USC Viterbi
School of Engineering

Course ID and Title: [BME 499 Introduction to Deep Learning for Biomedical Engineering]
Units: 2
Term—Day—Time: [Spring 2025] — TBD - (One 110-minute lectures per week)

Location: [TBD Physical address and/or course-related URLs, etc.]

Instructor: Shaoying (Kathy) Lu
Office: [TBD Physical or virtual address]
Office Hours: [TBD Office hours.]
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Teaching Assistant:
Office: [TBD Physical or virtual address]
Office Hours:
Contact Info: [Email, phone number (office, cell), Skype, etc.]

Catalogue Description
Introduction to deep learning for biomedical engineering: Deep neural networks, machine learning, computer vision, biomedical data, microscopic and pathological image analysis and classification, convolution neural network, recurrent neural network, deep learning model, data analytics.

Course Description
Artificial intelligence with deep learning methods has demonstrated power in many biomedical engineering problems: microscopic and pathological imaging analysis and classification, sequence analysis and structure/function prediction, and more. Our goal is to introduce undergraduate biomedical engineering students to the cutting-edge development of deep neural network algorithms in the field. Through this course, students will get familiar with the python programming language and computing tools available in the field of deep learning (DL). They will learn how to apply the deep convolution neural network (CNN) models on biomedical image and sequence analysis and develop an appreciation of DL models. They will also learn how to set up their own data to generate new and improved models.

Learning Objectives
Students will be able to list, describe, and implement programming and computing tools available for deep learning in biomedical engineering. They can understand cutting edge literature and development in the field. They can prepare biomedical imaging and sequence data for analysis. They can apply deep learning models on new data and use new data to improve models.

Prerequisite(s): BME 210 or approved by the instructor
Co-Requisite(s):
Concurrent Enrollment:
Recommended Preparation:
Linear Algebra (specifically matrix-vector operations), Multivariable Calculus (derivatives and the chain rule), Statistics (conditional probability and some understanding of the Bayesian analysis)

Course Notes
Copies of lecture slides and other class information will be posted on Brightspace.

Technological Proficiency and Hardware/Software Required
Previous experience with Python, MATLAB, or another programming language.

Required Readings and Supplementary Materials
Deep Learning (MIT Press) by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
- A free online version is available at http://www.deeplearningbook.org/

Optional Readings and Supplementary Materials
- Research papers will be assigned in class

Description of Assignments and How They Will Be Assessed
Pop-up Quizzes, 3 Assignments, 1 Final Exam

Grading Breakdown

Assessment Tool (assignments)	% of Grade
Pop-up Quizzes	10
Assignment #1-#3	50
Final Exam	40
TOTAL	100

Pop-up Quizzes
These quizzes will "pop up" in lecture. They will, generally, be graded just for completion, with results gone over in the same class period to discuss the answers collectively. They must be completed during the class period.

Assignments:
These will be coding assignments you will complete individually. Your submissions will be a combination of written code and documentation. Generally, you can expect to be provided with starter code and a description of what's to be implemented, as well as some unit tests to ensure components of your code are compatible with the scripts to be used for grading. If you wish to dispute a grade, you must do so within *two weeks* of the posting of that grade.

Participation
Active participation in the course is highly encouraged and could be considered in the overall assessment of final grades. Participation comes in many forms including arriving on time and prepared for class, playing an active role in solving problems especially in group settings, interaction with peers and the teaching team, and asking relevant questions. Participation can also occur outside of class time as well.

Final Exam
The exam will be an open-book, multiple choice exam covering the material.

Grading Scale
A 93-100
A- 90-92
B+ 87-89
B 83-86

B- 80-82
C+ 77-79
C 73-76
C- 70-72
D+ 67-69
D 63-66
D- 60-62
F 59 and below
Letter grades decided by rounding floating point grades up to the nearest whole number (e.g., 92.2 -> A; 59.8 -> D-).

Assignment Submission Policy
Late submission of assignment will not be accepted. Assignments will be graded within two weeks after the due date, mostly.

Academic Integrity for this Class
Unless otherwise noted, this course will follow the expectations for academic integrity as stated in the USC Student Handbook. The general USC guidelines on Academic Integrity and Course Content Distribution are provided later in this syllabus.

For this class:
- Collaboration: In this class, you are expected to submit work that demonstrates your individual mastery of the course concepts. While you may consult with classmates regarding the homework assignments and on solution ideas, you are required to write your own homework reports. Python code may NOT be shared. Plagiarism of another's work is a very serious offense and all suspected cases will be dealt with according to University regulations (see SCampus). It is also not acceptable to copy and paste your answers from the internet (or from the lecture notes).
- Computer programs: Plagiarism includes the submission of code written by, or otherwise obtained from someone else.

