Example: Canoeing

Example	Rain Recently (RR)	Rain Today (RT)	Temp (T)	Wind (W)	Sunshine (S)	Canoeing (C)
1	Moderate	Moderate	Warm	Light	Some	Yes
2	Light	Moderate	Warm	Moderate	None	No
3	Moderate	Moderate	Cold	Gale	None	No
4	Moderate	Moderate	Warm	Light	None	Yes
5	Moderate	Light	Cold	Light	Some	No
6	Heavy	Light	Cold	Moderate	Some	Yes
7	Light	Light	Cold	Moderate	Some	No
8	Moderate	Moderate	Cold	Gale	Some	No
9	Heavy	Heavy	Warm	Moderate	None	Yes
10	Light	Light	Cold	Light	Some	No

- **Exercise:** Classify new examples using Naïve Bayes…

Example	Rain Recently (RR)	Rain Today (RT)	Temp (T)	Wind (W)	Sunshine (S)	Canoeing (C)
X1	Heavy	Moderate	Warm	Light	Some	???

Example	Rain Recently (RR)	Rain Today (RT)	Temp (T)	Wind (W)	Sunshine (S)	Canoeing (C)
X2	Light	Moderate	Warm	Light	Some	???

Solution: Canoeing X1

Test input example for hypothesis 1: *Canoeing=Yes*

Example	Rain Recently (RR)	Rain Today (RT)	Temp (T)	Wind (W)	Sunshine (S)	Canoeing (C)
1	Moderate	Moderate	Warm	Light	Some	Yes
2	Light	Moderate	Warm	Moderate	None	No
3	Moderate	Moderate	Cold	Gale	None	No
4	Moderate	Moderate	Warm	Light	None	Yes
5	Moderate	Light	Cold	Light	Some	No
6	Heavy	Light	Cold	Moderate	Some	Yes
7	Light	Light	Cold	Moderate	Some	No
8	Moderate	Moderate	Cold	Gale	Some	No
9	Heavy	Heavy	Warm	Moderate	None	Yes
10	Light	Light	Cold	Light	Some	No

Example	Rain Recently (RR)	Rain Today (RT)	Temp (T)	Wind (W)	Sunshine (S)	Canoeing (C)
X1	Heavy	Moderate	Warm	Light	Some	???

Apply NB for *Canoeing=Yes* by calculating product of probabilities for input's feature values and class probability:

$$P(C) = (2/4 \times 2/4 \times 3/4 \times 2/4 \times 2/4) \times 4/10$$

$$P(C) = 0.01875$$

Class Probability

$P(C) = 4/10$

Feature: Rain Recently

$P(L\_RR|C) = 0/4$

$P(M\_RR|C) = 2/4$

$P(H\_RR|C) = 2/4$

Feature: Rain Today

$P(L\_RT|C) = 1/4$

$P(M\_RT|C) = 2/4$

$P(H\_RT|C) = 1/4$

Feature: Temp

$P(C\_T|C) = 1/4$

$P(W\_T|C) = 3/4$

Feature: Wind

$P(L\_W|C) = 2/4$

$P(M\_W|C) = 2/4$

$P(G\_W|C) = 0/4$

Feature: Sunshine

$P(S\_S|C) = 2/4$

$P(N\_S|C) = 2/4$

Solution: Canoeing X1

Test input example for hypothesis 2: *Canoeing=No*

Example	Rain Recently (RR)	Rain Today (RT)	Temp (T)	Wind (W)	Sunshine (S)	Canoeing (C)
1	Moderate	Moderate	Warm	Light	Some	Yes
2	Light	Moderate	Warm	Moderate	None	No
3	Moderate	Moderate	Cold	Gale	None	No
4	Moderate	Moderate	Warm	Light	None	Yes
5	Moderate	Light	Cold	Light	Some	No
6	Heavy	Light	Cold	Moderate	Some	Yes
7	Light	Light	Cold	Moderate	Some	No
8	Moderate	Moderate	Cold	Gale	Some	No
9	Heavy	Heavy	Warm	Moderate	None	Yes
10	Light	Light	Cold	Light	Some	No

Example	Rain Recently (RR)	Rain Today (RT)	Temp (T)	Wind (W)	Sunshine (S)	Canoeing (C)
X1	Heavy	Moderate	Warm	Light	Some	???

Apply NB for *Canoeing=No* by calculating product of probabilities for input's feature values and class probability:

$$P(NC) = (0/6 \times 3/6 \times 1/6 \times 2/6 \times 4/6) \times 6/10$$

$$P(NC) = 0$$

Class Probability

$P(NC) = 6/10$

Feature: Rain Recently

$P(L\_RR|NC) = 3/6$

$P(M\_RR|NC) = 3/6$

$P(H\_RR|NC) = 0/6$

Feature: Rain Today

$P(L\_RT|NC) = 3/6$

$P(M\_RT|NC) = 3/6$

$P(H\_RT|NC) = 0/6$

Feature: Temp

$P(C\_T|NC) = 5/6$

$P(W\_T|NC) = 1/6$

Feature: Wind

$P(L\_W|NC) = 2/6$

$P(M\_W|NC) = 2/6$

$P(G\_W|NC) = 2/6$

Feature: Sunshine

$P(S\_S|NC) = 4/6$

$P(N\_S|NC) = 2/6$

Solution: Canoeing X1

- Calculated probabilities for two hypotheses (class labels):

