

Name: Sidharth Banerjee

CSE 4309 : Introduction to Machine Learning

Date: 09/12/2019

ID : 1001622703

**Assignment 2****Task 1**

Variables: M = Maine; S = Sahara; T = Temperature;  $e_1$  = email 1;  $e_2$  = email 2;  $e_3$  = email 3

Given:  $p(M) = 0.05 \Rightarrow p(S) = 1 - 0.05 = 0.95$   
 $p(T > 80 \mid M) = 0.2 \Rightarrow p(T < 80 \mid M) = 1 - 0.2 = 0.8$   
 $p(T > 80 \mid S) = 0.9 \Rightarrow p(T < 80 \mid S) = 1 - 0.9 = 0.1$

$$a) \quad p(M \mid T < 80) = \frac{p(T < 80 \mid M) \cdot p(M)}{p(T < 80)}$$

$$p(T < 80) = p(T < 80 \mid M) \cdot p(M) + p(T < 80 \mid S) \cdot p(S)$$

$$p(T < 80) = (0.8 \cdot 0.05) + (0.1 \cdot 0.95) = 0.04 + 0.095 = 0.135$$

$$P(M \mid T < 80) = \frac{(0.8) \cdot (0.05)}{0.135} = 4/13.5 = 0.29$$

$$b) \quad p(e_2 = T < 80 \mid e_1 = T < 80)$$

$$= [p(e_2 = T < 80 \mid M) \cdot p(M \mid e_1 = T < 80)] + [p(e_2 = T < 80 \mid S) \cdot p(S \mid e_1 = T < 80)]$$

$$= [0.8 \cdot 0.29] + [0.1 \cdot \frac{p(T < 80 \mid S) \cdot p(S)}{p(T < 80)}]$$

$$= 0.23 + 0.07$$

$$= 0.3$$

$$c) \quad p(e_3 = T < 80, e_2 = T < 80, e_1 = T < 80)$$

$$= (0.135 \cdot 0.135 \cdot 0.135) = 0.0025$$

**Task 2**

P is possible a probability function.  $P(A) + P(B)$  is less than one, however, we do not know the value of  $P(C)$  and  $P(D)$  so we cannot say for sure if they sum of all the individual probabilities will add up to one, in which case it will be a valid probability function, or if it will exceed of be less than one, in which case it will not be a valid probability function.

[Type here]

### Task 3

A probability density function is valid if integrals over an interval are  $\leq 1$ .

$$P(x) = \begin{cases} 0.3, & x \in [0, 10] \\ \text{unknown}, & x \notin [0, 10] \end{cases}$$

$$\int_0^{10} 0.3 dx = 0.3x = 0.3(10) - 0.3(0) = 3, \text{ which is greater than } 1$$

Therefore, this is not a probability density function.

### Task 4

Training stage for yeast\_training.txt

```
1, 1, 0.52, 0.10
1, 2, 0.54, 0.10
1, 3, 0.52, 0.07
1, 4, 0.41, 0.17
1, 5, 0.50, 0.01
1, 6, 0.00, 0.01
1, 7, 0.50, 0.05
1, 8, 0.24, 0.05
2, 1, 0.45, 0.11
2, 2, 0.45, 0.10
2, 3, 0.53, 0.06
2, 4, 0.23, 0.11
2, 5, 0.50, 0.04
2, 6, 0.00, 0.01
2, 7, 0.49, 0.06
2, 8, 0.33, 0.14
3, 1, 0.43, 0.10
3, 2, 0.48, 0.11
3, 3, 0.36, 0.06
3, 4, 0.22, 0.08
3, 5, 0.51, 0.05
3, 6, 0.00, 0.01
3, 7, 0.51, 0.04
3, 8, 0.27, 0.09
4, 1, 0.79, 0.07
4, 2, 0.76, 0.07
4, 3, 0.38, 0.06
4, 4, 0.32, 0.11
4, 5, 0.50, 0.01
4, 6, 0.00, 0.01
4, 7, 0.51, 0.07
4, 8, 0.27, 0.09
5, 1, 0.74, 0.16
5, 2, 0.62, 0.13
5, 3, 0.42, 0.08
5, 4, 0.30, 0.12
5, 5, 0.50, 0.01
```

[Type here]

```
5, 6, 0.00, 0.01
5, 7, 0.51, 0.06
5, 8, 0.24, 0.04
6, 1, 0.54, 0.14
6, 2, 0.50, 0.12
6, 3, 0.51, 0.05
6, 4, 0.24, 0.10
6, 5, 0.50, 0.01
6, 6, 0.49, 0.39
6, 7, 0.51, 0.03
6, 8, 0.24, 0.05
7, 1, 0.48, 0.11
7, 2, 0.47, 0.09
7, 3, 0.54, 0.06
7, 4, 0.22, 0.12
7, 5, 0.50, 0.04
7, 6, 0.00, 0.03
7, 7, 0.50, 0.06
7, 8, 0.26, 0.09
8, 1, 0.74, 0.11
8, 2, 0.73, 0.11
8, 3, 0.49, 0.05
8, 4, 0.29, 0.07
8, 5, 0.50, 0.01
8, 6, 0.00, 0.01
8, 7, 0.46, 0.08
8, 8, 0.23, 0.02
9, 1, 0.55, 0.14
9, 2, 0.56, 0.16
9, 3, 0.51, 0.07
9, 4, 0.20, 0.07
9, 5, 0.50, 0.01
9, 6, 0.00, 0.01
9, 7, 0.53, 0.05
9, 8, 0.24, 0.05
10, 1, 0.78, 0.06
10, 2, 0.73, 0.12
10, 3, 0.48, 0.11
10, 4, 0.33, 0.07
10, 5, 1.00, 0.01
10, 6, 0.00, 0.01
10, 7, 0.55, 0.02
10, 8, 0.23, 0.01
```

Test stage for yeast\_test.txt

Classification accuracy= 0.4483