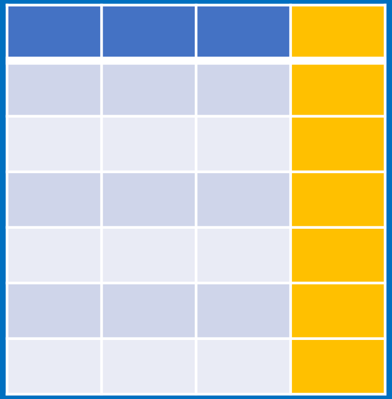
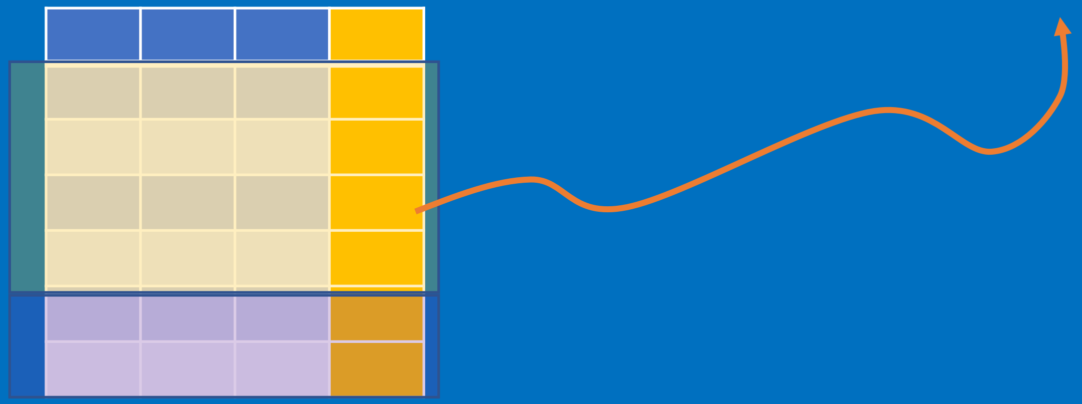
Permutation importance

Sijin Zhang



Assuming that we have the above dataset, with 3 features and 1 target

Step 1: use the training dataset to fit a model



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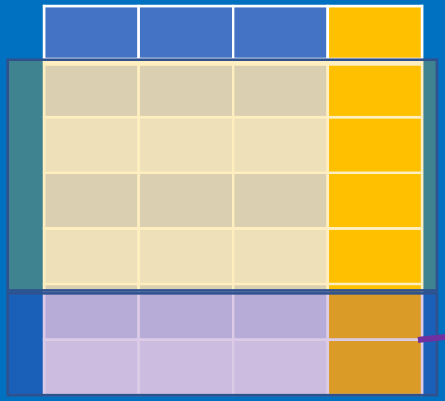
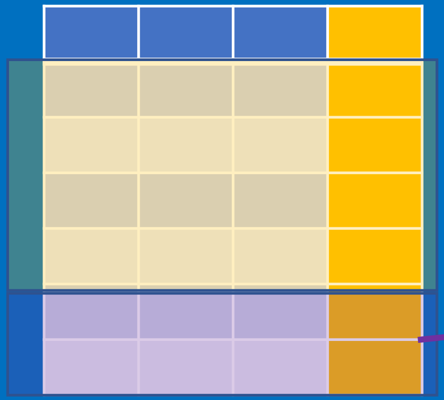


Assuming that we have the above dataset, with 3 features and 1 target

Step 1: use the training dataset to fit a model

Step 2: use test data to evaluate the trained model’s performance (e.g., we can use ACC or something else) 0.9

accuracy = 0.9



Assuming that we have the above dataset, with 3 features and 1 target

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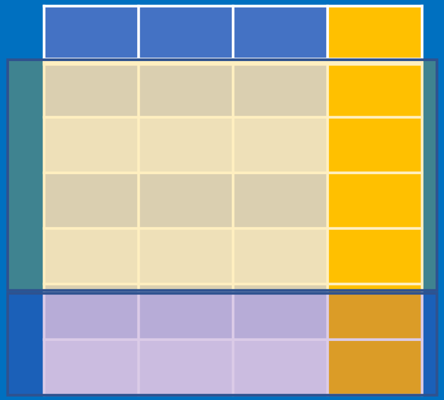
0.9