  Yes `P(C)  = 2/4 x 2/4 x 3/4 x 2/4 x 2/4 x 4/10 = 0.01875`

  No `P(NC) = 0/6 x 3/6 x 1/6 x 2/6 x 4/6 x 6/10 = 0`

- Normalise probabilities to sum to 1:

  Yes `P(C)' = 0.01875/(0.01875+0) = 1.0`

  No `P(NC)' = 0`

- Output Label: **Yes**

Solution: Canoeing X2

Test input example for hypothesis 1: *Canoeing=Yes*

Example	Rain Recently (RR)	Rain Today (RT)	Temp (T)	Wind (W)	Sunshine (S)	Canoeing (C)
1	Moderate	Moderate	Warm	Light	Some	Yes
2	Light	Moderate	Warm	Moderate	None	No
3	Moderate	Moderate	Cold	Gale	None	No
4	Moderate	Moderate	Warm	Light	None	Yes
5	Moderate	Light	Cold	Light	Some	No
6	Heavy	Light	Cold	Moderate	Some	Yes
7	Light	Light	Cold	Moderate	Some	No
8	Moderate	Moderate	Cold	Gale	Some	No
9	Heavy	Heavy	Warm	Moderate	None	Yes
10	Light	Light	Cold	Light	Some	No

Example	Rain Recently (RR)	Rain Today (RT)	Temp (T)	Wind (W)	Sunshine (S)	Canoeing (C)
X2	Light	Moderate	Warm	Light	Some	???

Apply NB for *Canoeing=Yes* by calculating product of probabilities for input's feature values and class probability:

$$P(C) = (0/4 \times 2/4 \times 3/4 \times 2/4 \times 2/4) \times 4/10$$

$$P(C) = 0$$

Class Probability

$P(C) = 4/10$

Feature: Rain Recently

$P(L\_RR|C) = 0/4$

$P(M\_RR|C) = 2/4$

$P(H\_RR|C) = 2/4$

Feature: Rain Today

$P(L\_RT|C) = 1/4$

$P(M\_RT|C) = 2/4$

$P(H\_RT|C) = 1/4$

Feature: Temp

$P(C\_T|C) = 1/4$

$P(W\_T|C) = 3/4$

Feature: Wind

$P(L\_W|C) = 2/4$

$P(M\_W|C) = 2/4$

$P(G\_W|C) = 0/4$

Feature: Sunshine

$P(S\_S|C) = 2/4$

$P(N\_S|C) = 2/4$

Solution: Canoeing X2

Test input example for hypothesis 2: *Canoeing=No*

Example	Rain Recently (RR)	Rain Today (RT)	Temp (T)	Wind (W)	Sunshine (S)	Canoeing (C)
1	Moderate	Moderate	Warm	Light	Some	Yes
2	Light	Moderate	Warm	Moderate	None	No
3	Moderate	Moderate	Cold	Gale	None	No
4	Moderate	Moderate	Warm	Light	None	Yes
5	Moderate	Light	Cold	Light	Some	No
6	Heavy	Light	Cold	Moderate	Some	Yes
7	Light	Light	Cold	Moderate	Some	No
8	Moderate	Moderate	Cold	Gale	Some	No
9	Heavy	Heavy	Warm	Moderate	None	Yes
10	Light	Light	Cold	Light	Some	No

Example	Rain Recently (RR)	Rain Today (RT)	Temp (T)	Wind (W)	Sunshine (S)	Canoeing (C)
X2	Light	Moderate	Warm	Light	Some	???

Apply NB for *Canoeing=No* by calculating product of probabilities for input's feature values and class probability:

$$P(NC) = (3/6 \times 3/6 \times 1/6 \times 2/6 \times 4/6) \times 6/10$$

$$P(NC) = 0.0056$$

Class Probability

$P(NC) = 6/10$

Feature: Rain Recently

$P(L\_RR|NC) = 3/6$

$P(M\_RR|NC) = 3/6$

$P(H\_RR|NC) = 0/6$

Feature: Rain Today

$P(L\_RT|NC) = 3/6$

$P(M\_RT|NC) = 3/6$

$P(H\_RT|NC) = 0/6$

Feature: Temp

$P(C\_T|NC) = 5/6$

$P(W\_T|NC) = 1/6$

Feature: Wind

$P(L\_W|NC) = 2/6$

$P(M\_W|NC) = 2/6$

$P(G\_W|NC) = 2/6$

Feature: Sunshine

$P(S\_S|NC) = 4/6$

$P(N\_S|NC) = 2/6$

Solution: Canoeing X2

- Calculated probabilities for two hypotheses (class labels):

  Yes `P(C)  = (0/4 x 2/4 x 3/4 x 2/4 x 2/4) x 4/10 = 0`

  No `P(NC) = (3/6 x 3/6 x 1/6 x 2/6 x 4/6) x 6/10 = 0.0056`

- Normalise probabilities to sum to 1:

  Yes `P(C)' = 0`

  No `P(NC)' = 0.0056/(0.0056+0) = 1.0`

- Output Label: **No**