

ITCS 4156 Machine Learning - Summer 2020 (Sec 080) - ONLINE

Instructor: Dr. Angelina A Tzacheva, Department of Computer Science, College of Computing and Informatics,
OfficeHours: Tuesday 4pm to 6pm Skype, Install Skype from [Skype.com](https://www.skype.com), call the userID angelina.tzacheva during office ho
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Teaching Assitants:

1. Akshaya Easwaran, OfficeHours: Monday, Tuesday 10am to 11:30am, by Live Web Conference using Skype, SkypeID:aks
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Prerequisites: ITCS 3153 - Introduction to Artificial Intelligence, STAT 2122 - Introduction to Probability and Statistics

Textbook:

1. "[Introduction to Machine Learning](#) ", Second Edition, Ethem ALPAYDIN, The MIT Press, 2010: ISBN-10: 0-262-01243-0
ISBN-13: 978-0-262-01243-0
2. "[Introduction to Data Mining](#)" by Pang-Ning Tan, Michael Steinbauch, and Vipin Kumar. Addison Wesley, 2005
ISBN-10: 0321321367

Course Outline:

- Knowledge discovery process
- Types of Data, Pre-processing, Distance Measures
- Association rules discovery methods
- Discretization algorithms
- Decision Trees
- Classification methods
- KNearest Neighbor
- Artificial Neural Networks
- Regression
- Clustering Analysis
- RSES, LERS, WEKA, ORANGE
- Hadoop, MapReduce, and distributed data mining
- Application is specific domain (health, financial, education, music)

Instructional Method:

This is an Online course which includes Video Lectures, Reading Assignments, Exercises, GroupActivites, and a Group Proj
Lectures Notes, Videos, and Reading Assignments are posted in the syllabus table below, as well as on [Canvas](#). Please d
and read each lecture material, and view each Video on the specified day.

All material by date is listed, including preparation for the exams with sample questions. The Exams are open-book / open-no
textbook is necessary, as exam questions are based on lecture notes AND on the text, and Exercises are assigned i
textbook.

Credit Hours: This is a 3 credit hour course.

This course is designed to require about 10 hours per week - for readings, exams, exercises, video cases, and group project
The material is technical, and requires dedication of time to comprehend. To complete course successfully, Please do not
cramming all lectures the day before the exam. Designate 3 hours every lecture day for reading the given lecture, and book
Designate additional 4 hours per week for Exercises, videocase assignments, and Group meetings / activites. You can m
your Group Members ONLINE through video conferencing - via Skype , GoogleHangout , or meet in person if desired. Stud
expected to communicate and meet with their group members in order to complete the project successfully.

Exercises are assigned after each chapter. The Exercises are due on [Canvas](#) on the dates they are assigned. Exercises
accepted* through e-mail. Late Exercises are not accepted.

Grading:

The final course grade is determined on the following weights:

- Exercises 20%
- GroupActivities 15%
- Midterm Exam 20%
- Group Project 25%
- Final Exam 20%

Gradig scale:

- A 90% - 100%
- B 80% - 89%
- C 70% - 79%

- D 60% - 69%
- F less than 60%
- X academic dishonesty

Academic Integrity and Honesty:

Students are required to read and abide by the [Code of Student Academic Integrity](#) available from Dean of Students Office. It forbids cheating, fabrication or falsification of information, multiple submissions of academic work, plagiarism (including others work without instructor permission), abuse of academic materials, and complicity of academic dishonesty. Violation Code of Student Academic Integrity, including plagiarism, result in disciplinary action as provided by the Code.

Civility:

We are concerned with a positive learning experience. This course strives to create an inclusive academic climate in which the dignity of all individuals is respected and maintained. We value diversity that is beneficial to both employers and society. Students are encouraged to actively and appropriately share their views in class discussions.

Inclement Weather:

University Policy Statement #13 states the University is open unless the Chancellor announces that the University is closed. In the event of inclement weather, check your e-mail, and [Canvas](#) instructor will post a message on [Canvas](#), and through e-mail. The instructor will use their best judgment as to whether class will be held.

Disability:

UNC Charlotte is committed to access to education. If you have a disability and need academic accommodations, please get a letter of accommodation from Disability Services early in the semester. For more information on accommodations, contact the [Office of Disability Services](#) at 704-687-0040 or visit their office in Fretwell 230.

Withdrawal:

The University policy on [Course Withdrawal](#) allows students a limited number of opportunities available to withdraw from a course. There are financial and academic consequences that may result from course withdrawal. If a student is concerned about their ability to succeed in this course it is important to make an appointment to speak with the instructor as soon as possible.

