AMIS 7640 – Data Mining for Business Intelligence

Autumn Semester 2016, Session 2

Contact Information:

Instructor: Prof. Waleed A. Muhanna (muhanna.1@osu.edu)  
Phone: (614) 292-3808; Fax: 292-2118  
Office: 420 Fisher Hall  
Office Hours: TR 1:00-2:00, and by appointment.

Course Overview:

Advances in information technologies and the increased digitization of business have led to an explosive growth in the amount of structured and unstructured data collected and stored in databases and other electronic repositories. Much—but certainly not all—of this data comes from operational business software (e.g., finance/accounting applications, Enterprise Resource Management (ERP), Customer Relationship Management (CRM), workflow and document management systems, surveillance and monitoring systems, and Web logs) and is often archived into vast data warehouses to become part of corporate memory. The result of this massive accumulation of data is that organizations have become data-rich yet still knowledge-poor. What can be learned from these mountains of data to improve decisions? How can an organization leverage its massive data warehouses for strategic advantage? A large number of methods with roots in statistics, informational retrieval and machine learning have been developed to address the issue of knowledge extraction from data sets—both small and large. The term "data-mining" refers to this collection of methods. These methods have broad applications; they have been successfully applied in areas as diverse as market-basket analysis of scanner data, customer relationship management, churn analysis, direct marketing, fraud detection, click-stream analysis, personalization and recommendation systems, risk management and credit scoring.

The key objectives of this course are two-fold: (1) to provide you with a theoretical and practical understanding of core data mining concepts and techniques; and (2) to provide you with hands-on experience in applying these techniques to practical real-word business problems using commercial data mining software. As an applied course, the emphasis will be less on the inner working of each method and more on when and how to use each technique and how to interpret the results.

Business Intelligence is a process for increasing the competitive advantage of a business through the intelligent use of available data in decision making. Business intelligence systems combine operational and other data with data mining tools to improve the timeliness and quality of inputs
to decision processes. Broadly defined, data mining is the process of selection, exploration and modeling of (often, but not necessarily, large) data sets, in order to discover predictive and descriptive models and patterns. It encompasses both top-down (confirmatory or hypothesis driven) analysis using traditional statistical techniques and bottom-up (exploratory) analysis using database and machine learning techniques to discover regularities, relations, or “local structure/patterns” that are at first unknown. (The confirmative tools of top-down analysis can then be used to confirm the discoveries and evaluate the quality of decisions based on those discoveries.) In keeping with this broad definition, topics and related methods discussed include information retrieval and enterprise reporting, classification, predictive modeling, clustering, association rules mining, and social network analysis. The application of these methods will be illustrated using modern software tools via examples, homework assignments and group term projects.

Upon completion of this course, students should be able to:
1. Fully appreciate the concept of data as a strategic resource;
2. Use existing data retrieval and manipulation tools for data/information extraction and enterprise reporting;
3. Understand how and when data mining can be used as a problem-solving technique;
4. Describe different methods of data mining;
5. Select an appropriate data mining technique for a specific problem;
6. Use existing data mining software to mine a prepared data set; and
7. Interpret and evaluate the results of data mining.

Prerequisites:
The course is specifically designed with MBA/MACC students as the intended target audience. The key prerequisites consist of good graduate standing and completion of an introductory course in probability and statistics. Assignments do not involve programming, per se, and no prior professional IT experience is assumed.

Course Materials:
- A set of articles, assignments, tutorials, data sets, lecture notes, and various supplementary materials which will made available through the course website on Carmen.

Course Organization:
The course will be run as a mixture of lectures, in-class demonstrations, assignments, and classroom discussions. Readings will be from the required text together with other supplementary materials. Some material will be covered only in the readings; other will be covered only in lecture which may depart from the text in either content or order. To maximize learning, classroom discussion and the amount of time spent on different topics will be adjusted according to the background and interests of the students.
Assignments

In addition to the reading requirements from the text and the supplementary materials, there will be 4-5 homework assignments, spaced out over the course of the 7-weeks term. They are designed to reinforce your understanding of the topics covered. Assignments are to be handed in on or before the class period of the due date. No late work is accepted. A limited amount of cooperation among students on homework and lab assignments is permitted. You may discuss with classmates general solution strategies. However, everyone should independently do and turn in his/her own work.

Exam

There will be one in-class exam: a final exam. The exam is closed-book and closed-notes, and it will be held in accordance with Fisher Graduate Programs schedule during the final examination period on Tuesday, December 13th (at 2:45 pm). The exam is designed to assess each student's (a) command of factual knowledge and concepts from the course; and (b) his or her ability to integrate and generalize these concepts and principles and apply them to new situations. The final exam must be taken during its scheduled time; make up exams will only be given for special and compelling cases, in accordance with University guidelines.

