



## IT-533 Spring 2018 Data Mining

<b>Dates:</b> 01/10-5/15/2017	<b>Mode: HYBRID</b> <ul style="list-style-type: none"> <li>In-class section: M 11:30-12:20 MEH-134, WF Online</li> <li>Online section: MWF Online</li> </ul>	<b>Location:</b> <a href="http://blackboard.valpo.edu">http://blackboard.valpo.edu</a>
<b>Instructor:</b> Sonja Streuber	<b>Office Hours:</b> MTWRF 10-11 am in MEH 145H	<b>Contact:</b> <a href="mailto:sonja.streuber@valpo.edu">sonja.streuber@valpo.edu</a>

### Introduction



Welcome to IT-533, Data Mining! Motivated by the growth of data collections routinely kept by many organizations, and by the high potential value of patterns discovered in those collections, Data Mining focuses on identifying useful regularities in large data sets, turning these regularities into models, and using these models to forecast future data behavior. For instance, bar code and loyalty card readers at supermarket checkouts generate data that can be used to predict future shopping trends among a certain demographic,

and daylight length, temperature, and rainfall data collected at strategic locations is used for weather forecasting. This makes Data Mining a broad area that integrates techniques from machine learning, statistics, artificial intelligence, and database systems, for the analysis of large volumes of data. This course gives a wide exposition of these techniques and their tools.

### Learning Objectives

Students who successfully complete this course will gain a strategic and analytical toolkit essential to Data Mining. Students will be able to:

- Analyze large sets of data and uncover patterns within the data
- Use mathematical algorithms to uncover patterns in both web and regular data
- Predict data based on the patterns discovered previously
- Use tools and statistical analysis to analyze data, including MS Excel, R, Python, and h2o
- Apply the learned techniques to many common data mining problems, such as text analytics, security, recommender systems, and more
- Describe legal, ethical and public relations implications of data mining

### Topics Covered

- Big Data and Statistics (incl. Correlation, Regression, Chi Square, ANOVA) with MS Excel
- Data, Databases, and Data Warehouses and Basic Statistics with R
- Preprocessing: Data Preparation for Data Mining
- Patterns, Associations, Correlations: Apriori, Frequent Pattern Growth, Support and Confidence Measures, Measures of Interestingness
- Classification and Prediction: Decision Trees; Naïve Bayes, kNearest Neighbor, Generalized Linear Models, Ensemble Learning, Neural Networks/ Deep Learning, Random Forest

- Clustering: kMeans, Hierarchical Clustering, DBScan
- Applications in Data Mining: Search Engines and Text Retrieval with Python
- Applications in Data Mining: Social Network Mining
- Applications in Data Mining: Big Data Processing and MapReduce
- Applications in Data Mining: Security—networking and banking
- Applications in Data Mining: Ethics and Electronic Profiling

### Course Format

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This is a hybrid course which means there is an in-class and an online section. Each Sunday evening, a communication from the instructor on Blackboard outlines the goals and tasks for the following week. We will be using the work rhythm below (all times CST):

<b>IN-CLASS SECTION:</b>	<b>ONLINE SECTION:</b>
<ul style="list-style-type: none"> <li>• <b>Monday:</b> Lecture 11:30 am-12:20 pm in MEH 134. This is an <b>ATTENDANCE REQUIREMENT. If you miss more than 5 sessions, you will fail the course.</b></li> <li>• <b>Wednesday (by 11:59 pm CST):</b> Finish all assigned readings and videos; complete the Discussion Assignment; work on Weekly Lab Assignment</li> <li>• <b>Friday (by 11:59 pm CST):</b> Complete the end-of-week quiz; finalize and upload the Weekly Lab Assignment</li> <li>• <b>Saturday (by 11:59 pm CST):</b> Drop-deadline for Weekly Project Assignment</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Monday:</b> Do all assigned readings and watch all assigned videos.</li> <li>• <b>Wednesday (by 11:59 pm CST):</b> Finish all assigned readings and videos; complete the Discussion Assignment; work on Weekly Lab Assignment</li> <li>• <b>Friday (by 11:59 pm CST):</b> Complete the end-of-week quiz; finalize and upload the Weekly Lab Assignment</li> <li>• <b>Saturday (by 11:59 pm CST):</b> Drop-deadline for Weekly Project Assignment</li> </ul>

The instructor is available in person and through Skype and Google Chat during the office hours posted above. Use the opportunity to interact with the instructor directly to get your homework questions answered! If you would like an in-person appointment at alternate times, please send an email first.

