SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Computational Intelligence	5520203033	Study Program Elective Courses	**T=3**	**P=0**	**ECTS=4.77**	5	May 7, 2021

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	....	Dr. Yuni Yamasari, M.Kom.	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-8	Able to implement computing needs by considering various appropriate methods/algorithms (COM-03)
	Program Objectives (PO)	
	PO - 1	Selecting knowledge representations and reasoning mechanisms.
	PO - 2	Understand the basic concepts and theories of computational intelligence along with the concepts and derivative algorithms.
	PO - 3	Determining a computational intelligence approach that suits the problem at hand.
	PO - 4	Applying computational intelligence by implementing algorithms using different approaches, namely supervised, unsupervised and semi-supervised according to the problems faced.
	PO - 5	Analyzing algorithm implementation using different approaches, namely supervised, unsupervised and semi-supervised.
	PO - 6	Evaluate algorithm implementation using different approaches, namely supervised, unsupervised and semi-supervised.
	PLO-PO Matrix	

P.O	PLO-8
PO-1	
PO-2	
PO-3	
PO-4	
PO-5	
PO-6	

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																
PO-6																

Short Course Description	This course provides students with basic concepts of artificial intelligence and soft computing, several types of data input, data processing and transformation, feature vectors and feature engineering, comprehensive understanding of classification methods with supervised and unsupervised learning, and optimization methods with evolutionary algorithms, as well as data dimension reduction. Students are also able to apply these methods to case studies in the form of project assignments, analyze and evaluate the results of their application, and present the modeling results in a paper. This course will discuss several methods related to their respective uses. Dimensional reduction and data transformation methods studied include Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), and Independent Component Analysis (ICA). Supervised learning includes Multi-Layer Perceptron (MLP), RBF, ANFIS, Support Vector Machine (SVM) while unsupervised learning includes a variety of clustering methods (K-Means, Hierarchical Clustering, DBSCAN). Then, the optimization methods used include evolutionary algorithms such as Genetic Algorithm (GA), Ant Colony (ACO), Particle Swarm Optimization (PSO), Artificial Bee Colony (ABC).						

References — **Main :**

1. S. Theodoridis, A. Pikrakis, K. Koutroumbas, D. Cavouras. 2010. Introduction to Pattern Recognitio: A MATLAB Approach. UK: Acacemic Press, Elsevier Inc.
2. D.G. Stork, R.O. Duda, P.E. Hart. 2001. Pattern Classification. New York: John Wiley & Sons Inc.
3. A. Konar. 2005. Computational Intelligence Principles, Techniques and Applications. Netherlands: Springer.
4. P. Gupta. 2021. Practical Data Science with Jupyter: Explore Data Cleaning, Pre-processing, Data Wrangling, Feature Engineering and Machine Learning using Python and Jupyter (English Edition). Noida: BPB Publications.
5. E. Alpaydin. 2020. Introduction to Machine Learning, 4rd edition, USA: MIT Press.
6. Z. Zhou, S. Liu. 2021. Machine Learning, Germany: Springer.

Supporters:

1. S.J. Russel, P. Norvig. 2009. Artificial Intelligence: A Modern Approach, 3rd edition. New Jersey: Pearson Education Inc.
2. C.M. Bishop. 2006. Pattern Recognition and Machine Learning, New York: Springer.
3. S.S. Ozdemir. D. Susarla. 2018. Feature engineering made easy identify unique features from your dataset in order to build powerful machine learning systems. UK: Packt Publishing.
4. P. Duboue. 2020. The Art of Feature Engineering, UK: Cambridge University Press.
5. S. Galli. 2020. Python Feature Engineering Cookbook, UK: Packt Publishing.
6. C.C. Aggarwal, C.K. Reddy. 2013. Data Clustering, USA: Chapman and Hall/CRC Press.
7. A.K. Kain, R.C Dubes. 2018. Algorithm for Clustering Data. USA: Michigan State University, Prentice Hall Reference.
8. Kementerian Komunikasi dan Informatika Republik Indonesia. 2022. Data Scientist: Artificial Intelligence untuk Dosen dan Instruktur. Thematic Academy, Digital Talent Scholarship.
9. Jurnal atau Prosiding Internasional yang relevan.

