94802-A

Subject to change

Geographic Information Systems

Spring Semester 2021 94-802A (12 units)

Course details

Mondays, Wednesdays - 8:30 AM - 9:50 AM
CMU REMOTE (REO)

Prerequisite

90-728, Introduction to Database Management Systems, equivalent course, or permission of instructor.

Professor

Chris Goranson (cgoranso@andrew.cmu.edu), Hamburg Hall 2105B, office hours by appointment.

Teaching Assistants (TAs)

Gisselt Gomez (**gegomez@andrew.cmu.edu (mailto:gegomez@andrew.cmu.edu)**)

Office hours to be posted on Canvas.

Course website

https://canvas.cmu.edu/courses/

Course description

A geographic information system (GIS) provides storage, retrieval, and visualization of geographically referenced data as well as design and analysis of spatial information. GIS provides unique analytical tools to investigate spatial relationships, patterns, and processes of cultural, biological, demographic, economic, social, environmental, health care, criminal, and other phenomena.

The course includes lectures, computer labs, and a project using the leading desktop GIS software, ArcGIS Pro, from Esri, Inc. Subject areas will include:

- *Geographic concepts* (world coordinate systems, map scale/projections, sea level/elevation),
- *Government-provided map infrastructure* (TIGER maps, census data, satellite and aerial photo images, local government cadastral maps),
- *Map design* (cartography, interactive maps, map animations, and Web-based GIS),
- *Geodatabases* (importing spatial and attribute data, geocodes, table joins, data aggregation, and map queries),
- *Creation of new spatial data* (digitizing, geocoding, and dissolving vector features),
- *Spatial data processing* (clipping, merging, appending, joining, dissolving),
- *Spatial analysis* (proximity analysis, risk surface, site suitability, spatial data mining),
- Other topics (raster GIS, 3D GIS, network analysis, etc.) as identified in course materials and selected the instructor.

Learning outcomes

1. Develop an understanding of the world's quickly-growing spatial data infrastructure and of how to put it to work for producing location-based information.

2. Identify the relevant spatial characteristics of diverse application areas enabling professionals to integrate spatial thinking and GIS analysis into their careers.

3. Have an ability to use geospatial technologies to gain a significant advantage in the information technology field.

Course materials

** Please note this course uses the latest version of GIS Tutorial for ArcGIS Pro 2.6, published in 2020 **

- Lab book(s): GIS Tutorial for ArcGIS Pro 2.6 by W.L. Gorr & K.S. Kurland, (2020), ISBN: 9781589485891. Text available on Amazon, Barnes & Noble, etc. **https://esripress.esri.com/display/index.cfm?fuseaction=display&websiteID=395&moduleID=0** ↗ **(https://esripress.esri.com/display/index.cfm?fuseaction=display&websiteID=395&moduleID=0)**
- Videos and readings provided on Canvas
- Slides from lectures
- ArcGIS Pro software: available from Heinz Computing Services or via Heinz VMWare
- GIS data available at **https://go.esri.com/GISTforPro2.6Data** ↗ **(https://go.esri.com/GISTforPro2.6Data)**

Downloading and installing the software on your own laptop is highly recommended - **you can**

review the latest system requirements for the software here ↗ **(https://pro.arcgis.com/en/pro-app/latest/get-started/arcgis-pro-system-requirements.htm)** .

If you intend to use a computer other than your own laptop with ArcGIS Pro installed on it (for example - in pre-pandemic times the computers in 2009 HBH) you will need to ensure you have your own flash drive.

There are a number of affordable options for flash drives - as of the writing of this syllabus, 32GB - 256 GB flash drives available for anywhere from about $7 - $30.

Grades

Homework assignments (8 @ 5% each) 40%

Case study 10%

Quizzes (2@ 10% each) 20%

Final project 30%

Class attendance

Students are expected to attend weekly lectures and lab sessions. You should alert me if you will miss a class due to interviews or other approved excuse.

Communication

Clarification and discussion of GIS concepts and procedural knowledge are not limited just to lectures and lab sessions. Also provided are the instructor's office and lab meetings, TA office hours, and a Canvas Discussion Board. Neither the instructor nor the TAs will answer questions through email that would have benefit for the class, but instead will monitor the Canvas Discussion Board and respond to questions.

