Course Overview

This course moves beyond basic GIS concepts and procedures to project applications and techniques in individual projects and interest areas. Each student will be required to determine a Geographic Information Systems (GIS) problem and devise an efficient, innovative, and practical solution using advanced techniques in spatial analysis, spatial statistics, and/or cartographic programming with Python. Discussion topics will include professionally relevant issues such as project management, budget and proposal development and customizing GIS with internal and external programming languages.

Course Objectives

By the end of the semester, students should be able to:

- Devise efficient, innovative, and practical solutions to GIS problems.
- Design, manage, and complete a research project that emphasizes GIS.
- Understand and use basic Python coding to customize workflows and tools.
- Effectively combine spatial analysis, spatial statistics or cartographic visualization techniques with internal or external programming.
- Research and discuss professionally relevant issues.

Required Materials

- Assignments and exercises will be available on WMU eLearning (use goWMU)
- Required readings will be available online through eLearning links.
- A USB drive, at least 500mb. Backup this drive regularly, please.

Grading Scale:

Grades will assigned using the following scale:

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<tr>
<th>Grade</th>
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<tr>
<td>A</td>
<td>92 – 100</td>
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<td>BA</td>
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<td>B</td>
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<td>DC</td>
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<td>E</td>
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In-Class: Exercises/Discussions/Participation: 20%
Take Home: Lab Assignments/Readings/Puzzles: 20%
Exams: 20%
Tool Project and Final Project: 40%
It is essential that exams, assignments and discussions MUST BE completed in a timely manner throughout the semester.

- ALL Late assignments will be graded down significantly.
- No make-up work will be accepted two weeks after the due date.
- Students must complete exams and projects to receive a passing grade in the course

**Lecture:** Attendance at lectures is mandatory throughout the semester. The foundation of a seminar course is the discussion among participants. Working groups will be formed, composed by topic of interest, to lend peer review and support individual projects.

**Exercises:** Lab exercises will be completed outside of scheduled class time.

**Assignments:** Students will participate in a variety of assignments including: research driven discussion, involving the critical reading of professional peer-reviewed publications; development of a programming proposal that will result in completed ArcGIS tools that can be shared among the class and beyond at the end of the semester; development of a project proposal that will implement the tool for practical applications using publically available data sources. There will be no make-ups allowed for in-class assignments discussions. If you are absent from class, it is your responsibility to obtain the information you missed. Through the semester project, students will apply skills learned in the lab and lecture concepts to an area of personal interest. Additional information regarding all assignments will be provided as the semester progresses.

**e-Learning:** All assignments and lab exercises will be posted online at eLearning. Relevant course links, grades and other information will also be posted on eLearning. You will be expected to submit all assignments on eLearning unless otherwise indicated.

**Contact:** You are welcome to email, call or drop in during office hours if you have questions or concerns about an assignment or lecture topic. Emails and phone messages will typically be answered within 24 hours (weekdays).

**Integrity:** Directly copying answers from others, or plagiarism of any type is not acceptable. You are responsible for making yourself aware of and understanding the policies and procedures in the Undergraduate and Graduate Catalogs that pertain to Academic Honesty. These policies include cheating, fabrication, falsification and forgery, multiple submission, plagiarism, complicity and computer misuse. [The policies can be found at http://catalog.wmich.edu under Academic Policies, Student Rights and Responsibilities.] If there is reason to believe you have been involved in academic dishonesty, you will be referred to the Office of Student Conduct. You will be given the opportunity to review the charge(s). If you believe you are not responsible, you will have the opportunity for a hearing. You should consult with your instructor if you are uncertain about an issue of academic honesty prior to the submission of an assignment or test.
**TENTATIVE SCHEDULE**

**Week I.  January 9**

**Lecture 1.01  Intro to Python Programming**

**Lecture 1.02  ArcModelbuilder to ArcPy**

(a) **In-Class Assignments**

(i) Intro to Oshtemo Township dataset
(ii) ModelBuilder – Buffer NWI
(iii) Export as Python
(iv) Rerun in Python window of ArcGIS

(b) **Out-of-Class Assignments**

(i) Install: Make Python 2.7.10; IDLE; from Explorer home
(ii) Reading: Do Python Tutorial, Chapters 1-4  
    [https://docs.python.org/2/tutorial/index.html](https://docs.python.org/2/tutorial/index.html)
(iii) Reading: Do Getting Started with ArcPy tutorial  
    Do ‘Introduction’ section
(iv) Problem Solving: Imagine a Python script that creates separate buffers for each of five distance classes from Oshtemo’s wetlands (250m; 500m; 750m; 1000m; 1500m). Without actually doing the coding, think of five different ways to code out the problem.

