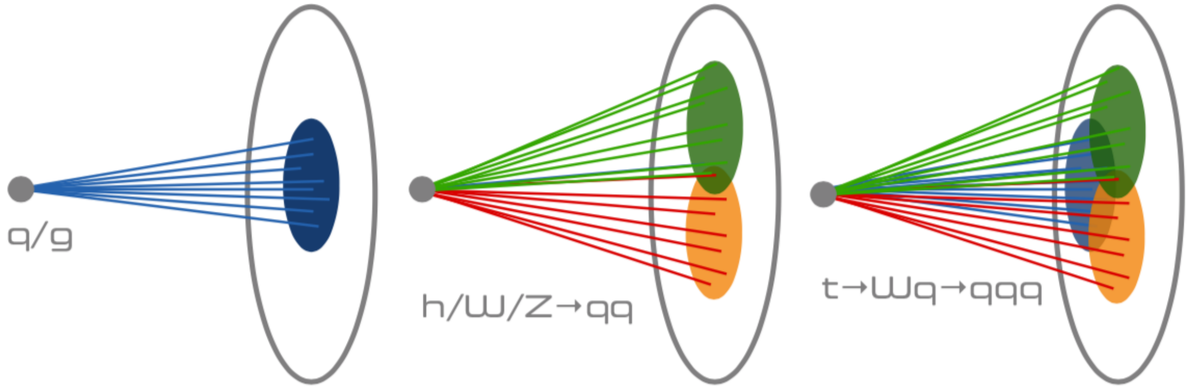
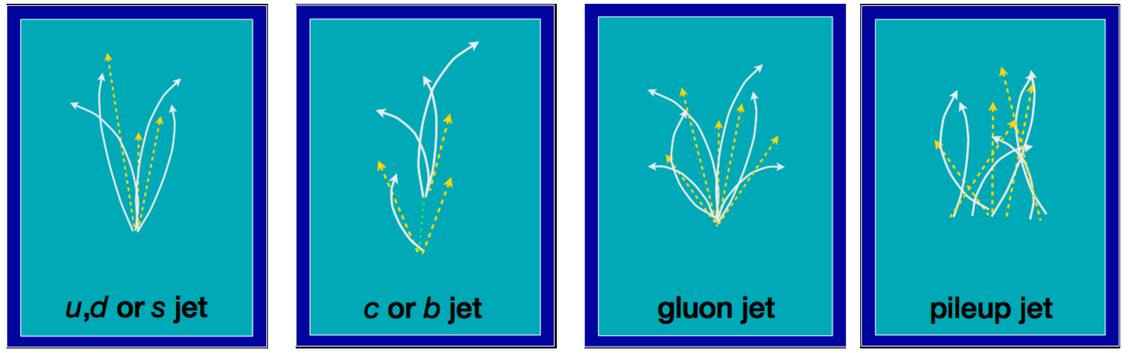
# Example: jet tagging

- *You have a jet at LHC: spray of hadrons coming from a "shower" initiated by a fundamental particle of some kind (quark, gluon, W/Z/H bosons, top quark)*
- *You have a set of jet features whose distribution depends on the nature of the initial particle*
- *You can train a network to start from the values of these quantities and guess the nature of your jet*
- *To do this you need a sample for which you know the answer*

