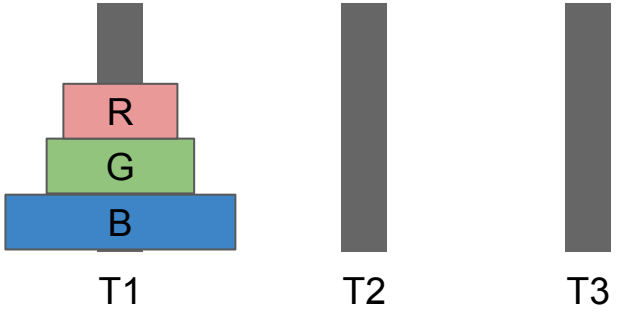
Towers of Hanoi

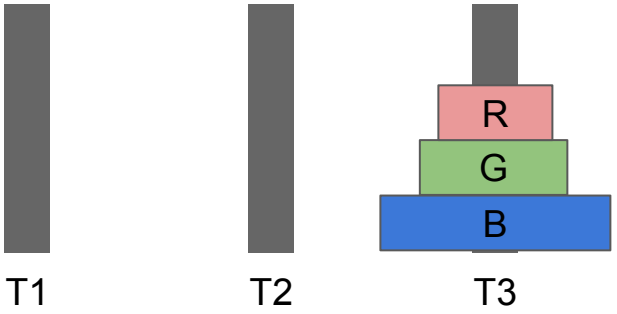
Consider the classic problem “Towers of Hanoi.” It consists of three rods and three disks of different diameters, which can slide onto any rod. There are three restrictions on how to act in this problem:

1. Only one disk may be moved at a time.
2. Each move consists of taking the upper disk from one of the stacks and placing it on top of another stack or an empty rod.
3. No disk may be placed on top of a disk that is smaller than it

Define a domain description and a problem instance such that we can use a classical planner to solve the problem.



Initial State



Goal State

Answer

Object symbols:

R, G, B, T1, T2, T3

Predicate symbols:

On(x, y): x is on y. x can only be a disk, y can be a disk or a rod.

Clear(x): there is no disk on x. x can be a disk or a rod.

Smaller(x, y) : disk x is smaller than disk y.

Disk(x): x is a disk.

Answer (continued)

We also need to define an action operator:

Move(x, y, z):

Preconditions: Clear(x), On(x, y), Clear(z), Disk(x), Smaller(x, z)

Adds: On(x, z), Clear(y)

Deletes: Clear(z), On(x, y)

Semantic meaning: Move a disk x from y onto z.

Answer (continued)

And the problem instance is:

Initial State: Clear(R), On(G, B), On(R, G), On(B, T1), Clear(T2), Clear(T3), Disk(R), Disk(B), Disk(G), Smaller(R, G), Smaller(G, B), Smaller(R, B), Smaller(R, T1), Smaller(B, T1), Smaller(G, T1), Smaller(R, T2), Smaller(B, T2), Smaller(G, T2), Smaller(R, T3), Smaller(B, T3), Smaller(G, T3)

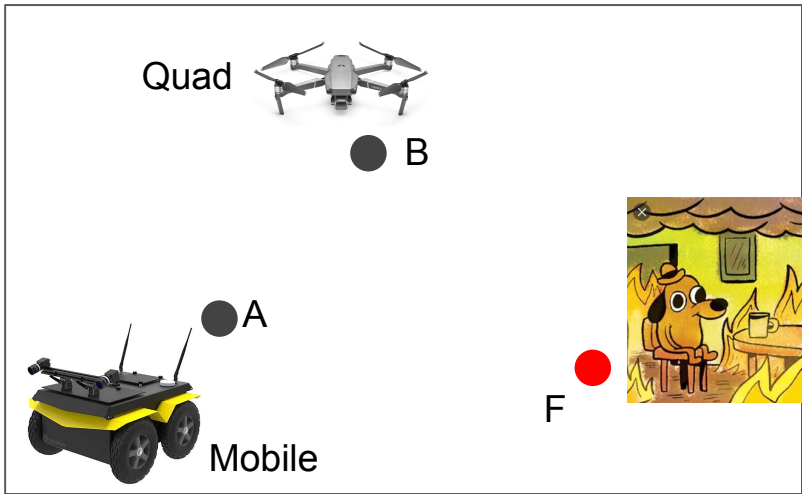
Goal: Clear(R), On(R, G), On(G, B), On(B, T3)

Robot Rescue Problem

The goal of this problem is to have a pair of robots put out a fire at location **F**. This domain has two robots, a quadcopter (**Quad**) and a mobile robot (**Mobile)**. The quadcopter can fly around a location spraying water to put out a fire, but cannot travel between locations. Rather, it must land on the mobile robot, which can travel between locations.

- Start conditions: the quadcopter is flying and at location **B**. The mobile robot is at location **A**.
- Goal: Put out the fire.

Propose a list of predicate symbols and operator definitions to define the domain, as well as the initial state and goal conditions for the problem.



Answer

Predicate symbols:

At(o1, o2): robot o1 is at location o2

Mobile(o): o is the mobile robot

Quad(o): o is the quadrotor

Loc(o): o is a location

Fly(o): robot o is flying currently

On(o1, o2): robot o1 is on robot o2

Fire(o): There is a fire is at location o

FireGone(o): Fire at a location o is put out

Answer (continued)

Pour():
    Preconditions: Fire(F), At(Mobile,F), Fly(Quad)
    Effects: Add: FireGone(F),
        Delete: Fire(F)
Takeoff(x):
    Preconditions: On(Quad,Mobile), At(Mobile,x), Loc(x), At(Quad, x)
    Effects: Add: At(Quad,x), Fly(Quad)
        Delete: On(Quad, Mobile)
Land(x):
    Preconditions: At(Quad,x), At(Mobile,x), Loc(x), Fly(Quad)
    Effects: Add: On(Quad,Mobile),
        Delete: Fly(Quad), At(Quad,x)
Travel(x, y):
    Preconditions: At(Mobile,x), Loc(x), Loc(y)
    Effects: Add: At(Mobile,y)
        Delete: At(Mobile,x)

Answer (continued)

Initial conditions:

At(Quad,B), At(Mobile,A), Loc(A),Loc(B), Fire(F), Loc(F), Loc(W), Fly(Quad)

Goal conditions: FireGone(F)