
Task 1

Knowns given problem statement: (M=Maine, S=Sahara, H=Hot(>=80), C=Cold(<80))

- P(M) = 0.0500
- P(S) = 0.9500
- P(H|M) = 0.2000, P(C|M) = 0.8000
- P(H|S) = 0.9000, P(C|S) = 0.1000

Calculated values:

- P(H) = P(H|M)*P(M)+P(H|S)*P(S) = 0.8650
- P(C) = P(C|M)*P(M)+P(C|S)*P(S) = 0.1350

a) P(M|C) = P(C|M)*P(M)/P(C) = **0.2963**

b) If you know the previous day showed a cold temperature, the probabilities for the locations changes for the second calculation: P(M) <- P(M|C) = 0.2963, P(S) <- P(S|C)= 0.7037. Now just do sum rule again but replace the probabilities of the locations.
P(C) = P(C|M)*P(M|C)+P(C|S)*P(S|C) = **0.3074**

c) There are two scenarios: the sensor is in Maine or the Sahara. Do the sum rule over these possibilities:
$P(C^3) = P(C|M)^3*P(M)+P(C|S)^3*P(S)$ = **0.0266**

The notation used to show what the answer is asking is probably slightly wrong, but the answers should be correct.

Task 2

P is possibly a probability function. A probability function must sum up to 1.0 over all possibilities. since P(A)+P(B)=0.9, as long as P(C)+P(D)<=0.1 then its valid, but if not then its invalid.

Task 3

P is definitely not a probability density function. Probability density functions have a cumulative sum of 1.0. The total probability of P is 0.3*(10-0) = 3.0. Since this is larger than 1.0 and negative probabilities don’t exist, P is invalid.

Task 4

Knowns given problem statement:

- p(B=r) = 0.4
- p(B=b) = 0.6
- p(F=a | B=r) = 0.25
- p(F=o | B=r) = 0.75
- p(F=a | B=b) = 0.75
- p(F=o | B=b) = 0.25

Calculated values:

- P(F=a) = p(F=a | B=r)*p(B=r) + p(F=a | B=b)*p(B=b) = 0.5500
- P(F=o) = p(F=o | B=r)*p(B=r) + p(F=o | B=b)*p(B=b) = 0.4500
- P(B=b | F=a) = P(F=a | B=b)*P(B=b)/P(F=a) = 0.8182 <-
- P(B=r | F=a) = P(F=a | B=r)*P(B=r)/P(F=a) = 0.1818
- P(B=b | F=o) = P(F=o | B=b)*P(B=b)/P(F=o) = 0.3333
- P(B=r | F=o) = P(F=o | B=r)*P(B=r)/P(F=o) = 0.6666 <-

The classifier will choose B=b when given F=a and will choose B=r when given F=o. To find the probability of success we need use sum rule over all the successful scenarios:
P(correct) = P(F=a | B=b)*P(B=b) + P(F=o | B=r)*P(B=r) = **0.7500**
P(wrong) = P(F=a | B=r)*P(B=r) + P(F=o | B=b)*P(B=b) = 0.2500

There is a 75% chance that the classifier is correct.

