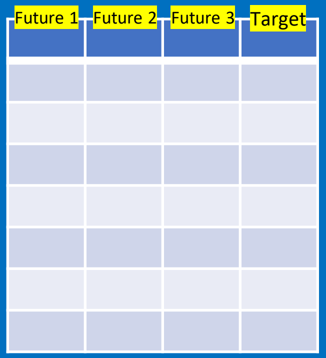
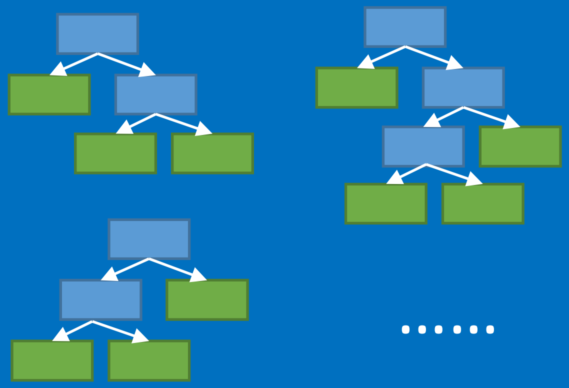
Feature importance – Gini based method

Sijin Zhang

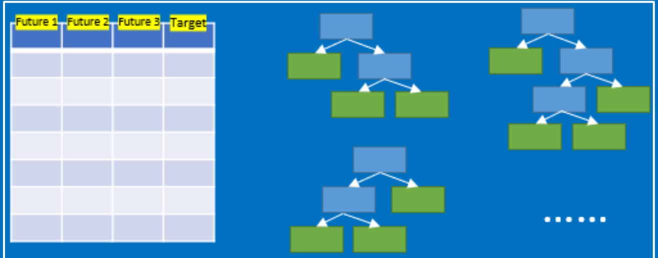
Impurity based feature importance





Assuming that we have a bunch of samples, and through Bagging we created many decision trees

Impurity based feature importance

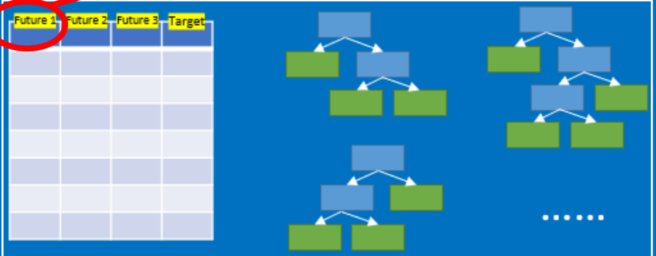


Assuming that we have a bunch of samples, and through Bagging we created many decision trees

Usually the importance is estimated as below:

- For each feature
  - For each tree
    - Compute impurity decrease
    - Weighted by number of samples at node
  - Averaged over all trees
- Normalize the results if needed

Impurity based feature importance



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Usually the importance

For example, we have 3 features in this example, let’s look at feature 1, “F1”

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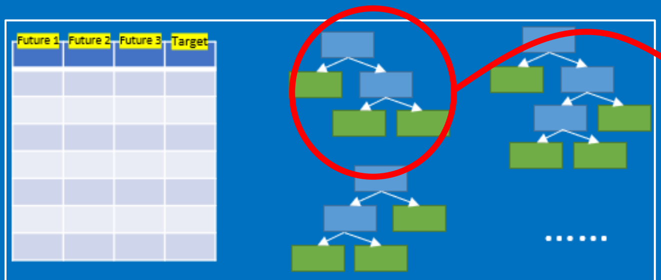
Impurity based feature importance



Assuming that we have a bunch of samples, and through Bagging we created many decision trees

Usually the importance is estimated as below:

