GEOG 5212 Geospatial Databases for GIS – Spring 2020

Meeting Times:
Lecture/Lab: TR 12:45-2:05pm, Derby Hall 135

Instructor Name and Email: Dr. Emily S. Castellucci, castellucci.5@osu.edu
Office Hours and Location: https://osu.zoom.us/j/5747586898
Information about availability will be posted on the course website.

Teaching Assistant(s):

Name, Email	*Office Hours and Location*
Nicholas Kinyanjui, kinyanjui.3@osu.edu	https://osu.zoom.us/j/2613165901 Information about availability will be posted on the course website.

Course Description: This course focuses on designing, implementing, querying, and managing geospatial databases or persistent data stores where most entities have footprints in geographic space and time. This is critical for designing and implementing GIS for projects and organizations. It is also crucial for moving beyond GIS to the bigger world of geographic information services.

In designing any GIS project, a fundamental decision is how to represent the world of interest in the computer. This is critical since no GIS or spatial analysis tools – no matter how powerful – can extract more information than is designed in the database representation. The growing size of geospatial databases requires these databases to support efficient querying and searching. A well-designed spatial database can also evolve as the questions in the project or organization change over time. A poorly designed spatial database is difficult to rewind and fix.

Understanding spatial database design and management is not only essential for designing and implementing GIS, but also to support a much wider range of geographic information services such as Google Maps and location-based services such as the location apps on your smartphone. This is a much bigger market than the market for professional GIS services.

Database Technologies: The most common spatial database management system (SDBMS) technology is a specialized object-relational database management system (ORDBMS). An ORDBMS supports objects within a relational (table-based) database and its associated query language, Structured Query Language (SQL). An ORDBMS is a SDBMS if it also supports spatial objects through spatial indexing and spatial (geometric) operations.

ORDBMS with spatial objects is the approach used by ESRI's Geodatabase as well as open-source software such as PostGreSQL/PostGIS. It is also supported by other major vendors such as IBM. In this course, we will be working with ESRI's ArcGIS Geodatabase and PostGreSQL/PostGIS. There will be a series of assignments using these technologies. These will be provided via the course website and discussed in class.

Course Learning Objectives:
Upon completion of this course, students should be able to…

- Understand database design with spatial objects.
- Write spatial queries.
- Understand physical data storage and performance tuning.
- Understand spatio-temporal and moving objects data.
- Have practical GIS data skills.

Schedule: You can find the schedule as a Google Doc at this link: Schedule.

Textbook:

- There is no required textbook for this course.
- All readings and resources will be provided on the course website.
    - B: Bolstad, P. (2019). *GIS Fundamentals*, 6th edition.
    - CM: Coronel, C. & Morris, S. (2016). *Database Systems: Design, Implementation, and Management*, 12th edition.
    - EN: Elmasri, R. & Navathe, S. (2016). *Fundamentals of Database Systems*, 7th edition.
    - N: Nasser, H. (2014). *Learning ArcGIS Geodatabases*.
    - OH: Obe, R. & Hsu, L. (2015). *PostGIS in Action,* 2nd edition.
    - R+: Rigaux, P., Scholl, M., & Voisard, A. (2002). *Spatial Databases with Application to GIS*.
    - RG: Ramakrishnan, R. & Gehrke, J. (1999) *Database Management Systems*, 2nd edition.
    - SC: Shekhar, S. & Chawla, S. (2003) *Spatial Databases: A Tour*.
    - WD: Worboys, M. & Duckham, M. (2004) *GIS: A Computing Perspective*, 2nd edition.
    - Z: Zeiler, M. (2010) *Modeling Our World: The ESRI Guide to Geodatabase Concepts*, 2nd edition.

Evaluation:

- Labs: 48%
    - There will be 12 labs, and all labs will be counted toward your final grade in the course. No labs will be dropped.
    - Do not expect to complete all of your lab work during the scheduled lab time. You will need to dedicate time outside of class to completing your labs.
- Exams: 42%
    - There will be 3 exams, and your lowest exam grade will be dropped.
    - Exams will be administered via the course website, and they will be timed, open-note exams that you must complete *individually*.

- Participation/Attendance: 10%
    - Attendance will be taken at all lecture meetings and lab meetings using a sign-in sheet. You must sign the sheet during the scheduled class time to be considered present. Failure to sign the sheet during the scheduled class time is considered an absence.
    - Attendance is worth 10 points in total. You are allowed 1 unexcused absence from lecture and 1 unexcused absence from lab without penalty. After this, every unexcused absence results in a -1 point deduction. No more than 10 points can be lost toward your attendance score.
    - Excused absences may be requested by contacting the instructor/TA. Decisions about excused absence requests are made at the discretion of the instructor/TA. It is highly recommended that documentation in support of the request is provided as soon as possible to expedite the decision-making process.
    - Due to cancellation of all remaining face-to-face class meetings, attendance will only be recorded for grade purposes through Friday, March 6th.
- *Grading Scale* (OSU standard scale):

A	93-100%	B-	80-82%	D+	67-69%
A-	90-92%	C+	77-79%	D	60-66%
B+	87-89%	C	73-76%	E	0-59%
B	83-86%	C-	70-72%		

Note: Your final grade as seen on the course website is rounded to the nearest whole number (e.g. an 89.49 is a B+ but an 89.50 is an A-). No other adjustment or curve will be applied. The letter grade that you see on the course website is what will be submitted to the registrar at the end of the semester.