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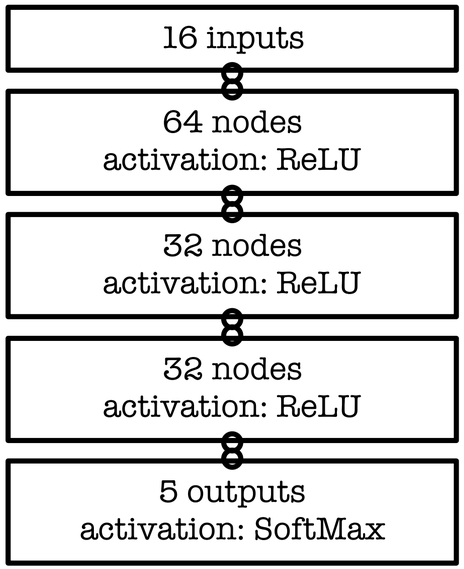
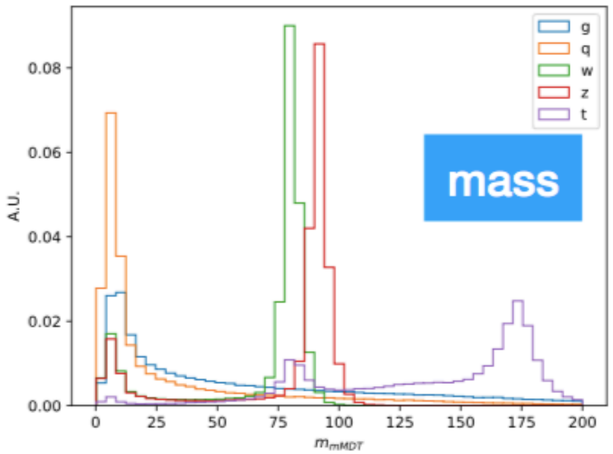
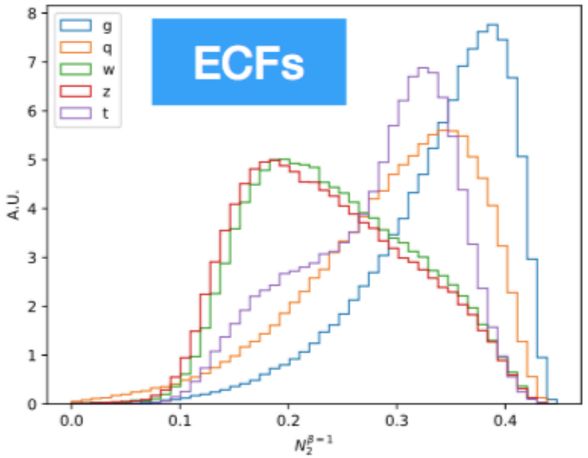
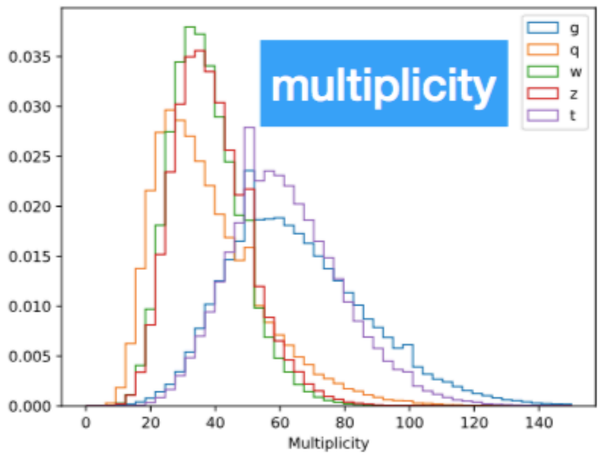


