PROPOSAL DATE: 3/1/2016
15-DAY REVIEW END DATE:

DEPARTMENT: Electrical and Computer Engineering

COURSE DESIGNATOR AND NUMBER: ECE 6524 (CS 6524)

TITLE OF COURSE: Deep Learning

TRANSCRIPT (ADP) TITLE (MAX-30 Characters): Deep Learning

INSTRUCTOR and/or DEPARTMENTAL CONTACT: Dhruv Batra

CONTACT PHONE: 1-7561

CONTACT E-MAIL: dbatra@vt.edu

MAILCODE: 0111

Please count this course toward the following scorecard metrics area:
☐ Study Abroad ☐ Service Learning ☐ Experiential ☐ Undergraduate Research

CHECK ONLY ONE OF THE FOLLOWING BOXES

☐ NEW COURSE ☐ REVISED COURSE [Revision>20% ☐ Revision<20%] ☐ OTHER: ____________________________

☐ NEW COURSE & INCLUSION IN THE CLE [Area________ ] ☐ REVISIEd COURSE FOR INCLUSION IN THE CLE OR CLE AREA CHANGE

☐ REVENCED COURSE FOR INCLUSION IN THE CLE OR CLE AREA CHANGE

*Courses routed directly to the University Curriculum Committee For Liberal Education MUST be endorsed by the appropriate Department Head or Dean.
*The Chair of the University Curriculum Committee For Liberal Education shall inform the appropriate college curriculum committee of all courses under review by the University Curriculum Committee For Liberal Education.

A Attach Statement from Dean or Departmental Representative as to whether Teaching this Course will Require or Generate the Need for Additional Departmental Resources.

B Attach Appropriate Letters of Support from Affected Departments and/or Colleges.

C Effective Semester: Spring 2017

D Change in Title From: ____________________________

To: ____________________________

E Change in Lecture and/or Lab Hours From: ____________________________

To: ____________________________

F Change in Credit Hours From: ____________________________

To: ____________________________

G Percentage of Revision from Current Syllabus: ____________________________

Revision Summary: ____________________________

H Course Number(s) and Title(s) to be Deleted from the Catalogue with APPROVAL of course: ____________________________

APPROVAL SIGNATURES

Department Representative ____________________________ Date: 2/26/2016

College Curriculum Committee Representative ____________________________ Date: 3/15/16

College Dean ____________________________ Date: 3/16/16

Rev 04-20-2012
Deep Learning
ECE 6524 / CS 6524
(ECE is Home Department)

I -- Catalog Description

Advanced concepts in Machine Learning and Deep Learning. Models (multi-layer perceptrons, convolutional neural networks, recurrent neural networks, long short-term memory networks, memory networks), learning algorithms (backpropagation, stochastic sub-gradient descent, dropout), connections to structured predictions (Boltzmann machines, "unrolled" belief propagation), and applications to perception and Artificial Intelligence (AI) problems (image classification, detection, and segmentation; image captioning; visual question answering; automatic game playing). Pre: 5424G or CS 5824 (3H, 3C).

Course Number: 6524 (CS 6524)

ADP TITLE: Deep Learning

II - Learning Objectives

Having successfully completed this course, the student will be able to:

- Analyze and contrast broad classes of deep learning models (multilayer perceptrons vs. ConvNets vs RNNs)
- Derive and implement backpropagation-based parameter learning and modern optimization techniques in such models
- Summarize and review state-of-art approaches in deep learning
- Discuss and critique research papers on these topics
- Identify open research questions in these areas

III - Justification

Reason for Teaching the Course:

Deep Learning is a branch of machine learning based on a set of algorithms and techniques that attempt to model high-level abstractions in data by using multiple processing layers. We are witnessing an explosion in data – from billions of images shared online to Petabytes of tweets, medical records and GPS tracks, generated by companies, users and scientific communities.

Deep Learning is rapidly emerging as one of the most successful and widely applicable technique across a range of applications. Many universities are
expanding programs in deep learning, and employers are hiring at a frenzied pace in this domain. Students trained in a principled understanding of deep machine learning techniques will be better equipped to make fundamental contributions to research in machine learning, and applied areas such as perception (vision, text, speech), robotics, bioinformatics, etc.

This course will expose students to cutting-edge research – starting from a refresher in basics of neural networks, to recent developments. The class will begin with instructor lectures, and the emphasis will be on student-led paper presentations. Through in-class discussion and semester-long research projects, this course will improve students’ critical thinking skills, presentation skills and problem solving skills, which are essential for a student to develop their own successful research.

• Level Justification:

This course is at the 6xxx level as it is course on advanced concepts in machine learning and requires the understanding of fundamentals of machine learning covered by 5424G (CS 5824) Advanced Machine Learning.

IV - Prerequisites and Corequisites

Pre: 5424G or CS 5824.

V - Texts and Special Teaching Aids

A. Required Course Materials:

• The Perceptron: A Probabalistic Model For Information Storage And Organization In The Brain. Psychological Review 65 (6): 386.408, 1958..


• Sequence to Sequence Learning with Neural Networks. Ilya Sutskever, Oriol Vinyals, Quoc Le, NIPS 2014.


B. Required Text:

None required. Recommended Text:
VI - Syllabus

<table>
<thead>
<tr>
<th>Topic</th>
<th>Percent of Course</th>
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<tbody>
<tr>
<td>1. History of Neural Networks and Background</td>
<td>10%</td>
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<tr>
<td>a) Perceptron</td>
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<td>b) Multi-layer Perceptron</td>
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<td>c) Backprop</td>
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<td>c) Universal Function Approximators</td>
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<tr>
<td>2. Deep Learning Models</td>
<td>20%</td>
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<tr>
<td>a) Convolutional Neural Networks</td>
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<tr>
<td>b) Recurrent Neural Networks</td>
<td>10%</td>
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<td>c) Long Short-Term Memory networks</td>
<td>10%</td>
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<tr>
<td>d) Memory Networks and Boltzmann Machines</td>
<td>10%</td>
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<tr>
<td>3. Modern Learning and Optimization Techniques</td>
<td>15%</td>
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<tr>
<td>a) Rectified Linear units</td>
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<td>b) Dropout</td>
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<td>c) Distillation and model compression</td>
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<td>4. Applications to Perception, Robotics, and AI</td>
<td>10%</td>
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<tr>
<td>a) Image Classification, Detection, Segmentation</td>
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<td>b) Image to Sentence Generation</td>
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<tr>
<td>c) Robotics, Reinforcement Learning</td>
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<td>5. Design and implementation of a technical project</td>
<td>15%</td>
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<td>100%</td>
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February 24, 2016

To Whom It May Concern:

The Department of Computer Science supports the Electrical and Computer Engineering Department’s proposal for ECE 6524, “Deep Learning,” which will be cross-listed as CS 6524. We understand that ECE should be considered the home department for this course, and that if ECE ceases to teach the course, a new course proposal will need to be submitted before the course can be offered again.

Sincerely,

Calvin J. Ribbens
Professor
Department Head
Feb. 25, 2016

TO: CoE Graduate Curriculum Committee

FROM: Dr. J. De La Ree, ECE Assistant Department Head

SUBJECT: New Course Proposal for ECE 6524 (CS 6524)

Attached is a new course proposal for ECE 6524 Deep Learning.

No additional resources will be required for the ECE Department with the approval of this new course.

If you have any questions regarding this course proposal, please contact me.

Attachment:
Course proposal: ECE 6524