Computer Science
Course Number: 26:198:622
Course Title: Machine Learning

COURSE OVERVIEW

Many successful applications of machine learning exist already, including systems that analyze past sales data to predict customer behavior, identify fraudulent credit card transactions, and recognize faces or spoken speech. This course will cover supervised learning, Bayesian decision theory, parametric methods, multivariate methods, dimensionality reduction, clustering, nonparametric methods, decision trees, linear discrimination, multilayer perceptrons, hidden Markov models, assessing and comparing classification algorithms, and combining multiple learners.

COURSE MATERIALS

- Ethem ALPAYDIN. *Introduction to Machine Learning, Third Edition*. The MIT Press, August 2014, ISBN 978-0-262-028189.
  https://mitpress.mit.edu/books/introduction-machine-learning-third-edition
- Author's Web site for this textbook (providing, in particular, errata and the PPT presentations to be used in class) can be found at:
  http://www.cmpe.boun.edu.tr/~ethem/i2ml3e/

The course will utilize the Canvas online facilities, which can be found at:

https://canvas.rutgers.edu/

For a student to gain access to our Canvas system, they must be enrolled and they must have a NETID. Once an enrolled student obtains a NETID, they will be added to the roster within 2 business days. Students should also check their email account in the system and if it is not correct, they need to update their official student record. Students who do not have a NETID, can create one online using this link:

https://netid.rutgers.edu/

COURSEWORK

The coursework includes attendance of lectures and participation in class discussions, writing a research paper and presenting it in class, completing a computational project in machine learning and submitting its results for evaluation, and taking the final exam that will be a review of a published machine learning paper.

RESEARCH PAPER

Every student is required to write a research paper devoted to an important topic in machine learning. While it is expected that most students will choose a topic devoted to applications of machine learning in business, other topics may work as well. Every student is required to prepare a three page long proposal for the research paper, and submit this proposal for instructor's evaluation by (). The Word document must be posted to the appropriate Canvas discussion forum, and its printout should be submitted in class. The research paper should be presented during the last meeting of the class on (). Both the research paper and the presentation should also be posted to the appropriate Canvas forum before the last meeting of the class. The research articles to be covered in the research paper can be found in the following theoretical and applied journals publishing relevant articles:

- Machine Learning: http://link.springer.com/journal/10994
- Journal of Machine Learning Research: http://jmlr.org/
- Data Mining and Knowledge Discovery: http://link.springer.com/journal/10618
- IEEE Transactions on Knowledge and Data Engineering: https://www.computer.org/csdl/journal/tk
- Intelligent Systems in Accounting, Finance & Management: http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1099-1174
- Journal of Emerging Technologies in Accounting: http://aaapubs.org/loi/jeta
- Decision Support Systems: http://www.sciencedirect.com/science/journal/01679236

Most of these journals are available through the Rutgers University Library subscriptions, and can be accessed from campus computers or from home through the library Web site:

http://www.libraries.rutgers.edu/find_articles

The following online research tools can be useful in conducting bibliographic searches for your research paper:

- DBLP Computer Science Bibliography: http://dblp.uni-trier.de/db/
- CiteSeer - Scientific Literature Digital Library and Search Engine: http://citeseer.ist.psu.edu/
- Google Scholar: http://scholar.google.com/

Important guidance on writing machine learning papers can be found in the following manuscript:

- Pat Langley, Crafting Papers on Machine Learning: http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.23.5877

ACADEMIC INTEGRITY

I do NOT *tolerate cheating*. Students are responsible for understanding the RU Academic Integrity Policy (http://academicintegrity.rutgers.edu/).

I will strongly enforce this Policy and pursue *all* violations. On all examinations and assignments, students must sign the RU Honor Pledge, which states, "On my honor, I have neither received nor given any unauthorized assistance on this examination or assignment." I will screen all written assignments through *SafeAssign* or *Turnitin*, plagiarism detection services that compare the work against a large database of past work. Don't let cheating destroy your hard-earned opportunity to learn. See business.rutgers.edu/ai for more details.

COMPUTATIONAL PROJECT

Every student is required to carry out a computational project focused on experimental comparison of several machine learning methods on different datasets. The computational experiment should compare at least **FIVE** different machine learning methods on at least **FOUR** different datasets. Every student is required to prepare a computational project proposal and submit this proposal for instructor's evaluation by (). The Word document describing the machine learning methods and the datasets to be utilized in the experiment, as well as the proposed experimental methodology, must be posted to the appropriate Canvas discussion forum, and its printout should be submitted in class. The description of results of the computational experiment should also be posted to the appropriate Canvas forum and its printout should be submitted during the last meeting of the class on (). It is recommended that the computational experiments be conducted using the public domain Machine Learning software package called **Weka** (using the most recent book version - currently 3-8-4). Here are some useful Weka links:

- Weka Homepage: http://www.cs.waikato.ac.nz/~ml/weka/
- WekaWiki: https://waikato.github.io/weka-wiki/
- Weka Documentation: https://waikato.github.io/weka-wiki/documentation/
- Weka Frequently Asked Questions: https://waikato.github.io/weka-wiki/faq/

Another good public domain Machine learning software package that can be use in experiments in addition to (or instead of) Weka is RapidMiner:

http://rapidminer.com/

The datatsets for use in computational experiments can be obtained from the **UCI Machine Learning Repository**:

http://archive.ics.uci.edu/ml/index.php

It is absolutely essential to start working on the research paper and the computational project as soon as possible.

FINAL EXAM

You will be given 24 hours starting at **()** **on** **()** to write a critical review of a published machine learning article. The article will be made available in the Assignments section of the Canvas. The completed review has to be submitted through the Assignments section of the Canvas by **()** **on** **()**.