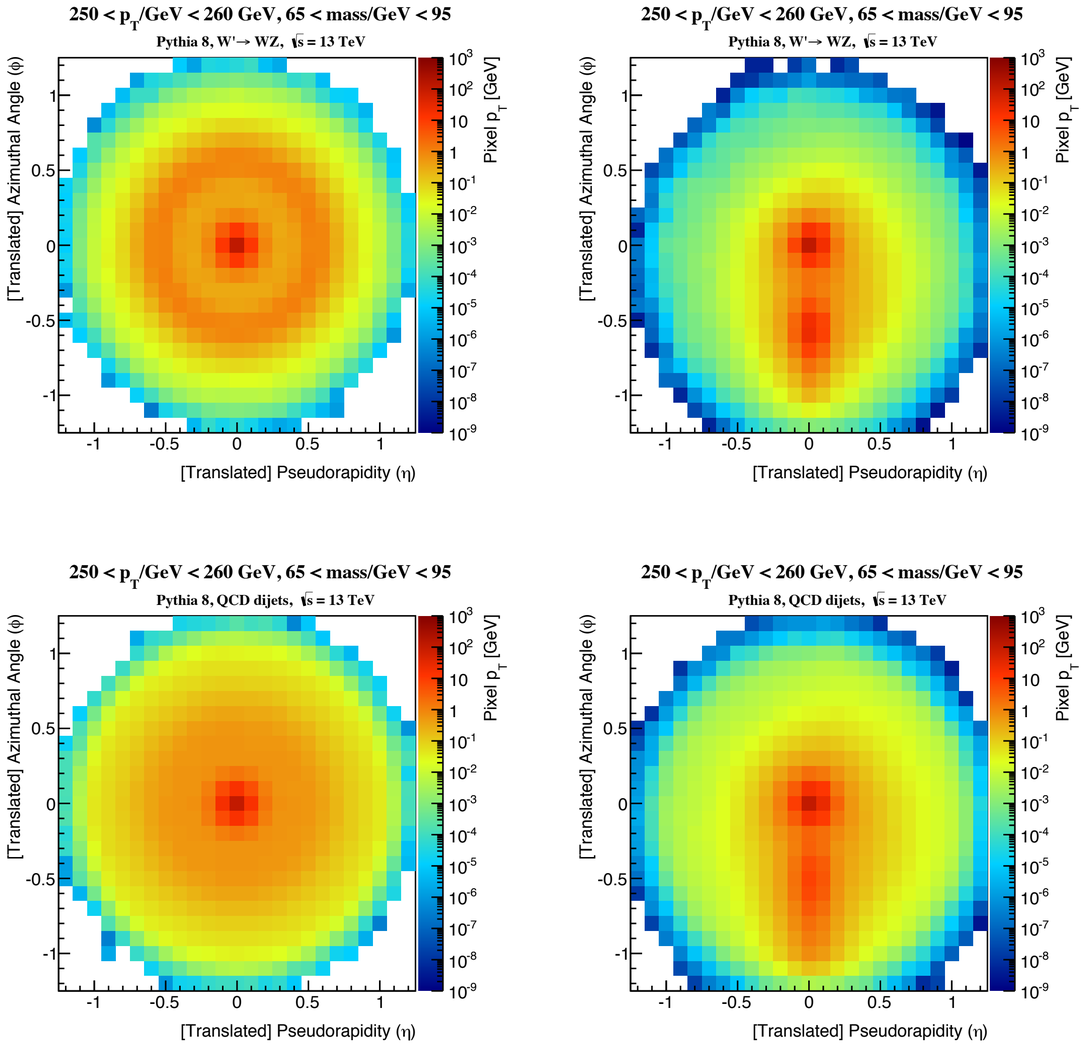



# Jet as images (for ConvNN)

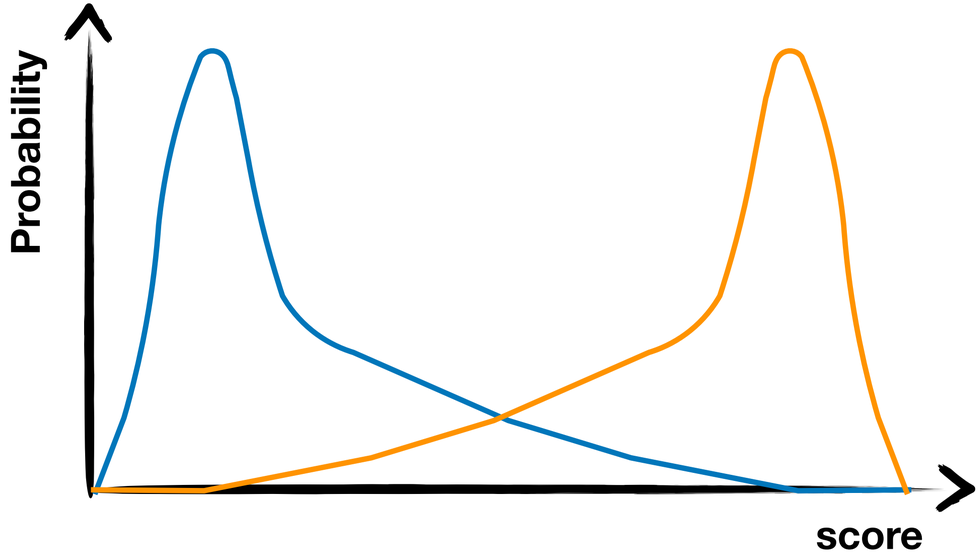
- *One can pixelate the surface crossed by the jet and create an image with the momentum deposited in each cell*
- *Such an image can then be processed with computing-vision techniques*
- *Pros: can benefit of the progresses made in optimizing computing vision*
- *Cons: underlying assumption on detector geometry (regular array of pixels) made sacrificing information of the actual detector*

