MSA 8010: Data Programming for Analytics

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As with any document, be aware that this may contain clerical errors. Please tell me if you spot one.

The instructor reserves the right to modify the syllabus as necessary to improve student learning and provide appropriate evaluation. Students will be notified of any such modification in-class and via the web site.

1 Catalog Description
The current university catalog description of this course can be obtained in the University's Catalog:
http://www.gsu.edu/es/catalogs_courses.html
A recent university catalog description follows:

Data Programming. Prerequisite: MRM 8000. This course builds upon the student's foundation of programming principles through the introduction of application programming for data analysis. Major areas covered include inheritance and polymorphism, common programming data structures, and file and database access. Students will implement data analysis applications, which will be evaluated according to advanced programming principles. The programming language will be noted in the course listing for each semester.

1.1 Prerequisites
Required: MRM 8000

1.2 Sections

<table>
<thead>
<tr>
<th>Room</th>
<th>Days</th>
<th>Time</th>
</tr>
</thead>
</table>

2 Instructor
Dr. William N. Robinson; http://wrobinson.cis.gsu.edu; wrobinson@gsu.edu
Office (404) 413-7374; Dept: (404) 413-7360; FAX: (404) 413-7394
Office hours: TBA & by appointment. Ask me about Instant Messaging (MS Messenger Live).

2.1 Contact the instructor... Please!
During the term, it is highly recommended that you contact the instructor, in-person or via email. I am available to help you focus your projects, gain access to resources, and answer your questions. Please try to see me, phone me, or e-mail me at least once during the term to discuss your project. Your class members are also a good source of help.

2.2 Course web site
Web sites for our course are on www.onedrive.com. See your email for details.

3 Overview
This class covers the principles of programming emphasizing fundamentals, methods, and tools with application to data analysis.

3.1 Intended audience
Anyone with a keen interest in data mining will do well in this course. It's mainly geared to produced Data Analysts.
3.2 Learning objectives

Upon successful completion of this course, you will accomplish the following objectives and outcomes. In particular, students who complete this course will gain “Ready for work” skills (along with theory), including:

1. Specifying and reasoning about data mining problems
2. Applying data mining tools & techniques

Specific objectives include the following:

1. Understanding programming
   a. Classes, objects, sequences, decisions, loops
   b. Collections and common data structures
   c. File & database handling, exceptions
   d. Searching, sorting, recursion
   e. OOD patterns
2. Data programming
   a. Data loading & storage
   b. Programmatic data transformations
   c. Programmatic data visualization
3. Programmatic data analysis
   a. Aggregation & grouping
   b. Correlation
   c. Linear regression
   d. Matrix operations
4. Demonstrate critical thinking, integrative reasoning, & communication skills

4 Schedule

The following table defines the schedule. However, the topics and readings may change according to the interests and abilities of the class. See the Academic Calendar. On the web, the underlined items link to supporting information. Materials may be updated 24 hours prior to class; please check before attending class.

<table>
<thead>
<tr>
<th>#</th>
<th>Date</th>
<th>Readings</th>
<th>In class</th>
<th>Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Introduction &amp; review: §1-4(Zelle 2004) Introduction &amp; review: §1</td>
<td>Demonstration: IPython, Eclipse Python</td>
<td>HW Write a program that draws some sort of face Student mining presentation</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Objects, sequences, decision, &amp; loops: §5 - 9(Zelle 2004)</td>
<td></td>
<td>HW Extend the simulation program 1 Student mining presentation</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Classes, collections: §10 - 11(Zelle 2004)</td>
<td></td>
<td>HW Extend the simulation program 2 Student mining presentation</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>OOD: §12(Zelle 2004)</td>
<td></td>
<td>HW Modify the Dice Poker program Student mining presentation</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>Searching, recursion, sorting: §13(Zelle 2004)</td>
<td></td>
<td>HW Modify the Fibonacci program</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>Data programming with Python §1-5(McKinney 2012)</td>
<td>Demonstration: Python NumPy Demonstration: Python pandas</td>
<td>HW Modify the Fibonacci program</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>Exam 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week</td>
<td>Topic</td>
<td>Demonstration</td>
<td>HW</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------------------------------------</td>
<td>---------------</td>
<td>----</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Data loading and storage (files &amp; DBs) §6(McKinney 2012)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Data transformations §7(McKinney 2012)</td>
<td>Demonstration: Python matplotlib</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HW Load &amp; Store DB data</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Data Visualization §8(McKinney 2012)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Data aggregation §9(McKinney 2012)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Time series §9(McKinney 2012)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Economic data analysis §9(McKinney 2012)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>OOD Revisited (design patterns, exception handling)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Advanced data analysis §10(McKinney 2012)</td>
<td>Demonstration: Python Advance NumPy, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Exam 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HW Matrix operations</td>
<td></td>
</tr>
</tbody>
</table>
5 Readings by Session

