FLORIDA ATLANTIC UNIVERSITY™

Graduate Programs—NEW COURSE PROPOSAL[1]

UGPC APPROVAL _____
UFS APPROVAL _____
SCNS SUBMITTAL _____
CONFIRMED _____
BANNER POSTED _____
CATALOG _____

DEPARTMENT: DEPT. OF COMPUTER & ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

COLLEGE: COLLEGE OF ENGINEERING AND COMPUTER SCIENCE

RECOMMENDED COURSE IDENTIFICATION:

PREFIX ____CAP_____ **COURSE NUMBER** __6619_____ **LAB CODE** (L or C) ____

(TO OBTAIN A COURSE NUMBER, CONTACT NMALDONADO@FAU.EDU)

COMPLETE COURSE TITLE: DEEP LEARNING

EFFECTIVE DATE
(first term course will be offered)
__FALL 2017_____

CREDITS[2]:
3

TEXTBOOK INFORMATION:
Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press, 2016. Available online at http://www.deeplearningbook.org.

GRADING *(SELECT ONLY ONE GRADING OPTION)*: **REGULAR** __X___ **SATISFACTORY/UNSATISFACTORY** _____

COURSE DESCRIPTION, NO MORE THAN THREE LINES:
This course teaches students basic concepts of deep learning, with applications in computer science, engineering, business and other areas. The class will cover major topics including math preliminaries, machine learning basics, deep forward networks, convolution networks, autoencoders, representation learning networks, their implementations and applications.

PREREQUISITES *:
COP3530 Data Structures and Algorithm Analysis or equivalent

COREQUISITES*:

REGISTRATION CONTROLS (MAJOR, COLLEGE, LEVEL)*:
GRADUATES IN COMPUTER ENGINEERING, COMPUTER SCIENCE, AND ELECTRICAL ENGINEERING.

* *PREREQUISITES, COREQUISITES AND REGISTRATION CONTROLS WILL BE ENFORCED FOR ALL COURSE SECTIONS.*

MINIMUM QUALIFICATIONS NEEDED TO TEACH THIS COURSE:
MEMBER OF THE GRADUATE FACULTY OF FAU AND HAS A TERMINAL DEGREE IN THE SUBJECT AREA (OR A CLOSELY RELATED FIELD)

Faculty contact, email and complete phone number:
Taghi Khoshgoftaar, khoshgof@fau.edu
Xingquan Zhu, xzhu3@fau.edu
Hanqi Zhuang, zhuang@fau.edu
561-297-3452/561-297-3413

Please consult and list departments that might be affected by the new course and attach comments.[3]
N/A

Approved by:	*Date:*
Department Chair:	9/22/16
College Curriculum Chair:	10/24/16
College Dean:	9/29/2016
UGPC Chair:	
Graduate College Dean:	
UFS President:	
Provost:	

1. **Syllabus** must be attached; see guidelines for requirements: *www.fau.edu/provost/files/course syllabus.2011.pdf*
2. Review **Provost Memorandum: Definition of a Credit Hour** *www.fau.edu/provost/files/Definition_Credit_Hour_Memo_2012.pdf*
3. **Consent** from affected departments (attach if necessary)

Email this form and syllabus to *UGPC@fau.edu* **one week before** the University Graduate Programs Committee meeting so that materials may be viewed on the UGPC website prior to the meeting.

Department of Computer and Electrical Engineering and Computer Science
Florida Atlantic University
Course Syllabus

1. Course title/number, number of credit hours	
Deep Learning – CAP 6619	3 credit hours

2. Course prerequisites, corequisites, and where the course fits in the program of study

Prerequisites: COP3530 Data Structures and Algorithm Analysis or equivalent

3. Course logistics

Term: Fall 2017

Class location and time: TBD

4. Instructor contact information

Instructor's name	Dr. Taghi Khoshgoftaar, Dr. Xingquan Zhu and Dr. Hanqi Zhuang
Office address	Engineering East (EE-96) Bldg.
Office Hours	TBD
Contact telephone number	561-297-3452/561-297-3413
Email address	khoshgof@fau.edu, xzhu3@fau.edu, zhuang@fau.edu

5. TA contact information

TA's name	N/A
Office address	N/A
Office Hours	N/A
Contact telephone number	N/A
Email address	N/A

6. Course description

This course teaches students basic concepts of deep learning, with applications in computer science, engineering, business and other areas. The class will cover major topics including math preliminaries, machine learning basics, deep forward networks, convolution networks, autoencoders, representation learning networks, their implementations and applications.

Note:

Deep learning is a field that studies deep artificial neural networks composed of many hidden layers. It is made possible due to available big datasets and fast computing power. Many favorable results in applications have been obtained, especially for applications where the cost function is complex, the datasets are huge, and labels may not be completely available.