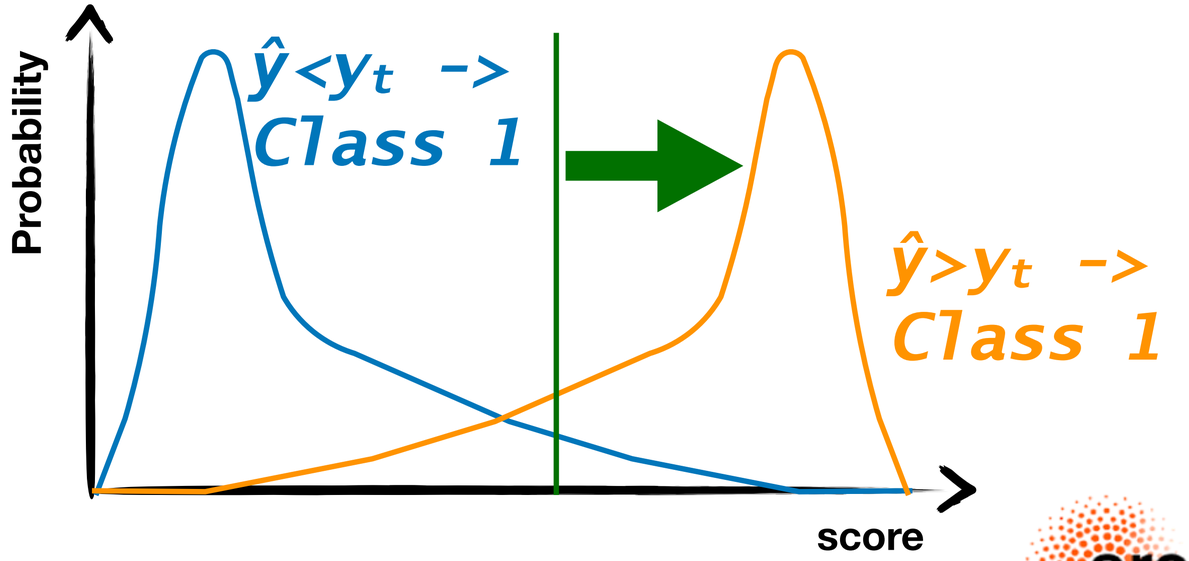



https://arxiv.org/abs/1511.05190

# Classifier metrics

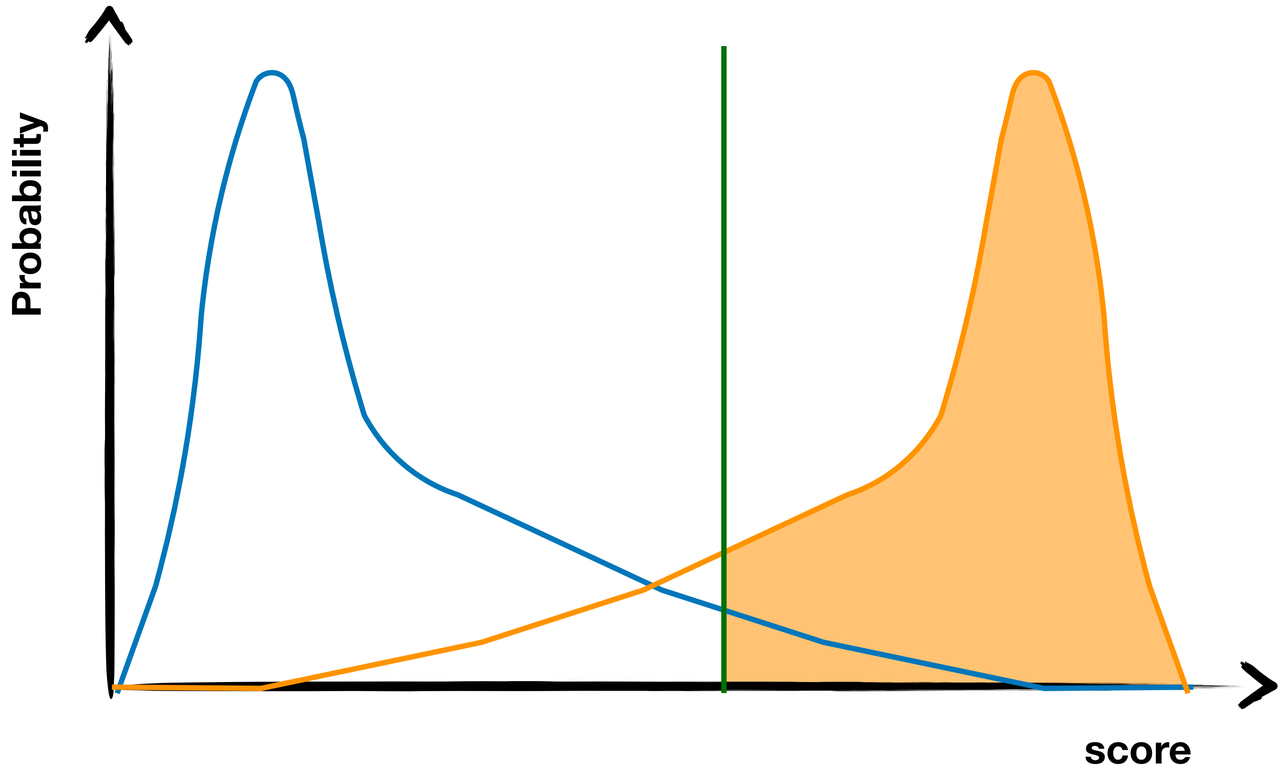
- Consider a binary classifier
- Its output $\hat{y}$ is a number in [0,1]
- If well trained, value should be close to 0 (1) for class-0 (class-1) examples
- One usually defines a threshold $y_t$ such that:
  - $\hat{y}>y_t$ -> Class 1
  - $\hat{y}<y_t$ -> Class 0



