

GEOG 5212 Geospatial Databases for GIS - Spring 2018

Instructor	Prof. Harvey J. Miller
Lecture/lab meeting time and location	Tuesdays Thursday 11:10AM - 12:30PM Derby Hall 0135
Office hours and location	Tuesdays, Thursday 9:30AM – 10:50AM, or by appointment, Derby 1176
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Course prerequisites

CSE 1114 Introduction to Databases Using MS Access
GEOG 5210 Fundamentals of GIS

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 this technology. These will be provided via Carmen and discussed in class.

Learning objectives

After successful completion of this course, you should:

1. Understand the geospatial database design with spatial objects;
2. Be able to write spatial queries;
3. Understand physical data storage and performance tuning;
4. Have practical data modeling and GIS database skills

Textbook

None. All readings and resources will be provided at the course website

Readings:

- **B:** Bolstad, P. (2016). *GIS Fundamentals*, 5th 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

- **Examinations:** 50%
 - There will be two exams, consisting of multiple choice, matching, true/false, and other questions, which will be administered via the course website. You must be present in class on the day of the exam to take the exam. See other exam policies below.
 - Exam questions and answers will not be available to you after you complete the exam. If you wish to review your exam, you will need to schedule a meeting with your instructor.
- **Labs:** 50%
 - The labs will involve the process of designing, building, and querying a spatial database.
 - You will have one week to complete each lab, unless otherwise noted. Labs will be due at the beginning of class on the due date
 - Do not expect to complete all of your lab work during the scheduled lab time. You may need to dedicate time outside of class to completing your labs.
- **Grading scale:** (OSU standard scale)

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

Attendance and engagement

We expect attendance in class and engagement with the material at the Carmen site. We will take attendance during the first week of the semester and periodically at random, unannounced dates during the semester. We will not use your attendance record directly to determine your grade for the course. We will use your attendance record along with the record of your engagement with the Carmen site (how much time spent on Carmen, what you accessed, etc) to determine if you deserve a bump to a higher grade if you are on the border when the final grades are calculated. If your attendance and Carmen engagement records indicate good effort, you are more likely to get a bump to the higher grade. If not, your final grade as calculated will stand regardless of how close you are to the next highest grade. The instructor's decision in this matter is final.

Course Policies

Disability services. Students with disabilities that have been certified by OSU Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. OSU Disability Services is located in 098 Baker Hall, 113 W. 12th Ave. Telephone: 614-292-3307. FAX: 614-292-4190. VRS: 614-429-1334. Website: <http://slds.osu.edu/>

Academic misconduct. There is a zero tolerance policy for academic misconduct in this class. The university's Code of Student Conduct defines academic misconduct as "any activity that tends to compromise the academic integrity of the University, or subvert the educational process." This encompasses a wide scope of student behaviors which include, but are not limited to, the following:

- Violation of course rules
- Knowingly providing or receiving information during a course exam or program assignment
- Possession and/or use of unauthorized materials during a course exam or program assignment
- Knowingly providing or using assistance in the laboratory, on field work, or on a course assignment, unless such assistance has been authorized specifically by the course instructor or, where appropriate, a project/research supervisor
- Submission of work not performed in a course: This includes (but is not limited to) instances where a student fabricates and/or falsifies data or information for a laboratory experiment or other academic assignment. It also includes instances where a student submits data or information (such as a lab report or term paper) from one course to satisfy the requirements of another course, unless submission of such work is permitted by the instructor of the course or supervisor of the research for which the work is being submitted
- Submitting plagiarized work for a course/program assignment
- Serving as or asking another student to serve as a substitute (a "ringer") while taking an exam
- Alteration of grades in an effort to change earned credit or a grade

Without exception, all allegations of academic misconduct will be referred to the OSU Committee on Academic Misconduct (COAM) for investigation and possible penalties.

If you witness or are otherwise aware of academic misconduct in this class you are obliged to report it according to the Code of Student Conduct - as well as your honor as a Buckeye. Report these allegations to the instructor, GTA or directly to COAM.

