Geography 5113
Special Topics in GIScience: “Fuzzy Set Theory in GIScience”

Time and location: Fr 9-12 GUGG 201E

Instructor: Stefan Leyk, GUGG 201 F, stefan.leyk@colorado.edu
Office hours: Wed 11am-12pm & Fr 2-3pm

Overview:
Where is the mountain? What is a forest? In our world we find many phenomena, which are difficult to locate or delineate because their meaning is not well defined. Fuzzy set theory represents an alternative approach to classic set theory. Problems that arise from subjectivity, vagueness or ambiguity in linguistic terms require such alternative approaches to model our real imperfect world. This seminar introduces fuzzy set theory in the context of soft computing for spatial decision-making and modeling in GIS and Remote Sensing. We will discuss different examples where the use of fuzzy sets and fuzzy logic operators allows for an extension of the analysis by incorporating concepts of partial and multi-memberships of spatial objects. These examples focus on spatial decision-making, spatial uncertainty assessment, and classification procedures to solve problems in ecological, environmental and socio-economic studies.

Class meetings consist of lectures, student presentations, discussions and in-class exercises based on the readings announced. Each pair of students will give two presentations on particular reading topics and lead the discussions during the class sessions. At the end of the semester students will work on a small project that can be connected to their own research, give a final presentation at the end of the semester, and write a term paper. Different options exist for this term paper. Students can write a complete literature review of methodological issues and conceptual approaches of fuzzy sets in their field. Students can also work on a concrete analysis with real data at hand and develop (implement) a solution that incorporates fuzzy set theory. The course is designed for graduate students from Geography, Environmental Sciences, Geology, Ecology or Information Sciences with experience in GIScience or Remote Sensing and an interest in exploring alternative concepts for spatial modeling and decision-making.

PREREQUISITES: Experience in GIScience, spatial statistics or Remote Sensing. Familiarity with basic concepts of spatial analysis and modeling. A grasp of set theories...

READINGS: We will mainly rely on research papers and book chapters from different sources. A preliminary list of references is given below. All required readings will be available as pdf documents on the class homepage. One introductory textbook that I can recommend is:

TERM PROJECT: You will choose one topic for your final project and write a proposal of ca. 300 words, to be submitted by Oct 09, 2009. You should have data prepared if you choose the data analysis option by the same date. It might be useful to look through the literature ahead to find ideas for your project. I will comment on your proposals and require some revision if necessary. The project period is anticipated from week 9 to week 16. At the end of the semester each student will give a final presentation about the work done. Final papers are due Dec 11, 2009.

GRADING: The class grade is based on 200 points in total.
- Reading presentations and discussion leads (70 points)
- Class participation and attendance (20 points)
- Term paper and presentation (proposal 20, presentation 30, final paper 60; to be submitted Dec 11, 8pm; 120 points).
## Schedule Fall 2009

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<td>Introduction: Uncertainty &amp; Sets theory;</td>
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<td>Why Fuzzy Sets? Why in Geography?</td>
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<td>Geography</td>
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<td>11</td>
<td>Setting the scene: Fuzzy sets in GIS &amp;</td>
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<td>Remote Sensing</td>
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<td>Soil mapping</td>
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<td>Risk evaluation</td>
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<td>7</td>
<td>09</td>
<td>Classification accuracy - Proposals due!!!</td>
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<td>8</td>
<td>16</td>
<td>Mapping the landscape</td>
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<td>9</td>
<td>23</td>
<td>Landcover change and map comparison</td>
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<td>10</td>
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<td>Terrain and Morphometry</td>
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<td>Ecological Modeling, disturbance and</td>
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<td>conservation</td>
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<td>Evaluation of places and views</td>
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<td>Areas of fuzzy entities &amp; classes</td>
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<td>FALL BREAK – NO CLASS</td>
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<td>16</td>
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<td>Final presentations &amp; Discussion</td>
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<td>Final papers due Fri 12/11 8pm</td>
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**Readings** (* indicates reading material required for this seminar)

**Books and edited volumes**


**Articles and book chapters**


Hagen A 2003 Fuzzy set approach to assessing similarity of categorical maps. International Journal of
Geographical Information Science 17: 235–249


Lagacherie et al., 1996


*Varzi A 2001 Vagueness in geography. Philosophy and Geography 4: 49–65


Department of Geography Code of Conduct

In the Department of Geography, instructors strive to create an atmosphere of mutual trust and respect in which learning, debate, and intellectual growth can thrive. Creating this atmosphere requires that instructors and students work to achieve a classroom in which learning is not disrupted. At the most basic level, this means that everyone attend class, be prepared with readings and assignments completed, and that students pay attention. This means no conversations with friends, reading the newspaper, coming late, or leaving early. Such behavior is disruptive to the instructor and to your fellow classmates.

These basics of classroom etiquette are an important means of building and showing mutual respect. Inevitably, however, disagreements will arise. Sometimes these disagreements will be about content, sometimes about grades or course procedures, and sometimes they will be about the treatment of participants in the class. In order to facilitate the resolution of these disagreements, the following guidelines should be followed by everyone:

- All interactions must be guided by mutual respect and trust.
- If you are bothered by some aspect of the class, identify what it is that is bothering you and center the discussion on that issue.
- Address issues that concern you early. Problems are easier to resolve before they fester.
- Consider whether it is best to address your concerns in class or in a separate appointment with the instructor. Remember, behavior that disrupts your fellow classmates is not acceptable.
- Abusive speech or behavior will not be tolerated in any interaction between students or between student and instructor. If an instructor feels that your speech or behavior is abusive, you will be asked to leave the room. If you believe an instructor has become abusive, you may leave the room and talk with the department chairperson. Debate and discussion can continue when all parties proceed with mutual respect.
- If mutual respect cannot be restored, either you or the instructor may take the issue to the department chairperson or the Campus Ombuds Office.

Policy on Plagiarism

The College of Arts and Sciences has an Honor Code that prohibits plagiarism, cheating, fabrication, aiding academic dishonesty, lying, bribery, and threats at the University of Colorado. A key element of this code is that CU students will not plagiarize which means you may not use someone else’s words, pictures, ideas, or procedures as your own. In some instances, it is appropriate to do so when you provide proper acknowledgement. Cases of plagiarism and violations of the CU Honor Code will not be tolerated. More information can be found online at http://www.colorado.edu/academics/honorcode/, particularly under the “Student Information, What is a Violation?” section.
GEOG 5113  
Fall, 2009  

QUESTIONNAIRE  

NAME_________________________________    YEAR _________  
(optional)  

MAJOR______________________    CONCENTRATION _________________  

WHAT OTHER COURSEWORK have you taken related to Cartography / GIS / Remote Sensing,  
Environmental Modeling, Information Sciences, Set theories?  

1. _____________________________  2. _____________________________  

3. _____________________________  4. _____________________________  

WHAT DO YOU EXPECT TO LEARN BY TAKING THIS SEMINAR?  

__________________________________________________________________________________  

__________________________________________________________________________________  

__________________________________________________________________________________  

WHAT CONCERNS DO YOU HAVE ABOUT TAKING THIS SEMINAR?  

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Thanks for filling this out. This will help us to understand more about you.