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UNIVERSITY REGISTRAR
VIRGINIA TECH

CM-8160 APPROVED
GCC: 4.27.23
CGPSP: 5.3.23

ENTERED
6.6.23 ~BS

Coversheet - Proposal for New and Revised Courses

(Use for non-Pathways courses)

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

General Information			
Proposal Date:	2/8/23	*Department:*	Computer Science
Course Designator and Number (Cross-listed Course Designator and Number):	CS 5624		
Title of Course:	Natural Language Processing	*Credit Hours:*	3
Course Transcript (ADP) Title (30 Characters & Spaces Maximum):	Natural Language Processing		
Instructor and/or Departmental Contact:	Trey Mayo - Director of Graduate Programs		
Contact Phone:	X0780	*Contact E-mail:*	treymayo@vt.edu
Please refer to Office of University Registrar for guidelines and policy requirements: https://registrar.vt.edu/governance.html			

Please count this course toward the following Scorecard Metrics areas:

☐ Study Abroad ☐ Service Learning ☐ Experiential ☐ Undergraduate Research

Scorecard Metrics Definitions can be found here: https://registrar.vt.edu/faculty-toolbox/scorecard-metrics.html

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

☐ First Year Experience (FYE) *Include approval letter from FYE Director. More information can be found here:* http://www.fye.vt.edu

Select **ONE** of the following boxes			
X	New Course		*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*** (e.g., prerequisite, corequisite, or cross-list memo) from affected departments and/or colleges.			
C:	***Effective Semester:***	Fall 2023		
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	Please see attached coversheet	*Date*	
College Curriculum Committee Rep		*Date*	
College Dean or Designee		*Date*	

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General Information			
Proposal Date:	2/8/23	*Department:*	Computer Science
Course Designator and Number (Cross-listed Course Designator and Number):	CS 5614		
Title of Course:	Natural Language Processing	*Credit Hours:*	3
Course Transcript (ADP) Title (30 Characters & Spaces Maximum):	Natural Language Processing		
Instructor and/or Departmental Contact:	Trey Mayo - Director of Graduate Programs		
Contact Phone:	X0780	*Contact E-mail:*	treymayo@vt.edu
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H:	***Course Number(s) and Title(s) to be deleted from the Catalog with APPROVAL:***			

Approval Signatures			
Department Representative	DocuSigned by: Cliff Shaffer 5ABBF057372B402...	*Date*	3/22/2023
College Curriculum Committee Rep		*Date*	3/23/2023
College Dean or Designee		*Date*	3/23/2023

UNIVERSITY REGISTRAR
VIRGINIA TECH

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

Course Information

Catalog Description

Provides an overview to Natural Language Processing (NLP). Explores common NLP tasks, algorithms for effectively solving problems, and methods for evaluating performance. Focuses on high-level applications, deep neural networks and statistical algorithms that are trained on annotated text corpora to automatically acquire the knowledge needed to perform the tasks. Pre: 5805. (3H, 3C).

Learning Objectives

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

1. Describe a breadth of concepts and tasks in natural language processing (NLP).
2. Select the appropriate methods and evaluation metrics for various natural language processing tasks.
3. Evaluate the strengths and weaknesses of various high-level NLP technologies and frameworks.
4. Utilize the open-source state-of-the-art NLP toolkits.
5. Conduct NLP research, including reading and analyzing research papers, analyzing results, and improving the approaches.

Justification

Natural Language Processing (NLP) is a rapidly developing field that aims to allow machines to break down and interpret human language. It combines the power of linguistics and computer science and takes advantage of machine learning techniques to learn the rules and structure of language and build intelligent systems that can understand, analyze and generate natural language text. Other Machine Learning courses only cover the basic machine learning concepts and algorithms. This NLP course covers more in-depth topics of NLP-related tasks, deep learning models, and real-world applications.

This course is taught at the 5000 level because it pulls from material covered in undergraduate degree programs in computer science, electrical and computer engineering, and mathematics to include data structures, algorithms, machine learning, and python programming. Students are assumed to be familiar with the statistical techniques and machine learning basics that are taught in CS 5805 - Machine Learning, which serves as a pre-requisite for this course.

Prerequisites and Corequisites

Pre: 5805 Machine Learning

Texts and Special Teaching Aids

No textbook is required as no single text covers all of the necessary information in the course, but recommended materials include:

- Eisenstein, J. (2018). *Natural language processing.* MIT Press. https://github.com/jacobeisenstein/gt-nlp-class/blob/master/notes/eisenstein-nlp-notes.pdf
- Goldberg, Y. (2015). *A primer on neural network models for natural language processing.* https://u.cs.biu.ac.il/~yogo/nnlp.pdf
- Jurafsky, D. & Martin, J. H. (2023). *Speech and language processing* (3rd ed.). Stanford University. https://web.stanford.edu/~jurafsky/slp3/
- Tunstall, L., von Werra, L. & Wolf, T. (2022). *Natural language processing with transformers: Building language applications with Hugging Face.* O'Reilly. pp. 406.

