A Course Syllabus

for

CS 5720

Neural Network & Deep Learning

(Three semester hours credit)

in the

School of Computer Science and Mathematics

of the

COLLEGE OF HEALTH, SCIENCE AND TECHNOLOGY

Catalog Description:
This course provides opportunities to learn various deep learning techniques to model data for classification and prediction. Concepts and methods are illustrated with real-world applications.

UNIVERSITY OF CENTRAL MISSOURI

Lee Summit's, Missouri

Spring 2024

Instructor	Email	Office#	Office Hour
Muhammad Zubair Khan	mzkhan@ucmo.edu	WCM 215	TBA

Course Time and Location

Time: Tuesday 6:20 PM – 9:00 PM
Location: MIC, LS MO B201
Credits: 3 Credit Hours

Description:

Neural Network & Deep Learning
This class is a Hybrid format. Students will meet in-person at the scheduled time plus one extra in person day for midterm to be determined by the faculty. For weeks that are not scheduled as in-person, attendance is required during the scheduled class meeting time via Zoom. An in-person midterm will be scheduled during the class meeting time of the extra in-person day. There is a total of 7 in-person days, 7 Zoom days, and one day for in-person midterm, for 15 meetings. An in-person Final Exam will be given during final exam week.

Personal Zoom Link: https://ucmo.zoom.us/j/5771503689

Technology Requirements

You are expected to have the computing resources necessary to complete this course through personal, University channels (e.g., remote computer labs) or both. Please contact me if you will be without email access for a short-term basis during this course. We can make alternate arrangements should your reason for being without computer access warrant an accommodation (note: travel for vacation/work does not necessitate accommodations).
Below is a list of some helpful computer requirements for full participation in this class:

- The latest version of GitHub Desktop at https://desktop.github.com/
- The latest version of Python IDE (Desktop or Web)
- A current word processing software
- A headset with microphone
- A webcam

- Firefox, Chrome, or Safari browser.
- A Broadband Internet connection is preferred. Examples of broadband Internet connection are high-speed DSL or a Cable modem

Participation Policies

This course is not designed to be self-paced. Rather, you are expected to participate in class activities along with the group. At the same time, I recognize that there might be times during the semester that you need to complete work in advance in order to meet other life demands

Course Time Commitment

Courses, both in-person and online, can be varied in their design and expectations for student involvement and time. If this course were completely taught face-to-face during the 16-week session, one would expect to be in class (engaged in lecture and discussion) for approximately 3 hours/week and spend additional time outside of class in preparation for active course engagement and course assessment (reading, completing assignments). So, you should be prepared to spend similar amounts of time engaged in this course in an online format. Compared to traditional face-to-face learning environments, you should anticipate that in this course, you will experience less time in passive learning activities (i.e., lecture). And more time engaged in active learning activities and communication with your peers and me (i.e., In-class programming (ICPs), Quizzes via Zoom, and discussion board postings).

Expectations of Faculty in this Course

We will aim to respond to all email questions within 48 hours. Questions that are posted to the General Questions Discussion Board will be answered within 24 hours. Weekly assignments will typically be graded by Monday of the following week. Exams, in general, will have a two-week grading turn-around timeframe.

Purpose of the Course

The main purpose of this course is to introduce students to deep learning, the study of computer systems that improve their performance automatically through experience. Students will learn the latest deep learning algorithms and models that constitute typical learning systems. They will also gain the necessary foundations and background to both build practical deep learning systems and conduct research in state-of-the-art problems.

Intended Objectives

After finishing this course, you will have the knowledge to be able to write
Machine Learning and Deep Learning programs

1. Complete the weekly In-class programming assignments (ICPs)
2. Complete weekly quizzes
3. Complete course project

Student Learning Outcomes

Computer Science Outcomes

- Apply algorithmic principles and computing theories to solve advanced problems in Computer Science.
- Apply design and development principles in construction of computer- based systems of varying complexity.
- Be able to use current techniques, skills, and tools necessary for computing practice.
- Recognize the need for and engage in continuing professional development.

Cybersecurity Outcomes

- An ability to apply algorithmic principles and formal models to solve advanced problems in cybersecurity and computing.
- An ability to communicate effectively to a range of audiences, work effectively in a team environment, and recognize the need for continual professional development.

Course Content Outline

A. Textbooks:

Recommended:

- Machine Learning and Deep Learning with Python, scikit-learn and TensorFlow by Sebastian Raschka and Vahid Mirjalili, 2017.
- Deep learning with python by francois Chollet, 2017.
- Deep learning with keras by Antonio gulli et. al, 2017.
- Deep learning by Ian Goodfellow et. Al, MIT Press, 2016.
- Learn Python the Hard Way by Zed Shaw, Third Edition

Essential Links:

- https://scikit-learn.org/stable/
- https://numpy.org/
- https://matplotlib.org/
- https://pandas.pydata.org/
- https://keras.io/
- https://www.tensorflow.org/

