Master Course Description for EE-443 (ABET sheet)

Title: Machine Learning for Signal Processing Applications

Credits: 4

UW Course Catalog Description

Coordinator: Jenq-Neng Hwang, Professor of Electrical and Computer Engineering

Goals: The goal of this course is to provide senior ECE students with significant machine learning and deep learning experience and introduce them to important laboratory components using cloud-based computing resources for solving real-world signal processing applications.

Learning Objectives: Providing students with the fundamental skills and hands-on experience in applying machine learning and deep learning theories to various signal and image processing applications based on cloud-based CPU/GPU computing resources. The course involves biweekly team-based Labs on provided real-world training and testing data for students' machine learning designs, live demos and report writing.

Reference Materials: Technical papers will be provided for references

Prerequisites: minimum grade of 1.0 in E E 242; and either MATH 136, or MATH 208; and either IND E 315, MATH 394/STAT 394, or STAT 390.

Topics:

- Introduction and Lab Usage Tutorial
- Unsupervised Machine Learning
- Supervised Machine Learning
- From MLP to CNN Deep Learning
- Generative Adversarial Learning
- Open Long-Tailed Recognition
- Object Detection and Segmentation
- Deep Learning for Image/Video Applications

Course Structure: The class meets for two two-hour lectures a week. The whole class is divided into small groups (2-3 students). There are 4 warm-up homework (group based Lab projects) assignments that include some CPU/GPU design projects to get students familiar with the cloud-based resource system on the machine learning algorithms based on the related signal and image data that will be covered in the class, and on how to write Python code in the Pytorch environment which is based on Google Colab. Students are required to demo their

results and answer questions on each question of the homework/Lab assignments. Every homework/Lab report will be required to contain experimental results, code (online registered) and interpretations of the results. In addition, there will be a team-based final project assignment, which contains some open-ended projects ,given some specially provided signal and image data, and requires students to read some reference papers and propose their own solutions, the final project requires a submitted final project report and should be presented to the whole classroom in the final week about the adopted methods and performance.

• **Computer Resources:** Colaboratory	(Colab) is a Google research project created
to help disseminate machine learning education and research. It is a Jupyter notebook environment that requires no setup to use and runs entirely in the cloud. It allows you to use virtual machines with a GPU (or TPU) to accelerate machine learning workloads for up to 12 hours at a time. It is free to use! There is a paid option called "Colab Pro" which gives access to faster GPUs, more RAM, more CPU cores, more disk space, and longer runtimes, but the paid version won't be necessary for this course.	

Laboratory Resources: None

Grading: 4 team-based homework/Lab assignments (15% each), one final project assignment (10% for group presentation, 30% for project report).

ABET Student Outcome Coverage: This course addresses the following outcomes:

H = high relevance, M = medium relevance, L = low relevance to course.

(1) *An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.* **(M)**

(2) *An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well*

as global, cultural, social, environmental, and economic factors. **(L)**

(3) *An ability to communicate effectively with a range of audiences.* **(M)**

(4) *An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.* **(L)**

(5) *An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.* **(M)**

(6) *An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.* **(H)**

(7) *An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.* **(M)**

Religious Accommodations:

Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy (https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/). Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form.)

(https://registrar.washington.edu/students/religious-accommodations-request/)..)

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