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  - For each tree

    Let's look at the first tree
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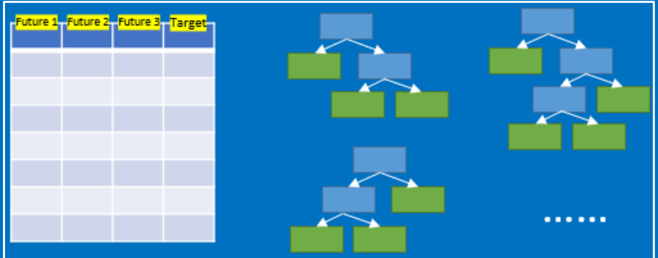
Impurity based feature importance



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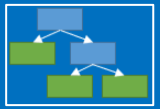
    - For each tree 
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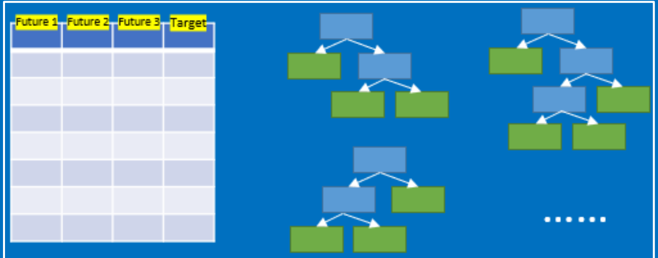

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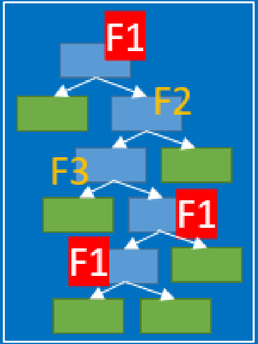
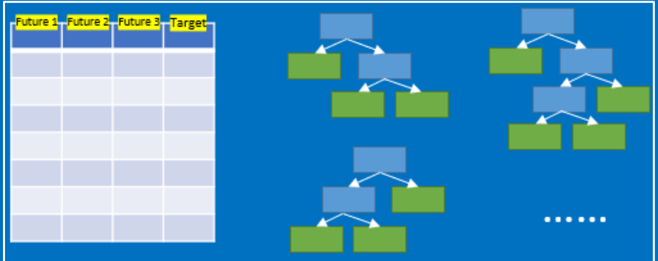


Assuming we have 5 levels of tree, and 3 “F1” features are included.

Impurity based feature importance



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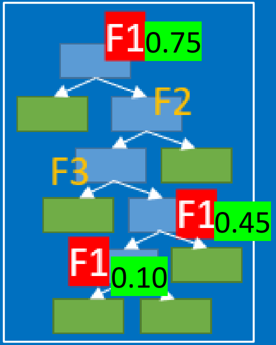
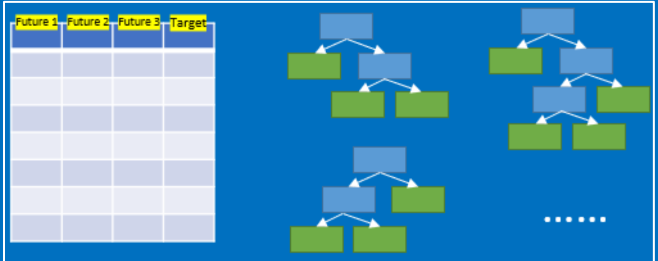


Assuming we have the “Gini” values as left …

Impurity based feature importance



Assuming that we have a bunch of samples, and through Bagging we created many decision trees

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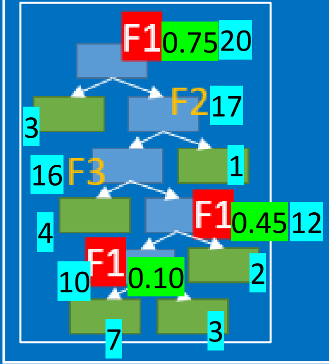
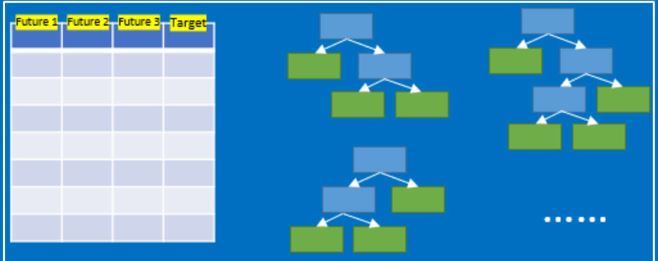