### Textbooks & Materials

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- **Tools:**
  - A laptop computer (Windows, Mac, or Linux) with at least 4GB RAM
  - Microsoft Excel, free for Valparaiso University students through [Dreamspark](http://dreamspark.com).
  - R for Statistics (<http://www.r-project.org/>) and R Studio (<http://www.rstudio.com/>)
  - Python 2.7 (<https://www.python.org/download/releases/2.7/>) and/ or Canopy (<https://store.enthought.com/downloads/#default>)
  - H2o (<http://www.h2o.ai/>)
  - Weka 3.6.12 (<http://www.cs.waikato.ac.nz/ml/weka/>)
  - This course uses a Cloudera Hadoop VM in one of the later Applied Data Mining sections. Check Blackboard for details.
- **Books etc. (Valpo eBooks require login. ONE shared copy ONLY):**
  - Ron Zacharski, *A Programmer's Guide to Data Mining*. <http://guidetodatamining.com/>
  - Yan Chang Zhao, *R and Data Mining: Examples and Case Studies*. [https://cran.r-project.org/doc/contrib/Zhao\\_R\\_and\\_data\\_mining.pdf](https://cran.r-project.org/doc/contrib/Zhao_R_and_data_mining.pdf)

- **FOR REFERENCE**--Valpo eBooks (require login, ONE shared copy ONLY):
  - Ledolter, Johannes. Data Mining and Business Analytics with R. Somerset, NJ, USA: John Wiley & Sons, 2013.  
<http://site.ebrary.com/lib/valpo/detail.action?docID=10716644>
  - Witten, Ian H., Frank, Eibe, and Hall, Mark A.. *Data Mining: Practical Machine Learning Tools and Techniques* (3rd Edition). St. Louis, MO, St. Louis, MO, USA: Morgan Kaufmann, 2011.  
<http://site.ebrary.com/lib/valpo/detail.action?docID=10525052&p00=witten>
  - Han, Jiawei, Kamber, Micheline, and Pei, Jian. *Data Mining: Concepts and Techniques: Concepts and Techniques* (3rd Edition). Saint Louis, MO, USA: Morgan Kaufmann, 2011.  
<http://site.ebrary.com/lib/valpo/detail.action?docID=10483440&p00=han+jiawei>
- Lynda.com at Valparaiso University. Access at <https://apps.valpo.edu/authentication/lynda/>

### Workload and Grading

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This 3-credit course requires SIGNIFICANT individual and teamwork (plan on 5-9 hrs per week). You will be completing the following tasks every week:

- **Weekly Discussion and Quizzes (15\*(5 points for post; 5 points for quiz) =150 points):** Every Wednesday, you will answer the discussion question for the week; this will prepare you for the quiz on Friday. Every Friday, you will complete the end-of-week quiz. After Spring Break, these quizzes will turn into longer homework assignments. Speed, correctness, and thoughtful responses that help your peers increase their understanding of the topic will earn you extra credit. Due to their timebound nature, these assignments **CANNOT BE MADE UP**.
- **1 Final Project (10\*10 +100 points = 200 points):** The final project requires that your assigned team pursues an interesting and useful question about an assigned dataset. You will draft the project in 10 stages (10 points each) and apply everything that you learn in this course, including preprocessing, algorithm selection and application, visualization, and interpretation. All Final Project labs are due in Blackboard each **Saturday** at 11:59 pm CST. The aggregated final draft (100 points) is due as shown on the course schedule.
- **Final Exam (100 points):** The final exam format will combine multiple choice and analytical questions about an unknown dataset to be released 24 hours before the exam. It is scheduled by the registrar as shown on the course schedule.

