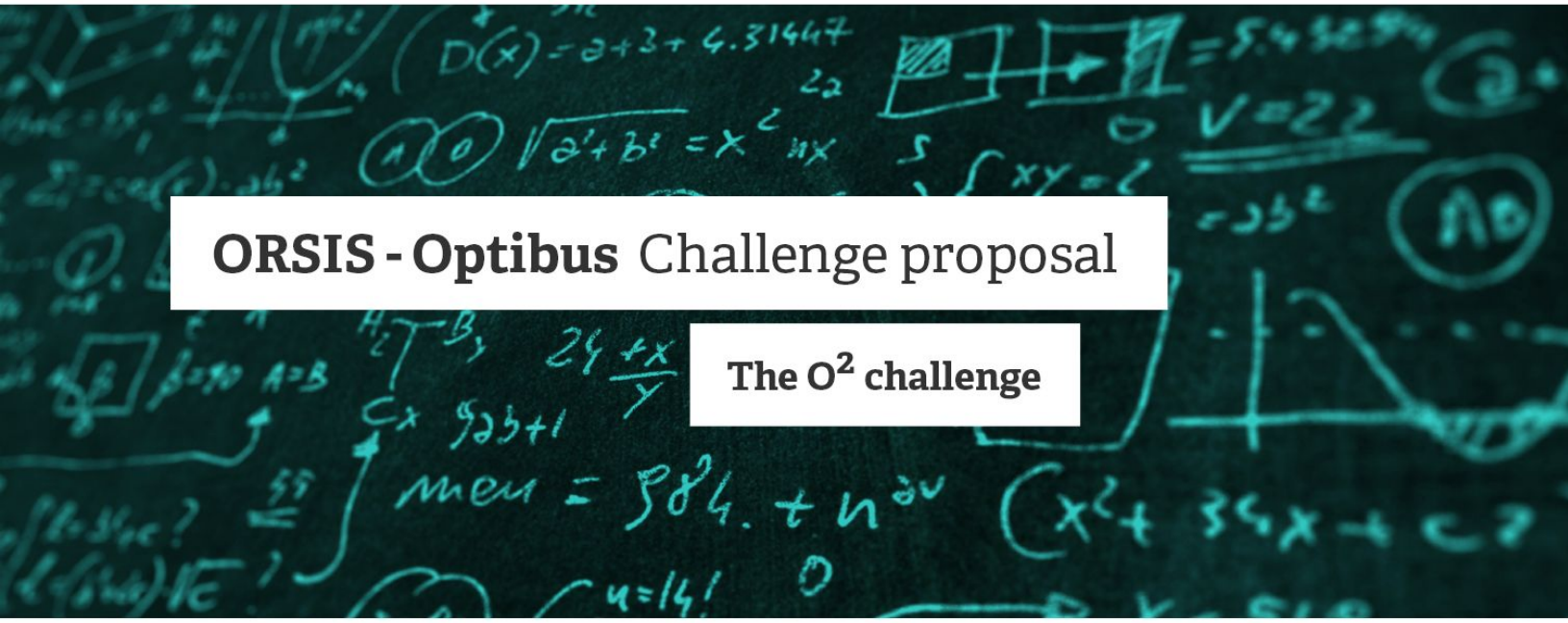


The $O^2$ challenge is a cooperation between ORSIS and Optibus, designed to strengthen ties between industry and academia in the field of Operations Research. It is an opportunity to expose students and researchers to practical problems, and for Optibus to be involved with the research community. In the future, ORSIS will attempt to establish similar cooperation with additional companies.
The first part of this document states the challenge problem and the second provides instructions for participants.

## Problem definition

1. The $O^2$ challenge's problem is to propose an efficient drivers schedule to a set of given trips already assigned to vehicles.
2. The objective is to minimize the number of scheduled duties and the total working time as a secondary objective. That is, different solutions with the same number of duties are ranked by the total working time.
3. The working time of a duty is defined to be the time passed between the beginning of its first trip and the end of its last trip, including penalties as described below and all breaks (long breaks, a.k.a splits, are considered as regular breaks for simplicity).
4. The service trips data consists of a set of 945 trips taken from the public transit transportation system of the Canadian city Barrie.