Supporting lecturer	Dr. Yuni Yamasari, 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	Students are able to understand the basic concepts of artificial intelligence and soft computing.	Ability to produce a summary of the basic concepts of artificial intelligence and soft computing as well as attitudes in accepting, responding to and appreciating opinions	**Criteria:** Assessment Rubric (attached) **Form of Assessment** : Participatory Activities	- Various lectures - Role play - Question and answer - Discussion Task 1: Present the results of a summary of the basic concepts of artificial intelligence and soft computing and their application in society. 3 X 50	- Various lectures - Questions and answers - Discussions - Google Meet/Zoom - Google Classroom Task 1: Present the results of a summary of the basic concepts of artificial intelligence and soft computing and their application in society. 3 X 50	**Material:** Basic concepts of artificial intelligence and soft computing. **Bibliography:** *S. Theodoridis, A. Pikrakis, K. Koutroumbas, D. Cavouras. 2010. Introduction to Pattern Recognition: A MATLAB Approach. UK: Acacemic Press, Elsevier Inc.* **Material:** Basic concepts of artificial intelligence and soft computing. **References:** *DG Stork, RO Duda, PE Hart. 2001. Pattern Classification. New York: John Wiley & Sons Inc.* **Material:** Basic concepts of artificial intelligence and soft computing. **Bibliography:** *A. Konar. 2005. Computational Intelligence Principles, Techniques and Applications.*	2%

Netherlands: Springer.

						Material: Basic concepts of artificial intelligence and soft computing. **Bibliography:** *P. Gupta. 2021. Practical Data Science with Jupyter: Explore Data Cleaning, Pre-processing, Data Wrangling, Feature Engineering and Machine Learning using Python and Jupyter (English Edition). Noida: BPB Publications.*	
						Material: Basic concepts of artificial intelligence and soft computing. **Bibliography:** *E. Alpaydin. 2020. Introduction to Machine Learning, 4th edition, USA: MIT Press.*	
						Material: Basic concepts of artificial intelligence and soft computing. **References:** *Z. Zhou, S. Liu. 2021. Machine Learning, Germany: Springer.*	
						Material: Basic concepts of artificial intelligence and soft computing. **Bibliography:** *SJ Russell, P. Norvig. 2009. Artificial Intelligence: A Modern Approach, 3rd edition. New Jersey: Pearson Education Inc.*	
						Material: Basic concepts of artificial intelligence and soft computing. **Reader:** *CM Bishop. 2006. Pattern Recognition and Machine Learning, New York: Springer.*	
2	Students are able to explain the various types of data input and describe the data transformation process.	Ability to produce summaries of data input types and descriptions of data transformation processes as well as	**Criteria:** Assessment Rubric (attached) **Form of Assessment** : Participatory Activities, Practice/Performance	- Discussion of task 1 - Role play - Question and answer - Discussion of Task 2:	- Discussion of task 1 - Various lectures - Questions and answers - Discussion - Google Meet/Zoom - Google Classroom	**Material:** Data input and description of the data transformation process. **Bibliography:** *S. Theodoridis,*	2%

			attitudes in accepting, responding to and respecting opinions.		Present the types of data input and an overview of the data transformation process in an incident in society. 3 X 50	Task 2: Present the types of data input and an overview of the data transformation process in an event in society. 3 X 50	*A. Pikrakis, K. Koutroumbas, D. Cavouras. 2010. Introduction to Pattern Recognition: A MATLAB Approach. UK: Acacemic Press, Elsevier Inc.*	
							Material: Data input and description of the data transformation process. **References:** *DG Stork, RO Duda, PE Hart. 2001. Pattern Classification. New York: John Wiley & Sons Inc.*	
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							Material: Data input and description of the data transformation process. **Bibliography:** *E. Alpaydin. 2020. Introduction to Machine Learning, 4th edition, USA: MIT Press.*	
							Material: Data input and description of the data transformation process. **References:** *Z.*	

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							Zhou, S. Liu. 2021. Machine Learning, Germany: Springer.	
							Material: Data input and description of the data transformation process. **Bibliography:** *SJ Russell, P. Norvig. 2009. Artificial Intelligence: A Modern Approach, 3rd edition. New Jersey: Pearson Education Inc.*	
							Material: Data input and description of the data transformation process. **Reader:** *CM Bishop. 2006. Pattern Recognition and Machine Learning, New York: Springer.*	
							Material: Data input and description of the data transformation process. **Library:** *Ministry of Communication and Information of the Republic of Indonesia. 2022. Data Scientist: Artificial Intelligence for Lecturers and Instructors. Thematic Academy, Digital Talent Scholarship.*	
3	Students are able to explain the various types of data input and describe the data transformation process.	Ability to produce summaries of data input types and descriptions of data transformation processes as well as attitudes in accepting, responding to and respecting opinions.	**Criteria:** Assessment Rubric (attached) **Forms of Assessment**: Participatory Activities, Project Results Assessment / Product Assessment, Practice / Performance, Tests	- Discussion of task 1 - Role play - Question and answer - Discussion of Task 2: Present the types of data input and an overview of the data transformation process in an incident in society. 3 X 50	- Discussion of task 1 - Various lectures - Questions and answers - Discussion - Google Meet/Zoom - Google Classroom Task 2: Present the types of data input and an overview of the data transformation process in an event in society. 3 X 50	**Material:** Data input and description of the data transformation process. **Bibliography:** *S. Theodoridis, A. Pikrakis, K. Koutroumbas, D. Cavouras. 2010. Introduction to Pattern Recognition: A MATLAB Approach. UK: Acacemic Press, Elsevier Inc.*	2%
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									Material: Data input and description of the data	

| | | | | | | transformation process.
Reader: *CM Bishop. 2006. Pattern Recognition and Machine Learning, New York: Springer.*

