CE 670: Advanced Research Methods for Built Environment Informatics

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Fall 2024 Syllabus

Tuesdays 1:00 - 3:30pm
WHP 400

Catalogue Description:
Research methods in informatics for intelligent built environments; data acquisition, analysis and interpretation for adaptive and responsive built environments and their interactions with end users.

Expanded Course Description:
The goal of this course is to introduce students to the advanced research methods in the area of informatics for intelligent built environments. Specifically, the course focuses on the following research areas: 1) adaptive and responsive built environments; 2) building informatics; and 3) built environment and end-user interactions. Students are first introduced to the concepts, approaches and implementation issues associated with intelligent built environments. Then students are introduced to the research methodologies for informatics for intelligent built environments including the types of data that are collected for intelligent built environments, data acquisition systems, and processing techniques. Students also gain experience with designing research through hands on research assignments.

This is a new and rapidly developing research area with many open problems of cross-disciplinary interest. This course also aims to train students in the craft of academic research. Students will have an opportunity to contribute to this area through the publication of results from the final research project for this class. Substantial emphasis will be placed on reading research papers in a critical and analytical manner. Students will be required to turn in regular written critiques of papers. The final project will be closely monitored through out-of-class meetings and emails, and will span the full research cycle -from problem formulation to obtaining & analyzing results to paper writing.

Prerequisites:
There are no prerequisites for the course. Students are expected to have strong research interests and analytical ability. The course is meant to be for PhD students in the area of Informatics for Intelligent Built Environments as well as MS students with a high level of ability, self-motivation and an interest in research.

Office Hours:
Students are advised to make appointments with the professor ahead of time and be specific with the subject matter to be discussed. Students should also be prepared for their appointment by bringing all applicable materials and information.

Class Communication:
Blackboard will be used for class communication, assignment submissions and reading materials.

Policy about Assignments:
It is crucial that students turn in whatever they have on the due date. NO assignment will be accepted late. An incomplete grade will only be issued when a student is unable to complete the work because of documented illness.

Reading Assignments:
This course aims to train students in the craft of academic research. Substantial emphasis will be placed

on reading research papers in a critical and analytical manner. Students will be required to turn in regular written critiques of papers.

Final Research Project:
Besides the weekly lectures, critiques, and discussion, a large component of the course will be the execution and delivery of a research project. Students will prepare a proposal for their research project that could be designed, implemented and analyzed within a semester. Details on this will be provided during the semester. The projects will be graded on the basis of individual effort, regular progress updates, the mid-term and final project reports, and final project presentations.

Grading Schema:
In this advanced PhD-level course, it is expected that all students will be motivated, responsible for their own learning, and participate enthusiastically. Each student must present and participate actively in the discussions each week in class and complete all assignments in a timely manner. The course grading policy is accordingly as follows:

Assignments 1-2: Each 5% (Totaling 10%)
Research proposal (Assignment #3: Midterm): 30%
Research project (Assignment #4: Final): 50%
Participation in the class discussions: 10%

Return of Course Assignments:
Returned paperwork, unclaimed by a student, will be discarded after a year and hence, will not be available should a grade appeal be pursued following receipt of his/her grade.

Required Readings:
We will read and discuss the most recent papers from the literature. Reading list will be announced and updated during the semester.

The following books are recommended for the research methodologies part of the class.
1. Craft of Research, Wayne Booth

2. Research Methods for Engineers, David C Thiel

Assignment #1
Reviewing Research:
Students will research and identify national or international research groups that share similar interests with the course topics and review their research projects. Then students will choose two projects that interest them the most and prepare a presentation for the class. Presentations should include the details of the research, such as point of departure (motivation), methodology, results, etc. Presentations will be around 20 minutes, following a 10-minute Q&A. In addition to the project details, students will include comparative studies that have been done around the topic. Some suggestions are:
http://cba.mit.edu
http://wyss.harvard.edu
https://www.media.mit.edu/research/groups-projects (several research groups are listed here)
http://www.harvardcgbc.org
https://cbe.berkeley.edu
http://www.bpi.tuwien.ac.at
http://www.cs.berkeley.edu/~culler/
https://www.mdsi.tum.de/gni/startseite/
https://www.cs.ucf.edu/research/virtual-reality-and-hci/
http://relationalagents.com/
https://www.hcii.cmu.edu/research

Assignment #2:
Research Topics:
Each student will propose a research project that can be executed within a semester and that he or she is interested in exploring. Each student will prepare a formal presentation and we will discuss about the feasibility and novelty of the project during the class. This will include a short literature review and gap analysis on this topic.

Assignment #3:
Writing a Research Proposal (MIDTERM):
Each student will prepare their research proposal that they would like to execute for the remaining part of the semester. A good proposal should include introduction and problem statement, review of related literature, and statement of the hypothesis, methodology, instruments, research design, data collection and analysis methods, and the plan for reporting your findings. The proposal should be around 5-10 pages accompanied with a presentation. Students will present their proposal to the class; be prepared for questions. Students in the class and the instructor will provide feedback.