Policies:

1. *Course correspondence policies.*
    a. Use the proper title when addressing your instructors/TAs. Recommended resource: What should I call my professor? For example: Because Emily S. Castellucci has a Ph.D., it's always Dr. Castellucci, *never* Ms., Mrs., or Miss.
    b. When emailing your instructors/TAs using OSU email, always include the course number and meeting time somewhere in the subject or body of the email. This information will help your instructor/TA respond more quickly.
    c. You are responsible for all announcements, assignments, and other material posted on Carmen. It is highly recommended that you review your Carmen Canvas notification settings each semester to ensure that you are receiving the information that you need to succeed.
    d. If you need help with lab assignments outside of class time, you should post your question(s) to the appropriate discussion on the course website. This is great practice for posting in online forums for assistance when working on projects outside of class. Additionally, using discussion boards for lab questions helps us respond to questions in an efficient manner, so do not send your questions via OSU email or Carmen message, unless it is grade-related.
2. *Late policy*.

a. You can submit assignments up to one week late unless otherwise posted, but the late penalty is 5% (of the total possible score) per day. The late penalty will not reduce grades to below 70% (of the total possible score). Late penalties are managed by the course website and automatically applied.
b. Extensions are NOT typically granted due to getting "stuck," encountering unexpected errors, software crashes, lost work, inability to access the lab classrooms and/or Derby Hall, or other issues related to these. This is because these are realistic issues that you are likely to encounter when performing GIS work outside of this class, and you need to learn how to manage these issues when they arise. However, do keep in touch with your instructor/TA when issues arise so that we can provide support.

3. *Exam policies*.
   a. Make-up exams are allowed, but they may be classified as excused (no penalty) or unexcused (10% penalty), as deemed appropriate by the instructor.
   ~~b. You are expected to arrive to all exams *on time*. If you arrive late, you might not be allowed to begin the exam, as deemed appropriate by the instructor.~~
   ~~c. You are expected to finish all exams *on time*. Exams begin when scheduled class time begins, and exams end when the scheduled class time ends. At the end of the scheduled class time, you are to stop working and turn in your exam. You may not continue working on your exam after the scheduled class time.~~
4. *Disability services policy*. The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.
5. *Academic integrity/misconduct policies*.
   a. It is the responsibility of the Committee on Academic Misconduct (COAM) to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct: http://studentlife.osu.edu/pdfs/csc_12-31-07.pdf.
   b. IMPORTANT: "Warnings" are not given due to an offense being one's first offense, due to ignorance of what constitutes academic misconduct, or due to any other circumstances. *All* instances of suspected misconduct must be reported.

c. For specific academic integrity/misconduct information relevant to this course, see the Academic Integrity Supplement link under Modules > Course Information on the course website.

6. *Other policies.*
    a. If you are ill, please consider the health of your fellow classmates and your instructor/TA when deciding whether or not you should come to class. If you are displaying symptoms indicating that what you have may be contagious (e.g. fever, etc.), please do not come to class. Instead, notify your instructor of your illness and ask how you can make up the missed class.
    b. Practice your professionalism by ensuring that your work is free from spelling and grammatical errors. Such errors may be penalized at the discretion of the instructor/TA.

Student Support Services:

For information about student support services, see the Student Support Services link under Modules > Course Information on the course website.

Technology:

For information about software access, computer access, classroom access, and building access, see the Technology Access link under Modules > Labs on the course website.

Feedback:

If you'd like to make a suggestion for how this course could be improved for future semesters, please submit that suggestion in the Suggestion Box (Google Form). However, please keep in mind that form submissions are not likely to be viewed until after the semester has ended, so if your concern requires a timely response, please email your instructor and/or TA, as appropriate.

Disclaimer:

This course syllabus provides a general plan for the course; deviations may be necessary. Such deviations may be made for individuals or for the entire class, as deemed appropriate by the instructor. Any changes that affect the entire class will be announced by the instructor with as much advance notice as possible.

