

ISE 599 Special Topics: **Introduction to Deep Learning**

Units: 4

Term—Day—Time: [Spring 2024] — [TuTh 12–01:50pm]

This course serves as an introduction to the fundamentals and practical applications of Deep Learning (DL). Students will gain knowledge about neural networks (NN), optimization techniques to enhance their performance, prevalent NN architectures, and the utilization of DL models in analytics and artificial intelligence (AI). These applications encompass regression, classification, decision-making, image classification, and image identification. Additionally, students will acquire skills in implementing these applications using the Python library Keras.

Location: SGM 226

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Catalogue Description

Deep Learning techniques are introduced and applied to common types of data present in the literature.

Course Description

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Learning Objectives

Upon completing this course, students will have a comprehensive understanding of:

- The fundamental principles underpinning Neural Network models.
- The components that constitute a neural network model.
- The most commonly used types of NN architectures and their suitability for various problem types.

- How to construct and employ NN models for predictive and classification tasks in business data analytics.
- How to create and utilize NN models for artificial intelligence applications.

Prerequisite(s): None

Co-Requisite(s): None

Concurrent Enrollment: None

Recommended Preparation: It is strongly recommended to have python programming experience on the level of ISE150.

Course Notes

The Course Material will be available on blackboard.

Technological Proficiency and Hardware/Software Required

The Python programming language will be utilized extensively throughout the course.

Required Readings and Supplementary Materials

None.

Optional Readings and Supplementary Materials

Textbook

- CholletF., *Deep Learning with Python*, 2nd Ed., Manning, 2021, ISBN 978-16172996864

Supplementary Materials (for reference only)

- Goodfellow I. et al., *Deep Learning*, MIT Press, 2017, ISBN 978-0262035613
- VanderPlas, *Python Data Science Handbook*, O'Reilly, 2017
- Kutner et al., *Applied linear Statistical Models*, 5th Ed., 2005, ISBN 007-112221-4
- Other references as suggested during the introduction.

Description of Assignments and How They Will Be Assessed

Biweekly homework assignments will be given, involving programming tasks in Python. Students will write and execute their code using Google Colab and submit both the completed assignment and a Jupyter Notebook containing the corresponding Python code. The assignments will extensively utilize Tensorflow and Keras, and introductory materials on Python, Tensorflow, Keras, and the Google Colab Environment will be provided on the first day of class.

Project Timeline:

- Week 4: Identifying team members and project topics
- Week 7: Proposal due (team member, topics and milestone)
- Week 14: Project presentation

- Finals week: Final report due (task and model description, major discovery, lessons learned)

Participation

When students enroll in this course, they are expected to actively participate in class discussions and make a commitment to attend regularly. Simply attending class is not enough; students are encouraged to contribute to the learning environment by asking relevant questions and engaging in discussions. While attendance policies do not provide rewards for attending class, they may impose penalties for non-attendance. Being late or missing class due to working on assignments is not an acceptable excuse. Students must arrive on time and fully prepared to participate in each class meeting.

While there may be legitimate reasons for a student to miss class, excessive absences can hinder their ability to fulfill the requirements of the course. In such cases, the instructor may recommend that the student withdraw from the course, not as a punishment for missing class, but as an acknowledgment that the student may not be able to complete the course assignments due to their frequent absences.

Note: The instructor might ask the students to watch a video or read an article as a preparation for a certain class. While such an assignment will not be graded, not proceeding with it will lead to your inability to participate in the class discussion associated with it.

Two Networking assignments:

Networking is a very important part of being a professional. The best place to network and meet other professionals is the classroom itself. Unfortunately, many students take classes where they barely – or even do not – meet anyone. These assignments will help you combat such an inconvenience. Throughout the semester, each student will be required to participate in two networking meetings with their classmates (groups of 5 to 10). Each group will agree unanimously on a time and place where they will be meeting and just socializing. The duration should be at least one hour. A group picture must be taken. Each student will therefore send the group picture as evidence, and they will mention who was in the meeting and what did they do. More details on the deadlines and specificities will be mentioned in class. Groups have to be different for each of the two assignments.

Grading Breakdown

The following percentage breakdown will be used in determining the grade for the course.