You can earn up to 450 points in this course. No extra credit assignments will be given.

#### Letter Grade Conversion:

A	>93%	A-	90 to 93%	B+	87 to <90%	B	83 to <87%	B-	80 to <83%
C+	77 to <80%	C	73 to < 77%	C-	70 to <73%	F	<70%		

#### Assignment Submission, Late Work, and Academic Honesty

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- **Assignment Submission:** All Assignments must be submitted on Blackboard. **No emailed Assignments will be accepted.**

- **Late Work:** Work is considered late if not posted to Blackboard by 11:59 pm CST of the day on which it is due. All late work must be turned in by the date and time of the Course Final. **Late work will lose 50% of the assignment grade.**
- **Academic Honesty:** All work you submit for this course must be your own. You may NOT use anyone else's words (from blogs, webpages, purchased solutions, etc.) without giving a clear source citation. If you are unsure, consult <http://www.plagiarism.org/> or the Writing Center. In addition, you must write and sign with your name the following statement on all course work:

**I have neither given nor received, nor have I tolerated others' use of unauthorized aid.**

For more information about Valparaiso University's Academic Honor Code, case review cycles, and potential penalties, please refer to <http://www.valpo.edu/student/honorcouncil/index.php>

**Any work suspected in noncompliance the Valparaiso University Honor Code will receive 0 points and be referred to the Graduate School for adjudication.**

## Diversity and Inclusion

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Valparaiso University aspires to create and maintain a welcoming environment built on participation, mutual respect, freedom, faith, competency, positive regard, and inclusion. This course will not tolerate language or behavior that demeans members of our learning community based on age, ethnicity, race, color, religion, sexual orientation, gender identity, biological sex, disabilities (visible and invisible), socio-economic status, or national origin. The success of this class relies on all students' contribution to an anti-discriminatory environment where everyone feels safe, welcome, and encouraged to engage, to explore, and ultimately, "to embark on a rewarding personal and professional journey" (Pres. Heckler).

## Title IX

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Valparaiso University strives to provide an environment free of discrimination, harassment, and sexual misconduct (sexual harassment, sexual violence, dating violence, domestic violence, and stalking). If you have been the victim of sexual misconduct, we encourage you to report the incident. If you report the incident to a University faculty member or instructor, she or he must notify the University's Title IX Coordinator about the basic facts of the incident. Disclosures to University faculty or instructors of sexual misconduct incidents are not confidential under Title IX. Confidential support services available on campus include: Sexual Assault Awareness & Facilitative Education Office "SAAFE" (219-464-6789), Counseling Center (219-464-5002), University Pastors (219-464-5093), and Student Health Center (219-464-5060). For more information, visit <http://www.valpo.edu/titleix/>.

## Access and Accommodation Services

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The Access & Accommodations Resource Center (AARC) is the campus office that works with students to provide access and accommodations in cases of diagnosed mental or emotional health issues, attentional or learning disabilities, vision or hearing limitations, chronic diseases, or allergies. You can contact the office at [aarc@valpo.edu](mailto:aarc@valpo.edu) or 219.464.5206. Students who need, or think they may need, accommodations due to a diagnosis, or who think they have a diagnosis, are invited to contact AARC to arrange a confidential discussion with the AARC office. Further, students who are registered with AARC are required to contact their professor(s) if they wish to exercise the accommodations outlined in their letter from the AARC.

## Academic Support

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To get help, use the [Academic Success Center \(ASC\) online directory](http://valpo.edu/academicsuccess) (valpo.edu/academicsuccess) or contact the ASC (academic.success@valpo.edu) to help point you in the right direction for academic support resources for this course. Valpo's learning centers offer a variety of programs and services that provide group and individual learning assistance for many subject areas. These learning centers include:

- [Graduate Tutoring Lab](#): Serves the academic needs of Graduate students – tutors offer suggestions on organization of papers, assist in research and citations, and help in understanding difficult assignments. Additional one on one tutoring is also available.
- [Writing Center](#): Primarily serves the needs of undergraduate students, but is also available for Graduate students. Writing Consultants provide proofreading and editing assistance for papers and assignments.

