



**ISE 599 Special Topics:**  
**Introduction to Deep Learning**  
Summer 2023, MW 9-11:30 a.m.  
**Location:** KAP 145

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**IT Help:**  
**Hours of Service:**  
**Contact Info:**

### **Course Description**

This course introduces Deep Learning (DL) fundamentals and applications. Students will learn the elements of neural networks (NN), the methods used to optimize their performance, the most common NN architectures, and applications of DL models to analytics and AI. These applications range from regression, classification, decision making, image classification, and image identification. Students will learn how to implement these applications using python library Keras.

### **Learning Objectives and Outcomes**

At the end of the course the students will know

- the fundamental principles of NN models
- the elements of a neural network model
- the most common types of NN architectures and what type of problems each is suitable for
- how to build and implement NN models for prediction and classification business data analytics problems
- how to build and implement NN models for artificial intelligence applications

**Prerequisite(s):** None

**Recommended Preparation:** Undergraduate courses as follows

- It is strongly recommended to have python programming experience
- Calculus to the level of MATH 229 or equivalent
- Statistics to the level of ISE 225 or equivalent

### **Course Notes**

The course material is available on Blackboard.

## Technological Proficiency and Hardware/Software Required

Required software: Python programming language is used throughout the course. Jupyter Notebook is used as the main interface for documenting the scripts and results.

## Textbook (required)

- Chollet F., *Deep Learning with Python*, 2<sup>nd</sup> 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
- Other references as suggested during the class sessions

## Description and Assessment of Assignments

All assignments and examinations are on-line. Unless otherwise noted the assignments are individual. All homework assignments are released and distributed one-week in advanced. Dates are shown in the Course schedule on page 4. Submit on to Blackboard by the due date. No late homework will be accepted.

## Grading Policy

| Assignment | Points                             | % of Grade |
|------------|------------------------------------|------------|
| Homework   | 100 each (6+ homework assignments) | 30         |
| Midterm    | 100                                | 30         |
| Final      | 100                                | 40         |
| TOTAL      |                                    | 100        |

## Grading Scale (Course final grades will be determined using the following scale)

|    |         |    |         |    |                |
|----|---------|----|---------|----|----------------|
| A  | 94-100  | B- | 80-82.9 | D+ | 67-69          |
| A- | 90-93.9 | C+ | 77-79   | D  | 63-66.9        |
| B+ | 87-89   | C  | 73-76.9 | D- | 60-62.9        |
| B  | 83-86.9 | C- | 70-72.9 | F  | 59.9 and below |

## Assignment Submission Policy

Assignments should be typewritten and clean. Email submissions and late submissions are not allowed. No make-up exams are considered.

## Timeline and Rules for submission

Assignments must be submitted on the due date. Solutions will be released soon after the homework due date.

