**ABET Course Syllabus – CS4662**

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| **Code** | CS4662 | **Credits** | 3 |
| **Title** | Advanced Machine Learning | **Coordinator** | Mohammad Pourhomayoun |

**Course Information**

1. **Catalog Description:** Advanced algorithms, tools, and techniques for supervised and unsupervised machine learning and its applications. The course will cover advanced learning methods including Ensemble Learning, Artificial Neural Networks, and Deep Learning.
2. **Prerequisites**: CS4661.
3. **Contact Hours:** Lecture 3 hours.
4. **Required/Elective:** This course is an elective course in the BS program.

**Textbook**

No textbook is required.

**Course Goals**

The Student Learning Outcomes that are addressed by the course are:

* SLO1. Students will be able to apply concepts and techniques from computing and mathematics to both theoretical and practical problems.
* SLO2. Students will be able to demonstrate fluency in at least one programming language and acquaintance with at least three more.
* SLO3. Students will have a strong foundation in the design, analysis, and application of many types of algorithms.
* SLO5. Students will have the training to analyze problems and identify and define the computing requirements appropriate to their solutions.
* SLO7. Students will be able to communicate effectively orally and in writing.
* SLO9. Students will have the ability to analyze the local and global impact of computing on individuals and society.

Other outcomes of instruction:

At the end of the course, students are able to

* Understand the main concepts, applications, and algorithms of *data analytics* and *machine learning*, including *supervised/unsupervised learning.*
* Understand and use statistical modeling and machine learning algorithms including *SVM, Ensemble Learning, Principal Component Analysis (PCA), Neural Networks, Deep Learning,* etc.
* Understand and resolve the main issues involved in statistical modeling and machine learning including, for example, *overfitting, missing values, outlier samples*, etc.
* Understand and use *result visualization/validation, error identification, cross validation, various metrics for evaluation the prediction accuracy*.
* Understand and use tools, software packages, and libraries for data processing, analytics, and machine learning.

**Topics Covered**

* *Introduction and Review of Learning Methods: Supervised learning vs Unsupervised learning, Review of classification, regression, clustering*
* *Review of Learning methods and Error Evaluation: Training/Validation/Testing, Cross Validation, Result validation, error identification, various metrics for evaluation the prediction performance*
* *Ensemble Learning algorithms*
* *Support Vector Machine (SVM)*
  + *Linear SVM*
  + *Non-linear SVM*
  + *Kernel Theory*
* *Principal Component Analysis (PCA) for Dimensionality Reduction*
* *Artificial Neural Networks (ANN)*
  + *Introduction, motivations, applications*
  + *Multi-Layer Perceptron*
  + *Definitions, Algorithms, Methods*
  + *Backpropagation for training an ANN*
* *Deep Learning*
  + *Introduction, motivations, applications*
  + *Deep Neural Networks (DNN)*
  + *Challenges with Deep Neural Networks*
  + *Restricted Boltzmann Machines (RBM)*
  + *Deep Belief Networks (DBN)*
  + *Deep AutoEncoder*
  + *Convolutional Neural Networks (CNN, ConvNet)*
  + *Recurrent Neural Networks (RNN)*
  + *Practical Tutorials, Tools, and Frameworks*

**ADA statement:** Reasonable accommodation will be provided to any student who is registered with the Office of Students with Disabilities and requests needed accommodation.

**Academic honesty statement:** Students are expected to do their own work and to abide by the University Policy on academic honesty, which is stated in the Schedule of Classes. See http://www.calstatela.edu/academicsenate/handbook/ch5a#cheating.

**Student responsibilities:** Students are responsible for being aware of all announcements that are made in class. Students are responsible for announcements made on days that they are absent. Students must check their CSULA email account regularly for information from the instructor and the Department. Failure to do so may result in missed deadlines or other consequences that might adversely affect students. Note that you can forward this email account to any other account of your choosing.