### **Library Services**

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The librarian best able to help you navigate information resources for independent research or additional reading is listed on the library research guide for our department. Click the link to Library Guides within the Blackboard table of contents for this course.

### **Class Cancellations**

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Notifications of class cancellations will be made through Blackboard with as much advance notice as possible. It will be both posted on Blackboard and sent to your Valpo e-mail address. If you don't check your Valpo e-mail account regularly or have it set-up to be forwarded to your preferred e-mail account, you may not get the message. Please check Blackboard and your Valpo e-mail (or the e-mail address it forwards to) before coming to class.

## Schedule

Week	Start Date (all 2018)	Topic	Reading and Other Preparation	Graded Work Due <ul style="list-style-type: none"> <li>M=Mon 11:59 pm CST</li> <li>F=Fri 11:59 pm CST</li> <li>S=Sat 11:59 pm CST</li> </ul>
1	01/10	Big Data and Basic Statistics with MS Excel	<ul style="list-style-type: none"> <li>Zacharski 1</li> <li>Han/ Kamber 1</li> <li>Witten/Eibe 1</li> <li>Videos as posted on Blackboard</li> <li>Lynda Course "Techniques and Concepts of Big Data"</li> <li><i>Install MS Excel</i></li> </ul>	<p><b>F: Post 1:</b> Post your Lynda course completion certificate</p> <p><b>SUN: EOW Quiz 1:</b> Complete Basic Stats question in Excel</p>
2	01/15	Data, Databases, and Data Warehouses and Basic Statistics with R	<ul style="list-style-type: none"> <li>Zhao 3</li> <li>[Han/ Kamber 4,5]</li> <li>[Witten/Eibe 2]</li> <li>Videos as posted on Blackboard</li> <li>Lynda Course " R Statistics Essential Training" mod. 1-4</li> <li><i>Install R/ R Studio</i></li> </ul>	<p><b>W: Post 2:</b> Basic Stats question in R (also: Find your group and assigned dataset on Blackboard)</p> <p><b>F: EOW Quiz 2</b></p> <p><b>S: FINAL_PROJECT_1:</b> On 1 single-spaced page in MS Word, describe your dataset. What are the attribute data types in your data set? Display the attributes in R and generate a 5 number summary. How are the attribute values distributed?</p>
3	01/22	Preprocessing: Data Preparation for Data Mining	<ul style="list-style-type: none"> <li><a href="#">An introduction to data cleaning with R</a></li> <li><a href="#">Ledolter 2</a></li> <li>[Han/ Kamber 3]</li> <li>[Witten/ Eibe 7]</li> <li>Lynda Course "R Statistics Essential Training" mod. 5-end</li> <li>Videos as posted on Blackboard</li> </ul>	<p><b>W: Post 3:</b> Preprocessing using MS Excel and R</p> <p><b>F: EOW Quiz 3</b></p> <p><b>S: FINAL_PROJECT_2:</b> Determine 3 attributes in your dataset that present quality or analysis problems and transform and evaluate them.</p>
4	01/29	More Statistics: Correlation, Regression and Chi	<ul style="list-style-type: none"> <li>Zhao 5</li> <li>Zacharski 2</li> <li>Ledolter 3 (Standard</li> </ul>	<p><b>W Post 4:</b> Adv. Stats in R</p> <p><b>F: EOW Quiz 4</b></p>

