Course Outline Report

CS 060 - Applications of Artificial Intelligence and Deep Learning

COLLEGE:
Merritt College

ORIGINATOR: Brown, Courtney

DIVISION/DEPARTMENT:
Merritt - Division II/M - Technology

STATE CONTROL NUMBER: CCC000601583

DATES:
BOARD OF TRUSTEES APPROVAL DATE: 01/08/2019
STATE APPROVAL DATE: 01/31/2019
CURRICULUM COMMITTEE APPROVAL DATE: 11/29/2018
REQUISITE VALIDATION:

CURRENT EFFECTIVE DATE: 08/01/2019

1. REQUESTED CREDIT CLASSIFICATION:

D - Credit - Degree Applicable

N - Not Basic Skills

1 - Program Applicable

2. DEPT/COURSE NO:

CS 060

3. COURSE TITLE:

Applications of Artificial Intelligence and Deep Learning

4. COURSE:

Course
MC New Course

TOP NO. 0701.00 - Information Technology, General*

5. UNITS:

Variable No

Units (Min) 3.000

Min Total

Hours

Lecture Hours (Min) 2.000

35

Lab/Studio/Activity Hours (Min) 3.000

52.5

6. SELECTED TOPIC:

NO. OF TIMES OFFERED AS SELECTED TOPIC:

AVERAGE ENROLLMENT:

7. JUSTIFICATION FOR COURSE:

This course prepares the student to utilize recent breakthroughs in Machine Learning and computation for their own research, business, or product development. It provides a foundation for using software artifacts created through Artificial Intelligence (AI) research to implement programs capable of learning from data. It incorporates a range of techniques into one toolkit; linear regression, neural networks, and third party frameworks such as Scikit-learn and Tensorflow using a unified approach. Students completing this course will have basic knowledge to compete for positions in the workforce as Data Science specialists.

8. COURSE/CATALOG DESCRIPTION

Use of systems that analyze data and suggest patterns: Scripts and computation intensive software libraries (neural networks, image classifiers) to detect patterns, trends, and groupings; exploration of classification models and data sets using tools (Python, Scikit-Learn, Tensorflow and Graphics Processing Units) to emulate learned behavior in software.

9. OTHER CATALOG INFORMATION

a. Modular: No

If yes, how many modules:

b. Open entry/open exit: No

c. Grading Policy: Both Letter Grade or Pass/No Pass

d. Eligible for credit by Exam: No

e. Repeatable according to state guidelines: No

f. Required for degree/certificate (specify):

g. Meets GE/Transfer requirements (specify): Local AA/AS Area 4c

h. C-ID Number:

Expiration Date:

i. Are there prerequisites/corequisites/recommended preparation for this course? Yes

10. LIST STUDENT PERFORMANCE OBJECTIVES (EXIT SKILLS):

If an Objective cannot be deleted, make sure a Content-Review found in the Content Validation Page is not using that objective.

Objectives

1. **Explore the machine learning landscape, particularly Neural Nets**
2. **Track an example machine learning project form end-to-end.**
3. **Implement programs capable of learning from data.**

11. COURSE CONTENT:

LECTURE CONTENT:

1. Fundamentals of Machine Learning (10%) Historical survey of knowledge representation: Frame based knowledge representation, expert systems, fuzzy systems, decision trees, neural networks, genetic algorithms.
2. Classification (10%) - mathematical partitions, linearly independent vectors, Bayesian classification, rubrics and scoring
3. Training Models (10%) - foundation of requirements for distinct and independent Test, Training, and Validation, data sets. Error estimation and adjustment through back propagation and other techniques.
4. Support Vector Machines (10%) - classification using regression analysis; model building using partitions and curated data sets. Point mapping, supervised, and unsupervised classification.
5. Dimensionality Reduction (10%) - reducing the number of variables under consideration, identification of principal variables, principal component analysis.
6. Control Flow Graphs (10%) - graph notation, graph traversal methods, representation of possible paths through sets of node entry, exits, and edges.
7. Introduction to Artificial Neural Networks (10%) - biological basis of neuron models, organization of neuron collections and connections, activation functions, signals, layers, and output encoding.
8. Tensorflow and Deep Neural Networks (10%) - Convolutional Neural Networks and Control Flow Graphs, pattern detection, neural network configuration for recognition, Model inputs, model training, model prediction.
9. Autoencoders (10%) - Unsupervised learning and backpropagation. Linear regression, logistic regression, and vectorization. Debugging - Gradient Checking, Bias, and Variance.
10. Reinforcement Learning (10%) - definition and enumeration of system states. Control optimization through identification of best actions for a given state. Tabular organization of data and application to Tensorflow.

