Solution for Homework 1

In [2]:
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robot_localization()
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Initial Position:
bel(x0 = p0) =  0.25
bel(x0 = p1) =  0.25
bel(x0 = p2) =  0.25
bel(x0 = p3) =  0.25

At step t=1, after the control u1, the robot returns a measurement of z1 =doo
r.

State Transition Probability:
(x1 = p0|u1,x0=p0, x0=p1,x0=p2, x0=p3)=  [0.2, 0, 0, 0]
(x1 = p1|u1,x0=p0, x0=p1,x0=p2, x0=p3)=  [0.7, 0.2, 0, 0]
(x1 = p2|u1,x0=p0, x0=p1,x0=p2, x0=p3)=  [0.1, 0.7, 0.2, 0]
(x1 = p3|u1,x0=p0, x0=p1,x0=p2, x0=p3)=  [0, 0.1, 0.7, 0.2]

Calculations of bel_bar for all potential locations (p0~p3):
bel_bar(x1=p0)=  0.05
bel_bar(x1=p1)=  0.225
bel_bar(x1=p2)=  0.25
bel_bar(x1=p3)=  0.25

Probability of the robot sensing the door at step = 1:
p(z1 = door|x1=p0)= 0.3
p(z1 = door|x1=p1)= 0.8
p(z1 = door|x1=p2)= 0.3
p(z1 = door|x1=p3)= 0.8

Normalization and η calculation:
bel(x1 = p0) = p(z1 = door|x1=p0)*bel_bar(x1 = p0)*η = 0.015*η
bel(x1 = p1) = p(z1 = door|x1=p1)*bel_bar(x1 = p1)*η = 0.18*η
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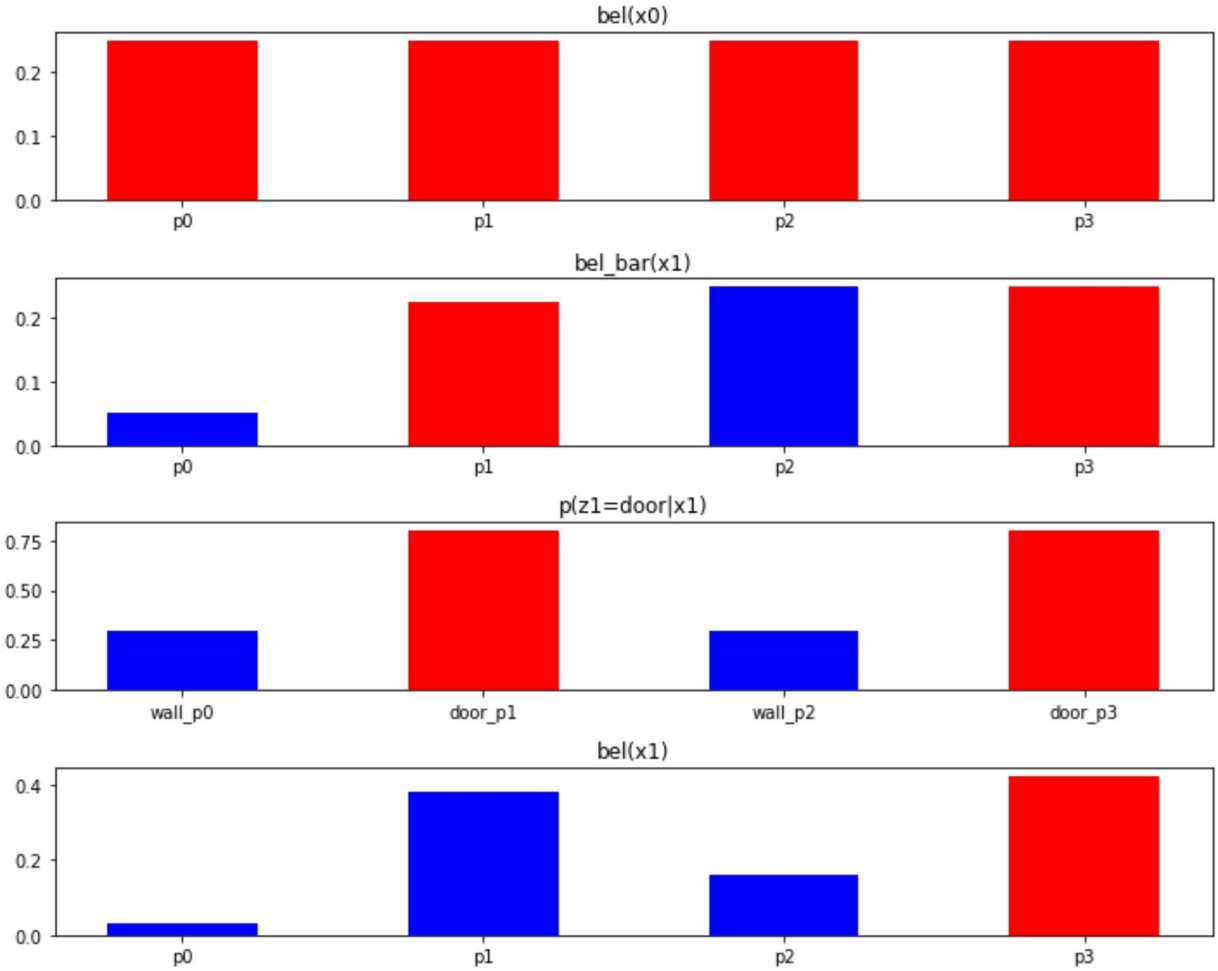
bel(x1 = p2) = p(z1 = door|x1=p2)*bel_bar(x1 = p2)*η = 0.075*η
bel(x1 = p3) = p(z1 = door|x1=p3)*bel_bar(x1 = p3)*η = 0.2*η
η = 1/0.47 = 2.128