Lesson	Description	Tools/Technologies
Week-1	Introduction and Fundamental concepts. Python Features, Applications	Python / Jupyter Notebooks
Week-2	Data Normalization and Performance Evaluation	Python / Jupyter Notebooks
Week-3	Introduction to supervised learning, Simple Linear Classifier K-Nearest Neighbor Decision Tree	Python/ Jupyter Notebooks
Week-4	Terminology in machine learning, Support Vector Machines Logistic Regression Naïve Bayes Perceptron Neural Networks	Python/ Jupyter Notebooks/ Numpy/Matplotlib
Week-5	Data Analysis, Unsupervised learning	Matplotlib/Pandas/NumPy/ Jupyter Notebooks
Week-6	Data Analysis, Dimensionality reduction	scikit-learn (sklearn) /NumPy/ Jupyter Notebooks
Week-7	Natural Language processing, Python NLTK package, Stemming, POS, Lemmatization, N-grams, Name entity recognition	NLTK/Python/ Jupyter Notebooks
Week-8	Brief introduction to deep learning, Installation, TensorFlow graphs and sessions	Google Colab/ Jupyter Notebooks
Week-9	Constants, Basic operations, Tensor Ranks, Variables, Placeholders and feeding inputs, Lazy loading, TensorBoard, loss functions.	Python, scikit-learn, Keras, NumPy, matplotlib, Jupyter Notebooks
Week-10	Neural Networks, Transfer Learning	Python, scikit-learn, Keras, NumPy, matplotlib, Jupyter Notebooks
Week-11	Artificial Neural Networks, types of artificial neural networks, activation function, types of activation functions and Image/Text classification with CNN.	Python, scikit-learn, Keras, NumPy, matplotlib, Jupyter Notebooks
Week-12	Logic behind Activation functions, RNN, LSTM, Implementing Text Generator	Python, scikit-learn, Keras, NumPy, matplotlib, Jupyter Notebooks
Week-13	Basics and types of Autoencoder. Dimensionality reduction with MNIST data with Autoencoders.	Python, scikit-learn, Keras, NumPy, matplotlib, Jupyter Notebooks
Week-14	Generative Adversarial Networks (GAN's)	Python, scikit-learn, Keras, NumPy, matplotlib, Jupyter Notebooks

Procedures/Assessment

- The lecture format will be the hybrid mechanism used in the course. Computer demonstrations in the classroom will be used whenever appropriate.
- Programming assignments relating to machine learning and deep learning techniques will be assigned, specifically building and testing models for various applications. A brief report should be submitted with each assignment.
- Students' performance will be assessed based on their understanding of the subject material demonstrated through multiple assignments, quizzes, project, a mid-term and a final exam.

Late Submission Policy on Assignments

Assignments that completed after the due date will no longer be accepted.

1. '-10' points for one day late submission
2. '-20' points for two days late submission
3. No submission will be allowed after Two days unless permission was provided.

DO NOT EMAIL your work, always use the appropriate platform to submit and your work should be original and independent.

Tasks	Contribution	% of the Final Grade	Point Value
Assignments (12)	Individual	30%	100 points each
Quizzes (2)	Individual	5%	100 points each
Journal club (1)	Team of (4)	5%	100 points each
Project (1)	Team of (4)	25%	100 points each
Exams (2)	Individual	35%	100 points each
Total	100%		

Grading

Grading Scale

Percent (%)	Grade
90 – 100	A
80 – 89	B
70 – 79	C
60 – 69	D
0 – 60	F

Midterm and Final Exam: The exams will consist of questions that emphasize the principles and analytic techniques for machine learning and deep learning. In addition, the exams will be divided into two sets of questions: one set for programming questions and other emphasize on principals' concepts and techniques.

Quiz: pop quizzes are given to make sure that students are keeping up with the class and understand the necessary facts.

Assignments: Students will need to complete the required assignments in time.

1. Once finished your assignment push your source code to your repo and explain the work through the ReadMe file properly. Make sure you add your student info in the ReadMe file.
2. Comment your code appropriately (show your understanding). IMPORTANT.
3. Make a simple video about 2 to 3 minutes which includes demonstration of your work and explanation of code snippets.
4. Any submission after provided deadline is considered as a late submission.

Term Project: A student will complete a term project. The project is 25% of your grade. You can do it either individually or in a group of 4. A good project is one that applies one or more learning algorithms covered in class, in novel ways to a dataset. An excellent project is a research project that will result in a paper at a major conference. The project will provide you with a unique opportunity for exploring one or more areas of deep learning that we did not cover in depth. Some examples are graphical models, collaborative filtering, inductive logic programming, topic models, language models, GAN's, and Graphical neural networks. You should choose a data set, apply learning techniques from these fields to it and compare their performance with the techniques covered in class.

