Course Syllabus [Spring 2015]

Urban Systems Modeling

Time: 8-10am IL / 3-5pm SE /6-8pm UAE
Room: Virtual Lecture Lab
Instructors: Vladimir Cvetkovic KTH (vdc@kth.se)
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Credits: 3-4 Hours (Depending on Institution)
Prerequisite: Consent of Instructor

v. 6 Feb 2015

COURSE DESCRIPTION & OBJECTIVES

The city is the venue for very complex interactions among natural and human systems. A model, as an abstract representation of a real system (a real state or process), is an instrument that enables experimentation with, learning about, and finally understanding of the system of interest. It is particularly valuable when experimentation is not possible in the real world with the system of interest. Planning academics and professionals, dealing with the systems with one or more physical, social, economic, and environmental aspects, have employed a variety of models to understand the complexity and dynamics of planning issues, determine appropriate policy actions as well as timing of intervention and, ultimately, shape the desired future of our society.

This course will consider the challenges of modeling urban systems and interpreting modeling results. Students will review some of the models employed and widely used by the field of planning over the last several decades, and discuss how prospective planning scholars or practitioners can develop/use the models more effectively for analyses and research. It is expected that you will 1) have a solid understanding of not only the possible benefits but also the limitations of models and 2) get hands-on experience of designing/developing a model for a particular planning problem and deriving a set of applicable policies to address the problem.

LEARNING PHILOSOPHY

The course involves reading, classroom learning (lecture and discussion), and computer lab practice. Some of the required reading and discussions will be led by students and participatory learning will be essential and stressed. Therefore, in the cases of most classes, you are responsible for completing the readings on time and coming to class prepared to participate in discussions.

Each week, a modeling exercise will be assigned and must be completed individually. Later in the semester, these exercises will be completed by teams rather than individuals.

It should be noted that modeling is not just technical work. Rather, it is a series of cyclical steps – understanding, theorizing, formulating, experimenting, learning, which leads back to understanding – which can be facilitated and assisted by discussion with others. As a result, effective team work will be an important component of the learning experience.

LEARNING OUTCOMES

By the end of the course, students must be able to:

1. Create simple models of human and natural systems
2. Use models in planning and policy analysis
3. Identify the challenges in creating and using urban systems models
4. Recount the legacy and evolution of urban systems models

COURSE APPROACH AND MATERIALS

Students will enroll in the course from four different institutions: University of Illinois at Urbana-Champaign; KTH Stockholm; American University of Sharjah (United Arab Emirates); National Technical University of Singapore. This will require accommodating different time zones and different semester schedules. Teams will involve students from different locations and must accommodate cultural differences. We expect the benefits of this collaboration to far outweigh inconveniences caused by these differences.

Course reading materials will be available online and can be downloaded at the class web-site.

Modeling exercises will be carried out using Insight Maker (https://insightmaker.com/) and LEAM (http://TBD).

Please contact us if you have any trouble findings readings or using the software.

GRADING

Grading will be based on the following elements (subject to modification):

Class Participation and Attendance	10%
Assignments	30%
Term Project Proposal	10%
Final Presentation	20%
Final Papers	30%

SPECIAL CIRCUMSTANCES

Please communicate any expected or unexpected absences with the instructor as early as possible. Every effort will be made to work with students with unusual or unexpected obligations outside the course (family emergencies, health issues, participation in University sanctioned activities, etc.). Students with disabilities or special needs who require any accommodations to facilitate full participation and completion of the course should contact the instructor as soon as possible.