Team-Based Term Project

Students will have the opportunity to further sharpen their skills and acquire hands-on experience with practical databases and real data mining problems through a term project. The projects will be carried out in teams of 3-4 students and involve the use of DM software. Although I am generally open to suggestions, each project will normally involve the selection, design, and performance of a data mining plan using a public data set (such as those provided by the SAS Institute or in the UCI KDD Archive (http://kdd.ics.uci.edu/) or a non-proprietary data set available through private student contacts. A case assignment will be made available as an alternative to team proposed projects. Teams will submit a written project proposal partway through the term, followed by a written report and, if time permits, brief class presentation on the project during the last class meeting.

Software

The methods discussed in this class are computationally intensive and non-trivial; they cannot be performed using Excel. Fortunately, these methods have matured enough to the point where they are now implemented in commercial software. We will use Microsoft Access to familiarize you with relational query language SQL, the industry standard for data extraction, summarization and enterprise reporting. XLMiner, an EXCEL © add-in, will be introduced in class and used by students to do assignments and solve business problems using data mining techniques. If you buy a new copy of the textbook, your copy should include a complementary 6-month license to XLMiner (in the back of the book you will find an insert that contains the license for downloading the add-in). Alternatively, I will provide you with a special Textbook Code and Course Code that will enable you to download the software, and use it throughout the term with a 140-day license.

Participation
A portion of the final grade will be based on your class attendance and active participation, elements that are crucial to the success of class meetings. Attendance refers to punctual attendance. Your fellow students and I will expect you to come fully prepared to answer questions and discuss the assigned readings. Each individual is expected to actively and constructively contribute to class discussions. Good contributions transcend assigned readings and are inspired, timely, analytical, and relevant to the topics discussed. Students can also earn participation credit by drawing attention to related development, information and resources dealing with related topics. Your class participation grade will reflect my judgment of the quality and quantity of your contributions during the entire term.

Cold calling: On occasion, I will make “cold calls”. This is not intended to put you on the spot but to encourage class discussion and participation.

Evaluation:

30% of the final grade will be based on graded homework assignments. The final exam will account for 40% of your grade. The group term project will account for 20% of the grade. The remaining 10% is assigned to class participation. Final grades will be based on overall class performance.

Feedback and Continuous Improvement:

Students are strongly encouraged to visit with me in my office and/or use e-mail to ask questions, to share suggestions about any aspect of the course, or to clear up possible points of confusion. I will use your feedback to continuously improve and fine-tune the coverage levels and the teaching/learning processes. Please note that I may not always be able to make all of the changes suggested, but I will do my best to accommodate your suggestions.

Standards of Integrity and Conduct:

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Each student in this course is expected to be familiar with and abide by the principles and standards set forth in The Ohio State University’s code of student conduct and code of academic conduct. You can view these documents or download pdf versions at:

http://studentaffairs.osu.edu/resource_csc.asp
http://www.gradsch.ohio-state.edu/academic-and-research-misconduct.html

It is also expected that each student will behave in a manner that is consistent with the Fisher Honor Statement, which reads as follows:

As a member of the Fisher College of Business Community, I am personally committed to the highest standards of behavior. Honesty and integrity are the foundations from which I will measure my actions. I will hold myself accountable to adhere to these standards. As a future leader in the community and business environment, I pledge to live by these principles and celebrate those who share these ideals.
**Students with Disabilities:**

Any student who feels s/he may need an accommodation based on the impact of a disability should contact me privately to discuss your specific needs. I rely on the [Office for Disability Services](#) for assistance in verifying the need for accommodations and developing accommodation strategies. If you have special needs and have not previously contacted the Office for Disability Services, I encourage you to do so.

**Tentative Course Schedule:**

The following schedule gives the general plan for the course; changes may be made at my discretion but are designed to optimize the quality and flow of the content. The course web site gives the dynamic picture and is an integral part of the class; please make sure to check it on a regular basis.

<table>
<thead>
<tr>
<th>Session &amp; Date</th>
<th>Topics and Required Readings</th>
</tr>
</thead>
</table>
| Session 1 (T 10/18) | **Course Introduction**  
  - Overview/goals of data mining  
  - Myths about data mining  
  - The Data Mining process  

  Readings:  
  - Cases:  
    - “Diamonds in the Data Mine” *HBR*, 5/03 (PDF)  
    - “A golden vein” *The Economist*, 1/04. (PDF)  
    - “How Verizon cut Customer churn” *Financial Express*, 10/03. (PDF)  
  - TB: Chapters 1 & 2 |
| Session 2 (R 10/20) | **Data Extraction and Manipulation**  
  - The Relational Data Model and Relational DBMS  
  - Enterprise Reporting  
  - Relational Algebra  
  - SQL: The Relational Query Language  