For more information on academic misconduct, and a link to report allegations, see: <https://oaa.osu.edu/academic-integrity-and-misconduct>

Email correspondence. You are responsible for all course related emails, so be sure to check your email frequently (i.e. daily on weekdays). When emailing your instructor, always include the course number (e.g. 5212, etc.) somewhere in the subject or body of the email

Course website. You are responsible for all announcements, additional reading, assignments and other material posted at the Canvas site, so be sure to check it frequently (i.e. daily on weekdays).
Note:

- You may find that it helps to update your notifications. You can do this by going to Account > Notifications. There are four notification options, and I suggest that you turn on “Notify me right away” or at least “Send daily summary” for everything until you figure out which notifications are most beneficial to you.
- There is a Canvas app available for iPhone and Android, which you may find beneficial for keeping up with the course website.

Lab questions/discussions. On the course website, there will be a discussion for each lab. If you have questions about labs outside of the scheduled lab time, you are required to use the appropriate discussion to post your questions. Your instructor and TA will be notified of your post and will respond as soon as possible. Please do NOT email your lab-related question to your instructor or TA, unless it is a grade-related question.

Assignments and labs. Labs will be accepted up to *three business days* after the due date, subject to a 10% reduction for each business day late. The first business day begins at the due date and time. *Late labs will not be accepted after three business days.* All course assignments, other than labs, will not be accepted late.

Examinations. *Exams must be taken at the scheduled time, unless you have a documented, valid reason that has been approved by the instructor prior to the exam.* Valid reasons for missing the regularly scheduled exam include, but are not limited to, official OSU business, medical conditions or other serious circumstances. Unacceptable reasons for missing a regularly scheduled exam include, but are not limited to, having to work, already-purchased plane tickets or confusion about the time or place of the exam. The only exceptions to this policy are emergency situations. “Emergency” is meant to be taken literally: this must be an unavoidable, unforeseen situation that prevents you from participating in the examination. The instructor’s decision about the validity of your reason for not taking an exam at the scheduled time is final.

You are expected to arrive to all exams *on time*. Students who arrive late to the exam will be permitted to begin the exam until the first student leaves. After a student completes the exam and leaves, students who arrive late will not be permitted to begin the exam, will be asked to leave, and will be considered absent.

You are expected to finish all exams *on time*. Exams begin when schedule 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.

Classroom and Computers

You must swipe your BuckID to access the classroom in Derby 0135. (Note: The card scanners are sometimes unreliable. You may need to swipe more than once, and you may need to wait a second or two after swiping to open the door, giving the scanner a chance to unlock the door. If you continue to have problems, please notify the office staff in Derby 1036.)

To access the computers in Derby 0135 and 0140, you may use the following login information:

- Username: G5212
- Password: Geog-5212SP18

To access the internet, you need to visit the following website and login:

<https://nauth1.auth.infosec.ohio-state.edu>

If you need to return to the computer lab outside of class time, please be aware that the building is usually locked at night, over weekends, and on holidays, so be sure to plan accordingly. When you do return to the computer lab outside of class time, there may be a class in session. Please attempt to avoid interrupting classes that are in session, and if there *is* a class in session, check the computer lab across the hall in Derby 140. It has the same software as Derby 135, and it is usually available.

Software. You are NOT required to download the software we will be using in the course onto your own computer. However, information on obtaining ArcGIS is provided here:

ArcGIS. You may request a 1-year student trial license from your TA. Just email your TA, and your TA will send you an activation code. You will then need to activate the code and download the software here: http://www.esri.com/software/landing_pages/arcgis/desktop-ed. (If you want your version to match the version used on the lab computers this semester, you'll want to choose 10.4.1.)

If you choose to go this route, there is a detailed document regarding the entire process of downloading and installing ArcGIS and authorizing it using an authorization code available on the course website, entitled [ESRI installation tips.pdf](#). If your installation-related questions are not answered by this document, you will need to contact ESRI Customer Support at 1 (888) 377-4575.

Please note that ArcGIS for Desktop is NOT certified or supported on the Mac operating system. However, if you have an Apple computer running Windows, you can install ArcGIS for Desktop using VMWare, BootCamp, or Parallels. To learn more, please visit this link: <http://edcommunity.esri.com/software-and-data/mac-os-support>.

Other software. If you choose to install PostgreSQL, pgAdmin or other software that we are using in this course onto your personal machine, your instructor and TA are NOT responsible for answering your installation-related questions. You will need to troubleshoot such issues yourself.

