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

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Mathematical Computation	4420102179	Study Program Elective Courses	T=2	P=0	ECTS=3.18	3	August 25, 2023

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 that is charged to the course

Program Objectives (PO)

PO - 1	Able to apply the concepts of elementary linear algebra and statistics in the field of computing critically and creatively
PO - 2	Able to implement the principles of data grouping and image processing in the Maple/Scilab/R/Pyton programming language
PO - 3	Have a responsible attitude in completing tasks, be open to input/criticism, and be able to make decisions
PO - 4	Able to answer problems given, prepare answers/reports on problems given in writing and/or communicate them orally
PO - 5	Able to solve applied mathematical problems in everyday life with the help of mathematical applications (Maple/Scilab/R/Pyton)

PLO-PO Matrix

P.O
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 examines the application of Elementary Linear Algebra and Statistics in the field of computing. Students are introduced to mathematical application programs (Maple/Scilab/R/Python) to group data using K-Means and classify data (K-Nearest Neighbor) as well as compressing images using the PCA method

References

Main :

1. Anton, H. dkk. 2019. Elementary Linear Algebra Application Version (12th Edition). Hoboken: John Wiley & Sons.
2. Baskar, A. dkk. 2023. Digital Image Processing. Oxon: CRC Press

Supporters:	
1. Russ, J. C. & Neal, F. B. 2016. The Image Processing Book (7th Edition). Boca Raton: CRC Press 2. Maplesoft. 2022. Maple Fundamental Guide. Waterloo Maple Inc. 3. Scilab. 2023. Scilab Tutorial. France: Dassault Systemes 4. Paradis, E. 2005. R for Beginners. France: Institut des Sciences de l'Evolution	
Supporting lecturer	Rudianto Artiono, S.Pd., M.Si. Dimas Avian Maulana, S.Si., M.Si. Riska Wahyu Romadhonia, S.Si., 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	Able to recognize the work environment of the Mathematics Application Program (Maple)	1. Describe the use of Maple applications in mathematical problems 2. Develop simple programs in Maple applications to solve mathematical problems	**Criteria:** Non-Test **Form of Assessment** : Participatory Activities	• Scientific approach: observing, asking, exploring • Method: lecture, discussion, question and answer, giving assignments 2 x 50 minutes		**Material:** Introduction to Maple applications **Library:** *Maplesoft. 2022. Maple Fundamentals Guide. Waterloo Maple Inc.*	2%
2	Able to recognize the work environment of the Mathematics Application Program (Scilab)	1. Describe the use of the Scilab application in mathematical problems 2. Develop simple programs in the Scilab application to solve mathematical problems	**Criteria:** Non-Test **Form of Assessment** : Practical Assessment	• Scientific approach: observing, asking, exploring • Method: lecture, discussion, question and answer, giving assignments 2 x 50 minutes		**Material:** Introduction to the Scilab application **Library:** *Scilab. 2023. Scilab Tutorials. France: Dassault Systemes*	2%
3	Able to recognize the work environment of the Mathematics Application Program (R)	1. Describe the use of R applications in statistical problems 2. Develop simple programs in R applications to solve statistical problems	**Criteria:** Non-Test and Practicum **Form of Assessment** : Practical Assessment	• Scientific approach: observing, asking, exploring • Method: lecture, discussion, question and answer, giving assignments 2 x 50 minutes		**Material:** Introduction to R applications **References:** *Paradis, E. 2005. R for Beginners. France: Institut des Sciences de l'Evolution*	2%
4	Able to integrate the concepts of eigenvectors and eigenvalues in elementary linear algebra concepts	1. Describe the concept of eigenvectors and eigenvalues of a matrix 2. Determining the eigenvectors and eigenvalues of a matrix 3. Solving real problems in the mathematical form of elementary linear algebra	**Criteria:** Non-Test **Form of Assessment** : Participatory Activities	• Scientific approach: observing, asking, exploring • Method: lecture, discussion, question and answer, giving assignments 2 x 50 minutes		**Material:** Eigenvectors and Eigenvalues **References:** *Anton, H. et al. 2019. Elementary Linear Algebra Application Version (12th Edition). Hoboken: John Wiley & Sons.*	2%

