

## Course Information

[illegible]

Learning Outcomes	<p>Upon the completion of this course, the student will be able to:</p> <ol style="list-style-type: none"> <li>1. Define machine learning.</li> <li>2. Evaluate a given model.</li> <li>3. Apply typical techniques such as dimension reduction, using decision trees, naive bayes</li> <li>4. Work with features</li> <li>5. Work with real world data</li> </ol>
Course Content	<ol style="list-style-type: none"> <li>1. Concepts of Machine Learning (Standard Examples, Relations with Other Fields, Approaches); Building an initial estimation model; Model evaluation criteria</li> <li>2. Building a first kNN Model</li> <li>3. Model Selection Criteria; Linear models (Linear regression, Logistic regression, Ridge, Lasso); Comparison of advantages and disadvantages of techniques</li> <li>4. Dimension reduction; Feature selection strategies; Feature projection strategies (PCA, NMF, Kernel PCA, LDA, GDA); Comparison of advantages and disadvantages of techniques</li> <li>5. Decision trees; Basic terminology; Basic methods for splitting trees (Variance reduction, Knowledge Gain, Gini, Chi-square); Alternative methods to decision trees (Random forest, XGBoost)</li> <li>6. Working with Features (Date-Time data, Categorical data, Reframing Numerical Quantities, Scaling Numerical Quantities)</li> <li>7. Working with Text Files (Using Regex, Text Cleanup)</li> <li>8. Naive Bayes</li> <li>9. Factor Analysis</li> </ol>
References	<ol style="list-style-type: none"> <li>1. Bishop. CM. 2006. Pattern Recognition and Machine Learning. Springer.</li> <li>2. Murphy, KP. 2012. Machine Learning: A Probabilistic Perspective. MIT Press.</li> <li>3. Kelleher, A, Kelleher, A. 2019. Machine Learning in Production: Developing and Optimizing Data Science Workflows and Applications. Addison Wesley.</li> <li>4. Burkov, A. 2019. The Hundred-Page Machine Learning Book. (Free E-Book)</li> </ol>

**Course Schedule:** Friday 13:30 – 16:20; 211 İB

**Office Hours:** Available upon request, through Zoom (evenings).

## Weekly Course outline

Week	Topics	Pre-study
1	Concepts of Machine Learning <ul style="list-style-type: none"> <li>• Standard Examples</li> <li>• Relations with Other Fields</li> <li>• Approaches</li> <li>• Building an initial estimation model</li> <li>• Model evaluation criteria               <ul style="list-style-type: none"> <li>• Confusion Matrix</li> <li>• Precision</li> <li>• Accuracy</li> <li>• Recall</li> <li>• R-Square</li> </ul> </li> </ul>	Install necessary software (Knime, Python, R, Java, MySQL or SQLite) <b>First assignment:</b> Establish Github account and follow course Github page
2	Building a first kNN Model Model Selection Criteria <ul style="list-style-type: none"> <li>• Over-fitting</li> <li>• Under-fitting</li> <li>• Verification</li> <li>• Bias</li> </ul>	Form Project Teams
3	Linear models <ul style="list-style-type: none"> <li>• Linear regression</li> <li>• Logistic regression</li> </ul>	<b>Select Team Project Topics</b>
4	Linear models (cnt'd) <ul style="list-style-type: none"> <li>• Ridge</li> <li>• Lasso</li> <li>• Comparison of advantages and disadvantages of techniques</li> </ul>	
5	Dimension reduction <ul style="list-style-type: none"> <li>• Feature selection strategies</li> <li>• Feature projection strategies               <ul style="list-style-type: none"> <li>◦ PCA</li> <li>◦ NMF</li> <li>◦ Kernel PCA</li> </ul> </li> </ul>	
6	Dimension reduction (cnt'd) <ul style="list-style-type: none"> <li>• Feature projection strategies               <ul style="list-style-type: none"> <li>◦ LDA</li> <li>◦ GDA</li> <li>◦ Comparison of advantages and disadvantages of techniques</li> </ul> </li> </ul>	
7	Mid-Term Examination	
8	Decision trees <ul style="list-style-type: none"> <li>• Basic terminology</li> <li>• Basic methods for splitting trees</li> </ul>	