Policy on collaboration and cheating

I will follow Heinz College policies on ethics and discipline as stated in student handbooks. A specific policy of this course is as follows:

Homework assignments—**Do not copy or modify homework solutions done by others for your homework solutions. Homework must be individual work unless otherwise stated.** You may consult each other on clarification, technical and conceptual issues, but you must do individual problem solving and derive your own solutions, including your own computer work.

You are not permitted to be in possession of *any* assignments from another student or other source either from the current semester or from past semesters whether they are electronic or

paper. Possession of or sharing such files constitutes an infraction of the academic integrity policies of this course.

Plagiarism means using words, ideas, or arguments from another person or source without citation. Cite all sources consulted to any extent (including material from the internet), whether or not assigned and whether or not quoted directly. For quotations, four or more words used in sequence must be set off in quotation marks, with the source identified.

Any form of cheating on a homework assignment or the case study will result in the highest grade possible in the course being a "C" for the first offense and will drop a letter grade for each successive offense. Any form of cheating on the exams or project will result in failing the course. As a matter of Heinz College policy, when you fail a course, the failing grade remains on your transcript permanently and you cannot replace the failing grade by retaking the course.

By remaining enrolled, you consent to this policy.

Late homework policy

GIS assignments build upon each other, so it is important to be up to date on your assignments. **No assignment will be accepted after the due date** unless previously arranged with me due to extraordinary circumstances (for example, illness, out of town).

Re-grading policy

Grade sheets contain solutions as well as feedback and scores for your assignments. If you believe that there was an error in grading an assignment, please contact the TA who graded it to resolve the issue. If you cannot resolve the issue to your satisfaction with the TA, then please send an email message to me with the issue. Please ask for any re-grading of an assignment within one week after it was returned, otherwise the assignment will not be re-graded.

If you believe that there was an error in grading your quiz, please contact me immediately.

University's policy on accommodations

Accommodations, academic adjustments, and auxiliary aids and services (collectively "accommodations") are provided to students with disabilities, as required by the Americans with Disabilities Act (ADA), the Rehabilitation Act of 1973, and other applicable federal, state and local laws. Please refer to CMU's website for information.

Diversity, Equity and Inclusion

We must treat every individual with respect. We are diverse in many ways, and this diversity is fundamental to building and maintaining an equitable and inclusive campus community. Diversity can refer to multiple ways that we identify ourselves, including but not limited to race, color,

national origin, language, sex, disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status, or genetic information. Each of these diverse identities, along with many others not mentioned here, shape the perspectives our students, faculty, and staff bring to our campus.

Each of us is responsible for creating a safer, more inclusive environment. Unfortunately, incidents of bias or discrimination do occur, whether intentional or unintentional. They contribute to creating an unwelcoming environment for individuals and groups at the university. If you experience or observe unfair or hostile treatment, you can take advantage of the following resources:

- **Center for Student Diversity and Inclusion: csdi@andrew.cmu.edu (mailto:csdi@andrew.cmu.edu)** , (412) 268-2150
- **Report-It** ↗ **(http://www.reportit.net/) online anonymous reporting platform: reportit.net** ↗ **(http://www.reportit.net/)** username**:** *tartans* password**:** *plaid*

All reports will be documented and deliberated to determine if there should be any following actions.

Health and wellness

Carnegie Mellon University and I believe in hard work but a balanced lifestyle. Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.

All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support.

Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website at http://www.cmu.edu/counseling/. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

Class Schedule

subject to change

Week 1, Introduction - ch. 1

02/01 and 02/03

Assignment #1, due 11:59 p.m., Sunday 02/07 (See Canvas for assignment details)

- Course overview and policies

- GIS Definition

- Map layers and their properties

- Geospatial data types (vector, raster, networks, 3D)

Video lectures (view on your own)

- ArcGIS Pro Overview

- History of GIS (optional)

02/03 - Lab: (GIS Tutorial for ArcGIS Pro 2.6, Chapter 1)

Week 2, Map design - ch. 2

02/08 and 02/10

Assignment #2, due 11:59 p.m., Sunday 02/14

02/08 – Lecture / Lab (GIS Tutorial for ArcGIS Pro 2.6, Chapter 2)

- Map design principles

- Map types

- Symbolizing maps

- Color (spectrum, hue, color wheel, saturation)

Video lectures

- 2.5 Numeric scales (uniform, clustering, geometric, quantiles)

- 2.6 Feature labels

- 2.7 Additional guidelines

Week 3, Map outputs for GIS projects - ch. 3

02/15 and 02/17

Assignment 3 due 11:59 p.m., Sunday 02/21

02/15 – Lecture

- GIS Projects and traditional outputs

- Map layouts (maps, legend, text, scale bar)

- GIS Outputs

- Story Maps

02/17 – Lab (GIS Tutorial for ArcGIS Pro 2.6, Chapter 3)

Week 4, Geodatabases - ch. 4

02/22 and 02/24

Assignment #4 due 11:59 p.m., Sunday 02/28

02/22 – Lecture

- Modifying tables and attributes

- Table calculations

- Joining tables

- Attribute queries

- Data aggregation with a spatial join

02/24 – Lab (GIS Tutorial for ArcGIS Pro 2.6, Chapter 4)

Week 5, Spatial Data - ch. 5

03/01 and 03/03

No homework to turn in this week, prep for quiz and finish book tutorial.

03/01 – Lecture

- Map projections (small and large scale, conformal versus equivalent projections, spatial reference data)

- Projected coordinate systems (geographic/spherical versus rectangular, spheroids)

- Basemap data sources (physical surface, environmental, political, populations, biology/ecology)

- WGS Web Mercator Pro Demo

- US Census map layers and tabular data

03/03 – Lab (GIS Tutorial for ArcGIS Pro: A Platform Workbook, Chapter 5)

Week 6, Geoprocessing - ch. 6 (Quiz #1 - no in-class lab this week)

03/08 and 03/10

Quiz #1, 03/08

Assignment #6, due 11:59 p.m., Sunday 03/14

03/08 – Lecture

- Attribute proximity selections

- Geoprocessing overview

- Append and merge

- Union and Intersect

- Tabulate intersection

Week 7, Case study

03/15 and 03/17

Case Study, Part I, due 11:59 p.m., Sunday 03/21

Week 8, Case study & Geocoding - ch. 8

03/22 and 03/24

Case Study, Part II, due 11:59 p.m., Sunday 03/28

03/22 – Work on case study & Chapter 8 - Geocoding tutorial

- Get an overview of the geocoding process.

- Geocode using ZIP Codes.

- Geocode addresses using streets.

- Use alias tables for place-name geocoding.

Week 9, Spatial Analysis - ch. 9

03/29 and 03/31

Assignment # 9 due 11:59 p.m., Sunday, 04/04

03/29 - Case Study Presentations

03/31 – Lecture & Lab - Chapter 9

Week 10, Raster GIS - ch. 10

04/05 and 04/07

Assignment # 10 due 11:59 p.m., Sunday, 04/11

04/05 - Recap of Chapter 9 work

04/07 – Lecture & lab - Chapter 10

- Extract and symbolize raster maps

- Create hillshade maps

- Smooth point spatial data with kernel density smoothing

- Build a raster-based risk index

Week 11, New topics, Quiz #2

04/12 and 04/14

04/12- Quiz #2

Assignment # 11 due 11:59 p.m. Sunday, 04/18

Week 12 - Final Project Part I

04/19 and 04/21

Final Project Part I due 11:59 p.m. Sunday 04/25

Week 13 - Final Project Part II

04/26 and 04/28 - work on final projects.

Final Project Part II due 11:59 p.m. Sunday 05/02

Week 14 / 15 - Final Project Part III

05/03 and 05/05 - work on final projects

05/03 – Work on final projects (**soft deadline - GIS project analysis due 11:59 p.m. Monday**)

05/05 – Work on final projects. **Final Project Part III due 11:59 p.m. Wednesday 05/05**