Readings provide content for class discussions. Thus, readings must be read prior the class. For example, week 1 readings must be read prior to class on week 1. The readings are in order of importance. Thus, where there are many readings, you may need to scan the last articles.

Do not get more than 1 week ahead of the class in the readings. Sometimes (mostly rarely) readings may be changed 1 week prior to their presentation in class.

1. Introduction & review: §1-4(Zelle 2004)
2. Objects, sequences, decision, & loops: §5 - 9(Zelle 2004)
4. OOD: §12(Zelle 2004)
6. Data programming with Python §1-5(McKinney 2012)
7. Exam 1
8. Data loading and storage (files & DBs) §6(McKinney 2012)
9. Data transformations §7(McKinney 2012)
10. Data Visualization §8(McKinney 2012)
11. Data aggregation §9(McKinney 2012)
12. Time series §9(McKinney 2012)
13. Economic data analysis §9(McKinney 2012)
14. OOD Revisited (design patterns, exception handling)
15. Advanced data analysis §10(McKinney 2012)
16. Exam 2

5.1 References

Students must have access to the two primary textbooks:

Primary Textbooks:


Some books can be accessed from E-book from Books24x7. Most articles have a URL, which can be used to download the article. (This assumes that you are on the university network directly or VPN. You may be prompted for your campus ID and password.)

Some articles may be only available from our web site. To find other articles, use the method described in section 10, How to scan Computing literature.)

Readings

McKinney, W. Python for data analysis: Data wrangling with Pandas, NumPy, and IPython " O'Reilly Media, Inc.", 2012.

5.2 E-book from Books24x7

Consider the E-books as good resource; they are free to our students. See this note: http://www2.cis.gsu.edu/cis/news/newandnoteworthy2.asp Access from the GSU online library: http://homer.gsu.edu/search/databases/proxy/GLL25038; select the link Books24x7. You can also scroll down to Books 24x7 in the list of “databases”: http://homer.gsu.edu/search/databases/alphabetical#B

5.3 Software

Additionally, much of the software is available for download, either from the instructor, or from the CIS agreements with MSDNAA and the IBM Academic Initiative.
5.4 Data sets

These datasets are from the UCI Machine Learning Repository.

<table>
<thead>
<tr>
<th>DATASETS</th>
<th>DATA TYPES</th>
<th>DESCRIPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iris (CSV)</td>
<td>Real</td>
<td>Iris description (TXT)</td>
</tr>
<tr>
<td>Wine (CSV)</td>
<td>Integer, real</td>
<td>Wine description (TXT)</td>
</tr>
<tr>
<td>Haberman's Survival (CSV)</td>
<td>Integer</td>
<td>Haberman description (TXT)</td>
</tr>
<tr>
<td>Housing (TXT)</td>
<td>Categorical, integer, real</td>
<td>Housing description (TXT)</td>
</tr>
<tr>
<td>Blood Transfusion Service Center (CSV)</td>
<td>Integer</td>
<td>Transfusion description (TXT)</td>
</tr>
<tr>
<td>Car evaluation (CSV)</td>
<td>Categorical</td>
<td>Car description (TXT)</td>
</tr>
<tr>
<td>Mushroom (CSV - 1.9MB)</td>
<td>Binary</td>
<td>Mushroom description (TXT)</td>
</tr>
<tr>
<td>Pen-based recognition of handwritten digits (CSV)</td>
<td>Integer</td>
<td>Digits description (TXT)</td>
</tr>
</tbody>
</table>

6 Evaluation

Students are evaluated by the deliverables summarized in Table 1. The course credits are earned according to the following Table 1.