Task 5

Training stage output:

```
Class 1, attribute 1, mean = 0.52, std = 0.10
Class 1, attribute 2, mean = 0.54, std = 0.10
Class 1, attribute 3, mean = 0.52, std = 0.07
Class 1, attribute 4, mean = 0.41, std = 0.17
Class 1, attribute 5, mean = 0.50, std = 0.01
Class 1, attribute 6, mean = 0.00, std = 0.01
Class 1, attribute 7, mean = 0.50, std = 0.05
Class 1, attribute 8, mean = 0.24, std = 0.05
Class 2, attribute 1, mean = 0.45, std = 0.11
Class 2, attribute 2, mean = 0.45, std = 0.10
Class 2, attribute 3, mean = 0.53, std = 0.06
Class 2, attribute 4, mean = 0.23, std = 0.11
Class 2, attribute 5, mean = 0.50, std = 0.04
Class 2, attribute 6, mean = 0.00, std = 0.01
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Class 2, attribute 7, mean = 0.49, std = 0.06
Class 2, attribute 8, mean = 0.33, std = 0.14
Class 3, attribute 1, mean = 0.43, std = 0.10
Class 3, attribute 2, mean = 0.48, std = 0.11
Class 3, attribute 3, mean = 0.36, std = 0.06
Class 3, attribute 4, mean = 0.22, std = 0.08
Class 3, attribute 5, mean = 0.51, std = 0.05
Class 3, attribute 6, mean = 0.00, std = 0.01
Class 3, attribute 7, mean = 0.51, std = 0.04
Class 3, attribute 8, mean = 0.27, std = 0.09
Class 4, attribute 1, mean = 0.79, std = 0.07
Class 4, attribute 2, mean = 0.76, std = 0.07
Class 4, attribute 3, mean = 0.38, std = 0.06
Class 4, attribute 4, mean = 0.32, std = 0.11
Class 4, attribute 5, mean = 0.50, std = 0.01
Class 4, attribute 6, mean = 0.00, std = 0.01
Class 4, attribute 7, mean = 0.51, std = 0.07
Class 4, attribute 8, mean = 0.27, std = 0.09
Class 5, attribute 1, mean = 0.74, std = 0.16
Class 5, attribute 2, mean = 0.62, std = 0.13
Class 5, attribute 3, mean = 0.42, std = 0.08
Class 5, attribute 4, mean = 0.30, std = 0.12
Class 5, attribute 5, mean = 0.50, std = 0.01
Class 5, attribute 6, mean = 0.00, std = 0.01
Class 5, attribute 7, mean = 0.51, std = 0.06
Class 5, attribute 8, mean = 0.24, std = 0.04
Class 6, attribute 1, mean = 0.54, std = 0.14
Class 6, attribute 2, mean = 0.50, std = 0.12
Class 6, attribute 3, mean = 0.51, std = 0.05
Class 6, attribute 4, mean = 0.24, std = 0.10
Class 6, attribute 5, mean = 0.50, std = 0.01
Class 6, attribute 6, mean = 0.49, std = 0.39
Class 6, attribute 7, mean = 0.51, std = 0.03
Class 6, attribute 8, mean = 0.24, std = 0.05
Class 7, attribute 1, mean = 0.48, std = 0.11
Class 7, attribute 2, mean = 0.47, std = 0.09
Class 7, attribute 3, mean = 0.54, std = 0.06
Class 7, attribute 4, mean = 0.22, std = 0.12
Class 7, attribute 5, mean = 0.50, std = 0.04
Class 7, attribute 6, mean = 0.00, std = 0.03
Class 7, attribute 7, mean = 0.50, std = 0.06
Class 7, attribute 8, mean = 0.26, std = 0.09
Class 8, attribute 1, mean = 0.74, std = 0.11
Class 8, attribute 2, mean = 0.73, std = 0.11
Class 8, attribute 3, mean = 0.49, std = 0.05
Class 8, attribute 4, mean = 0.29, std = 0.07
```

```
Class 8, attribute 5, mean = 0.50, std = 0.01
Class 8, attribute 6, mean = 0.00, std = 0.01
Class 8, attribute 7, mean = 0.46, std = 0.08
Class 8, attribute 8, mean = 0.23, std = 0.02
Class 9, attribute 1, mean = 0.55, std = 0.14
Class 9, attribute 2, mean = 0.56, std = 0.16
Class 9, attribute 3, mean = 0.51, std = 0.07
Class 9, attribute 4, mean = 0.20, std = 0.07
Class 9, attribute 5, mean = 0.50, std = 0.01
Class 9, attribute 6, mean = 0.00, std = 0.01
Class 9, attribute 7, mean = 0.53, std = 0.05
Class 9, attribute 8, mean = 0.24, std = 0.05
Class 10, attribute 1, mean = 0.78, std = 0.06
Class 10, attribute 2, mean = 0.73, std = 0.12
Class 10, attribute 3, mean = 0.48, std = 0.11
Class 10, attribute 4, mean = 0.33, std = 0.07
Class 10, attribute 5, mean = 1.00, std = 0.01
Class 10, attribute 6, mean = 0.00, std = 0.01
Class 10, attribute 7, mean = 0.55, std = 0.02
Class 10, attribute 8, mean = 0.23, std = 0.01
```

Last line of classification output:

```
classification accuracy=0.4483
```
