GEOG 490: LOCATION-AWARE SYSTEMS

Instructor: Hedda R. Schmidtke
Lecture: Tuesday/Thursday 10:00am-10:50am, 260 CON
Labs: Tuesday 1200-1350, 445 MCK or Tuesday 1400-1550, 445 MCK

COURSE DESCRIPTION
Location-aware systems are the foundation of today’s easy access to geospatial information for everyone. A smart phone that knows where you are can provide you with an appropriate map of your surroundings without searching. Location-awareness also allows your phone to access location based services, e.g. for finding restaurants or shops in the vicinity. Location based services may also feed advertisements to your phone directing you at shops or special opportunities nearby. Geofencing applications may even reach out to you as you pass by a store or restaurant with targeted offers. Moreover, location-aware social networking apps allow you to connect with people around you or to track your friends’ or children’s locations. The collected geospatial movement information about a growing number of users world-wide poses up to now unknown potential for analysis of massive geospatial data about human behavior. All these are exciting technological developments, but there are also many challenges and caveats, the most obvious being privacy and the potential for abuse of spatial data for criminal purposes, such as burglary when the house owners are on vacation.

This course, on the one hand, introduces the technical fundamentals of location-aware systems including the smart phone technology making location-awareness possible, the spatial models and data structures developed to manage locations as part of a computer network, and the operation and structure of location-based services as supported by GI systems; on the other hand, it discusses ethical challenges of the different technologies, in particular how to protect user privacy both technically and legally.

EXPECTED LEARNING OUTCOMES
After successfully completing the course students

- Understand all steps of how a location-aware application works: how location information is obtained, potentially sent to a location based service and transported through a network, potentially anonymized or obfuscated, translated into a query, and finally answered.
- Are able to critically evaluate location-aware technologies as to their potential, importance, and risks, and to develop alternatives that minimize risks.
- Gain an overview of recent widely used location-aware systems or services enhanced with location-awareness
- Understand the scientific usage of data from these services for geographic purposes
- Are able to develop a location-aware smart phone application

Students with sufficient technical background can additionally gain experience in programming a location-aware smart phone application as part of their final project.

ESTIMATED STUDENT WORKLOAD
The course contains lectures, reading assignments, and in-class activities/quizzes, as well as lab assignments, including a final project. Students spend two hours in lectures and two hours in labs. Each lecture consists of 30 mins of presentation by the instructor and 20 mins of in-class activities. Presentations are interleaved with in-class activities, in order to allow students to actively engage with concepts and to make theoretical material tangible with hands-on experience. In-class activities include short quizzes, discussion group exercises, and computational exercises using location-aware systems components.
Assignments deepen the practical part of the learning experience enabling students to apply the presented concepts so as to reach learning objectives. Assignments practice the main steps for developing a location-aware system and give hands-on experience with components of such a system, as well as techniques for assessing its risks and developing alternatives. In the final project, students will combine all the knowledge and methods learned previously to write their own location-aware system, which obtains data from a social media stream, connects users over a network, and provides information to users that addresses their location-dependent information needs in a manner that allows users to protect their privacy and safety. Students are expected to spend about eight hours per week on assignments and the final project: two hours in labs and on average six hours outside of classroom. Another two hours outside of classroom are required for course readings.

**GRADING**

**GEOG 490**

Examinations (30%): mid term (10%), final (20%)

Final project (30%)

Lab assignments (30%): four lab assignments

In-class activities (10%)

**READINGS**


All readings will be posted on Canvas.
GRADING RUBRIC
Grading criteria follow http://gradeculture.uoregon.edu:
A+ Only used when a student’s performance significantly exceeds all requirements and expectations for the
class. Typically very few to no students receive this grade.
A Excellent grasp of material and strong performance across the board, or exceptional performance in one
aspect of the course offsetting somewhat less strong performance in another. Typically no more than a
quarter of the students in a class receive this grade, fewer in lower-division classes.
B Good grasp of material and good performance on most components of the course. Typically this is the
most common grade.
C Satisfactory grasp of material and/or performance on significant aspects of the class.
D Subpar grasp of material and/or performance on significant aspects of the class.
F Unacceptable grasp of material and/or performance on significant aspects of the class.
The following expectations regarding point ranges are applied:

