**University of Michigan - Dearborn**

# **CIS Deep Learning, 3 Credit hours, Lecture/Online**

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# Instructor: Prof. Jin Lu

# Office Location: 216 CIS

# Office Hours: Monday 1:30 PM – 3:00 PM

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Dearborn Discovery Core Category or Categories: **None**

**Course Description**:

This course is an introduction to deep learning, a branch of machine learning concerned with the development and application of modern deep neural networks. Students will learn to build up deep learning models and review the state-of-the-art deep learning literature to solve real-world computational problems. Students will delve into selected deep learning topics, discussing a range of model architectures such as CNN (convolutional neural network), RNN (recurrent neural network), LSTM (long short-term memory network), GAN (generative adversarial network), etc., and commonly used model optimizers. Students will participate in a research-oriented project in this course.

**Program Goals:**

* An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
* An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.
* An ability to design, implement and evaluate a computer-based system, process, component, or program to meet desired needs.

**Course Objectives:**

* Understand basic context of modern neural networks.
* Understand major deep learning algorithms and the problem settings.
* Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
* Implement deep learning algorithms and solve real-world problems.
* Learn how to use deep learning software packages.

**Text:**

1. Deep Learning (Adaptive Computation and Machine Learning Series) 1st edition by Goodfellow, I., Yoshua Bengio, and Aaron Courville. ", 2016: ISBN-10: 0262035618
2. Ketkar, Nikhil, and Eder Santana. Deep learning with Python. Vol. 1. Berkeley, CA: Apress, 2017.
3. Pattern Recognition and Machine Learning (Information Science and Statistics) 2nd edition by Bishop, Christopher M. springer, 2006: ISBN-10: 0387310738

None of the textbooks will be required. However, having one or two of them may complement and expand the materials discussed in lectures. Lectures will come with slide files and tutorial/review papers for students to study after lectures.

**Assignment and Grading Distribution:**

Your grade in this course will be determined by your scores on the assignments (50%), class participation (10%), and the final project (40%). Late work will be penalized (5% each working day, weekends count as 5%). Homework assignments/Final Project: All could be done by a team with at most two members.

**Grading Scale:**

**[93% - 100%] A [90% - 93%] A-**

**[85% - 90%] B+ [80% - 85%] B**

**[75% - 80%] B- [70% - 75%] C+**

**[65% - 70%] C [60% - 65%] C-**

**[57% - 60%] D+ [53% - 57%] D**

**[50% - 53%] D-**

**Tentative Course Outline:**

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| **Lec#** | **Topic** |
| **#1** | **Introduction to Deep Learning** |
| **#2** | **Artificial Neural Nets and Gradient Descent** |
| **#3** | **Programming for Training Neural Nets (Keras\Pytorch)** |
| **#4** | **Word Embeddings and Recommendation Systems** |
| **#5** | **CNN I: Convolutional Neural Nets** |
| **#6** | **CNN II: Object Detection and Image Segmentation** |
| **#7** | **RNN I: Recurrent Neural Nets for NLP** |
| **#8** | **RNN II: Sequence to sequence, attention and memory** |
| **#9** | **Theory: Optimization, Generalization, and Expressivity** |
| **#10** | **Imbalanced classification and metric learning** |
| **#11** | **Unsupervised Deep Learning and Generative models I** |
| **#12** | **Unsupervised Deep Learning and Generative models II** |
| **#13** | **Project Final Presentation I** |
| **#14** | **Project Final Presentation II** |