EURO PhD School on Routing and Logistics

Department of Economics and Management

University of Brescia

June 24th - July 3rd, 2015

FINAL REPORT

General information

Location:

Department of Economics and Management, University of Brescia – Italy

Dates:

June 24th (Wednesday) - July 3rd (Friday), 2015

Organizing committee:

Speranza M.Grazia (chair), Angelelli Enrico, Archetti Claudia, Bertazzi Luca, Bianchessi Nicola, Filippi Carlo, Fontana Dario, Guastaroba Gianfranco, Mansini Renata, Morandi Valentina, Vindigni Michele.

Scope:

The School aims at training PhD students in the area of routing and logistics and is organized with the financial support of EURO.

Topics:

Introduction to routing and logistic problems, branch-and-cut methods, branch-and-price methods, design and analysis of heuristics, worst-case analysis, arc routing problems, optimization problems in logistics, software and applications.

Maximum number of participants: 35

ECTS credits:

2 credits (50 hours: classes 3h/day, supervised training 3h/day, personal work 1h/day).

Registration fee:

300 Euros. The registration fee covered accommodation in a twin room with breakfast (a limited number of single rooms are available at an extra cost of 8 euro per night), conference material, coffee breaks, lunches, social activities and social dinner. The EURO working group VeRoLog covered the registration fee for two students.

Application deadline: January 31st, 2015.

Notification of acceptance: February 15th, 2015.

Deadline for the payment of the registration fee: February 28th, 2015.

Contact: eps.ral@unibs.it

Web site: http://eps-ral.unibs.it/

How to apply

The following information was posted on the web site to inform the potential applicants.

Eligibility:

Participants have to be from a EURO member society country, or studying in a EURO member society country. They have to be enrolled in a PhD program and, preferably, in early stage of their studies. A maximum number of 35 participants will be accepted.

Scientific prerequisites:

The interested students should know linear programming, mixed integer linear programming and a computer language.

Application:

Interested students should send the following documents to eps.ral@unibs.it within January 31st, 2015:

1. Application letter including:
   a. Name, affiliation and email address;
   b. PhD program you are enrolled in, current stage of studies, your supervisor's name;
   c. Background possessed: linear programming, mixed integer linear programming, a computer language;
   d. Motivation to attend the School;
   e. Possible motivated request for financial support from VeRoLog (the registration fee of two students will be covered).
2. Curriculum vitae.
3. A recommendation letter from the supervisor.
4. Accommodation requests:
   a. Arrival and departure dates if different from June 24 and July 3;
   b. Person you are willing to share the twin room OR specify you prefer a single room at extra cost of 8 Euro per night.

Participants

Applications:

87 applications were received.

Selection process:

We selected the students on the basis of the following criteria:

- Stage of the PhD program (early stage preferred)
- Interest in the topic of the school
- Letter of recommendation
- Group balance (we selected at most 1 student per supervisor)
- Country balance
- Gender balance

Admitted students:

We admitted 35 students from 15 Countries, as described below:

Student	Country	Supervisor
Ait Haddadene Syrine Roufaida	France	Nacima Labadie
Amorosi Lavinia	Italy	Paolo Dell'Olmo
Arslan Alp Muzaffer	The Netherlands	Niels Agatz
Baller Annelieke	The Netherlands	WEH Dullaert
Ben Ticha Hamza	France	N. Absi, D. Feillet
Bencomo Dominguez Martin	Spain	JJ Salazar
Brandstatter Georg	Austria	Markus Leitner
Bruck Bruno Petrato	Italy	Manuel Iori
Clemente Monica	Italy	Walter Ukovich
Daza Escorcia Julio Mario	Spain	EB Lopez
De Maio Annarita	Italy	R. Musmanno
Doege Alexander	Germany	Rainer Kolisch
Eisenhandler Ohad	Israel	Michal Tzur
Farham Mohammad Saleh	Turkey	Haldun Sural
Huerta Diana	Spain	Elena Fernandez
Keskin Merve	Turkey	Bülent Çatay
Koza David Franz	Denmark	Stefan Ropke

Student	Country	Supervisor
Markov Iliya	Switzerland	Michel Bierlaire
Michelini Stefano	Belgium	Yasemin Arda
Mirhedayatian Seyed Mostafa	Norway	William Wallace
Montoya Echeverri Jose Alejandro	France	Jorge Mendoza
Moreira Fabio	Portugal	Bernardo Almada-Lobo
Nikolopoulou Amalia	Greece	Christos Tarantilis
Padungwech Wasin	United Kingdom	Jonathan Thompson
Peiro Juanio	Spain	Angel Corberan
Pollaris Hanne	Belgium	Gerrit Janssens
Sadati Mir Ehsan Hesam	Turkey	Denis Aksen
Sarasola Briseida	Austria	Karl Doerner
Tamke Felix	Germany	Udo Buscher
Turkes Renata	Belgium	Kenett Sorensen
Van Den Bossche Thomas	Belgium	Greet Vanden Berghe
Vargas Suarez Leticia Gloria	France	Nicolas Jozefowiez
Victoria-Trujillo Jorge Fernando	France	Christian Prins
Zajac Sandra	Germany	Martin Josef Geiger
Zambirinis Sofoclis	United Kingdom	Richard Eglese

Academic program

Methodology:

The School was organized in morning and afternoon sessions. All morning sessions were devoted to lectures delivered by experienced and well known scientists. Afternoon sessions took place in a computer lab and were aimed at enabling the students to learn how the models and methods presented in the mornings can be implemented.

