

# **Mathematics Mini Project 3**

FM 122 – Mathematics of Uncertainty

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## Question 1:

### Matlab Code:

```
1 clear all;
2 clc;
3 format long;
4
5 P = [0.2 0.8; 0.4 0.6];
6 E = [0.2 0.4 0.4; 0.3 0.25 0.45];
7 pi = [0.43 0.57];
8 S = ["rainy" "sunny"];
9 Y = [1 1 2 1 3];
10 k = length(S);
11 T = length(Y);
12
13 for i = 1:k
14     viterbi_prob(i,1) = pi(1,i)*E(i,Y(1,i)); %#ok<SAGROW>
15     viterbi_path(i,1) = 0;
16 end
17
18 for j = 2:T
19     for i = 1:k
20         for v = 1:k
21             term(v) = E(i,Y(1,j))*P(v,i)*viterbi_prob(v,j-1);
22         end
23         [viterbi_prob(i,j), viterbi_path(i,j)] = max(term);
24     end
25 end
26
27 for a = 1:k
28     pos(a) = viterbi_prob(a,T);
29 end
30
31 [c, z(T)] = max(pos);
32 x(T) = S(z(T));
33
34 for j = T:-1:2
35     z(j-1) = viterbi_path(z(j),j);
36     x(1,j-1) = S(z(j-1));
37 end
38
39 viterbi_prob %#ok<NOPTS>
40 viterbi_path
41 x
```

## Output:

```
viterbi_prob =  
  
    0.0860000000000000    0.0136800000000000    0.0049248000000000    0.0003693600000000    0.0001891123200000  
    0.1710000000000000    0.0307800000000000    0.0046170000000000    0.0011819520000000    0.0003191270400000  
  
viterbi_path =  
  
    0    2    2    2    2  
    0    2    2    1    2  
  
x =  
  
1x5 string array  
  
    "sunny"    "sunny"    "rainy"    "sunny"    "sunny"
```

## Question 2:

### Matlab Code:

```
1 clear all;
2 clc;
3 format long;
4
5 P = [0.7 0.1 0.2; 0.4 0.5 0.1; 0.2 0.3 0.5];
6 E = [0.6 0.4; 0.3 0.7; 0.2 0.8];
7 pi = [0.8 0.1 0.1];
8 S = ["normal" "alternate" "direct"];
9 k = length(S);
10 Y = [1 2 2 2 2 1 1 2 2 2 2];
11 T = length(Y);
12
13 for i = 1:k
14     viterbi_prob(i,1) = pi(1,i)*E(i,Y(1,i)); %#ok<SAGROW>
15     viterbi_path(i,1) = 0;
16 end
17
18 for j = 2:T
19     for i = 1:k
20         for v = 1:k
21             term(v) = E(i,Y(1,j))*P(v,i)*viterbi_prob(v,j-1);
22         end
23         [viterbi_prob(i,j) viterbi_path(i,j)] = max(term); %#ok<NCOMMA>
24     end
25 end
26
27 for a = 1:k
28     pos(a) = viterbi_prob(a,T);
29 end
30
31 [c z(T)] = max(pos);
32 x(T) = S(z(T));
33
34 for j = T:-1:2
35     z(j-1) = viterbi_path(z(j),j);
36     x(1,j-1) = S(z(j-1));
37 end
38
39 viterbi_prob %#ok<NOPTS>
40 viterbi_path
41 x
```

## Output:

```
viterbi_prob =

Columns 1 through 7

0.480000000000000    0.134400000000000    0.037632000000000    0.010536960000000    0.002950348800000    0.001239146496000    0.000520441528320
0.070000000000000    0.033600000000000    0.016128000000000    0.006451200000000    0.002580480000000    0.000442368000000    0.000066355200000
0.080000000000000    0.076800000000000    0.030720000000000    0.012288000000000    0.004915200000000    0.000491520000000    0.000049565859840

Columns 8 through 11

0.000145723627930    0.000040802615820    0.000011424732430    0.000003198925080
0.000036430906982    0.000017486835352    0.000006994734141    0.000002797893656
0.000083270644531    0.000033308257812    0.000013323303125    0.000005329321250

viterbi_path =

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

x =

1x11 string array

"normal"    "normal"    "normal"    "normal"    "normal"    "normal"    "normal"    "direct"    "direct"    "direct"    "direct"
```