

#### **Coversheet - Proposal for New and Revised Courses**

(Use for non-Pathways courses)

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

General Information					
Proposal Date: 2/10/2	1		Department:	Computer Science	
Course Designator and Numb	er (Cross-listed Cou	rse Designator and	Number): CS 5	644	
Title of Course: Mach	tle of Course: Machine Learning with Big Data Credit Hours: 3				Credit Hours: 3
Course Transcript (ADP) Title (30 Characters & Spaces Maximum): Machine Learning with Big Data					
Instructor and/or Department	Instructor and/or Departmental Contact: Trey Mayo & Nicole Akers				
Contact Phone: (540)	ontact Phone: (540) 231-0780 Contact E-mail: treymayo@vt.edu				
Please refer to Office of Unive	rsity Registrar for g	uidelines and policy	requirements: <u>htt</u>	<u>ps://registrar.vt.edu/governa</u>	unce.html
Please count this course tow	ard the following Sc	orecard Metrics a	eas:		
Study Abroad	Service Learnin	g	Experiential	Undergraduate 1	Research
Scorecard Metrics Definitions	can be found here:	https://registrar.vt	.edu/faculty-too	lbox/scorecard-metrics.ht	<u>ml</u>
Please insert an X if this cou	rse should count to	vard First Year Ex	perience:		
First Vear Experience (F	VF) Include approva	l lattar from FVF D	irector More info	rmation can be found here: <u>I</u>	attn://www.fva.vt.adu
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*Please include a summary of	course revisions to th	ne Justification sect	ion of proposal		
A: <i>Attach statement from Dean or Departmental Representative</i> as to whether teaching this course will require or generate the need for additional departmental resources.					
<b>B:</b> Attach appropriate letters of support (e.g., prerequisite, corequisite, or cross-list memo) from affected departments and/or colleges.					
C: Effective Semester:	Summer 2021	•			<b>_</b>
D: Change in Title From:					
To:					
E: Change in Transcript T					
· · · ·					
G: Change in Lecture and		:		To:	
H: Course Number(s) and Title(s) to be deleted from the Catalog with <u>APPROVAL</u> :					

Approval Signatures				
Department Representative	CMSh	Date	2/15/2021	
College Curriculum Committee Rep	Alixander Leonesse	Date		
College Dean or Designee	Sythans	Date	3/15/21	



# **Course Information**

#### Catalog Description

Basic principles and techniques for big data analytics, including methods for storing, searching, retrieving, and processing large datasets; introduction to basic machine learning libraries for analyzing large datasets; data visualization; case studies with real-world datasets. Not for graduate credit for MS and PhD degrees in Computer Science and Applications (CSA); MEng degrees in CSA allowed to receive credit. Pre: 5044 (3H, 3C).

#### Learning Objectives

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

1.

2.

#### Justification

The changes to the course restriction are to differentiate that the MS and PhD degrees in CSA cannot receive credit, but the MEng can receive credit. Given the practitioner nature of the MEng degree, students in this particular degree program may find it appropriate to take this course to enhance the requirements for their intended career path.

#### Prerequisites and Corequisites

Pre: 5044 Object-Oriented Pgmming Java



#### Texts and Special Teaching Aids

Please identify specific examples and whether these are Required or Recommended. If no required text, provide justification and include examples of "Recommended" materials that will be used.

Topic Syllabus

Example Topic 1 Example Topic 2 Subtopic, as applicable when topics are >20% Subtopic

Topic

Percent of Course

Total: 100%

#### Old (Current) Topic Syllabus

N/A for new courses. For an existing course that is being revised with a new course number, including the syllabus can be helpful. Copy-and-paste the topic syllabus from the proposal on file.

Nicole,

I am writing to let you know that the proposed changes to CS 5644 will not generate the need for additional resources.

Please let me know if you have any questions.

Thank you.

