3.2 The H is a 4×4 matrix which is shown below:

$$\begin{matrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{matrix}$$

For $\pi[k]^T = \pi[k-1]^T H$, with $\pi[0] = [\frac{1}{2},\ \frac{1}{2},\ 0,\ 0]^T$,

$$\pi[0] = [\frac{1}{2}, \frac{1}{2}, 0, 0]^T$$

$$\pi[1] = [0, \frac{1}{2}, \frac{1}{2}, 0]^T$$

$$\pi[2] = [0, 0, \frac{1}{2}, \frac{1}{2}]^T$$

$$\pi[3] = [\frac{1}{2}, 0, 0, \frac{1}{2}]^T$$

$$\pi[4] = [\frac{1}{2}, \frac{1}{2}, 0, 0]^T$$

Note that $\pi[k]\ will\ loop\ between\ \pi[0]\ to\ \pi[3]$.

Solving $\pi^{*T} = \pi^{*T} H$ with $\sum_i \pi_i^* = 1$, we have $\pi^* = [\frac{1}{4}, \frac{1}{4}, \frac{1}{4}, \frac{1}{4}]$

3.3 The H matrix is

0	1	0	0	0
1	0	0	0	0
1/3	0	1/3	0	1/3
0	0	1/2	0	1/2
0	0	0	0	0

The $\widehat{H}$ matrix is

0	1	0	0	0
1	0	0	0	0
1/3	0	1/3	0	1/3
0	0	1/2	0	1/2
1/5	1/5	1/5	1/5	1/5

Using the excel file attached to compute the π^* until π^* does not change after one iteration. The result is calculated based on the G matrixes for different θ, which were shown below

For $\theta = 0.1$,The G matrix is

0.18	0.28	0.18	0.18	0.18
0.28	0.18	0.18	0.18	0.18
0.213333	0.18	0.213333	0.18	0.213333
0.18	0.18	0.23	0.18	0.23
0.2	0.2	0.2	0.2	0.2

$\pi^* = [0.211171, 0.205114, 0.199859, 0.183997, 0.199859]$

For $\theta = 0.3$,The G matrix is

0.14	0.44	0.14	0.14	0.14
0.44	0.14	0.14	0.14	0.14
0.24	0.14	0.24	0.14	0.24
0.14	0.14	0.29	0.14	0.29
0.2	0.2	0.2	0.2	0.2

$\pi^* = [0.237897, 0.222994, 0.193742, 0.151625, 0.193742]$

For $\theta = 0.5$,The G matrix is

0.1	0.6	0.1	0.1	0.1
0.6	0.1	0.1	0.1	0.1
0.266667	0.1	0.266667	0.1	0.266667
0.1	0.1	0.35	0.1	0.35
0.2	0.2	0.2	0.2	0.2

$\pi^* = [0.27451, 0.254902, 0.176471, 0.117647, 0.176471]$

For $\theta = 0.85$,The G matrix is

0.03	0.88	0.03	0.03	0.03
0.88	0.03	0.03	0.03	0.03
0.313333	0.03	0.313333	0.03	0.313333
0.03	0.03	0.455	0.03	0.455
0.2	0.2	0.2	0.2	0.2

$\pi^* = [0.39413, 0.38033, 0.090111, 0.045319, 0.090111]$

From the result, I observed that with different θ, the π^* will be different. Besides, the larger the θ is, the less different between G matrix and $\hat{H}$. Also note that $\pi^*[3]$ and $\pi^*[5]$ will always be the same no matter how the θ changes, because the 3rd column and the 5th of the G matrix are always the same.