This is used as the baseline performance



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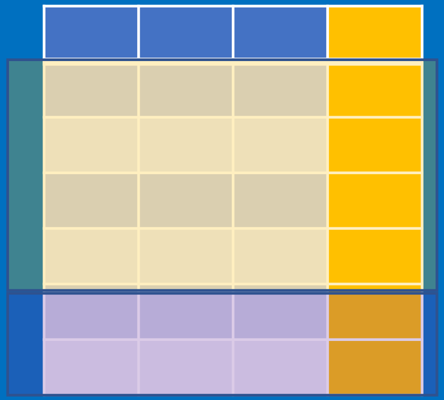
Step 3: data permutation



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Step 1: use the training dataset to fit a model

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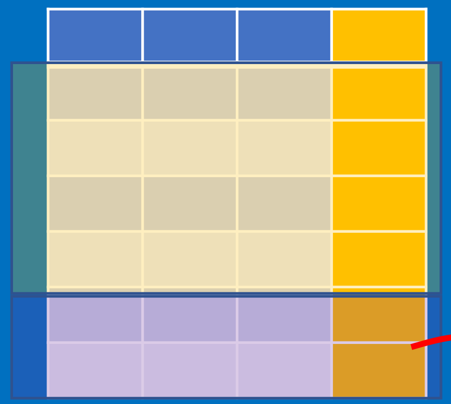
Step 3: test data permutation

For 1st feature, we randomly permute the column



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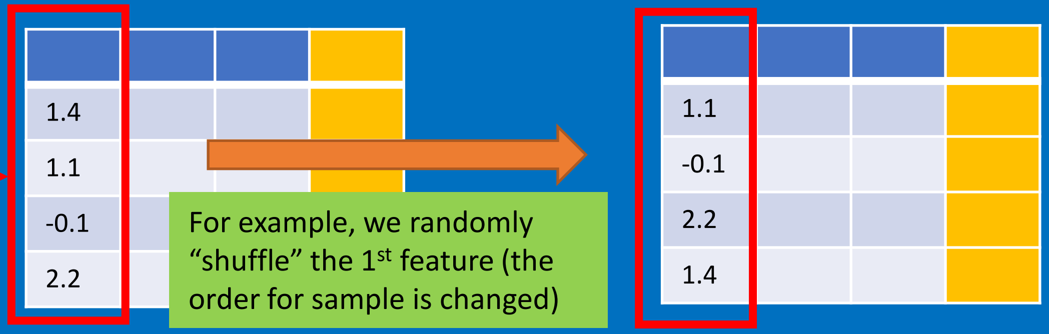

1.4			
1.1			
-0.1			
2.2			

For example, we randomly "shuffle" the 1st feature (the order for sample is changed)

1.1			
-0.1			
2.2			
1.4			

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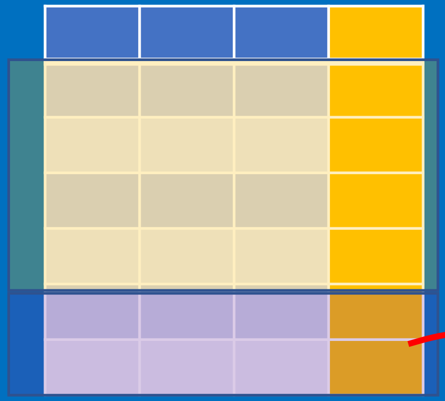