New updated belief of the robot's localization probability after step 1:
bel(x1 = p0) = 0.032
bel(x1 = p1) = 0.383
bel(x1 = p2) = 0.16
bel(x1 = p3) = 0.426



At step t=2, after the control u2, the robot returns a measurement of z2 =wal
l.

State Transition Probability:
(x2 = p0|u2,x1=p0, x1=p1,x1=p2, x1=p3)= [0.2, 0, 0, 0]
(x2 = p1|u2,x1=p0, x1=p1,x1=p2, x1=p3)= [0.7, 0.2, 0, 0]
(x2 = p2|u2,x1=p0, x1=p1,x1=p2, x1=p3)= [0.1, 0.7, 0.2, 0]
(x2 = p3|u2,x1=p0, x1=p1,x1=p2, x1=p3)= [0, 0.1, 0.7, 0.2]

Calculations of bel_bar for all potential locations (p0~p3):
bel_bar(x2=p0)= 0.006
bel_bar(x2=p1)= 0.099
bel_bar(x2=p2)= 0.303
bel_bar(x2=p3)= 0.235

Probability of the robot sensing the wall at step = 2:

p(z2 = wall|x2=p0)= 0.7
p(z2 = wall|x2=p1)= 0.2
p(z2 = wall|x2=p2)= 0.7
p(z2 = wall|x2=p3)= 0.2

Normalization and η calculation:
bel(x2 = p0) = p(z2 = wall|x2=p0)*bel_bar(x2 = p0)*η = 0.004*η
bel(x2 = p1) = p(z2 = wall|x2=p1)*bel_bar(x2 = p1)*η = 0.02*η
bel(x2 = p2) = p(z2 = wall|x2=p2)*bel_bar(x2 = p2)*η = 0.212*η
bel(x2 = p3) = p(z2 = wall|x2=p3)*bel_bar(x2 = p3)*η = 0.047*η
η = 1/0.284 = 3.527

New updated belief of the robot's localization probability after step 2:
bel(x2 = p0) = 0.016
bel(x2 = p1) = 0.07
bel(x2 = p2) = 0.749
bel(x2 = p3) = 0.166