STUDENT CONDUCT

From the University Student Code, Article 1, Part 3: Students enrolling in the University assume an obligation to conduct themselves in a manner compatible with the University's function as an educational institution and suitable to members of the academic community. Students are responsible for knowing their rights and responsibilities as found in the student code at

http://www.admin.uiuc.edu/policy/code/index.html

COURSE CONTENT

Introduction

1. *City-Regions as Complex Systems under Transition*
   - Material and non-material structure and functions of a city-region, with living spaces, all infrastructure, citizens and key institutions.
   - City-regions as multi-level networks and/or systems of energy and material flows.
   - Interactions between different types of subsystems, especially the natural/technical features of the interactions and ways their dynamics can be represented quantitatively.
   - Outline main challenges of urban-regional transitions, vulnerabilities and resilience building, in the context of deep uncertainties

   Assignment. Dynamic Models

Social System Dynamics

2. *Humans in the Anthropocene*
    - Values and perceptions, from the individual to collective, from human nature to culture and science; from individual actions and choices to global impacts.
    - Focus on roles and actors, both human and organizational/institutional, and how these apply expert knowledge and methodologies in shaping urban-regional futures.
    - Ethical and functional role of ecosystems and biodiversity.
    - Innovation and transitions.
    - What kind of a future is desirable in the Anthropocene?

Assignment. Dynamic Models

3. *Demographics and Economics*
    - Economics and landuse
    - LEAMecon
    - Ecosystem services supply and demand
    - LEAM density calculations
    - LEAM social drivers
    - Market factors

    Assignment. Demographic Models
    Assignment. Economic Models

Physical System Dynamics

4. *Water Systems and Material Flows*
    - Water flow and use in urban systems
    - Material flows, transformation and storage
    - Technology for water and resources handing

    Assignment. Urban-Regional Models
    Assignment. The LEAM Model
    - LEAM accessibility calculation
    - Accessibility graphs
    - LEAM probability surfaces

5. *Transportation Systems*
    - Transportation models
    - 4 step models
    - Transportation impacts
        - congestion
        - carbon
    - LEAM model coupling
    - Transit issues and LEAM

` **A**ssignment. Transportation Models

6. *The Energy Systems*
    - Technology, building and system design
    - Policy assessment

    Assignment. CLEWS Model

7. *Other Systems Analysis*

- Ecosystem Services
- Stress analysis

` **A**ssignment. Ecosystem Service Model
Assignment. Ecosystem Stress Model

Urban Systems Integration

8. Cities Visions and Intelligence

- Urban metabolism and symbiosis
- The social and infrastructural significance of ICT and big data; the challenges of integration.
- Modeling as process of understanding, conceptualising, formulating, experimenting, learning about urban/complex systems.
- Different types of tools/models operationally used on different levels in urban context; modular structure of models; validation and calibration; evaluation and learning.
- Developing global networks for cities intelligence.

` **A**ssignment. Data Visualization.

9. Planning Support Systems and Cloud computing

- History of planning support systems
- PLONE
- LEAM coud
- Running LEAM

Assignment. PSS Implementation

Communication and Innovation

10. Collaborative processes, decision making and uncertainty

- Scientific/theoretical basis of the social dimensions of urban systems analysis and planning, the socio-human side.
- Decision-making and planning theories.
- Decision-making from the individual to collective/institutional levels.
- Role of various types of tools and models in these processes.
- Critical discourse on institutional planning and decision-making under (deep) uncertainty.
- Alternative frameworks for collaborative processes and consensus building.
- Scenario building
    - back casting, forecasting

Assignment. Scenarios and Scenario Analysis

11. Comparative Analysis, Systems Learning and Innovation

- Understanding local, regional and global impacts of city-regions, on short and long time scales.
- Alternative approaches and tools for environmental impact assessment of city-regions.
- City2city “peer” learning networks, framework for comprehensive and systematic comparative studies of cities; role of innovation.
- Comparison, collaboration and competition among cities.

Assignment. Comparative Analysis

Application

12. Interdisciplinary Projects

- students choose a topic and develop it as a project.

        - The project can either focus on a specific engineering topic that will typically include socioeconomic aspects such as analysis and design of underground facilities, analysis and design of small-scale waste water treatment facilities, or on a broad topic such as regional or transportation planning.
    - The student considers the whole process including problem formulation, characterization, conceptualization/process definition, analytical and quantitative analyses, evaluation and finally communication of project outcomes.
13. *Project work*
14. *Presentations / Papers*
    - Presentations
        - Presented to multi institutional set of faculty
        - Travel?
    - Papers
        - academic research type term papers for grade