Classifying heavy Higgs

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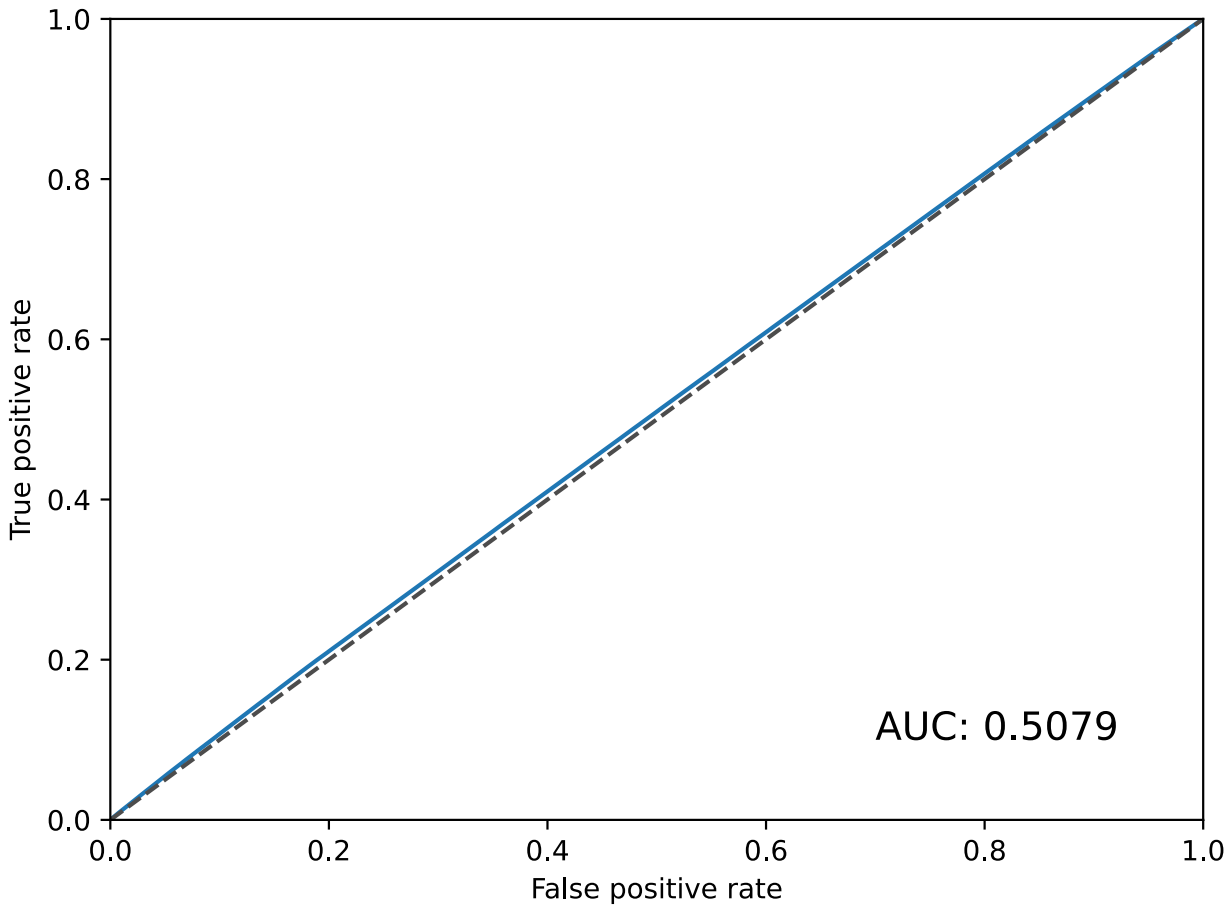
HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

