## CRP 4080: Introduction to Geographic Information Systems (GIS)

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|  | **Semester:** |  |  |
|  | **Location:** | Barclay Gibbs Jones Lab, Sibley Hall (3rd floor) |  |
| ­­ | **Day/time:** | Mondays and Wednesdays, 9:05 am – 11:00 am |  |
|  | **Instruction Dates:** | August 30, 2021 - December 6, 2021 |  |
|  | **Instructor**: |  |  |
|  | **Office:** |  |  |
|  | **E-mail:** |  |  |
|  | **Teaching Assistants**: |  |  |
|  | **Credit:** | 4 hours |  |
|  | **Instructor Office Hours:** | Thursdays 10 am - 12 pm (Tentative) or during lab session. |  |
|  | **TA Office Hours** | TBD, Barclay Gibbs Jones Lab |  |

# COURSE DESCRIPTION

This course is designed to provide students with a conceptual understanding of geographic information systems (GIS) and sciences, practical hands-on experience with GIS software, and understanding of how GIS can be applied to planning practice and social science research. Students will be introduced to the basic concepts, structures, and functions of GIS as well as their applications and limitations. Topics include classification and thematic mapping, visualization and map design; querying and editing attribute information; projections, geoprocessing, georeferencing, onscreen digitizing and editing; census data manipulation, data preparation, geocoding and address matching, geodatabases, raster and vector data models, data sources, and more.

While GIS is an essential technical skill for practicing planners, many academics and practitioners have criticized GIS technology because it advances particular ways of representing space while limiting others. More specifically, GIS technology makes it relatively easy to map existing, clean data and makes it relatively difficult to map subjective, perceived space. This feature of GIS means that routine workflows are inherently conservative. To address this limitation, we will briefly explore alternative workflows, new data sources and technologies, and critical GIS literature. Course materials will briefly introduce open data sources and open source software for data collection and mapping.

We will also encounter processes for collecting data from the Internet and explore linkages between Internet data, GIS software, spreadsheets, databases, and Google Earth. Lecture materials

will cover alternative platforms to ArcGIS, including QGIS. During the weekly lab sessions, students will learn the basic functions of ArcGIS (version 10.7.1) software.

**LEARNING GOALS**

• Independently apply appropriate GIS techniques to analyze and think critically about complex urban and regional issues; and use online resources and software documentation to learn new GIS techniques when necessary.

• Create original knowledge regarding urban and regional issues using GIS methodologies.

• Communicate spatial information effectively using maps (visual communication) and connect visual communication to expository writing and argumentation.

• Examine and be able to apply and spatialize basic statistical and qualitative knowledge of urban and regional issues.

• Produce and interpret maps and other forms of spatial information found in professional planning reports, research articles, news media, and public forums.

**COURSE FORMAT**

The class will be conducted as a lecture in conjunction with computer lab sessions. The course format stresses hands-on application and building familiarity with the software through practice. I will spend a portion of the class each week introducing the material, and then we will begin on that week’s lab. Depending on the week, we will spend the other session on in-class lab work, with the lab assignment due the following week. The purpose of the lab session is also to encourage peer teaching, so get to know the people around you. I and several TAs will be present and available during the labs to help with coursework. In addition, I will hold weekly office hours where the PhD TA will be available to help. From time to time, additional material, guest speakers, or in-class demonstrations will take place with advance notice.

Students will have access to the Canvas site as well as the “crp4080” course folder, which you can access on the lab computers by logging in with your Cornell email address and password. Optional readings will be posted on Canvas by weekly subject. Remember, when logging into the course folder in the computer lab that you need to type your entire email address and not just your netid (e.g., abc123@cornell.edu, not abc123). In the course folder, you will access the lab instructions, lab data, and Powerpoint lecture slides for each week. When you start a lab, first copy and paste the data onto your own flash drive. Make sure you have enough space for the output files that you will produce. The recommended readings will be up on Canvas. When you complete a lab, upload it to Canvas.

In order to work on the labs, you will need access to the lab on the 3rd floor of Sibley Hall, which runs ArcGIS version 10.7.1. The Barclay Jones Lab is open from 7:30 a.m. to 3 a.m. except for some holiday breaks. It’s reserved for CRP students after 5 p.m., meaning you need to use your ID card to get in, and if you are not a CRP or URS student, you need someone to let you in. One option, if you run into difficulties, is to use Mann Library, which also has ArcGIS installed, although an older version (currently 10.5). Another option is to get a free, 1-year student license of ArcGIS for your own laptop or desktop PC. For Mac users, it’s a little more complicated because ArcGIS desktop software is designed for Windows OS and you may need to partition your drive or run Parallels in order to use ESRI desktop software. If you want your own student license, go to AAP IT Solutions, located in xxxx, and they will help you get started. If you download ArcGIS to your laptop, you may bring it to the lab to use instead of the desktops.