Lecturers and titles of lectures:

- M.G. Speranza (Univ. of Brescia) *Introduction to routing and logistics*
- J.-F. Cordeau (HEC Montreal - Canada) *Branch-and-cut methods*
- S. Irnich (Univ. of Mainz - Germany) *Branch-and-price methods*
- D. Vigo (Univ. of Bologna) *Heuristics*

- L. Bertazzi (Univ. of Brescia) *Inventory routing*
- A. Corberan (Univ. of Valencia - Spain) *Arc routing*
- F. Semet (Ecole Centrale de Lille - France) *Optimization problems in logistics*
- M. Savelsbergh (Georgia Tech - Atlanta - USA) *Applications*
- C. Archetti, E. Angelelli (Univ. of Brescia) *Computer Lab*
- M. Vindigni, E. Angelelli (Univ. of Brescia) *Tools for street level routing*

Schedule:

	9.00-10.30	10.30-11.00	11.00-12.30	12.30-14.00	14.00-15.30	15.30-16.00	16.00-17.30
Jun-24 - Wednesday					Lecture: **M.G. Speranza**		Lecture: **M.G. Speranza**
Jun-25 - Thursday	Lecture: **J.-F. Cordeau**	*Coffee break*	Lecture: **J.-F. Cordeau**	*Lunch*	Lab: **C. Archetti E. Angelelli**	*Coffee break*	Lab: **C. Archetti E. Angelelli**
Jun-26 – Friday	Lecture: **S. Irnich**		Lecture: **S. Irnich**		Lab: **C. Archetti E. Angelelli**		Lab: **C. Archetti E. Angelelli**
Jun-27 - Saturday							
Jun-28 – Sunday							
Jun-29 - Monday	Lecture: **D. Vigo**	*Coffee break*	Lecture: **D. Vigo**	*Lunch*	Lab: **C. Archetti E. Angelelli**	*Coffee break*	Lab: **C. Archetti E. Angelelli**
Jun-30 - Tuesday	Lecture: **L. Bertazzi**		Lecture: **L. Bertazzi**		Lab: **C. Archetti E. Angelelli**		Lab: **C. Archetti E. Angelelli**
Jul-01 - Wednesday	Lecture: **A. Corberan**		Lecture: **A. Corberan**		Lab: **C. Archetti E. Angelelli**		Lab: **C. Archetti E. Angelelli**
Jul-02 - Thursday	Lecture: **F. Semet**		Lecture: **F. Semet**		Lab: **M. Vindigni E. Angelelli**		Lab: **M. Vindigni E: Angelelli**
Jul-03 - Friday	Lecture: **M. Savelsbergh**		Lecture: **M. Savelsbergh**				

Focus on lab:

Computer lab was focused on heuristic and exact approaches for routing problems. The sessions took place in a lab equipped with a personal computer for each student. The

programming language used was Java 8 with IDE NetBeans 8. Cplex 12.6 was used as exact solver.

A framework embedding exact and heuristic algorithms for the Traveling Salesman Problem (TSP) was provided to the students and presented during the sessions.

The first two afternoons were devoted to exact solvers. The following topics were covered: solving the TSP using a compact formulation with a standard branch-and-bound algorithm, inserting cuts for a branch-and-cut algorithm, implementing ad-hoc branching rules. The following two afternoons were devoted to heuristic algorithms. The following topics were covered: constructive algorithms for the TSP (nearest neighbor, cheapest insertion), local search and variable neighborhood search.

The sessions were organized as follows. First, the routines implemented in the framework were shown to the students, then exercises were provided which consisted in implementing new procedures. Finally, a challenge was organized where the students were asked to develop exact or heuristic approaches for the solution of the Orienteering Problem (OP). The last afternoon was dedicated to the challenge. The students were organized in groups of two or three members. The codes developed by all groups were then tested on a set of instances and on a single machine and winners were identified and celebrated at the end of the last morning lecture.

The last day focused on an introductory overview of tools and methods for Street Level Routing. The practical lecture aimed at showing, through the examples provided by different software, which information is made available today by various open and legacy GIS systems and show how data from different sources can be easily integrated to solve a (not so) simple VRP problem on the road network as a case study.