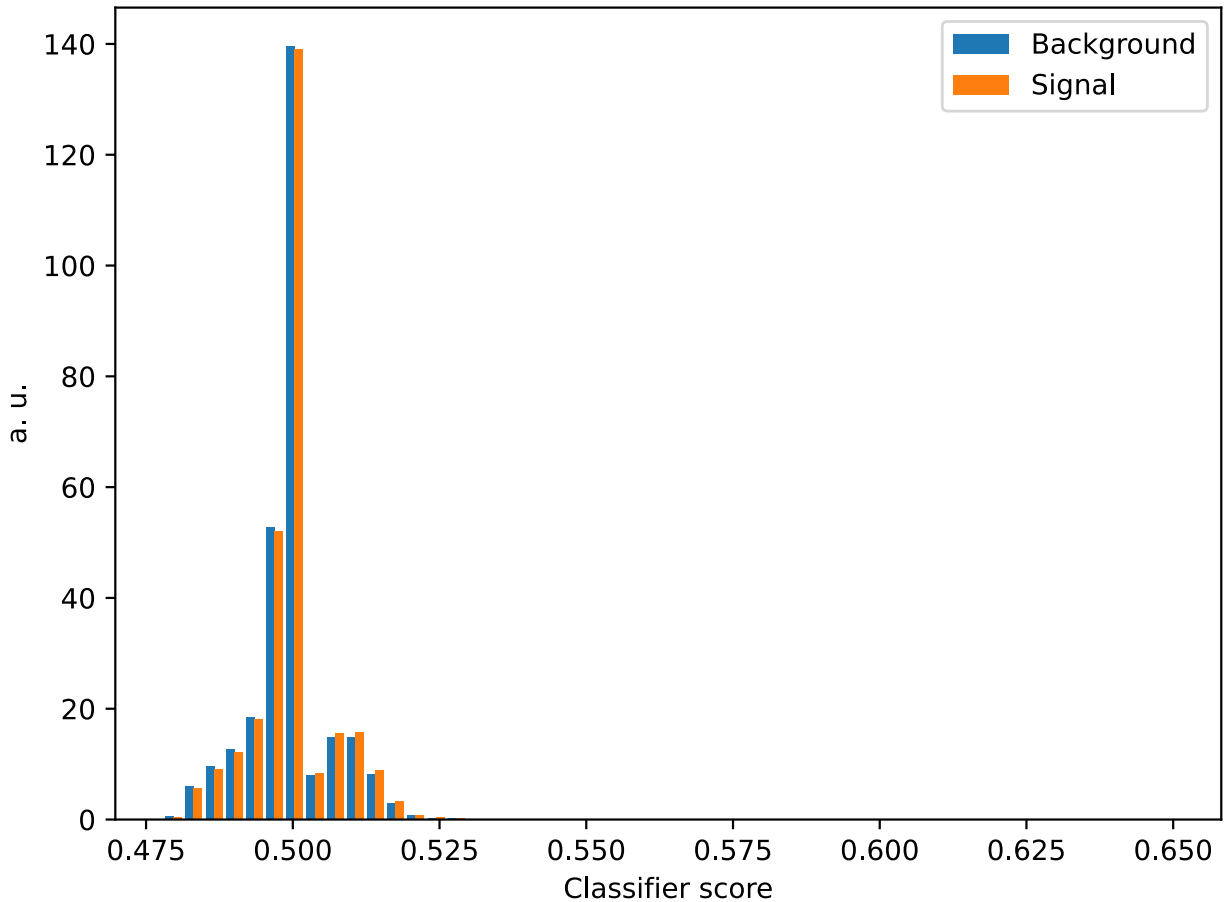
SM vs. SM + heavy Higgs classifier

Built a basic neural network for classification.



As expected: Very low AUC, problems during training.