		Square, ANOVA	<p>Linear Regression)</p> <ul style="list-style-type: none"> <li>• [Han/ Kamber 2]</li> <li>• Other materials as posted</li> <li>• Lynda Course “Up and Running with Python”</li> <li>• <i>Install Python 2.7</i></li> </ul>	<p><b>S: FINAL_PROJECT_3:</b> Using R or Excel, determine which attributes in your dataset are closely correlated. Select two attributes for which to predict future values with regression. Use Excel and R. How do the results differ, and why?</p>
5	02/05	Patterns, Associations, Correlations: Frequent Itemsets, Apriori, Support and Confidence Measures, Recommender Systems	<ul style="list-style-type: none"> <li>• Zhao 9</li> <li>• Zacharski 2</li> <li>• Ledolter 16 (Market Basket Analysis)</li> <li>• [Han/ Kamber 6]</li> <li>• [Witten/Eibe 3, 4.1, 17.2]</li> <li>• Other materials as posted</li> </ul>	<p><b>W Post 5:</b> Recommender systems</p> <p><b>F: EOW Quiz 5</b></p> <p><b>S: FINAL_PROJECT_4:</b> Using R or Python, preprocess your dataset to run with Apriori. Show and describe the output. What do the results tell you about the attributes in your dataset?</p>
6	02/12	Patterns, Associations, Correlations: Frequent Pattern Growth, Measures of Interestingness	<ul style="list-style-type: none"> <li>• <a href="#">Association Mining with R</a></li> <li>• <a href="#">Data Mining Algorithms In R/Frequent Pattern Mining/The FP-Growth Algorithm</a></li> <li>• Zacharski 2</li> <li>• [Witten/Eibe 6.3, 6.7, 11.7]</li> <li>• Other materials as posted</li> </ul>	<p><b>W Post 6:</b> Correlation Exercise</p> <p><b>F: EOW Quiz 6</b></p> <p><b>S: FINAL_PROJECT_5:</b> Using R, preprocess your dataset to run with Apriori and FP Growth. Then run both algorithms and compare the output. Which algorithm produces better results and why? What do the results tell you about the attributes in your dataset?</p>
7	02/19	Classification & Recommendation Systems: Decision Trees; Naïve Bayes, kNearest Neighbor, Generalized Linear Models	<ul style="list-style-type: none"> <li>• Zhao 4</li> <li>• Zacharski 4,5,6</li> <li>• Ledolter 9, 13</li> <li>• [Han/ Kamber 8]</li> <li>• [Witten/Eibe 4]</li> <li>• Other materials as posted</li> <li>• <i>Install h2o on R</i></li> </ul>	<p><b>W Post 7:</b> Naïve Bayes, kNN</p> <p><b>F: EOW Quiz 7</b></p> <p><b>S: FINAL_PROJECT_6:</b> Preprocess your dataset to run with a simple Decision Tree, Naïve Bayes, kNN, and Generalized Linear Models algorithms, then run the algorithms and compare the output. What do the results about class membership tell</p>



