GEOG 506: Advanced Geo-Information Science

Tuesdays, 11:35-2:25pm (except for the last weeks of class)
Room 511 Burnside Hall

Instructor: R E Sieber, renee.sieber@mcgill.ca
Geography/McGill School of Environment
Office Hours: Tuesday 2:45-5pm

Instructor: R Sengupta, raja.sengupta@mcgill.ca
Geography/McGill School of Environment
Office Hours: TBD

Introduction

Digital Geospatial Information (GI) and its associated geographic information systems and technologies (GIS&T, which includes Geographic Information Systems {GIS}, remote sensing, the Geospatial Web 2.0 {e.g., Digital Earths like Google Maps}, Global Positioning Systems and Location based Services {LBS}) increasingly represent the innovative edge in research and industry. Altogether they represent a major industry in Canada, with over $2bCN in annual revenues. GI was originally conceived as a more efficient way to produce maps. Increased quantities of digital GI allows us, for example, improve the provision of social services to new immigrants, analyze the geographic relation between specific diseases and water quality, and conduct multiscalar modelling of climate change. Combining digital GI, software and technology has allowed for new economic services (e.g., proximity based cell phone advertisements, use of augmented reality for tourism), scientific exploration (use of mobile platforms to track the movement of turtles) and entertainment (e.g., FourSquare). In terms of popular culture, Google Maps was hailed as the killer app of the 21st Century.

Whether the application concerns social work, robotics or hydrology, managing, analyzing and delivering GI through GIS&Ts requires a deeper understanding of the underlying science guiding use of information and emergence of technologies. This deeper understanding has us asking questions such as, from physical science perspectives, what is the impact of combining data of different geographic scales in computer modeling? Which statistical techniques are appropriate for a particular application? How does one visualize both time and space? Which algorithms best estimate error in spatial data? From social sciences perspectives, one can explore whether GIS&Ts are neutral tools or are they, by their very nature, instruments of capitalist control? How does the modern librarian balance paper maps and digital assets? What is the spatial data accuracy of crowdsourced GI? These are a few of the far ranging questions that underlay the science of GI and its associated technologies.

Course Goals

This course merges the theoretical study of GIS&Ts with original student research. In this course students are introduced to the conceptual questions that drive GIS&T research, geographic information science (GIScience). Students will learn to critically analyze the major themes in the GIScience literature and draw out the practical ramifications for

GIS&Ts. Students will learn to contrast GIS as a tool with GIS as a science. They will conduct GI research and apply GIScience concepts to that research. On a practical note, students will gain experience in synthesizing and lecturing on complex scientific material and functioning as discussants and authors of scientific papers.

Course Format

This graduate course is run in a seminar format in which the major concepts in GIScience are considered. Initial classes will be run as standard seminars, approximately 1 1/2 hours long with a break in the middle and followed by in-class work on student projects.

Once student presentations have begun, classes will be divided into two parts. For classes with one student presentation, for the first part of these classes, students will work on his/her own research projects, guided by the instructor. Students also will be expected to assist each other in projects. The second part will be a seminar, which will be given by students. Each student will choose and then present a major theme in GIScience and, presumably, of pertinence to his/her own GIScience research. A student will be selected as a discussant to formally comment on the substance of each seminar and will lead the rest of the class in broader discussion. For classes with two student presentations, we will omit the research project work time.

At the end of the course, two half day-long or evening classes will allow students to present projects. A date(s) will be chosen by class, which may be during exam period. Final projects (i.e., the GIS&T application itself and GIScience paper) will be due during the exam period.

Course Requirements

In-class Participation	15%
Blog Posts	10%
Seminar Presentation and Paper	25%
Discussant Assessment of Seminar	10%
Research Project Final Paper	30%
Presentation of Research Project	10%
Total	100%

Participation: Participation—whether advancing opinions, reflecting on course material, or connecting current discussions to other class content—is essential to full understanding GIScience. Students are expected to actively participate in each class. Students are encouraged to be imaginative and speculative in their comments. To participate fully, the student needs to attend class and he/she needs to read the papers assigned for each class prior to class.

Participation occurs during and outside of class. In class, students talk. This is a key portion of getting the most from this class. Outside of class, students will post to the blog, Computers, Society and Nature, http//rose.geog.mcgill.ca/wordpress. Each week a student must submit 2-4 posts per week, one per article assigned. The blog post should be the student's opinion of the article and its central themes. Do not simply write a summary. Critique the article, which is not the same as being critical of the article. There

is no length requirement for the blog posts, but remember that the blog medium generally has shorter pieces (~250 words) designed for a wide audience.

Posts must be submitted to the blog by midnight the night *before* the class in which the articles are discussed. We do not want 15 identical posts. The first person(s) who posts, has the greatest luxury of deciding upon which theme he/she wishes to post. Sooner is better than later.