Material: Data input and description of the data transformation process.
Library: *Ministry of Communication and Information of the Republic of Indonesia. 2022. Data Scientist: Artificial Intelligence for Lecturers and Instructors. Thematic Academy, Digital Talent Scholarship.* | |
| **4** | Students are able to explain feature vectors and feature engineering. | Ability to explain feature vectors and feature engineering as well as attitude in accepting, responding to and respecting opinions. | **Criteria:**
Assessment rubric (attached)

Form of Assessment :
Participatory Activities, Practice/Performance | - Discussion of assignment 2
- Varied lectures
- Questions and answers
- Discussion
3 X 50 | - Discussion of assignment 2
- Varied lectures
- Question and answer
- Discussion
- Google Meet/Zoom
- Google Classroom
3 X 50 | **Material:** Feature Vectors and Feature Engineering
Bibliography: *S. Theodoridis, A. Pikrakis, K. Koutroumbas, D. Cavouras. 2010. Introduction to Pattern Recognition: A MATLAB Approach. UK: Acacemic Press, Elsevier Inc.*

Material: Feature Vectors and Feature Engineering
Library: *DG Stork, RO Duda, PE Hart. 2001. Pattern Classification. New York: John Wiley & Sons Inc.*

Material: Feature Vectors and Feature Engineering
References: *A. Konar. 2005. Computational Intelligence Principles, Techniques and Applications. Netherlands: Springer.*

Material: Feature Vectors and Feature Engineering
Library: *P. Gupta. 2021. Practical Data Science with Jupyter:* | 3% |

								Explore Data Cleaning, Pre-processing, Data Wrangling, Feature Engineering and Machine Learning using Python and Jupyter (English Edition). Noida: BPB Publications.	
								Material: Feature Vectors and Feature Engineering **Library:** *E. Alpaydin. 2020. Introduction to Machine Learning, 4th edition, USA: MIT Press.*	
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								Material: Feature Vectors and Feature Engineering **References:** *Z. Zhou, S. Liu. 2021. Machine Learning, Germany: Springer.*	
								Material: Feature Vectors and Feature Engineering **References:** *SJ Russel, P. Norvig. 2009. Artificial Intelligence: A Modern Approach, 3rd edition. New Jersey: Pearson Education Inc.*	
								Material: Feature Vectors and Feature Engineering **Library:** *CM Bishop. 2006. Pattern Recognition and Machine Learning, New York: Springer.*	
								Material: Feature Vectors and Feature Engineering **Library:** *SS Ozdemir. D. Susarla. 2018. Feature engineering*	

						makes it easy to identify unique features from your dataset in order to build powerful machine learning systems. UK: Packt Publishing.	
						Material: Feature Vectors and Feature Engineering **Library:** *P. Duboue. 2020. The Art of Feature Engineering, UK: Cambridge University Press.*	
						Material: Feature Vectors and Feature Engineering **Library:** *Ministry of Communication and Information of the Republic of Indonesia. 2022. Data Scientist: Artificial Intelligence for Lecturers and Instructors. Thematic Academy, Digital Talent Scholarship.*	
						Material: Feature Vectors and Feature Engineering **Literature:** *Relevant International Journals or Proceedings.*	
5	Students are able to explain feature vectors and feature engineering.	Ability to explain feature vectors and feature engineering as well as attitude in accepting, responding to and respecting opinions.	**Criteria:** Assessment rubric (attached) **Forms of Assessment**: Participatory Activities, Project Results Assessment / Product Assessment, Practice / Performance, Tests	- Discussion of assignment 2 - Varied lectures - Questions and answers - Discussion of assignment 3: Create a report on experimental results from search and feature engineering for an example problem. 3 X 50	- Discussion of assignment 2 - Various lectures - Questions and answers - Discussion - Google Meet/Zoom - Google Classroom Assignment 3: Create a report on experimental results from search and feature engineering for an example problem. 3 X 50	**Material:** Feature Vectors and Feature Engineering **Bibliography:** *S. Theodoridis, A. Pikrakis, K. Koutroumbas, D. Cavouras. 2010. Introduction to Pattern Recognition: A MATLAB Approach. UK: Acacemic Press, Elsevier Inc.*	3%
						Material: Feature Vectors and Feature Engineering **Library:** *DG Stork, RO Duda, PE Hart. 2001. Pattern Classification. New York: John Wiley & Sons Inc.*	

