

**Eastern Illinois University**  
**New/Revised Course Proposal Format**  
(Approved by CAA on 4/3/14 and CGS on 4/15/14, Effective Fall 2014)

**Banner/Catalog Information (Coversheet)**

1.  **New Course** or  **Revision of Existing Course**
2. **Course prefix and number:** CSM 4986
3. **Short title:** Deep Learning
4. **Long title:** Deep Learning and Neural Networks
5. **Hours per week:** 3 Class 0 Lab 3 Credit
6. **Terms:**  Fall  Spring  Summer  On demand
7. **Initial term:**  Fall  Spring  Summer Year: 2023
8. **Catalog course description:** This course focuses on both theory and practice in neural networks and deep learning and covers models for many kinds of applications. Topics include learning in neural networks, deep feedforward neural networks, training optimization, convolutional neural networks, recurrent neural networks, autoencoders and adversarial networks, and deep learning to solve applications in computer vision, speech recognition, natural language processing, and other related areas.
9. **Course attributes:**  
General education component: None  
 Cultural diversity  Honors  Writing centered  Writing intensive  Writing active
10. **Instructional delivery**  
**Type of Course:**  
 Lecture  Lab  Lecture/lab combined  Independent study/research  
 Internship  Performance  Practicum/clinical  Other, specify: \_\_\_\_\_  
**Mode(s) of Delivery:**  
 Face to Face  Online Synchronous  Online Asynchronous  Study Abroad  
 Hybrid, specify approximate amount of on-line and face-to-face instruction 33% online and 67% face-to-face \_\_\_\_\_
11. Course(s) to be deleted from the catalog once this course is approved.  
None
12. **Equivalent course(s):** None
  - a. **Are students allowed to take equivalent course(s) for credit?**  Yes  No
13. **Prerequisite(s):** CSM 4985
  - a. **Can prerequisite be taken concurrently?**  Yes  No

b. Minimum grade required for the prerequisite course(s)? C

c. Use Banner coding to enforce prerequisite course(s)?  Yes  No

d. Who may waive prerequisite(s)?

No one  Chair  Instructor  Advisor  Other (specify)

14. Co-requisite(s): None

15. Enrollment restrictions

a. Degrees, colleges, majors, levels, classes which may take the course: All

b. Degrees, colleges, majors, levels, classes which may not take the course: None

16. Repeat status:  May not be repeated  May be repeated once with credit

17. Enter the limit, if any, on hours which may be applied to a major or minor: 3

18. Grading methods:  Standard  CR/NC  Audit  ABC/NC

19. Special grading provisions:

Grade for course will not count in a student's grade point average.

Grade for course will not count in hours toward graduation.

Grade for course will be removed from GPA if student already has credit for or is registered in:

\_\_\_\_\_

Credit hours for course will be removed from student's hours toward graduation if student already has credit for or is registered in: \_\_\_\_\_

20. Additional costs to students:

Supplemental Materials or Software \_\_\_\_\_

Course Fee  No  Yes, Explain if yes \_\_\_\_\_

21. Community college transfer:

A community college course may be judged equivalent.

A community college may not be judged equivalent.

Note: Upper division credit (3000+) will not be granted for a community college course, even if the content is judged to be equivalent.

