

Computer Science
Course Number: 26:198:644
Course Title: Data Mining

COURSE DESCRIPTION

Recent advances in information technology along with the phenomenal growth of the Internet have resulted in an explosion of data collected, stored, and disseminated by various organizations. Because of its massive size, it is difficult for analysts to sift through the data even though it may contain useful information. Data mining holds great promise to address this problem by providing efficient techniques to uncover useful information hidden in the large data repositories.

Awareness of the importance of data mining for business is becoming wide spread. The industry has created more and more job opportunities for people who have interdisciplinary data analytic skills. Indeed, this course intends to bridge the gap between data mining techniques and business applications. The students have the opportunities to learn both domain and technical knowledge to face the big data challenges in the industry.

COURSE MATERIALS

- **Text Book:** “Introduction to Data Mining”, by Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Addison Wesley, ISBN: 0-321-32136-7, 2005.
- **Additional Reading Materials**
 - a) “Data Science for Business”, by Foster Provost and Tom Fawcett, O’REILLY, ISBN: 978-1-449-36132-7, 2013.
 - b) “Data Mining: Concepts and Techniques, Third Edition (The Morgan Kaufmann Series in Data Mining Systems) by Jiawei Han and Micheline Kamber, 2011.

COURSE WEB SITE

The Canvas site for this course will contain lecture notes, reading materials, assignments, and late breaking news. It is accessible via: <https://canvas.rutgers.edu>. You should check it frequently to remain updated. You are responsible for keeping aware of the announcements on the course web site.

LEARNING GOALS AND OBJECTIVES

The key objectives of this course are two-fold: (1) to teach the fundamental concepts of data mining and (2) to provide extensive hands-on experience in applying the concepts to real-world applications. The core topics to be covered in this course include classification, clustering, association analysis, and anomaly/novelty detection. This course consists of about 13 weeks of lecture, followed by 1 week of project presentations by students who will be responsible for developing and/or applying data mining techniques to applications such as intrusion detection, Web usage analysis, financial data analysis, text mining, bioinformatics, systems management, Earth Science, and other scientific and engineering areas. At the end of this course, students are expected to possess the fundamental skills needed to conduct their own research in data mining or to apply data mining techniques to their own research fields.

In particular, after taking this course, the students should be able to (1) approach business problems data-analytically. Think carefully & systematically about whether & how data can improve business performance, to make better-informed decision for management, finance, marketing and some other business activities; (2) interact competently on the topic of data mining for business intelligence. Know the basics of data mining processes, algorithms, & systems well enough to interact with CTOs, data mining experts, consultants, etc.

Focus: This course will explain the fundamental principles, uses, and some technical details of data mining techniques by lectures and real-world case studies. The emphasis is on understanding the business applications of data mining techniques. We will discuss the mechanics of how data analytics techniques work as is necessary to understand the fundamental concepts and business applications.

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.

GRADING POLICY

Attendance (including in-class work)	10%
Assignments	20%
Project/Presentation/Paper	20%

Exam I 25%

Exam II 25%

Note that the final letter grade is based on a curve.

COURSE SCHEDULE

1. Introduction

- Why Big Data? What is data mining? Why data mining? Data Mining Process, relation to Business Intelligence techniques.
- Introduction to Data Mining Tasks (Classification, Clustering, Association Analysis, Anomaly Detection). What is a model? Basic terminologies, predictive modeling.
- Real-world data mining applications

2. Data and Preprocessing

- Understanding of Data, what is data? Types of attributes, properties of attribute values, types of data, data quality
- Sampling, Data Normalization, Data Cleaning, Similarity Measures
- Feature Selection/Instance Selection, the importance of feature selection/instance selection in various big data scenarios

3. Classification

- Decision-Tree Based Approach (e.g. C4.5)
- Rule-based Approach (e.g. Ripper)
- Instance-based classifiers (e.g. k-Nearest Neighbor).
- Support Vector Machines (SVMs)
- Ensemble Learning
- Classification Model Selection and Evaluation
- Applications: B2B customer buying stage prediction, Recommender Systems

4. Clustering

- Partitional and Hierarchical Clustering Methods
- Graph-based Methods
- Density-based Methods
- Cluster Validation
- Applications: Customer Profiling, Market Segmentation

5. Association Analysis

- Apriori Algorithm and its Extensions
- Association Pattern Evaluation
- Sequential Patterns and Frequent Subgraph Mining
- Applications: B2B Customer Buying Path Analysis, Medical Informatics, Telecommunication alarm diagnosis

6. Anomaly Detection

- Statistical-based and Density-based Methods

- Ethics of data mining, privacy, what can/do firms know?

7. Data Mining Case Studies

- Big Data Analytics in Mobile Environments
- Fraud Detection and Prevention with Data Mining Techniques
- Big Data Analytics in Business Environments

ATTENDANCE, ASSIGNMENTS, EXAMS

- **Reading Material:** A lot of reading material from top conferences/journals will be made available online or in class as required. In addition, lecture notes will be available on line
- **Attendance:** Regular attendance is compulsory. You are **not** allowed to check your emails, access Web sites not related to the course or work on something that is beyond the scope of this course during the class time.
- **Assignments:** You may have discussions with your class members, but you have to submit your own work. Please be sure to keep a copy of the assignment by yourself in case that there is any problem with your hand-in or you have to use it later this semester. Assignments have to be submitted **before** the beginning of the class on the specified due day. **No late submissions will be accepted.** For assignments and project reports, you are encouraged to **type your work**.
- **Exams:** There will be no make-up exams. You are required to present a written proof for situations such as going on to an emergency room due to unexpected and serious illness. Chatting during the exam is **not** allowed. **No** collaboration between class members will be allowed during any exam. There will be **no** extra-credit project.
- Students are responsible for reviewing the specified chapters covered by the lecture. Please note that you are responsible for the ENTIRE contents of each chapter plus any additional handouts, unless otherwise notified. You are not allowed to possess, look at, use, or in any other way derive advantage from the solutions prepared in prior years, whether these solutions are former students' work or copies of solutions that were made available by instructors.
- **Scholastic Dishonesty Policy:** The University defines academic dishonesty as cheating, plagiarism, unauthorized collaboration, falsifying academic records, and any act designed to avoid participating honestly in the learning process. Scholastic dishonesty also includes, but not limited to, providing false or misleading information to receive a postponement or an extension on assignments, and submission of essentially the same written assignment for two different courses without the permission of faculty members. The purpose of assignments is to provide individual feedback as well to get you thinking. Interaction for the purpose of understanding a problem is not considered cheating and will be encouraged. However, the actual solution to problems must be one's own.
- **Helpful Comments:** To get full benefit out of the class you have to work regularly. Read the textbook regularly and start working on the assignments soon after they are handed out. Plan to spend at least 12 hrs a week on this class doing assignments or reading.

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.]