VeRoLog Solver Challenge 2015

The second international Vehicle Routing solver challenge

EURO Working Group on Vehicle Routing and Logistics Optimization - VeRoLog

www.verolog.eu

Overview

Following the great success of the first edition, VeRoLog, the EURO Working Group on Vehicle Routing and Logistics Optimization, in collaboration with PTV group, is proud to announce the second edition of the VeRoLog Solver Challenge (VSC2015). This challenge is aimed at comparing on a specific variant of Vehicle Routing Problem (VRP), this year proposed by PTV, the computer codes implemented by the participants and submitted in executable form to the jury. The codes will be compared by considering the quality of the solutions obtained within a specific time limit on a set of test instances that will be defined by the jury. The declaration of the winners will take place at VeRoLog 2015 in Vienna, June 8-10, 2015.

The problem that is the subject of VSC2015 is called the Coach Trip with Shuttle Service Problem (CTSSP) and will be described in detail in the following. The participant teams have to pre-register by sending an email to the jury at ewg.verolog@gmail.com indicating:

- a nickname of the group;
- the name, email and affiliation of the team leader that will be used for all communication;
- the name and affiliation of additional team members.

There is no limit to the number of participants and we encourage teams formed by junior researchers. After the registration and before a prescribed date (see below) each team, through its team leader can submit queries to the jury including clarification requests about the problem definition and completion rules. Answer to the queries will be made available to all participants.

At the end of the pre-registration, an information package will be distributed, including the final description of the problem and the rules, the requisites of the executable code to be submitted, a first set of test instances, and an executable code that performs a feasibility check and computes the value of a solution.

In case the number of pre-registered teams is large, a selection will take place in spring. Only the selected teams will be entitled to participate to the final round that will be performed in June before the VeRoLog conference. Each team is free to choose the specific algorithmic approach to be coded and submitted in executable form to the challenge. However, originality and scientific or practical interest may be taken into account in the final evaluation. The actual evaluation rules will be part of the final package.

The jury of VSC2015 is chaired by Werner Heid and includes Karl Doerner and Daniele Vigo.

Both the possible pre-selection and the final stage will be performed by the jury by using the executable codes submitted by the participating teams. The winner is awarded a certificate and a monetary prize. The teams presenting particularly effective, innovative, and original approaches will be encouraged to submit their work to Computers and Operations Research. The jury will select the finalists and the winner at its sole discretion. All decisions will be final.

Important Dates

Pre-registration deadline:	December 31, 2014
Query deadline:	January 15, 2015
Challenge package distribution:	January 31, 2015
Query deadline:	February 15, 2015
Pre selection submission deadline:	April 05, 2015
Announcement which teams are in final round:	April 15, 2015
Final code submission deadline:	May 15, 2015
Winner proclamation:	June 8-10, 2015 in Vienna

VSC2015 Problem description

Coach Trip with Shuttle Service Problem (CTSSP)

Travelers who have booked a coach trip have to be picked up at defined bus stops. They are transported to a hub (or meeting point) where the actual journeys begin. The challenge is focused only on this part of the transportation of passengers, namely that from their origin stop to the hub; the trip from the hub to the final destinations is not considered and is not relevant. The collection of the passengers is done by the main coaches and additional shuttle vehicles may be used if needed. The shuttle vehicles carry the passengers either to a bus stop that is visited by a coach or directly to the hub. The transportation time for each passenger from their original bus stop to the hub must not exceed a given duration.

- The scope of the defined planning problem covers the collection of the passengers at the bus stops and their ride to the hub, thus generating routes for the coaches and the shuttle vehicles. The main challenges of this problem are to decide
  - which bus stop shall be visited by the main coaches
  - which bus stop shall be served by shuttle vehicles and
  - which bus stops, if necessary, shall be chosen as transfer points to allow the shuttle passengers to change to a coach
- The planning task does not include the optimization of the journeys from the hub to the actual travel destinations.

The following list describes the different objects and characteristics of the planning problem in more detail:

- **bus stops**
  - a set of **n** bus stops (i=1, …, n) is given
  - passengers are assigned to bus stops $\mathbf{s_i}$. For each bus stop $\mathbf{s_i}$, (i=1, …, n) we thus know the number of assigned passengers $\mathbf{q_i} \geq 0$.
  - all passengers must be transported to the hub **H**.
  - All stops, including the hub **H**, can be used as transfer stops (transferring shuttle passengers into a main coach) if appropriate. There can be bus stops with quantity 0, i.e., with no passengers assigned. These stops don't have to be visited but they can be used as transfer stops as well.
  - splits of the service for the passengers at a bus stop are not allowed. All passengers at a stop must fit into the vehicle that visits this stop.

