ECE 322
Assignment 2

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To test the individual states, we are concerned with the stationary probabilies. The following linear system of equations is derived from the graph: (Note: there was a typo addressed by the professor. The transition from C to B has a weight of 1. In general, the sum of probabilities of edges leaving any node is equal to 1.)

$$p_A = 0.5p_E$$

$$p_B = p_A + p_C$$

$$p_C = 0.5p_E + 0.6B$$

$$p_D = 0.4p_B$$

$$p_E = p_D$$

The last equation is dropped, because otherwise the system would be linearly dependent. p_D is determined from the following relationship:

$$p_A + p_B + p_C + p_D + p_E = 1$$

The system of equations is solved using the following code:

```
import numpy as np
import string

a = np.array(
    [
        # a   b   c   d   e
        [-1, 0, 0, 0, 0.5],
        [1, -1, 1, 0, 0],
        [0, 0.6, -1, 0, 0.5],
        [0, 0.4, 0, -1, 0],
        #[0, 0, 0, 1, -1],
        [1, 1, 1, 1, 1],
    ]
)

#b = np.array([0, 0, 0, 0, 0, 1])
b = np.array([0, 0, 0, 0, 1])

x = np.linalg.solve(a, b)

alphabet = string.ascii_uppercase

d = dict()
for i in range(len(x)):
    d[alphabet[i]] = x[i]

for k,v in sorted(d.items(), key=lambda x: x[1], reverse=True):
        print(f"{k}: {v}")
```

which results in:
p_B: 0.3571428571428571
p_C: 0.28571428571428564
p_E: 0.1428571428571429
p_D: 0.14285714285714288
p_A: 0.07142857142857145

Thus, the order in which to test the individual states is: B, C, E, D, A.

As for testing the transitions, we look at the probabilities of the transitions, and pick the highest ones first. Therefore, the transitions I would test first are:
$A \to B$
$D \to E$

$C \rightarrow B$

, since they all have the highest probability of 1

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Unknown relationships: $4 \times 5 \times 2 \times 5 \times 2 \times 3 = 1200$ test cases.

Dependencies known: $4 \times 5 \times 2 = 40$ for x, 5 for y, and $2 \times 3 = 6$ for z. Summing these together, we get 51 total test cases as an upper bound if the relationships are known.