Syllabus Revision:

The instructor may modify the class schedule and syllabus during the course of the semester. For example - additional educational videos may be posted. Same changes will appear on [Canvas](#). Students are responsible for refreshing their syllabus once per week.

E-Mail Communication:

Students are responsible for *all* announcements made in class and on the class online resources. Students should check their class resources throughout the semester. The Instructor and Teaching Assistants send occasional e-mails with important information. We send this information to the student's UNCCCharlotte e-mail address listed on Banner system. If a student is not checking their UNCCCharlotte e-mail address (ex. userName@uncc.edu) please be sure to access this e-mail and check it regularly during the course.

Class Expectation:

By attending class beyond the first week, students agree to follow the framework and rules related to this course as described in the syllabus.

Syllabus:

Date	Material
Jun 29	<p>Preview of course syllabus Find your Group - members here for the Group Project</p> <p>Group Project Description</p> <p>ML_01_Introduction</p> <p>Read Chapter 1 from the Book 1. - Machine Learning today.</p> <p>Overview of Knowledge Discovery in Databases (KDD) - I</p> <p>Video: L01_01_OverviewOfKnowledgeDiscoveryInDatabases</p>
	<p>Read Chapter 1 from the Book 2. - Data Mining today.</p> <p>Exercise: 2. Chapter 1 //to turn in: save solution in a text file and upload to Canvas</p> <p>Overview of KDD (continued) - II</p> <p>video: L01_01KDDDefinition</p> <p>video: L01_02DataInformationKnowledge</p> <p>video: L01_03KDDProcess</p> <p>video: L01_04KDDContributingAreas</p>
Jun 30	<p>Data - Types, Quality, Pre-processing, Similarity Measures</p> <p>Read Chapter 2 from the Book 2. - Data Mining today.</p>

	Exercises: 2. and 14. Chapter 2 VideoCase_01_Data Preparation video: L02_01WhatsData_TypesOfAttributes video: L02_02TypesOfAttributes_Outliers video: L02_03PlottingOfObjects_CurseOfDimensionality video: L02_04SamplingFeatureSelection_DistanceEculidean
	ML_06_DimensionalityReduction Read Chapter 6 from the Book 1. - Machine Learning today. VideoCase_02_HandlingNoisyData
July 1	Mathematical Background Review - Intro To Set Theory Association Rule Mining - Agrawal (Apriori) method (frequent item-sets) Read Chapter 6 from the Book 2. Data Mining today. Exercise: 2. (a) (b) Chapter 6 video: L03_01IntroToSetTheorySetsElementsEmptySetUniversalSet video: L03_02IntroToSetTheoryIntersectionUnionComplementSetDifference video: L03_03AssociationRulesIntroAprioriAgrawalMethod
	Argawal (Apriori) method (frequent item-sets) Example Exercise: 6. Chapter 6 video: L04_01SupportAndConfidence_AssociationRules video: L04_02AprioriEample_FrequentItemsets video: L04_03AprioriExample_AssociationRules
July 2	Decision rules - LERS (certain and possible rules) video: L06_01LERSIntroduction video: L06_02LERSExampleFirstLoop video: L06_03LERSExampleCertainPossibleRules video: L06_04LERSExampleSecondLoop video: L06_05LERSExampleThirdLoopEnd
	Exercise: download LERS software - calculate rules using data from the lecture above // to turn in: take a screen shot of your runtime environment showing the rules upload the screen shot to Canvas Exercise8.Chapter6. (ExtraCreditOnly) // this exercise is Optional and it is for ExtraCredit . Submit ONLY if you missed one exercise before
July 3	Holiday - No Classes
July 6	ML_02_SupervisedLearning Read Chapter 2 from the Book 1. - Machine Learning today. video: L07_01:ML_02_SupervisedLearning ML_03_BayesianDecisionTheory DM_04_NaiveBayes video: L07_02:DM_04_NaiveBayes ML_14_BayesianEstimation Read Chapter 3 from the Book 1. - Machine Learning today. Read Chapter 14 from the Book 1. - Machine Learning today. Read Chapter 5.3 from the Book 2. - Data Mining today. VideoCase03_NaiveBayesModel
July 7	ML_04_ParametricMethods Read Chapter 4 from the Book 1. - Machine Learning today. video: L20_01:ML_04_ParametricMethods