- **fleet**
  - a set of **m** coaches and one of **k** shuttles are given
  - Each coach starts its journey at a specific vehicle location $\mathbf{VL_j}$ (j=1, …, m) picks up passengers at the bus stops and finally arrives at the hub **H**.
  - Each coach has a specific passenger capacity equal to $\mathbf{C_j}$.
  - Each coach has to drive to the hub **H**.
  - Each shuttle bus starts its journey at a specific vehicle location $\mathbf{VS_h}$ (h=1, …, k) picks up passengers at the bus stops and bring them either to a bus stop or to the hub **H**.
  - The Coaches and shuttles don't have to return to their locations **VL** and **VS**.
  - Each shuttle has a passenger capacity equal to $\mathbf{CS_h}$, (h=1, …, k).
  - shuttle vehicles are only used if the busses cannot pick up all passengers at the bus stops due to the $\mathbf{D_{max}}$ and $\mathbf{S_{max}}$ constraints.
- **Constraints**
  - For each passenger the transportation time from their bus stop to the hub must not exceed a given duration $\mathbf{D_{max}}$.
  - The number of bus stops on a coach route is limited to $\mathbf{S_{max}}$.
  - The capacities of all vehicles (coaches, shuttle vehicles) must not be exceeded.
  - Distances and driving times between all relevant locations are given in a square matrix. The values are based on shortest path calculations in digital road networks. Two different matrices with distances and driving periods are provided:
    - one matrix to be used for all the coaches
    - one matrix to be used for all the shuttle vehicles