Assuming that in total we have 20 samples, and the samples that each node has is shown left

Impurity based feature importance



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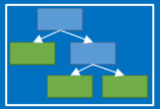
    - For each tree 
        - Compute impurity decrease
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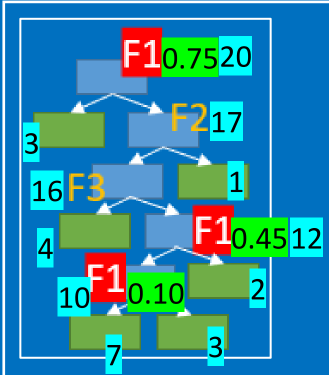


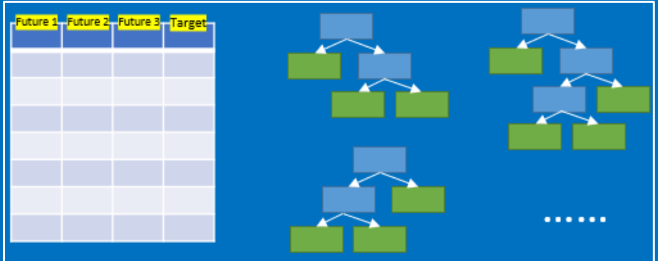
The impotence for F1 can be calculated as

$$I = \sum P \bigtriangleup Gini$$

weight

Gini decrease

Impurity based feature importance



Assuming that we have a bunch of samples, and through Bagging we created many decision trees

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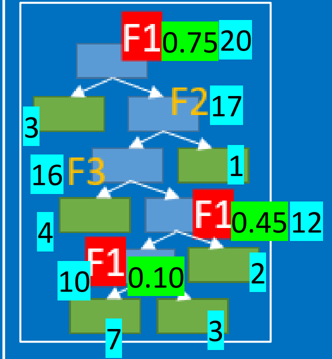

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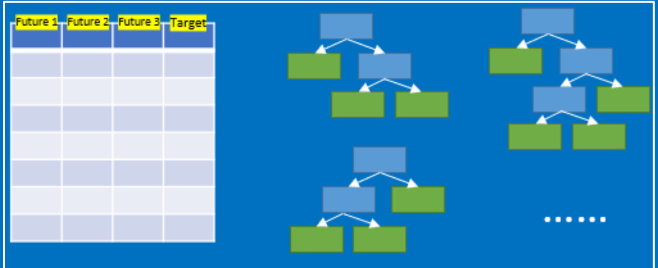
weight

Gini decrease

Step 1: calculate the percentage of samples for each level

Impurity based feature importance



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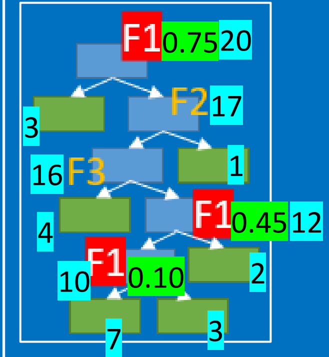