  Assignments:  
  - Assignment 1 |
| Session 3 (T 10/25) | **OLAP and Multidimensional Data Analysis**  
  - Datawarehousing and Multidimensional Databases |
| Session 4  (R 10/27) | **Data Exploration and Dimension Reduction**  
|----------------------|----------------------------------------------------------------------------------|
|                      | - Data Summarization and Visualization  
|                      | - Correlation Analysis  
|                      | - Principal Component Analysis  
|                      | **Readings:**  
|                      | - TB: Chapters 3 & 4  
|                      | **Assignments:**  
|                      | - Assignment 2  

| Sessions 5 & 6  (T 11/1 & R 11/3 ) | **Classification and Predictive Modeling**  
|------------------------------------|----------------------------------------------------------------------------------|
|                                    | - Decision Tree induction  
|                                    | - Model Evaluation and Interpretation  
|                                    | **Readings:**  
|                                    | - TB: Chapters 9 & 5  
|                                    | **Assignments:**  
|                                    | - Assignment 2  

| Sessions 7 & 8  (T 11/8 & R 11/10) | **Predictive Modeling Using Regression**  
|------------------------------------|----------------------------------------------------------------------------------|
|                                    | - Review of OLS Regression  
|                                    | - Logistic Regression  
|                                    | - Model Evaluation and Interpretation  
|                                    | **Readings:**  
|                                    | - TB: Chapters 6 & 10  
|                                    | **Assignments:**  
|                                    | - Assignment 3  

| Session 9  (T 11/15) | **Predictive Modeling Using Neural Networks & Ensemble Methods**  
|----------------------|----------------------------------------------------------------------------------|
|                      | - Introduction to Neural Networks  
|                      | - Neural Networks vs. Regression  
|                      | - Model Ensemble  
|                      | **Readings:**  
|                      | - TB: Chapter 11  

- Data Quality  
- Summarization and Data Cubes  
- OLAP Tools and Pivot Tables  

Readings:  
- (Check course web site)  
- “An Introduction to OLAP Multidimensional Terminology and Technology” (PDF)
<table>
<thead>
<tr>
<th>Sessions 10 &amp; 11</th>
<th>Association &amp; Market-Basket Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>(R 11/17 &amp; T 11/22)</td>
<td>- Frequent Itemset and Association Rule Mining</td>
</tr>
<tr>
<td></td>
<td>- Pattern evaluation (subjective and objective interestingness measures)</td>
</tr>
<tr>
<td></td>
<td>- Sequential patterns</td>
</tr>
<tr>
<td>Readings:</td>
<td>- TB: Chapter 13</td>
</tr>
<tr>
<td>Assignments:</td>
<td>- Assignment 4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sessions 12 &amp; 13</th>
<th>Cluster Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>(R 11/29 &amp; T 12/1)</td>
<td>- Segmentation and Personalization</td>
</tr>
<tr>
<td></td>
<td>- The K-means algorithm</td>
</tr>
<tr>
<td></td>
<td>- Hierarchical (Agglomerative) Clustering</td>
</tr>
<tr>
<td></td>
<td>- Cluster Validation and Interpretation</td>
</tr>
<tr>
<td>Readings:</td>
<td>- TB: Chapter 14</td>
</tr>
<tr>
<td>Assignments:</td>
<td>- Assignment 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Session 14</th>
<th>Link and Social Network Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>(R 12/6)</td>
<td>- Network Centrality / Centralization</td>
</tr>
<tr>
<td></td>
<td>- Identifying Prestige / Influence</td>
</tr>
<tr>
<td></td>
<td>- Discovering Key Opinion Leaders</td>
</tr>
<tr>
<td></td>
<td>- Tracking Organized Networks</td>
</tr>
</tbody>
</table>

| 12/13 | Final Exam |
About The Instructor:

Dr. Waleed A. Muhanna is Professor of Accounting & Management Information Systems at the Fisher College of Business, The Ohio State University. He received his undergraduate degree in computer science from the University of Tulsa, and holds a master’s degree in computer science and doctorate in management information systems from the University of Wisconsin—Madison. Dr. Muhanna’s teaching and consulting activities span a number of areas, with particular emphasis on e-commerce, data management and mining, and information systems strategy. Professor Muhanna’s current research focuses on IT strategy, data analytics, assessing the business value of information technology, and understanding the impact of information technology, including the Internet, on organizations and markets. His other research interests include trust and reputation online, e-commerce strategy, model and database management systems, and system performance modeling and evaluation. Professor Muhanna has published numerous articles in scholarly journals, including Management Science, MIS Quarterly, Strategic Management Journal, Decision Sciences, the Journal of Information Systems, the International Journal of Accounting Information Systems, ACM Transactions on Computer Systems, IEEE Transactions on Software Engineering, Communications of the ACM, Decision Support Systems, Information & Management, European Journal of Operational Research, Computers in Human Behavior, and the Annals of Operations Research. Dr. Muhanna’s teaching and consulting activities span a number of areas, with particular emphasis on e-commerce, data management and mining, business analytics, internet entrepreneurship, and information systems strategy. He recently completed a 3-year term as Chairperson of the Department of Accounting & Management Information Systems at the Fisher College of Business, and prior to that as the Director of the Ph.D. Program in Accounting & MIS. He also previously served as Vice-Chair of INFORMS' Information Systems Society and serves on the editorial boards of multiple leading academic journals.