Solution:

Lets calculate the training data and the probability of each class

P(C) : The probability of class C is 3/7

P(W) : The probability of class W is 2/7

P(F) : The probability of class F is 2/7

P(W1|C): The probability that the word "W1" appears on the 3 class documents

Number of times the word "W1" appears on the 3 class C documents : 4

Number of times the word appeared in the 3 class C documents : 12

number of vocabulary(W1 W2 W3 W4 W5 W6) : 6

= (count(W1, C) + 1) / (count(C)+|V|)

= (4+1) / (12+6) = 5/18

P(W1|W) : probability that the word "W1" appears in the 3 class W documents

= (count(W1, W) + 1) / (count(W)+|V|)

= (1+1) / (8+6) = 2/14 = 1/7

Number of times the word "W1" appears on the 2 class W documents : 1

Number of words in the 3 class W documents : 8

(W1 W2 W3 W4 W5 W6) : 6

P(W1|F) : probability that the word "W1" appears on the 2 class F documents

Number of times the word "W1" appears in the 2 class F documents : 0
number of vocabulary: (W1 W2 W3 W4 W5 W6) : 6

= (count(W1, F) + 1) / (count(F)+|V|)

= (0+1) / (9+6) = 1/15

P(W3|C) : probability that the word "W3" appears in the 3 class C documents

Number of times the word "W3" appear in the 3 class C documents : 2

Number of words in the 3 class C documents : 12

Number of vocabulary: (W1 W2 W3 W4 W5 W6) : 6

= (count(W3, C) + 1) / (count(C)+|V|)

= (2+1) / (12+6) = 3/18 = 1/6

P(W3|W) : probability that the word "W3" appears on the 3 class W documents

Number of times the word "W3" appear in the 2 class W documents :1

Number of words in the 3 class W documents : 8
Number of vocabulary: (W1 W2 W3 W4 W5 W6) : 6

= (count(W3, W) + 1) / (count(W)+|V|)

= (1+1) / (8+6) = 2/14 = 1/7

P(W3|F) : probability that the word "W3" appears in the 2 class F documents

Number of times the word "W3" appear in the 2 class F documents : 2

Number of words in the 3 class F documents : 9

number of vocabulary: (W1 W2 W3 W4 W5 W6) : 6

= (count(W3, F) + 1) / (count(F)+|V|)

= (2+1) / (9+6) = 3/15 = 1/5

P(W4|C) : probability that the word "W4" appears in the 3 class C documents

Number of times the word "W4" appear on the 3 class C documents ; 2

Number of words in the 3 class C documents : 12

number of vocabulary: (W1 W2 W3 W4 W5 W6) : 6

= (count(W4, C) + 1) / (count(C)+|V|)

= (2+1) / (12+6) = 3/18 = 1/6

P(W4|W) : probability that the word "W4" appears in the 3 class W documents

Number of times the word "W4" appear on the 2 class W documents : 1

Number of words in the 3 class W documents : 8

number of vocabulary: (W1 W2 W3 W4 W5 W6) : 6

= (count(W4, W) + 1) / (count(W)+|V|)

= (1+1) / (8+6) = 2/14 = 1/7

P(W4|F) : probability that the word "W4" appears in the 2 class F documents

Number of times the word "W4" appear in the 2 class F documents : 2

Number of words in the 3 class F documents : 9

number of vocabulary: (W1 W2 W3 W4 W5 W6) : 6

= (count(W4, F) + 1) / (count(F)+|V|)

= (2+1) / (9+6) = 3/15

P(W5|C): probability that the word "W5" appears on the 3 class C documents

Number of times the word "W5" appears in the 3 class C documents ; 2

Number of words in the 3 class C documents : 12

number of vocabulary: (W1 W2 W3 W4 W5 W6) : 6

= (count(W5, C) + 1) / (count(C)+|V|)