The impotence for F1 can be calculated as

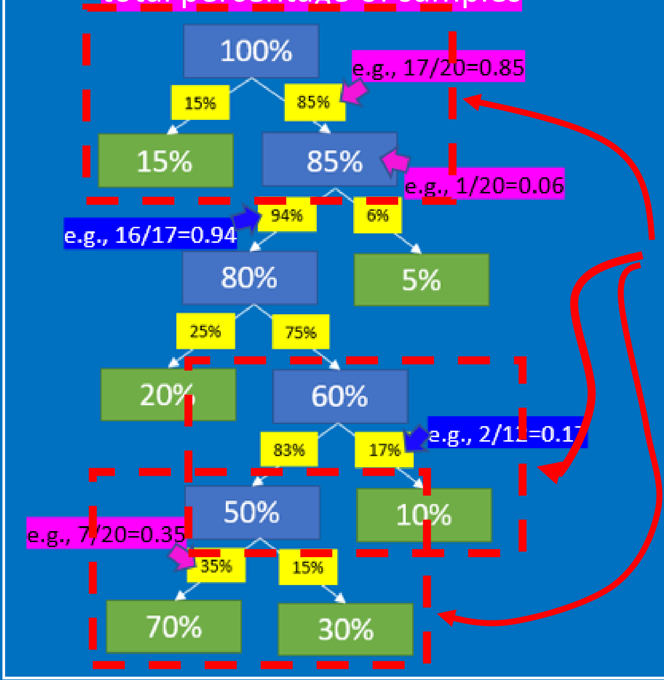
$$I = \sum P \triangle Gini$$

weight

Gini decrease

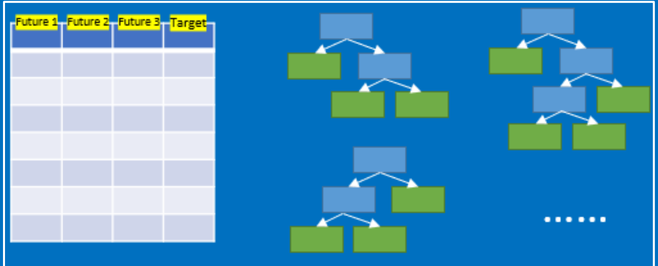
Step 1: calculate the

- level dependant percentage of samples, and
- total percentage of samples



We have 3 “F1” feature appear in the tree

Impurity based feature importance



Assuming that we have a bunch of samples, and through Bagging we created many decision trees

Usually the importance is estimated as below:

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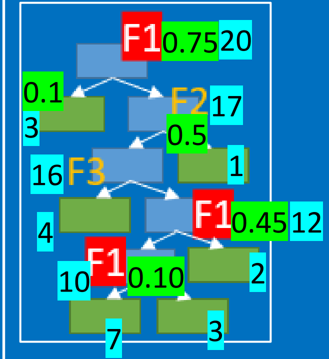
We can calculate $\triangle\, Gini$ as

$$\triangle\, Gini_1 = 0.75 - (0.85 \times 0.5 + 0.15 \times 0.1) = 0.31$$

Node Gini
Total percentage of samples
Next node Gini
Total percentage of samples
Next leaf Gini



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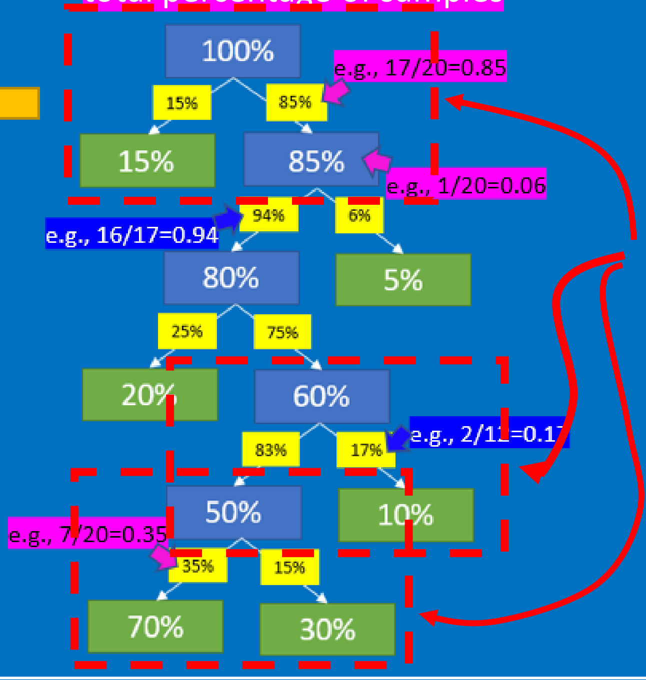