# Classifier metrics

- *A given threefold defines the following qualities*
  - *True-positives: Class-1 events above the threshold*
  - *True-negatives: Class-0 events below the threshold*
  - *False-positives: Class-0 events above the threshold*
  - *False-negatives: Class-1 events below the threshold*



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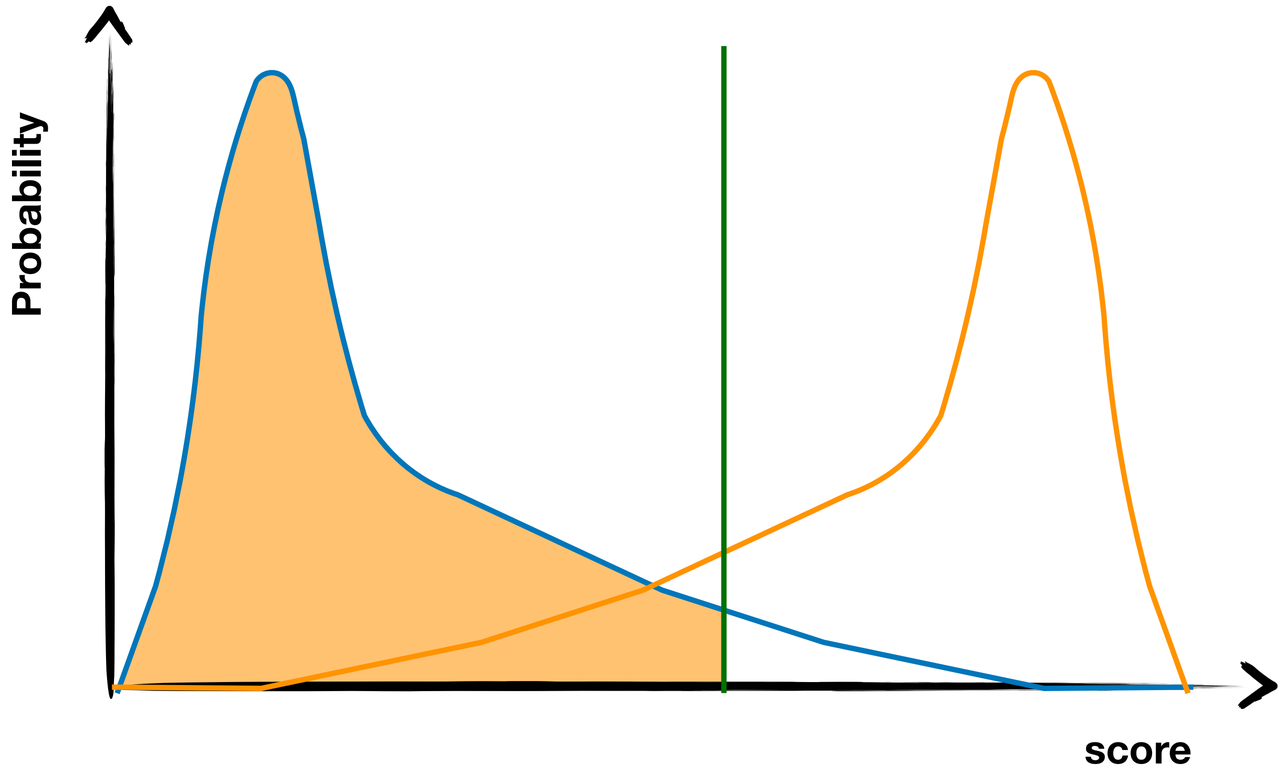