Some interesting geodata sources (Open Street Map, Google Maps, etc ...) were analyzed in detail and we discussed how to put together the different information layers involved in a real world application working with "maps": the rendering of the maps starting from vector or raster data, the geocoding process, where GPS coordinates are retrieved starting from addresses, and the routing activity, aiming to find best routes between points on the map. In the last part we discussed several promising research directions, as the definition of ad hoc routing metrics for specific problems (oversize/emergency/security transports, restricted traffic zones, turning weights), and the integration of dynamic information (real time traffic, meteo, recurring traffic patterns).

Social Program

The social event took place on Saturday, June 27, 2015. In the early afternoon a tourist bus has left from Brescia heading to Sirmione, the so called "pearl of Garda lake", located on the border between Lombardy and Veneto, in an excellent position. The town of Sirmione is the most characteristic one of Garda Lake, located at the center of the lake at the tip of its peninsula, enclosed within the walls of an ancient scaligero castle. The old town offers to visitors a historical center completely pedestrian that important figures of the past decanted. The whole area on the top of the peninsula is occupied by Grotte di Catullo, a huge residential villa from the imperial Roman times, hosting the remains of a thermal complex of huge proportions. After a (not so) short guided tour through the town, participants were left free to explore the area on their own.

In the evening, a boat transfer has been organized to bring participants to Lazise, where the social dinner took place at Doana Restaurant (http://www.ristorantedoana.it/).

Lazise is a lakeside town with an authentic medieval feel. Located in the south eastern portion of Lake Garda, its name means "place on the lake." The town is enclosed in the 14th century walls built to provide the city with protection. The restaurant is located in the harbor area, close to the ancient Lazise Customs House (the "Doana"), that became center of trade in the area. After the dinner, some quality time was spent wandering through the narrow streets and shopping around.

Some pictures
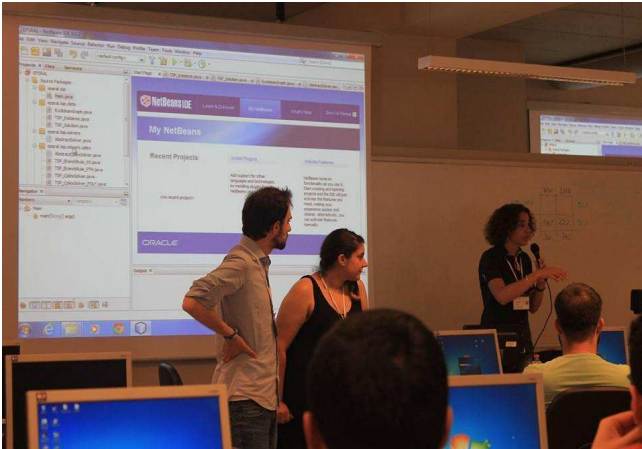
Financial report

The school had a total expenditure of € 26,505.00 and a total income of € 26,505.00. Expenditure items and income items are summarized in the balance sheet (see next page).

The **expenditures** are grouped in four sections: Hotel, Travel, Food/Beverage/Social, and Administration/Materials. The first section includes hotel expenses for speakers (lodged at "Albergo Orologio") and students (lodged at "Convitto Vescovile San Giorgio"). The second section includes travel expenses to and from the school venue for the speakers and travel expenses for the organizer committee during the preparation, implementation, and conclusion of the school. The third section includes all expenses for food and social activities. Since writing materials and bags have been offered by the Department of Economics and Management, the fourth section includes only the fee for "Rosa D'Eventi", the society that organized catering and social activities.

The **incomes** include only two items: EURO support and Student fees. Notice that 14 students asked for a single room accommodation, implying a total extra of € 1005.

Budget EPS - RaL

Expenditure

Item		Amount
Hotel		
Invited Speakers		
Savelsbergh	€	327.30
Cordeau	€	384.00
Irnich	€	192.00
Vigo	€	96.00
Corberan	€	192.00
Semet	€	178.00
Total	**€**	**1 369.30**
Students	€	7 980.00
Extras for single room	€	1 005.00
Total	**€**	**8 985.00**
Travel		
Invited Speakers		
Savelsbergh	€	1 000.04
Cordeau	€	1 270.00
Irnich	€	176.86
Vigo	€	86.00
Corberan	€	178.74
Semet	€	475.42
Total	**€**	**3 187.06**
Organizers		
Total	**€**	**1 266.30**
Food / Beverage / Social		
Coffee breaks	€	1 732.50
Lunches	€	5 197.50
Social dinner	€	1 265.04
Dinners (invited speakers)	€	1 467.30
Social activities		
Private Boat	€	420.00
Bus	€	460.00
Private tour guide	€	155.00
Total	**€**	**10 697.34**
Administration / Materials		
Administration and Secretariat	€	1 000.00
Materials	€	-
Bags	€	-
Total	**€**	**1 000.00**

Total expenditure	**€ 26 505.00**

Income

Item	Amount
EURO support	€ 15 000.00
Student Fees	€ 10 500.00
Extras for single room	€ 1 005.00

Total Income	**€ 26 505.00**