1. Description
GIS (Geographic Information Science or Geographic Information Systems) refers to a set of theories, methodologies, and computer-based technologies that deal with geographic information. GIS has been widely used in many domains including geography, geology, ecology, sociology, urban planning, engineering, business, health studies, public administration, and others. Geography 58 is an ice-breaking course into the basic theories and technologies of GIS. Emphasis will be placed on the nature of geographic information, spatial data models and structures, data input and editing, spatial query and analysis, computerized cartographic output and presentation, and error analysis.

The course consists of two components: the lectures and the labs. In the lectures, the conceptual elements of the above topics are explained. In the labs, you will gain hands-on experience in data input, data management, data analyses, and result presentation in a geographical information system. You will use the knowledge and skills you learn in the lectures and labs to complete a small project of which the topic is chosen by yourself.

2. Objectives
After taking this class, you should have acquired solid comprehension of basic structures, concepts, and theories of GIS; should be capable of designing and performing basic GIS operations for your own study or work; and should feel prepared when you take more advanced GIS application and technical classes.

3. Prerequisites
Introductory courses in geography, earth science, or environment science. The students should have basic computer operating skills.
4. Computing Environment and Software
ESRI's ArcGIS will be used for lab exercises.

5. Grading
5.1 Components
   - Lab Exercises ........ 40%
   - Term Project ........ 10%
   - Midterm Exam .......... 20%
   - Final Exam ............ 25%
   - Class Attendance ....... 5%

5.2 Due date and time
Each of the lab assignments has a due date clearly written under the title of the assignment. The due
time is the beginning of the lab session on the due day. Any assignment that is turned in after the due
time on the due day is considered late. Late assignments will receive penalty.

5.3 Penalty for late assignments
The penalty for a late assignment is based on the number of days late (including weekends). If an
assignment is late less than 24 hours, it is considered 1 day late. If an assignment is late less than 48
hours but more than 24 hours, it is considered 2 days late, and so on. **Late assignments are penalized 10% of the original score per day.**

The minimum value of Points_get is 0. Assignments handed in after the co-instructor has returned the
graded assignment to class (usually a week after the due date) will receive **no points.**

6. Other Important Issues
- Ample time will be given to complete each assignment. There is no reason for the co-instructor to
  be told that the computer is down or the software is not working a day before the assignment is
due. This will **NOT** be taken as an excuse for a late assignment!
- If sickness is used as an excuse for turning in an assignment later or missing an examination, a
  written report from a medical doctor stating your inability to attend class and/or to complete an
  assignment is required.
- Discussions about the lecture and lab materials are highly encouraged. HOWEVER, copying
  other people’s assignments, including created database, analysis results, and answers to the
  exercise questions, is considered violating the Dartmouth Standards of Conduct and Academic
  Regulations.
- Students with disabilities and need special accommodations are welcome to discuss the condition
  with the instructor so that appropriate arrangements can be made. However, the instructor should
  be notified about the situation by the end of the second week of the quarter. All the discussions
  will remain confidential, although the Student Disabilities Coordinator may be consulted to verify
  the documentation of the disability.

7. Course Materials
   Text:
References:


8. Intended Schedule

1st Week
Lecture 1. Introduction (I) (September 24)
- Topic
  - Introduction to Geog 58
  - Get a general feeling about GIS and its applications
  - The nature of geographic information
- Reading:
  - Preface, Ch. 1, Ch. 2, and Ch. 5 in textbook
  - Ch. 1 in Burrough 1998
  - Ch. 1 in Bernhardsen 1999

Lecture 2. Introduction (II) (September 26)
- Topic
  - What is GIS
  - GIS and other computer systems
- Reading:
  - pp. 1 – 47 in Longley et al. 1999 (the “big book”)

No lab this week
2\textsuperscript{nd} Week

\textbf{Lecture 3. Data Representation (I) (September 29)}
- Topic:
  - Attribute information
- Reading:
  - Ch. 3, 3.1-3.4 in textbook
  - pp. 35-39 in Burrough 1998
  - pp. 61 – 70 in Longley et al. 1999 (the “big book”)

\textbf{Lecture 4. Data Representation (II) (October 1)}
- Topic:
  - Spatial Information
- Reading:
  - Ch. 4 in textbook
  - Ch. 2 in Burrough 1998
  - Ch. 2 in Clarke 2003

\textbf{Lecture 5. Data Representation (III) (October 3)}
- Topic:
  - Spatial Data Models: Vector Data Model (I)
- Reading:
  - Ch. 3, 3.5 in textbook
  - Ch. 3 in Burrough 1998

\textbf{Lab 1. Digitizing a landuse map}

3\textsuperscript{rd} Week

\textbf{Lecture 6. Data Representation (IV) (October 6)}
- Topic:
  - Spatial Data Models: Vector Data Model (II)
- Reading:
  - pp. 71 – 80 in Longley et al. 1999 (the “big book”)

\textbf{Lecture 7. Data Representation (V) (October 8)}
- Topic:
  - Spatial Data Models: Raster Data Models (I)
- Reading:
  - Ch.3, 3.6 in textbook
  - 3.1-3.4 in Clarke 2003

\textbf{Lecture 8. Data Representation (VI) (October 10)}
- Topic:
  - Spatial Data Models: Raster Data Models (II)
- Reading:
  - pp. 209 in textbook
  - pp. 52-57 in Burrough 1998
  - 4.3.3, 4.3.4 in Bernhardsen, 1999
Lab 1. Digitizing a landuse map (cont.)