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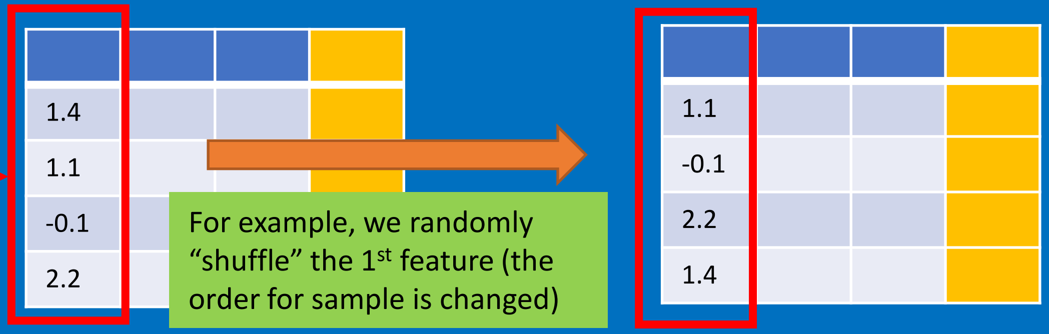

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For example, we randomly "shuffle" the 1st feature (the order for sample is changed)

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Note that we are not touching any other features and the target

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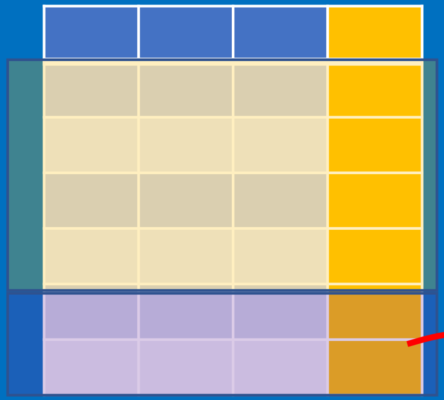

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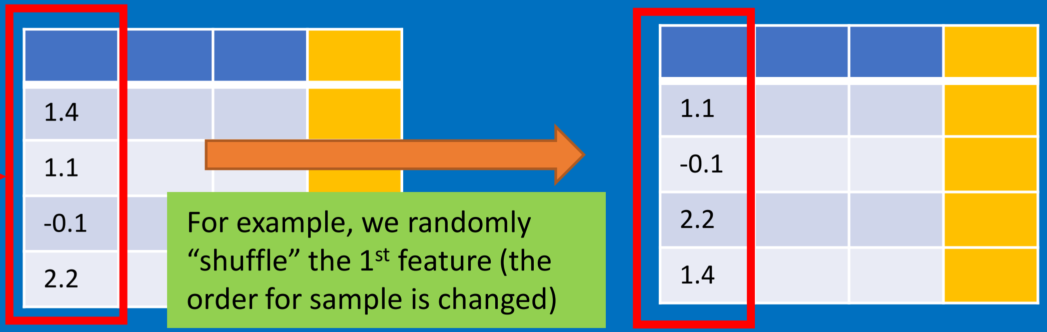

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-0.1			
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Note that we are not touching any other features and the target

Then we use the permuted data to evaluate the trained model’s performance

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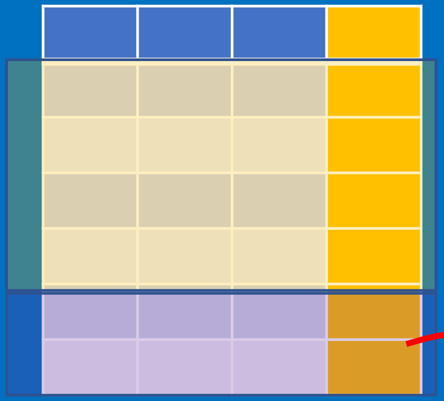

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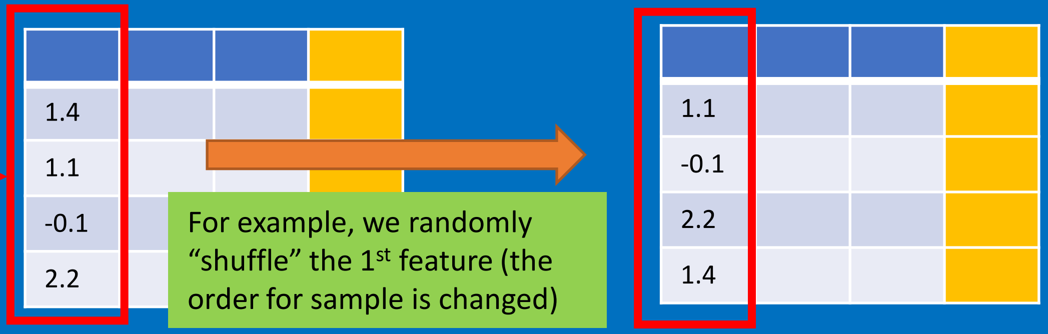