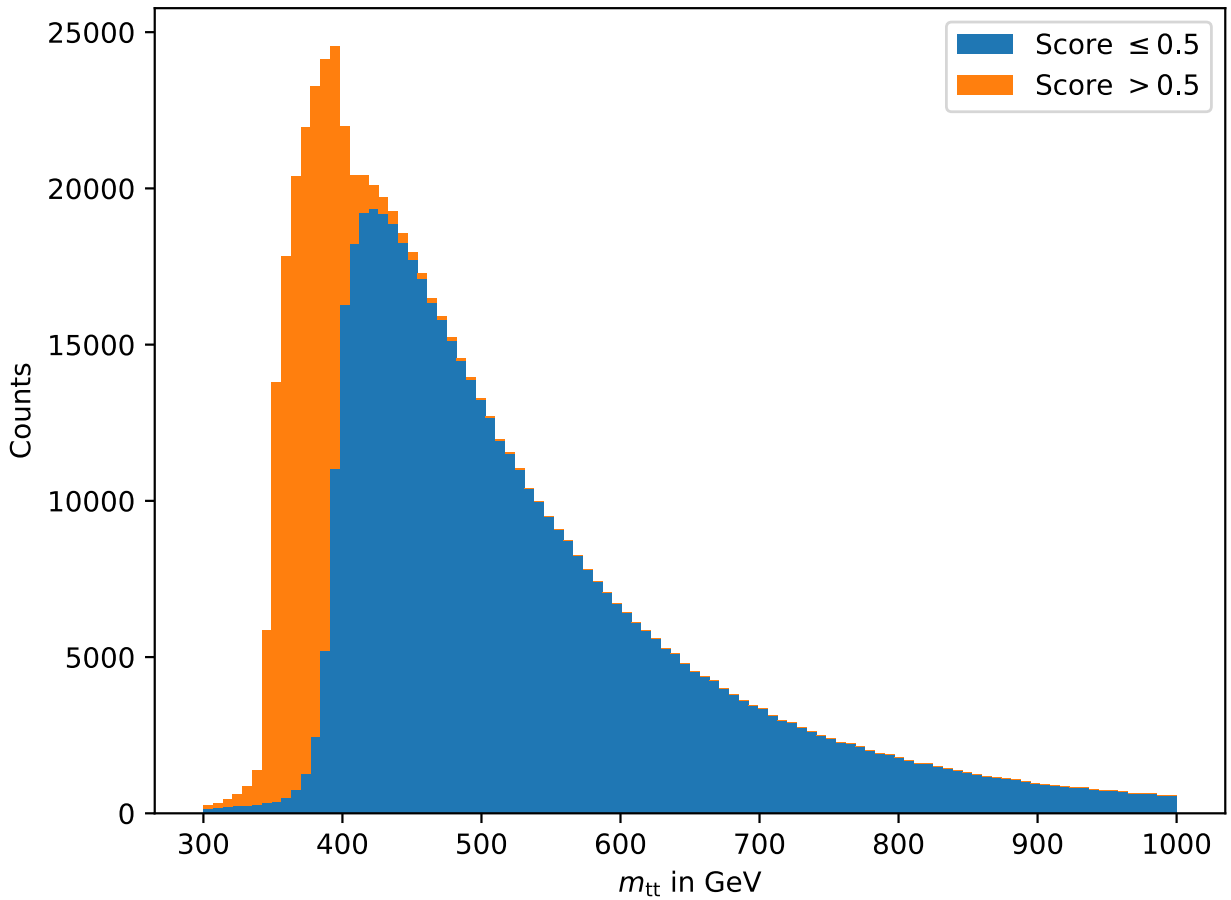
SM vs. SM + heavy Higgs classifier



Bins of signal (SM + HH) are a little than background (SM) higher at scores > 0.5.