Homework assignments	20%
Networking Assignments	5%
Participation	10%
Midterm exam	25%
Project	40%
Total	100%

Grading Scale

The following shows the tentative grading scale to be used to determine the letter grade.

93% and above	A
90% - 92%	A-
87% - 89%	B+
83% - 86%	B
80% - 82%	B-
77% - 79%	C+
73% - 76%	C
70% - 72%	C-
67% - 69%	D+
64% - 66%	D
63% and below	F

The instructor reserves the right to change grading percentages and scale the way they deem fit/necessary.

Policies

Assignment Submission Policy

All material is expected to be turned in on time and in the proper format. Assignments will be penalized for grammatical mistakes, spelling errors, format mistakes, and typos. Please proof your assignment prior to submission.

Course-Specific Policies

Students might need to use their computer for some of the classes.

Attendance

Students who miss class are expected to get in touch with their peers to keep up with the material they missed.

Academic Integrity

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 in the subsequent “Statement on Academic Conduct and Support Systems” section.

- Group work: Unless specifically designated as a ‘group project,’ all assignments are expected to be completed individually.
- Computer programs: Plagiarism includes the submission of code written by, or otherwise obtained from someone else.

If found responsible for an academic violation (like plagiarism), students may be assigned university outcomes, such as suspension or expulsion from the university, and grade penalties, such as an “F” grade on the assignment, exam, and/or in the course.]

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.

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.

Use of Generative AI in this Course

[Description of if/how Generative AI and similar tools may be used in this course.]

C) Generative AI is encouraged: You are expected to use AI (e.g., ChatGPT and image generation tools) in this class. Learning to use AI is an emerging skill; this is an opportunity for you to discuss with the instructor appropriate use of these tools. Keep in mind the following:

- AI tools are permitted to help you brainstorm topics or revise work you have already written.
- If you provide minimum-effort prompts, you will get low-quality results. You will need to refine your prompts to get good outcomes. This will take work.
- Proceed with caution when using AI tools and do not assume the information provided is accurate or trustworthy. If it gives you a number or fact: assume it is incorrect unless you either know the correct answer or can verify its accuracy with another source. You will be responsible for any errors or omissions provided by the tool. It works best for topics you understand.
- AI is a tool, but one that you need to acknowledge using. Please include a paragraph at the end of any assignment explaining if, how, and why you used AI and indicate/specify the prompts you used to obtain the results. Failure to do so is a violation of academic integrity policies.

	Topics/Daily Activities	Readings/Preparation	Deliverables
Week 1	Introduction. Python Review. Library Numpy. Matplotlib. Data Manipulation		
Week 2	Introduction to select techniques in Machine Learning and Deep Learning. Train, validate, test		HW1: Train, validate and test
Week 3	Introduction to Neural Networks (NN). DL Architectures. The NN as a Nonlinear regression model. Overfitting, dropout, regularization		HW1 Due
Week 4	The MultiLayerPerceptron. Backpropagation		HW2: Regularization
Week 5	Deep Learning applications. Classification.		HW2 Due
Week 6	Convolutional Neural Networks (CNN). Basic Components of a CNN. Architectures of CNN		HW3: CNN
Week 7	Convolutional Neural Networks (CNN). CNN applications. Image classification.		Finalizing Project Teams and Topics
Week 8	Physics Informed Neural Networks and PDEs		HW3 Due
Week 9	MIDTERM review - Midterm		
Week 10	SPRING BREAK		SPRING BREAK
Week 11	DeepONets		HW4: Physics Informed NN
Week 12	GENERATIVE ADVERSARIAL NETWORKS (GANs)		
Week 13	CONDITIONAL GENERATIVE ADVERSARIAL NETWORKS (CGANs)		HW4 Due
Week 14	PROJECT PRESENTATIONS		
Week 15	PROJECT PRESENTATIONS		
FINAL	Final Report due		

Statement on Academic Conduct and Support Systems

Academic Integrity:

The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, comprises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university's mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s).

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

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

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 relationship to the class, whether obtained in class, via email, on the internet, or via any other media. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

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.

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 is comprised 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) 740-5086 or (213) 821-8298

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.