	DM_4.6.1_LinearRegression video:L22_01:DM_4_6_1_LinearRegression VideoCase04_LinearRegression DM_4.6.2_LogisticRegression Video:L23_01:DM_4.6.2_LogisticRegression
July 8	ML_08_NonparametricMethods Read Chapter 8 from the Book 1. - Machine Learning today. ML_09_DecisionTrees Read Chapter 9 from the Book 1. - Machine Learning today. VideoCase05_DecisionTree Video_ML_08_NonparametricMethods Video_ML_09_DecisionTrees
July 9	Decision Trees - Discovery System ID3 Read Chapter 4.3 from the Book 2. - Data Mining today. Exercise: 2. Chapter 4 video: L09_01DecisionTreesIntroduction video: L09_02DecisionTreesIntroExamples video: L09_03DecisionTreesEntropyInformationGain
	System ID3 Example Mathematical Background Review - Logarithm Exercise: 3. Chapter 4 video: L10_01System_ID3_Example_Entropy video: L10_02System_ID3_Example_Entropy02 video: L10_03System_ID3_Example_AttributeSelection video: L10_04Mathematical_Background_Review_Logarithm Video_Decision_Trees_Discovery_System_ID3
July 13	DM_04_4.3_Chap4_K_NearestNeighbor video: L18_01DM_04_Chap4_K_NearestNeighbor Read Chapter 5.2 from the Book 2. - Data Mining today. VideoCase06_K_NearestNeighbor Preparing for MidTerm Exam Sample Questions Answer Key
July 14	Midterm Exam - access exam on Canvas - may complete exam any time of the day today (finish no later than 11:55pm) - allowed time for exam is: 3:00 hours
July 15	Discovery System Rosetta video: L11_01DiscoverySystemRosetta_Example video: L11_02DiscoverySystemRosetta_DiscernibilityMatrix video: L11_03DiscoverySystemRosetta_DiscernibilityFunction
	Mining Incomplete Data video:L24_01MiningIncompleteData
	GroupActivity_01 : Download RSES Software Calculate Rules and Classify Data // one group member submits this Exercise for the whole group // to turn in : save your .rses project file (File Save As in RSES) and upload the .rses file to Canvas
July 16	ML_05_MultivariateMethods ML_11_MultilayerPerceptrons DM_04_4.7_Chap4_ArtificialNeuralNetworks Read Chapter 5 from the Book 1. - Machine Learning today.

	<p>Read Chapter 11 from the Book 1. - Machine Learning today. Read Chapter 5.4 from the Book 2. - Data Mining today.</p> <p>VideoCase_07_NeuralNetworks</p>
July 20	<p>DM_04_4.9_Chap4_SupportVectorMachines</p> <p>Read Chapter 5.5 from the Book 2. - Data Mining today.</p> <p>video: L21_01DM_04_4.9_Chap4_SupportVectorMachines</p> <p>VideoCase_08_SupportVectorMachines</p>
	<p>Discretization Discretization Example RSES</p> <p>GroupActivity_02 : using RSES software open a dataset discretize the dataset // to turn in : save your .rses project file (File Save As in RSES) and upload the .rses file to Canvas // one group member submits this Exercise for the whole group</p> <p>video: L13_01DiscretizationIntroduction video: L13_02DiscretizationonQuantization video: L13_03RSESAAlgorithmOptimalSetOfCuts video: L13_04DiscretizationExampleRSESPart1 video: L13_05DiscretizationExampleRSESPart2 video: L13_06DiscretizationExampleRSESPart3 video: L13_07DiscretizationIntroduction_Example</p>
July 21	<p>Project Assignment - files due //to turn in: upload PowerPoint file , VideoFile , and SourceCode to Canvas</p>
July 22	<p>Cluster Analysis - Basic Concepts and Algorithms Read Chapter 8.1 - 8.2 from the Book 2. - Data Mining today.</p> <p>video: L14_01ClusterAnalysisAlgorithm video: L14_02ClusterAnalysisIntroPlottingOfObjects video: L14_03ClusterAnalysisPreProcessingCharacteristicsOfData video: L14_04ClusterAnalysisTypesOfClusters video: L14_05PartitioningClusteringKMeans video: L14_06PartitioningClusteringKMeansContinued</p>
	<p>ML_07_Clustering Read Chapter 07 from the Book 1. - Machine Learning today. Partitioning Clustering - K-Means Example</p> <p>video: L15_01KMeansExampleProblemPart1 video: L15_02KMeansExampleProblemPart2 video: L15_03KMeansExampleProblemPart3</p> <p>VideoCase_09_KMeansClustering</p>
July 23	<p>Clustering Techniques (Continued) Hierarchical Clustering Read Chapter 8.3 from the Book 2. - Data Mining today.</p> <p>video: L16_01HierarchicalClustering video: L16_02HierarchicalClusteringAgglomerativeProximityMatrix video: L16_03HierarchicalClusteringInterClusterDistances</p>
	<p>Hierarchical Clustering - Single Link Example Exercise: 16. Chapter 8</p> <p>video: L17_01HierarchicalClusteringSingleLinkExamplePart1 video: L17_02HierarchicalClusteringSingleLinkExamplePart2 video: L17_03HierarchicalClusteringSingleLinkExamplePart3 video: L17_04HierarchicalClusteringSingleLinkExamplePart4</p> <p>VideoCase_10_HierarchicalClustering</p>
July 27	<p>ML_19_DesignAnalysisOfMachineLearningExperiments Read Chapter 19 from the Book 1. - Machine Learning today.</p>

