Spatial Data Modeling and Design  
University College, U90 422 – Fall 2017

Mondays 5:30 pm - 8:00 pm, Rudolph Hall room 308

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Rudolph Hall room 183a - 314-935-8426  
Office hour: Thursday 2:00 to 3:00 pm and by appointment

Please contact me by email when possible. I will check this regularly throughout the day but am less available after 5 pm and on weekends. Office hour is available for walk-in assistance, other meeting times can be arranged by request.

Course Description

This course expands on the fundamental principles of GIS and applications of geographic information systems (GIS) focusing on spatial database concepts and workflow automation. You should have completed the Introduction to GIS course or have at least 1 year of experience using the ArcGIS software suite; completion of (or concurrent enrollment in) the Advanced GIS course is highly recommended. In addition, you must be familiar with common file management tasks such as file transfer and compression. The course is divided into two parts; the first half explores spatial database design with emphasis on the ESRI Geodatabase (GDB), and the second focusing on automating workflows using ESRI ModelBuilder. Topics include data needs assessment; conceptual modeling, logical design, and physical creation of GDB schema; population of the GDB with basic features and other data; using models to process data, execute complex GP workflows, automate spatial analysis, including iteration and logic. Lectures are supplemented with lab exercises to develop proficiency and problem-solving skills using ArcGIS software and associated tools.

Course Goals

Students who complete this course successfully will:

• Understand ESRI GDB concepts, major GDB components, and management functions.
• Evaluate spatial data requirements and design appropriate GDB to meet needs.
• Create GDB schema and populate with features.
• Create and edit spatial datasets.
• Design, build, and troubleshoot geoprocessing models using ESRI Modelbuilder.
• Solve spatial problems using custom models to execute workflow.

Required Texts, Materials, or Equipment

• David W. Allen – Getting to Know ArcGIS Modelbuilder, 2011. ESRI Press
• Other readings as assigned via Blackboard
• ArcGIS Desktop software (v10.5.1)– students will have access to the GIS Teaching Lab (Rudolph Hall room 308) whenever classes are not meeting. Students are also able to install a fully functional ‘student evaluation copy’ of ArcGIS Desktop on their personal computer with a 365-day license. See the student installation guide on this page for instructions.
Daily Work/Homework
Most class sessions will include a lecture and many will also feature a hands-on lab exercise illustrating some of the concepts discussed in the lecture. In some cases, the class period will not be sufficient to complete the exercise and students will be expected to finish the work on their own. Questions based on some of the exercises will be included in the assigned Problem Sets.

Major Assignments: Descriptions
Problem Set (3) – these feature conceptual questions based on lecture material and practical exercises that require the student to perform GIS functions in order to obtain the answer. Each Problem Set is worth 50 points and students will have 2 weeks to complete each set.

Quiz (2) – The first quiz (50 points) will be a set of questions structured around topics covered in exercises and reading assignments and will be in class with a time limit. Open notes/texts will be allowed. Students will be required to provide written answers or complete a task using the GIS software to arrive at the answer. The second quiz (50 points), called a “3 by 3” will be your opportunity to discuss your plans for the final project. Each student will have 3 minutes to present 3 slides outlining their project idea followed by questions from the class. The 3 slides should address the Project Description, Data Requirements & Sources, and Outline of the expected GIS workflow and deliverables.

Final Project (100 points) – A student selected final project represents the culmination of the course and you must give a presentation and prepare a paper detailing your work. The project should demonstrate your understanding of concepts covered during the semester and show a practical application to a real-world problem. This assignment tests your ability to plan and complete a project; effectively communicate GIS concepts, and workflows; and explain your results both orally and in written form. You may use a scenario/dataset that is of interest or that you may already be researching; subject to my approval. If you have trouble selecting a project, I’ll help you devise one of suitable scope. Each student will present their project to the class on 12/19 then take questions from the group. The paper (10-15 pages maximum; also due on 12/19) should explain your project in sufficient detail that an experienced GIS practitioner could recreate your results. The project must include creation of a GDB and at least 2 models. All datasets in the GDB must include metadata in the “Item Description”. Presentations must include a description of the project purpose and GDB structure, figures showing the geodatabase and models created, and a brief ‘walk-through’ of your models explaining the workflow. The paper should summarize the project and explain what GDB design and Model Builder concepts from this class were applied to complete the project. Full-page figures showing **readable** images of each of your models must be included but will not factor into the page count. These figures should include annotation labels and notes similar to those demonstrated in class examples.

