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Solution

BS_i represent Belief after ith ~~ob~~ action and observation.

So according to conditions given in question :-

Roll number = 2019101080

$\therefore$ $x = 0.99$

$y = 1$.

Now let $P(O = Red \mid S = Red) = 0.95 = y_1$

and $P(O = Green \mid S = Green) = 0.8 = y_2$.

$$\boxed{BS_0 = \left[\frac{1}{3}, 0, \frac{1}{3}, 0, 0, \frac{1}{3}\right]}$$

So If B_i is of form $[P(R), P(G)]$ then this means that he may be in a red state with probability $P(R)$ and in green with probability $P(G)$.

So $B_0 = [1, 0]$.

(i) Action = Right and observation = Green.

$P(S_1) = \frac{1}{3}(1-x)(1-y_1) = 0.000167$

$P(S_2) = \frac{1}{3} \times x \times y_2 = 0.264$

$P(S_3) = \frac{1}{3}(1-x)(1-y_1) = 0.000167$

$P(S_4) = \frac{1}{3} x\, y_2 = 0.264$

$P(S_5) = 0$

$P(S_6) = \frac{1}{3}(1-y_1) = 0.016667$

$\text{Sum} = \sum P(S_i) = 0.545001.$

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After normalizing :-

$\cancel{B_1} = BS_1 = [0.000306, 0.484403, 0.000306, 0.484403, 0, 0.030582]$

$B_1 = [0.031194, 0.968806]$

(ii) Action = left and observation = red

$P(S_1) = BS_1(S_1) . y_1 + BS_1(S_2) . x . y_1$
$= 0.455872.$

$P(S_2) = BS_1(S_2).(1-x).(1-y_2) + BS_1(S_3).x.(1-y_2)$
$= 0.001029$

$P(S_3) = y_1 \times (BS_1(S_3).(1-x) + BS_1(S_4).x).$
$= 0.455584$

$P(S_4) = (1-y_2)(BS_1(S_4)(1-x) + BS_1(S_5).x).$
$= 0.000969$

$P(S_5) = (1-y_2)(BS_1(S_5)(1-x) + BS_1(S_6).x).$
$= 0.006055$

$P(S_6) = y_1 \times BS_1(S_6)(1-x).$
$= 0.0002901$

Sum $= 0.9198$

After Normalizing :-

$BS_2 = [0.495621, 0.001119, 0.495308, 0.001053, 0.006582, 0.000316]$

$B_2 = [0.991245, 0.008754].$

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(iii) Action = left and observation = Green.

$P(S_1) = BS_2(S_1).(1-y_1) + BS_2(S_2)x.(1-y_1)$
$= 0.024836$

$P(S_2) = (BS_2(S_2)(1-x) + BS_2(S_3)x).y_2.$
$= 0.392293$

$P(S_3) = (BS_2(S_3)(1-x) + BS_2(S_4)x)(1-y_1)$
$= \cancel{0.00029}$ 0.0003

$P(S_4) = (BS_2(S_4)(1-x) + BS_2(S_5)x) y_2.$
$= 0.005221$

$P(S_5) = (BS_2(S_5)(1-x) + BS_2(S_6)x) y_2.$
$= 0.000303$

$P(S_6) = BS_2(S_6)(1-x) \cancel{y_1} (1-y_1)$
$= 0.000000$

Sum $= 0.422953$

$\cancel{BS_3} = [\cancel{0.024836}, \cancel{0.392293}, \cancel{0.0003}, \cancel{0.005221}, \cancel{0.000303}, \cancel{0.422}$

$$\boxed{BS_3 = [0.058720, 0.927510, 0.000709, 0.012344, 0.000716, 0.000000]}$$

$B_3 = [0.059429, 0.94057]$

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