Project Submission Guidelines:

1. The project submission is with a team of (4) students max.
2. Submit your source code and documentation to GitHub, ReadMe file must have team information and short introduction.
3. Comment your code appropriately.
4. Video submission (3 to 5 min video showing the demo of the project, with brief voiceover on the code explanation)
5. Submit the unplagiarized report.
6. Submission after the deadline considered a late submission. (Check the Late Submission Policy on Assignments in the syllabus)
7. The report should follow the IEEE format and should include the following details:
    a. Introduction
    b. Objectives
    c. Approaches/Methods
    d. Workflow
    e. Datasets (if applicable)
    f. Parameters (if applicable)
    g. Evaluation & Discussion (if applicable)
    h. Conclusion

Rubric Details

Assignments

Criteria	Novice	Competent	Proficient
ReadMe file Completed	Missing Student info. Missing Short Description. Missing Video link (if applicable). (>=70 to <=80)	Missing some information. (>=80 to <=90)	Meets all the ReadMe file requirement. (>=90 to <=100)
Video	No Video. (0)	Video missing proper explanation. No Audio. (>=50 to <=85)	Video with all details and proper technical explanation. (>=85 to <=100)
Completeness of given assignment	It is partially solved. (<=75)	Completely solved. (>=75 to <=95)	It is completely solved in an efficient way. (>=90 to <=100)
Commenting the code	Not useful comments. (<=70)	Appropriate comments. (>=70 to <=90)	Appropriate comments. (>=90 to <=100)
Time of submission	Submission after the due date. Check the 'Late Submission Policy on Assignments' section in the syllabus	It is submitted on the deadline. No score will be deducted from the obtained score.	It is submitted on or before the deadline. No score will be deducted from the obtained score.

Project

Criteria	Novice	Competent	Proficient
ReadMe file Completed	Missing Student info. Missing Short Description. Missing Video link (if applicable). (>=70 to <=80)	Missing some information. (>=80 to <=90)	Meets all the ReadMe file requirement. (>=90 to <=100)
Video	No Video. (0)	Video missing proper explanation. No Audio. (>=50 to <=85)	Video with all details and proper technical explanation. (>=85 to <=100)
Report	Basic report. (>=80 to <=85)	Report on the required details. (>=85 to <=95)	Report with all details and making it easy to follow and understand Visually looking good. (>=90 to <=100)
Report similarity	>30 % (>=80 to <=85)	<30 % (>=85 to <=95)	<15 % (>=90 to <=100)
Completeness of given assignment	It is partially solved. (<=75)	Completely solved. (>=75 to <=95)	It is completely solved in an efficient way. (>=90 to <=100)
Commenting the code	Not useful comments. (<=70)	Appropriate comments. (>=70 to <=90)	Appropriate comments. (>=90 to <=100)
Code similarity	>50 % (>=50 to <=70)	<50 % (>=70 to <=90)	<30 % (>=90 to <=100)
Time of submission	Submission after the due date. Check the 'Late Submission Policy on Assignments' section in the syllabus	It is submitted on the deadline. No score will be deducted from the obtained score.	It is submitted on or before the deadline. No score will be deducted from the obtained score.
Submission (including feedback)	Submission with partial details. Miss any important details. (<=90)	Submission with all required details. (>=90 to <=100)	Submission with all required details. (>=90 to <=100)
Presentation (Individual effort)	Basic presentation with not explaining the crucial details of the assignment. (>=80 to <=85)	Presentation with explaining the crucial details of the assignment. (>=85 to <=95)	Presentation with crucial details of the assignment comparing with a similar project. (>=90 to <=100)

Americans With Disabilities Act

Students with documented disabilities who are seeking academic accommodations should contact the Office of Accessibility Services, Union 220, (V) (TTY) 660-543-4421.

Accessibility Services

Students with disabilities who are seeking accommodation should contact the Office of Accessibility Services at Union 222, 660-543-4421. If you want to share information about your needs that I should be aware of, such as emergency medical information or special arrangements for field trips or internships, please see me privately after class or during office hours.

Sexual Discrimination and Sexual Misconduct Statement

The University of Central Missouri seeks to foster a safe and healthy environment built on mutual respect and trust. Sex discrimination, including sexual harassment, sexual violence, and other forms of sexual misconduct will not be tolerated. All faculty and most staff are considered mandated reports by the University and must disclose all information they receive about sexual misconduct to the Title IX Coordinator. As a faculty or staff member of the University, I am a mandated reporter. This means I am required to report information shared with me regarding sex discrimination and sexual misconduct.

If you, or someone you know, has experienced sex discrimination or sexual misconduct, please know assistance and options are available. UCM strongly encourages all members of the community to seek support and report incidents of this nature to the Title IX Coordinator. Anyone who wishes to report sexual misconduct, to learn more about the University process and options available, or to utilize a confidential resource, please visit ucmo.edu/titleix.

Diversity, Equity, and Inclusion

The University of Central Missouri strives to develop a campus environment that welcomes and recognizes all dimensions of diversity and inclusiveness. What this means is that all students are welcomed in the classroom, and differences are to be recognized rather than erased or denied. Dimension of diversity can include sex, race, age, national origin, ethnicity, gender identity and expression, intellectual and physical ability, sexuality, income, faith, and non-faith perspectives, socio-economic class, primary language, family status, military experience, and more. Inclusive learning is facilitated by creative and innovative thought and mutual respect; being in this classroom means that you, your faculty member, and your peers pledge to foster a welcoming and equitable environment for all.