Whether in class or a blog post outside class, the best participation should:

- Situate the subject in GIScience (as the student currently understands it).
- Connect the content in the articles to the student's own seminar or research topic(s).
- Constructively critique the readings: About what would the student have liked to read more? Was it a good article? What could the author have improved on (either in the research itself or the explanation of it)? What specifically was unclear or challenging?
- What major questions arose from reading the articles? Has the article made the student want to follow up on the topic? What is omitted from the article and why? If it is an older article, how may the topic have changed or evolved in the intervening time?

Seminar Presentation and Paper: Each student is expected to lecture on one of the major themes of GIScience. See below for potential topics. He/she will be required to present a lecture suitable for a student in a 300-level course. The presentation should be structured as follows

- Provide any necessary definitions
- Present historical antecedents
- Present major strains of thought and emergent debates
- Conclude with ramifications for GIScience.

Jargon in the seminars must be limited or concisely explained. Seminars are no less than one-half hour and no more than one hour in length, followed by discussants' remarks and student questions. Presenters may elect to use document overheads, handouts, and/or PowerPoint, Prezi for their presentation.

In advance of the seminar, presenters must prepare a short review paper, approximately 10 double-spaced pages in length, which contains an abstract, a concise definition of the topic, the historical antecedents, major strains of thought, emergent debates and ramifications for GIS (systems, studies or software) as well as a reading list/bibliography (not included in page count). It is assumed that this paper will form the major part of the literature review of the student's final project paper. The student must email the 10 pager to the discussant the Thursday (8am) before the presentation (copied to both instructors). Because this paper forms an essential part of the final research paper and because we do not want to ensure a good discussant presentation, there is a two percent penalty per day for delays in submission.

Each presentation must be accompanied by one or two peer-reviewed journal articles (depending on length). Presenters must select and supply the articles for the class (posted

to webct or handed out at during the previous class). These selections are done in consultation with the instructors and should represent classics in the field (hint: look at number of times the article has been cited in Google Scholar) The grade in part will be assessed on quality of the article selected for presentation, so care must be taken to determine the definitive reading for the topic. The student must email the articles to the class one week before their presentation.

One last thing: The student MUST present his/her seminar as a general lecture on his/her GIScience topic. It should not refer to one's project. The student will have the opportunity to present his/her project during the last two weeks of class.

Discussant Assessment of Seminar: For each seminar, a discussant will be assigned to organize the presentation. Prior to the seminar, the discussant will determine any A/V needs of the presenter and ensure these are set up. Then the discussant will introduce the speaker. After the seminar, the discussant will critically assess the substance of the presentation, 10 page review paper and article(s) and then lead the rest of the class in discussion. To augment his/her comments, the discussant is highly encouraged to conduct his/her own research on the subject as well as draw upon any prior knowledge of and experience with GIS.

The best discussions are not mere summaries of the articles and seminar but are syntheses and critical analyses of the material. As discussant, the student should:

- Situate the subject in GIScience (as the student currently understand it). The discussant may choose to link it to his/her subject area(s).
- Constructively critique the lecture (presentation content and style): What would the discussant have liked to hear more about? What was enjoyable? What was unclear?
- What major questions arise from the discussant's reading of the background paper, the associated articles and listening to the lecture? The student may need to read a bit more on the subject to provide these questions.
- Frame the subsequent discussion by the rest of the class. The discussant should try to engage classmates in considering one or two key aspects of the presentation. Look for exciting, interesting, or controversial points on which to build. The student may choose to do this as a series of questions to the class.

The discussant portion should be no longer than 15 minutes. Discussions (discussant presentation and student participation) are anticipated to last approximately 30-40 minutes. Discussants will be graded on the substance of their critique and the role they play in encouraging other students to discuss major themes of the literature.

Research Project Final Paper: Students conduct original GIScience research in this course. For many students, this entails working on his/her own spatial data set and revealing the underlying GIScience through a GIS&T application. For others, this may entail developing an original application based on the chosen topic. [Note: The Research Project is not a literature review. Conducting research in some of the topics below requires some understanding of computer programming.] For yet others, the student may elect to conduct social science research, via surveys, interviews or web harvesting. In the

past, students have conducted research on numerous subjects and for various locales: data sharing between the Quebec government and the Cree, agent-based modeling of renter preferences in Boston, spatial data uncertainty estimations of salmonid populations in Argentina, geographic masking of sensitive public health information in Barbados, and land use modeling of transportation expansion over time (temporal GIS) in NDG. In a social theory application, one student adopted the role of flaneur and, armed with the poems of Baudelaire, the paintings of Jean-Paul Riopelle, a GPS unit and a camera, created geospatial art of the streets of Montreal. There is enormous range in the domains to which GIScience can be applied. The student is encouraged to apply GIScience to an existing research project (e.g., graduate work), with which we can assist if the student does not have one.

