ABDULLAH GÜL UNIVERSITY
INSTITUTE OF SCIENCE
ELECTRIC and COMPUTER ENGİNEERING ANABİLİM DALI
INDIVIDUAL COURSE DESCRIPTION

Course Ttitle	Code	Semester	T+U Hours	Credit	ECTS
MACHINE LEARNING	ECE-562	FALL+SPRING	3 + 0	3	10

Prerequisities and co-re-requisities	Introduction to Computer Programming, Probability and Statistics, Linear Algebra

Type	Elective
Language	English
Coordinator	Assist. Prof. Dr. Zafer Aydin
Instructor	Assist. Prof. Dr. Zafer Aydin
Adjunt	None
Aim	This course provides an introduction to machine learning. Students will learn the concepts behind the algorithms by exploring the fundamental theoretical principles without going deeply into the mathematics and gain practical experience by applying the techniques on selected problems.
Learning Outcomes	1. Explain the types of learning techniques 2. Explain the mathematical and algorithmic principles of fundamental classification, clustering, transformation and optimization methods 3. Solve a machine learning problem by applying the appropriate mathematical and algorithmic methodologies 4. Implement machine learning methods using an appropriate software (e.g. Python, WEKA) 5. Apply a machine learning method to a real problem by completing a course project
Course Content	• Types of learning strategies • Linear discriminants • Neural networks • Dimensionality reduction • Probabilistic learning • Support vector machines • Unsupervised learning • Optimization methods

WEEKLY TOPICS AND PRELIMINARY STUDY

Week	Topics	Prelimanary Study
1	**Introduction and preliminaries:** types of machine learning, weight space, curse of dimensionality, testing machine learning algorithms, overfitting, train testing validation sets, confusion matrix, accuray metrics, minimising risk, basic statistics	
2	**Linear Regression Models:** Linear basis function models, bias variance decomposition	
3	**Linear Models for Classification:** discriminant functions, linear separability, probabilistic generative models, probabilistic discriminative models	
4	**Multi-layer perceptron:** brain and neuron, perceptron, going forward, backpropagation of error, amount of training data, number of hidden layers, when to stop learning, neural network examples	
5	**Multi-layer perceptron:** neural network examples, derivation of backpropagation	
6	**Midterm 1**	
7	**Radial basis functions and splines:** receptive fields, RBF network, interpolation and basis functions	

8	**Support vector machines:** optimal separation, kernels	
9	**Support vector machines:** SVM algorithm, extensions	
10	**Dimensionality reduction:** linear discriminant analysis, principal component analysis, factor analysis,	
11	**Dimensionality reduction:** independent component analysis, locally linear embedding, isomap	
12	**Midterm 2**	
13	**Ensemble Methods:** bagging, boosting	
14	**Ensemble Methods:** stacking, model fusion strategies	
15	**Advanced Learning Methods:** Pattern-based classification, clustering assisted classification,semi-supervised learning	
16	**Final Exam**	

SOURCES	
Lecture Notes	Lecture slides
Other Sources	**Course Textbook:** 1. Pattern Recognition and Machine Learning, Christopher Bishop, 2006. **Additional Materials**: **1.** Introduction to Machine Learning, 2nd ed. Ethem Alpaydin **2.** "Data Mining: Practical Machine Learning Tools and Techniques", Ian H. Witten, Eibe Frank, Mark A. Hall, Morgan Kaufmann Publishers, 2011. **3.** Machine Learning, The Art and Science of Algorithms that Make Sense of Data, Peter Flach **4.** Machine Learning: Hands-On for Developers and Technical Professionals, Jason Bell

COURSE MATERIALS SHARING	
Documents	Lecture notes, slides
Homeworks	10
Exams	2 Midterm and 1 Final Exam

EVALUATION SYSTEM		
SEMESTER STUDY	**NUMBER**	**CONTRIBUTION**
Midterm	2	30
Homework	10	10
Semester Project	2	40
Final Exam	1	20
Contribution of Semester Study		80
Contribution of Final Exam	1	20
TOTAL		100

Course Category	
Sciences and Mathemetics	%50
Engineering	%50
Social Sciences	%0

RELATIONSHIPS BETWEEN LEARNING OUTCOMES AND PROGRAM QUALIFICATIONS							
No	Program Qualitications	Contribution Level					
		1	2	3	4	5	
1	The skills of using mathematics, science and engineering information in advanced research				X		
2	The skills of analyzing, designing and/or implementing an original system that will be able to solve an engineering problem					X	
3	The skills of using the required software, hardware and modern measurement equipments in their field of research					X	

4	The skills of planning independent research and implementing in detail			X		
5	The skills of following literature, listening to and making technical presentation, writing a paper in academic level			X		
6	The skills of innovative and interrogative thinking and finding original solutions		X			

Increasing from 1 to 5

ECTS/ WORK LOAD TABLE			
Activities	Number	Duration (Hours)	Total Work Load
Course Length (includes exam weeks: 16x total course hours)	16	3	48
Out of class study time (pre-study, practice)	16	8	128
İnternet search, library work, literature search	1	5	5
Presantation			
Homework	10	5	50
Midterm Exam	2	20	40
Final Exam	1	30	30
Total Work Load			291
Total Work Load/ 30			291/30
Course ECTS Credit			10