
	PLO-16	Mastering data science theories and concepts
	Program Objectives (PO)	
	PO - 1	Work together and have social sensitivity and bring change to the environment using data science knowledge
	PO - 2	Able to apply logical, critical, systematic and innovative thinking in designing, implementing and evaluating science and technology that pays attention to and applies humanities values in the field of data science
	PO - 3	Able to design and develop algorithms for various computing needs
	PO - 4	Identify and analyze user needs and consider them in selecting, creating, integrating, evaluating, and administering algorithms and computer program code
	PO - 5	Master the theoretical concepts of data structures and algorithms in depth, and be able to formulate solutions to procedural problems related to data science
	PLO-PO Matrix	

P.O	PLO-8	PLO-9	PLO-16
PO-1			
PO-2			
PO-3			
PO-4			
PO-5			

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																
PO-5																

Short Course Description	This course is a project-based course that studies basic techniques for abstracting data, creating algorithms that can access that data, and manipulating the abstract structure. In this course, space and time complexity analysis will also be introduced in implementing an algorithm. Topics covered include: abstract data type concepts, linear data models (array and dynamic list, stack and queue), sets, hierarchical data models (binary tree, heap, binary search tree, AVL-tree, B-Tree), graph data structure model, tracking algorithm. Students will create group projects to apply data structure theories and concepts to problems in the field of Data Science.

References	**Main :**	
	1. Kenneth Lambert. 2018. Fundamentals of Python: Data Structures (2nd. ed.). Cengage Learning. 2. Benjamin Baka. 2017. Python Data Structures and Algorithms (1st ed.). Packt Publishing. 3. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser. 2013. Data Structures and Algorithms in Python (1st. ed.). Wiley Publishing.	
	Supporters:	
	1. Jay Wengrow. 2020. A Common-Sense Guide to Data Structures and Algorithms: Level Up Your Core Programming Skills. The Pragmatic Programmer.	
Supporting lecturer	Dr. Atik Wintarti, M.Kom. Dr. Elly Matul Imah, M.Kom. Riskyana Dewi Intan Puspitasari, M.Kom. Fadhilah Qalbi Annisa, S.T., M.Sc.	

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	Get to know data types with static allocation	1. Explain the concept of memory, Array, Struct 2. Using the concept of static data types for stateful programming	**Form of Assessment** : Participatory Activities	Lecture; Discussion; Simple problem analysis; 3x50 minutes		**Material:** Why Data Structures Matter; Why Algorithms Matter; **Reader:** *Jay Wengrow. 2020. A Common-Sense Guide to Data Structures and Algorithms: Level Up Your Core Programming Skills. The Pragmatic Programmer.* **Material:** Array-Based Sequence **Bibliography:** *Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser. 2013. Data Structures and Algorithms in Python (1st. ed.). Wiley Publishing.* **Material:** Python Data Types and Structures **Reader:** *Benjamin Baka. 2017. Python Data Structures and Algorithms (1st ed.). Packt Publishing.*	2%

2	Get to know data types with dynamic allocation	Explain the concept of Linked List, Double Linked list, Circular Linked List	**Form of Assessment** : Participatory Activities	Lecture; Discussion; Simple problem analysis; 3x50 minutes		**Material:** Linked Lists **Bibliography:** *Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser. 2013. Data Structures and Algorithms in Python (1st. ed.). Wiley Publishing.* **Material:** Arrays and Linked Structures **Reader:** *Kenneth Lambert. 2018. Fundamentals of Python: Data Structures (2nd. ed.). Cengage Learning.* **Material:** Lists and Pointer Structures **Reader:** *Benjamin Baka. 2017. Python Data Structures and Algorithms (1st ed.). Packt Publishing.*	2%

3	Get to know data types with dynamic allocation	1. Explain the concept of Stack and Queue 2. Using the concept of type	**Form of Assessment** : Participatory Activities	Lecture; Discussion; Simple problem analysis; 3x50 minutes		**Material:** Stacks, Quesues, and Deques **Bibliography:** *Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser. 2013. Data Structures and Algorithms in Python (1st. ed.). Wiley Publishing.* **Material:** Stacks; Queues; **Bibliography:** *Kenneth Lambert. 2018. Fundamentals of Python: Data Structures (2nd. ed.). Cengage Learning.* **Material:** Stacks and Queues **Reader:** *Benjamin Baka. 2017. Python Data Structures and Algorithms (1st ed.). Packt Publishing.*	2%
4	Get to know the algorithm and its complexity	1. Know various computer algorithms and their implementation 2. Explain the concepts of worst case, average case, and best case	**Criteria:** Lecture; Discussion; Simple problem analysis; **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Practices / Performance	Lecture; Discussion; Simple problem analysis; 3x50 minutes		**Material:** Algorithm Analysis **Bibliography:** *Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser. 2013. Data Structures and Algorithms in Python (1st. ed.). Wiley Publishing.* **Material:** Principles of Algorithm Design **Reader:** *Benjamin Baka. 2017. Python Data Structures and Algorithms (1st ed.). Packt Publishing.*	7%