7. Course objectives/student learning outcomes/program outcomes

Course objectives	The goal of this class is for students to gain theoretical foundation and hands-on experiences on deep learning. At the end of the class, students should be able to understand the fundamentals of deep learning, algorithmic and implementation details and should be able to apply popular deep learning models to study their research problems.

8. Course evaluation method

4 Home Works (each home work is worth 10%) - 40%
Test - 30%
Project - 30%

9. Course grading scale

Grading Scale:
90 and above: "A", 85-89: "A-", 76-84: "B+", 70-75: "B", 66-74 : "C+", 60-65: "C", 50-59: "D", 49 and below: "F."

10. Policy on makeup tests, late work, and incompletes

Makeups are possible, and are given only if there is solid evidence of medical or otherwise family/personal emergency issues that prevent the student from participating in the exam. Makeup exam should be administered and proctored by department personnel unless there are other pre-approved arrangements

Late work is not acceptable.

A grade of incomplete will be assigned only in the case of solid evidence of medical or otherwise serious emergency situation.

11. Special course requirements

N/A

12. Classroom etiquette policy

University policy requires that in order to enhance and maintain a productive atmosphere for education, personal communication devices, such as cellular phones and laptops, are to be disabled in class sessions.

13. Disability policy statement

In compliance with the Americans with Disabilities Act (ADA), students who require special accommodations due to a disability to properly execute coursework must register with the FAU Students Accessibility Services (SAS) located in Boca Raton, Davie, and Jupiter campuses and follow all SAS procedures http://www.fau.edu/sas.

14. Honor code policy

Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty is considered a serious breach of these ethical standards, because it interferes with the university mission to provide a high quality education in which no student enjoys unfair advantage over any other. Academic dishonesty is also destructive of the university community, which is grounded in a system of mutual trust and place high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. See University Regulation 4.001 at www.fau.edu/regulations/chapter4/4.001_Code_of_Academic_Integrity.pdf

15. Required texts/reading

Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press, 2016. Available online at

http://www.deeplearningbook.org.

16. Supplementary/recommended readings

Research papers and forums, see explanations.

17. Course topical outline, including dates for exams/quizzes, papers, completion of reading

Weekly course topics (tentative)

Weekly schedule	Topic	
Week 1	Introduction/Overview	
Week 2	Linear Algebra Review: vectors, matrices, tensors; linear dependence and span; normed space; eigen-decomposition; SVD; PCA;	HW1
Week 3	Optimization Basics: Gradient-based optimization; constrained optimization	
Week 4	Probability Review: Probability; marginal probability; conditional probability; Bayes' rule; intro to information theory; estimators, bias and variance	HW2
Week 5-6	Machine Learning Overview: Learning algorithms; capacity, overfittng and underfitting; validation sets; Bayesian statistics; supervised learning algorithms; unsupervised learning algorithms; stochastic gradient descent	
Week 7-8	Deep Forward Networks: Gradient-based learning; hidden units; Architecture design; differential algorithms; examples	Hw3
Week 9-10	Convolution Neural Networks: The convolution operation; motivation; pooling; variants of convolution function; structured output; combine CNN with DFN	Test, Project Announcement
Week 11	Recurrent Neural Networks: Unfolding computational graphs; recurrent neural networks; other variations	HW4
Week 12-13	Autoencoder learning: Undercomplete autoencoders; regularized autoencoders; representational power, layer size and depth; stochastic encoders and decoders; learning manifold with autoencoders	
Week 14-15	Representation Learning Networks: unsupervised deep learning; transfer learning and domain adaptation; semi-supervised learning; distributed representation	
Week 16	Project Report	

Project: The goal of the term project is to practice the algorithms and techniques learned in class. Students will work on the project in the second half of the class. Each student will select a topic related to the material taught in class. A list of tentative topics such as image classification will be provided in class. Students are expected to conduct research in that topic, implement and validate the algorithms, and collect experimental results. At the end of the project, the students will submit a report and the programming source code for evaluation.

Research papers and forums (updates will be given from time to time):

- Representation Learning: A Review and New Perspectives, Yoshua Bengio, Aaron Courville, Pascal Vincent, Arxiv, 2012.
- The monograph or review paper Learning Deep Architectures for AI (Foundations & Trends in Machine Learning, 2009).
- Deep Machine Learning – A New Frontier in Artificial Intelligence Research – a survey paper by Itamar Arel, Derek C. Rose, and Thomas P. Karnowski.
- Graves, A. (2012). *Supervised sequence labelling with recurrent neural networks*(Vol. 385). Springer.
- Schmidhuber, J. (2014). Deep Learning in Neural Networks: An Overview. 75 pages, 850+ references, http://arxiv.org/abs/1404.7828, PDF & LATEX source & complete public BIBTEX file under http://www.idsia.ch/~juergen/deep-learning-overview.html.
- LeCun, Yann, Yoshua Bengio, and Geoffrey Hinton. "Deep learning." *Nature* 521, no. 7553 (2015): 436-444.
- http://www.deeplearning.net/
- http://www.deeplearningbook.org/