**Please note:** *As per College policy, the computer lab will be closed during the Thanksgiving break. Please keep this in mind when making plans for completing the labs and working on the final project.*

**Fall 2021 Update:** *This course is scheduled to be conducted in-person and students are expected to comply with all Cornell University COVID-19 policies. Depending on circumstance, this course may be required to transition to online instruction and students will be updated on any course changes. This syllabus will be adjusted accordingly.*

## READINGS (recommended)

**Selections from a few of these will be posted on Canvas to support the lab work each week.**

* Maantay, J. and Ziegler, J. (2006). *GIS for the Urban Environment*, ESRI Press
* Curtin, K. M. (2007). Network Analysis in Geographic Information Science: Review, Assessment, and Projections. *Cartography and Geographic Information Science*, *34*(2), 103–111. <https://doi.org/10.1559/152304007781002163>
* Luo, J., Joshi, D., Yu, J., & Gallagher, A. (2011). Geotagging in multimedia and computer vision—A survey. *Multimedia Tools and Applications*, *51*(1), 187–211. <https://doi.org/10.1007/s11042-010-0623-y>
* Peters, A. H., & MacDonald, H. I. (2004). *Unlocking the census with GIS.* Redlands, Calif.: ESRI Press.
* MacDonald, H. I., & Peters, A. H. (2011). *Urban policy and the census.* Redlands, Calif.: Esri Press.

**Other**

* Harvey, F. (2008) *A primer of GIS: Fundamental geographic and cartographic concepts*, The Guilford Press, London and New York
* Kennedy, M. (2009) *Introducing Geographic Information Systems with ArcGIS: A workbook approach to learning GIS*, Wiley and Sons, 2nd ed.
* Mitchell, A. (2012) *The ESRI Guide to GIS Analysis: Volume 3: Modeling Suitability, Movement, and Interaction*, ESRI Press
* Monmonier, Mark S. *How to Lie with Maps.* Third edition. Chicago: The University of Chicago Press, 2018. (Reserve1)
* Nyerges, T. and Janklowski, P. (2010) *Regional and Urban GIS: A decision support approach*, The Guilford Press
* Ormsby, Tim, et al. Getting to Know ArcGIS Desktop: Basics of ArcView, ArcEditor, and ArcInfo. ESRI Press.
* Peters, A. and MacDonald, H. (2004) *Unlocking the census with GIS* (ESRI Press) Redlands, CA.
* Tufte, Edward R. *The Visual Display of Quantitative Information.* 2nd ed. Cheshire, Conn.: Graphics Press, 2001. (Online)
* Tyner, J. (2010) *Principles of map design*, The Guilford Press, New York and London Wood, D. and Krygier, J. (2005) *Making maps: A visual guide to map design for GIS*, The Guilford Press, London and New York – *an over view of cartographic techniques*
* Zieler, M. (1999) *Modeling our world: The ESRI Guide to Geodatabase design*, ESRI Press
* Longley, P., Goodchild, M., Maguire, D., and Rhind, D. (2010) *Geographic Information Systems and Science*, 3rd Edition (John Wiley & Sons).

# COURSE GRADING

## Labs (60%)

Both the lab as well as the associated data are all located on the course folder, to be accessed through the computer lab. There are 10 scheduled lab assignments. These generally consist of a lab component and a list of homework assignment deliverables, meant to be done on your own. Students should be aware they will probably need to spend time outside of class working on labs and homework assignments. Labs will usually be due the following Monday after they are assigned. Students should upload each completed lab assignment to Canvas via the ‘Assignments’ link. Labs should be saved as a single **Word document** (with any maps embedded as jpegs) as your last name\_lab #.doc. LATE lab assignments will automatically be downgraded unless there is a medical or family emergency:

3% per day late submission will be automatically deducted.

ALL outstanding labs are due, no later than **Wednesday, December 6.** Otherwise, you will receive a 0 for the outstanding lab(s). Try to get your work done on time, noting that TAs are students too and may not have the time to spend during final exam week to comb through and grade late work. In general, students must be respectful of the TAs’ time and only seek assistance outside office hours when necessary.

## Quiz (5%)

An open book/open notes midterm quiz is scheduled for **Wednesday, October 27th**, and will cover the material up until that point. No make-up will be given, except under extraordinary circumstances. The exam is mainly to test your understanding of GIS concepts.