				you about your dataset?
8	02/26	Classification: Ensemble Learning, Neural Networks/ Deep Learning, Random Forest	<ul style="list-style-type: none"> <li>• Zhao 4</li> <li>• Zacharski 4,5,6</li> <li>• [Han/ Kamber 9.1-9.5]</li> <li>• [Witten/Eibe 6,8,11.4]</li> <li>• <a href="#">Random Forest with h2o (Tutorial)</a> OR</li> <li>• <a href="#">Deep Learning with h2o (Tutorial)</a></li> <li>• Other materials as posted</li> </ul>	<p><b>W Post 8:</b> Neural Networks, Random Forest</p> <p><b>F: EOW Quiz 8</b></p> <p><b>S: FINAL_PROJECT_7:</b> Run your dataset through Neural Networks and Bagging algorithms in EITHER R or Python AND in h2o (use the tutorials as your technical guide). How do the results compare to your previous classification analysis?</p>
<b>SPRING RECESS 03/02 8 pm CST to 03/18 8 am CST</b>				
9	3/19	Clustering: kMeans, Hierarchical Clustering, DBScan	<ul style="list-style-type: none"> <li>• Zhao 6</li> <li>• Zacharski 8</li> <li>• [Han/ Kamber 10.1-10.6]</li> <li>• [Witten/Eibe 4.8, 6.8, 11]</li> <li>• <a href="#">kMeans Clustering with h2o (Tutorial)</a></li> <li>• Other materials as posted</li> </ul>	<p><b>W Post 9:</b> kMeans, Hierarchical Clustering</p> <p><b>F: EOW Quiz 9</b></p> <p><b>S: FINAL_PROJECT_8:</b> Preprocess your dataset to run with the kMeans, Hierarchical Clusterer, and DB Scan algorithms. How did you tune each algorithm to achieve optimal results? Which algorithm produces the best results and why?</p>
10	03/26	Applications in Data Mining: Search Engines and Text Retrieval in R	<ul style="list-style-type: none"> <li>• <a href="#">Text Data Management and Analysis: A Practical Introduction to Information Retrieval and Text Mining</a>, 3,5,6 (all available pages)</li> <li>• Zhao 10</li> <li>• [Witten/ Eibe 9]</li> <li>• Other materials as posted</li> </ul>	<p><b>W Post 10:</b> Exercise about basic text processing techniques such as tokenization, stemming, and stopword removal</p> <p><b>F: EOW Quiz 10</b></p> <p><b>S: FINAL_PROJECT_9:</b> Review your previous submissions and rework one of them.</p>
11	04/02	Applications in Data Mining: Search Engines and Text Retrieval in Python	<ul style="list-style-type: none"> <li>• Zacharski 7</li> <li>• <a href="#">Building a Search Engine</a> in Python blog</li> <li>• Video: 01 <a href="#">Building Search</a></li> </ul>	<p><b>W Post 11:</b> Build a basic text retrieval engine in Python</p> <p><b>F: EOW Quiz 11</b></p>

			<a href="#">Engine using Python</a> downloading and extracting links	<b>S: FINAL_PROJECT_10:</b> Review your previous submissions and visualize what conclusions about your dataset your analysis has revealed.
12	04/09	Applications in Data Mining: Social Network Mining	<ul style="list-style-type: none"> <li>• Zhao 10, 11</li> <li>• Other materials as posted on Blackboard</li> <li>• Feida Zhu et al., "<a href="#">Network Mining and Analysis for Social Applications</a>" KDD 2014 Tutorial.</li> <li>• "<a href="#">Relationship Mining on Twitter Shows How Being Dumped Hurts More than Dumping</a>" <i>MIT Technology Review</i>. 10/01/2014</li> </ul>	<b>W Post 12:</b> Perform a Facebook sentiment analysis using R  <b>F: EOW Quiz 12</b>
13	04/16	Applications in Data Mining: Big Data Processing and MapReduce	<ul style="list-style-type: none"> <li>• Hadoop: <a href="#">Big Data Analysis Framework</a></li> <li>• Install the Cloudera Hadoop VM on VirtualBox</li> <li>• Lynda.com Course on <a href="#">Hadoop Fundamentals</a></li> </ul>	<b>W Post 13:</b> Write a MapReduce job in Python  <b>F: EOW Quiz 13</b>
14	04/23	Applications in Data Mining: Security—networking and banking	<ul style="list-style-type: none"> <li>• Zhao 7</li> <li>• [Han/ Kamber 12, 13.3]</li> <li>• Security Case studies posted on Blackboard</li> <li>• Other materials as posted on Blackboard</li> </ul>	<b>W Post 14:</b> Solve one of the case studies.  <b>F: EOW Quiz 14</b>  <b>S: FINAL PROJECT DUE:</b> Ensure that all questions regarding your final project have been answered and turn in a polished paper.
15	04/30	Applications in Data Mining: Ethics and Electronic Profiling  Course Summary  Practice Final	<ul style="list-style-type: none"> <li>• Lei Xu et al., "<a href="#">Information Security in Big Data: Privacy and Data Mining.</a>" IEEE Explore. 9/21/2014.</li> <li>• Ellen Rooney Martin, "<a href="#">The Ethics of Big Data.</a>" <i>Forbes</i>. 3/27/2015</li> <li>• Other materials as posted on Blackboard</li> </ul>	<b>W Post 15:</b> Solve an ethics question  <b>F: EOW Quiz 15</b>

Final	05/12	FINAL EXAM 1-3 pm	<b>USE:</b> Books&slides& assignments <b>DO NOT USE:</b> Friends, the internet, etc.	<b>Course Final Exam</b> , 1-3 pm CST on Blackboard.
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**Final Project (8-15 pages) (100 points)—Completed in stages; check the syllabus for due dates**

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This course requires a major project, which you will complete in your assigned groups. For this project, you will **be assigned** a useful real-world dataset and **conduct** your own data mining activities as prompted through the weekly questions.

