Project Proposal - Planning And Reasoning

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1 Description of the Domain

The addressed problem concerns the management of a restaurant that uses a robot waiter, whose purpose is to plan the room service based on the specific problem.
A robot is able to assign each group of customers to an available table in based on its size, takes the group's orders and then serves the group. Finally, when the customers at a table have finished their consumption, it is able to bring them the bill and clear the table.
The idea is to manage customers as groups and each group that arrives at the restaurant must wait for the robot to identify a free table of appropriate size to be seated. To simplify event management, we assume that the time needed for the group to eat is instantaneous. Furthermore, the robot, being battery powered, must take into account its residual percentage to plan the actions to be performed. The battery decreases based on the effort needed to perform a certain action and, if it runs out, the robot must recharge. When the robot serves a table, a cost is paid. The cost is directly proportional to the size of the group, the order in which it is served and, every time the robot recharges, a constant cost is paid. The actions that the robot can perform are:

- If there is a group of size n and a free table of size $\geq n$, the robot executes the action *BringToTheTable(g,t)*, which has the effect of occupying the table t and unlocking the possibility of serving the group g.
- If there is a group g sitting at a table t and either all other tables are occupied or there are no groups waiting, the robot performs the action *TakeOrder(g)* which enables the possibility of serving a table.
- If there is a group g that has executed the order, the robot executes the action *Serve(g)* which has the effect of serving the group and, considering that a group takes an instant time to finish the consumption, unlocks the possibility of having the bill paid.
- If there is a group g at table t that has finished consuming, the robot performs the action *ClearTable(g,t)* which has the effect of freeing t and increasing the total profit thanks to the payment.

- If the robot's battery level is lower than the amount of battery used by the least expensive action, the robot r executes the *Charge(r)* action which has the effect of raising the battery level to the maximum.

2 Faced Problems

For this domain we decided to define five different problems:

1. In the initial state we have n groups all of the same size waiting, m free tables, infinite battery level and the goal is to serve all the n groups.
2. In the initial state we have n groups of different sizes waiting, m free tables, finite battery level and the goal is to serve all the n groups, considering that the battery level decreases with each action.
3. In the initial state we have n groups of different sizes waiting, m free tables and the goal is to reach a certain sum in euros while minimizing the number of groups served.
4. In the initial state we have n groups of different sizes waiting, m free tables. Considering that based on the order in which a group is served we pay a cost (which can be seen as the total time waited by customers), the objective is to serve all the tables while minimizing the total cost.
5. In the initial state we have n groups of different sizes waiting, m free tables. Considering that based on the order in which a group is served we pay a cost (which can be seen as the total time waited by customers), the objective is to serve all the tables while minimizing the total cost and taking into account that the robot starts from a low battery level.

3 Planner and Heuristics

The planner we have chosen is Fast DownWard.
The search algorithm we intend to use is A* with three different heuristics to highlight the differences in the executions, these are:

- blind
- ff
- hmax