LAB CONTENT:
Projects and Exercises on

1. Working with Real Data (20%)
    1. Get the Data
    2. Create Test, Training, and Validation sets
    3. Data cleaning
    4. Analyze models and their errors
2. Classification (20%)

    1. MNIST and Image Classification
    2. Performance Measures
    3. Multiclass, Multilabel, Multioutput classifcation
    4. Error Analysis
3. Training Models (20%)
    1. Linear Regression
    2. Gradient Descent
    3. Logistic Regression
    4. Learning Curves
4. Control Flow Graphs and Tensorflow (20%)
    1. Creating and Running your First Graph
    2. Implementing Gradient Descent
    3. Feeding Data to the Training Algorithm
    4. Visualizing the Graph and Training Curves with Tensorboard
5. Artificial Neural Networks (20%)
    1. From Biological to Artificial Neurons
    2. Phases of Training with Tensorflow - Construction, Execution, Production Usage
    3. Convolutional Neural Networks (CNN)
    4. Recurrent Neural Networks (RNN)
    5. Deep Neural Networks (DNN)

12. METHODS OF INSTRUCTION (List methods used to present course content):

- Lecture
- Lab
- Observation and Demonstration
- Discussion
- Critique
- Multimedia Content
- Threaded Discussions

Other Methods:

13. ASSIGNMENTS

Out-of-class Assignments (List all assignments, including library assignments. Requires two (2) hours of independent work outside of class for each unit/weekly lecture hour. Outside assignments are not required for lab-only courses, although they can be given.)

Override Outside Class Hours: No

Outside-of-Class Hours (Min) 4.000

Outside-of-Class Hours (Max) 0.000

Override Outside-of-Class Hours (Min) 0.000

Override Outside-of-Class Hours (Max) 0.000

Out of class Assignment
Use and annotate an example machine learning project.
Describe differences between neural network architectures.
Use the Tensorflow Library to build and train neural nets.
Create several projects using distinct training models.

14. STUDENT ASSESSMENT: (Grades are based on):

- ESSAY (Includes "blue book" exams and any written assignment of sufficient length and complexity to require students to select and organize ideas, to explain and support the ideas, and to demonstrate critical thinking skills.)
- COMPUTATION SKILLS
- NON-COMPUTATIONAL PROBLEM SOLVING (Critical thinking should be demonstrated by solving unfamiliar problems via various strategies.)
- SKILL DEMONSTRATION
- MULTIPLE CHOICE

OTHER (Describe):
Create executable programs.

15. TEXTS, READINGS, AND MATERIALS

A. Textbooks:
YesNo37
Geron, Aurelien. *Hands-On Machine Learning with SciKit-Learn and Tensorflow*. 1 edition O'Reilly, 2017.

*Date is required: Transfer institutions require current publication date(s) within 5 years of outline addition/update.

B. Additional Resources:
Library/LRC Materials and Services:

The instructor, in consultation with a librarian, has reviewed the materials and services of the College Library/LRC in the subject areas related to the proposed new/updated course
Print Materials were reviewed? No

Non-Print Materials were reviewed? No

Online Materials were reviewed? No

Services were reviewed? No

Specific materials and/or services needed have been identified and discussed. Librarian comments:

C. Readings listed in A and B above are: (See definition of college level):
YesNo39
Primarily college level

16. DESIGNATE OCCUPATIONAL CODE:

B - Advanced Occupational

17. LEVEL BELOW TRANSFER:

Y - Not applicable

18. CALIFORNIA CLASSIFICATION CODE:

Y - Credit Course

19. NON CREDIT COURSE CATEGORY:

Y - Not Applicable, Credit course

20. FUNDING AGENCY CATEGORY:

Y - Not Applicable (funding not used to develop course)

REQUISITES AND ADVISORIES

RECOMMENDED PREPARATION:
CIS 005 Introduction to Computer Science or CIS 006 Introduction to Computer Programming and MATH 003E Linear Algebra

STUDENT LEARNING OUTCOMES

1. **Select the appropriate training model for analysis of a data set.**
   Written program or description of data and control flow that produces measurable error.
2. **Select modules from frameworks and libraries to build a neural net.**
   Creation of an executable Tensorflow model applied to well-known dataset.
3. **Identify the impact of errors in applying interpretation of results.**
   Written report on degree of confidence and scope of data used as the basis for training.