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						Pearson Education Inc.	
						Material: Feature Vectors and Feature Engineering **Library:** *CM Bishop. 2006. Pattern Recognition and Machine Learning, New York: Springer.*	
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						Material: Feature Vectors and Feature Engineering **Literature:** *Relevant International Journals or Proceedings.*	
6	Students are able to apply Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), the difference between PCA and LDA,	Ability to produce creative and useful products by utilizing data dimension reduction	**Criteria:** Assessment rubric (attached) **Forms of Assessment**: Participatory Activities,	- Discussion of assignment 3 - Project based learning - Question and answer - Discussion 3 X 50	- Discussion of assignment 3 - Project based learning - Question and answer - Discussion - Google Meet/Zoom	**Material:** Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA),	3%

		Independent Component Analysis (ICA).	processes as well as attitudes in accepting, responding to and respecting opinions.	Project Results Assessment / Product Assessment, Practices / Performance	3 X 50	- Google Classroom 3 X 50	differences between PCA and LDA, Independent Component Analysis (ICA). **Bibliography:** *S. Theodoridis, A. Pikrakis, K. Koutroumbas, D. Cavouras. 2010. Introduction to Pattern Recognition: A MATLAB Approach. UK: Acacemic Press, Elsevier Inc.*		
							Material: Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), differences between PCA and LDA, Independent Component Analysis (ICA). **References:** *DG Stork, RO Duda, PE Hart. 2001. Pattern Classification. New York: John Wiley & Sons Inc.*		
							Material: Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), differences between PCA and LDA, Independent Component Analysis (ICA). **Bibliography:** *A. Konar. 2005. Computational Intelligence Principles, Techniques and Applications. Netherlands: Springer.*		
							Material: Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), differences between PCA and LDA, Independent Component Analysis (ICA). **Bibliography:** *P. Gupta. 2021. Practical Data Science with Jupyter: Explore Data Cleaning, Pre-processing, Data Wrangling, Feature Engineering and Machine Learning using Python and*		

Jupyter (English Edition). Noida: BPB Publications.

Material: Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), differences between PCA and LDA, Independent Component Analysis (ICA). **Bibliography:** *E. Alpaydin. 2020. Introduction to Machine Learning, 4th edition, USA: MIT Press.*

Material: Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), differences between PCA and LDA, Independent Component Analysis (ICA). **References:** *Z. Zhou, S. Liu. 2021. Machine Learning, Germany: Springer.*

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						Material: Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), differences between PCA and LDA, Independent Component Analysis (ICA). **Bibliography:** *Relevant International Journals or Proceedings.*	
7	Students are able to apply Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), the difference between PCA and LDA, Independent Component Analysis (ICA).	Ability to produce creative and useful products by utilizing data dimension reduction processes as well as attitudes in accepting, responding to and respecting opinions.	**Criteria:** Assessment rubric (attached) **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Practices / Performance	- Discussion of assignment 3 - Project-based learning - Question and answer - Discussion of assignment 4: Create an application to reduce data dimensions. 3 X 50	- Discussion of assignment 3 - Project-based learning - Question and answer - Discussion - Google Meet/Zoom - Google Classroom Assignment 4: Create an application to reduce data dimensions. 3 X 50	**Material:** Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), differences between PCA and LDA, Independent Component Analysis (ICA). **Bibliography:** *S. Theodoridis, A. Pikrakis, K. Koutroumbas, D. Cavouras. 2010. Introduction to Pattern Recognition: A MATLAB Approach. UK: Acacemic Press, Elsevier Inc.* **Material:** Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), differences between PCA and LDA, Independent Component Analysis (ICA). **References:** *DG Stork, RO Duda, PE Hart. 2001. Pattern Classification. New York: John Wiley & Sons Inc.* **Material:** Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), differences between PCA and LDA, Independent Component Analysis (ICA). **Bibliography:** *A. Konar. 2005. Computational Intelligence Principles, Techniques and Applications. Netherlands: Springer.* **Material:** Principal	3%

								Component Analysis (PCA), Linear Discriminant Analysis (LDA), differences between PCA and LDA, Independent Component Analysis (ICA). **Bibliography:** *P. Gupta. 2021. Practical Data Science with Jupyter: Explore Data Cleaning, Pre-processing, Data Wrangling, Feature Engineering and Machine Learning using Python and Jupyter (English Edition). Noida: BPB Publications.*	
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						Jersey: Pearson Education Inc.	
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						Material: Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), differences between PCA and LDA, Independent Component Analysis (ICA). **Bibliography:** *Relevant International Journals or Proceedings.*	
8	Subsummative Exam/Midterm Exam	Subsummative Exam/Midterm Exam	**Criteria:** Subsummative Exam/Midterm Exam **Form of Assessment** : Practice / Performance	- Essay - Project Based Learning (Demonstrating a simple program) 1 X 50		**Material:** Subsummative Exam/Midterm Exam **References:** *S. Theodoridis, A. Pikrakis, K. Koutroumbas, D. Cavouras. 2010. Introduction to Pattern Recognition: A MATLAB Approach. UK: Acacemic Press, Elsevier Inc.* **Material:** Subsummative Exam/Midterm Exam **Readers:** *DG Stork, RO Duda, PE Hart. 2001. Pattern Classification. New York: John Wiley & Sons Inc.* **Material:** Subsummative Exam/Midterm Exam **Reference:** *A. Konar. 2005. Computational Intelligence Principles, Techniques and Applications. Netherlands: Springer.* **Material:** Subsummative Exam/Midterm	20%

