Cloud Services for Machine Learning

CSE 41331

Syllabus

UCSD Extension

Class Meeting Information

Start Date: June 29, 2020
End Date: August 23, 2020
8 class meetings
Online

Instructor Information

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Ash Pahwa, Ph.D.

Ash Pahwa, Ph.D., is an educator, author, entrepreneur, and technology visionary with three decades of industry and academic experience. He has founded several successful technology companies during his career, the latest of which is A+ Web Services.

Dr. Pahwa earned his doctorate in Computer Science from the Illinois Institute of Technology in Chicago. He is listed in *Who's Who in the Frontiers of Science and Technology*. He is also a Google Certified Analytics Consultant. His expertise includes search engine optimization, web analytics, web programming, digital image processing, database management, digital video, and data storage technologies.

In Industry, Dr. Pahwa has worked for General Electric, AT&T Bell Laboratories, Xerox Corporation, and Oracle. He founded CD-Gen, Inc. and DV Studio Technologies, LLC., which introduced successful products for CD-Recording (CDR) and MPEG encoding. His book, *CD-Recordable Bible* was published in English, Japanese, and German.

In Academia, Dr. Pahwa teaches courses at California Institute of Technology (Pasadena) and the University of California system. Since 2008, he taught many courses at UC Irvine, UCLA, and UC San Diego.

Course Description

Artificial intelligence (AI) builds smart machines capable of performing tasks that require human intelligence. Advancements in machine learning and deep learning are the foundations of AI. The applications of AI include object recognition in images, natural language processing, human speech recognition, and language translation. From a product development perspective, autonomous cars are likely to be a major application of Deep Learning. Object recognition within an image is a necessary aspect of such an application.

AI models are currently built using TensorFlow, Keras, Python software products and require a significant amount of computing resources. This precludes running AI models on personal computers. Generally, they are not powerful enough. Convolutional Neural Networks (CNN) and Generative Adversarial Networks (GAN), a specific type of Neural Networks, can only run on cloud servers because they have enough computing resources. Consequently, Fortune 500 companies build Machine Learning models on cloud servers.

The 3 most popular cloud services are AWS (Amazon Web Services), GCP (Google Cloud Platform), and Azure from Microsoft. They offer computing resources (CPU + Memory + Storage + Networking) to clients needing to build and run AI models. Cloud servers provide access to GPU (Graphics Processing Units) and TPU (Tensor Processing Units). These processors can execute trillions of floating instructions per second. Due to parallel processor architecture built in GPU and TPU, they are ideal for matrix multiplication operations—the most frequently used operation in Machine and Deep Learning models.

This course starts with covering Deep Learning and Neural Networks. The fundamentals of Neural Network Mathematics and the optimization techniques will be covered. Next, this course will focus on how to set up GCP for AI projects. A few AI (Neural Network) models will be built and run on cloud servers. GCP also provides Artificial Intelligence API which are Vision API, Natural Language API, Speech API, Translation API and Video Intelligence API. These APIs will be covered in detail.

Course Prerequisites:

Introduction to Programming (CSE-40028) or a basic working knowledge of Python. Students must have access to a web-enabled computer.

Course Objectives

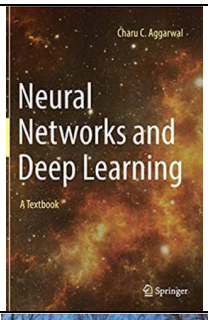
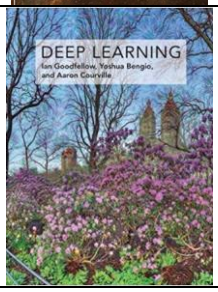
Upon completing the program, students will be able to:

- Setup Google Cloud Platform (GCP) account
- Implement CNN in TensorFlow and GCP using Vision API
- Implement Speech conversion into text application using GCP Speech API
- Implement Translate application to translate from one language to another
- Implement Natural Language GCP API
- Implement Video Intelligence GCP API

Course Materials: Books: All books are Optional

Most of the material for this course will come from Google Cloud Platform (GCP) web service. The following 2 books are optional.

Text Books

1 Optional	Neural Networks & Deep Learning by Charu Aggarwal Publisher: Springer		
2 Optional	"Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville		

Course Outline

1.0	**Machine Learning, Neural Networks & Deep Learning**
1.1	Overview of the course
1.2	Introduction to Google Cloud Platform
1.3	Google's Colab & Codelabs
1.4	What is Machine Learning + Deep Learning
1.5	Tools for Building DL Models: TensorFlow
2.0	**Regression in GCP**
2.1	Regression in GCP: No Python + Colab
2.2	Regression in GCP: Python + Colab
3.0	**GCP Vision**
3.1	Computer Vision
3.2	Convolution Neural Networks
3.3	Generate GCP Vision API Key
3.4	GCP Vision API
4.0	**GCP Natural Language Analysis**
4.1	GCP Natural Language API
5.0	**GCP Speech to Text**
5.1	GCP Speech to Text API
6.0	**GCP Translation**
6.1	GCP Translate API
7.0	**GCP Video Intelligence**
7.1	GCP Video Intelligence API
8.0	**GCP Generative Adversarial Networks**
8.1	GCP Generative Adversarial Networks

Evaluation and Grading

Each week, a homework assignment will be posted. It will contain a few questions based on that week's material. The purpose of the homework assignment is for students to research that topic and formulate the answers. This will help enable students to retain the knowledge. Each homework assignment is worth 10 points.

Evaluation of Student Performance

Homework assignments (total 8 assignments)	80 points
Total	80 points

Grading Scale

A = 91% – 100% B = 81% – 90% C = 71% – 80% D = 61% – 70%

Grading Policy

Each homework assignment is worth 10 points. All students are expected to submit homework assignments on or before the due date. I will post the answer of the homework questions after the due date. These answers can be downloaded. You can critique my answers by sending an email to me.

Late Submission

Since the answers to the homework questions will be posted shortly after the due date, students submitting their homework assignments after the due date will lose points for that homework assignment, based on the following table:

Homework Submission Date	Maximum Points Earned
On Time	100%
1 Week Late	80%
2 Weeks Late	50%
3+ Weeks Late	0%

If you do not submit homework, you will get 0/10.

Code of Conduct

All participants in the course are bound by the University of California Code of Conduct, found at http://www.ucop.edu/ethics-compliance-audit-services/_files/stmt-stds-ethics.pdf).

Netiquette

In an online course, vast majority of our communication takes place in the course forums. However, when we have a need for communication that is private, whether personal, interpersonal, or professional, we will use individual email or telephone. Our primary means of communication is written. The written language has many advantages: more opportunity for reasoned thought, more ability to go in-depth, and more time to think through an issue before posting a comment. However, written communication also has certain disadvantages, such a lack of the face-to-face signaling that occurs through body language, intonation, pausing, facial expressions, and gestures. As a result, please be aware of the possibility of miscommunication and compose your comments in a positive, supportive, and constructive manner.

Academic Honesty Policy

The University is an institution of learning, research, and scholarship predicated on the existence of an environment of honesty and integrity. As members of the academic community, faculty, students, and administrative officials share responsibility for maintaining this environment. It is essential that all members of the academic community subscribe to the ideal of academic honesty and integrity and accept individual responsibility for their work. Academic dishonesty is unacceptable and will not be tolerated at the University. Cheating, forgery, dishonest conduct, plagiarism, and collusion in dishonest activities erode the University's educational, research, and social roles.

Students who knowingly or intentionally conduct or help another student engage in dishonest conduct, acts of cheating, or plagiarism will be subject to disciplinary action at the discretion of the University.