	<ul style="list-style-type: none"> <li>○ Variance reduction</li> <li>○ Knowledge Gain</li> <li>○ Gini</li> <li>○ Chi-square</li> </ul>	
9	Decision trees (cnt'd) <ul style="list-style-type: none"> <li>• Alternative methods to decision trees               <ul style="list-style-type: none"> <li>○ Random forest</li> <li>○ XGBoost</li> </ul> </li> </ul>	
10	Working with Features <ul style="list-style-type: none"> <li>• Date-Time data</li> <li>• Categorical data</li> <li>• Re-framing Numerical Quantities</li> <li>• Scaling Numerical Quantities</li> </ul>	
11	Working with Text Files <ul style="list-style-type: none"> <li>• Using Regex</li> <li>• Text Cleanup</li> </ul>	
12	Naive Bayes	
13	Factor Analysis	
14	Project Presentations	

### Assesment methods

Course Activities	Number	Percentage %
Attendance ( <b>mandatory after add-drop week</b> )	12	%10
Assignments ( <b>programs and/or reports, submissions through Github</b> )	4	%40
Midterm Exam ( <b>in-class, short duration, with discussion questions</b> )	1	%20
Final Project ( <b>a program, with a report, submissions through Github</b> )	1	%30
Total	18	100
Percentage of semester activities contributing grade success	18	100
Percentage of final exam contributing grade success		
Total	18	100

**Attendance:** Attendance after add-drop period is mandatory. Students are required to attend at least %70 of classes. Typical excuses such as health reports should be communicated with the instructor.

**Use of Programming Languages:** Course discussions are language-independent. Some examples will be visualized through Knime.

Assignments will be primarily based on Java, Python or R code unless there is a specific requirement. Students are expected to have a fundamental understanding of programming language. Some limited guidance is available.

**Course Category:** Major Area Courses

**Workload and ECTS Calculation**

Activities	Number	Duration (Hours)	Total Work Load
Course Duration ( Including Exam Week: 16 x Total Hours)	14	3	42
Laboratory			
Application			
Specific practical training (if any)			
Field Activities			
Study Hours Out of Class (Preliminary work, reinforcement, etc)	13	3	39
Presentation / Seminar Preparation			
Projects	1	30	30
Homework assignment	4	6	24
Midterms ( Study duration )	1	25	25
Final ( Study duration )			
Total Workload			160

### Matrix of the Course Learning Outcomes Versus Program Outcomes

Program Outcomes	Contribution Level*				
	1	2	3	4	5
1 Deepen and develop advanced level and current knowledge in economics to an expert level based on the competencies of the economics education and acquire the skills make original thoughts, views, and contributions to science.					x
2 To comprehend the interaction between economics and related fields; to achieve original results by using expert knowledge in analysis, and evaluation of new and complex ideas.					x
3 To acquire high level skills in applied methods in economics and to be able to systematically follow new theoretical developments in applied economics.					x
4 To be able to apply existing techniques to an original research idea.					x
5 To find a new scientific method.					x
6 To broaden the knowledge of economics by publishing scientific articles related to economics in national or international refereed journals and to publish these articles in a scientific ethical way.					x
7 To be able to identify, participate in, organize and lead activities, such as panels, workshops and conferences, that aim to develop solutions for novel and interdisciplinary problems.			x		
8 To follow pioneering and innovative theories and methods in economics, to be able to use them in analysis and research and to be able to contribute to the process of becoming an information society.					x
9 To be able to analyze the relationships and processes in economics and to develop functional and effective communication networks.			x		
10 To make some scientific contributions to projects aiming to increase the productivity in business.					x
11 To be able to share his/her work and to criticize works of others by using academic networks in economics efficiently.					x

1: Lowest, 2: Low, 3: Average, 4: High, 5: Highest