Programme Doctoral en Recherche Opérationnelle

Zinal Winter Seminar 2016, January 17–21

	Sunday 17	Monday 18	Tuesday 19	Wednesday 20	Thursday 21
07:30 - 08:30		Breakfast	Breakfast	Breakfast	Breakfast
08:30 - 10:00		Gendron	Jaillet	Gendron	Jaillet
10:00 - 10:30		Coffee	Coffee	Coffee	Coffee
10:30 - 12:00		Jaillet	Gendron	Jaillet	Gendron
12:00 - 17:00		Sport and discussions			
17:00 - 18:00		Paper Presentation Workshop	Paper Presentation Workshop	Paper Presentation Workshop	
18:00 - 19:00	Welcome cocktail				
19:30	Dinner	Dinner	Dinner	Dinner	

Venue:
Hotel Europe
3961 Zinal
Tel.: 027 475 44 04

Public transport:
Station *Zinal Poste*

Sports options:

- Skiing: `http://www.rma.ch/tourisme/tarifs-hiver-2015-2016-39.html`
  Bring your keycard from last year if possible.
- Tobogganing: Rent a toboggan for 12.- a day in every sports shop in Grimentz: `http://www.rma.ch/tourism/toboggan-trails-69.html`. Bus: Zinal 12:07 - Grimentz 12:26 and Grimentz 14:49 - Zinal 15:10 or Grimentz 16:22 - Zinal 16:43
- Ice Skating, for example in Zinal: Free entrance:
  `http://www.valdanniviers.ch/tourism/skating-rinks-1609.html`
- Curl'Charlette (a form of Curling): Equipment can be rented for free at the Tourist Office in Zinal. Max. 8 people at the same time.

Keynote presentations

Bernard Gendron (Université de Montréal): **Decomposition for Network Design**

This lecture series will focus on network design problems arising in transportation and logistics. We will classify network design problems and some of their most important features, including the interplay between investment and operational costs, the multicommodity aspect, and the presence of capacity constraints. We will study mathematical programming approaches and present methods designed to solve large-scale network design instances: cutting-plane and column generation methods, as well as Benders decomposition and Lagrangian relaxation approaches.

Lecture 1: Basic notions of mixed-integer programming

We review the basic notions of linear and mixed-integer programming, including polyhedral theory. This is necessary material to understand the decomposition methods covered in the lecture series. The lesson ends with the study of modeling alternatives for a simple network design problem, the two-level uncapacitated facility location problem.

Lecture 2: Introduction to network design and decomposition

Following a short description of network design problems, we study classical decomposition methods: cutting-plane and column generation, as well as the celebrated Benders decomposition and Lagrangian relaxation approaches.

Lecture 3: Multicommodity capacitated fixed-charge network design

We focus on a difficult network design problem, the multicommodity capacitated fixed-charge network design, and study the application of the decomposition methods seen in Lecture 2.

Lecture 4: Multicommodity capacitated network design

We study a problem similar to that of Lecture 3, where instead of a fixed cost for using an arc, a cost for installing capacity units on an arc has to be paid. This problem is generally modeled with general integer variables. We show how to reformulate the problem with binary variables, provide a Lagrangian-based interpretation of this reformulation, and show how to solve it with a column-and-row generation method.

Patrick Jaillet (MIT): **Online Learning and Optimization under Uncertainty**

There are many situations in which present actions must be made and resources allocated with incomplete knowledge of the future. The difficulty in these situations is that we may have to make decisions based only on the past and on the current task we have to perform. It is not even clear how to measure the quality of a proposed decision strategy, unless we make some additional assumptions about what we mean by uncertainty.

In the so-called adversarial setting, a proposed "online" strategy which operates with no knowledge of the future is compared with the performance of an optimal offline strategy that has complete knowledge of the future (and can adversarially choose that future to make the proposed online strategy the worst possible). This worst-case situation provides a baseline for what more one can achieve under additional information.

If the future can be described with a probabilistic model, and that model is precisely known to the decision maker/strategy designer, one could hope to find strategies which may perform better "on average".

If the future does come from an underlying probabilistic structure, but that structure is not known a priori to the decision-maker, or may be known only approximately, but could potentially be learned along the way, strategies involving both learning and optimization may be the right approach.

In this series of lecture we will provide an overview of the state of the art associated with several relevant frameworks (online optimization, online learning, data-driven optimization) for tackling such questions. Motivated by important practical applications, we will specifically concentrate on online variants of two classical optimization problems in operations research, (i) bipartite matching and (ii) linear programming.

Lecture 1: Introduction - Main concepts and frameworks

Lecture 2: Online bipartite matching problems and variants

Lecture 3: Online linear programing problems and variants

Lecture 4: What about data-driven optimization?

Paper Presentation Workshop

1. **Cordeau, J.; Costa, A. M.; Gendron, B. (2009): Benders, metric and cutset inequalities for multicommodity capacitated network design. Computational Optimization and Applications 42, 371–392**

   Cevallos Manzano Alfonso (EPFL), Forrer Salome (UNIBE), Lücker Florian (EPFL)

2. **Chouman, M.; Crainic, T. G.; Gendron, B. (2015): Commodity Representations and Cutset-Based Inequalities for Multicommodity Capacitated Fixed-Charge Network Design. Transportation Science, to appear**

   Pacheco Paneque Meritxell (EPFL), Strub Oliver (UNIBE), Vié Marie-Sklaerder (UNIGE)

3. **Jaillet, P.; Wagner, M. (2008): Generalized Online Routing: New Competitive Ratios, Resource Augmentation and Asymptotic Analyses. Operations Research 56, 745-757**

   Bongiovanni Claudia (EPFL), Nassajian Mojarrad Hossein (EPFL), Rihm Tom (UNIBE), Shafieezadeh Abadeh Soroosh (EPFL)

4. **Jaillet, P.; Lu, X. (2014): Online Traveling Salesman Problems with Rejection Options. Networks 64, 84-95**

   Bellocchi Leonardo (EPFL), Kocyigit Cagil (EPFL), Zimmermann Adrian (UNIBE)

Organization of the workshop:

- Objective: provide an overview of the paper and present some parts of the paper in detail (e.g., by presenting an illustrative example)
- Presentation should take approximately 20–25 minutes per group (30 minutes for groups of 4 students)
- Active participation in preparation and in presentation: 1 ECTS per seminar (can be accumulated)
- First group meeting on Monday after lectures
- Bernard Gendron and Patrick Jaillet will be present on Monday and on Tuesday 5–7pm for discussing questions of the students (bar area of the hotel)
- Presentations: Wednesday 5–7pm (lecture room)