## **Rationale, Justifications, and Assurances (Part I)**

1. \_\_\_ Course is required for the major(s) of \_\_\_\_\_  
\_\_\_ Course is required for the minor(s) of \_\_\_\_\_  
\_\_\_ Course is required for the certificate program(s) of \_\_\_\_\_  
\_√\_ Course is used as an elective
2. **Rationale for proposal:** This course is designed for upper-level undergraduate students and graduate students. Over the past few years, neural network and deep learning has brought a wide array of impressive innovations, such as self-driving car, face recognition, and human-like speech generators. High job demand for deep learning expertise motivates us to propose this course. With focus on both theory and practice in neural network and deep learning, this course also covers models for many kinds of applications.
3. **Justifications for (answer N/A if not applicable)**  
Similarity to other courses: N/A  
Prerequisites: Student need a basic knowledge of machine learning, including types of machine learning, training and testing of machine learning models.  
Co-requisites: N/A  
Enrollment restrictions: N/A  
Writing active, intensive, centered: N/A
4. **General education assurances (answer N/A if not applicable)**  
General education component: N/A  
Curriculum: N/A  
Instruction: N/A  
Assessment: N/A
5. **Online/Hybrid delivery justification & assurances (answer N/A if not applicable)**  
Online or hybrid delivery justification: Because this course involves a significant project-centered approach, it can be delivered effectively in either a face-to-face or a hybrid/online setting.  
Instruction: A variety of learning materials, such as videos, video lectures, research articles, credible websites, and programming tools, will be utilized. All faculty who deliver this course online will be OCDi (or appropriate equivalent) trained.  
Integrity: The instructor will correspond with each student on a regular basis. The exams will be timed and available for a limited time span with Respondus Lockdown browser or other proctoring software enabled; however, notes and other resources can be utilized. Academic

integrity of written work will be preserved and monitored for originality and authenticity with the most current technology available.

Interaction: Online synchronous mechanism will be used for lecture delivery. Outside the online synchronous class, faculty will be available for student interaction at the faculty member's discretion, but could include email, feedback via assignment dropboxes, telephone, and on-line office hours.

## **Model Syllabus (Part II)**

**1. Course number and title:** CSM4986 Deep Learning

**2. Catalogue Description:** This course focuses on both theory and practice in neural networks and deep learning and covers models for many kinds of applications. Topics include learning in neural networks, deep feedforward neural networks, training optimization, convolutional neural networks, recurrent neural networks, autoencoders and adversarial networks, and deep learning to solve applications in computer vision, speech recognition, natural language processing, and other related areas.

**Prerequisites:** CSM4985 (Machine Learning and Artificial Intelligence)

### **3. Learning Objectives:**

Upon completion of this course, students will be able to:

- Identify the major concepts and techniques in deep learning. (CT-3; QR-4; Grad 1-2)
- Implement, train, and test neural network and deep learning algorithms. (CT-4; QR-2; QR-4; QR-6; Grad 1-3)
- Demonstrate neural network and deep learning skills by designing and implementing algorithms to solve practical problems. (CT-3; CT-4; QR-2; QR-4; QR-6; Grad 1-5)
- Plan and carry out a term project on neural network and deep learning. (CT-4; CT-5; QR-2; QR-3; QR-4; QR-6; WR-3; WR-6; Grad 1-5)

Graduate students only

- Demonstrate expertise in deep learning by presenting research papers. (CT-6; QR-3; QR-4; QR-5; WR-3; WR-6; Grad 1-5)

### **4. Course Materials:**

**Textbook:** The required textbook for the course is

Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, <http://www.deeplearningbook.org>, 2016

Other recommended supplemental textbooks on general machine learning:

- Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995.
- Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. 4<sup>th</sup> Edition, Pearson Series in Artificial Intelligence. 2020.

**Topics to be covered:** The course will focus on the topics, including (but not limited to):

- Introduction to Neural Networks and Deep Learning
- Learning in Neural Networks
  - Backpropagation
  - Gradient descent

- Regularization, etc.
- Deep Feedforward Neural Networks
- Optimization for Training Deep Learning Models
  - Adam
  - Minibatch Stochastic Gradient Descent
  - Coordinate Descent, etc.
- Convolutional Neural Networks
- Recurrent Neural Networks
- Autoencoders and adversarial networks
- Deep Learning to Solve Applications
  - in computer vision, speech recognition, natural language processing, and other related areas

**5. Weekly outline of content:** The following are the (tentative) topics of study divided into weekly modules. Each module will last for 1 to 2 weeks. Students should monitor D2L and/or emails from the instructor for the activities associated with each module. The instructor reserves the right to modify/relocated topics of study as needed.

