Exercise 14

There are 12 records used as a training set
First compute prior probabilities of each class
P(mammal) = 4/12
P(reptile) = 3/12
P(fish) = 2/12
P(amphibian) = 1/12
P(bird) = 2/12

Test record X1: Porcupine

X1 = (Body Temperature = warm-blooded, Skin Cover = quills, Gives Birth = yes, Aquatic Creature = no, Aerial Creature = no, Has Legs = yes, Hibernates = yes)

P(X1 | mammal) = P(Body Temperature = warm-blooded | mammal) x P(Skin Cover = quills | mammal) x P(Gives Birth = yes | mammal) x P(Aquatic Creature = no | mammal) x (Aerial Creature = no | mammal) x P(Has Legs = yes | mammal) x P(Hibernates = yes | mammal)
= 4/4 x 0/4 = 0
(I stopped after computing the Skin Cover because 0 will make the entire computation 0 anyway)

P(X1 | reptile) = P(Body Temperature = warm-blooded | reptile) x P(Skin Cover = quills | reptile) x P(Gives Birth = yes | reptile) x P(Aquatic Creature = no | reptile) x (Aerial Creature = no | reptile) x P(Has Legs = yes | reptile) x P(Hibernates = yes | reptile)
= 0/3 = 0

P(X1 | fish) = P(Body Temperature = warm-blooded | fish) x P(Skin Cover = quills | fish) x P(Gives Birth = yes | fish) x P(Aquatic Creature = no | fish) x (Aerial Creature = no | fish) x P(Has Legs = yes | fish) x P(Hibernates = yes | fish)
= 0/2 = 0

P(X1 | amphibian) = P(Body Temperature = warm-blooded | amphibian) x P(Skin Cover = quills | amphibian) x P(Gives Birth = yes | amphibian) x P(Aquatic Creature = no | amphibian) x (Aerial Creature = no | amphibian) x P(Has Legs = yes | amphibian) x P(Hibernates = yes | amphibian)
= 0/1 = 0

P(X1 | bird) = P(Body Temperature = warm-blooded | bird) x P(Skin Cover = quills | bird) x P(Gives Birth = yes | bird) x P(Aquatic Creature = no | bird) x (Aerial Creature = no | bird) x P(Has Legs = yes | bird) x P(Hibernates = yes | bird)
= 2/2 x 0/2 = 0

The posterior probability for all the classes is 0 because their class-conditional probability is 0.

So Naïve Baysian Classification is not able to classify the record.

Test record X2: Eel

X2 = (Body Temperature = cold-blooded, Skin Cover = scales, Gives Birth = no, Aquatic Creature = yes, Aerial Creature = no, Has Legs = no, Hibernates = no)

P(X2 | mammal) = P(Body Temperature = cold-blooded | mammal) x P(Skin Cover = scales | mammal) x P(Gives Birth = no | mammal) x P(Aquatic Creature = yes | mammal) x (Aerial Creature = no | mammal) x P(Has Legs = no | mammal) x P(Hibernates = no | mammal)
= 0/4

P(X2 | reptile) = P(Body Temperature = cold-blooded | reptile) x P(Skin Cover = scales | reptile) x P(Gives Birth = no| reptile) x P(Aquatic Creature = yes | reptile) x (Aerial Creature = no | reptile) x P(Has Legs = no | reptile) x P(Hibernates = no | reptile)
= 2/3 x 2/3 x 2/3 x 0/3 = 0

P(X2 | fish) = P(Body Temperature = cold-blooded | fish) x P(Skin Cover = scales | fish) x P(Gives Birth = no | fish) x P(Aquatic Creature = yes | fish) x (Aerial Creature = no | fish) x P(Has Legs = no | fish) x P(Hibernates = no | fish)
= 2/2 x 2/2 x 1/2 x 2/2 x 2/2 x 2/2 x 2/2 = 1/2

P(X2 | amphibian) = P(Body Temperature = cold-blooded | amphibian) x P(Skin Cover = scales | amphibian) x P(Gives Birth = no | amphibian) x P(Aquatic Creature = yes | amphibian) x (Aerial Creature = no | amphibian) x P(Has Legs = no | amphibian) x P(Hibernates = no | amphibian)
= 1/1 x 0/1 = 0

P(X2 | bird) = P(Body Temperature = cold-blooded | bird) x P(Skin Cover = scales | bird) x P(Gives Birth = no | bird) x P(Aquatic Creature = yes | bird) x (Aerial Creature = no | bird) x P(Has Legs = no | bird) x P(Hibernates = no | bird)
= 0/2

The posterior probability for class fish is P(fish | X2) = (a) x (2/12) x (.5) = .083a where a = 1/P(X2) is a constant term. The posterior probability for all the other classes is 0 because their class-conditional probability is 0.

Since P(fish | X2) is greater than all the others, the record is classified as fish.

Test record X3: Salamander

X3 = (Body Temperature = cold-blooded, Skin Cover = none, Gives Birth = no, Aquatic Creature = semi, Aerial Creature = no, Has Legs = yes, Hibernates = yes)

P(X3 | mammal) = P(Body Temperature = cold-blooded | mammal) x P(Skin Cover = none | mammal) x P(Gives Birth = no | mammal) x P(Aquatic Creature = semi | mammal) x (Aerial Creature = no | mammal) x P(Has Legs = yes | mammal) x P(Hibernates = yes | mammal)
= 0/4 = 0

P(X3 | reptile) = P(Body Temperature = cold-blooded | reptile) x P(Skin Cover = none | reptile) x P(Gives Birth = no| reptile) x P(Aquatic Creature = semi | reptile) x (Aerial Creature = no | reptile) x P(Has Legs = yes | reptile) x P(Hibernates = yes | reptile)
= 3/3 x 0/3 = 0

P(X3 | fish) = P(Body Temperature = cold-blooded | fish) x P(Skin Cover = none | fish) x P(Gives Birth = no | fish) x P(Aquatic Creature = semi | fish) x (Aerial Creature = no | fish) x P(Has Legs = yes | fish) x P(Hibernates = yes | fish)
= 2/2 x 0/2 = 0

P(X3 | amphibian) = P(Body Temperature = cold-blooded | amphibian) x P(Skin Cover = none | amphibian) x P(Gives Birth = no | amphibian) x P(Aquatic Creature = semi | amphibian) x (Aerial Creature = no | amphibian) x P(Has Legs = yes | amphibian) x P(Hibernates = yes | amphibian)
= 1/1 x 1/1 x 1/1 x 1/1 x 1/1 x 1/1 x 1/1 = 1

P(X3 | bird) = P(Body Temperature = cold-blooded | bird) x P(Skin Cover = none | bird) x P(Gives Birth = no | bird) x P(Aquatic Creature = semi | bird) x (Aerial Creature = no | bird) x P(Has Legs = yes | bird) x P(Hibernates = yes | bird)
= 0/2 = 0

The posterior probability for class amphibian is P(amphibian | X3) = (a) x (1/12) x (1) = .083a where a = 1/P(X3) is a constant term. The posterior probability for all the other classes is 0 because their class-conditional probability is 0.

Since P(amphibian | X3) is greater than all the others, the record is classified as amphibian.