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accuracy = 0.7

Then we use the permuted data to evaluate the trained model’s performance 0.7

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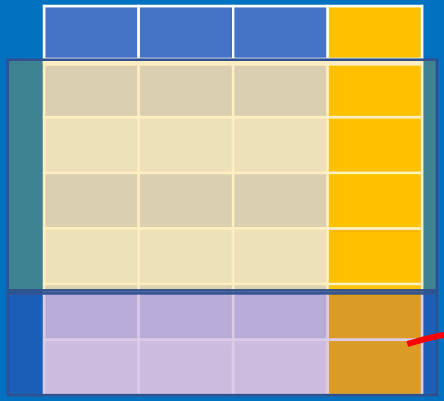

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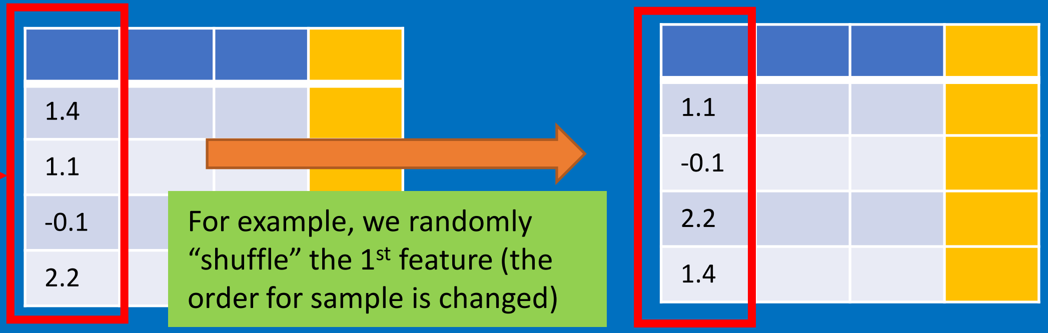

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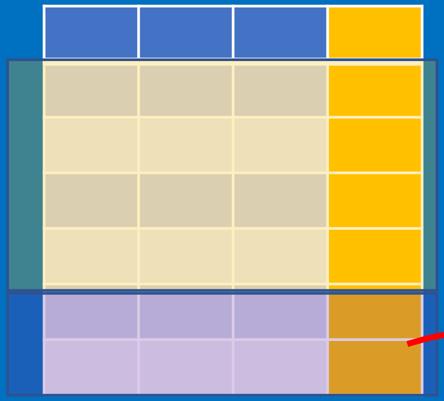
(usually we shuffle the dataset many times and get the average performance …)



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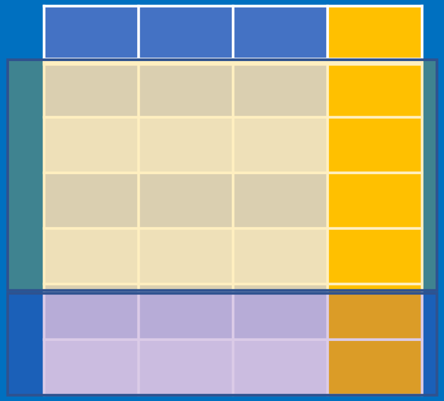
We would repeat the above process for all the features (in this case there are three features)



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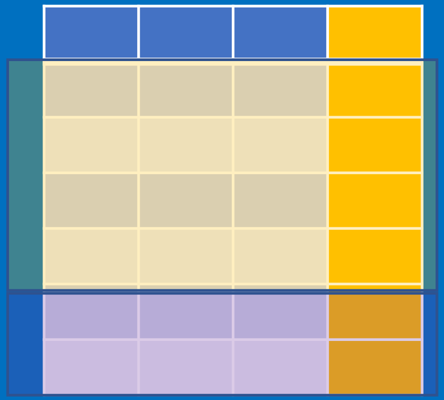
Step 3: test data permutation