(v) Project Management: All Grads and ½ Undergrads

Find one active RFP for a contract or grant that the class could feasibly apply. Take a few notes on your process (what you searched, where you searched, the 10 RFPs you looked at before finding one, etc) and put a link to your selected RFP in the eLearning discussion. Print or download for extended discussion in next class.

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**Week II.  January 16 (MLK Day - No Class)**

(a) Follow assignments from Week 1

**Week III.  January 23**

**Lecture 3.01  Loops and Modules**

**Lecture 3.02  RFP Discussion; Midterm Projects**

(a) **In-Class Assignments**

(i) Discussion: Looping the NWI buffer
(ii) Putting loops into action
(iii) RFP: Skills; Knowledge; Timeline; $$
(iv) Answering the CAE questions

(b) **Out-of-Class Assignments**

(i) Reading: Do Getting Started with ArcPy tutorial  
    Do ArcPy functions and ArcPy classes sections
(ii) Reading: Do Python Tutorial, Chapter 5 (Modules)
(iii) Problem Solving: All Grads and ½ Undergrads

Find and download a Python tool that works with ArcGIS 10:4. Run the tool. Identify 5 ways that you can manipulate/modify the Python to customize the tool. Put the Python text in word, and put your modifications as comments (so the original remains intact and I can see where you have identified text to customize).

(iv) Project Management:

1) Decide on a midterm Python tool creation project.
2) Time=money, carefully record how long it takes you to complete (iii).
Week IV. January 30
Lecture 4.01  Modules and Modification
Lecture 4.02  Planning Time and Effort
(a)  In-Class Assignments
   (i) Discussion: Tool modification
   (ii) Python Review
   (iii) Creating budgets for your homework time (above); Importance of specifications
   (iv) More work on the CAE application
   (v) Selection of RFP
(b)  Out-of-Class Assignments
   (i) Reading: Do Python Tutorial, Chapter 7 &8 (In/Output; Errors) https://docs.python.org/2/tutorial/index.html
       Do ArcPy modules. Understand basics of all 4 – select one to study in depth for discussion next week. (Grad-led disc.)
   (iii) Problem Solving: Independent Python puzzles
   (iv) Project Management: Project plan for midterm tools

Week V. February 6
Lecture 5.01  Python Programming Quiz
Lecture 5.02  RFP and Project Discussion/Worktime
(a)  In-Class Assignments
   (i) Python and ArcPy Quiz
   (ii) Python module discussion (by module of interest)
   (iii) Project plan discussion (by interest)
   (iv) RFP: Framing the problem (& Wordle)
(b)  Out-of-Class Assignments
   (i) Reading: Scripting for ArcGIS Chapter 7
   (ii) Problem Solving: Write a script that creates a 1000-meter buffer around features in an Kalamazoo_NWI (National Wetland Inventory) feature class classified as forested and a 2000-meter buffer around features classified as emergent. The results should be two separate feature classes, one for each airport type.
   (iii) Midterm Tool: WORK!
   (iv) Project Management: Progress report (brief) on midterm tools
Week VI. February 13
Lecture 6.01 Progress and Obstacles
Lecture 6.02 Project Worktime
(a) In-Class Assignments
   (i) Review Tool Progress Reports
   (ii) Review Problem Solving assignment
   (iii) ORIBAHA
   (iv) Brainstorming sessions as necessary
(b) Out-of-Class Assignments
   (i) Reading: Scripting for ArcGIS Chapter 8
   (ii) Problem Solving: Write a script that creates an envelope polygon feature class for the Kalamazoo_NWI. There is actually a tool that accomplishes this called Minimum Bounding Geometry. You can look at the tool to get some ideas, but your script needs to work directly with the geometry properties.
   (iii) Midterm Tool: WORK!
   (iv) Project Management: Progress report (brief) on midterm tools

Week VII. February 20
Lecture 7.01 TBA
Lecture 7.02 Project Worktime
(a) In-Class Assignments
   (i) Discussion as necessary
(b) Out-of-Class Assignments
   (i) Midterm Tool: WORK!