5	Able to implement the concept of Principal Component Analysis (PCA) in real problems	1. Explaining the concept of Principal Component Analysis (PCA) 2. Implementing digital signal and image compression with PCA 3. Using matrix decomposition for data security / watermarking	**Criteria:** Non-Test and Practicum **Form of Assessment** : Participatory Activities	• Scientific approach: observing, asking, exploring • Method: lecture, discussion, question and answer, giving assignments 2 x 50 minutes		**Material:** Principal Component Analysis (PCA) **References:** *Baskar, A. et al. 2023. Digital Image Processing. Oxon: CRC Press*	2%
6	Able to implement the concept of Principal Component Analysis (PCA) in real problems	1. Explaining the concept of Principal Component Analysis (PCA) 2. Implementing digital signal and image compression with PCA 3. Using matrix decomposition for data security / watermarking	**Criteria:** Non-Test and Practicum **Form of Assessment** : Practical Assessment	• Scientific approach: observing, asking, exploring • Method: lecture, discussion, question and answer, giving assignments 2 x 50 minutes		**Material:** Principal Component Analysis (PCA) **References:** *Russ, JC & Neal, FB 2016. The Image Processing Book (7th Edition). Boca Raton: CRC Press*	2%
7	Able to implement the concept of Principal Component Analysis (PCA) in real problems	1. Explaining the concept of Principal Component Analysis (PCA) 2. Implementing digital signal and image compression with PCA 3. Using matrix decomposition for data security / watermarking	**Criteria:** Non-Test and Practicum **Form of Assessment** : Practical Assessment	• Scientific approach: observing, asking, exploring • Method: lecture, discussion, question and answer, giving assignments 2 x 50 minutes		**Material:** Principal Component Analysis **References:** *Baskar, A. et al. 2023. Digital Image Processing. Oxon: CRC Press*	2%
8	Midterm exam	Complete UTS questions well, correctly, responsibly and on time	**Form of Assessment** : Participatory Activities, Tests	Written Exam 2 x 50 minutes		**Material:** Introduction to Mathematics Applications; Eigenvectors and Values **Literature:** *Anton, H. et al. 2019. Elementary Linear Algebra Application Version (12th Edition). Hoboken: John Wiley & Sons.*	20%
9	Able to implement the concept of grouping (clustering) on a simple set of data	1. Describes the concept of k-means in data grouping 2. Perform k-means calculations with simple datasets 3. Implementing the k-means algorithm in mathematical application programs 4. Applying the k-means concept to real problems	**Criteria:** Non-Test **Form of Assessment** : Participatory Activities, Practical Assessment	• Scientific approach: observing, asking, exploring • Method: lecture, discussion, question and answer, giving assignments 2 x 50 minutes		**Material:** K-means **References:** *Anton, H. et al. 2019. Elementary Linear Algebra Application Version (12th Edition). Hoboken: John Wiley & Sons.*	2%