4th Week
Lecture 9. Data Representation (VII) (October 13)
- Topic:
  - Spatial Data Models: TIN
- Reading:
  - Ch. 3, 9.2.3.4 in textbook
  - pp. 64-72 in Burrough 1998
  - pp. 373 – 384 in Longley et al. 1999 (the “big book”)

Lecture 10. Data Representation (VIII) (October 15)
- Topic:
  - Summary of Spatial Data Models
- Reading:
  - Ch. 9 in textbook

Lecture 11. GIS Database Creation and Maintenance (I) (October 17)
- Topic:
  - Linking attribute data with spatial data
- Reading:
  - Ch. 11, 11.1-11.5 in textbook
  - Chapter 4 in Bernhardsen's, 1999, pp. 78-84

Lab 2. Associate attribute data with spatial data (Lab 1 due)

5th Week
Lecture 12. GIS Database Creation and Maintenance (II) (October 20)
- Topic:
  - Coordinate Transformation
  - Topology
- Reading:
  - pp. 103-109 in Bonham-Carter 1994 (coordinate transformation)
  - 3.4 in Clarke 2003 (topology)
  - pp. 81 – 89 in Longley et al. 1999 (the “big book”)

Lecture 13. GIS Database Creation and Maintenance (III) (October 22)
- Topic:
  - Accuracy of Spatial Databases
- Reading:
  - Ch. 6 in textbook
  - Ch. 9 and Ch. 10 in Burrough 1998
  - pp. 175 – 189 in Longley et al. 1999 (the “big book”)

Lecture 14. GIS Database Creation and Maintenance (IV) (October 24)
- Topic:
  - Metadata
  - Data standards
  - Database creation guidelines
- Reading:
  - Ch. 7 in textbook
  - Ch. 10 and 11.6-11.10 in Textbook
  - pp. 84-92 in Burrough 1998
  - pp. 677 – 706 in Longley et al. 1999 (the “big book”)

Lab 3. Integrating Multiple Data Layers (Lab 2 Due)

6th Week
Lecture 15. Midterm Examination (65 minutes) (October 27)

Lecture 16. Spatial Query and Analysis (I) (October 29)
- Topic:
  - Spatial Queries
- Reading:
  - Ch. 13 in the textbook
  - pp. 234-242 in Bernhardsen 1999
  - pp. 235 – 237 and pp. 253 – 266 in Longley et al. 1999 (the “big book”)

Lecture 17. Spatial Query and Analysis (II) (October 31)
- Topic:
  - Measurement operations
  - Connectivity operations
- Reading:
  - pp. 141-151 in Chrisman 1997 (Measurement)
  - pp. 220-235 in Aronoff 1989 (Connectivity)
  - pp. 283 – 292 in Longley et al. 1999 (the “big book”)

Lab 4. Download Data from Web and Compile Them into the Database (Lab 3 Due)

7th Week
Lecture 18. Spatial Query and Analysis (III) (November 3)
- Topic:
  - Spatial Buffer
- Reading:
  - 13.4.1 in textbook
  - pp. 179, 199-200 in Burrough 1998
  - pp. 159-167 in Bonham-Carter 1994
  - pp. 503 – 526 in Longley et al. 1999 (the “big book”)

Lecture 19. Spatial Query and Analysis (IV) (November 5)
- Topic:
  - Spatial Overlay
- Reading:
  - 13.4.2 and 13.4.3 in textbook
  - Lesson 8 in ESRI Understanding GIS (Note: there are two errors in pp. 8-20 diagram)

Lecture 20. Spatial Query and Analysis (V) (November 7)
- Topic:
  - Map Algebra
• Reading:
  - pp. 184-186 in Burrough 1998
  - Ch. 1 in Tomlin 1990
  - pp. 527 – 542 in Longley et al. 1999 (the “big book”)

Lab 5. Spatial Analysis – Site Selection (Vector Format) (Lab 4 due)

8th Week

Lecture 21. Spatial Query and Analysis (VI) (November 10)
  • Topic:
    - Interpolation operations
  • Reading:
    - 13.4.4 in textbook
    - Ch. 5 in Burrough 1998
    - pp. 481 – 492 in Longley et al. 1999 (the “big book”)

Lecture 22. GIS Presentation (Visualization) (I) (November 12)
  • Topic:
    - Cartography basics
  • Reading:
    - Ch 12 in Textbook

Lecture 23. GIS Presentation (Visualization) (II) (November 14)
  • Topic
    - Map design
  • Reading: TBA

Lab 6. Spatial Analysis – Site Selection (Raster Format) (Lab 5 Due)
Term project proposal is due on November 10 (Monday).

9th Week

Lecture 24. Using GIS to Solve Geographic Problems (November 17)
  • Reading:
    - pp. 493 – 502 in Longley et al. 1999 (the “big book”)

Lecture 25. GIS, GPS and RS (Remote Sensing) (November 19)
  • Reading:
    - 10.2 in textbook
    - 4.4.2 (GPS), 4.4.3 (remote sensing), 10.2 (Future Data) in Clarke’s 2003
    - pp. 164-172 in Bernhardsen’s, 1999 (remote sensing)
    - pp. 178-182 in Bernhardsen’s, 1999 (GPS)

Lecture 27. The future of GIS (November 21)
  • Reading:
    - pp. 309 – 316 in Longley et al. 1999 (the “big book”)
    - pp. 567 – 580 in Longley et al. 1999 (the “big book”)

Lab 6 due

10th Week
Work on term projects
Term project progress report (on data) is due on November 24 (Monday).

11th Week
Project presentation (December 1)
Project presentation (December 2, lab time)
Project Presentation (December 3)

Term project (final report) due