Trey Mayo

#### Trey Mayo, M.S.Ed.

Director of Graduate Programs Department of Computer Science Virginia Tech <u>treymayo@vt.edu</u> <u>http://cs.vt.edu</u>

"Too bad all the people who know how to run the country are busy driving cabs and cutting hair." - George Burns

"Education is not preparation for life; education is life itself." - John Dewey

"It's not the years in your life that count. It's the life in your years." - Abraham Lincoln

CM-2868

COVER SHEET - NEW and REVISED COU	RSES
Commission on Undergraduate Studies and Policies/ Commission on Graduate Studies and Policies/ Univ Education	ersity Curriculum Committee For Liberal
Effective September 2010	
•SEE I - VIII for Basic Course Proposal Guidelines• •SEE APPENDIX FOR NOTES, EXPLANATIONS AND ADDITIONAL GUI •PRINT CLEARLY, TYPE or COMPLETE ELECTRONICALL	IDELINES. GCC 4-28-16 ST. CGSP S-H-16
PROPOSAL DATE: Feb. 8, 2016 15-DAY REVIEW END DATE:	
DEPARTMENT: Department of Computer Science	
COURSE DESIGNATOR AND NUMBER: CS 5644	
TITLE OF COURSE: Machine Learning with Big Data	
TRANSCRIPT (ADP) TITLE (MAX-30 Characters): Machine Learning with Big	Data
INSTRUCTOR and/or DEPARTMENTAL CONTACT: Naren Ramakrishnan	CONTACT MAILCODE: 0379
CONTACT PHONE:CONTACT E-MAIL:571-858-3331naren@cs.vt.edu	
Please count this course toward the following scorecard metrics area:	
Study Abroad Service Learning Experiential	Undergraduate Research
CHECK ONLY ONE OF THE FOLLOWING BOXE	9
	Revision<20%]
NEW COURSE & INCLUSION IN THE CLE [Area]	
REVISED COURSE FOR INCLUSION IN THE CLE OR CLE AREA CHANGE	Attachment, If Needed
•Courses routed directly to the University Curriculum Committee For Liberal Education MUST be endorsed by th •The Chair of the University Curriculum Committee For Liberal Education aball information and the University Curriculum Committee For Liberal Education and the University Curriculum Committee For Liber	e appropriate Department Head or Dean.
•The Chair of the University Curriculum Committee For Liberal Education shall inform the appropriate college cureview by the University Curriculum Committee For Liberal Education.	
•A Attach Statement from Dean or Departmental Representative as to will will Require or Generate the Need for Additional Departmental Resource	nether Teaching this Course rces.
•B Attach Appropriate Letters of Support from Affected Departments and	
•C Effective Semester: Fall 2016	
•D Change in Title From:	
То:	
•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 Sum	mary:
•H Course Number(s) and Title(s) to be Deleted from the Catalogue with A	
APPROVAL SIGNATURES	na an a
Department Representative College Curriculum Committee	Datepril 6, 2016

Department Representative	Date:
College Curriculum Committee	
Representative	Date:
College Dean	Date:

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Commission on Undergrad	· · · · · · · · · · · · · · · · · · ·	- NEW and REVI	Rest Classic destalling and destal destands and the second states of	
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	•SEE APPENDIX FOR NOTE	for Basic Course Proposal ( S, EXPLANATIONS AND A <b>TYPE or COMPLETE EL</b>	DDITIONAL GUIDEL	INES.
PROPOSAL DATE: Marc	h 14, 2016 1	15-DAY REVIEW END	date:	and and the second s
DEPARTMENT: Comp	outer Science			
COURSE DESIGNATO	R AND NUMBER: (	CS 5644		
TITLE OF COURSE:	Machine Learning wit	h Big Data		
TRANSCRIPT (ADP) T Machine Learning with	<b>TTLE</b> (MAX-30 Character h Big Data	ërs):	n og som at s	
INSTRUCTOR and/or DEPARTMENTAL CONT	ACT: Naren Ramakrishn	ian		CONTACT MAILCODE: 0379
C <b>ONTACT PHONE:</b> 571-858-3331		CONTACT E-I naren@cs.vt.e		
Please count this cou Study Abroad	urse toward the following Service Learning	Complete strategy		Undergraduate Research
	CHECK ONLY	Y ONE OF THE FOLLOWI	NG BOXES	
NEW COURSE	REVISED C	COURSE [Revision	>20%	Revision<20%]
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### Machine Learning with Big Data CS 5644