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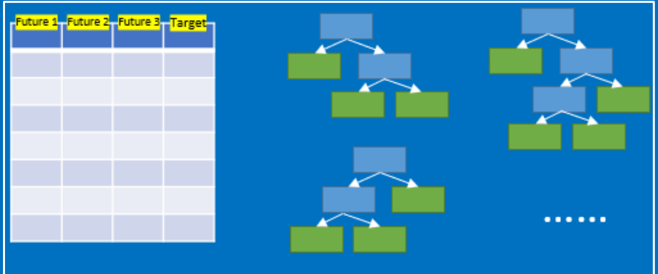

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Node Gini

Total percentage of samples

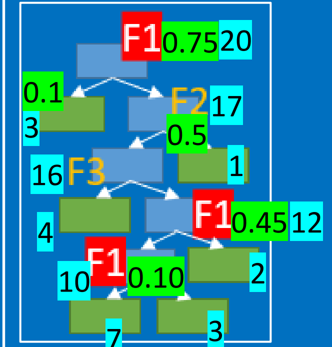
Next node Gini

Total percentage of samples

Next leaf Gini

$$\triangle\, Gini_2 = 0.25$$

$$\triangle\, Gini_3 = 0.1$$



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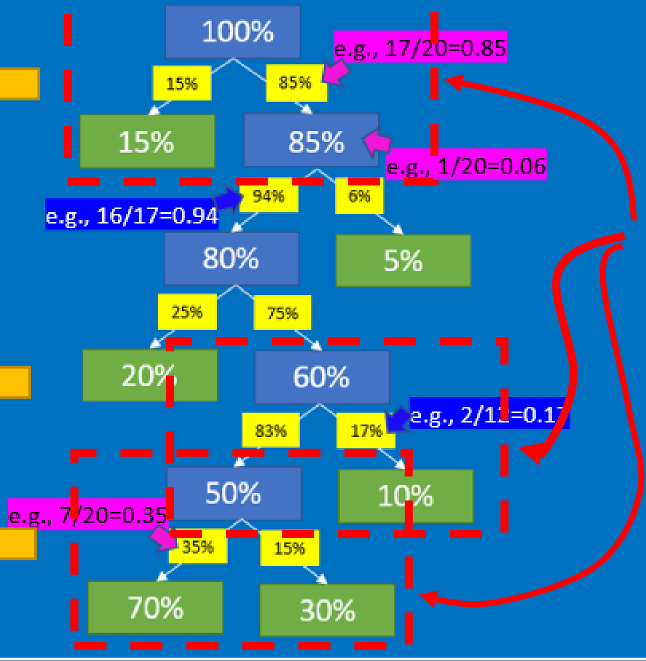

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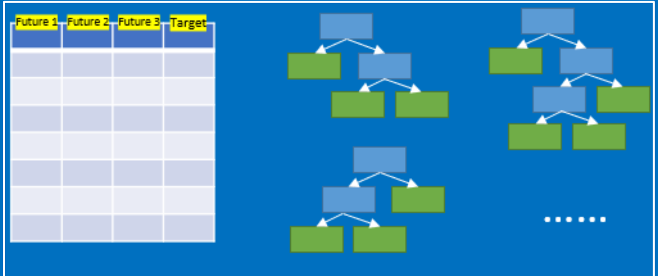

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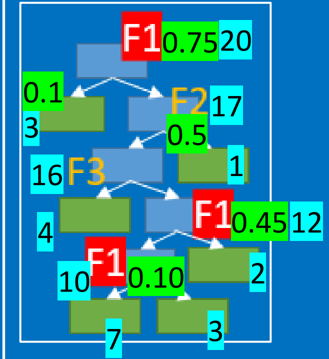