						Exam **Reader:** *P. Gupta. 2021. Practical Data Science with Jupyter: Explore Data Cleaning, Pre-processing, Data Wrangling, Feature Engineering and Machine Learning using Python and Jupyter (English Edition). Noida: BPB Publications.* **Material:** Subsummative Exam/Midterm Exam **Reader:** *E. Alpaydin. 2020. Introduction to Machine Learning, 4th edition, USA: MIT Press.* **Material:** Subsummative Exam/Midterm Exam **References:** *Z. Zhou, S. Liu. 2021. Machine Learning, Germany: Springer.*	
9	Students are able to analyze various clustering methods, including K-Means, Hierarchical Clustering, DBSCAN.	Ability to produce creative and useful work by applying clustering methods and attitudes in accepting, responding to and respecting opinions.	**Criteria:** Assessment rubric (attached) **Form of Assessment** : Participatory Activities, Practice/Performance	- Discussion of assignment 4 and results of Mid-Semester Evaluation/Mid-Semester Exam - Project-based learning - Questions and answers - Thematic (presentation and discussion) 3 X 50	- Discussion of assignment 4 and results of Mid-Semester Evaluation/Mid-Semester Exam - Project-based learning - Questions and answers - Thematic (presentation and discussion) - Google Meet/Zoom - Google Classroom 3 X 50	**Material:** Clustering **Literature:** *S. Theodoridis, A. Pikrakis, K. Koutroumbas, D. Cavouras. 2010. Introduction to Pattern Recognition: A MATLAB Approach. UK: Acacemic Press, Elsevier Inc.* **Material:** Clustering **Literature:** *DG Stork, RO Duda, PE Hart. 2001. Pattern Classification. New York: John Wiley & Sons Inc.* **Material:** Clustering **Literature:** *A. Konar. 2005. Computational Intelligence Principles, Techniques and Applications. Netherlands: Springer.* **Material:** Clustering **Literature:** *P. Gupta. 2021. Practical Data Science with Jupyter: Explore Data Cleaning, Pre-*	4%

						Material: Clustering processing, Data Wrangling, Feature Engineering and Machine Learning using Python and Jupyter (English Edition). Noida: BPB Publications.	
						Material: Clustering **Library:** *E. Alpaydin. 2020. Introduction to Machine Learning, 4th edition, USA: MIT Press.*	
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						Material: Clustering **Library:** *CM Bishop. 2006. Pattern Recognition and Machine Learning, New York: Springer.*	
						Material: Clustering **Bibliography:** *CC Aggarwal, CK Reddy. 2013. Data Clustering, USA: Chapman and Hall/CRC Press.*	
						Material: Clustering **Literature:** *AK Kain, RC Dubes. 2018. Algorithm for Clustering Data. USA: Michigan State University, Prentice Hall Reference.*	
						Material: Library Clustering : *Relevant International Journals or Proceedings.*	
10	Students are able to analyze various clustering methods, including K-Means, Hierarchical	Ability to produce creative and useful work by applying clustering	**Criteria:** Assessment rubric (attached) **Forms of Assessment**	- Discussion of assignment 4 and the results of the Mid-Semester	- Discussion of assignment 4 and the results of the Mid-Semester Evaluation/Mid-	**Material:** Clustering **Literature:** *S. Theodoridis, A. Pikrakis, K.*	4%

| | | Clustering, DBSCAN. | methods and attitudes in accepting, responding to and respecting opinions. | : Participatory Activities, Project Results Assessment / Product Assessment, Practices / Performance | Evaluation/Mid-Semester Exam - Project-based learning - Questions and answers - Thematic (presentation and discussion)

Assignment 5: Analyze the application of the clustering method in an application created.
3 X 50 | Semester Exam - Project-based learning - Questions and answers - Thematic (presentation and discussion) - Google Meet/Zoom - Google Classroom

Assignment 5: Analyze the application of the clustering method in an application created.
3 X 50 | *Koutroumbas, D. Cavouras. 2010. Introduction to Pattern Recognition: A MATLAB Approach. UK: Acacemic Press, Elsevier Inc.*

Material: Clustering **Literature:** *DG Stork, RO Duda, PE Hart. 2001. Pattern Classification. New York: John Wiley & Sons Inc.*

