Miami Dade College

Course Description

CAI4510C | Machine Intelligence | 3.00 credits

The course will cover advanced modeling techniques, including ensemble learning, extended linear models and kernel methods (PCA, support vector machines), probabilistic graphical models, Bayesian networks, mixture, and latent variable models, biologically inspired computing (neural networks), feature selection and feature engineering techniques, Markov models, and temporal modeling to find patterns over time. Prerequisites: CAI3822C, COP3350.

Course Competencies:

Competency 1: The student will demonstrate knowledge of machine intelligence by:

1. Describing the fundamentals of machine learning, related areas, applications, and software tools
2. Explaining the basics behind each machine learning method, as well as the respective pros and cons, for solving machine learning problems

Competency 2: The student will demonstrate an understanding of regression by:

1. Applying methods using linear regression, polynomial regression, locally weighted regression, numerical optimization, gradient descent, and kernel methods to solve various problems dealing with prediction
2. Using nearest neighbors' regression to combine various numerical values into a representative summary statistic
3. Using root means squared error to quantify the performance of regression predictions

Competency 3: The student will demonstrate the use of the appropriate classification method by:

1. Applying classification methods, including k-nearest neighbor, decision trees, and nonparametric methods, to build classification models that capture the relationships between attributes of a training set
2. Using a Naïve Bayes classifier for text classification and support vector classifiers for minimizing the number of training errors and obtaining the most significant margin between classes
3. Analyzing the performance of various classifiers on training data

Competency 4: The student will demonstrate how to evaluate and compare different learning methods by:

1. Generating optimal or near-optimal training and testing datasets from a sample dataset
2. Using the appropriate model to avoid overfitting and underfitting from the training dataset
3. Applying different learning algorithms on the training set and evaluating the effectiveness of each method on the testing dataset
4. Determining the type and magnitude of error by deconstructing the error into bias and variance measures of the model

Competency 5: The student will demonstrate how to evaluate classifiers and regressors by:

1. Choosing the most appropriate regressor evaluation technique (i.e., R2, ROC curves, confusion matrices)
2. Determining which metrics to use to evaluate the accuracy of the regression
3. Using mean squared error (and root mean squared error) as a measure of success for measuring regression results

Competency 6: The student will demonstrate an understanding of neural networks and their applications in pattern recognition by:

1. Describing the theoretical and mathematical concepts of the perceptron algorithm and the training procedures, localized network structure, and structures of deep neural networks
2. Using multilayer perceptron NNs, backpropagation to synthesize an NN from training patterns
3. Applying nonlinear regression and multiclass discrimination to extract clusters from parametrized data
4. Training procedures, localized network structure, deep neural networks

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Competency 7: The student will demonstrate an understanding of graphical and sequential models learning by:

1. Exploring Bayesian networks, conditional independence, Markov, and hidden Markov models
2. Decoding states from observations, learning HMM parameters, Markov random fields, inference in graphical models, and belief propagation

Competency 8: The student will demonstrate an understanding of unsupervised learning by:

1. Using K-means clustering, expectation-maximization, Gaussian mixture density estimation, and a mixture of naive Bayes methods

Learning Outcomes:

- Communicate effectively using listening, speaking, reading, and writing skills
- Use quantitative analytical skills to evaluate and process numerical data
- Solve problems using critical and creative thinking and scientific reasoning
- Formulate strategies to locate, evaluate, and apply information
- Use computer and emerging technologies effectively