Class Participation
The Class Participation (CP) component of your grade is designed to encourage active participation in class discussions and is unrelated to the formal assignments that require speaking in front of the class. During the semester, there will be opportunities for you to become more comfortable speaking in such a setting and the CP score will be based on your engagement in class discussions; asking questions, answering questions posed, and
providing constructive feedback to your peers. In addition, this course will feature extensive hands-on class exercises; arriving late to class should be avoided as that will have a detrimental effect on your ability to complete the exercises and also will impact your fellow classmates. Late arrivals and unexcused or excessive absence WILL impact CP score.

Course Grading
Problem sets and the first quiz will be graded based on written answers to conceptual questions and results obtained from GIS process-based problems that will require students to perform queries, examine datasets, or conduct an analytical workflow to determine the answer.

The final project presentation and paper will be graded based on the following criteria:

- Introduction/Executive Summary (5%)
- Thoroughness and accuracy of methods description (15%)
- Description and appropriate documentation of geodatabase and models (20%)
- Thoroughness of discussion and results (20%)
- Currency and legitimacy of data sources and references (10%)
- Accurate and appropriate visual presentation of data and maps (10%)
- Presentation organization, delivery, and clarity of content (10%)
- Paper organization, grammar, and clarity (10%)

Summary of Grading System

- Quizzes - 2 (50 pts each) 100 pts
- Problem Sets - 3 (50 pts each) 150 pts
- Project 100 pts
- Class Participation 50 pts
  400 pts total

Grade Distribution

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<tr>
<th>Score</th>
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<tbody>
<tr>
<td>100% - 95%</td>
<td>A</td>
<td>86% - 84%</td>
<td>B</td>
<td>76% - 74%</td>
<td>C</td>
</tr>
<tr>
<td>94% - 90%</td>
<td>A-</td>
<td>83% - 80%</td>
<td>B-</td>
<td>73% - 70%</td>
<td>C-</td>
</tr>
<tr>
<td>89% - 87%</td>
<td>B+</td>
<td>79% - 77%</td>
<td>C+</td>
<td>&lt; 69%</td>
<td>F</td>
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## Schedule of Topics, Readings, and Assignments

<table>
<thead>
<tr>
<th>Date</th>
<th>Topics/Assigned Readings/Homework</th>
<th>Major Assignments and Deadlines</th>
</tr>
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</table>
| 8/29   | **1**  
Topic: GIS Review, Projections, Intro to GDB  
Reading: Zeiler Chapters 1 & 2  
Lab Exercises: Examining GDB structure  
Data modeling for facilities management.  
Homework: Complete WashU schema construction |                                  |
| 9/4    | Labor Day Holiday – no class                                                                     |                                  |
| 9/11   | **2**  
Topic: Working with vector features  
Reading: Zeiler Chapters 3 & 4  
Lab Exercises: Populating the GDB,  
Network Dataset creation  
Homework: PS1, Create Network Dataset Exercise | Problem Set #1                  |
| 9/18   | **3**  
Topic: Creating and editing spatial data  
Reading: Editing in ArcGIS (TBD)  
Lab Exercise: Data creation and editing  
Homework: PS1, Data creation and editing exercise |                                  |
| 9/25   | **4**  
Topic: Raster Datasets and the GDB  
Reading: Zeiler Chapter 7  
Lab Exercises: Importing rasters into the GDB  
Working with satellite imagery  
Homework: none | PS#1 Due                          |
| 10/2   | **5**  
Topic: Surfaces and temporal modeling  
Reading: Zeiler Chapters 8 & 9  
Lab Exercise: Modeling time and enabling time aware layers  
Homework: none | Quiz #1                           |
| 10/9   | **6**  
Topic: Enterprise GDB (guest lecturer – Brad Averbeck)  
Reading: Zeiler Chapter 1 pg. AND Chapter 10  
Lab Exercise: ArcSDE database operations  
Homework: PS2 | Problem Set #2                    |
| 10/16  | Fall break – no class                                                                            |                                  |
| 10/23  | **7**  
Topic: Automating geoprocessing workflows with Modelbuilder  
Reading: Zeiler Chapter 11 AND Allen Chapter 1  
Lab Exercise: Basic model creation  
Homework: PS2, Chapter 1 Exercises |                                  |
<table>
<thead>
<tr>
<th>Date Week</th>
<th>Topics/Assigned Readings/Homework</th>
<th>Major Assignments and Deadlines</th>
</tr>
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<tbody>
<tr>
<td>10/30</td>
<td>Topic: Making models interactive &amp; using variables Reading: Allen Chapter 2 Lab Exercises: Creating versatile models Processing GPS data with Modelbuilder Homework: Chapter 2 Exercises</td>
<td>PS#2 Due</td>
</tr>
<tr>
<td>11/6</td>
<td>Topic: Process control and python scripting in MB Reading: Allen Chapter 3 Lab Exercise: Using logic and flow control in MB Homework: PS3, Chapter 3 Exercises</td>
<td>Problem Set #3</td>
</tr>
<tr>
<td>11/13</td>
<td>Topic: Sharing models and troubleshooting MB Reading: Allen Chapter 4 Lab Exercises: Model sharing Repairing model errors Homework: PS3, Chapter 4 Exercises</td>
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<tr>
<td>11/20</td>
<td>Topic: Advanced modeling techniques: logic &amp; iteration Reading: Allen Chapter 6 Lab Exercises: Making decisions in a model Modeling an active volcano Homework: Chapter 6 Exercises</td>
<td>PS#3 Due</td>
</tr>
<tr>
<td>11/27</td>
<td>Topic: Collaboration and model documentation Reading: Allen Chapter 7 Lab Exercise: Model sharing &amp; documentation Homework: Chapter 7 Exercises</td>
<td>Quiz #2 – “3x3”</td>
</tr>
<tr>
<td>12/4</td>
<td>Topic: Working session for final projects</td>
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<tr>
<td>12/11</td>
<td>Topic: Working session for final projects</td>
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<tr>
<td>12/18</td>
<td>Final Project presentations</td>
<td>Final paper Due</td>
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**Course Policies and Information for Students**

