

# CEE 5190 / 6190: GIS for Civil Engineers

Spring 2024

Last Updated: 01/01/2024

## Course Description

CRN: 15905 (CEE 5190)

CRN: 15913 (CEE 6190)

Credit Hours: 3

## Class Schedule

Lecture: Monday / Wednesday **3:30 – 4:20 PM** (Different from your course listing!)

Laboratory: Friday 2:30 – 4:20 PM

Class Location: ENGR 307

## Instructors

**Pin Shuai**, Assistant Professor

Department of Civil and Environmental Engineering

Offices: ENGR 215 / UWRL 248

Office Hours: same as lab hour

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## Course Overview and Topics Covered

Many of the problems Civil and Environmental Engineers address have a spatial component. Important tasks include making maps of project sites, manipulating spatial data to support hydrologic modeling activities, mapping and inventory of civil infrastructure, and many others. Geographic Information System (GIS) software has proven to be an important tool for Civil and Environmental Engineers to use in their work. The overall goal of this course is to introduce core concepts of GIS and geospatial analysis, including coordinate systems, spatial data formats, and openly available geospatial data resources. Another goal is to provide hands-on experience with an industry standard GIS to perform practical tasks that include spatial analysis and extending core GIS functionality using scripting. Finally, this class will include a field data collection component to expose students to GIS data creation and Global Positioning Systems (GPS).

## Learning Objectives

Upon successfully completing this course, students will be able to:

1. Use GIS data and software tools to conduct spatial analyses.
2. Locate and obtain geospatial data resources from federal, state, and local data providers.
3. Correctly convert data into a common coordinate system appropriate for a study site and objectives.

4. Work with data in formats common to GIS, including shapefiles, rasters, and geodatabases.
5. Create maps of study sites that would be acceptable for use in engineering reports and academic publications.
6. Apply spatial analysis routines for problems relevant to Civil and Environmental Engineering using vector and raster data.
7. Perform simple editing tasks on vector data to create new feature classes or to modify existing feature classes.
8. Perform queries (both spatial and tabular) using geodatabases and SQL.
9. Create a Python script that automates a complex geoprocessing task not easily accomplished with core GIS software functionality.
10. Collect data using GPS technology for use with GIS.

### **Prerequisites**

#### *Required:*

- Proficiency in Microsoft Excel

#### *Recommended:*

The following skills will be helpful for those attending the class but are not required. This class assumes that there will be a mix of students, some of whom may have some of these skills and others that do not.

- Familiarity with Microsoft Access or other relational database management system.
- Concurrent or prior enrollment in a course on computer programming or databases, computer aided drafting (CAD), hydrologic modeling, GIS in water resources, or related.
- Familiarity with and ability to write simple programs in any programming language such as C, C++, C#, Fortran, Visual Basic, R, Matlab, Python, or Java.

### **Texts**

There is no required textbook. Required readings will be posted on this website or distributed in class.

Some potential references, but not required:

**GIS Fundamentals: A First Text on Geographic Information Systems** (recommended)

Author: Paul Bolstad

Publisher: XanEdu Publishing Inc.

ISBN 978-1-59399-552-2

7th Edition

Available online at: <https://www.gisfundamentals.org/> (also available on Amazon)

### Getting to Know ArcGIS for Desktop

Authors: Michael Law and Amy Collins

Publisher: ESRI Press

ISBN: 978-1589485105

Fifth Edition – Updated for ArcGIS Desktop 10.6

Publication Date: 2018

### Understanding GIS: An ArcGIS Project Workbook

Authors: David Smith, Nathan Strout, Christian Harder, Steven Moore, Tim Ormsby, and Thomas Balstrom

Publisher: ESRI Press

ISBN: 978-1589485266

Fourth Edition

Publication Date: 2018

### GIS Tutorial for ArcGIS Pro 3.1

Authors: Wilpen L. Gorr, Kristen S. Kurland

Website: <https://www.esri.com/en-us/esri-press/browse/gis-tutorial-for-arcgis-pro-3-1>

## **Software**

We will be extensively using ESRI's **ArcGIS Pro** software for this course. It is installed for student use in the 3<sup>rd</sup> floor computer lab in the engineering building. Students may also install the software on their personal computers. Instructions for obtaining the software and license can be found here: [https://usu.service-now.com/aggies?id=kb\\_article\\_view&sysparm\\_article=KB0015353](https://usu.service-now.com/aggies?id=kb_article_view&sysparm_article=KB0015353)

## **Class Lecture Schedule**

The class lecture schedule will be maintained on the course website in Canvas. Please check the course Canvas page regularly for updates to the schedule as it is subject to change. Lecture materials and assigned readings will be posted to the Canvas website.