Grading in basic activities, such as examinations and lab assignments, evaluates in how far an answer
reflects that the question with its background was understood and solved following the methods to be applied
in the specific answer. Grading of advanced activities with higher degrees of freedom, such as advanced
labs, the final project, or literature reviews, additionally evaluates the suitability of the choices made, e.g.
the final project plan, the method chosen for analysis, the choice of articles selected for review. Students
should make sure that they seek guidance early for these tasks so as to actively discuss alternatives and
should justify their choices in write-ups.
COURSE SCHEDULE AND ASSIGNMENTS

WEEK 1
Lecture 1
INTRODUCTION & OVERVIEW,
Reading: Peterson (2014), Chapter 19, pp. 361-375
Lecture 2
WHAT ARE LOCATION-AWARE SYSTEMS?,
Reading: Peterson (2014), Chapter 20, pp. 376-386
Lab 1
Me on My Map

WEEK 2
Lecture 3
SMART PHONES AS SENSING SYSTEMS,
Reading: Schmidt et al. (1999)
Lecture 4
IMPLICIT INTERACTION,
Reading: Lieberman and Selker (2000)
Lab 2
Apps that Use Location Data

WEEK 3
Lecture 5
COMMUNICATION NETWORKS,
Reading: Stallings (2005), Chapter 3 pp. 46-68
Lecture 6
NETWORK PROTOCOLS,
Reading: Stallings (2005), Chapter 4 pp. 69-94
Lab 3
Introduction: Network Trace

WEEK 4
Lecture 7
THE SPATIAL INTERNET & GOOGLE’S BIG TABLE,
Reading: Chang et al. (2008)
Lecture 8
THE SPATIAL INTERNET & MARKETING,
Reading: Gupta et al. (2014)
Lab 4
Work session: Network Trace

WEEK 5
Lecture 9
SOCIAL MEDIA AND LOCATION,
Reading: Sakaki et al. (2010)
Lecture 10
Midterm,
Lab 5
Introduction: Analysing Spatial Data from Twitter
### WEEK 6

**Lecture 11**  
LOCATIONS FROM SOCIAL MEDIA,  
Reading: Ahmed et al. (2013)

**Lecture 12**  
ANALYSIS OF LOCATION-BASED DATA,  
Reading: Eagle and Pentland (2006)

**Lab 6**  
Work session: Analysing Spatial Data from Twitter

### WEEK 7

**Lecture 13**  
LOCATION PRIVACY BY DESIGN,  
Reading: Langheinrich (2001)

**Lecture 14**  
PRIVACY AND THE GEOWEB,  
Reading: Elwood and Leszczynski (2011)

**Lab 7**  
Introduction: Final Project

### WEEK 8

**Lecture 15**  
LOCATION PRIVACY ATTACKS,  
Reading: Wernke et al. (2014)

**Lecture 16**  
LOCATION-BASED DATA FOR PUBLIC HEALTH  
Reading: Goranson (2013)

**Lab 8**  
Work session: Final Project

### WEEK 9

**Lecture 17**  
LOCALIZATION TECHNIQUE PRINCIPLES,  
Reading: Karl and Willig (2007), Chapter 9.1-9.3 pp. 231-240

**Lecture 18**  
LOCALIZATION TECHNIQUE PROTOCOLS,  
Reading: Karl and Willig (2007), Chapter 9.4-9.8 pp. 240-250

**Lab 9**  
Work session: Final Project

### WEEK 10

**Lecture 19**  
Presentations,  
Reading: project handouts

**Lecture 20**  
Presentations,  
Reading: project handouts

**Lab 10**  
Work session: Final Project

### WEEK 11

**Final Exam**