Programme Doctoral en Recherche Opérationnelle

Zinal Summer Seminar 2015, June 7-11

	Sunday 7	Monday 8	Tuesday 9	Wednesday 10	Thursday 11
07:30 - 08:30		Breakfast	Breakfast	Breakfast	Breakfast
08:45		Cable Car			
9:00 - 10:30		Ahmed		Coffee	Stauffer
10:30 - 11:00		Coffee		Ahmed 10:00-11:30	Coffee
11:00 - 12:30		Stauffer	Stauffer		Ahmed
12:30 - 13:30		Lunch	Lunch	Lunch 11:45-13:00	
13:30 - 14:00		Cable Car		Stauffer 13:00-14:30	
14:00 - 15:00		Sport and discussions	Ahmed 14:00-15:30		
15:00 - 17:00				Paper Presentation Workshop	
17:00 - 18:00		Paper Presentation Workshop	Paper Presentation Workshop	Apéro	
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

- Minigolf in Zinal. Equipment can be borrowed for free at the Tourist Office.
  `http://www.valdanniviers.ch/tourism/minigolf-zinal.html`
- There are a lot of hiking possibilities, depending on the snow remaining.
  For the hiking map click here: `http://www.valdanniviers.ch/data/montagne/documents/Anniviers/Plans_Rando/Plan_rando_t_SITE.pdf`

Keynote presentations

Shabbir Ahmed (Georgia Tech): **Stochastic Integer Programming**

Title: **Stochastic integer programming: An overview**

Abstract: Stochastic integer programs combine the complexities associated with integer programming with those of stochastic programming and represents a formidable problem class. On the other hand numerous important applications give rise to such problems urging the need for effective resolution techniques. The last few decades have witnessed enormous progress in computational technologies for deterministic integer programming. Combining these with the developments in stochastic programming presents us with an unprecedented opportunity to address algorithmic stochastic integer programming. In this lecture we will review some of the progress on this front. In particular we will discuss computational challenges, sampling based approximations, and present an overview of various decomposition techniques for these problems.

Title: **Cutting planes for stochastic integer programming**

Abstract: Cutting planes are one the most computationally effective tools for solving integer programming problems. A tremendous amount of research has been, and continues to be, conducted on studying wide classes of cutting plane schemes. However much of these developments are restricted to deterministic integer programming problems, and do not extend in a straightforward manner to the stochastic setting. In this talk, we survey our work on extending deterministic cutting plane theory to stochastic integer programming. The key element in our approach is to non-trivially combine deterministic cuts from different scenarios of the uncertain problem paramters to obtain a strong cut for the stochastic problem. We illustrate this scheme on some classes of multi-stage stochastic integer programs as well as chance constrained stochastic programs.

Title: **Exploiting submodularity in stochastic integer programming**

Abstract: Various classes of stochastic integer programming models can be reformulated as deterministic formulations involving non-linear functions of binary variables that exhibit a diminishing marginals property knows as submodularity. In this lecture we focus on linearization techniques for submodular functions to take advantage of mixed-integer linear programming solvers. Standard linearization approaches designes for general submodular functions are typically ineffective, except for very small instances. By exploiting the specific structure of submodular functions arising in stochastic integer programs we develop significant strengthening of the linearization techniques. Computational experiments on expected utility maximization in capital budgeting show the effectiveness of the proposed approaches. Time permitting we will also dicuss approximation algorithms for some classes of stochastic integer programs involving submodularity.

Title: **Scenario decomposition of stochastic integer programs**

Abstract: In this lecture, we present a scenario decomposition algorithm for stochastic programs involving binary variables based on relaxing non-anticipativity constraints. The algorithm recovers an optimal solution by iteratively exploring and cutting-off candidate solutions obtained from solving scenario subproblems. The scheme is applicable to quite general problem structure and can be implemented in a distributed framework. We provide a theoritical justification of the effectiveness of the proposed scheme. We also extend the approach to risk averse and chance-constrainted stochastic 0-1 programs. Illustrative computational results demonstrating near linear parallel speedup on standard test instances are presented.

Gautier Stauffer (Grenoble INP): **Stochastic Shortest Path: From Golf to Research**

The stochastic shortest path problem is a natural generalization of the classical shortest path problem whereby deciding to traverse an arc does not necessarily bring you to a pre-determined vertex but might have several outcomes, with different probabilities. This is typically the case in the game of golf: A player wants to hole his ball in as few shots as possible by choosing sequentially a target to aim at; however he might end up in neighboring positions whose distance to the original target might vary according to his skills. If the golfer's goal is to minimize his average score and if we assume that the probabilities are independent on the history (they only depend on the current vertex / position), the problem is a special case of Markov Decision Process (MDP). In this series of lectures, we will introduce MDPs, recall the standard results (structural and algorithmic) and explain the pecularities of the stochastic shortest path problem and the current state of the art. We will then discuss the relation with network flows and present possible research directions.

Lecture 1: Motivation and introduction to Markov Decision Process: Optimizing Golf strategy

Lecture 2: Foundation of Markov Decision Process

Lecture 3: Stochastic shortest path: State of the art

Lecture 4: Stochastic shortest path: Relation to network flows and research questions