**Table 1 Relative weights assigned to course deliverables.**

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1</td>
<td>25</td>
</tr>
<tr>
<td>Exam 2</td>
<td>30</td>
</tr>
<tr>
<td>In class exercises</td>
<td>5</td>
</tr>
<tr>
<td>Data Mining Headlines (team)</td>
<td>10</td>
</tr>
<tr>
<td>Homework</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

The following table overviews how credit will be assigned. Note that all group work includes a peer review, which can distinguish an individual’s assigned points from the group’s assigned points. (See Self-Managed Teams in the Workload Expectations section.)

**Table 2 Grading standards.**

<table>
<thead>
<tr>
<th>Work quality</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolutely fantastic, walk on water, overflow grade</td>
<td>110</td>
</tr>
<tr>
<td>Excellent answer on all counts</td>
<td>100</td>
</tr>
<tr>
<td>Excellent answer on most counts</td>
<td>90</td>
</tr>
<tr>
<td>Very good answer, but not excellent</td>
<td>80</td>
</tr>
<tr>
<td>Professionally done and adequate</td>
<td>70</td>
</tr>
<tr>
<td>Inadequate, needs work</td>
<td>60</td>
</tr>
<tr>
<td>Varying degrees of inadequacy</td>
<td>0 - 50</td>
</tr>
</tbody>
</table>

The following breakout depicts how grades will be assigned under this system.
### Grade Percentage

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>≥ 97</td>
</tr>
<tr>
<td>A</td>
<td>≥ 90</td>
</tr>
<tr>
<td>A-</td>
<td>≥ 87</td>
</tr>
<tr>
<td>B+</td>
<td>≥ 83</td>
</tr>
<tr>
<td>B</td>
<td>≥ 80</td>
</tr>
<tr>
<td>B-</td>
<td>≥ 77</td>
</tr>
<tr>
<td>C+</td>
<td>≥ 73</td>
</tr>
<tr>
<td>C</td>
<td>≥ 70</td>
</tr>
<tr>
<td>C-</td>
<td>≥ 67</td>
</tr>
<tr>
<td>D</td>
<td>≥ 60</td>
</tr>
<tr>
<td>F</td>
<td>&lt; 60</td>
</tr>
</tbody>
</table>

### In class exercises

Each exercise is intended as a group effort, which illustrates important concepts introduced in the associated readings. More detailed description and associated materials shall be found on the course web site.

- **Deliver** your results to the course web site during class (only).
  - Authors shall receive credit for each in-class exercise.
  - Prominently (at the top) of the delivered document, place the names of authors.
  - Do not include the name of anyone who is absent or did not contribute. Doing so will result in zero credit for all ‘authors’.
  - Late deliverables (after class) shall receive zero credit.

#### 7.1 Demonstration: IPython, Eclipse Python

#### 7.2 Demonstration: Python NumPy

#### 7.3 Demonstration: Python pandas

#### 7.4 Demonstration: Python matplotlib

#### 7.5 Demonstration: Python Advance NumPy, etc.

#### 7.6 Data Mining Headlines

Your group will present a data mining issue that has been in the headlines within the last 10 years (or 20 years if it is still considered a significant case). The goals of the assignment are to:

- Show the relevance of data mining for everyone
- Present data mining course materials in the context of real, ongoing, problems
- Generate discussion about data mining —in particular, tradeoffs, decision-making, and consequences of data mining for organizations and people

In your presentation:

- Show the news article(s), blogs, etc.
• Present a few PowerPoint slides summarizing the articles, the data mining issues, and provide issues and questions for subsequent discussion
• Moderate a brief discussion

Deliver to our web site:
• Your PowerPoint slides
• Any notes that might be relevant to aid further study

8 Homework
See the web site for the most recent and detailed information on these assignments. The following is provided as an introduction to each assignment.

8.1 HW Write a program that draws some sort of face
8.2 HW Extend the simulation program 1
8.3 HW Extend the simulation program 2
8.4 HW Modify the Dice Poker program
8.5 HW Modify the Fibonacci program
8.6 HW Load & Store DB data
8.7 HW Aggregate & histogram data
8.8 HW Rolling correlation of data
8.9 HW Linear regression
8.10 HW Matrix operations

