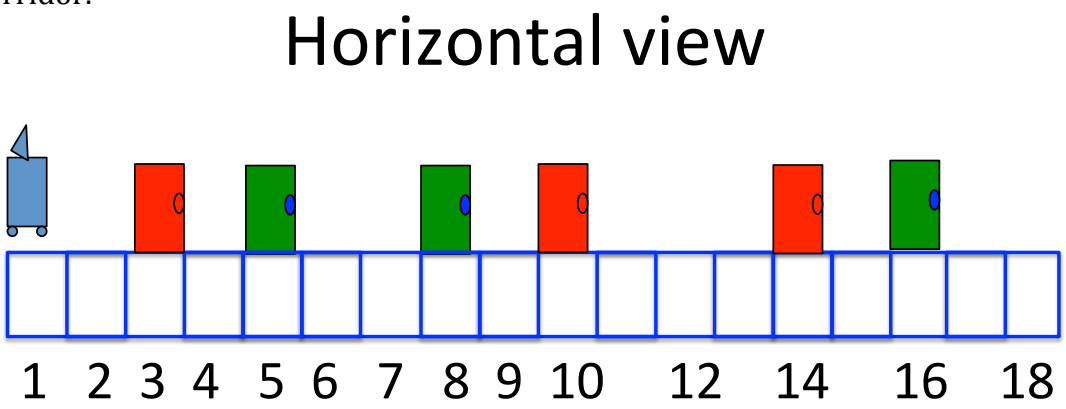
Robotics

Seminar 4

Part One. Localization, environment modeling, knowledge representation

EXERCISE 1

A robot is in a tiled corridor (18 tiles), the corridor has red and green doors, the robot has no knowledge where it is when its starts, it could be in any of the tiled squares and has only a sensor that can discriminate if there is a door in front of it or not (but not the color of the door). The robot has the following map about the corridor.



What is the state space of the robot?

The robot moves one tile to the right and sees a door. If we represent the belief of where the robot is as a probability distribution of the 18 tiles, what is the probability distribution now?

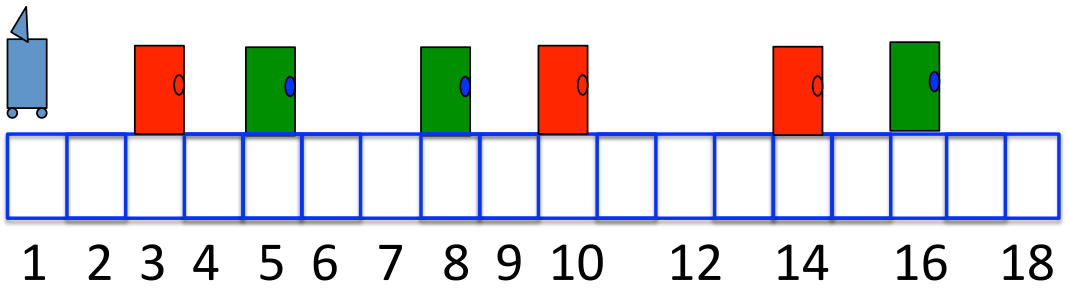
The robot moves now 2 more tiles to the right and sees another door after this move. What are the values of the probability distribution know?

Repeat the exercise with a robot that can also sense the color of the doors, if the first door found is red and the second is green.

EXERCISE 2

You get on board of a subway at some station and you are given a map. You do not know at what station you got on, and you know there is a total of (18 stations), most stations have no landmarks, but some stations have red and green land-mark doors (for subway staff offices), like the previous exercise, you are the robot trying to discover where you boarded this subway.

Horizontal view



This subway is in a country where you do not speak the local language, but you know that the drivers of the subway are conducting regular protest for the economic restrictions imposed by the local government. So, in each station, they flip a 6 face dice, and if the number is prime (1,2,3, or 5) they move the train forward to the next station, if the dice lands in 4 it is bad luck and they actually drive the train backwards. And when the dice lands 6 they pretend to move forwards but then they go back and open the train-doors at the same station.

Unfortunately, you cannot tell in which direction the train moves, just that it has open and closed the train-doors. You cannot tell red from green.

After the first time the train-doors opened and you boarded at a station with no landmark-door, that is, the next time the train-doors open, you see a land-mark door. If you represent the belief of where you are as a probability distribution of the 18 stations, what is the probability distribution now?

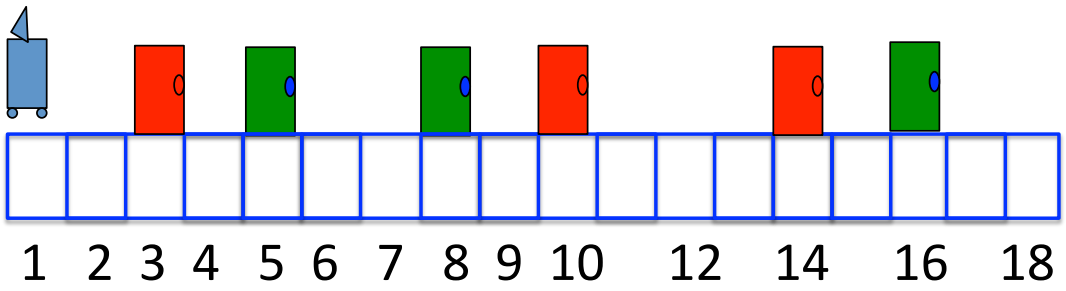
The train does two more moves (the train-doors have opened and closed twice), the first time you saw NO landmark-door, but the next time you DO see a landmark-door. What are the values of the probability distribution now?

Repeat the exercise with the ability that can also sense the color of the land-mark-doors, if the first landmark-door found is red and the second is green.

EXERCISE 3

You get on board of a subway at some station and you are given a map. You do not know at what station you got on, and you know there is a total of (18 stations), most stations have no landmarks, but some stations have red and green land-mark doors (for subway staff offices), like the exercises of the previous seminars, you are the robot trying to discover where you boarded this subway.

Horizontal view



This subway is in a country where you do not speak the local language, but you know that the drivers of the subway are conducting regular protest for the economic restrictions impose by the local government. So, in each station, they flip a 6 face dice, and if the number is prime (1,2,3, or 5) they move the train forward to the next station, if the dice lands in 4 it is bad luck and they actually drive the train backwards. And when the dice lands 6 they pretend to move forwards but then they go back and open the train-doors at the same station.

Unfortunately, you cannot tell in which direction the train moves, just that it has open and closed the train-doors. You cannot tell red from green, as you are color blinded, but you have some idea. When there is a red-door, you see it as red 75% of the time, but green 25% of the time. Similarly, a green-door appears to you green 75% of the time, but red 25% of the time.

After the first time the train-doors opened and you boarded at a station with no landmark-door, that is, the next time the train-doors open, you see a land-mark door, and it appears GREEN to you. If you represent the belief of where you are as a probability distribution of the 18 stations, what is the probability distribution now?

The train does two more moves (the train-doors have opened and closed twice), the first time you saw NO landmark-door, but the next time you DO see a landmark-door, and it looks again GREEN. What are the values of the probability distribution now?

Repeat the exercise with the fact that the both doors appeared RED to you.