

# MDL Assignment 3

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## 1 Part1

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### 1.1 Variables Initialization

**Roll Number:**2019114015

**x:** 0.74

**y:** 4

**States, S** = [S1, S2, S3, S4, S5, S6]

**Actions, A** = [Right, Left]

### 1.2 Formulae

Formula being used:  $b'(s') = (P(o | s', a) \sum_{s \in S} P(s' | a, s) * b(s)) / P(o | a, b)$

Where  $b'$  is the new belief state,  $b$  is the original belief state,  $o$  is the observation and  $a$  is the action taken

We first calculate the numerator for each term and then normalize all by dividing each by the summation of all the terms.

### 1.3 Mannual Calculations

**After Step 1: Action = Right Observed = Green**

$b'[S(1)]: (1.00 - 0.8) * ((1 - 0.74) * 0.333 + (1 - 0.74) * (0.0)) = 0.01733$

$b'[S(2)]: (0.95) * (0.74 * 0.333 + (1 - 0.74) * 0.333) = 0.31666665$

$b'[S(3)]: (1.00 - 0.8) * ((0.74) * 0.0 + (1 - 0.74) * (0.0)) = 0.0$

$b'[S(4)]: (0.95) * (0.74 * 0.333 + (1 - 0.74) * 0.0) = 0.23433$

$$b'[S(5)]: (0.95) * (0.74 * 0.0 + (1 - 0.74) * 0.333) = 0.08233$$

$$b'[S(6)]: (1.00 - 0.8) * ((0.74) * 0.0 + (0.74) * (0.333)) = 0.04933332$$

$$\text{Denominator} = \sum_{s \in S} B(s') = 0.01733 + 0.31666665 + 0.0 + 0.23433 + 0.08233 + 0.04933332 = 0.7$$

$$\text{Belief}(1): 0.02476$$

$$\text{Belief}(2): 0.4523$$

$$\text{Belief}(3): 0.0$$

$$\text{Belief}(4): 0.3347$$

$$\text{Belief}(5): 0.1176$$

$$\text{Belief}(6): 0.0704$$

### After Step 2: Action = Left Observed = Red

$$b'[S(1)]: (0.8) * ((0.74) * 0.02476 + (0.74) * (0.452)) = 0.2824$$

$$b'[S(2)]: (1 - 0.95) * ((1 - 0.74) * 0.02476 + (0.74) * (0.0)) = 0.000321$$

$$b'[S(3)]: (0.8) * ((1 - 0.74) * 0.452 + (0.74) * (0.3347)) = 0.2922$$

$$b'[S(4)]: (1 - 0.95) * ((1 - 0.74) * 0.0 + (0.74) * (0.11761904761904762)) = 0.00435$$

$$b'[S(5)]: (1 - 0.95) * ((1 - 0.74) * 0.3347 + (0.74) * (0.0704)) = 0.00695$$

$$b'[S(6)]: (0.8) * ((1 - 0.74) * 0.1176 + (1 - 0.74) * (0.0704))$$

$$\text{Denominator} = \sum_{s \in S} = 0.2824 + 0.0003 + 0.2922 + 0.0043 + 0.0069 + 0.0391 = 0.6255$$

$$\text{Belief}(1): 0.451$$

$$\text{Belief}(2): 0.000$$

$$\text{Belief}(3): 0.467$$

$$\text{Belief}(4): 0.006$$

$$\text{Belief}(5): 0.111$$

$$\text{Belief}(6): 0.062$$

### After Step 3: Action = Left Observed = Green

$$b'[S(1)]: (1 - 0.8) * ((0.74) * 0.4515 + (0.74) * (0.000514)) = 0.0669$$

$$b'[S(2)]: (0.95) * ((1 - 0.74) * 0.4515 + (0.74) * (0.467)) = 0.440$$

$$b'[S(3)]: (1 - 0.8) * ((1 - 0.74) * 0.000514 + (0.74) * (0.00695)) = 0.0010$$

$$b'[S(4)]: (0.95) * ((1-0.74) * 0.467 + (0.74) * (0.01112)) = 0.1232$$

$$b'[S(5)]: (0.95) * ((1-0.74) * 0.00695 + (0.74) * (0.0625)) = 0.0456$$

$$b'[S(6)]: (1-0.8) * ((1-0.74) * 0.01112 + (1-0.74) * (0.0625)) = 0.003831$$

$$\text{Denominator} = \sum_{s \in S} = +0.066 + 0.440 + 0.001 + 0.123 + 0.045 + 0.003 = 0.680$$

**Belief(1): 0.098**

**Belief(2): 0.646**

**Belief(3): 0.001**

**Belief(4): 0.181**

**Belief(5): 0.067**

**Belief(6): 0.005**

## 1.4 Example Iteration of States

Assuming start state to be S1. Same can be done for two of the remaining states.