## Course Schedule: A Weekly Breakdown

|    | Date                 | Topics/Daily Activities   | Deliverables               | slides   | ref. and files  |
|----|----------------------|---|----------------------------|--|---|
| 1  | June 28              | <b>Introduction.</b> Quick review of Python and Jupyter Notebook (JN). Library numpy. Gradient Descent.                                   | HW1<br>Python and numpy    | overview.ppt<br>python.ppt<br>numpy.ppt<br>python basics.pdf | intro.ipynb Ch 3.4<br>numpy.ipynb<br>numpyreg.ipynb<br>Tour-on-python.pdf                     |
| 2  | July 3<br>(recorded) | <b>Generalization.</b> Overfitting. Regularization. Holdout cross validation. Pandas review.  |                            | generalization.ppt<br>rr.ppt<br>pandas basics.pdf            | Ch 5.1, 5.2, 5.4<br>ridge9.ipynb<br>cancerRR.ipynb<br>hitters.csv, small.csv                  |
| 3  | July 5               | <b>Intro to Neural Networks (NN)</b> The Densely connected NN. The NN as a NL regression model. The Gradient. Building a NN with sklearn. | HW1 due                    | nlreg.ppt<br>nn4.ppt   | Kutner Ch. 13<br>Ch. 2.2, 2.3, 2.4<br>gradient.ipynb<br>perceptron.ipynb<br>multilayerp.ipynb |
| 4  | July 10              | <b>Introduction Deep Learning (DL).</b> The MLP. A first DL model with Keras. Multilabel classification models.                           |                            | mnist.ppt  | Ch 2.1, 2.4, 2.5<br>mnist.ipynb   |
| 5  | July 12              | <b>Deep Learning applications.</b> NN for classification. Binary and Multiclass classification models.                                    | HW2                        | classification.ppt   | Ch 4.1, 4.2<br>imdb.ipynb<br>reuters.ipynb  |
| 6  | July 17              | <b>Deep Learning applications.</b> NN for Regression problems. K-fold cross validation.   |                            | dlreg.ppt<br>cv3.ppt   | Ch 4.3, 5.2<br>boston.ipynb   |
| 7  | July 19              | <b>Convolutional Neural Networks (CNN).</b> Basic Components of a CNN. CNN applications. Image classification.                            | HW2 due<br>Midterm release | cnn.ppt  | Ch. 8. vision.ipynb<br>Ch 9. image.ipynb  |
| 8  | July 24              | <b>Deep learning for Time Series.</b> Forecasting application. Introduction to Recurrent NN.  |                            | lstm.ppt   | Ch. 10<br>temperature. ipynb  |
| 9  | July 26              | <b>Deep learning for text data.</b> Natural language processing. Pre-processing text data.  | Midterm due                | text.ppt   | Ch. 11.2<br>nlp.ipynb   |
| 10 | July 31              | <b>Deep learning for sequences.</b> Processing a sentence as a sequence. Sequence Models.   | HW3                        | seq.ppt  | Ch. 11.3<br>sequences.ipynb   |
| 11 | Aug 2                | <b>Transformers.</b> Transformer encoders. Sequence to sequence learning  | HW3 due<br>Final release.  | transf.ppt   | Ch. 11.4<br>transformer.ipynb   |
| 12 | Aug 7                | <b>Generative Deep learning.</b> Generative Adversarial Networks.   |                            | gdl.ppt  | Ch. 12  |
| 13 | Aug 9                | <b>FINAL EXAM</b>   |                            |  |   |

## Statement on Academic Conduct and Support Systems

### Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” [policy.usc.edu/scampus-part-b](http://policy.usc.edu/scampus-part-b). Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, [policy.usc.edu/scientific-misconduct](http://policy.usc.edu/scientific-misconduct).

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the Office of Equity and Diversity <http://equity.usc.edu> or to the Department of Public Safety <http://capsnet.usc.edu/departments/departments-public-safety/online-forms/contact-us>. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The Center for Women and Men <http://www.usc.edu/student-affairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage <http://sarc.usc.edu> describes reporting options and other resources.

### Support Systems:

*Student Health Counseling Services - (213) 740-7711 – 24/7 on call*  
[engemannshc.usc.edu/counseling](http://engemannshc.usc.edu/counseling)

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

*National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call*  
[suicidepreventionlifeline.org](http://suicidepreventionlifeline.org)

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

*Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 – 24/7 on call*  
[engemannshc.usc.edu/rsvp](http://engemannshc.usc.edu/rsvp)

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

*Office of Equity and Diversity (OED) | Title IX - (213) 740-5086*  
[equity.usc.edu](http://equity.usc.edu), [titleix.usc.edu](http://titleix.usc.edu)

Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

*Bias Assessment Response and Support - (213) 740-2421*  
[studentaffairs.usc.edu/bias-assessment-response-support](http://studentaffairs.usc.edu/bias-assessment-response-support)

Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

*The Office of Disability Services and Programs - (213) 740-0776*

[dsp.usc.edu](http://dsp.usc.edu)

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

*USC Support and Advocacy - (213) 821-4710*

[studentaffairs.usc.edu/ssa](http://studentaffairs.usc.edu/ssa)

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

*Diversity at USC - (213) 740-2101*

[diversity.usc.edu](http://diversity.usc.edu)

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*

[dps.usc.edu](http://dps.usc.edu), [emergency.usc.edu](http://emergency.usc.edu)

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) 442-120 – 24/7 on call*

[dps.usc.edu](http://dps.usc.edu)

Non-emergency assistance or information.