101st ESGI

European Study Groups with Industry in Portugal

5th - 9th May 2014

Universidade Nova de Lisboa
http://eventos.fct.unl.pt/esgi101

PT MATHS IN
rede portuguesa de **matemática** para a **indústria** e **inovação**

working groups

CHALLENGE 1

AMT (airline maintenance technicians) timetabling optimization

industry_**TAP Maintenance and Engineering**
sector_ **Aeronautic**

TAP Maintenance & Engineering provides integrated solutions for airline companies, from airframe, engines and components, to the engineering and material support. TAP Maintenance & Engineering and in particular the Line Maintenance Department, operates in the major Portuguese International Airports as well as in some other foreign stations offering a wide variety of services that includes pre-flight, transit and daily checks, troubleshooting and malfunction corrections, engine trend monitoring and pool agreements, for different aircrafts. This service must be developed ensuring high quality, and safety standards in agreement with tight schedules and predefined routing constraints, like AMT types certifications requirements. The management and allocations of the AMT (airline maintenance technicians) "in service" timetabling is crucial for the efficiency of the service provided, which depends on a correct adjustment of the working force to the continuous daily demand. Operating in a continuous base schedule, laboring timetabling has to meet several constraints such as seasonality, laboring and resting rules, allowed consecutive period switching, AMT types certifications among others. For simplicity reasoning the knowledge of an hour base daily deterministic demand is assumed. The challenge proposed by TAP Maintenance & Engineering is the development of a methodology for automatic generation of laboring timetabling for the AMT with the best adjustment to the predefined man work daily needs and in accordance to laboring rules.

CHALLENGE 2

Identification of energy supply units

industry_**EDP**
sector_ **Energy**

EDP is a company in the energy sector, with a consolidated position in the Iberian market. Its activity consists in production, distribution and selling of electricity and gas. It is among the major European operators in the energy sector, and is one of the largest energy operators of the Iberian Peninsula and the 3rd largest producer of wind energy in the world. In June 2007 a joint initiative of the Portuguese and Spanish Governments gave rise to the Iberian Electricity Market. In the daily electricity market, which takes place the day before energy is delivered, a price of the electricity for each hour of the delivery day (the market price) is settled. This price results from the matching of offers to buy and sell from different market agents through their supply units. On each day, agents (buyers and sellers) specify supply blocks, i.e., pairs consisting of a quantity and a price at which they propose to negotiate (buy or sell) energy, for each hour of the next day. These supply blocks are represented as supply curves depicting certain patterns. The challenge proposed by EDP is the following. Using past information on published daily data identifying production and/or technologies offers by the different units for past supply curves, the goal is to match, in the daily publication of offers from various supply units, each block to the corresponding supply unit.

CHALLENGE 3

Optimizing crew operations in railways and subways

industry_**SISCOG**
sector_ **IT and Software**

SISCOG – Sistemas Cognitivos is a Portuguese software company that develops products and systems that provide decision support for planning, managing, and dispatching resources in transportation companies. The challenge that SISCOG brings to ESGI101 is to improve one of the combinatorial optimization algorithms used by CREWS. CREWS is the most mature and deployed product developed by SISCOG. It is being used nowadays to perform the work assignments of more than 20,000 drivers and guards on several European countries on a daily basis. The challenge that SISCOG brings to ESGI101 is the following: find an algorithm to solve the shortest path with additional constraints that outperforms the existing algorithm implemented in CREWS.

CHALLENGE 4

Packing and shipping cardboard tubes efficiently

industry_**Spiralpack**
sector_ **Pulp, Paper and Cork**

SpiralPack – Manipulados de Papel, S.A. is a Portuguese company specializing in the production of tubes, angles, multipurpose packaging and cardboard formwork, supplying their products to several sectors, and one of the main Iberia players on the production of standard and high performance cardboard tubes. In the context of tube manufacturing, there are certain processes that SpiralPack would like to improve. With a production totalling almost 17.5 million tubes/year, arising from more than 1500 different references corresponding to almost 100 tubes with different diameters, an important part of Spiralpack resources is assigned to the packing and shipping process. Currently, tubes with the same reference are grouped in three different ways: honeycomb shape, vertically or horizontally. The grouping may depend on the client specification and the tube size (e.g. the transportation vehicle height is an important restriction on the way the tube is packed). After grouping the tubes, they must be packed in a container, and for that purpose they are placed on palettes either in vertical or horizontal orientation and, in some cases, placed in rectangular cardboard boxes. Spiralpack would like to address the following questions:

- Given an order for a certain reference or a grouping specification request, what is the maximum number of tubes that can be packed inside a given container (usually the truck space)?
- Given several packs of tubes, what is the most efficient way to arrange them in a container?
- Are there more efficient ways to group and pack tubes than the one currently used (accounting for the dimension of the transportation container)?

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