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Material: Clustering **Literature:** *P. Gupta. 2021. Practical Data Science with Jupyter: Explore Data Cleaning, Pre-processing, Data Wrangling, Feature Engineering and Machine Learning using Python and Jupyter (English Edition). Noida: BPB Publications.*

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Material: Clustering | | |

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						Material: Clustering **Literature:** *AK Kain, RC Dubes. 2018. Algorithm for Clustering Data. USA: Michigan State University, Prentice Hall Reference.*	
						Material: Library Clustering : *Relevant International Journals or Proceedings.*	
11	Students are able to analyze various artificial neural network methods, Multilayer Perceptron (MLP), RBF, ANFIS, and SVM.	Ability to produce creative and useful products by applying classification methods and attitudes in accepting, responding to and respecting opinions.	**Criteria:** Assessment rubric (attached) **Form of Assessment** : Participatory Activities, Practice/Performance	- Discussion of assignment 5 - Project based learning - Question and answer - Thematic (presentation and discussion) 3 X 50	- Discussion of assignment 5 - Project-based learning - Question and answer - Thematic (presentation and discussion) - Google Meet/Zoom - Google Classroom 3 X 50	**Material:** Library Classification **:** *S. Theodoridis, A. Pikrakis, K. Koutroumbas, D. Cavouras. 2010. Introduction to Pattern Recognition: A MATLAB Approach. UK: Acacemic Press, Elsevier Inc.*	4%
						Material: Library Classification : *DG Stork, RO Duda, PE Hart. 2001. Pattern Classification. New York: John Wiley & Sons Inc.*	
						Material: Literature Classification : *A. Konar. 2005. Computational Intelligence Principles, Techniques and Applications. Netherlands: Springer.*	
						Material: Library Classification : *P. Gupta. 2021. Practical Data Science with Jupyter: Explore Data Cleaning, Pre-processing, Data Wrangling, Feature*	

						Engineering and Machine Learning using Python and Jupyter (English Edition). Noida: BPB Publications.	
						Material: Library Classification : *E. Alpaydin. 2020. Introduction to Machine Learning, 4th edition, USA: MIT Press.*	
						Material: Library Classification : *Z. Zhou, S. Liu. 2021. Machine Learning, Germany: Springer.*	
						Material: Library Classification : *SJ Russel, P. Norvig. 2009. Artificial Intelligence: A Modern Approach, 3rd edition. New Jersey: Pearson Education Inc.*	
						Material: Library Classification : *CM Bishop. 2006. Pattern Recognition and Machine Learning, New York: Springer.*	
						Material: Literature Classification : *Relevant International Journals or Proceedings.*	
12	Students are able to analyze various artificial neural network methods, Multilayer Perceptron (MLP), RBF, ANFIS, and SVM.	Ability to produce creative and useful products by applying classification methods and attitudes in accepting, responding to and respecting opinions.	**Criteria:** Assessment rubric (attached) **Form of Assessment** : Participatory Activities	- Discussion of assignment 5 - Project-based learning - Questions and answers - Thematic (presentation and discussion) Assignment 6: Analyze the application of classification methods in an application that has been created. 3 X 50	- Discussion of assignment 5 - Project-based learning - Question and answer - Thematic (presentation and discussion) - Google Meet/Zoom - Google Classroom Assignment 6: Analyze the application of classification methods in an application that has been created. 3 X 50	**Material:** Library Classification **:** *S. Theodoridis, A. Pikrakis, K. Koutroumbas, D. Cavouras. 2010. Introduction to Pattern Recognition: A MATLAB Approach. UK: Acacemic Press, Elsevier Inc.* **Material: Library** Classification : *DG Stork, RO Duda, PE Hart. 2001. Pattern Classification. New York: John Wiley & Sons Inc.* **Material: Literature** Classification :	4%

						A. Konar. 2005. Computational Intelligence Principles, Techniques and Applications. Netherlands: Springer.	
						Material: Library Classification : *P. Gupta. 2021. Practical Data Science with Jupyter: Explore Data Cleaning, Pre-processing, Data Wrangling, Feature Engineering and Machine Learning using Python and Jupyter (English Edition). Noida: BPB Publications.*	
						Material: Library Classification : *E. Alpaydin. 2020. Introduction to Machine Learning, 4th edition, USA: MIT Press.*	
						Material: Library Classification : *Z. Zhou, S. Liu. 2021. Machine Learning, Germany: Springer.*	
						Material: Library Classification : *SJ Russel, P. Norvig. 2009. Artificial Intelligence: A Modern Approach, 3rd edition. New Jersey: Pearson Education Inc.*	
						Material: Library Classification : *CM Bishop. 2006. Pattern Recognition and Machine Learning, New York: Springer.*	
						Material: Literature Classification : *Relevant International Journals or Proceedings.*	
13	Students are able to apply optimization methods with evolutionary algorithms, Genetic Algorithm (GA), Ant Colony (ACO), Particle Swarm Optimization	Ability to produce creative and useful products by applying optimization methods to work results that utilize	**Criteria:** Assessment rubric (attached) **Form of Assessment** : Participatory Activities, Practice/Performance	- Discussion of assignment 6 - Project based learning - Question and answer - Discussion 3 X 50	- Discussion of assignment 6 - Project based learning - Question and answer - Discussion - Google Meet/Zoom - Google Classroom 3 X 50	**Material:** Optimization Methods **Literature:** *S. Theodoridis, A. Pikrakis, K. Koutroumbas, D. Cavouras. 2010.*	5%