Students will vary in the degree to which they use GIS&Ts as tools or GI as a science for their application. Because the main focus of the course is GIScience, students must choose a GIScience 'angle' for his/her project (e.g., scale issues in data when modeling Montreal's storm sewers). In the projects, students may choose to apply the same theme they present in class or another theme. The GIS&T application must be sufficiently documented, for example with metadata.

The final paper should be approximately 25 pages, not including references, appendices or images. The GIS&T application and final paper are due during finals week, on a date to be announced. Details on the composition of the proposal and final paper will be posted on the web during the course.

On the Friday of Week 6, students are required to submit a research proposal containing a synopsis of the research, detailed (!) methodology, proposed data sets, a timeline, and a preliminary literature review (part application and part GIScience literature) and bibliography. The approximate total page length is 5-8 pages, excluding charts, diagrams, references, and any figures. Students must confer with the instructor(s) prior to the deadline to obtain approval for their research projects. We consider the proposal so important to the successful completion of the research that there is a two percent penalty per day for late proposals.

Many students conduct surveys or interviews as part of research. Projects involving human subjects (e.g., survey respondents) require ethics approval. The student must submit the ethics application as early as possible to ensure timely approval. Any survey instrument must be included in the ethics application and attached to the proposal as an appendix.

Presentation of Research Project: On a day(s) selected by the students and instructor, each student must give a 20 minute final presentation on his/her research. Presentations must be of conference quality. One week before the presentations, students must prepare an abstract that will be emailed to interested faculty and students who will be invited to attend.

Language

In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded.

(approved by Senate on 21 January 2009 - see also the section in this document on Assignments and evaluation.)

Academic Integrity

McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see www.mcgill.ca/students/srr/honest/ for more information). (approved by Senate on 29 January 2003)

Specific to GEOG 506: Because students are unfamiliar with the course material, there is a temptation in a course such as this to copy and paste from websites and articles. We urge all students to resist such temptations, particularly as we are familiar with much of the work in GIScience, have found examples of plagiarism, and have submitted these cases to the university. If the student is at all uncertain about what constitutes plagiarism, then come to us. If enough people are interested, we could hold a workshop in it or, more generally, on writing scientific literature reviews.

Undergraduates are reminded that this is a graduate course. Graduate coursework is demanding and requires the student to plan for this heightened demand throughout the semester. Students should begin work on their seminars and projects early; early starts will not necessarily ensure A level work, but achieving this high level will require a significant investment of time. As with other GIS or remote sensing courses, the work cannot be accomplished over a weekend. To balance this demand, a graduate course and projects conducted in that course have high prestige on one's record.

Student Assessment

For information on university and department policies for student assessment, please go to http://www.mcgill.ca/geography/studentassessment

Syllabus

Week 1. Introduction

In the first part of class we will introduce the concept of GIScience and the major questions that drive its research. We will discuss the course outline and we will cover what is expected for seminar presentations, how to select readings and how to read and think about academic papers. In the second part of the class, we will discuss the student research projects, including expectations, necessary data sets and possible GIScience topics. Based on student research and class interest, we will collectively select the seminar topics and set the schedule.

Weeks 2-4: Overview of Current Topics in GIScience

Selected readings available on Webct

Weeks 5-12. Student Topics

The following are possible topics (one student per topic, 1-2 per week):

Location Based Services
Geospatial Ontologies
Intelligent Agents/Dynamic Modeling
GeoVisualization/Cartography 2.0
Temporal GIS/Space Time Geographies
Spatial Cognition
Scale in GIScience
Spatial Data Mining
Generalization
Interoperability
Spatial Data Infrastructures
Grid/Distributed Computing
Augmented Reality
A Specific Spatial Statistic (e.g., nearest neighbor, routing/network analysis)
Semantics and Natural Languages
Spatial Data Access and Data Sharing
Critical GIS
Spatial Data Uncertainty and Error
User Interfaces (GUIs and NUIs) for Location
Locationally Aware Robotics
Neogeography/Volunteered Geographic Information
Geoweb/Digital Earths
Geocomplexity
Privacy/Geosurveillance
Geospatial Cloud Computing/Cyberinfrastructure
Map/Geolibraries
Big Data
The Sharing Economy
Drones
Citizen Science
Anonymization/ Geographic Masking
Spatial Aspects of Social Network Analysis
Self-organizing Maps
Quantified self movement and fitness devices
Internet of Things

For additional topics in GIScience look at http://www.giscience.org/program_overview.html#details or the more computationally-intense http://sigspatial2013.sigspatial.org/program/

Week 13. Student Presentations of Research Projects