INCLUSIVE LEARNING ENVIRONMENT STATEMENT
The best learning environment—whether in the classroom, studio, laboratory, or fieldwork site—is one in which all members feel respected while being productively challenged. At Washington University in St. Louis, we are dedicated to fostering an inclusive atmosphere, in which all participants can contribute, explore, and challenge their own ideas as well as those of others. Every participant has an active responsibility to foster a climate of
intellectual stimulation, openness, and respect for diverse perspectives, questions, personal backgrounds, abilities, and experiences, although instructors bear primary responsibility for its maintenance.

A range of resources are available to those who perceive a learning environment as lacking inclusivity, as defined in the preceding paragraph. If possible, we encourage students to speak directly with their instructor about any suggestions or concerns they have regarding a particular instructional space or situation. Alternatively, students may bring concerns to another trusted advisor or administrator (such as an academic advisor, mentor, department chair, or dean). All classroom participants—including faculty, staff, and students—who observe a bias incident affecting a student may also file a report (whether personally or anonymously) utilizing the online Bias Report and Support System.

1. ATTENDANCE POLICY
   While attendance is expected at each class session, I understand that this may not always be possible. Absences from class should be prearranged with the instructor when feasible. Making up any missed assignments is the responsibility of the student and must be coordinated with the instructor (see below). Absence from more than one class session will negatively impact your class participation score.

2. PENALTIES FOR LATE WORK and REQUESTS FOR EXTENSIONS
   Problem sets are due 2 weeks after the date of assignment. Submission date and time will be determined by the upload time stamp on Blackboard. Late submissions will accrue a 10-point penalty for each day beyond the assigned due date.

3. POLICIES ON MISSED EXAMS, MAKE-UP EXAMS OR QUizzes
   Students who will miss class on a day when a quiz is assigned are expected to contact the instructor prior to class. You will also need to make arrangements to come to campus and make up the quiz prior to the next scheduled class meeting. The final project must be turned in on the assigned date in order to allow time for grading. If an extension is required, the student should apply for an “Incomplete”.

4. REGRADING POLICY
   Any questions on grading or interpretation should be addressed to the instructor within 24 hours of the return of a graded assignment. Requests for regrading must be submitted in writing with a clear explanation of the issue and a proposed resolution. The instructor will evaluate the request and respond. Please keep in mind that regrade requests may result in the increase or decrease of the assigned grade.

5. REQUESTS FOR INSTRUCTOR FEEDBACK ON DRAFTS AND REQUESTS TO REVISE
   Your final project will be developed and executed over the course of several weeks including 2 full class sessions. All students will have the opportunity to discuss their plans and any complications with the instructor during these sessions. Final papers will not be reviewed prior to submission.