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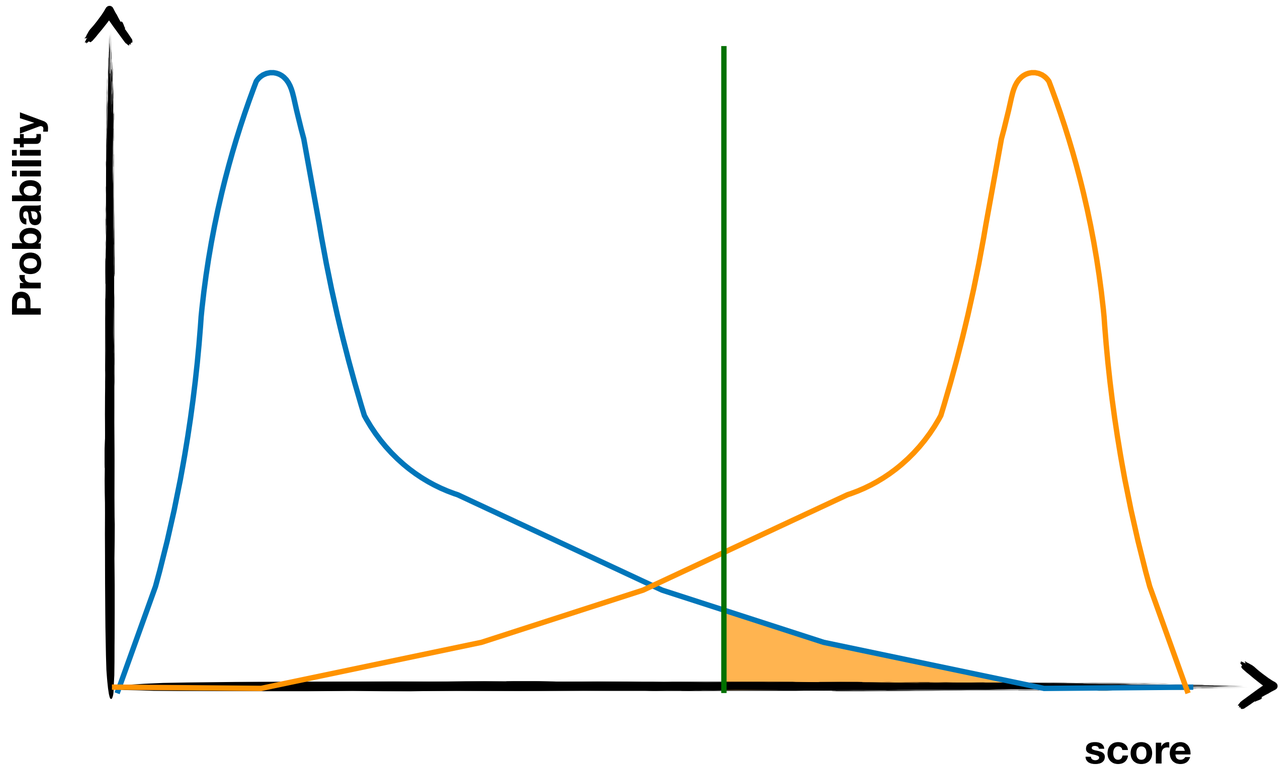