9 Examinations
Online review guides to be updated one-half week prior to the exam.

9.1 Exam 1
See the online exam review for a description.

9.2 Exam 2
Comprehensive! Similar in nature to a certification exam. See the online exam review for a description.

10 How to scan Computing literature

10.1 Software
Install EndNote:
1. Free EndNote @ GSU

10.2 Literature review
Search for peer reviewed articles using keywords:
2. Scan the web
   a. www.google.com

3. Scan the web using scholar search engines
      i. Set the Google Scholar Preferences to
         1. Show library access links for Georgia State University
         2. Show links to import citations into EndNote
   c. http://citeseer.ist.psu.edu/

4. Scan using library databases (@GSU)
   a. http://www.galileo.usg.edu
   b. In particular, the following databases
      i. ABI/INFORM Complete
      ii. ACM Digital Library
      iii. IEEE Xplore

11 Workload Expectations

Students should plan for 2 - 3 hours of work outside of class each week for each course credit hour. Thus, a 3-credit course averages between 6 and 9 hours of student work outside of the classroom, each week. See GSU sites for Academic Success:

- http://www2.gsu.edu/~wwwcam/incept/successtips.html
- http://www2.gsu.edu/~wwwctr/sac/StudySkills.htm

Students must take responsibility for their learning. In contrast to high school, college has fewer opportunities for student teacher interactions. Consequently, students must prepare to gain the most from each interaction.

Self-Managed Teams: Teams will be allowed for some activities during the term. Please note that unless the activity is explicitly identified as a “team activity”, I expect everyone to perform their own work (your hands on the keyboard). For team activities, you will be allowed to work with partners (of your choosing).

- Initial teams must be established by the second week of classes. Established teams may continue working together on subsequent team activities. Team membership may change during the term, if problems arise. However, team members must be designated within one week of the due date for the team activity. Exception: you may withdraw from a team at any time and submit an assignment individually.
- Teams will submit one assignment for all team members. In most cases, each member of the team will get the same score. However, an individual’s score may be reduced at the discretion of the instructor.

Each team assignment must include the following:
- Tasks completed by each member.
- Percentage of the total work completed by each member.

- Any individual with a low team contribution will be removed from their team.

Arbitration: There will be a one-week arbitration period after graded activities are returned. Within that one-week period, you are encouraged to discuss any assumptions and/or misinterpretations that you made on the activity that may have influenced your grade.

Attendance: If you are unable to attend a class session, it is your responsibility to acquire the class notes, assignments, announcements, etc. from a classmate. The instructor will not give private lectures for those that miss class.

Submission of Deliverables: Unless specific, prior approval is obtained, no deliverable will be accepted after the specified due date.

If you have a legitimate personal emergency (e.g., health problem) that may impair your ability to submit a deliverable on time, you must take the initiative to contact the instructor before the due date/time (or as soon after your emergency as possible) to communicate the situation.

Make-up exams will not be given: However, if a student has a planned absence, he or she may take the exam earlier with the permission of the instructor.
12 Student Behavior

Behavior in class should be professional at all times. People must treat each other with dignity and respect in order for scholarship to thrive. Behaviors that are disruptive to learning will not be tolerated and may be referred to the Office of the Dean of Students for disciplinary action.

12.1 Discrimination and harassment

Discrimination and/or harassment will not be tolerated in the classroom. In most cases, discrimination and/or harassment violates Federal and State laws and/or University Policies and Regulations. Intentional discrimination and/or harassment will be referred to the Affirmative Action Office and dealt with in accordance with the appropriate rules and regulations.

Unintentional discrimination and/or harassment is just as damaging to the offended party. But, it usually results from people not understanding the impact of their remarks or actions on others, or insensitivity to the feelings of others. We must all strive to work together to create a positive learning environment. This means that each individual should be sensitive to the feelings of others, and tolerant of the remarks and actions of others. If you find the remarks and actions of another individual to be offensive, please bring it to their attention. If you believe those remarks and actions constitute intentional discrimination and/or harassment, please bring it to my attention.

12.2 Official class policies

1. Prerequisites are strictly enforced. Students failing to complete any of the prerequisites with a grade of “C” or higher will be administratively withdrawn from this course with loss of tuition fees. There are no exceptions, except as granted by the instructor with the approval of the department.

2. Students are expected to attend all classes and group meetings, except when precluded by emergencies, religious holidays, or bona fide extenuating circumstances.

3. Students who, for non-academic reasons beyond their control, are unable to meet the full requirements of the course should notify the instructor, by email, as soon as this is known and prior to the class meeting. Incompletes may be given if a student has ONE AND ONLY ONE outstanding assignment.

