

Course title	Machine Learning																												
Course number	COMP 551																												
Credit hours (lecture and lab)	3 (2 + 1)																												
ECTS (weekly contact and self-study load)	6 (3 + 3)																												
Prerequisites/co-requisites by course number and name	COMP 364 Introduction to Artificial Intelligence and Machine Learning																												
Prerequisites by topic (other than the formal prerequisites above)	None																												
Level and type (compulsory, elective)	BE elective course																												
Year of study and semester	Any																												
Catalogue description	Machine learning and statistical pattern recognition. Applications of machine learning in robotic control, data mining, autonomous navigation, bioinformatics, speech recognition, and text and web data processing. Also, includes supervised learning, generative/discriminative learning, parametric/non-parametric learning, neural networks, support vector machines; unsupervised learning, clustering, dimensionality reduction, kernel methods.																												
Objectives	This course introduces the concepts, principles, and methods of Machine Learning. The course puts emphasis on using machine learning techniques and their implementation to solve real problems. The students are introduced to the use of modern machine learning tools.																												
Intended learning outcomes	Upon successful completion of this course, students will be able to: <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">No</th> <th style="text-align: center;">Intended learning Outcome (ILO)</th> <th style="text-align: center;">PLO*</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td>Demonstrate understanding of different areas within artificial intelligence.</td> <td style="text-align: center;">1, 4</td> </tr> <tr> <td style="text-align: center;">2</td> <td>Demonstrate understanding of the fundamental principles and applications of machine learning.</td> <td style="text-align: center;">1, 2</td> </tr> <tr> <td style="text-align: center;">3</td> <td>Demonstrate understanding of the benefits and drawbacks of different machine learning techniques.</td> <td style="text-align: center;">1, 2</td> </tr> <tr> <td style="text-align: center;">4</td> <td>Demonstrate understanding of different learning paradigms in machine learning.</td> <td style="text-align: center;">1, 2</td> </tr> <tr> <td style="text-align: center;">5</td> <td>Implement algorithms to solve typical machine learning tasks.</td> <td style="text-align: center;">2, 6, 7</td> </tr> <tr> <td style="text-align: center;">6</td> <td>Represent data to facilitate machine learning.</td> <td style="text-align: center;">2, 6, 7</td> </tr> <tr> <td style="text-align: center;">7</td> <td>Select an appropriate model for a task and evaluate its performance.</td> <td style="text-align: center;">2, 6, 7</td> </tr> <tr> <td style="text-align: center;">8</td> <td>Use machine learning to solve real-life problems</td> <td style="text-align: center;">2, 3, 5, 6, 7</td> </tr> </tbody> </table> <p>(*) The Program learning outcome (PLOs) are listed in the appendix</p>		No	Intended learning Outcome (ILO)	PLO*	1	Demonstrate understanding of different areas within artificial intelligence.	1, 4	2	Demonstrate understanding of the fundamental principles and applications of machine learning.	1, 2	3	Demonstrate understanding of the benefits and drawbacks of different machine learning techniques.	1, 2	4	Demonstrate understanding of different learning paradigms in machine learning.	1, 2	5	Implement algorithms to solve typical machine learning tasks.	2, 6, 7	6	Represent data to facilitate machine learning.	2, 6, 7	7	Select an appropriate model for a task and evaluate its performance.	2, 6, 7	8	Use machine learning to solve real-life problems	2, 3, 5, 6, 7
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Teaching and learning methods	<p>Development of ILOs is promoted through the following teaching and learning methods:</p> <ul style="list-style-type: none"> • The Digital Systems Lab. is open for the students to practice the practical aspects and solve the programming homework assignments. • The student attends the class presentations and participates in the discussions. • The student joins the related online team/group and participates in its discussions. • The student studies the reference material, including books and videos. • The student solves the programming assignments in machine learning. • The student carries out a term project for solving a problem using machine learning techniques. • The student develops a professional report for the term report. • The student presents the term project in class. 																																																															
