

AGENDA

Reconnect 2022 Optimization

June 12-17, 2022

Chauncey Conference Center, ETS, Princeton NJ

The notion of optimization is ubiquitous in everyday life—nearly every decision, at its core, is an optimization problem. The broad field of “optimization” emerged to provide the language and tools to surmount complex problems in real applications, and optimization tools and algorithms have since transformed fields ranging from biology to finance. Optimization capabilities touch our everyday lives through more efficient supply chains, better traffic management, and more secure power grids. In the short history of the field of mathematical optimization, advances in underlying theory, practical implementation, and computing power have brought us from solving linear programs (LPs) with a few hundred variables to those with more than a million, and widely available general-purpose solvers make sophisticated tools for linear, integer, and nonlinear programming broadly accessible.

Reconnect 2022 will review classic methods for linear and integer programming with an eye toward introducing software tools and activities that are engaging and accessible for use with students. The workshop will also explore a variety of real-world applications that make use of optimization methods. Several researchers affiliated with the newly established DHS Center of Excellence, SENTRY, will provide an overview of SENTRY’s research mission and offer examples of how they will use optimization methods in the center’s research. These include allocating resources for disaster management, deploying “virtual sentries” to protect civilian spaces—so-called “soft targets”—around the country, and several others.

Sunday, June 12 – Welcome dinner at 6:30 PM at the Conference Center – **Solomon room**

Introductions, including by Michael Silivitch, Northeastern University and PI for the SENTRY COE

Expectations for the week Midge Cozzens

Monday June 13:

7:00 - 9:00 AM Breakfast at the Center - **Solomon room**

9:00 Overview of the week – Midge Cozzens, Rutgers – **Mallard room (daily)**

Welcome and Description of SENTRY, the DHS Center of Excellence at Northeastern University – Michael Silivetch, School of Engineering (video)

9:45 Robert Vanderbei, Professor of Operations Research, Princeton University

The talk will start with a refresher on some key traditional optimization algorithms for solving linear (and maybe quadratic) optimization problems. The talk will cover a few interesting variants of the simplex method and will show how to use an online pivot tool to solve

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problems of this type. For the second half of the talk we will look at some real-world examples including the Markowitz model for portfolio selection and a linear programming model to adjust for grade inflation.

10:45 Break - **Mallard Foyer room**

11:15 Continuation of Robert Vanderbei's talk with discussion

12:00 - 1:00 Lunch at the Center - **Solomon room**

1:30 Optimization Activities

3:00 Break - **Mallard Foyer room**

3:30 Discussion of possible modules and discussion of activities

5:00 End for the day with assignment of two problems to think about

6:00 -7:30 Dinner at the Center – **Solomon room**

7:00 Slide show of optimization techniques and the night sky, Bob Vanderbei

Tuesday, June 14, 2022

7:00 - 9:00 AM Breakfast at the Center - **Solomon room**

8:30 Review of Monday's material and discussion of the two homework problems, Bob Vanderbei

9:15 Robert Bosch, Professor at Oberlin College:
Opt Art: From Mathematical Optimization to Visual Design

I will describe how I have used discrete linear optimization (integer programming) to design mosaics. Examples will include mosaics made out of complete sets of dominos, map colored mosaics, Game-of-Life mosaics, and lenticular dice mosaics. In this part of the talk, I will review branch and bound, discuss various tricks for modeling with binary variables, and share my experience in using "Opt Art" projects in undergraduate mathematics and computer science courses.

10:15 Break - **Mallard Foyer room**

10:45 Continuation of Bosch talk

I will focus on Opt Art projects related to the Traveling Salesperson Problem: continuous line drawings obtained by finding high quality solutions to large-scale TSP instances, figurative tours, and knight's tours. In this part of the talk I will spend some time on cutting plane algorithms and heuristics.

12:00 - 1:00 Lunch - **Solomon room**

1:30 Optimization Activities

3:00 Break - Mallard Foyer room

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- 3:30 Discussion of possible modules and discussion of activities
- 5:00 End for the day with assignment of two problems to think about
- 6:00 -7:30 Dinner at the Center – **Solomon room**

Wednesday, June 15, 2022

- 7:00 - 9:00 AM Breakfast at the Center - **Solomon room**
- 8:30 Review of Tuesday’s material and discussion of the two homework problems and possible modules
- 9:30 Jun Zhuang, University of Buffalo Industrial Engineering Department Professor
“Game Theory, Optimization, and Homeland Security”: We will introduce the elements of game theory, different types of game-theoretical models, interaction to optimization, and some applications to homeland security and disaster management.
- 10:30 Break - **Mallard Foyer room**
- 11:00 Continuation of talk by Jun Zhuang
- 12:00 - 1:00 Lunch - **Solomon room**
- 1:30 Activities suggested by Jun
- 3:00 Break - **Mallard Foyer room**
- 3:30 Rusty Lee, Professor University of Delaware

The Multi-Network Interdependent Critical Infrastructure Program for Analysis of Lifelines (MUNICIPAL) is a set of mixed integer models designed as a decision support system for infrastructure system managers. MUNICIPAL was designed to model any set of systems and their interdependencies, its interconnectivity to other systems. The original model was designed to assist in system restoration following a disruptive event and conduct vulnerability assessments of this set of systems. It has also seen applications in resource allocation following natural and man-made disasters and in analyzing and improving supply chains.

- 4:30 Discussion
- 4:15 Report of module topics considered and formation of groups
- 5:00 Two homework problems to think about.
- 6:00 -7:30 Dinner – **Solomon room**

Thursday, June 16, 2022

- 7:00 - 9:00 AM Breakfast at the Center - **Solomon room**

8:30 Discussion of homework questions

9:30 Carl Crawford (stay Wed night) CSUPTWO, a consulting practice specializing in medical imaging, Homeland Security, and product development. He will talk about applications of optimization tools to industry and the government.

10:30 Break - **Mallard Foyer room**

11:00 Continuation of the talk by Carl Crawford

12:00 - 1:00 Lunch - **Solomon room**

1:30 Activities suggested by speakers and others, discussion of module topics and teams

3:00 Break - **Mallard Foyer room**

3:30 Work in groups around module topics

4:30 Talk

6:00 -7:30 Dinner – **Solomon room**

Friday, June 17, 2022

7:00 - 9:00 AM Breakfast at the Center - **Solomon room**

8:30 Wrap up discussion of the week

9:30 Participants present their module topics and the groups working on the topics.
Discussion and feedback from all participants.

12:00 - 1:00 Box lunches - **Mallard Foyer room**