Syllabus
Civil Engineering 560.608
Multilevel and Multiobjective Optimization in Systems
Fall, 2016
(3 credits, Graduate)

Description
Provide an introduction to multilevel and multiobjective optimization problems involving systems. The course will start with an introduction to optimization theory followed by looking at formulating interventions in advanced equilibrium problems including market, spatial, and network models. Solution techniques to these types of problems will be discussed, along with applications to systems engineering.

Instructor
Prof. Sauleh Siddiqui, siddiqui@jhu.edu, http://ce.jhu.edu/sauleh/
Office: Latrobe 109, 410-516-6411
Office hours: By appointment

Meetings
Tuesday, Thursday, 3:00–4:15 pm, Maryland 226

Textbook
There are no required texts for this course, but the readings are available online through the JHU library and will be made available on blackboard as well. Some good references are:

2) (JL) Linear Programming by Jon Lee (JL) (https://umich.app.box.com/s/aov81syecqxlz0tyonhy23itsstjip4t4);
3) (BV) Convex Optimization by Boyd and Vandenberghe, (http://stanford.edu/~boyd/cvxbook/);
5) (IP) Integer programming by Conforti, Cornuejols, Zambelli

Online Resources
Please log in to Blackboard for all materials related to this course.

Course Objectives
Upon successful completion of EN.560.608, students will be able to:
- Formulate multiobjective and multilevel optimization problems in words with individual objective and constraints for each problem
- Program algorithms for these problems using software (GAMS, MATLAB, etc.) and obtain solutions
- Define what it means for a system to be in equilibrium and how to intervene in such a system
Course Topics
This course provides an introduction to multilevel and multiobjective problems involving systems. This course is application based, and the goal of this course is to expose you to mathematical decision tools used in systems. This class requires the use of a programming package (e.g. GAMS, MATLAB, or AMPL).

Course Expectations & Grading
A problem set will be due on **Wednesdays at 11pm** as indicated in the syllabus. Late problem sets will not be accepted. Students are permitted and encouraged to work together on problem sets as long as they cite all their names in their individual submissions. All problem sets must be submitted on blackboard and typed up professionally in complete sentences. I expect the solutions to read like academic research papers. I encourage you to use LaTeX or at least MathType/Microsoft equation.

The project will analyze one or more multilevel or multiobjective optimization topics by implementing an appropriate model on a problem with real or realistic data OR explaining and implementing a model described in an academic paper. Students are encouraged to talk with me about possible topics prior to the proposal deadline. I expect groups to be composed of 2-3 students with the understanding that all students must contribute significantly on all phases of the project (proposal, plan, and presentation).

1) **(20 Points)** Written proposal for intended project due **October 19th, 11pm** on Blackboard. This should be no more than 1000 words. You should include why you are interested in the project, what is the model you will build and code, sources for data, and your expected outcome.

2) **(25 Points)** Annotated code in GAMS or MATLAB written for the project along with all datasets in a zip file. Should be descriptive enough to not require further instructions for implementation with all variables, equations, definitions clearly annotated and run when I press run.

3) **(10 Points)** Evaluation of other presentations during the final week of class

4) **(45 Points)** Final presentation (to be scheduled during the final week of class, but due in electronic form by **December 5th, 5pm**). No late presentations accepted.

The grade for the course project will be based on the creativity in the presentation, the professionalism of the work (e.g., clear arguments with ample documentation for data files, software used, etc.), as well as the overall quality of the project.

Grading

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<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Problem Sets</td>
<td>50%</td>
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<tr>
<td>Midterm</td>
<td>25%</td>
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<tr>
<td>Project</td>
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A(94%+), A-(90%-94%), B+(87%-90%), B(84%-87%), B-(80%-84%), C+(77%-80%), C(74%-77%), C-(70%-74%), D+(67%-70%), D(64%-67%), D-(60%-64%), F(60% or below)

Ethics
The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. In addition, the specific ethics guidelines for this course are:
You are allowed to work together on homeworks but you must write your own code and submission.
You are not allowed to work with anyone on the midterm
You must report any violations you witness to the instructor.

You can find more information about university misconduct policies on the web at these sites:
- For undergraduates: http://e-catalog.jhu.edu/undergrad-students/student-life-policies/
- For graduate students: http://e-catalog.jhu.edu/grad-students/graduate-specific-policies/

Students with Disabilities
Any student with a disability who may need accommodations in this class must obtain an accommodation letter from Student Disability Services, 385 Garland, (410) 516-4720, studentdisabilityservices@jhu.edu.

TOPICS AND READINGS: Spring 2016
*There are additional readings on blackboard

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<tr>
<th>Week</th>
<th>Topic</th>
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<td>1.</td>
<td>Tuesday, Sep 6  Convex Optimization, (BV Chapters 1,4,5)</td>
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<td>2.</td>
<td>Tuesday, Sep 13  Convex Optimization (Continued)</td>
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<td>3.</td>
<td>Tuesday, Sep 20  Integer Optimization (IP Chapters 1,2), PS 1 Due Wed</td>
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<td>4.</td>
<td>Tuesday, Sep 27  Complementarity problems (CEM Chapters 1,2,3,4)</td>
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<td>5.</td>
<td>Tuesday, Oct 4  MPECs (CEM Chapters 2,8,3,5,6) PS 2 Due Wed</td>
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<td>6.</td>
<td>Tuesday, Oct 11  Midterm (No Class all week)</td>
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<td>7.</td>
<td>Tuesday, Oct 18  Multiobjective Optimization, Proposals Due Wed</td>
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<td>8.</td>
<td>Tuesday, Oct 25  MOPECs</td>
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<td>9.</td>
<td>Tuesday, Nov 1  EPECs (CEM Chapter 7), PS 3 Due Wed</td>
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<td>10.</td>
<td>Tuesday, Nov 8  EPECs (No Class Nov 10)</td>
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<td>11.</td>
<td>Tuesday, Nov 15  Binary Equilibrium, PS 4 Due Wed</td>
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<td>12.</td>
<td>Tuesday, Nov 28  Binary Equilibrium</td>
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<td>13.</td>
<td>Tuesday, Dec 6  Project Presentations</td>
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<td>14.</td>
<td>Exam Week  Problem Set 5 Due</td>
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