

CM-5290

ENTERED
11/15/19
BS

APPROVED
GCC 10/10/19
CGSP 10/16/19



UNIVERSITY REGISTRAR
VIRGINIA TECH

Coversheet - Proposal for New and Revised Course
(Use for non-Pathways courses)

For CLE/Pathways course, form can be found here: <https://www.pathways.prov.vt.edu/proposal-forms.html>

General Information			
Proposal Date:	3/11/2019	15-Day Review End Date:	
Department:	Computer Science		
Course Designator and Number:	CS 5814		
Title of Course:	Introduction to Deep Learning	Credit Hours:	3
Please refer to Office of University Registrar for guidelines and policy requirements https://www.registrar.vt.edu/faculty/teaching/instructional-minutes.html			
Course Transcript (ADP) Title: (30 Character Maximum)	Introduction to Deep Learning		
Instructor and/or Departmental Contact:	Chandan Reddy, Cliff Shaffer		
Contact Phone:	571-858-3307	Contact E-mail:	reddy@cs.vt.edu, shaffer@vt.edu

Please count this course toward the following Scorecard Metrics areas:

- Study Abroad
 Service Learning
 Experiential
 Undergraduate Research

Scorecard Metrics Definitions can be found here: <http://www.registrar.vt.edu/faculty/forms/scorecard-metrics.html>

Please insert an X if this course should count toward First Year Experience:

- First Year Experience (FYE)
 For more information see: <http://www.fye.vt.edu>

Select ONE of the following boxes	
<input checked="" type="checkbox"/> New Course	<input type="checkbox"/> *Revised Course (Revision > 20% _____ Revision < 20% _____)

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*Please include a summary of course revisions to the Justification section of proposal

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 2020	<input checked="" type="checkbox"/>
D:	Change in Title From:		
	To:		
E:	Change in Transcript Title (ADP) From:		To:
F:	Change in Credit Hours From:		To:
G:	Change in Lecture and/or Lab Hours From:		To:
H:	Course Number(s) and Title(s) to be deleted from the Catalog with APPROVAL:		

Approval Signatures			
Department Representative		Date	3/11/2019
College Curriculum Committee Rep	see next page for signatures	Date	
College Dean		Date	



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Title of Course:	Deep Learning	Credit Hours:	3
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Course Transcript (ADP) Title: (30 Character Maximum)	Deep Learning		
Instructor and/or Departmental Contact:	Chandan Reddy, Cliff Shaffer		
Contact Phone:	313-577-9005	Contact E-mail:	reddy@cs.vt.edu , shaffer@vt.edu

Please count this course toward the following Scorecard Metrics areas:

- Study Abroad Service Learning Experiential Undergraduate Research

Scorecard Metrics Definitions can be found here: <http://www.registrar.vt.edu/faculty/forms/scorecard-metrics.html>

P

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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:	Fall 2019	
D:	Change in Title From:		
	To:		
E:	Change in Transcript Title (ADP) From:	To:	
F:	Change in Credit Hours From:	To:	
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H:	Course Number(s) and Title(s) to be deleted from the Catalog with <u>APPROVAL</u> :		

Approval Signatures

Department Representative		Date	3/11/2019
College Curriculum Committee Rep		Date	3/22/19
College Dean		Date	3/27/19.

CS 5814 Introduction to Deep Learning

I -- Catalogue Description

History and basic concepts of artificial neural networks. Activation functions, optimization methods and regularization strategies used in deep multi-layered networks. Network architectures such as convolutional networks and recurrent neural networks. Deep reinforcement learning algorithms including deep Q-learning and policy gradient methods. Deep unsupervised models such as auto-encoders, and deep generative models including variational auto-encoders and generative adversarial networks. Encoder-decoder architectures and their applications in real-world problems such as machine translation, image captioning, visual question answering, and text summarization. Pre: 5525 or 5824. Duplicates ECE 6524 (CS 6524). (3H, 3C)

Course Number: CS5814

ADP TITLE: Introduction to Deep Learning

II - Learning Objectives

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

1. Implement artificial neural network models.
2. Present the pros and cons of various deep learning architectures.
3. Train deep learning models.
4. Apply optimization techniques to training deep learning models
5. Design computational graphs for neural network training
6. Investigate deep reinforcement learning models
7. Design and implement deep learning solutions to problems in text analytics and computer vision
8. Train deep unsupervised learning models
9. Apply deep learning algorithms to problems involving real-world (big) data.

III - Justification

Deep Learning has seen breakthrough results in many real-world applications such as speech recognition, machine translation, image understanding, computer gaming, and robotics. Deep learning is an important area within the field of artificial intelligence. Hence, it is important to train students with practical skillsets and fundamental knowledge in deep learning. This course introduces the basic principles, algorithms and applications of deep learning. It will provide an in-depth understanding of various concepts and popular techniques in deep learning. Students will also be provided with an extensive set of practical implementations of various deep learning methods. Ability to handle large-scale data and apply intelligent tool has already become a requirement for any CS graduate and this course will be helpful in preparing students to handle challenging tasks that arise in practical real-world problems. This course is more "instructor-led" whereas ECE 6524 is research based, making them distinctive experiences.

Course is taught at the 5000-level because graduate-level experience in programming and mathematical maturity in undergraduate coursework such as algorithms, linear algebra, calculus, and probability is assumed. It is also necessary that the students have sufficient background in machine learning (CS5824) and/or data analytics (CS5525).

IV - Prerequisites and Corequisites

Pre: 5525 Data Analytics or 5824 Advanced Machine Learning

V - Texts and Special Teaching Aids

Required Textbooks

Aggarwal, C. (2018) *Neural Networks and Deep Learning: A Textbook*, New York, NY: Springer. pp. 497

Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. Cambridge, MA: MIT Press. pp. 800

VI – Syllabus

Course Topic	Percent of Course
1. History of Deep Learning	10%
2. Neural Network Basics	10%
a. Loss Functions	
b. Computational Graphs	
c. Back Propagation	
3. Training Deep Models	10%
a. Activation Functions	
b. Optimization Methods	
c. Regularization Strategies	
4. Recurrent Neural Networks	10%
5. Convolutional Networks	10%
6. Encoder-Decoder Architectures	5%
7. Deep Reinforcement Learning	15%
a. Q-Learning	
b. Policy Gradient Methods	
8. Auto-encoders	5%

9. Deep Generative Models	10%
10. Deep Learning Applications:	15%
Text Analytics, Computer Vision, Visual Question Answering	
TOTAL:	100%




VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY

Department of Computer Science
College of Engineering

2000A Torgersen Hall, Blacksburg, Virginia 24061-0106
(540) 231-4354
Email: shaffer@vt.edu
WWW: <http://people.cs.vt.edu/~shaffer>

March 12, 2019

TO: Course Approval Committees

FROM: Cliff Shaffer 
Associate Department Head for Graduate Studies

RE: CS 5814

The Department of Computer Science is requesting approval for a new course, CS5814 ~~XXXX~~
~~XXXXXX~~ Introduction to Deep Learning

No additional resources will be required in order to offer this course.