Disclaimer: This course syllabus 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 Spring 2018 Schedule

Date	Lecture	Reading	Notes
Section 1: Introduction to Spatial Databases			
Tue 1/9	Lab 1 <i>Learning ArcGIS Geodatabases</i> - Chapter 1 <i>Learning ArcGIS Geodatabases</i> - Chapter 2	Z Chapter 1	
Thu 1/11	Lecture: Databases	CM Chapters 1 & 2 WD pp. 1-43	
Tue 1/16	Lab 2 <i>PostGIS in Action</i> - Chapter 1		Lab 1 DUE
Thu 1/18	Lecture: Spatial Databases	SC Chapter 1	Syllabus Quiz DUE
Section 2: Designing Spatial Databases			
Tue 1/23	Lecture: 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	
Thu 1/25	Lab 3 Cottonwood Heights Database - Phase 1 <i>Learning ArcGIS Geodatabases</i> - Chapter 3		Lab 2 DUE
Tue 1/30	Lecture: Logical Data Modeling and Normalization	WD pp. 66-71 CM Sections 6.1-6.3, 6.6-6.9 B pp. 357-364	
Thu 2/1	Lab 4 Cottonwood Heights Database - Phase 2 <i>PostGIS in Action</i> - Chapter 2 (first half)		Lab 3 DUE
Tue 2/6	Lecture: 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	

Thu 2/8	Lab 5 Cottonwood Heights Database - Phase 3 <i>PostGIS in Action</i> - Chapter 2 (second half)		Lab 4 DUE
Tue 2/13	Lecture: Spatial Fields and Spatial Objects	WD pp. 133-165	
Thu 2/15	Lab 6 Cottonwood Heights Database - Phase 4 <i>PostGIS in Action</i> - Chapter 3 (first half)		Lab 5 DUE
Tue 2/20	Exam 1		
Thu 2/22	Lab 7 Cottonwood Heights Database - Phase 5 <i>PostGIS in Action</i> - Chapter 5 <i>PostGIS in Action</i> - Chapter 3 (second half)		Lab 6 DUE
Section 3: Querying Spatial Databases			
Tue 2/27	Lecture: Querying and Relational Algebra	B pp. 340-343 RG Chapter 4 (pp. 91-100 only)	
Thu 3/1	Lecture: SQL and Spatial Querying	CM Chapter 7 RG Chapter 5 (pp. 121-150 only) SC Chapter 3	
Tue 3/6	Lab 8 Cottonwood Heights Database - Phase 6 <i>PostGIS in Action</i> - Chapter 6 (first half)		Lab 7 DUE
Thu 3/8	Lecture: Data Storage and File Structures	EN Chapter 16	
Tue 3/13	No class – Spring Break		
Thu 3/15	No class – Spring Break		
Section 4: Spatial Data Storage and Access			
Tue 3/20	Lab 9 Cottonwood Heights Database - Phase 7 <i>PostGIS in Action</i> - Chapter 6 (second half)		Lab 8 DUE
Thu 3/22	Lecture: Non-Spatial Database Indices	WD pp. 225-229	

		EN Chapter 17	
Tue 3/27	Lab 10 <i>PostGIS in Action</i> - Chapter 9		Lab 9 DUE
Thu 3/29	Lecture: Spatial Database Indices 1	WD pp. 229-239 RG Chapter 26 (pp. 777-786 only) R+ Section 6-6.1 SC Section 4.1.5	
Tue 4/3	Lab 11 <i>PostGIS in Action</i> - Chapter 10 <i>Learning ArcGIS Geodatabases</i> - Chapter 4		Lab 10 DUE
Thu 4/5	Lecture: Spatial Database Indices 2	WD pp. 240-258	
Tue 4/10	No class – AAG annual meeting		
Thu 4/12	No class - AAG annual meeting		
Tue 4/17	Lab 12 <i>PostGIS in Action</i> - Chapter 11		Lab 11 DUE
Thu 4/19	Review session/lab time		
Tue 4/24	No class. (Last day of scheduled classes is 4/23)		Lab 12 DUE
Monday 4/30	Exam 2 10:00 – 11:45am Derby 135		