MDL ASSIGNMENT 3 PART 1

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Variables Used

Roll Numbers: 2019101120 and *2019111030*

x = $1 - ((1030\%30) + 1)/100 = 0.89$ y = $(30\%4) + 1 = 3$

`Obervation Probabilities`:

Observation	Probability
P (Observation = RED | State = RED)	0.85
P (Observation = GREEN | State = GREEN)	0.9

`Initial States`: S_1, S_3, S_6 with equal probability

Calculation

`Initial Belief State`: [$\frac{1}{3}$, 0, $\frac{1}{3}$, 0, 0, $\frac{1}{3}$]

Step 1: Right with Observation Green

$$P(Green|Right) = (0.89 * 0.9 + 0.11 * 0.15) * \frac{1}{3} + (0.89 * 0.9 + 0.11 * 0.9) * \frac{1}{3} + (0.89 * 0.15 + 0.11 * 0.9) * \frac{1}{3} = 65$$

From S_1, going `right` can lead to S_1 or S_2.

$$P(S_1) = 0.11, P(S_2) = 0.89$$

$$P(Green|Green) = 0.9, P(Green|Red) = 0.15$$

$$P(Green|Right) = 0.89 * 0.9 + 0.11 * 0.15 = 0.8175$$

$$b(s_1) = \frac{0.11 * 0.15}{0.65} * \frac{1}{3} \approx 0.008461538461538461$$

$$b(s_2) = \frac{0.89 * 0.90}{0.65} * \frac{1}{3} \approx 0.4107692307692308$$

From S_3, going `right` can lead to S_4 or S_2.

$$P(S_2) = 0.11, P(S_4) = 0.89$$

$P(Green|Green) = 0.9$

$b(s_2) = \frac{0.11*0.90}{0.65} * \frac{1}{3} \approx 0.05076923076923077$

$b(s_4) = \frac{0.89*0.90}{0.65} * \frac{1}{3} \approx 0.4107692307692308$

From S_6 going `right` can lead to S_6 or S_5

$P(S_5) = 0.11, P(S_6) = 0.89$

$P(Green|Green) = 0.9, P(Green|Red) = 0.15$

$b(S_5) = \frac{0.11*0.9}{0.65} * \frac{1}{3} \approx 0.05076923076923077$

$b(S_6) = \frac{0.89*0.15}{0.65} * \frac{1}{3} \approx 0.06846153846153846$

`Belief State after Step 1`: [0.008461538461538461, 0.46153846153846156, 0, 0.4107692307692308, 0.05076923076923077, 0.06846153846153846]

Step 2: Left with Observation Red

$P(Red|Left) = (0.89 * 0.85 + 0.11 * 0.1) * 0.008461538461538461 + (0.89 * 0.85 + 0.11 * 0.85) * 0.46153846153846156 + (0.89 * 0.85 + 0.11 * 0.1) * 0.4107692307692308 + (0.89 * 0.1 + 0.11 * 0.85) * 0.05076923076923077 + (0.89 * 0.1 + 0.11 * 0.85) * 0.06846153846153846 = 0.735826923076923$

From S_1 going `left` can lead to S_1 or S_2

$P(S_1) = 0.89, P(S_2) = 0.11$

$P(Red|Red) = 0.85, P(Red|Green) = 0.1$

$b(S_1) = \frac{0.89*0.85}{0.735826923076923} * 0.008461538461538461 \approx 0.00869926560907404$

$b(S_2) = \frac{0.11*0.1}{0.735826923076923} * 0.008461538461538461 \approx 0.00012649295664218\underline{7}$

From S_2 going `left` can lead to S_1 or S_3

$P(S_1) = 0.89, P(S_3) = 0.11$

$P(Red|Red) = 0.85, P(Red|Green) = 0.1$

$b(S_1) = \frac{0.89*0.85}{0.735826923076923} * 0.46153846153846156 \approx 0.47450539685858406$

$b(S_3) = \frac{0.11*0.85}{0.735826923076923} * 0.46153846153846156 \approx 0.05864673444319578\underline{5}$

From S_4 going `left` can lead to S_3 or S_5

$P(S_3) = 0.89, P(S_5) = 0.11$

$P(Red|Red) = 0.85, P(Red|Green) = 0.1$

$b(S_3) = \frac{0.89*0.85}{0.735826923076923} * 0.4107692307692308 \approx 0.42230980320413986$

$b(S_5) = \frac{0.11*0.1}{0.735826923076923} * 0.4107692307692308 \approx 0.006140658076993441$