Week VIII. February 27
Lecture 8.01 Tool Roundup
Lecture 8.02 Exploring applications and research extensions
(a) In-Class Assignments
   (i) Small group demo and tool trade
   (ii) Constructive criticism
(b) Out-of-Class Assignments
   (i) Video lectures: RapidMiner
   (ii) Problem Solving: Independent Python Puzzles
   (iii) Project Management: Ponder final project directions

Week IX. March 13
Lecture 9.01 Management Forms and Reports
Lecture 9.02 Working groups
(a) In-Class Assignments
   (i) Working groups:
      1) RFP
      2) RapidMiner
      3) Anaconda & PySal
      4) R & Python
      5) etc
(b) Out-of-Class Assignments
   (i) Reading: Project Communication Documents
   (ii) Problem Solving: Case Study Stumpers (grads, ½ underg)
   (iii) Project Management: Working group organization and assignments
   (iv) Finalize final project ideas
Week X. March 20

Lecture 10.01 Project Management: Planning
Lecture 10.02 Project worktime

(a) In-Class Assignments
   (i) Discuss Stumpers
   (ii) Institutional politics and economic justifications
   (iii) Discuss final project plans
   (iv) Working groups

(b) Out-of-Class Assignments
   (i) Reading: Project Management Planning
   (ii) Problem Solving: Case Study Stumpers II (grads, ½ undergrad)
   (iii) Project Management: Working group organization and assignments

Week XI. March 27

Lecture 11.01 Last call: RFP recap and review
Lecture 11.02 Project worktime

(a) In-Class Assignments
   (i) Stumpers II discussion
   (ii) Working groups

(b) Out-of-Class Assignments
   (i) Reading: Thought Leadership and Pulse of Profession

Week XII. April 3 (AAG 5-9)

Lecture 12.01 Thought Leadership Discussion
Lecture 12.02 Project Worktime

(a) In-Class Assignments
   (i) Discuss Thought Leadership
   (ii) Working groups

(b) Out-of-Class Assignments
   (i) Project Management: Final project progress report

Week XIII. April 10

Lecture 13.01 Project worktime

Week XIV. April 17

Lecture 14.01 Project Management Quiz
Lecture 14.02 Project Worktime

Week XV. April 24

Lecture 15.01 Final project presentations – TBA
Possible Tool Project Ideas:

1. **Map the Map Sales:**
   Create a tool that takes a list of maps from a master database, matches them to a geodatabases (attribute join) and maps out the result in a choropleth map. This includes both 1 to 1 joins (for single maps), and 1 to many joins (for map bundles).

2. **Township Conservation Planning:**
   Create a site selection tool that directly combines Michigan geographic framework data with data from National Land Cover Database to automatically create conservation priorities for a township.

3. **Inequality Statistical Tool**
   The Lorenz Curve and associated Gini Coefficient are often used to quantify inequity in a variable across a region using aggregated subregion values. Create a tool that implements Lorenz Curve and Gini Coefficient in ArcGIS using PySAL. Gini already exists in PySAL; the assignment is making an easy to use tool for research use. Input should be dbf or of any aggregation unit (e.g. all block groups in a county), output should be Gini coefficient and csv file for making a graph of the Lorenz curve in any software package with graphing capability (Excel, SPSS).

4. **Fieldwork as Football**
   Use techniques for mapping NFL drive charts for mapping fieldwork patterns from GPS data of researchers in the field. Full examples of football mapping are here: [https://arcpy.wordpress.com](https://arcpy.wordpress.com) – how this might pertain to researchers in the field could be interesting...

5. **NFL-style Coaching of Fieldwork**
   As above, but use techniques for mapping NFL drive charts for mapping survey generated fieldwork routing patterns (drawn with pencil on paper by participants) that have been converted to shapefiles.