AGU Graduate School of Engineering and Science Electrical and Computer Enginering Program

COURSE RECORD

Code	**ECE 518**
Name	**Fundamentals of Big Data Analytics**
Hour per week	3+0 (Theory + Practice)
Credit	3
ECTS	7,5
Level/Year	Graduate
Semester	Fall, Spring
Type	Elective
Location	
Prerequisites	Calculus, Probability and Statistics, Linear Algebra, Data Mining
Special Conditions	
Coordinator(s)	Mustafa Coşkun PhD
Webpage	
Content	This course provides an introduction to big data analytics. It covers fundamental mathematical background of data mining and machine learning applications. The course also provides applications of graph mining tasks such as PageRank, etc. Methods will be implemented by a software and applied on various machine learning and data mining problems.
Objectives	O1. Gain an understanding of mathematical background of data mining O2. Learn the techniques used for solving problems involving very large datasets O3. Gain practice by completing programming assignments O4. Apply the concepts to a real problem by completing a course project
Learning Outcomes	LO1. Explain the mathematical and algorithmic principles of deep learning models LO2. Solve a machine learning/ data mining problem using efficient numerical algebra methods LO3. Implement a big data analytics models model using a software LO4. Apply big data analytic methods to a real problem
Requirements	A GPA higher than 3.0 or high letter grades from prerequisite courses.
Reading List	1. Applied Numerical Algebra by J.W Demmel 2. Numerical Optimization by Jorge Nocedal 3. Iterative Methods by Yousef Saad 3rd edition
Ethical Rules and Course Policy	Cheating in assignments and exams is strictly prohibited.

LEARNING ACTIVITIES

Activities	**Number**	**Weight (%)**
Lectures (on-site)	14	30%
Lectures (online videos)	7	20%
Problem solving and assignments	12	30%
Project and Presentations	1	20%
	Total	100

ASSESSMENT

Evaluation Criteria	**Weight** (%)
Quizzes	10%

Homework Assignments	30%
Project Assignment and Presentation	20%
Midterm Exam	20%
Final Exam/Submission	20%
Total	100%

For a detailed description of grading policy and scale, please refer to the website https://goo.gl/HbPM2y section 28.

COURSE LOAD

Activity	**Duration** (hour)	**Quantity**	**Work Load** (hour)
Lectures	3	14	42
Research (web, library)	5	1	5
Required Readings	1	14	14
Online course videos	1	7	7
Assignments	7	10	70
Project	30	1	30
Pre-work for Presentation	4	1	4
Pre-work for Quizzes	1	5	5
Pre-work for Midterm	20	1	20
Pre-work for Final	30	1	30
		General Sum	**227**

ECTS: 7,5 (Work Load/25-30)

CONTRIBUTION TO PROGRAMME OUTCOMES*

	PO1	PO2	PO3	PO4	PO5	PO6
LO1	5	5	3	3	3	3
LO2	5	5	4	4	4	3
LO3	4	5	5	5	3	3
LO4	4	5	5	5	5	4

* Contribution Level: 0: None, 1: Very Low, 2: Low, 3: Medium, 4: High, 5: Very High

WEEKLY SCHEDULE

W	**Topic**	**Outcomes**
1	Numerical linear algebra review, optimization problems, linear least squares	LO1, LO2
	Activity: Online video lectures, readings	
2	Tikhonov regularization / ridge regression, Lasso, pivoted QR	LO1, LO2, LO3
	Activity: Online video lectures, readings, homework	
3	Basics of iterative solvers and sparse linear least squares	LO1, LO2, LO3
	Activity: Online video lectures, readings, quiz, homework	
4	Latent factor models, linear dimensionality reduction, and matrix factorization	LO1, LO2, LO3
	Activity: Online video lectures, readings, homework	
5	Basics of Krylov subspace methods, LSQR, LSMR	LO1, LO2, LO3, LO4
	Activity: Online video lectures, readings, homework	
6	Randomized numerical linear algebra	LO1, LO2, LO3, LO4
	Activity: Readings, quiz, homework	
7	Midterm Exam	LO1, LO2
8	Semester break	
9	Eigenvectors and decompositions, PageRank Random Walk With Restarts	LO1, LO2, LO3, LO4
	Activity: Online video lectures, readings, homework	
10	Basic network analysis, structure, heavy tails, random graph models	LO1, LO2, LO3, LO4
	Activity: Readings, quiz, homework	
11	Learning on graphs: unsupervised network clustering and community	LO1, LO2, LO3

	detection Activity: Readings, quiz, homework	
12	Graph-based semi-supervised learning Activity: Readings, homework	LO1, LO2, LO3
13	Node Representation Learning (Node Embedding) Activity: Readings, homework	LO1, LO2, LO3
14	Small patterns in networks (Graphlet) Activity: Readings, homework, quiz	LO1, LO2, LO3, LO4
15	Ranking and network centrality, Recommendation Systems, Katz, HITs Activity: Online video lectures, readings, homework	LO1, LO2, LO3, LO4
13	Final exam Activity: Project presentations	LO1, LO2, LO4

Prepared by
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