- **Trip Structures**

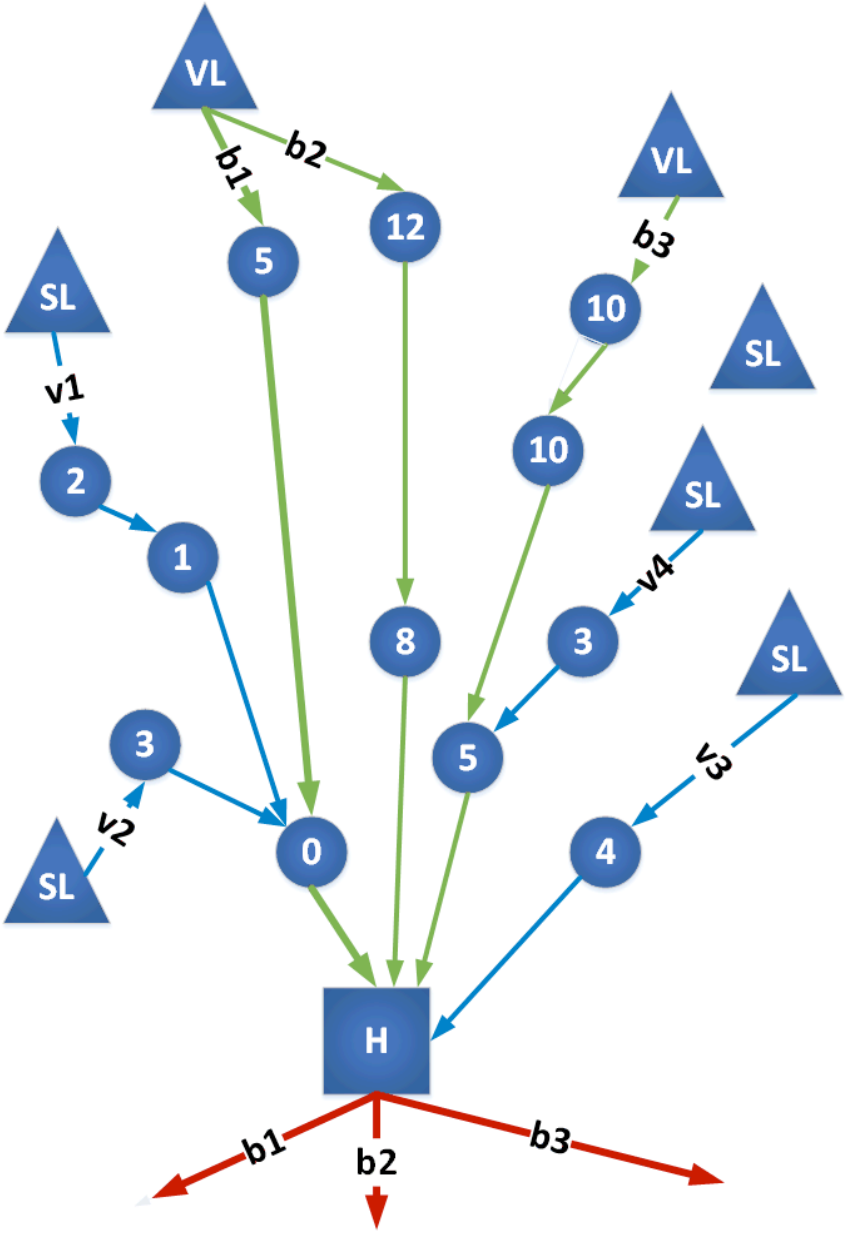

Figure 1: typical trip structures for coach trips

- Figure 1 illustrates typical trip structures for this planning problem.
  - The numbers in the bus stops define the passenger count at the stops
  - Green arcs represent the coach trips. Three coaches b1, b2, b3 start at two different vehicle locations with the main trips. They collect passengers at different bus stops and meet at the hub H.

- Blue arcs describe the trips for the shuttles. Four shuttle vehicles v1, v2, v3 and v4 are hired to help collecting the passengers. Please note that one stop is only used as a transfer stop (passenger count 0).
- Red arcs illustrate the actual journeys for the coaches. After necessary changes they start the journeys J1, J2 and J3.

- **cost structure**
  - coaches
    - no costs are incurred
      as all coaches have to drive from their vehicle location to the hub and the time constraint for the transportation period limits the length of a coach trip.
  - Shuttle vehicles
    Shuttle vehicles are regarded as additional external resources that have to be booked extra. We suggest to use these cost parameters for the individual vehicle types:
    - fixed value per vehicle if used
    - variable costs per km traveled, i.e. the distance from the shuttle location to the chosen bus stop or the hub **H**.
- **objective function**
  - The goal is to minimize the total costs of the plan, i.e. the additional costs incurred by the shuttles required to complete the service.

Test instances

We are planning to provide three different test instances for the participants. Instances will be provided as plain text files including all instance data according to a specified format. The test instances will differ in

- Number of bus stops (varying from approximately 20 to 500)
- Number of coaches and shuttles

Furthermore we will define an additional set of “private” instances which shall be used by the jury to determine the winner of the competition.

Data files

All data are given in text files, where the first line gives the description and the following lines give data separated by a semicolon;

Busstops.txt

- Bus stops and hub data are listed in the text file **busstops.txt**. The meaning is as follows:
  - stop type (BUSSTOP or HUB)
    for the challenge we expect the description of the hub in the first data line (i.e. the second line in the file). All following stops have to be of the type BUSSTOP.

- a descriptive name, the post code and the city (for descriptive purposes only)
- X and Y coordinates of the geographic point of the location: The pair of X,Y coordinates of the location will be used as identifier to determine the distance and time of the trip to other locations in the distance and time tables
- number of passengers, for bus stops only
- maximum transportation time, for bus stops only

Fleet.txt

- All available vehicles are given in the **Fleet.txt** file. The vehicles are described by these attributes:
  - vehicle type (COACH or SHUTTLE)
  - X and Y coordinates of the geographic point of the vehicle location: The pair of X,Y coordinates of the location will be used as identifier to determine the distance and time of the trip to other locations in the distance and time tables
  - maximum number of passengers
  - maximum number of bus stops, for coaches only
  - distance cost in monetary units per Km, for shuttles only
  - fixed cost in monetary units per use, for shuttles only

DistanceTimesCoordinates.txt

- This is a list of X and Y coordinates of the geographic points corresponding to locations.

DistanceTimesData_COACHES.txt and DistanceTimesData_SHUTTLES.txt

- These two files contain distances and driving times between all relevant locations. The file DistanceTimesData_COACHES.txt is used for the coaches. DistanceTimesData_SHUTTLES.txt is relevant for the shuttles. For each point corresponding to bus stops, hub and vehicle locations (IN THE SAME ORDER AS LISTED in the DistanceTimesCoordinates.txt file) the matrix-files contain:
  - The distance d_{ij} and driving period p_{ij} between the start-location i and each destination-location j for $j = 1,...,n$ are stored in separate rows separated by a semicolon (;).

    For example: A distance table that consists of the distances and driving periods between 3 locations is stored as follows:
    d_{11}; p_{11}; d_{12}; p_{12}; d_{13}; p_{13}
    d_{21}; p_{21}; d_{22}; p_{22}; d_{23}; p_{23}
    d_{31}; p_{31}; d_{32}; p_{32}; d_{33}; p_{33}
  - The distance unit in the matrices is meter [m]. The unit for driving times is the second [s].

A zip file including a sample instance together with a solution will be distributed in January, 2015.

Feasibility tool

We will provide a simple tool for the participants of the contest (and for us of course) to check the feasibility and the objective value of the obtained solutions. Probably this will be a simple console application for Windows.