Please ask the instructor [and/or TA(s)] if you are unsure about what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

Class Recordings and Course Content Distribution: You may not record this class without the express permission of the instructor and all other students in the class. Distribution of any notes, recordings, exams, or other materials from a university class or lectures — other than for individual or class group study — is prohibited without the express permission of the instructor; violations will be considered an intentional act to facilitate or enable academic dishonesty and reported to the university.

Use of Generative AI in this Course
Generative AI is permitted but limited as follows: In this course, you are permitted to use artificial intelligence (AI)-powered programs to help you, but only on assignments that explicitly indicate a permitted use of AI. However:
- You should also be aware that AI text generation tools may present incorrect information, biased responses, and incomplete analyses; thus, their answers may not meet the standards of this course.
- To adhere to our university values, _you must cite any AI-generated material (e.g., text, images, and other content) included or referenced in your work and provide the prompts used to generate the content_. Using an AI tool to generate content without proper attribution will be treated as plagiarism and reported to the Office of Academic Integrity.

Please review the instructions in each assignment for more details on how and when to use AI Generators for your submissions.

Course Evaluations

Course evaluation occurs at the end of the semester university-wide. It is an important review of students' experience in the class. The process and intent of the end-of-semester evaluation will be provided.

Course Schedule

	Topics/Daily Activities	Readings/Preparation	Deliverables
Week 1	Introduction to neural network (NN)		
Week 2	Linear Algebra, Matrix-Vector Operations		
Week 3	Derivatives and Gradients	Assignment #1	
Week 4	Introduction of Python and Numpy		
Week 5	Conditional Probability and Statistical Analysis		
Week 6	Programming with NN		
Week 7	Three-layer NN/Gradient descent	Assignment #2	Assignment #1 due
Week 8	Deep neural networks: Forward/backward propagation		
Week 9	Hyperparameter tuning and data preparation		
Week 10	No class		
Week 11	Transfer learning and Convolution NN (CNN)	Assignment #3	Assignment #2 due
Week 12	Case studies: LeNet-5/ AlexNet/ VGG/ ResNet		
Week 13	Biomedical Imaging		
Week 14	Pathology classification: CNN model		Assignment #3 due
Week 15	Recurrent Neural Network/ Sequence Analysis		
FINAL	Final Exam		

Academic Integrity

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct — which includes any act of dishonesty in the production or submission of academic work (either in draft or final form) — is in contrast to the university's mission to educate students through a broad array of academic, professional, and extracurricular programs.

This course will follow the expectations for academic integrity as stated in the USC Student Handbook. All students are expected to submit assignments that are their own original work and prepared specifically for this course and section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

Academic dishonesty has a far-reaching impact and is considered a serious offense against the university. Violations will result in a grade penalty, such as a failing grade on the assignment or in the course, and disciplinary action from the university itself, such as suspension or even expulsion.

For more information about academic integrity see the student handbook or the Office of Academic Integrity's website, and university policies on Research and Scholarship Misconduct.

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment or what information requires citation and/or attribution.

Course Content Distribution and Synchronous Session Recordings Policies

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. (Living our Unifying Values: The USC Student Handbook, page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relation to the class, whether obtained in class, via email, on the internet, or via any other media. Distributing course material without the instructor's permission will be presumed to be an intentional act to facilitate or enable academic dishonestly and is strictly prohibited. (Living our Unifying Values: The USC Student Handbook, page 13).

Statement on University Academic and Support Systems

Students and Disability Accommodations:
USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Student Financial Aid and Satisfactory Academic Progress:
To be eligible for certain kinds of financial aid, students are required to maintain Satisfactory Academic Progress (SAP) toward their degree objectives. Visit the Financial Aid Office webpage for undergraduate- and graduate-level SAP eligibility requirements and the appeals process.

Support Systems:
Counseling and Mental Health - *(213) 740-9355 – 24/7 on call*
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

988 Suicide and Crisis Lifeline - *988 for both calls and text messages – 24/7 on call*
The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline consists of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

Relationship and Sexual Violence Prevention Services (RSVP) - *(213) 740-9355(WELL) – 24/7 on call*
Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - *(213) 740-5086*
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - *(213) 740-2500*
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - *(213) 740-0776*
OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - *(213) 740-0411*
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - *(213) 740-2101*
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - *UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call*
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - *UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call*
Non-emergency assistance or information.

Office of the Ombuds - *(213) 821-9556 (UPC) / (323-442-0382 (HSC)*
A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - *(323) 442-2850 or otfp@med.usc.edu*
Confidential Lifestyle Redesign services for USC students to support health-promoting habits and routines that enhance quality of life and academic performance.