### I. Catalog Description

Basic principles and techniques for big data analytics, including methods for storing, searching, retrieving, and processing large datasets; introduction to basic machine learning libraries for analyzing large datasets; data visualization; case studies with real-world datasets. Not for graduate credit for degrees in Computer Science and Applications (CSA) Pre: 5044. (3H, 3C)

### Course Number: 5644

ADP TITLE: Machine Learning with Big Data

# II. Learning Objectives

Having successfully completed this course, students will be able to:

- Describe challenges associated with handling large datasets.
- Store, search, retrieve, and process large datasets using modern computing methodologies and data processing pipelines.
- Apply widely used machine learning tools and libraries to implement basic machine learning models (regression, classification, clustering, time-series analysis) and apply them to large datasets.
- Comparatively analyze machine learning methods and evaluate their performance.
- Communicate patterns discovered by the machine learning models from large datasets using basic data visualization techniques implemented using modern object-oriented libraries.

# III. Justification

The ubiquity of social media, sensor networks, and technological advances in data collection have resulted in massive datasets that demand methods for analysis and visualization. CS 5644 introduces the practical challenges associated with storing, retrieving, accessing and processing large datasets, machine learning methods for inferring patterns from data, and their subsequent interpretation using data visualizations. The course requires students to implement basic data analytic pipelines using machine learning libraries, such as Weka (Java) and scikit-learn (Python).

This course is designed for students pursuing a graduate certificate or degree as part of the Master of Information Technology program.

Graduate credit is required for this course. Students will apply advanced, extensive, and in-depth knowledge that builds on undergraduate learning with analysis of large datasets. Students will develop the ability to analyze and investigate massive datasets independently using machine learning techniques, and to deepen their scholarly development in empirical research into large-scale dataset analysis.

# **IV. Prerequisites and Corequisites**

Pre: 5044.

# V. Texts and Special Teaching Aids

### **Required Textbooks:**

Chodorow, Kristina, MONGODB: THE DEFINITIVE GUIDE. O'Reilly Publishers, 2013, 409

Witten, Ian H. and Eibe Frank. DATA MINING: PRACTICAL MACHINE LEARNING TOOLS AND TECHNIQUES. Morgan Kaufmann, 2005, 524

Garreta, Raul and Guillermo Moncecchi. LEARNING SCIKIT-LEARN: MACHING LEARNING IN PYTHON. Packt Publishing Ltd, 2013, 103

# VI. Syllabus

	Percent of Course
1. Introduction to the Python programming language	10
a. In-built modules in Python	
b. Implementing basic programs in Python	
c. Object-oriented programming in Python	
2. Storing, searching, accessing and processing large datasets	20
a. SQL, MySQL	
b. MongoDB, Redis	
c. High-level programming languages (Java, Python)	
3. Implementing machine learning models	20
a. Libraries for machine learning (Weka, Scikit-learn)	
b. Regression models	
c. Classification (Decision trees and logistic regression)	
d. Clustering (k-means)	
e. Time-series analysis and forecasting	
4. Data Visualization	25
a. Libraries for data visualization (Python, Java)	
b. Scalar visualization	
c. Vector visualization	
5. Specific case studies on real-world datasets	25
a. Social media analysis	
b. Electronic health records	
c. Sensor networks	
TOTAL	100
	100



Department of Computer Science College of Engineering

Mail Code 0106, Blacksburg, Virginia 24061 (540) 231-6931 Fax: (540) 231-6075 ribbens@vt.edu

TO: Course Approval Committees

FROM: Calvin Ribbens Cal Ribbens Department Head

RE: CS 5644 course proposal

**DATE:** March 14, 2016

The Department of Computer Science is requesting approval of a new course, CS 5644, "Machine Learning with Big Data." This course will be offered as part of the Masters of Information Technology (MIT) program.

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