## **Description of Required Course Work**

### **Assignments**

Students will complete a series of individual assignments. Each assignment will pose a problem related to data access, organization, management, visualization, or transformation and will require use of GIS software tools and/or scripting/automation to solve. The tentative list of

assignments follows, but is subject to change. The official list will be maintained on the Canvas website.

1. Introduction to ArcGIS Pro and Coordinate Systems
2. Vector vs. Raster Data and Geodatabase vs. Shapefile
3. Building a Geodatabase
4. Using Layouts and Creating Maps
5. GPS and GIS
6. Spatial Analysis Using Rasters
7. Terrain Processing Using Rasters
8. ArcToolbox, Model Builder, Automation, and Python Scripting
9. Story Map?

Students will submit assignments electronically as a PDF document via Canvas. Students should also upload any additional files required as part of the assignment to Canvas. Assignments should use the formatting requirements listed in the section on grading below. In general, solutions should include enough of the statement of the problem for us to see which part of the problem you are responding to, your solution, and a description of your methods where required by the assignment. If it is unclear to us which part of the assignment or problem you are responding to, you will likely lose points. All grading will be completed in Canvas.

### **Semester Project**

Part of the course work will involve a semester project. Student groups will choose a civil, environmental, transportation, hydrology, or water resources problem to study for the semester. Topics will be approved by the instructor, and students are encouraged to discuss potential topics with the instructor early in the course. Graduate students will be expected to work with other graduate students, and, likewise, undergraduate students will be expected to work with other undergraduates. Expectations, requirements, and grading for final projects will be different for graduate students versus undergraduates.

Students are strongly encouraged to select a topic that is relevant to their area of professional interest or research, but there must be a clear GIS component to the project. Details of the semester project will be made available via the Course Canvas website. As part of the project, students will identify and obtain the data required to solve the problem and develop appropriate data structures/databases to organize the data. Students will use querying and data transformation activities within an analysis that uses the data. GIS software will be used to develop appropriate visualizations, maps, and results. Students will report on their project and make recommendations based on their results.

**Project Oral Presentation:** Students will be expected to do a final oral presentation in class to report their project results. This will be a **group presentation**.

**Project Final Report:** Students will be expected to complete and submit a final project report that details the application of GIS for the topic they chose. Expectations of the final project report for graduate students will be different than those for undergraduates.

**Class Participation**

I expect students to read assigned readings ahead of time and come to class and share their impressions of the reading(s) or ask questions on points they did not understand. During lectures or discussions, I will ask many questions, and, if needed, I will call on you individually to ensure everyone participates. Additionally, there will be in-class polls, quizzes, or assignments that become part of the class participation.

**Grading of and Expectations for Submitted Work**

**Grading:**

|                     |     |
|---------------------|-----|
| Assignments         | 50% |
| Exam 1              | 15% |
| Semester Project    | 30% |
| Class Participation | 5%  |

I will use a standard grading scale:

| <b>% of Available Points</b> | <b>Grade</b> |
|------------------------------|--------------|
| 100 % to 93 %                | A            |
| < 93 % to 90 %               | A-           |
| < 90 % to 87 %               | B+           |
| < 87 % to 83 %               | B            |
| < 83 % to 80 %               | B-           |
| < 80 % to 77 %               | C+           |
| < 77 % to 73 %               | C            |
| < 73 % to 70 %               | C-           |
| < 70 % to 67 %               | D+           |
| < 67 % to 63 %               | D            |
| < 63 % to 60 %               | D-           |
| < 60 %                       | F            |

All submitted work will be graded for technical correctness, organization, clarity, presentation, and other criteria according to the Grading Rubric available on the class Canvas website for the

item. I will ask to meet with students who submit low quality work to discuss improvement strategies.

Submitted work must be:

- Original, typed, with 1” margins in a standard 12-point font.
- Submitted in PDF format.
- Have a title page with title, student name(s), date, email address(es), class, and instructor.
- Turned in on the due date listed on the Canvas web page.
- Turned in with the Group (and self) Rating Form completed (for group work items).
- For group work, only one Canvas copy need be submitted.

**Midterm Exam:** The midterm exam will be similar in format to the class homework assignments. Students will be asked to use GIS to solve 2-3 problems. Students are expected to work independently. Additional details about exam will be provided in class.