Schedule (revised)

Wk	Date	Lectures	Readings*	Exams	Labs
11	T 3/24	Lecture 9 - Data Storage and File Structures	EN Chapter 16		
	R 3/26				*Releasing Lab 9*
12	T 3/31	Lecture 10 - Non-Spatial Database Indices	WD pp. 225-229 EN Chapter 17		
	R 4/2				*Releasing Lab 10* **Lab 9 DUE @ 11:59pm**
13	T 4/7	Lecture 11 - Spatial Database Indexes - Part 1	WD pp. 229-239 RG Chapter 26 (pp. 777-786 only) R+ Section 6-6.1 SC Section 4.1.5		
	R 4/9				*Releasing Lab 11* **Lab 10 DUE @ 11:59pm** Lab 9 closes
14	T 4/14	Lecture 12 - Spatial Database Indexes - Part 2	WD pp. 240-258		
	R 4/16				**Lab 11 DUE @ 11:59pm** Lab 10 closes
15	M 4/20			Exam 2 opens (This exam covers Lectures 6-10.)	
	T 4/21	Lecture 13 - Architectures	WD pp. 259-291		
	R 4/23				**Lab 7 DUE @ 11:59pm** **Lab 8 DUE @ 11:59pm** Lab 11 closes
	F 4/24			**Exam 2 DUE @ 11:59pm** *Late submissions NOT accepted.*	

16	M 4/27			Exam 3 opens (This exam covers Lectures 1-10.)	
	T 4/28				
	R 4/30				Lab 7 closes Lab 8 closes
	F 5/1			**Exam 3 DUE @ 11:59pm** *Late submissions NOT accepted.*	

* The assigned reading helps you review the lecture.

Disclaimer: This course schedule provides a general plan for the course; deviations may be necessary. Any changes will be announced by the instructor with as much advance notice as possible.

GEOG 5212 Geospatial Databases for GIS - Spring 2020

Schedule (original)

Key: DARK PURPLE indicates lecture, and LIGHT PURPLE indicates lab.
Remember: *Lab sections always meet, regardless of what is taking place during lecture.*

Date	Lecture	Reading*	Notes
Section 1: Introduction to Spatial Databases			
T 1/7	Course Overview Lecture 1 - Databases	CM Chapters 1 & 2 WD pp. 1-43	
R 1/9	Lab 1	Z Chapter 1	
T 1/14	Lecture 2 - Spatial Databases	SC Chapter 1	
R 1/16	Lab 2		**Lab 1 DUE @ 11:59pm**
F 1/17	**Self Introduction and Syllabus Quiz DUE @ 11:59pm**		
Section 2: Designing Spatial Databases			
T 1/21	Lecture 3 - Conceptual Data Modeling	CM Sections 9.3-9.4, 3.1-3.2, 3.6, 3.9, 4.1-4.2 WD pp. 43-45,55-65 SC Section 2.2	
R 1/23	Lab 3		**Lab 2 DUE @ 11:59pm**
T 1/28	Lecture 4 - Logical Data Modeling and Normalization	WD pp. 66-71 CM Sections 6.1-6.3, 6.6-6.9 B pp. 358-365	
R 1/30	Lab 4		**Lab 3 DUE @ 11:59pm**
T 2/4	Lecture 5 - Object-Orientation	CM Appendix G pp. 1-18, 28-34, 41-46 CM Appendix H WD pp. 71-80 SC Sections 2-3.2-4	
R 2/6	Lab 5		**Lab 4 DUE @ 11:59pm**

T 2/11	Lecture 6 - Spatial Fields and Spatial Objects	WD pp. 133-165	
R 2/13	Lab 6		**Lab 5 DUE @ 11:59pm**
T 2/18	**Exam 1** (This exam covers Lectures 1-6.)		
R 2/20	Lab 7		**Lab 6 DUE @ 11:59pm**
Section 3: Querying Spatial Databases			
T 2/25	Lecture 7 - Querying and Relational Algebra	B pp. 340-343 RG Chapter 4 (pp. 91-100 only)	
R 2/27	Lab 8		**Lab 7 DUE @ 11:59pm**
T 3/3	Lecture8 - SQL and Spatial Querying	CM Chapter 7 RG Chapter 5 (pp. 121-150 only) SC Chapter 3	
R 3/5	Lab 9		**Lab 8 DUE @ 11:59pm**
Section 4: Spatial Data Storage and Access			
T 3/17	Lecture 9 - Data Storage and File Structures	EN Chapter 16	
R 3/19	Lab 10		**Lab 9 DUE @ 11:59pm**
T 3/24	Lecture 10 - Non-Spatial Database Indices	WD pp. 225-229 EN Chapter 17	
R 3/26	Lab 11		**Lab 10 DUE @ 11:59pm**
T 3/31	Lecture 11 - Spatial Database Indexes - Part 1	WD pp. 229-239 RG Chapter 26 (pp. 777-786 only) R+ Section 6-6.1 SC Section 4.1.5	
R 4/2	Lab 12		**Lab 11 DUE @ 11:59pm**

T 4/7	Lecture 12 - Spatial Database Indexes - Part 2	WD pp. 240-258	
R 4/9			**Lab 12 DUE @ 11:59pm**
T 4/14	**Exam 2** (This exam covers Lectures 7-12.)		
Section 5: Architectures			
R 4/16	Lecture 13 - Architectures	WD pp. 259-291	**Final Deadline: Late Submissions DUE @ 11:59pm**
R 4/23	**Exam 3** (This exam covers Lectures 1-13.) The exam will be **2:00pm - 3:45pm** in our normal classroom.		

* The assigned reading helps you review the lecture.

Disclaimer: This course schedule provides a general plan for the course; deviations may be necessary. Any changes will be announced by the instructor with as much advance notice as possible.