For 1st feature 0.7

For 2nd feature 0.4

For 3rd feature 0.6

⇦ Model accuracies for shuffled/permuted test data



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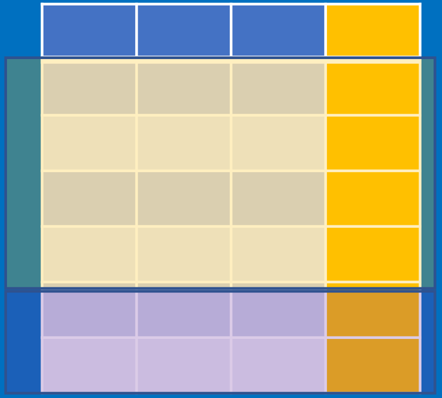
Step 3: test data permutation

For 1st feature	0.7	0.2
For 2nd feature	0.4	0.5
For 3rd feature	0.6	0.3

e.g., 0.9 – 0.7 = 0.2

Difference between the base model performance (0.9) and the one with permuted dataset



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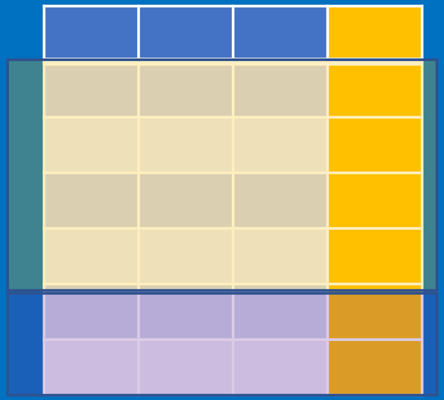
Difference between the base model performance (0.9) and the one with permuted dataset

We can think about the value as how much the model relies on this feature



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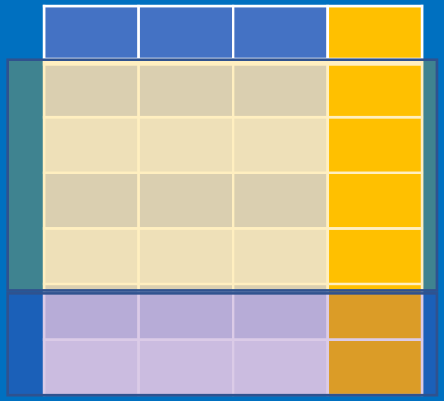
The larger the skill drops, the more the model relies on that particular feature



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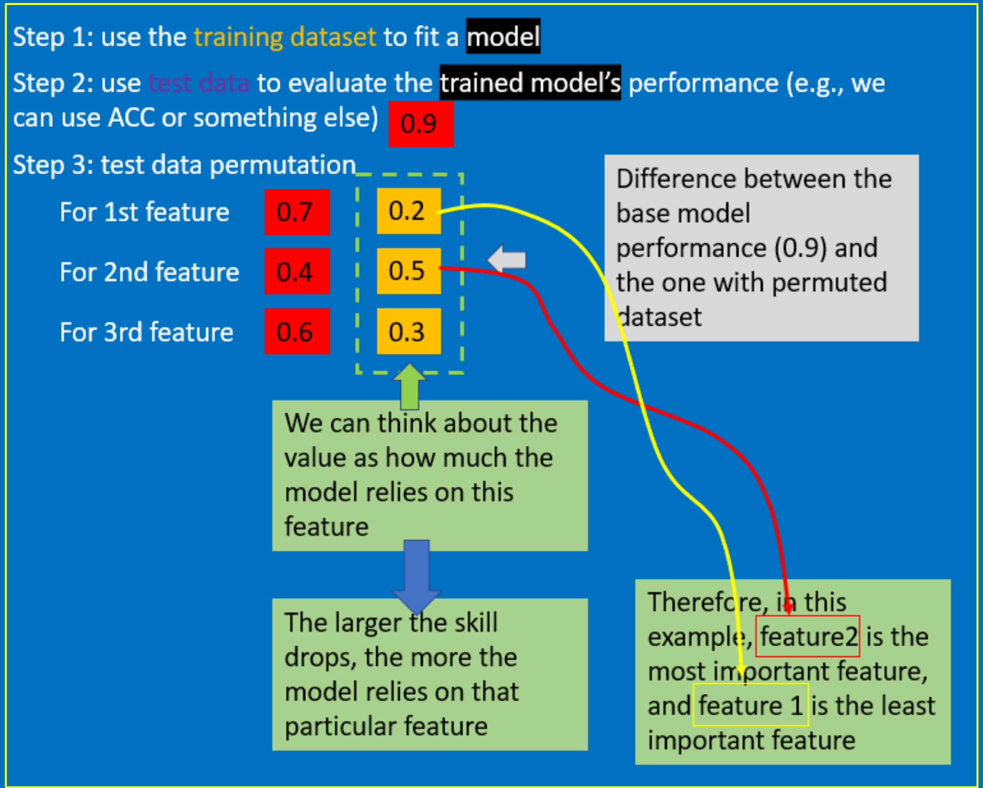
Therefore, in this example, feature2 is the most important feature, and feature 1 is the least important feature