5. The vehicle schedule is fixed (already optimized by Optibus OnSchedule optimization system).
6. The input for the problem is given as a csv file (available only after registration) at the website www.o2-challenge.com. It describes the scheduled trips during a working day, to be assigned to drivers in the following format:

Each row includes a single trip event, which consists of the following data items:

| Duty id | Vehicle Id | Event Type | Departure Time | Arrival Time | Origin Stop Id | Origin Stop Name | Destination Stop Id | Destination Stop Name |
|---|---|---|---|---|---|---|---|---|

The duty id column is empty and the participants are asked to fill into it their solution. This column only is to be submitted as the challenge result.

An event type can be one of the following::

1. "depot_pull_out" : Depot pull out (the first trip event of the vehicle, from the depot/garage to the first stop).
2. "service_trip": Regular service trip (i.e. a trip with passengers).
3. "depot_pull_in": Depot pull in (the last trip event of the vehicle, driving back to the depot/garage).

The first trip of each vehicle starts at "Depot - Welham Facility" (stop id 99999) and the last trip ends at this station.

7. Additional constraints for the solution to meet:
   a. A driver may switch a vehicle during her duty only at the same stop where she departed from the previous vehicle, but not more than once during her duty.
   b. Every 4 hours a driver must get a continuous break of at least 30 minutes length. That is, the maximum driving time without a continuous 30 minutes break is 4 hours. Built-in breaks in the vehicle's schedule, such as the one between trips 3 and 4 in the example below, may count towards the driver's break. This is indeed the case in the suggested solution for driver number 3.
   c. The length of a duty cannot exceed 9 hours (from start to end - including breaks).
   d. The operator prefers that the drivers will start and finish their duties at the depot (id 99999) or at Downtown Barrie Terminal (id 1). In any case a driver starts (or finishes) her duty at a different stop, a penalty of 30 minutes working time should be added to the driver's duty

(60 minutes if both, first and last stops are such). These penalties affect only the secondary objective function only. This 30/60 minutes penalty is not counted towards the 4 hours maximum working time without a break, nor for the maximum 9 hours duty work time.

8. In the following example we present a small problem instance with a solution (the solution is not necessarily optimal).
    a. The input is presented here.
    b. A solution (with the input) is presented here.
    c. The solution should be submitted as .csv file with a single column of duty numbers. (See example).

## Participation rules

1. Participation

   The Operations Research community is invited to take part in this challenge. Participation is allowed for teams of (one or) several members.

   Not allowed to participate:
    a. ORSIS president, ORSIS representatives in the prize committee and students under their supervision.
    b. Optibus employees.
2. Registration
    a. The $O^2$ challenge registration will be possible via a google form also available in the website www.o2-challenge.com starting on January 2016.
    b. Each team must register to the challenge in order to get access to the input data. Upon registration each team will have to provide a team name, the names and affiliation of the members and one e-mail address for correspondence.
3. Solution submission:
    a. Solutions must be submitted as a csv file in the format described above by Sunday, May 15th, noon (Israel time), to o2challenge2016@gmail.com with the subject "Solution - <Team name>".
    b. The solution file name should be the <team_name>.csv. Each solution will be accompanied by a 2-3 pages summary of the algorithm/method.

c. A Python script that validates the solution will be made available in the competition web-site. The teams are asked to use it in order to check their solutions before submitting.
d. Upon submission at least one member of the team must be an ORSIS member.

4. Additional conditions
   a. The names, solutions and reports of the leading teams will be published in the competition and in ORSIS' web-sites.
   b. The winning teams will be required to present their accomplishment in a dedicated session in 2016 annual ORSIS meeting on May 29th-30th, at Yearim hotel, Maale Hahamisha.
   c. The prizes will be awarded on this occasion.
   d. The copyright for all submitted materials and algorithms will remain the authors'.
5. Prizes:
   a. The prizes are the generous contribution of Optibus.
   b. The winner(s) will be determined by the challenge prize committee, comprised of Optibus and ORSIS representatives.
   c. The Winner of the $O^2$ challenge will be awarded 4000 NIS and a certificate.
   d. An additional prize of 1500 NIS and a certificate will be awarded to the best team whose members are all students. Such teams are required to submit a statement that the team's work was not led by a faculty member.
   e. The committee may decide to give a certificate of an honorable mention to one additional team.
6. Winning criteria:
   a. The main winning criterion will be the objective function value of the solution (as described in the problem definition section). However, the committee will also consider the solution methods and their methodological contribution.
   b. The competing teams are allowed to use commercial and open source general purposes solvers (such as CPLEX or SCIP) but solutions produced by software packages that are dedicated to public transit planning will not be accepted.
   c. The competing teams may use reasonable computing resources (brute force solutions are not likely to win anyway).