Day	Outlook	Temperature	Humidity	Wind	Play Tennis?
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cool	Normal	Weak	Yes
6	Rain	Cool	Normal	Strong	No
7	Overcast	Cool	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cool	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No

Let’s consider this example for the dataset.

Let's say we want to predict if someone will play tennis on a day when the weather conditions are:
- **Outlook:** Sunny
- **Temperature:** Cool
- **Humidity:** High
- **Wind:** Strong

How to apply Naive Bayes:
1. Calculate the prior probabilities for playing and not playing tennis.
2. Calculate the likelihood of the given conditions for both playing and not playing tennis.
3. Multiply the prior and likelihoods for both cases.
4. Compare the two probabilities to make a prediction.

Step 1 - Calculate the prior probabilities
- Given n as the total number of days, n_yes as the number of days when tennis is played, and n_no as the number of days when tennis isn’t played:

  P(Play = YES) = n_yes / n
  P(Play = NO) = n_no / n

Step 2 - Calculate the likelihoods
- For each feature f and each class c (YES or NO in our case), we calculate:

P(f | Play = c) = $\frac{Number\ of\ days\ with\ feature\ f\ and\ Play = c}{Number\ of\ days\ with\ Play = c}$

P(Outlook = Sunny | Play = YES) = $\frac{Number\ of\ sunny\ days\ when\ tennis\ is\ played}{Number\ of\ days\ when\ tennis\ is\ played}$

Step 3 - Calculate the Posterior Probabilities

- For each class c, the posterior probability given the feature is:

  P(Play = c | Features) = P(Play = c) × Π P(f | Play = c)

  P(Play = YES | Features) = P(Play = YES) × P(Outlook = Sunny | Play = YES) × P(Temperature = Cool | Play = YES) × ···

Step 4 - Make a prediction

- Finally, the class with the highest posterior probability is chosen as the prediction:

  Prediction = arg max P(Play = c | Features)

  P(Play = YES | Features) > P(Play = NO | Features) ⇒ Then the prediction is "YES", otherwise "NO"

Let's implement these steps for this example…

Prior Probability:

<u>Probability of playing tennis: P(Play = YES) = 0.643</u>
<u>Probability of not playing tennis: P(Play = NO) = 0.357</u>

Next, we need to calculate the likelihood of the given conditions (Sunny, Cool, High, Strong) for both playing and not playing tennis.

To do this, we'll compute:

When Playing Tennis (Yes):

<u>P(Outlook = Sunny | Play = YES) = 0.222</u>
<u>P(Temperature = Cool | Play = YES) = 0.333</u>
<u>P(Humidity = High | Play = YES) = 0.333</u>
<u>P(Wind = Strong | Play = YES) = 0.333</u>

When Playing Tennis (NO):

<u>P(Outlook = Sunny | Play = NO) = 0.600</u>
<u>P(Temperature = Cool | Play = NO) = 0.200</u>

P(Humidity = High | Play = NO) = 0.800
P(Wind = Strong | Play = NO) = 0.600

Next, we'll compute the posterior probabilities for playing and not playing tennis given the conditions. We'll multiply the prior probabilities with the respective likelihoods for each condition.

P(Play = YES | Conditions) = P(Play = YES) × ∏ Likelihoods for YES

P(Play = NO | Conditions) = P(Play = NO) × ∏ Likelihoods for NO

P(Play = YES | Conditions) = 0.00529
P(Play = NO | Conditions) = 0.02057

Here we can see, the probability of *not playing* is higher. Therefore our prediction is "**NO**"