Topic Syllabus

Topic	Percent of Course
Overview of natural language processing • NLP tasks in syntax and semantics • NLP applications such as information extraction • Question answering • Machine translation • The challenge of variety and ambiguity of language, and the role of machine (deep) learning in NLP.	5%

Common NLP tasks
• Language modeling, Part-of-Speech Tagging and sequence labeling - 10%
• Syntactic and semantic parsing - 10%
• Semantic analysis - 10%
  ○ lexical semantic representation learning
  ○ word sense disambiguation
  ○ text classification
  ○ sentiment analysis
	30%

High-level NLP applications • Information extraction including entity, relation and event extraction, entity linking, and coreference resolution. - 15% • Summarization and natural language generation - 15% • Machine translation - 10% • Question answering and natural language understanding. - 10%	50%
Deep learning for NLP • Basic neural networks for NLP	15%
Total	**100%**

Old (Current) Topic Syllabus

N/A for new courses.

Department of Computer Science
620 Drillfield Drive
Torgersen Hall, Suite 3210
Blacksburg, Virginia 24061
P: (540) 231-0780
treymayo@vt.edu

March 22, 2023

To: Course Approval Committees

From: Trey Mayo, Ed.D. Trey Mayo Digitally signed by Trey Mayo Date: 2023.03.22 11:11:43 -04'00'
Director of Graduate Programs
Computer Science

The Department of Computer Science is requesting approval of a new course proposal CS ~~5614~~ 5624 - Natural Language Processing. No new resources will be required in order to offer this course. TM 4/12/23

COLLEGE OF ENGINEERING
COMPUTER SCIENCE
VIRGINIA TECH

Department of Computer Science
2000A Torgersen Hall
Blacksburg, Virginia 24061-0106
shaffer@vt.edu, 540-231-4354
http://people.cs.vt.edu/shaffer

February 24, 2023

To: College and University Curriculum Committees
RE: Computer Science Course Revisions Package

The Department of Computer Science presents a coordinated package of new course proposals and course revisions for the purpose of reorganizing our graduate-level offerings in the core Computer Science domain of Machine Learning and related topics. Our current offerings are the result of uncoordinated individual actions often made in conjunction with other departments over several years. The result is a collection of courses with overlaps and inefficiencies that lead to confusion for our students.

This package is centered around a two-semester sequence directly covering the core of traditional Machine Learning topics, with the first course in the sequence also serving as the prerequisite for the other, related courses. This allows us to avoid duplicating background material across these courses. We support the core with a collection of three courses (one existing, two new) that span the generally recognized major topics related to Machine Learning: Natural Language Processing, Learning-based Computer Vision, and Deep Learning. As part of the overhaul, we break some existing cross-listings to courses long recognized as duplicative.

Our package includes the following new courses and course revisions.

- Two course sequence CS 5805-6 Machine Learning. CS 5805 partially duplicates existing course CS/STAT 5525. However, we do not currently seek any changes to CS/STAT 5525 since this course is presently integrated into other certificates and programs. Instead, we have an agreement with Statistics to support their future changes to CS/STAT 5525 to bring it more in line with their needs. CS 5806 will (within our curriculum) replace the role currently held by ECE 5424/CS 5824.
- We request to break the cross-listing agreement for CS 5824, leaving this as ECE 5424.
- We include a revision to CS 5814 Introduction to Deep Learning. In addition to minor topics list changes, CS 5805 will become the prerequisite course for CS 5814.
- We request to break the cross-listing agreement for ECE 6524/CS 6524 Deep Learning. Despite the names, this is largely duplicative with CS 5814. Breaking this cross listing will reduce existing confusion for both CS and ECE students.
- A new course proposal for CS 5624 Natural Language Processing. This course will have CS 5805 as a prerequisite.
- A new course proposal for CS 5864 Learning-based Computer Vision. This course will have CS 5805 as a prerequisite.

Implementing these proposals will leave our department with a collection of courses that properly represents

the major sub-fields within the broad area of Machine Learning and Artificial Intelligence, as is typical for major Computer Science Departments across the US.

We note that while there is duplication between CS 5805 and CS/STAT 5525, and between CS 5806 and ECE 5424, this should have relatively minor impact on the teaching loads for the departments or the health of any of these courses. Historically, we have taught multiple sections of each of these courses every year, involving instructors from each of the three departments. None of these courses will lack for students for the foreseeable future.

Implementing this package will require no new resources. The NLP and Learning-based Computer Vision courses are already in our teaching rotation having been run as special topics courses. So, all of these courses have already been taught in various forms, and are already built into our course offering structure.

Unrelated to the described collection of proposals, we also offer a new course proposal for CS 5784 Software Project Management. This course has been piloted twice already.

Sincerely,

Clifford A. Shaffer
Professor and Associate Department Head
for Graduate Studies