10	Able to implement the concept of grouping (clustering) on a simple set of data	1. Describes the concept of k-means in data grouping 2. Perform k-means calculations with simple datasets 3. Implementing the k-means algorithm in mathematical application programs 4. Applying the k-means concept to real problems	**Criteria:** Non-Test and Practicum **Form of Assessment** : Practical Assessment	• Scientific approach: observing, asking, exploring • Method: lecture, discussion, question and answer, giving assignments 2 x 50 minutes		**Material:** K-means **References:** *Anton, H. et al. 2019. Elementary Linear Algebra Application Version (12th Edition). Hoboken: John Wiley & Sons.*	2%
11	Able to implement the concept of grouping (clustering) on a simple set of data	1. Describes the concept of k-means in data grouping 2. Perform k-means calculations with simple datasets 3. Implementing the k-means algorithm in mathematical application programs 4. Applying the k-means concept to real problems	**Criteria:** Non-Tests and Assignments **Form of Assessment** : Participatory Activities, Practical Assessment	• Scientific approach: observing, asking, exploring • Method: lecture, discussion, question and answer, giving assignments 2 x 50 minutes		**Material:** K-means **References:** *Anton, H. et al. 2019. Elementary Linear Algebra Application Version (12th Edition). Hoboken: John Wiley & Sons.*	3%
12	Able to implement classification concepts on a simple data set	1. Describes the concept of K-Nearest Neighbor (KNN) in data classification 2. Performing KNN calculations with simple datasets 3. Implementing the KNN algorithm in mathematical application programs 4. Applying the KNN concept to real problems	**Criteria:** Non-Test **Form of Assessment** : Participatory Activities	• Scientific approach: observing, asking, exploring • Method: lecture, discussion, question and answer, giving assignments 2 x 50 minutes		**Material:** K-Nearest Neighbor (KNN) **References:** *Anton, H. et al. 2019. Elementary Linear Algebra Application Version (12th Edition). Hoboken: John Wiley & Sons.*	2%
13	Able to implement classification concepts on a simple data set	1. Describes the concept of K-Nearest Neighbor (KNN) in data classification 2. Performing KNN calculations with simple datasets 3. Implementing the KNN algorithm in mathematical application programs 4. Applying the KNN concept to real problems	**Criteria:** Non-Test and Practicum **Form of Assessment** : Participatory Activities, Practical Assessment	• Scientific approach: observing, asking, exploring • Method: lecture, discussion, question and answer, giving assignments 2 x 50 minutes		**Material:** K-Nearest Neighbor (KNN) **References:** *Anton, H. et al. 2019. Elementary Linear Algebra Application Version (12th Edition). Hoboken: John Wiley & Sons.*	3%

14	Able to implement classification concepts on a simple data set	1. Describes the concept of K-Nearest Neighbor (KNN) in data classification 2. Performing KNN calculations with simple datasets 3. Implementing the KNN algorithm in mathematical application programs 4. Applying the KNN concept to real problems	**Criteria:** Non-Tests and Assignments **Form of Assessment** : Participatory Activities, Practical Assessment	• Scientific approach: observing, asking, exploring • Method: lecture, discussion, question and answer, giving assignments 2 x 50 minutes		**Material:** K-Nearest Neighbor (KNN) **References:** *Anton, H. et al. 2019. Elementary Linear Algebra Application Version (12th Edition). Hoboken: John Wiley & Sons.*	3%
15	Designing programs for mathematical applications to solve real problems related to the concepts of PCA, K-Means, and KNN	1. Apply the concepts of PCA, K-means, and\or KNN to the problems raised 2. Develop programs on mathematical applications to solve the problems raised	**Criteria:** Progress Presentation **Form of Assessment** : Project Results Assessment / Product Assessment	Learning is carried out offline with the following PjBL stages: - Providing basic questions regarding the urgency of the problems raised - Determining the boundaries of the problem - Agreeing on the implementation schedule for project work - Monitoring the work process through progress presentations - Facilitating students to discuss and ask questions if they experience difficulties 2 x 50 minutes		**Material:** Applied Elementary Linear Algebra **References:** *Anton, H. et al. 2019. Elementary Linear Algebra Application Version (12th Edition). Hoboken: John Wiley & Sons.*	21%
16	Designing programs for mathematical applications to solve real problems related to the concepts of PCA, K-Means, and KNN	1. Apply the concepts of PCA, K-means, and\or KNN to the problems raised 2. Develop programs on mathematical applications to solve the problems raised	**Criteria:** Final Project Presentation **Form of Assessment** : Project Results Assessment / Product Assessment	Learning is carried out offline with the following PjBL stages: - Students present the final results of the projects carried out. while also conducting a demo of the program created. 2 x 50 minutes		**Material:** Applied Elementary Linear Algebra **References:** *Anton, H. et al. 2019. Elementary Linear Algebra Application Version (12th Edition). Hoboken: John Wiley & Sons.*	30%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	23.5%
2.	Project Results Assessment / Product Assessment	51%
3.	Practical Assessment	15.5%
4.	Test	10%
		100%

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.