SM vs. SM + heavy Higgs classifier

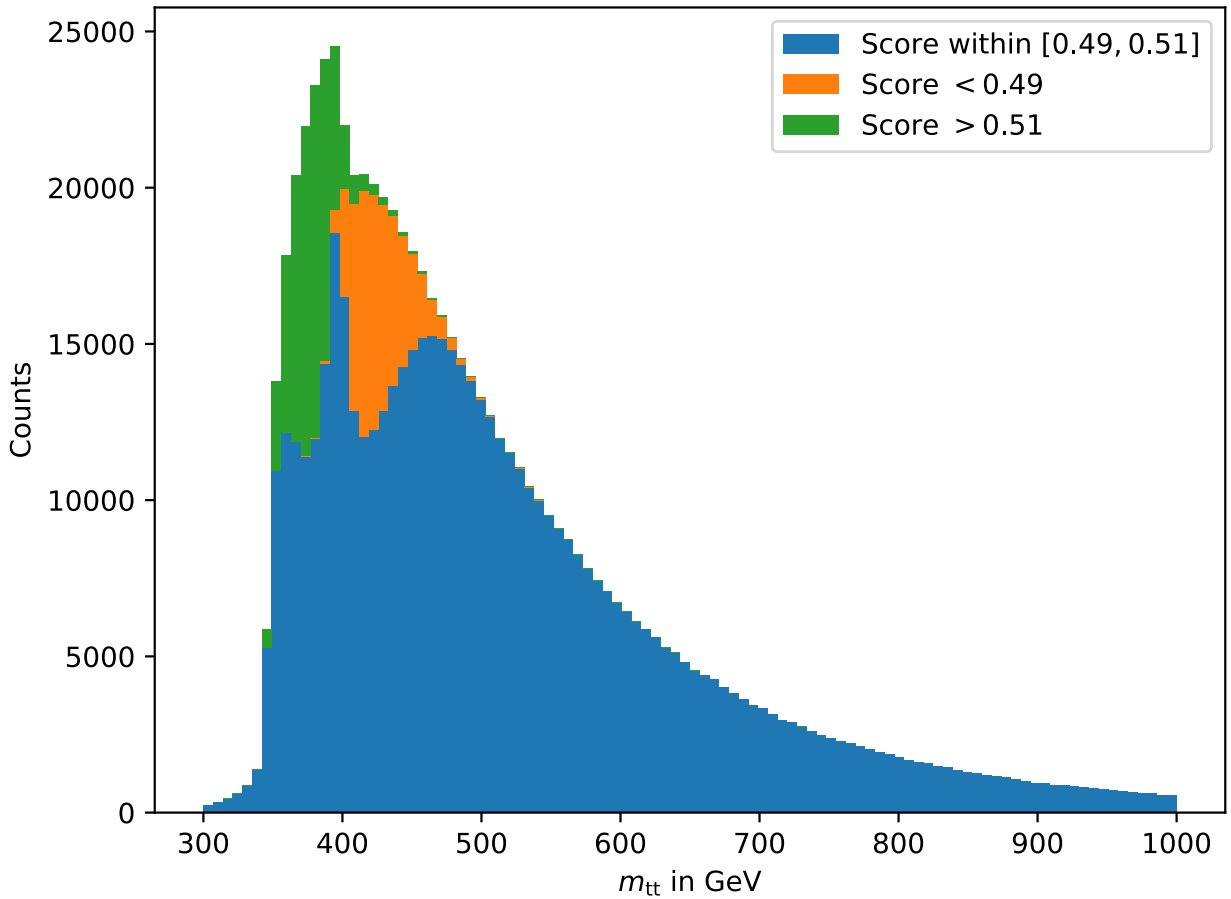
Shown are SM + HH events



Interference is ignored!

