CIVIL-557
Decision-Aid Methodologies in Transportation
Operations Research Project

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Outline

1. Problem Description

2. Project
   - Model
   - Solution Method
   - Solutions

Outline

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Tourist itinerary planning

Unki

Unki is an EPFL startup. The company wants to create itineraries for tourists that visit a new city.

- Based on the preferences of customers, a utility function is created for each possible activity.
- Tourist schedules are Hotel – Activity – Eat – Activity – Eat – Hotel.
- Constraints that consider the cost and time to travel from one activity to another are necessary. For example, going from the hotel to an activity that is too far away takes a lot of time.

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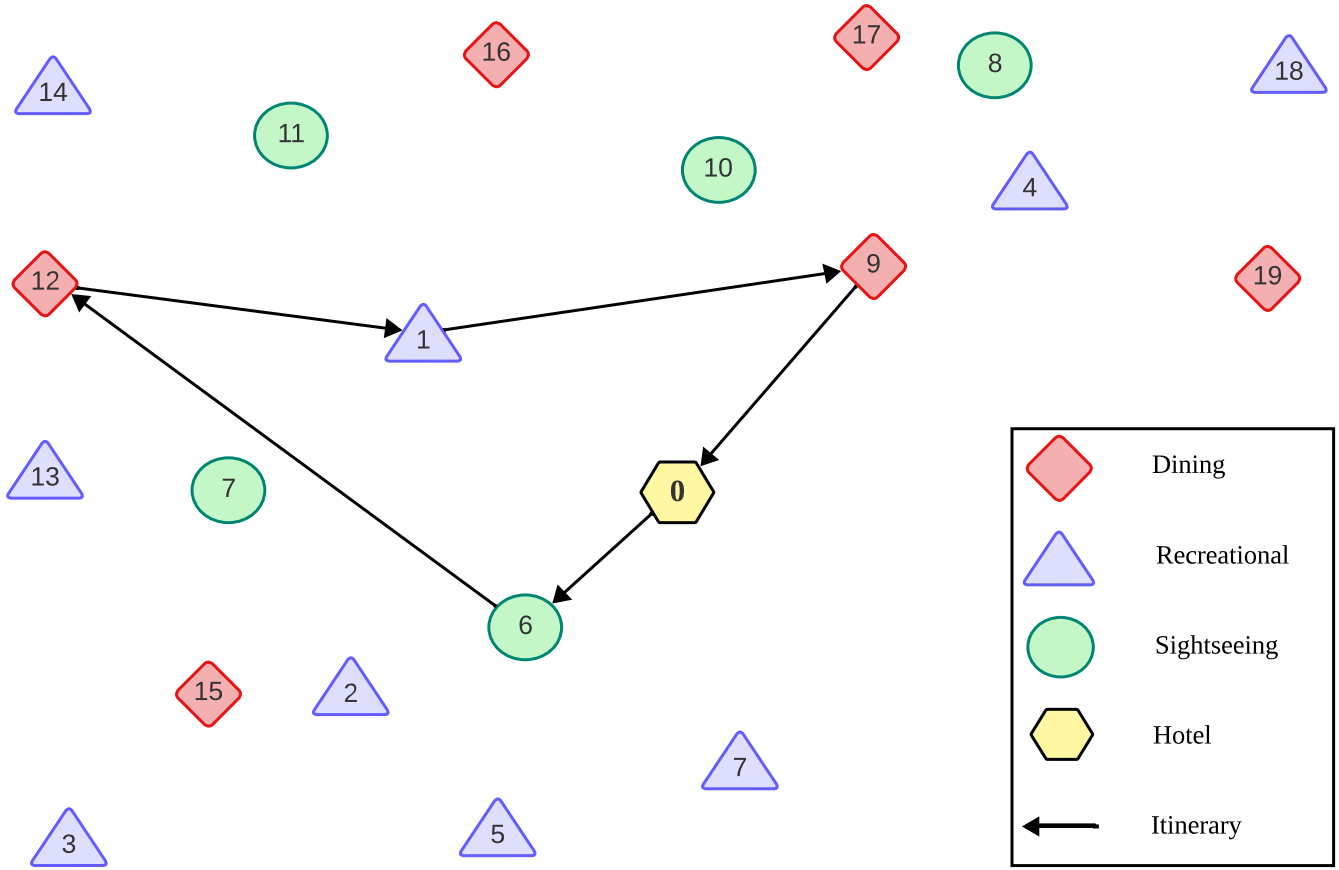
Problem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Dining
Recreational
Sightseeing
Hotel
Itinerary

Problem description

- G set of groups of activities, e.g., sightseeing.
- V_g set of activities in a group $g \in G$.
- V set of all activities in a group $V = \cup V_g$.

The tourist starts at the hotel, next he must go to an activity (i.e.,$a \in V$) to collect the utility of completing the activity. However, resources are used while traveling and completing an activity, i.e., time and cost. In addition, each activity has a time window, i.e.,$[e_a, \ell_a]$ $\forall a \in V$, for the earliest arrival time and latest arrival time respectively. Besides respecting the time windows for each activity, it is not allowed for the tourist to visit activities in the same group more than once, except dinning. The sequence of activities should be hotel–activity–dining–activity–dining–hotel. Thus, there can be a total of two dining and two other activities that are different. Also, dining must be done in different restaurants and the tourist has a budget for the B that he cannot go over.

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Mathematical Model for Itinerary Optimization

- **Objective:** Maximize the utility minus the cost of travel.
- **Variables:** Sequence of activities
- **Constraints:**
  - Budget limits for travel expenses.
  - Time windows for each activity.
  - Dining happens after every activity.
  - Only one activity per group of activities can be done.
  - Itinerary must start and end at the hotel.

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Outline

Grading

The OR-project is **25%** of the total grade in the course and it is divided in the 3 following parts:

- Modeling **9%**
- Solution method **9%**
- Analysis and Conclusion **7%**

Part 1: Model

Formulate an MIP of the tourist itinerary problem.

- Explain your model in the presentation and report.
- Your model must be a representation of the problem with the correct objective function and feasible region.
- Solve the model with a commercial solver, e.g., Gurobi and present results.
- Points will be deducted if your model does not represent the feasible region or objective.

Grading
Up to 9%

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Part 2: Solution Method

Develop another solution approach that does not require a commercial solver. To solve the problem you can use any method that you learned in class, for example, Labeling algorithms, ALNS, VNS, Column Generation, Branch-and-Cut, greedy algorithms, etc.

- Explain every operator in your heuristic or exact method.
- You will be graded based on your understanding of the method that you chose to implement.

Grading
Up to 9%

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Part 3: Quality of your Solution

Perform a sensitivity analysis on the parameters. For example, change the value of the utilities, or the cost, budget, time etc. Present results and discussion. For example, is the problem unfeasible if you change some parameters? do the itineraries become longer? etc.

Grading
Up to 7%

Deliverables

Deadline: 23:59:59 on Sunday April 28th 2024

- Your python code of the algorithm used.
- A report containing the description of the model, description of the solution method you used and the solution found by your method, sensitivity analysis and discussion. The report should be from 5 to 10 pages max.

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