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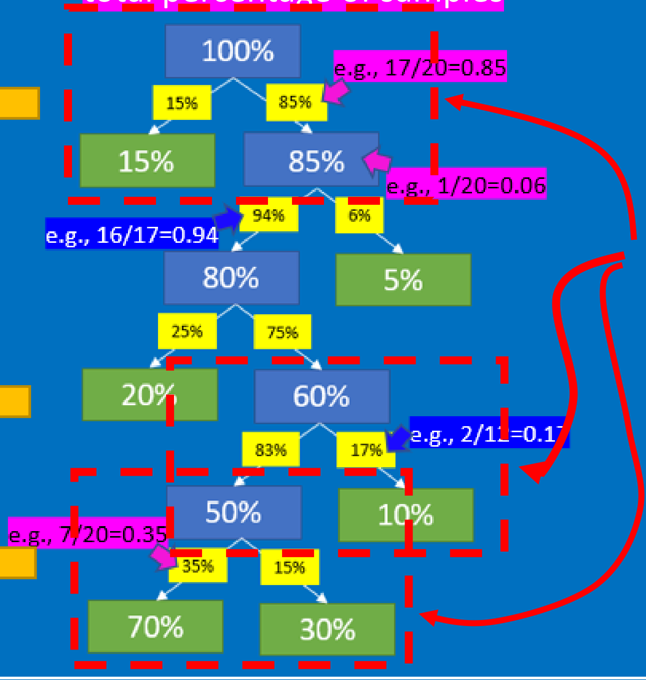

We have 3 "F1" feature appear in the tree

Level dependant percentage of samples

100%

We can calculate $\triangle\, Gini$ as

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Node Gini

Total percentage of samples

Next node Gini

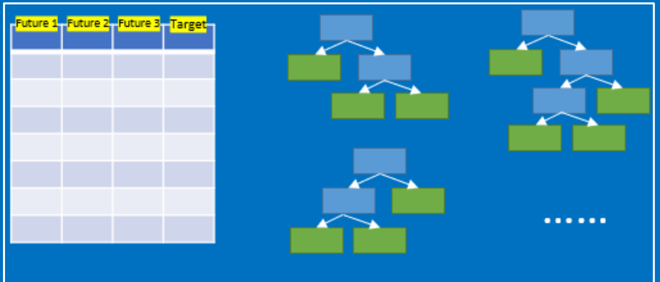
Total percentage of samples

Next leaf Gini

60% $\triangle\, Gini_2 = 0.25$

50% $\triangle\, Gini_3 = 0.1$

Impurity based feature importance



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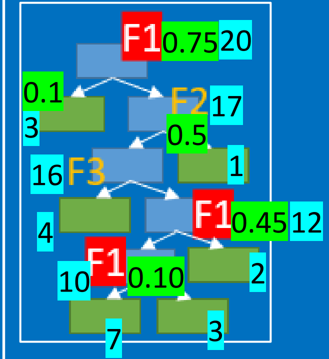

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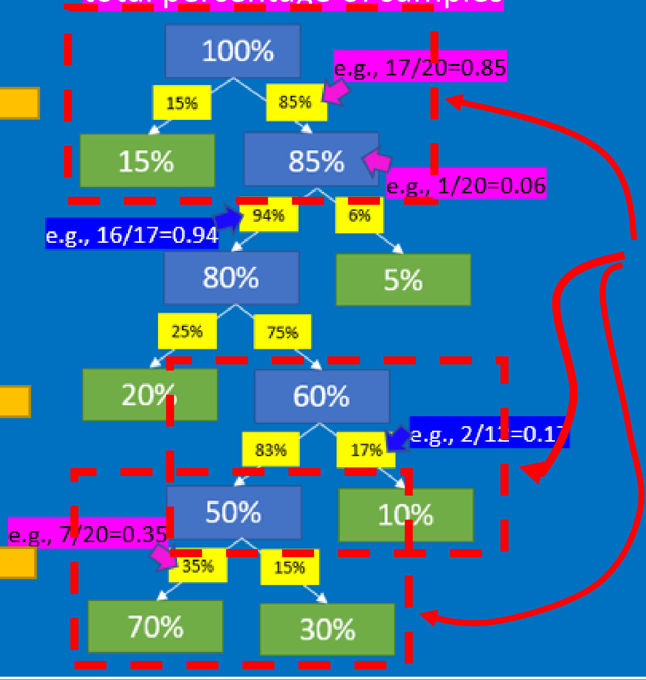