About project selection: First and foremost, it is important to choose a topic that you can execute in a semester. You need to think about instrumentation, access to instrumentation, cost of instruments, learning curve and lead times, time required for execution of the experiments, time required for analysis of the data and documentation. The project you are going to propose can be related to an ongoing project or can be a separate endeavor. You can recruit help from colleagues or propose projects that complement each other. Be innovative and make it fun!

Assignment #4 (FINAL): Following the research proposal, each student will execute his or her project. There will be several research meetings throughout the semester. Each student will report his or her research progress to the class. There is no final exam. Instead, students will present their work to the class on the last day of classes. The final report is due the same day of the class during the first week of the exam period. Students can submit their final report in a word document or if they choose, they can submit their final report as a conference submission to one of the conferences listed below or to a journal (encouraged but not required).

1. ISARC (International Symposium on Automation and Robotics in Construction)
2. ASCE International Conference on Computing in Civil Engineering
3. International Conference on Computing in Civil and Building Engineering
4. International Conference on Advances in Computing and Data Sciences
5. ACM International Conference on Computer Engineering, Technologies and Applications
6. International Convention on Information, Communication and Electronic Technology
7. ACM Conference on Human Factors in Computing Systems (CHI)
8. ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation (BuildSys)

Class Topics:
The following is an outline for the course, describing the topics we will cover through the lectures in this course (subject to change)

Week	Date	Topic	Assignments Due
1	08/27	**INTRODUCTION** To the instructors, class members and the course Introduction to building intelligence, building informatics, human-building interactions, adaptive and responsive environments **WHY RESEARCH?** What is research? Concept of research Making good arguments; claims; reasons and evidence	
2	09/03	**RESEARCH REVIEW** ➔ *STUDENT PRESENTATIONS OF RESEARCH PROJECTS FROM OTHER GROUPS*	*Assign # 1*
3	09/10	**FINDING A TOPIC** Initial search/selection of a topic Assembling a theoretical framework Literature review Gap analysis Proper referencing How to review a paper *Discussion: Papers on the topic will be provided*	
4	09/17	**RESEARCH DESIGN** Parts of a scientific paper Formulating research objectives, questions and hypotheses How to select a research approach? ➔ *STUDENT PRESENTATIONS OF PROJECT TOPICS*	*Assign #2*
5	09/24	**PROPOSAL WRITING** How to write a good proposal? Steps to take Evaluation of proposals Ethical issues *Discussion: Sample proposals for discussion will be provided*	
6	10/01	**RESEARCH METHODS** Experimental methods Correlational methods Mixed methods Data collection (requirements, human subjects, IRB, sampling, sample size, variables, etc.) *Discussion: Papers on the topic will be provided* *Discussion: UPDATE ON RESEARCH PROGRESS*	
7	10/08	➔ *STUDENT PRESENTATIONS OF THEIR RESEARCH*	

		PROPOSALS	Assign #3 (MIDTERM)
8	10/15	**DATA COLLECTION** Data requirements Collecting data from respondents (Working with human subjects) Sampling Sample size Instrumentation Variables *Discussion: Papers on the topic will be provided* *Discussion: UPDATE ON RESEARCH PROGRESS*	
9	10/22	**VALIDATION** Why is it important? How is it done? Potential sources of error Validity and reliability *Discussion: Papers on the topic will be provided* *Discussion: UPDATE ON RESEARCH PROGRESS*	
10	10/29	→ *STUDENT PRESENTATIONS: RESEARCH PROGRESS*	
11	11/05	**DATA ANALYSIS** Data recording Data analysis and interpretation *Discussion: Papers on the topic will be provided* *Discussion: UPDATE ON RESEARCH PROGRESS*	
12	11/12	**DATA ANALYSIS** Data recording Data analysis and interpretation *Discussion: Papers on the topic will be provided* *Discussion: UPDATE ON RESEARCH PROGRESS*	
13	11/19	**HOW TO REPORT FINDINGS** Preparing title, abstract, introduction, methods, results, discussion, references Effective graphs, tables, images Manuscript submission, review process, publishing process Use and misuse of English. Use of generative AI *Discussion: Papers on the topic will be provided* *Discussion: UPDATE ON RESEARCH PROGRESS*	
14	11/26	**ETHICS IN RESEARCH** Research ethics Intellectual property and data protection *Discussion: Papers on the topic will be provided* *Discussion: UPDATE ON RESEARCH PROGRESS*	
15	12/03	→ *STUDENT PRESENTATIONS OF FINAL PROJECTS*	Assign #4 (FINAL:

			PRESENTATI ON)
	12/17	**FINAL WRITTEN REPORT**	Assign #4 (FINAL: WRITTEN REPORT)

Statement on Academic Conduct and Support Systems

Academic Conduct
Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu or to the *Department of Public Safety* http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage http://sarc.usc.edu describes reporting options and other resources.

Support Systems
A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* http://emergency.usc.edu will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.