## Final project (20%)

The purpose of the project is to provide additional experience in collecting, processing and/or analyzing spatial data and should focus on a planning analysis/research problem that requires GIS data and spatial analysis. Students may work in teams or individually.

Requirements and guidelines for the final project will be elaborated on further in class. The final project grade will include a presentation component, in which you share your work during the final week of class.

## Attendance/Participation/Effort (15%)

Students are expected to attend each class on Mondays and Wednesdays, and ask questions/engage in discussion as appropriate. However, the ability to research and troubleshoot minor problems is an important skill in using GIS (also much appreciated by the TAs). Interacting with and supporting others is part of the learning process, so please help each other solve problems and feel free to ask TAs for assistance when you get stuck. A sign- in sheet will circulate the room each day to note your attendance. If you risk getting others sick, experience a family or other type of emergency, do not come to class. Your participation grade is not based solely on your attendance. However, if you never come to class, this will affect the participation portion of the grade, and your absence will probably be reflected in the quality of your work in other areas.

**Grading Scale**

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| --- | --- | --- | --- |
| A+ 97-100 | A | 94-96 | A- 90-93 |
| B+ 87-89 | B | 84-86 | B- 80-83 |
| C+ 77-79 | C | 74-76 | C- 70-73 |
| D+ 67-69 |  |  |  |

# ACADEMIC INTEGRITY

Each student in this course is expected to abide by the Cornell University Code of Academic Integrity. Any work submitted by a student in this course for academic credit will be the student’s own work. While helping each other is encouraged, your labs are individual assignments. Direct quotations of other work(s) should be enclosed with quotation marks, with a citation afterward and page number of the work where available. When you rely substantially on another person’s work without quoting from it directly, please use in text citations at the end of an appropriate section. Failure to provide complete and proper citations may constitute plagiarism, which violates the Cornell Code of Academic Integrity. If detected, plagiarism may result in a failing grade for the course.

# STRESS

If you are experiencing personal or academically related stress at any time during the semester, I encourage you to seek support early on. I am available to talk with you if you experience stress related to the class. Additionally, I can assist you in reaching out to any one of a wide range of campus resources, including:

Student Services Office, 255-6376

Cornell Learning Strategies Center at 255-6310, [http://lsc.sas.cornell.edu](http://lsc.sas.cornell.edu/) Gannett Health Services at 255-5155, [www.gannett.cornell.edu](http://www.gannett.cornell.edu/)

Let’s Talk Drop–In Consultation and Support [www.gannett.cornell.edu/Let](http://www.gannett.cornell.edu/Let)’sTalk Peer Support provided by Empathy Assistance and Referral Service at 255-EARS

# CIRCULATING OR SELLING CLASS MATERIALS

All materials of this course are copyrighted and it is prohibited to circulate or sell to commercial vendors the course materials, including syllabus, exams, lecture notes, images, presentations, and student papers. Such unauthorized behavior constitutes academic misconduct. Video and/or audio recording of class lectures and review sessions without my permission in advance is prohibited. If you have an accommodation letter from Student Disability Services or if you are interested in recording for your personal use as a study aid, please make an appointment, to meet in office hours before you record anything.

# RELIGIOUS HOLIDAYS

Cornell University is committed to supporting students who wish to practice their religious beliefs. Students are advised to discuss religious absences with their instructors well in advance of the religious holiday so that arrangements for making up work can be resolved before the absence.

The New York State Legislature (since July 1, 1992) requires all institutions (public and private) of higher education not to discriminate against students for their religious beliefs. Accordingly, the pertinent parts of Sections 3 and 4 of the law state:

“3. It shall be the responsibility of the faculty and of the administrative officials of each institution of higher education to make available to each student who is absent from school, because of his or her religious beliefs, an equivalent opportunity to . . . make up any examination, study or work requirements which he or she may have missed because of such absence on any particular day or days…”

“4. If . . . classes, examinations, study or work requirements are held on Friday after four o’clock post meridian or on Saturday, similar or makeup classes, examinations, study or work requirements shall be made available on other days, where it is possible and practicable to do so.”

