6.1.

$$p(m = occ|z = d) = 0.8 \rightarrow \boldsymbol{l(0.8)} = \ln\left(\frac{0.8}{1-0.8}\right) = 1.3863$$
$$p(m = occ|z > d) = 0.2 \rightarrow \boldsymbol{l(0.2)} = \ln\left(\frac{0.2}{1-0.2}\right) = -1.3863$$
$$p(m_i) = 0.35 \rightarrow \boldsymbol{l_0} = l(0.35) = \ln\left(\frac{0.35}{1-0.35}\right) = -0.619$$
$$\boldsymbol{l(x) = inv\_sensor\_model(m_i, x_t, z_t) + l_{t-1,i} - l_0}$$

a) if z = d:

$$l(x) = inv\_sensor\_model(m_i, x_t, z_t) + 1.3863 + 0.619$$
$$l(x) = inv\_sensor\_model(m_i, x_t, z_t) + 2.0053$$

if z > d:

$$l(x) = inv\_sensor\_model(m_i, x_t, z_t) - 1.3863 + 0.619$$
$$l(x) = inv\_sensor\_model(m_i, x_t, z_t) - 0.7673$$

b) Due to the recursion in the equation, it can be easily calculated as:

$$l(x) = 60 * 2.0053 - 40 * 0.7673 - l_o \approx 90$$
$$p(89.007) = 1 - \frac{1}{1 + \exp(90)} \approx 1$$

c)

$$Bel(m^{[xy]}) = \frac{hits(x,y)}{hits(x,y) + misses(x,y)} = \frac{60}{60+40} = 0.6$$

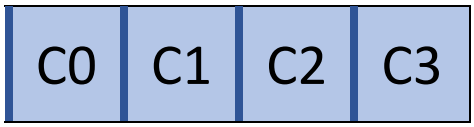
d) Benefits:

a. Another way of representing occupations
b. Determines how often a cell reflects a beam
c. Since it store in each cell the probability that a beam is reflected by a cell, so it shows the material of the object to some level
d. Simple way of considering the map as a grid of cells

Problems:

a. Reflection probability could be very small even though it's occupied

6.2. Grid Map:



When standing at c_0, there is 4 possible measurements: $z_{t0}, z_{t1}, z_{t2}, z_{t3}$.

Belief of the robot with regards to the occupancy of the 4 cells is $b_0 = 0.25, b_1 = \frac{1}{3}, b_2 = 0.5, b_3 = 1$.

Given three measurements taken at C_0: $z_{t0} = 0,\ z_{t2} = 3,\ z_{t3} = 1$.

$$\because b_0 = 0.25$$
$$\therefore 4\ rays\ passed\ by\ C_0$$
$$z_{t0} = 0 \rightarrow z_{t1} > 0$$

$$\because b_1 = \frac{1}{3}$$
$$\therefore 3\ rays\ passed\ by\ C_1$$

$$\because b_2 = 0.5$$
$$\therefore 2\ rays\ passed\ by\ C_2$$

$$\because b_3 = 1 \rightarrow \therefore 1\ ray\ passed\ by\ C_3$$

$$z_{t2} = 3, z_{t3} = 1$$

$$\therefore 2 \leq z_{t1} < 3 \rightarrow \boldsymbol{z_{t1} = 2}$$