GRADING POLICY

The evaluations of your research paper, the computational project, and the final exam article review will be the basis for the course grade:

40%	Research Paper
30%	Computational Project
30%	Final Exam Article Review

COURSE SCHEDULE

Preliminary Schedule:

1.
    Chapter 1 - Introduction to Machine learning
    Chapter 2 - Supervised Learning
2.
    Chapter 2 - Supervised Learning
    Chapter 3 - Bayesian Decision Theory
3.
    Chapter 4 - Parametric Methods
4.
    Chapter 5 - Multivariate Methods
5.
    Chapter 6 - Dimensionality Reduction
6.
    Chapter 7 - Clustering
    Chapter 8 - Nonparametric Methods
7.
    Chapter 8 - Nonparametric Methods
    Chapter 9 - Decision Trees
    o **Research Paper Proposal is due**
8.
    Chapter 19 - Design and Analysis of Machine Learning Experiments
9.
    Chapter 10 - Linear Discrimination
10.
    Chapter 11 - Multilayer Perceptrons
    o **Computational Project Proposal is due**

11.
> Chapter 13 - Kernel Machines
> Chapter 14 - Graphical Models

12.
> Chapter 14 - Graphical Models
> Chapter 16 - Bayesian Estimation

13.
> Chapter 16 - Bayesian Estimation
> Chapter 17 - Combining Multiple Learners

14.
> **Research Paper Presentations**
> **Computational Projects are due**

15.
> **Final Exam starts at**
> **Article review is due at () on ()**

SUPPORT SERVICES

If you need accommodation for a *disability*, obtain a Letter of Accommodation from the Office of Disability Services. The Office of Disability Services at Rutgers, The State University of New Jersey, provides student-centered and student-inclusive programming in compliance with the Americans with Disabilities Act of 1990, the Americans with Disabilities Act Amendments of 2008, Section 504 of the Rehabilitation Act of 1973, Section 508 of the Rehabilitation Act of 1998, and the New Jersey Law Against Discrimination. More information can be found at ods.rutgers.edu.

[Rutgers University-New Brunswick ODS phone (848)445-6800 or email dsoffice@echo.rutgers.edu]

[Rutgers University-Newark ODS phone (973)353-5375 or email ods@newark.rutgers.edu]

If you are *pregnant*, the Office of Title IX and ADA Compliance is available to assist with any concerns or potential accommodations related to pregnancy.

[Rutgers University-New Brunswick Title IX Coordinator phone (848)932-8200 or email jackie.moran@rutgers.edu]

[Rutgers University-Newark Office of Title IX and ADA Compliance phone (973)353-1906 or email TitleIX@newark.rutgers.edu]

If you seek *religious accommodations*, the Office of the Dean of Students is available to verify absences for religious observance, as needed.

[Rutgers University-New Brunswick Dean of Students phone (848)932-2300 or email deanofstudents@echo.rutgers.edu]

[Rutgers University-Newark Dean of Students phone (973)353-5063 or email DeanofStudents@newark.rutgers.edu]

If you have experienced any form of *gender or sex-based discrimination or harassment*, including sexual assault, sexual harassment, relationship violence, or stalking, the Office for Violence Prevention and Victim Assistance provides help and support. More information can be found at http://vpva.rutgers.edu/.

[Rutgers University-New Brunswick incident report link: http://studentconduct.rutgers.edu/concern/. You may contact the Office for Violence Prevention and Victim Assistance at (848)932-1181]

[Rutgers University-Newark incident report link: https://cm.maxient.com/reportingform.php?RutgersUniv&layout_id=7 . You may also contact the Office of Title IX and ADA Compliance at (973)353-1906 or email at TitleIX@newark.rutgers.edu. If you wish to speak with a staff member who is confidential and does **not** have a reporting responsibility, you may contact the Office for Violence Prevention and Victim Assistance at (973)353-1918 or email run.vpva@rutgers.edu]

If students who have experienced a temporary condition or injury that is adversely affecting their ability to fully participate, you should submit a request via https://temporaryconditions.rutgers.edu .

If you are a military *veteran* or are on active military duty, you can obtain support through the Office of Veteran and Military Programs and Services. http://veterans.rutgers.edu/

If you are in need of *mental health* services, please use our readily available services.

[Rutgers University-Newark Counseling Center: http://counseling.newark.rutgers.edu/]

[Rutgers Counseling and Psychological Services–New Brunswick: http://rhscaps.rutgers.edu/]

If you are in need of *physical health* services, please use our readily available services.

[Rutgers Health Services – Newark: http://health.newark.rutgers.edu/]

[Rutgers Health Services – New Brunswick: http://health.rutgers.edu/]

If you are in need of *legal* services, please use our readily available services: http://rusls.rutgers.edu/

Students experiencing difficulty in courses due to *English as a second language (ESL)* should contact the Program in American Language Studies for supports.

[Rutgers–Newark: PALS@newark.rutgers.edu]

[Rutgers–New Brunswick: eslpals@english.rutgers.edu]

If you are in need of additional *academic assistance*, please use our readily available services.

[Rutgers University-Newark Learning Center: http://www.ncas.rutgers.edu/rlc

[Rutgers University-Newark Writing Center: http://www.ncas.rutgers.edu/writingcenter]

[Rutgers University-New Brunswick Learning Center: https://rlc.rutgers.edu/]

[Optional items that many faculty include:

  - Students must sign, date, and return a statement declaring that they understand the RU Academic Integrity Policy.

  - Students must sign, date, and return a statement declaring that they understand this syllabus.]