Learning material type	<p>Textbook, class handouts, some instructor keynotes, selected YouTube videos, and access to a personal computer and the internet.</p>																																																															
Resources and references	<p>A- Required book(s), assigned reading and audio-visuals:</p> <ol style="list-style-type: none"> 1. Christopher Bishop, Pattern recognition and machine learning. Springer, 2006 <p>B- Recommended book(s), material and media:</p> <ol style="list-style-type: none"> 2. Russell, Stuart J., and Peter Norvig. "Artificial intelligence: a modern approach." Pearson Education Limited, 2016. 																																																															
Topic outline and schedule	<table border="1"> <thead> <tr> <th>Week</th> <th>Topic</th> <th>ILO</th> <th>Resources</th> </tr> </thead> <tbody> <tr><td>1-2</td><td>Introduction to AI and ML</td><td>1, 2, 3</td><td>1, 2</td></tr> <tr><td>2-3</td><td>Regression</td><td>5, 8</td><td>1</td></tr> <tr><td>4</td><td>Discriminative Algorithms</td><td>5, 8</td><td>1</td></tr> <tr><td>5</td><td>Bayesian Classifier</td><td>5</td><td>1</td></tr> <tr><td>6</td><td>Decision Tree Learning</td><td>4, 5, 8</td><td>1</td></tr> <tr><td>7</td><td>Neural Networks</td><td>4, 7</td><td>1</td></tr> <tr><td>8</td><td>Deep Learning</td><td>4, 7</td><td>1</td></tr> <tr><td>9</td><td>Support Vector Machine</td><td>5, 7, 8</td><td>1, 2</td></tr> <tr><td>10</td><td>SVM and VC-Dimension</td><td>5, 7, 8</td><td>1, 2</td></tr> <tr><td>11</td><td>K-Means and Expectation Maximization</td><td>5, 7, 8</td><td>1, 2</td></tr> <tr><td>12</td><td>Clustering</td><td>4, 5, 7, 8</td><td>1</td></tr> <tr><td>13</td><td>PCA Learning</td><td>4, 5, 6</td><td>1</td></tr> <tr><td>14</td><td>Reinforcement Learning</td><td>4, 7</td><td>1, 2</td></tr> <tr><td>15</td><td>Project Presentations</td><td>All</td><td></td></tr> </tbody> </table>	Week	Topic	ILO	Resources	1-2	Introduction to AI and ML	1, 2, 3	1, 2	2-3	Regression	5, 8	1	4	Discriminative Algorithms	5, 8	1	5	Bayesian Classifier	5	1	6	Decision Tree Learning	4, 5, 8	1	7	Neural Networks	4, 7	1	8	Deep Learning	4, 7	1	9	Support Vector Machine	5, 7, 8	1, 2	10	SVM and VC-Dimension	5, 7, 8	1, 2	11	K-Means and Expectation Maximization	5, 7, 8	1, 2	12	Clustering	4, 5, 7, 8	1	13	PCA Learning	4, 5, 6	1	14	Reinforcement Learning	4, 7	1, 2	15	Project Presentations	All				
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Evaluation tools	<p>Opportunities to demonstrate achievement of the ILOs are provided through the following assessment tools:</p> <table border="1" data-bbox="516 323 1500 579"> <thead> <tr> <th>No</th> <th>Intended learning Outcome (ILO)</th> <th>PLO*</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Introducing different areas within artificial intelligence.</td> <td>1, 4</td> </tr> <tr> <td>2</td> <td>Understanding of the fundamental principles and applications of machine learning.</td> <td>1, 2</td> </tr> <tr> <td>3</td> <td>Demonstrate understanding of supervised and unsupervised learning techniques.</td> <td>1, 2</td> </tr> </tbody> </table>	No	Intended learning Outcome (ILO)	PLO*	1	Introducing different areas within artificial intelligence.	1, 4	2	Understanding of the fundamental principles and applications of machine learning.	1, 2	3	Demonstrate understanding of supervised and unsupervised learning techniques.	1, 2
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Student requirements	<p>The student should have a computer and internet connection.</p>												
Course policies	<p>A- Attendance policies:</p> <ul style="list-style-type: none"> • Attendance is required. Class attendance will be taken every class and the university polices will be enforced in this regard. <p>B- Absences from exams and not submitting assignments on time:</p> <ul style="list-style-type: none"> • A makeup exam can be arranged for students with acceptable absence causes. • Assignments submitted late, but before announcing or discussing the solution can be accepted with 25% penalty. • The project report must be handed in in time. <p>C- Health and safety procedures:</p> <ul style="list-style-type: none"> • All health and safety procedures of the university and the school should be followed. <p>D- Honesty policy regarding cheating, plagiarism, misbehavior:</p> <ul style="list-style-type: none"> • Open-book exams • All submitted work must be of the submitting student. • Other text or code must be properly quoted with clear source specification. • Cheating will not be tolerated. <p>E- Available university services that support achievement in the course:</p> <ul style="list-style-type: none"> • Moodle course page • AI Lab for practicing the practical aspects and solving the programming assignments. • Program announcements Facebook group 												
Additional information	<p>None</p>												