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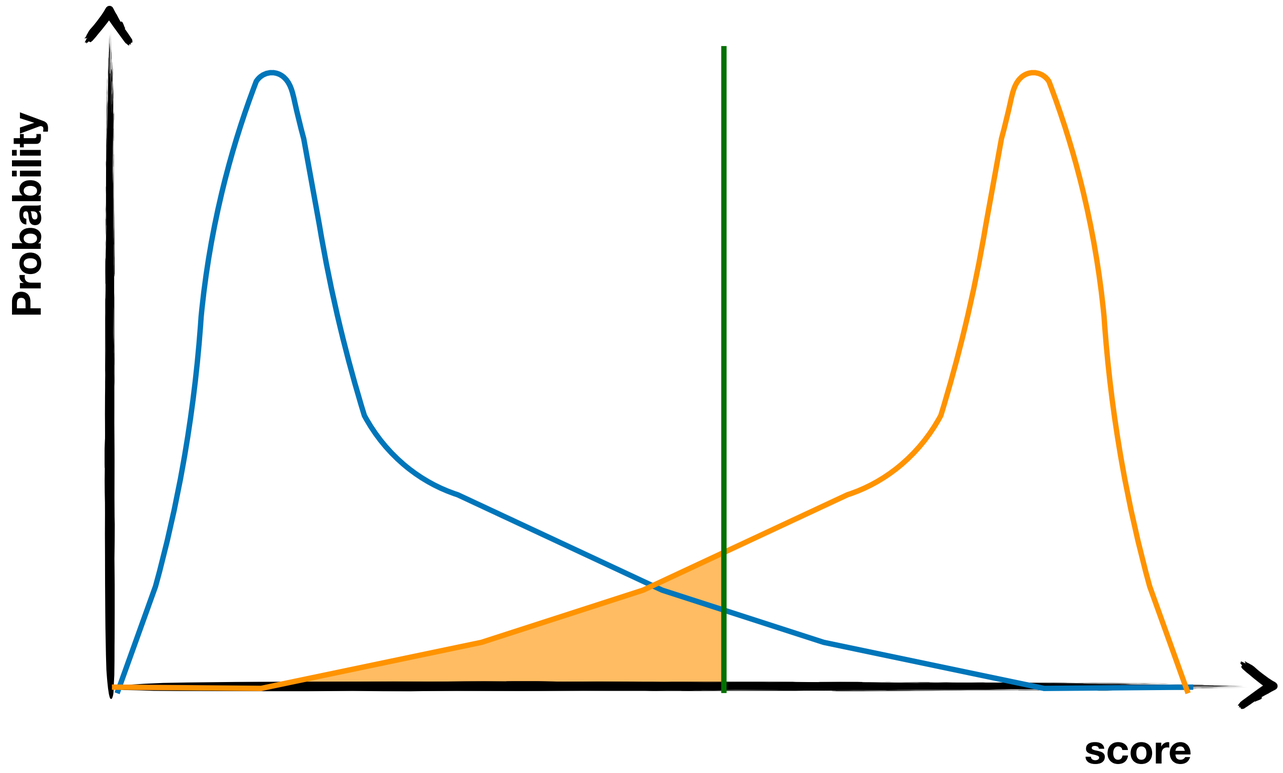

# Classifier metrics

- *Starting ingredients are true positive (TP) and true negative (TN) rates*
- *Accuracy: (TP+TN)/Total*
  - *The fraction of events correctly classified*
- *Sensitivity: TP/(Total positive)*
  - *AKA signal efficiency in HEP*
- *Specificity: TN/(Total negative)*
  - *AKA mistag rate in HEP*

# Jet tagging ROC curve