# ENGR 3321: Introduction to Deep Learning for Robotics (CRN27199)
# Fall, 2023

### Class

*Time:* Monday & Wednesday, 1:00 PM–2:15 PM
*Location:* Conway Corp Center for Science (CCCS) 105
*Course Materials:* https://linzhanguca.github.io/deep_learning-2023

### Instructor

*Name:* Lin Zhang
*Office:* LSC 110
*Office Hours:* Monday 10:00 AM – 12:00 PM *Look for me in LSC013 or LSCA105 if not in office.*
*Telephone:* 501-450-5904
*Email:* lzhang12@uca.edu
*Webpage:* https://uca.edu/physics/facultystaff/lin-zhang-phd/

## Overview

### Course Description

This course introduces the foundational concepts of neural networks and deep learning. Students will understand capabilities, challenges and consequences of deep learning. Students will be introduced to practical neural network architectures and techniques involved in the development of deep learning. This course provides both lectures and labs for students to get a deeper inception and to practice their skills. Students will work independently in each lab, but communications and discussions are highly encouraged. See **Course Contents** section for more details.

### Prerequisites

**No courses nor skills are required in advance.** Though, **MATH1496 Calculus I** and **MATH3320 Linear Algebra** may make your journey easier. Familiar with Python programming language can be helpful too.

### Textbooks

**No textbooks is required.** The free text book: Deep Learning by Ian Goodfellow is a good reference.

### Classroom Policy

The instructor and the students are expected to appear in the classroom/lab in every class. If any student cannot show up on time, he/she needs to contact the instructor in advance. The instructor will notify the students with any changes of a class in advance. No food nor drinks are allowed in the classroom/lab.

The Department of Physics and Astronomy provides computers for students to use in the classroom. Students cannot take any classroom belongings out without a permission from the department office.

## Grading

A's are 85-100%, B's are 75-84%, C's are 65-79%, D's are 64-50%, F's are 0-49%. The final grade will be determined by following criteria.

| Component | Percentage | Notes |
|---|---|---|
| Attendance | 1% | Attend every class |
| Labs/Assignments | 80% | |
| Final Project | 19% | Code, report & presentation |
| Total | 100% | |

## Other Policies

The policies and procedures detailed in the UCA 2022-2023 Student handbook are also part of this syllabus. Please refer to the relevant policies as your guidance.
https://uca.edu/student/files/2023/08/STUDENT-HANDBOOK-2023-2024.pdf

If a student discloses an act of sexual harassment, discrimination, assault, or other sexual misconduct to a faculty member (as it relates to "student-on-student" or "employee-on-student"), the faculty member is encouraged to report the act to the Title IX coordinator, deputy coordinator, or employee with the authority to institute corrective measures on behalf of the University. An investigation of a formal complaint of Title IX Sexual Harassment will only be initiated when the Complainant (individual who suffers actual harm from the violation of the Title IX Sexual Harassment Policy) or the Title IX Coordinator signs a complaint. For further information, please visit: https://uca.edu/titleix/. *Disclosure of sexual misconduct by a third party who is not a student and/or employee is also encouraged if the misconduct occurs when the third party is a participant in a university-sponsored program, event, or activity.

### Academic Integrity

The University of Central Arkansas affirms its commitment to academic integrity and expects all members of the university community to accept shared responsibility for maintaining academic integrity. Students in this course are subject to the provisions of the university's Academic Integrity Policy, approved by the Board of Trustees as Board Policy No. 709 on February 10, 2010, and published in the Student Handbook. Penalties for academic misconduct in this course may include a failing grade on an assignment, a failing grade in the course, or any other course-related sanction the instructor determines to be appropriate. Continued enrollment in this course affirms a student's acceptance of this university policy.

### Building Emergency Plan

An Emergency Procedures Summary (EPS) for the building in which this class is held will be discussed during the first week of this course. EPS and Building Emergency Plan (BEP) documents for most buildings on campus are available at https://uca.edu/go/bep-library. Every student should be familiar with emergency procedures for any campus building in which he/she spends time for classes or other purposes.

**Disabilities**

The University of Central Arkansas adheres to the requirements of the Americans with Disabilities Act. If you need an accommodation under this Act due to a disability, please contact the Office of Accessibility Resources and Services (OARS), 450-3613.

**Course Evaluation**

The Student Course Experience Survey is a crucial element in helping faculty achieve excellence in the classroom and the institution in demonstrating that students are gaining knowledge. Students may complete surveys for courses they are taking starting on Monday, November 20th, through the Sunday, December 17th after finals week by logging in to myUCA and clicking on the Course Evaluations task.

## Course Contents

Please refer to the following for a tentative course plan. The actual contents will be subject to changes due to the progress of the course. **Note: all assignments due on Wednesdays at 2:15 PM**

### Module 1 - Neural Networks

Introduce the basic concepts of neural networks. Students are expected to build a deep neural network from scratch.

- **Lab/Assignment 1:** Python and Numpy basics. **Due date:** Wednesday, 09/06/2023.
- **Lab/Assignment 2:** Logistic Regression. **Due date:** Wednesday, 09/13/2023.
- **Lab/Assignment 3:** Neural Network with One Hidden Layer. **Due date:** Wednesday, 09/20/2023.
- **Lab/Assignment 4:** Deep Neural Network Image Classification. **Due date:** Wednesday, 09/27/2023.
- **Lab/Assignment 5:** PyTorch. **Due date:** Wednesday, 10/04/2023.
- **Lab/Assignment 6:** Model Tuning. **Due date:** Wednesday, 10/11/2023.

### Module 2 - Convolutional Neural Networks

Introduce the evolution of computer vision and convolutional neural networks. Students are expected to understand and practice the core components of the convolutional neural networks.

- **Lab/Assignment 7:** Convolutional Model. **Due date:** Wednesday, 10/25/2023.

### Module 3 - More Neural Networks

More interesting neural network models will be introduced, including autoencoders, GANs, transformers, etc..

- **Lab/Assignment 8:** DCGAN. **Due date:** Wednesday, 11/08/2023.

### Final Project - Autonomous Race

Students will use the knowledge they've learned to train an autonomous racing vehicle. **Due date:** Wednesday, 12/13/2023.