Exercise 4
Implementing a centralized agent

Group 39 : Hugo Bonnome, Pedro Amorim

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1 Solution Representation

Unless noted otherwise, values that are not defined explicitely here use the definitions provided in the reference paper.

1.1 Variables

The following variables are used to define the CSP:

- P - a set of plans, one for each vehicle.

$$P = \{p_1, p_2, \cdots, p_{N_V}\}$$

- p_i - a doubly linked list representing the sequence of actions in a particular plan i.e. the deliveries and pickups that the vehicle should execute.

$$p_i = (u_1 \rightarrow u_2 \rightarrow d_2 \rightarrow \cdots | u_i \in U \wedge d_i \in D)$$

- U - the set of pickups associated to each task.

$$U = \{u_1, u_2, \cdots, u_{N_T}\}$$

- D - the set of deliveries associated to each task.

$$D = \{d_1, d_2, \cdots, d_{N_T}\}$$

1.2 Constraints

1. All tasks must be delivered i.e. $p_1 \cup p_2 \cup \cdots \cup p_{N_V} = U \cup D$
2. Max load of a given plan must be under the carrying capacity of the vehicle i.e. $maxLoad(p_i) \leq maxCapacity(v_i)\ \forall_{p_i \in P}$
3. A plan can only deliver a task it has previously picked up i.e. $u_i \in predecessors(d_i)\ \forall_{u_i, d_i \in p_i}$
4. A given action can only appear once in the set of all the plans.
5. If there is a pickup action in a plan then there is a corresponding delivery action in the same plan and vice versa. i.e. $u_i \in p_i \leftrightarrow d_i \in p_i\ \forall_{p_i \in P,\ u_i \in p_i,\ d_i \in p_i}$

1.3 Objective function

Let us first define the total cost of a vehicle v with a given plan.

$$c_v = \sum_{a_i \in p_v} (dist(a_i)) \cdot cost(v)$$

The total cost of the company is then defined by the sum of the costs of each vehicle in the company i.e.

$$\sum_{v_i \in V} c_{v_i}$$

2 Stochastic optimization

2.1 Initial solution

2.2 Generating neighbours

2.3 Stochastic optimization algorithm

3 Results

3.1 Experiment 1: Model parameters

3.1.1 Setting

3.1.2 Observations

3.2 Experiment 2: Different configurations

3.2.1 Setting

3.2.2 Observations