		(PSO), Artificial Bee Colony.	clustering or previous classification methods as well as attitudes in accepting, responding to and respecting opinions.				*Introduction to Pattern Recognition: A MATLAB Approach. UK: Acacemic Press, Elsevier Inc.*	
							Material: Optimization Methods **Literature:** *DG Stork, RO Duda, PE Hart. 2001. Pattern Classification. New York: John Wiley & Sons Inc.*	
							Material: Optimization Methods **Literature:** *A. Konar. 2005. Computational Intelligence Principles, Techniques and Applications. Netherlands: Springer.*	
							Material: Optimization Methods **Literature:** *P. Gupta. 2021. Practical Data Science with Jupyter: Explore Data Cleaning, Pre-processing, Data Wrangling, Feature Engineering and Machine Learning using Python and Jupyter (English Edition). Noida: BPB Publications.*	
							Material: Optimization Methods **Literature:** *E. Alpaydin. 2020. Introduction to Machine Learning, 4th edition, USA: MIT Press.*	
							Material: Optimization Methods **Literature:** *Z. Zhou, S. Liu. 2021. Machine Learning, Germany: Springer.*	
							Material: Optimization Methods **Literature:** *SJ Russel, P. Norvig. 2009. Artificial Intelligence: A Modern Approach, 3rd edition. New Jersey: Pearson Education Inc.*	

						Material: Optimization Methods **Literature:** *CM Bishop. 2006. Pattern Recognition and Machine Learning, New York: Springer.*	
						Material: Optimization Methods **Literature:** *Ministry of Communication and Information of the Republic of Indonesia. 2022. Data Scientist: Artificial Intelligence for Lecturers and Instructors. Thematic Academy, Digital Talent Scholarship.*	
14	Students are able to apply optimization methods with evolutionary algorithms, Genetic Algorithm (GA), Ant Colony (ACO), Particle Swarm Optimization (PSO), Artificial Bee Colony.	Ability to produce creative and useful products by applying optimization methods to work results that utilize clustering or previous classification methods as well as attitudes in accepting, responding to and respecting opinions.	**Criteria:** Assessment rubric (attached) **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Practices / Performance	- Discussion of assignment 6 - Project-based learning - Question and answer - Discussion of assignment 7: Create an application using an optimized classification or clustering method. 3 X 50	- Discussion of assignment 6 - Project-based learning - Question and answer - Discussion - Google Meet/Zoom - Google Classroom Assignment 7: Create an application using an optimized classification or clustering method. 3 X 50	**Material:** Optimization Methods **Literature:** *S. Theodoridis, A. Pikrakis, K. Koutroumbas, D. Cavouras. 2010. Introduction to Pattern Recognition: A MATLAB Approach. UK: Acacemic Press, Elsevier Inc.* **Material:** Optimization Methods **Literature:** *DG Stork, RO Duda, PE Hart. 2001. Pattern Classification. New York: John Wiley & Sons Inc.* **Material:** Optimization Methods **Literature:** *A. Konar. 2005. Computational Intelligence Principles, Techniques and Applications. Netherlands: Springer.* **Material:** Optimization Methods **Literature:** *P. Gupta. 2021. Practical Data Science with Jupyter: Explore Data Cleaning, Pre-processing, Data Wrangling, Feature Engineering and Machine Learning using Python and*	5%