4. A “W” grade will be assigned if a student withdraws before mid-semester if (and only if) he/she has maintained a passing grade up to the point of withdrawal. Withdrawals after the mid-semester date will result in a grade of “WF”. See the GSU catalog or registrar’s office for details.

5. Spirited class participation is encouraged and informed discussion in class is expected. This requires completing readings and assignments before class.

6. All exams and individual assignments are to be completed by the student alone with no help from any other person.

7. Collaboration within groups is encouraged for project work. However, collaboration between project groups will be considered cheating.

8. Copying work from the Internet without a proper reference is considered plagiarism and subject to disciplinary action as delineated in the GSU Student Handbook.

9. Any non-authorized collaboration will be considered cheating and the student(s) involved will have an Academic Dishonesty charge completed by the instructor and placed on file in the Dean’s office and the CIS Department. All instructors regardless of the type of assignment will apply this Academic Dishonesty policy equally to all students. Abstracted from GSU’s Student Handbook Student Code of Conduct “Policy on Academic Honesty and Procedures for Resolving Matters of Academic Honesty”

   a. http://www2.gsu.edu/%7Ewwwwdos/codeofconduct_conpol.html

   b. http://www2.gsu.edu/~wwwcam/

As members of the academic community, students are expected to recognize and uphold standards of intellectual and academic integrity. The University assumes as a basic and minimum standard of conduct in academic matters that students be honest and that they submit for credit only the products of their own efforts. Both the ideals of scholarship and the need for fairness require that all dishonest work be rejected as a basis for academic credit. They also require that students refrain from any and all forms of dishonorable or unethical conduct related to their academic work.
Students are expected to discuss with faculty the expectations regarding course assignments and standards of conduct. Here are some examples and definitions that clarify the standards by which academic honesty and academically honorable conduct are judged at GSU.

**Plagiarism.** Plagiarism is presenting another person's work as one's own. Plagiarism includes any paraphrasing or summarizing of the works of another person without acknowledgment, including the submitting of another student's work as one's own. Plagiarism frequently involves a failure to acknowledge in the text, notes, or footnotes the quotation of the paragraphs, sentences, or even a few phrases written or spoken by someone else. The submission of research or completed papers or projects by someone else is plagiarism, as is the unacknowledged use of research sources gathered by someone else when that use is specifically forbidden by the faculty member. Failure to indicate the extent and nature of one's reliance on other sources is also a form of plagiarism. Any work, in whole or part, taken from the Internet or other computer-based resource without properly referencing the source (for example, the URL) is considered plagiarism. A complete reference is required in order that all parties may locate and view the original source. Finally, there may be forms of plagiarism that are unique to an individual discipline or course, examples of which should be provided in advance by the faculty member. The student is responsible for understanding the legitimate use of sources, the appropriate ways of acknowledging academic, scholarly or creative indebtedness, and the consequences of violating this responsibility.

**Cheating on Examinations.** Cheating on examinations involves giving or receiving unauthorized help before, during, or after an examination. Examples of unauthorized help include the use of notes, texts, or “crib sheets” during an examination (unless specifically approved by the faculty member), or sharing information with another student during an examination (unless specifically approved by the faculty member). Other examples include intentionally allowing another student to view one’s own examination and collaboration before or after an examination if such collaboration is specifically forbidden by the faculty member.

**Unauthorized Collaboration.** Submission for academic credit of a work product, or a part thereof, represented as its being one's own effort, which has been developed in substantial collaboration with another person or source or with a computer-based resource is a violation of academic honesty. It is also a violation of academic honesty knowingly to provide such assistance. Collaborative work specifically authorized by a faculty member is allowed.

**Falsification.** It is a violation of academic honesty to misrepresent material or fabricate information in an academic exercise, assignment or proceeding (e.g., false or misleading citation of sources, the falsification of the results of experiments or of computer data, false or misleading information in an academic context in order to gain an unfair advantage).

**Multiple Submissions.** It is a violation of academic honesty to submit substantial portions of the same work for credit more than once without the explicit consent of the faculty member(s) to whom the material is submitted for additional credit. In cases in which there is a natural development of research or knowledge in a sequence of courses, use of prior work may be desirable, even required; however the student is responsible for indicating in writing, as a part of such use, that the current work submitted for credit is cumulative in nature.