Weeks	Topic
1-2	Introduction to Neural Networks and Deep Learning
3-4	Learning in Neural Networks
5-6	Deep Feedforward Neural Networks
7-8	Optimization for Training Deep Learning Models
9-10	Convolutional Neural Networks
11	Recurrent Neural Networks
12	Autoencoders and adversarial networks
13-15	Deep Learning to Solve Applications in Computer Vision, Speech recognition, Natural language processing, and other related areas
15	Term Project Presentation
16	Final Exam

**6. Evaluation:** The lecture format will be the basic mechanism used in the course. Computer demonstrations in the classroom will be used whenever appropriate.

Programming and written assignments relating to neural network and deep learning will be assigned, specifically building and testing programs for various applications.

Students will be required to complete a term project in which students need to design a solution for their chosen application.

Students' performance will be assessed based on their understanding of the subject material demonstrated through multiple written and programming assignments, a term project, two term exams, and a final exam. The final examination will be comprehensive.

Students electing this course for graduate credits will be required to read assigned research papers and present research paper(s) in the class.

The relative weights of the components of the course are as follows:

**Undergraduate:**

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Exam-1	20%
Exam-2	20%
Assignments	25%
Term Project	15%
Final Exam	20%

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**Graduate:**

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Exam-1	20%
Exam-2	20%
Assignments	20%
Term Project	15%
Research Paper Presentation	5%
Final Exam	20%

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Term Exams and Final Exams: The term exams and final exams will consist of questions that emphasize the principles and practical aspects for neural network and deep learning.

Assignments: Both undergraduate and graduate students will complete written and programming assignments.

Term Project: Both undergraduate and graduate students will complete a term project. The student will design their own (individual or team) solution to a practical application. As a result, the term project will strengthen students' critical thinking skills on the content of neural network and deep learning.

Research Paper Presentation (Graduate-level Assessment):

The graduate students will be additionally required to read research papers on neural networks and deep learning and present research papers in the class.

**7. Grading Scale:** The following scale will be used as a first approximation to your grade:

90– 100: A 80–89: B 70–79: C 55–69: D 0–54: F

In borderline cases, factors such as overall trends and the final exam score will be taken into consideration. It is possible that the “cut-off” scores given above will be lowered. As a result, an overall score of 80 is guaranteed to receive at least a B, whereas a score of 78 might result in a B.

**8. Correlation of learning objectives to assignments and evaluation.**

**Undergraduate:**

	Exams (60%)	Assignments (25%)	Term Project (15%)
Identify the major concepts and techniques in deep learning (CT-3; QR-4)	X	X	
Implement, train, and test neural network and deep learning algorithms. (CT-4; QR-2; QR-4; QR-6)		X	X
Demonstrate neural network and deep learning skills by designing and implementing algorithms to solve practical problems. (CT-3; CT-4; QR-2; QR-4; QR-6)		X	X
Plan and carry out a term project on neural network and deep learning. (CT-4; CT-5; QR-2; QR-3; QR-4; QR-6; WR-3; WR-6)			X

**Graduate:**

	Exams (60%)	Assignments (20%)	Term Project (15%)	Research Paper (5%)
Identify the major concepts and techniques in deep learning (CT-3; QR-4; Grad 1-2)	X	X		
Implement, train, and test neural network and deep learning algorithms. (CT-4; QR-2; QR-4; QR-6; Grad 1-3)		X	X	
Demonstrate neural network and deep learning skills by designing and implementing algorithms to solve practical problems. (CT-3; CT-4; QR-2; QR-4; QR-6; Grad 1-5)		X	X	
Plan and carry out a term project on neural network and deep learning. (CT-4; CT-5; QR-2; QR-3; QR-4; QR-6; WR-3; WR-6; Grad 1-5)			X	
Demonstrate expertise in deep learning by presenting research papers. (CT-6; QR-3; QR-4; QR-5; WR-3; WR-6; Grad 1-5)				X

**Date approved by the department or school:**

**Date approved by the college curriculum committee:**

**Date approved by the Honors Council (*if this is an honors course*):**

**Date approved by CAA:**

**Date approved by CGS:**