= (2+1) / (12+6) = 3/18 = 1/6

P(W5|W): probability that the word "W5" appears in the 3 class W documents

Number of times the word "W5" appear on the 2 class W documents : 2

Number of words in the 3 class W documents : 8

number of vocabulary: (W1 W2 W3 W4 W5 W6) : 6

= (count(W5, W) + 1) / (count(W)+|V|)

= (2+1) / (8+6) = 3/14

P(W5|F): probability that the word "W5" appears in the 2 class F documents

Number of times the word "W5" appear on the 2 class F documents : 2

Number of words in the 3 class F documents : 9

number of vocabulary: (W1 W2 W3 W4 W5 W6) : 6

= (count(W5, F) + 1) / (count(F)+|V|)

= (2+1) / (9+6) = 3/15

P(W6|C): probability that the word "W6" appears on the 3 class C documents

Number of times the word "W6" appear on the 3 class C documents : 0

Number of words in the 3 class C documents : 12

number of vocabulary: (W1 W2 W3 W4 W5 W6) : 6

= (count(W6, C) + 1) / (count(C)+|V|)

= (0+1) / (12+6) = 1/18

P(W6|W): probability that the word "W6" appears in the 2 class W documents

Number of times the word "W6" appear on the 2 class W documents : 2

Number of words in the 3 class W documents : 8

number of vocabulary: (W1 W2 W3 W4 W5 W6) : 6

= (count(W6, W) + 1) / (count(W)+|V|)

= (2+1) / (8+6) = 3/14

P(W6|F) : probability that the word "W6" appears in the 2 class F documents

Number of times the word "W6" appear on the 2 class F documents : 1

Number of words in the 3 class F documents : 9

number of vocabulary: (W1 W2 W3 W4 W5 W6) : 6

= (count(W6, F) + 1) / (count(F)+|V|)

= (1+1) / (9+6) = 2/15

P(C|d8) : P(C) * P(W1|C) * P(W4|C)* P(W6|C) * P(W5|C) * P(W3|C)

= ((3/7) * (5/18)* (1/6)* (1/18) *(1/6) *(1/6))

= 0.00003061924

approximately 0.00003

= 3/7 : P(C)

= There are 5 words in d8 : W1 W4 W6 W5 W3

Each word "W1" has P(W1|C) = 5/18

The word "W4" has P(W4|C) =3/18 = 1/6

The word "W6" has P(W6|C) = 1/18

The word "W5" has P(W5|C) = 3/18 = 1/6

The word "W3" has P(W3|C) = 3/18 = 1/6

P(W|d8) = P(W) * P(W1|W) * P(W4|W)* P(W6|W) * P(W5|W) * P(W3|W)

= (2/7* 2/14 * 2/14 * 3/14 * 3/14 * 2/14)

= 0.00003824936

approximately 0.00004

= 2/7 : P(W) : prior

There are 5 words in d8 : W1 W4 W6 W5 W3

Each word "W1" has P(W1|W) = 2/14

The word "W4" has P(W4|W)= 2/14

The word "W6" has P(W6|W)= 3/14

The word "W5" has P(W5|W) = 3/14

The word "W3" has P(W3|W) = 2/14

P(F|d8) = P(F) * P(W1|F) * P(W4|F)* P(W6|F) * P(W5|F) * P(W3|F)

=((2/7) * (1/15)*(3/15) * (2/15) * (3/15) * (3/15))

= 0.00002031746

approximately 0.00002

= 2/7:prior : P(F)

= There are 5 words in d8 : W1 W4 W6 W5 W3

- Each word "W1" has P(W1|F) = 1/15
- The word "W4" has P(W4|F)= 3/15
- The word "W6" has P(W6|F)= 2/15
- The word "W5" has P(W5|F)= 3/15
- The word "W3" has P(W3|F) = 3/15

Does d8 belong to C or W or F?

From our probability calculation, Document 8 should belong to the class W.

Google slides
https://docs.google.com/presentation/d/12O98adPJzAvU_tHdqHL8enbP2wL4eA34kP_2REGavyg/edit?usp=sharing