6. TECHNOLOGY POLICIES:
   All class related homework and projects should be completed using ArcGIS Desktop v10.5.1. This application is installed on computers in Rudolph Hall room 308 and also in the GIS Research Studio in Rudolph 183. Any student who wishes to install a copy on their personal laptop can obtain a free “Student
Evaluation Copy” that is fully functional and the same version as the Lab systems. Laptop use during class sessions is discouraged unless you are using your personal laptop for note taking or GIS analysis. Please refrain from checking email or browsing while lectures or class exercises are in progress. **Cell phone use during class is prohibited.**

7. ETHICS/VIOLATIONS OF ACADEMIC INTEGRITY: Ethical behavior is an essential component of learning and scholarship. Students are expected to understand, and adhere to, the University's academic integrity policy: [wustl.edu/policies/undergraduate-academic-integrity.html](http://wustl.edu/policies/undergraduate-academic-integrity.html). Students who violate this policy will be referred to the Academic Integrity Policy Committee. Penalties for violating the policy will be determined by the Academic Integrity Policy committee, and can include failure of the assignment, failure of the course, suspension or expulsion from the University. If you have any doubts about what constitutes a violation of the Academic Integrity policy, or any other issue related to academic integrity, please ask your instructor.

**Resources for Students**

1. DISABILITY RESOURCES: If you have a disability that requires an accommodation, please speak you're your instructor and consult the **Disability Resource Center** at Cornerstone ([cornerstone.wustl.edu/](http://cornerstone.wustl.edu/)). Cornerstone staff will determine appropriate accommodations and will work with your instructor to make sure these are available to you.

2. WRITING ASSISTANCE: For additional help on your writing, consult the expert staff of **The Writing Center** ([writingcenter.wustl.edu](http://writingcenter.wustl.edu)) in Olin Library (first floor). It can be enormously helpful to ask someone outside a course to read your essays and to provide feedback on strength of argument, clarity, organization, etc.

3. THE UNIVERSITY’S PREFERRED NAME POLICY FOR STUDENTS, with additional resources and information, may be found here: [registrar.wustl.edu/student-records/ssn-name-changes/preferred-name-policy/preferred-name-policy-student/](http://registrar.wustl.edu/student-records/ssn-name-changes/preferred-name-policy/preferred-name-policy-student/).

4. SEXUAL ASSAULT: The University is committed to offering reasonable academic accommodations to students who are victims of sexual assault. Students are eligible for accommodation regardless of whether they seek criminal or disciplinary action. Depending on the specific nature of the allegation, such measures may include but are not limited to: implementation of a no-contact order, course/classroom assignment changes, and other academic support services and accommodations. If you need to request such accommodations, please direct your request to Kim Webb ([kim_webb@wustl.edu](mailto:kim_webb@wustl.edu)), Director of the Relationship and Sexual Violence Prevention Center. Ms. Webb is a confidential resource; however, requests for accommodations will be shared with the appropriate University administration and faculty. The University will maintain as confidential any accommodations or protective measures provided to an individual student so long as it does not impair the ability to provide such measures.

SEXUAL ASSAULT REPORTING: If a student comes to me to discuss or disclose an instance of sexual assault, sex discrimination, sexual harassment, dating violence, domestic violence or stalking, or if I otherwise
observe or become aware of such an allegation, I will keep the information as private as I can, but as a faculty member of Washington University, I am required to immediately report it to my Department Chair or Dean or directly to Ms. Jessica Kennedy, the University’s Title IX Director. If you would like to speak with Ms. Kennedy, she can be reached at (314) 935-3118, jw kennedy@wustl.edu, or by visiting her office in the Women’s Building. Additionally, you can report incidents or complaints to Tamara King, Associate Dean for Students and Director of Student Conduct, or by contacting WUPD at (314) 935-5555 or your local law enforcement agency. You can also speak confidentially and learn more about available resources at the Relationship and Sexual Violence Prevention Center by calling (314) 935-8761 or visiting the 4th floor of Seigle Hall.

5. BIAS REPORTING: The University has a process through which students, faculty, staff and community members who have experienced or witnessed incidents of bias, prejudice or discrimination against a student can report their experiences to the University’s Bias Report and Support System (BRSS) team. See: brss.wustl.edu

6. MENTAL HEALTH: Mental Health Services’ professional staff members work with students to resolve personal and interpersonal difficulties, many of which can affect the academic experience. These include conflicts with or worry about friends or family, concerns about eating or drinking patterns, and feelings of anxiety and depression. See: shs.wustl.edu/MentalHealth

Disclaimer

The instructor reserves the right to make modifications to this information throughout the semester.