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Total percentage of samples

Next node Gini

Total percentage of samples

Next leaf Gini

100%

60%

$$\triangle Gini_2 = 0.25$$

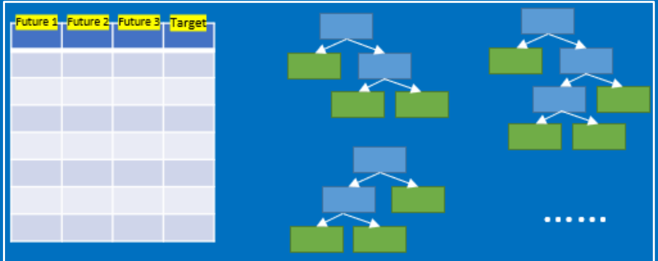
50%

$$\triangle Gini_3 = 0.1$$

$$I_{F_1} = 1 \times 0.31 + 0.6 \times 0.25 + 0.5 \times 0.1 = 0.51$$

The importance for F1

Impurity based feature importance



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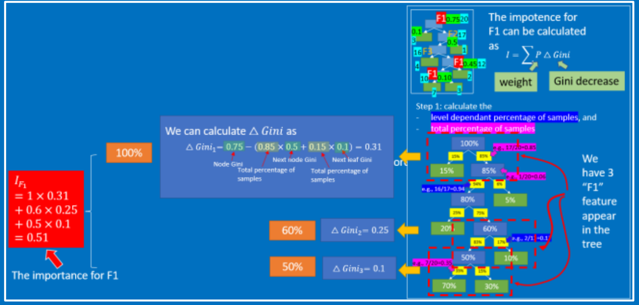


  - Averaged over all trees

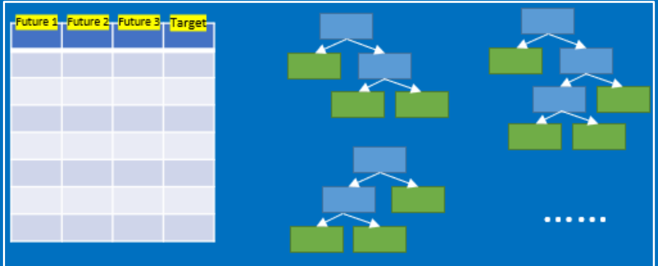
We go through all the trees with the last step, and average the results

- Normalize the results if needed

We through all the features for the above process, and normalize the results.
For example, we can divide the averaged results by the number of trees being used …

The high the value, the more important that the feature is

Impurity based feature importance



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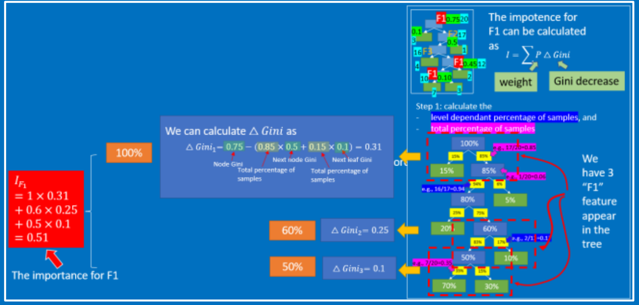

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Eventually, the higher the value, the more important the feature is