### **Late Assignment and Makeup Work Policy**

Late assignments will be accepted for no penalty if a valid excuse is communicated to the instructor **before the deadline**. After the deadline, assignments will be accepted for a 25% deduction to the score up to 2 days after the deadline. **After this any assignments handed in will be given 0.**

In the case of when a student misses a quiz or an exam, the student must have an official medical, religious, and university excused absence (with adequate documents provided to the instructor) to be allowed to take the test another time. Students should consult Student Code of Conduct for attendance and excused absence.

### **Electronic Policies**

1. Class Canvas Webpage: I will post all class materials to the class webpage in Canvas, including readings, lecture materials, and descriptions of and grading rubrics for all course work.
2. Canvas: Submit electronic versions of all work to Canvas (for grading and archiving purposes).
3. Canvas Discussion: Preferred way for asking questions about lectures, homework, projects, etc. I will get them back to you as soon as I can. Other students are also encouraged to respond if they can.
4. Email (if necessary): **Include “GIS” in the subject line** of all email so that I can respond to emails in a timely way. Unless you request that I don’t, I may forward email questions and answers to the entire class who may be struggling with similar questions/issues. My preference is that you email me directly, but I will also respond through Canvas.

## **Expectations of Students**

- Be on-time to class and ready to learn / participate when class starts.
- Read assigned readings ahead of time and come to class prepared to share your impression(s) of the reading(s) and/or ask questions on points you do not understand.
- Turn off or keep silent all electronic devices that may distract the instructors or other students. I will ask students using phones, etc. to leave class.
- Contribute to class discussions while being respectful of and listening to others' points of view.
- Turn in all work on time in the required format.
- Bring questions and concerns forward during class, office hours, or by email.

## **Expectations of the Instructor**

- Start class on time.
- Respect the value of student's time.
- Call equally on all students for class participation.
- Learn student names.
- Facilitate an environment of inclusivity and non-discrimination.
- Respond to email within 24 hours when I am not traveling out of town.
- Return graded work within 1 week from when work is submitted.

**Please direct further questions or concerns about the syllabus or the course to the instructor by email, in person, or phone.**

## **University Policies**

### **1) Academic Success**

Be aware of the Universities Academic Success Center, which has lots of valuable information on how to maximize your potential as a student. <http://www.usu.edu/asc/>

### **2) Academic Integrity**

The University expects that students and faculty alike maintain the highest standards of academic honesty. For the benefit of students who may not be aware of specific standards of the University concerning academic honesty, the following information is quoted from *The Code of Policies and Procedures for Students at Utah State University* (revised September 2009), Article VI, Section VI-1:

#### **Section VI-1. University Standard: Academic Integrity**

Students have a responsibility to promote academic integrity at the University by not participating in or facilitating others' participation in any act of academic dishonesty and by

reporting all violations or suspected violations of the Academic Integrity Standard to their instructors.

**The Honor Pledge** — To enhance the learning environment at Utah State University and to develop student academic integrity, each student agrees to the following Honor Pledge:

1. **Cheating:** (1) using or attempting to use or providing others with any unauthorized assistance in taking quizzes, tests, examinations, or in any other academic exercise or activity, including working in a group when the instructor has designated that the quiz, test, examination, or any other academic exercise or activity be done “individually”; (2) depending on the aid of sources beyond those authorized by the instructor in writing papers, preparing reports, solving problems, or carrying out other assignments; (3) substituting for another student, or permitting another student to substitute for oneself, in taking an examination or preparing academic work; (4) acquiring tests or other academic material belonging to a faculty member, staff member, or another student without express permission; (5) continuing to write after time has been called on a quiz, test, examination, or any other academic exercise or activity; (6) submitting substantially the same work for credit in more than one class, except with prior approval of the instructor; or (7) engaging in any form of research fraud.
2. **Falsification:** altering or fabricating any information or citation in an academic exercise or activity.
3. **Plagiarism:** representing, by paraphrase or direct quotation, the published or unpublished work of another person as one's own in any academic exercise or activity without full and clear acknowledgment. It also includes using materials prepared by another person or by an agency engaged in the sale of term papers or other academic materials.

## **Section VI-2. Reporting Violations of Academic Integrity**

The online [Academic Integrity Violation Form \(AIVF\)](#) provides guidance to instructors and students, ensures minimum due process requirements are met, and allows tracking of repeat offenders at the University level. The AIVF is available online through the Student Affairs website.

Once an instructor has determined that an academic violation has occurred and that a sanction is appropriate, an AIVF must be submitted prior to application of the sanction. The student may appeal the determination that an academic violation occurred if the AIVF is not filed.

