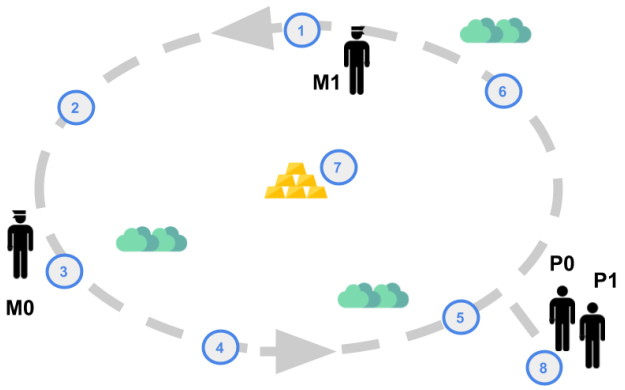
Exercise 1 (8 points)

Group A: Steal the gold. The goal of a team of 2 players is to steal the gold guarded by 2 policemen. The figure shows the environment, the initial location of the players and the gold. Assume that, in each state, agents (and objects) are at one of the locations denoted by a number in the figure and that each action is executed instantaneously. The policemen M0 and M1 patrol the environment moving to the next location on the circle in the direction of the grey arrows (excluding location 8). Players are always invisible to the policemen, except when they end up in the same location of a policeman, because they are protected by bushes. If the policeman sees the player, it will capture it (i.e. action is over). However, if in a location there are two players and a policeman, the players capture the policeman and make it inoffensive. If the players capture a policeman, it will stay in the capture location, but it is impossible to hide it; a captured policeman can be seen by the other policeman, when arriving to that location; then, an alarm will be issued immediately (even before a possible capture) and the players have to run away (i.e. action is over). The players have to be cautious and therefore move one at a time in the environment; moreover, one of them must move at each step. When they move, they can reach in one step each location in the circle. The goal is that one player gets the gold by reaching location 7 with the gold, which can be done in one step from any location of the circle, but only when the policemen have been taken care of.



(a) Characterize the state-space, the initial and the goal state

(b) Describe the operators needed to solve the problem

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

(d) Draw the first 2 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)

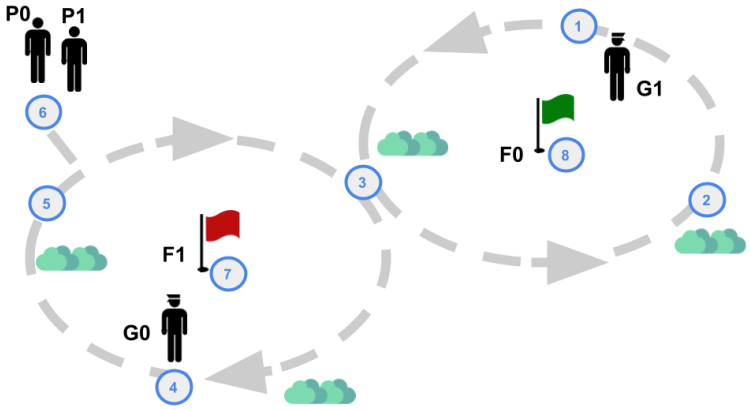
Describe the main difference between search and planning. Which is the state representation in a planning setting for the above problem (Ex. 1)? which are the heuristics applicable by a forward planner?

Exercise 3 (4 points)

Describe the general principle of local search and beam search in particular. Does it make sense to apply local search to solve the above search problem (Ex. 1)?

Exercise 1 (8 points)

Group B: Steal the flag. The goal of a team of 2 players is to steal 2 flags surveilled by 2 guards. The figure shows the environment, the initial location of the players and the flags. Assume that, in each state, agents and objects are at one of the locations denoted by a number in the figure and that each action is executed instantaneously. The two guards patrol the flags moving to the next location on each circle in the direction of the grey arrows (i.e. excluding location 6). Players are always invisible to the guards, except when they end up in the same location of a guard, because they are protected by bushes. If the policeman sees the player, it will capture it (i.e. action is over). However, if in a location the number of players is greater than the number of guards, the players capture the guard and make it inoffensive. If the players capture the guard in location 3, it is impossible to hide it and, if seen by the other guard moving in that location an alarm will be issued (even before the possible capture) and the players have to run away (i.e. action is over). The players have to be cautious and therefore move one at a time in the environment; they can reach in one step each location in the closest circle. Only from location 3 agents can reach every location in both circles; in the initial location they can only reach locations in the circle with the read flag. The locations of the flags can not be reached if there are guards patrolling. The players can cooperate in order to achieve the goal, which is to reach both locations with the flag (remember, only after both guards have been made inoffensive).



(a) Characterize the state-space, the initial and the goal state

(b) Describe the operators needed to solve the problem

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

(d) Draw the first 2 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 main difference between search and planning. Which is the state representation in a planning setting for the above problem (Ex. 1)? which are the heuristics applicable by a forward planner?

Exercise 3 (4 points)

Describe the general principles of genetic algorithms in particular. Is it possible to model the state of the problem in the above exercise in a suitable form for a genetic algorithm? Does it make sense to apply genetic algorithms to solve the above search problem (Ex. 1)?