From S_5, going `left` can lead to S_4 and S_6

$P(S_4) = 0.89, P(S_6) = 0.11$

$P(Red | Red) = 0.85, P(Red | Green) = 0.1$0

$b(S_4) = \frac{0.89*0.1}{0.735826923076923} * 0.05076923076923077 \approx 0.006140658076993441$

$b(S_6) = \frac{0.11*0.85}{0.735826923076923} * 0.05076923076923077 \approx 0.006451140788751536$

From S_6, going `left` can lead to S_5 or S_6

$P(S_5) = 0.89, P(S_6) = 0.11$

$P(Red|Red) = 0.85, P(Red|Green) = 0.1$

$b(S_5) = \frac{0.89*0.1}{0.735826923076923} * 0.06846153846153846 \approx 0.008280584376551763$

$b(S_6) = \frac{0.11*0.85}{0.735826923076923} * 0.06846153846153846 \approx 0.008699265609074042$

`Belief State after Step 2`: $[0.4832046624676581, 0.00012649295664218\,7, 0.48095653764733565, 0.006140658076993441, 0.014421242453545204, 0.015150406397825578]$

Step 3: Left with Observation Green

$P(Green | Left) = (0.89*0.15 + 0.11*0.90) * 0.4832046624676581 + (0.89*0.15 + 0.11*0.15) * 0.00012649295664218 7 + (0.89*0.90 + 0.11*0.90) * 0.48095653764733565 + (0.89*0.15 + 0.11*0.90) * 0.006140658076993441 + (0.89*0.90 + 0.11*0.15) * 0.014421242453545204 + (0.89*0.90 + 0.11*0.15) * 0.015150406397825578 = 0.5708274677887255

From S_1 going `left` can lead to S_1 or S_2

$P(S_1) = 0.89, P(S_2) = 0.11$

$P(Green|Green) = 0.9, P(Green|Red) = 0.15$

$b(S_1) = \frac{0.89*0.15}{0.5708274677887255} * 0.4832046624676581 \approx 0.11300756547214362$

$b(S_2) = \frac{0.11*0.90}{0.5708274677887255} * 0.4832046624676581 \approx 0.08380336315911775$

From S_2 going `left` can lead to S_1 or S_3

$P(S_1) = 0.89, P(S_3) = 0.11$

$P(Green|Green) = 0.9, P(Green|Red) = 0.15$

$b(S_1) = \frac{0.89*0.15}{0.5708274677887255} * 0.000126492956642187 \approx 0.000029583036319447\,24$

$b(S_3) = \frac{0.11*0.15}{0.5708274677887255} * 0.000126492956642187 \approx 0.0000036563303316170746$

From S_3 going `left` can lead to S_2 or S_4

$P(S_2) = 0.89, P(S_4) = 0.11$

$P(Green|Green) = 0.9, P(Green|Red) = 0.15$

$b(S_2) = \frac{0.89*0.90}{0.5708274677887255} * 0.48095653764733565 \approx 0.6748907654144336$

$b(S_4) = \frac{0.11*0.90}{0.5708274677887255} * 0.48095653764733565 \approx 0.08341346538830077$

From S_4 going `left` can lead to S_3 or S_5

$P(S_3) = 0.89, P(S_5) = 0.11$

$P(Green|Green) = 0.9, P(Green|Red) = 0.15$

$b(S_3) = \frac{0.89*0.15}{0.5708274677887255} * 0.006140658076993441 \approx 0.001436121944962\,2567$

$b(S_5) = \frac{0.11*0.90}{0.5708274677887255} * 0.006140658076993441 \approx 0.0010649893075001006$

From S_5 going `left` can lead to S_4 or S_6

$P(S_4) = 0.89, P(S_6) = 0.11$

$P(Green|Green) = 0.9, P(Green|Red) = 0.15$

$b(S_4) = \frac{0.89*0.90}{0.5708274677887255} * 0.014421242453545204 \approx 0.020236263769922706$

$b(S_6) = \frac{0.11*0.15}{0.5708274677887255} * 0.014421242453545204 \approx 0.0004168518754103928$

From S_6 going `left` can lead to S_5 or S_6

$P(S_5) = 0.89, P(S_6) = 0.11$

$P(Green|Green) = 0.9, P(Green|Red) = 0.15$

$b(S_5) = \frac{0.89*0.90}{0.5708274677887255} * 0.015150406397825578 \approx 0.021259445645930037$

$b(S_6) = \frac{0.11*0.15}{0.5708274677887255} * 0.015150406397825578 \approx 0.00043792865562777226$

`Belief State after Step 3`: [0.11303714850846307, 0.7586941285735513, 0.0014397782752938737, 0.10364972915822349, 0.022324434953430138, 0.0008547805310381651]