	<p>Evaluation Methods video: L12_01Evaluation_Methods Video ML_19_DesignAnalysisOFMachineLearningExperiments Read Chapter 4.5 from the Book 2 - Data Mining today.</p> <p>GroupActivity_03 : download WEKA software , and ORANGE software - run clustering, association rules discover and a decision tree (use one of the datasets - of your choice - which are pre-loaded in RSES) // to turn in : save your WEKA and Orange project files (go to File Save As) , and upload both your WEKA Orange project files to Canvas , also take screen shots and upload the screen shots to Canvas // one group member submits this Exercise for the whole group</p> <p>VideoCase_11_Evaluation_CrossValidation VideoCase_12_Evaluation_BootStrapping</p>
July 28	<p>Machine Learning for BigData - Hadoop MapReduce</p> <p>Distributed Data Mining - Hadoop , HDFS , MapReduce , HIVE Cloud Tools Overview Basic HDFS Commr</p> <p>GroupActivity_04 : Example MapReduce program Hadoop Environment Setup // one group member submits this Exercise for the whole group</p> <p>Instructions for logging in to the AWS EMR cluster Simple Commands Task2 video: AWS-EMR_Cluster_Setup</p> <p>GroupActivity_04: Example MapReduce program UsingAWS video: ExampleMapReduce_WordCount_using_AWS Video_Distributed_Data_Mining_Hadoop_HDFS_MapReduce_HIVE</p> <p>video: L02_01_Hadoop_DistributedFileSystem video: L02_02_HDFS_NameNode_DataNode video: L02_03_HDFS_Pipelining_Rebalancer_UI video: L02_04_HDFS_UserInterfaceCommands_BasicFeatures video: L02_05_HDFS_FSNamespace_Replication video: L02_06_HDFS_Protocol_Failure_Integrity video: L02_07_HDFS_Staging_Pipelining_Interface</p> <p>video: L19_01_Hadoop_DistributedFileSystem video: L19_02_HDFS_Architecture_NameNode_DataNode_Pipelining video: L19_03_HDFS_Rebalancer_UserInterface_BasicCommands video: L19_04_MapReduce_DataFlow_Features video: L19_05_MapReduce_WordCountCode_Partitioners_Combiners_Compression_Counters video: L19_06_MapReduce_SpeculativeExecution_ZeroReducers_DistributedFileCache</p>
Jul 29	<p>Machine Learning for BigData - Spark Machine Learning Library</p> <p>Intro to Spark , Programming with RDDs , Running on a Cluster , Spark SQL and MLlib , Spark Streaming</p> <p>Intro to Spark (continued)</p> <p>video: L05_01_IntroToSpark_LimitationsOfMapReduce video: L05_02_SparkComutingEngine_ResilientDistributedDatasetsRDDs video: L05_03_SparkBenefitsForUser_GeneralPlatform video: L05_04_Spark_MLlib_GraphX_Streaming_SQL video: L05_05_Spark_SoftwareStack_RunTimeArchitecture_ProgrammingRDDs video: L05_06_Spark_Continued_RunTimeArchitecture_ProgrammingRDDs_DataAnalysisExample</p> <p>video: IntroductionToSpark</p> <p>VideoCase 13. Spark</p>
Jul 30	<p>Preparing for FinalExam Sample Questions Answer Key</p>
Aug 3	<p>Reading Day - No Class</p>
Aug 4	<p>Final Exam</p> <ul style="list-style-type: none"> - access exam on Canvas - exam starts from 8:00pm - 11:00pm - allowed time for exam is: 3:00 hours

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