5	Get to know the divide and conquer algorithm	1. Using sequential and recursive design 2. Explain the concept of Divide-and-Conquer	**Form of Assessment** : Participatory Activities	Lecture; Discussion; Simple problem analysis; 3x50 minutes		**Material:** Recursion **Bibliography:** *Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser. 2013. Data Structures and Algorithms in Python (1st. ed.). Wiley Publishing.*	2%
6	Get to know sorting algorithms	Know the various sorting algorithms Bubble Sort, Shell Sort, Merge Sort, Quick Sort	**Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Practices / Performance	Lecture; Discussion; Simple problem analysis; 3x50 minutes		**Material:** Searching **Bibliography:** *Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser. 2013. Data Structures and Algorithms in Python (1st. ed.). Wiley Publishing.* **Material:** Searching, Sorting, and Complexity Analysis **Reader:** *Kenneth Lambert. 2018. Fundamentals of Python: Data Structures (2nd. ed.). Cengage Learning.*	5%
7	Get to know sorting algorithms	Know the various sorting algorithms Bubble Sort, Shell Sort, Merge Sort, Quick Sort	**Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Practices / Performance	Lecture; Discussion; Simple problem analysis; 3x50 minutes		**Material:** Searching **Bibliography:** *Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser. 2013. Data Structures and Algorithms in Python (1st. ed.). Wiley Publishing.* **Material:** Searching, Sorting, and Complexity Analysis **Reader:** *Kenneth Lambert. 2018. Fundamentals of Python: Data Structures (2nd. ed.). Cengage Learning.*	5%
8	Midterm exam		**Form of Assessment** : Project Results Assessment / Product Assessment, Test				20%

9	Get to know the search algorithm	Know the various search algorithms Sequential Search, Sentnel Linear Search, Binary Search, Meta Binary Search, Ternary Search, Jump Search, Interpolation Search, Exponential Search, Fibonacci Search, The Ubiquitous Search	**Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Practices / Performance	Lecture; Discussion; Simple problem analysis; 3x50 minutes		**Material:** Sorting **Bibliography:** *Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser. 2013. Data Structures and Algorithms in Python (1st. ed.). Wiley Publishing.* **Material:** Sorting and Selection **Reader:** *Benjamin Baka. 2017. Python Data Structures and Algorithms (1st ed.). Packt Publishing.* **Material:** Searching, Sorting, and Complexity Analysis **Reader:** *Kenneth Lambert. 2018. Fundamentals of Python: Data Structures (2nd. ed.). Cengage Learning.*	5%

10	Get to know the search algorithm	Know the various search algorithms Sequential Search, Sentnel Linear Search, Binary Search, Meta Binary Search, Ternary Search, Jump Search, Interpolation Search, Exponential Search, Fibonacci Search, The Ubiquitous Search	**Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Lecture; Discussion; Simple problem analysis; 3x50 minutes		**Material:** Sorting **Bibliography:** *Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser. 2013. Data Structures and Algorithms in Python (1st. ed.). Wiley Publishing.* **Material:** Sorting and Selection **Reader:** *Benjamin Baka. 2017. Python Data Structures and Algorithms (1st ed.). Packt Publishing.* **Material:** Searching, Sorting, and Complexity Analysis **Reader:** *Kenneth Lambert. 2018. Fundamentals of Python: Data Structures (2nd. ed.). Cengage Learning.*	2%
11	Get to know data tree representation	1. Explain the various data representations General Tree, Binary Tree 2. Using the Binary Search Tree search algorithm 3. Implementing Tree Traversal Algorithms	**Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Practices / Performance	Lecture; Discussion; Simple problem analysis; 3x50 minutes		**Material:** Trees **Bibliography:** *Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser. 2013. Data Structures and Algorithms in Python (1st. ed.). Wiley Publishing.* **Material:** Trees **Reader:** *Benjamin Baka. 2017. Python Data Structures and Algorithms (1st ed.). Packt Publishing.*	2%

12	Get to know data tree representation	1. Explain the various data representations General Tree, Binary Tree 2. Using the Binary Search Tree search algorithm 3. Implementing Tree Traversal Algorithms	**Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Practices / Performance	Lecture; Discussion; Simple problem analysis; 3x50 minutes		**Material:** Trees **Bibliography:** *Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser. 2013. Data Structures and Algorithms in Python (1st. ed.). Wiley Publishing.* **Material:** Trees **Reader:** *Benjamin Baka. 2017. Python Data Structures and Algorithms (1st ed.). Packt Publishing.*	2%
13	Implement data structure concepts in computer programs to solve problems related to data science	Designing data structure development projects	**Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Group Presentation 3x50 minutes			3%
14	Implement data structure concepts in computer programs to solve problems related to data science	Implement and realize the approved project design	**Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Independent Work 3x50 minutes	Make a group work report 1x50 minutes		5%
15	Implement data structure concepts in computer programs to solve problems related to data science	Presentation of progress and report on group work achievements	**Form of Assessment** : Project Results Assessment / Product Assessment	Group Presentation 3x50 minutes			5%
16	Final exams	1. Demonstration of data structure project results 2. Created project results report	**Form of Assessment** : Project Results Assessment / Product Assessment	Group Presentation 3x50 minutes			30%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	21.68%
2.	Project Results Assessment / Product Assessment	58.68%
3.	Practice / Performance	8.68%
4.	Test	10%
		99.04%

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.