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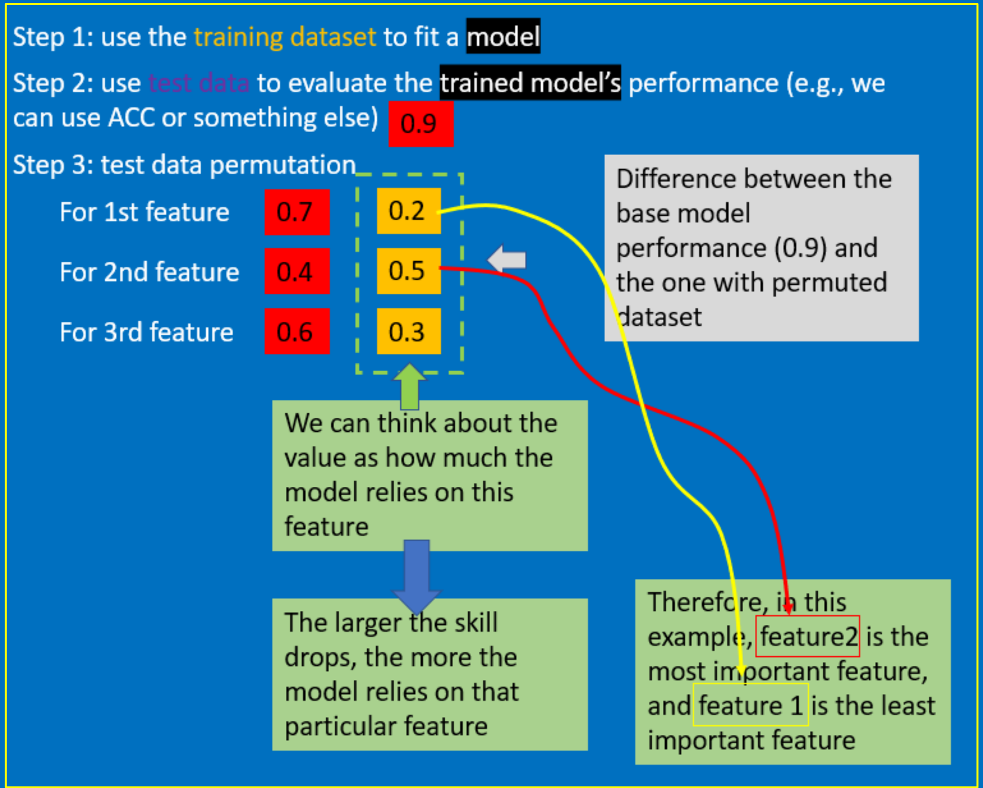
Note that there is a similar method called "column-drop" method

The difference is that:

- Instead of shuffle the feature, we remove the entire feature, and "refit" a model
- We compare the base model performance (the one with entire dataset) and the "refitted" model performance (the one with one less feature)
- The feature corresponds to the most dropped skill is usually considered the most important feature



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Compared to the permutation method, “column-drop” method is usually more accurate, but more expensive (we need to refit the model)