						Literature	
						Jupyter (English Edition). Noida: BPB Publications.	
						Material: Optimization Methods **Literature:** *E. Alpaydin. 2020. Introduction to Machine Learning, 4th edition, USA: MIT Press.*	
						Material: Optimization Methods **Literature:** *Z. Zhou, S. Liu. 2021. Machine Learning, Germany: Springer.*	
						Material: Optimization Methods **Literature:** *SJ Russel, P. Norvig. 2009. Artificial Intelligence: A Modern Approach, 3rd edition. New Jersey: Pearson Education Inc.*	
						Material: Optimization Methods **Literature:** *CM Bishop. 2006. Pattern Recognition and Machine Learning, New York: Springer.*	
						Material: Optimization Methods **Literature:** *Ministry of Communication and Information of the Republic of Indonesia. 2022. Data Scientist: Artificial Intelligence for Lecturers and Instructors. Thematic Academy, Digital Talent Scholarship.*	
15	Students are able to evaluate the application of clustering or classification methods that have been optimized on reduced data.	The ability to produce scientific work that is creative, original, tested and useful for scientific development by using the results of analysis and evaluation of the methods applied as well as attitudes in accepting, responding to and respecting opinions.	**Criteria:** 1. 2.Assessment rubric (attached) **Form of Assessment** : Participatory Activities	Direct Instruction Presentation, group discussion and reflection Project Based Learning - Discussion of assignment 7 - Case analysis (presentation) - Project based learning - Questions and answers - Final Project Discussion : Draft scientific work related to	- Discussion of Assignment 7 - Case analysis (presentation) - Project-based learning - Question and answer - Discussion - Google Meet/Zoom - Google Classroom Final Project: Draft scientific work related to the application, analysis and evaluation of data dimension reduction processes and clustering or classification	**Material:** Evaluation of Computational Intelligence Methods **References:** *S. Theodoridis, A. Pikrakis, K. Koutroumbas, D. Cavouras. 2010. Introduction to Pattern Recognition: A MATLAB Approach. UK: Acacemic Press, Elsevier Inc.*	6%

						the application, analysis and evaluation of the data dimension reduction process as well as clustering or classification techniques that have been optimized in solving problems. 3 X 50	techniques which has been optimized in solving problems. 3 X 50	**Material:** Evaluation of Computational Intelligence Methods **References:** *DG Stork, RO Duda, PE Hart. 2001. Pattern Classification. New York: John Wiley & Sons Inc.*	
								Material: Evaluation of Computational Intelligence Methods **Reference:** *A. Konar. 2005. Computational Intelligence Principles, Techniques and Applications. Netherlands: Springer.*	
								Material: Evaluation of Computational Intelligence Methods **Reference:** *P. Gupta. 2021. Practical Data Science with Jupyter: Explore Data Cleaning, Pre-processing, Data Wrangling, Feature Engineering and Machine Learning using Python and Jupyter (English Edition). Noida: BPB Publications.*	
								Material: Evaluation of Computational Intelligence Methods **Reference:** *E. Alpaydin. 2020. Introduction to Machine Learning, 4th edition, USA: MIT Press.*	
								Material: Evaluation of Computational Intelligence Methods **References:** *Z. Zhou, S. Liu. 2021. Machine Learning, Germany: Springer.*	
								Material: Evaluation of Computational Intelligence Methods **References:** *SJ Russel, P. Norvig. 2009. Artificial Intelligence: A Modern Approach, 3rd edition. New*	

						Jersey: Pearson Education Inc.	
						Material: Evaluation of Computational Intelligence Methods **Reference:** *CM Bishop. 2006. Pattern Recognition and Machine Learning, New York: Springer.*	
						Material: Evaluation of Computational Intelligence Methods **Literature:** *Relevant International Journals or Proceedings.*	
16	Summative Exam/Final Semester Exam	Summative Exam/Final Semester Exam	**Criteria:** Summative Exam/Final Semester Exam **Forms of Assessment**: Participatory Activities, Project Results Assessment / Product Assessment, Practices / Performance	Summative Exam/Final Semester Exam	Summative Exam/Final Semester Exam	**Material:** Summative Exam/Final Semester Exam **References:** *S. Theodoridis, A. Pikrakis, K. Koutroumbas, D. Cavouras. 2010. Introduction to Pattern Recognition: A MATLAB Approach. UK: Acacemic Press, Elsevier Inc.*	30%
						Material: Summative Exam/Final Semester Exam **Readers:** *DG Stork, RO Duda, PE Hart. 2001. Pattern Classification. New York: John Wiley & Sons Inc.*	
						Material: Summative Exam/Final Semester Exam **Reader:** *A. Konar. 2005. Computational Intelligence Principles, Techniques and Applications. Netherlands: Springer.*	
						Material: Summative Exam/Final Semester Exam **Reader:** *P. Gupta. 2021. Practical Data Science with Jupyter: Explore Data Cleaning, Pre-processing, Data Wrangling, Feature Engineering*	

							and Machine Learning using Python and Jupyter (English Edition). Noida: BPB Publications.
							Material: Summative Exam/Final Semester Exam **Reader:** *E. Alpaydin. 2020. Introduction to Machine Learning, 4th edition, USA: MIT Press.*
							Material: Summative Exam/Final Semester Exam **References:** *Z. Zhou, S. Liu. 2021. Machine Learning, Germany: Springer.*

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	37.25%
2.	Project Results Assessment / Product Assessment	16.25%
3.	Practice / Performance	45.25%
4.	Test	1.25%
		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.