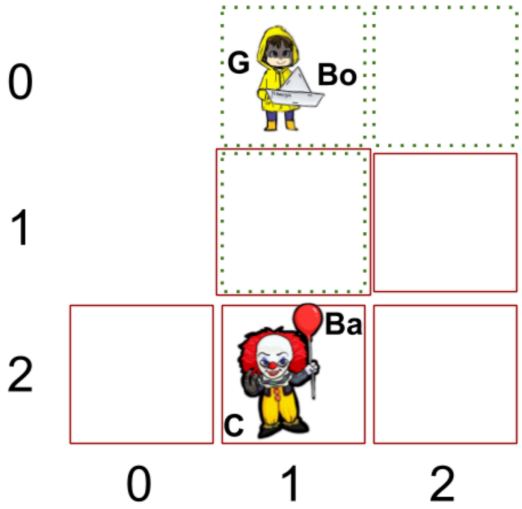
Exercise 1 (8 points)

Group B. A clown C and Georgie G are tired of playing with their toys and they want to exchange them. G wants to play with the balloon Ba while, C wants to play with the boat Bo. They are both very friendly and they want to be at the same cell Cij for exchanging them. Hence, they have to find a common place (for example Cell $\langle 1, 1\rangle$), where to drop and collect objects. G and C cannot hold two objects at the same time. Moreover, they cannot drop and collect objects, if they are not in the same cell simultaneously. The environment is depicted in the figure, G can only move within dotted cells; while C can only move within continuous perimeter cells. Cells of the same kind (i.e. $\{C01, C11, C02\}$ for the dotted set and $\{C11, C12, C20, C21, C22\}$ for the other) are connected only horizontally and vertically, in fact agents cannot move diagonally. The figure shows the initial state, where G holds Bo and he is at $C01$, and C holds Ba and he is at $C21$. The goal state is represented by G at $C02$ holding Ba and C at $C22$ holding Bo.



(a) Define the problem and the domain file in PDDL

(b) Show one possible sequence of actions to a goal state including all the states in the sequence

(c) Draw the first 3 steps of the tree generated by forward search assuming a perfect heuristic (a heuristic choosing the move in the plan given above). Show all the actions applicable at each of the traversed states, and the state reached.

Exercise 2 (4 points)

Describe the notion of *promotion* and *demotion* in the context of POP and provide examples, considering also the given problem.

Exercise 3 (4 points)

Discuss the properties and the limitations of A*. Give a possible heuristic for the given problem.