The report must be 8-15 pages, excluding source code but including figures, and should be well written. **It must have the following 9 sections (please copy the section headings into your final writeup):**

1. What does the dataset describe? -- 10 pts
2. What preprocessing was needed for what attributes? What replacement strategies for missing values were used and why? --10 pts
3. Which are the three most important attributes? Provide their basic statistical measures (see weeks 1 and 2) and explain what these measures tell you about the entire dataset. – 10 pts
4. Show how the three most important attributes relate to each other and to the class attribute (if it exists in your dataset) using correlation and regression analysis. What does this analysis tell you about the entire dataset? – 10 pts
5. Which association algorithms and tuning techniques did you use and what information did they give you about your dataset? – 10 pts
6. Which classification algorithms and tuning techniques did you use and what information did they give you about your dataset? – 10 pts
7. Which clustering algorithms and tuning techniques did you use and what information did they give you about your dataset? – 10 pts
8. Interpretation of results: Which data mining method used in points 3-7 provides the most useful and important information about your dataset? —10 pts
9. What action would you recommend management to take as a result of your data analysis, and where are the limitations of your analysis? Use at least 5 sentences to explain how you arrived at your recommendation, which managerial conclusions from your analysis would be useful, and which ones would be erroneous. – 20 pts

Please use the Final\_Project\_n submissions that you have worked on all semester as the basis for your Final Project submission and polish them into a professional-looking analysis paper. This includes proper English grammar, vocabulary, and expressions, and proper formatting.

**APPENDIX****Student Learning Objectives—Graduate School**

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1. Students will understand and practice methods of inquiry and strategies of interpretation within the student's field of study.
2. Students will master the knowledge and skills pertinent to the student's field of study.
3. Students will effectively articulate the ideas, concepts, and methods through written and oral presentation.
4. Students will understand the connection between their knowledge and skills on the one hand and their professional identity, responsibilities, and demands on the other.
5. Students will integrate knowledge and methods of their study with cognates and other disciplines.
6. Students will study, reflect upon, and practice ethical behavior and cultural sensitivity as they relate to professional and personal responsibility.

**Student Learning Objectives—Information Technology Program**

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1. To understand and practice methods of inquiry and strategies of interpretation within the student's field of study.
  - 1A. Students will master several programming environments.
  - 1B. Students will learn to identify and isolate problems.
2. To master the knowledge and skills pertinent to the student's field of study.
  - 2A. Students will acquire an extensive technology related vocabulary.
  - 2B. Students will become comfortable using a wide range of technology environments.
3. To effectively articulate the ideas, concepts, and methods through written and oral presentation.
  - 3A. Students will be taught how to make formal, oral presentations and be required to give 6 such presentations during their program.
  - 3B. Students will write numerous, thorough papers requiring extensive research. They will be required to use the services on the writing center.
4. To understand the connection between their knowledge and skills on one hand and their professional identity, responsibilities, and demands on the other.
  - 4A. Students will understand the implications of legal and professional regulations as they relate to information technology.
  - 4B. Students will study how technology can be made available to people that are traditionally less advantaged.
5. To integrate knowledge and methods of their study with cognates and other disciplines.
  - 5A. Students will learn techniques of modeling data from other disciplines.
  - 5B. Students will study human factors in IT.
6. To practice ethical and cultural sensitivity as it relates to professional and personal responsibility.
  - 6A. Students will examine a wide range of ethical issues related to technology and the potential effects on people and the environment.
  - 6B. Students will explore the relationship between IT and ethnic and cultural diversity.