All submitted AIVF forms are kept in the Vice President of Student Affairs Office for the duration of the student’s academic career at Utah State University. When resolution has been reached between the student and instructor, a Resolution Report detailing the action taken and agreement of both parties on that action shall be submitted to the Office of the Vice President of Student Affairs. If no Resolution Report has been filed for a submitted AIVF within the semester, the Campus Student Conduct Officer will investigate to determine if resolution was reached and why no Resolution Report was filed.



### **Section VI-3. Discipline Regarding Academic Integrity Violations**

An instructor has full autonomy to evaluate a student's academic performance in a course. If a student commits an academic violation (Section VI-1, above), the instructor may sanction the student. Application of this sanction must follow Section VI-4 procedural policy. Such sanctions may include: (1) requiring the student to rewrite a paper/assignment or to retake a test/examination; (2) adjusting the student's grade - for either an assignment/test or the course; (3) giving the student a failing grade for the course; or (4) taking actions as appropriate. Additional disciplinary action beyond instructor sanction shall be determined by the Student Conduct Officer and the University.

The complete *Code of Policies and Procedures for Students at Utah State University* can be viewed at: <https://studentconduct.usu.edu/studentcode/>

### **3) Responsibilities of Students**

As members of the academic community at Utah State University, students share responsibility for USU's growth and continued well-being, as well as for maintaining an environment which encourages free inquiry and expression. Students are expected to engage in reasonable and substantial preparation for their coursework, to follow course and class guidelines as set forth in syllabi and as enunciated by their instructors, and to complete all academic exercises with integrity. All interactions with faculty members, staff members, and other students shall be conducted with courtesy, civility, decency, and a concern for personal dignity. These responsibilities are the foundation of the University's Standards of Conduct. The University seeks to vest students with primary oversight of these responsibilities through their participation in hearings boards.

### **4) Rights of Students**

Utah State University is committed to equity in education for its students and that they not be discriminated against/harassed because of race, color, national origin, religion, sex, age, disability, or veteran status. In addition, discrimination on the basis of sexual orientation for employees in all aspects of employment and for students in academic programs and activities is prohibited.

Students can reasonably expect the following:

1. The right to a learning environment free of harassment and unlawful discrimination.
2. The right to due process in all disciplinary proceedings, which means fundamental and procedural fairness in accordance with the provisions of The Code of Policies and Procedures for Students.
3. The right to inquire, including specifically the right to engage in reasonable academic discussion and dissent within the framework of course material, with due regard to factors such as class size and the limits on the instructor's time for conferences.
4. The right, subject to time, place, and manner restrictions, to express personal opinions on campus, to support or oppose causes, to arrange public assemblies, and to hold rallies,

demonstrations, and pickets which do not materially and substantially interfere with normal University activities or the rights of others. Institutional control of facilities shall not be used as a censorship device. Any institutional regulation regarding time, place, and manner of expression must be content-neutral, must be narrowly tailored to serve a significant University interest, and must leave open ample alternative channels of communication.

5. The right to organize and the freedom of association.
6. The right to publish and the freedom from censorship.
7. The right to meaningful representation in the formulation of University policies which affect students.
8. The right to a proper academic evaluation through orderly procedures and announced criteria designed to prevent prejudice and capricious judgment.
9. The right to confidentiality of records and due limitation of disclosure of personally identifiable information.

You can learn about your student rights by visiting: <https://studentconduct.usu.edu/studentcode/>.

### **5) Disability Resource Center**

Students with ADA-documented physical, sensory, emotional or medical impairments may be eligible for reasonable accommodations. Veterans may also be eligible for services. All accommodations are coordinated through the Disability Resource Center (DRC) in Room 101 of the University Inn, (435)797-2444. Please contact the DRC as early in the semester as possible. Alternate format materials (Braille, large print, digital, or audio) are available with advance notice.

### **6) Withdrawal Policy and “I” Grade Policy:**

Students are required to complete all courses for which they are registered by the end of the semester. In some cases, a student may be unable to complete all of the coursework because of extenuating circumstances, but not due to poor performance or to retain financial aid. The term ‘extenuating’ circumstances includes: (1) incapacitating illness which prevents a student from attending classes for a minimum period of two weeks, (2) a death in the immediate family, (3) financial responsibilities requiring a student to alter a work schedule to secure employment, (4) change in work schedule as required by an employer, or (5) other emergencies deemed appropriate by the instructor. An incomplete will not be awarded if the student does not notify the instructor immediately and provide proper documentation.