A list of religious holidays can be found here:

<https://scl.cornell.edu/religiousholidays>

**ACADEMIC ACCOMMODATIONS**

In compliance with the Cornell University policy and equal access laws, I am available to discuss appropriate academic accommodations that may be required for students with disabilities. Requests for academic accommodations are to be made during the first three week of the semester, except for under unusual circumstances. You can find more information online regarding these resources at <https://sds.cornell.edu/accommodations-services/academic>

We understand that our students represent a rich variety of backgrounds and perspectives. The Department of City and Regional Planning is committed to providing an atmosphere for learning that respects diversity. While working together to build this community we ask all members to:

* share their unique experiences, values, and beliefs.
* be open to the views of others.
* honor the uniqueness of their colleagues.
* appreciate the opportunity that we have to learn from each other in this community.
* value each other’s opinions and communicate in a respectful manner.
* keep confidential discussions that the community has of a personal (or professional) nature.
* use this opportunity together to discuss ways in which we can create an inclusive environment in this course and across the Cornell community

**CLASS SCHEDULE:** This is a tentative schedule, which is subject to revision by the Instructor.

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| **Dates** | **Lecture Topics** | **Lab Assignments** | **Due Dates** | **Recommended Readings** |
| **Intro: GIS Basics, Effective Cartography, and Mapping** | | | | |
| Aug 30 – Sept 1 | Course Introduction, Syllabus, + Introduction to ArcGIS | **Lab #1 Introduction to ArcGIS**   * Adding polygon, polyline, and point * Creating a unique classification * Creating a layout * Adding map elements | Lab #1 due Wednesday, Sep 8 | Maantay & Ziegler, Ch 1 |
| Sep 8 | Visual Communication | **Lecture: Visual Communication, Graphic Representation, and Mapping**  **(No Class on Monday, Sept 6— Labor Day)** |  |  |
| Sep 13 –  Sep 15 | Thematic Mapping | **Lab #2 Thematic Mapping**   * Creating a shapefile * Querying Data * Classification Schemes * Uni- and Multivariate Maps | Lab #2 due Monday, Sep 20 | Maantay & Ziegler, Ch 3; |
| Sep 20 –  Sep 22 | Projections | **Lab #3 Map Projection**   * Understanding Map Projections * Project on the fly * Define a projection * Project Data | Lab #3 due Monday, Sep 27 | Maantay & Ziegler, Ch 2 |
| **Verse: Working with Geospatial Data** | | | | |
| Sep 27 –  Sep 29 | Geoprocessing | **Lab #4 Geoprocessing**   * Dissolve * Clip * Intersection/Union * Buffers * Merge | Lab #4 due Monday, Oct 4 | Maantay & Ziegler, Ch 9 |
| Oct 4 –  Oct 6 | Geocoding | **Lab #5 Geocoding and Address Matching**   * Importing GPS coordinates * Geocoding * Rematching addresses * Google Earth and ArcGIS * Creating a geodatabase | Lab # 5 due Wednesday, Oct 13 | Luo et al. (2011) |
| Oct 13 | Georeferencing | **Lab #6 Georeferencing and On-screen digitizing and editing**   * Georeferencing images and CAD files * Creating and Editing Shapefiles * Creating attribute information * Onscreen digitizing   **(No Class on Monday, Oct 11— Indigenous People’s Day & Fall Break)** | Lab # 6 due Wednesday, Oct 20 | Maantay & Ziegler, pg. 383-392 |
| Oct 18 –  Oct 20 | Manipulating Census Data | **Lab #7 Data Management and Census Data**   * Downloading Data and Boundary Files * Creating and editing features and attributes * Joining and relating tables   Selecting features by Attributes and location | Lab #7 due Monday, Nov 1 | Peters and MacDonald (2004), MacDonald and Peters (2011) |
| **Chorus: Advanced Spatial Analysis using ArcGIS** | | | | |
| Oct 25 –  Oct 27 | Network Analyst | **Lab #8: Network Analyst**   * Shapefile based network * Finding the best route * Finding the closest facilities * Calculating service areas * Origin-Destination cost Matrix Location-Allocation model | Lab #8 due Monday, Nov 15  **Final project proposal due**  **Wednesday Nov 10** | Curtin, K (2007) |
| Nov 1 –  Nov 3 | Raster Analysis | **Lab #9: Raster Data and Suitability Analysis**   * Understanding and working with Raster data * Spatial analyst extension * Reclassification * Weighting factors * Using Model builder | Lab #9 due Monday, Nov 22 |  |
| **Outro: Spatial Analysis beyond ArcGIS** | | | | |
| Nov 8 –  Nov 10 | Scenario Planning | **Lab #10:**  Scenario planning using Geoplanner Case study of alternative scenario development and comparing impacts |  |  |
| Nov 15 –  Nov 17 | Open Source and Online Mapping tools | **Lab #11:**  CartoDB and QGIS |  |  |
| Nov 29 –  Dec 1 | Work Session  In-Class Presentations | **Final Project Work Session**  **In-Class Presentations** |  |  |
| Dec 6 – | In-Class Presentations | **In-Class Presentations** |  |  |

\*\*\*Final Projects due TBD