SM vs. SM + heavy Higgs classifier

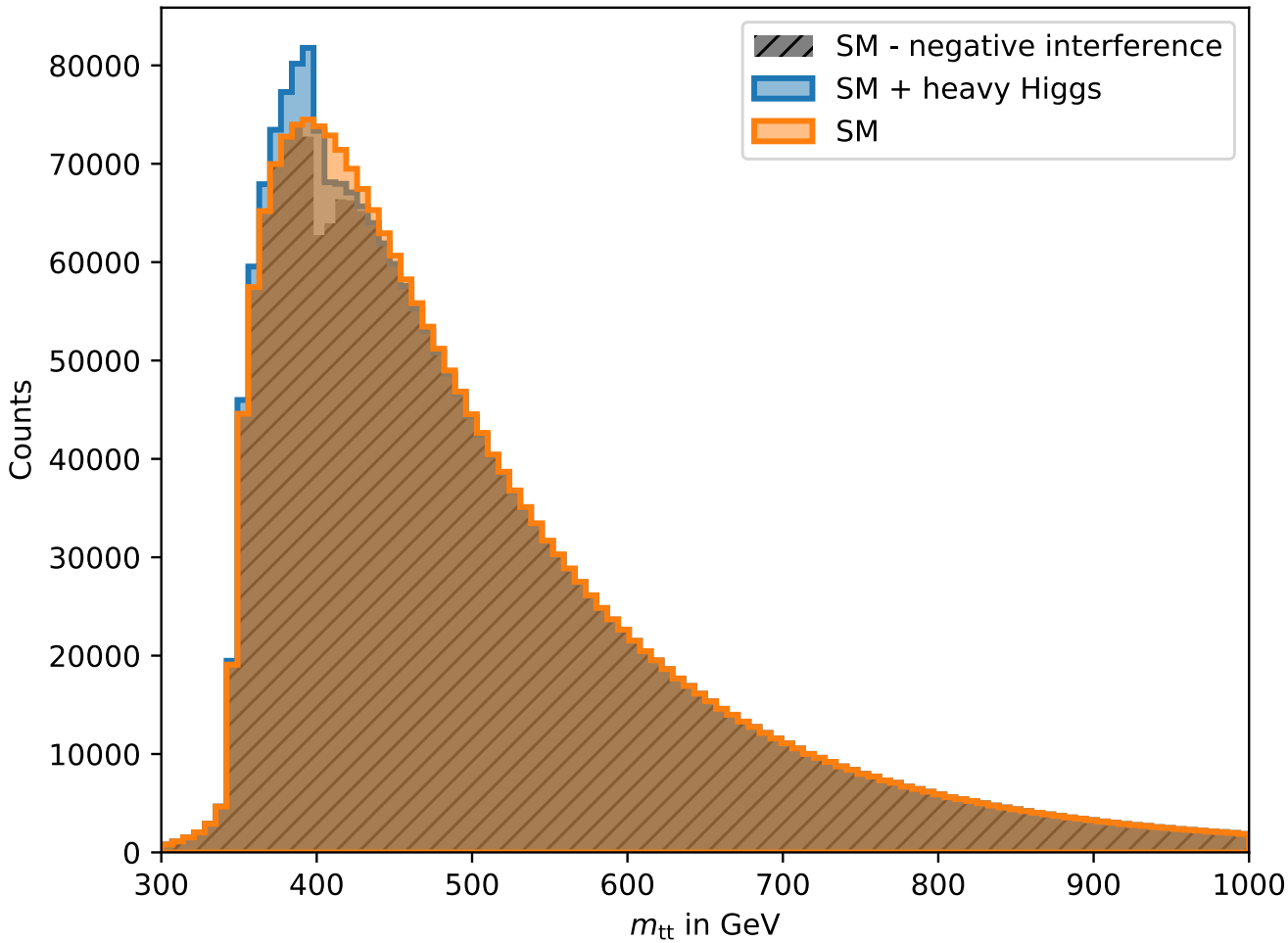
Shown are SM + HH events



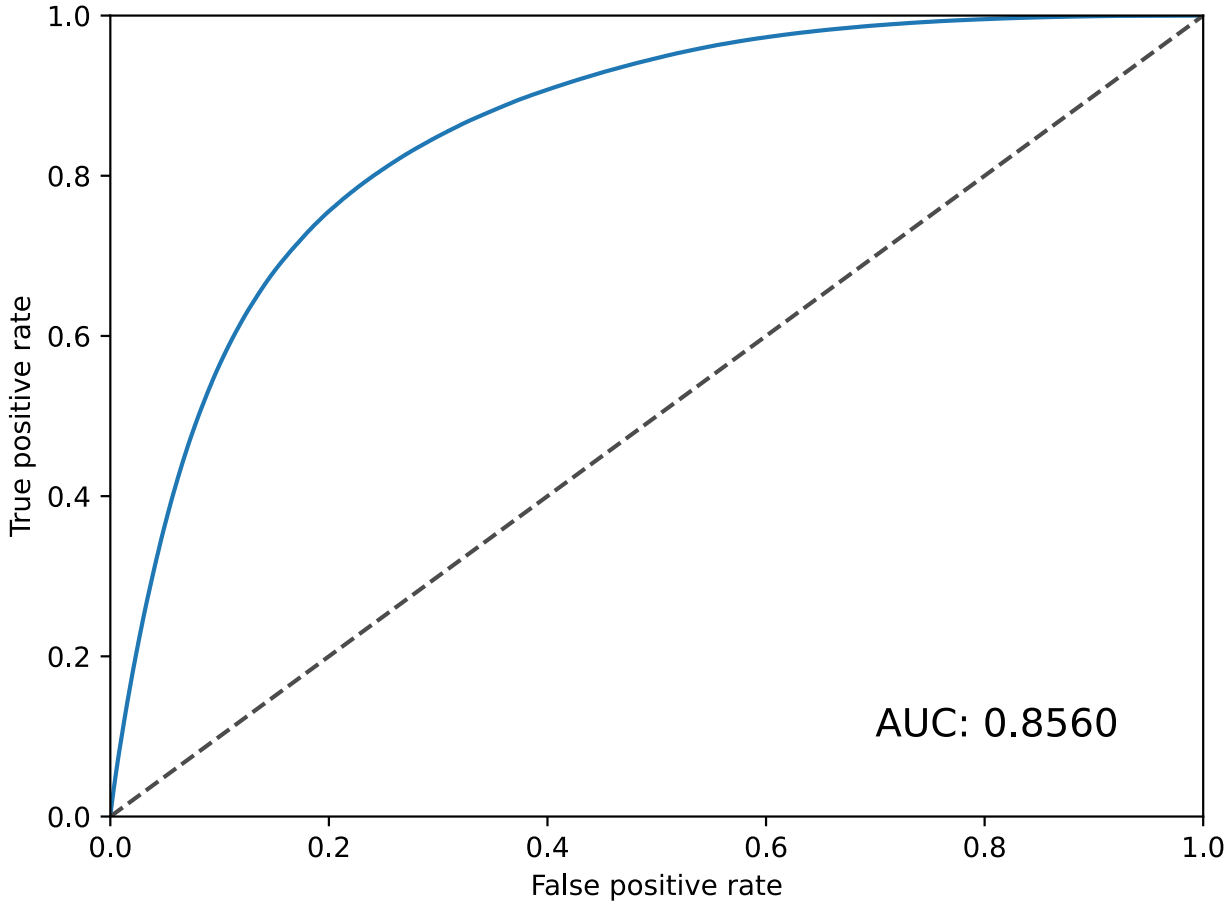
Events of interest actually lie outside an interval around a score of 0.5.

Taking a different approach

Not interested in phase space regions that are invariant under different hypotheses.

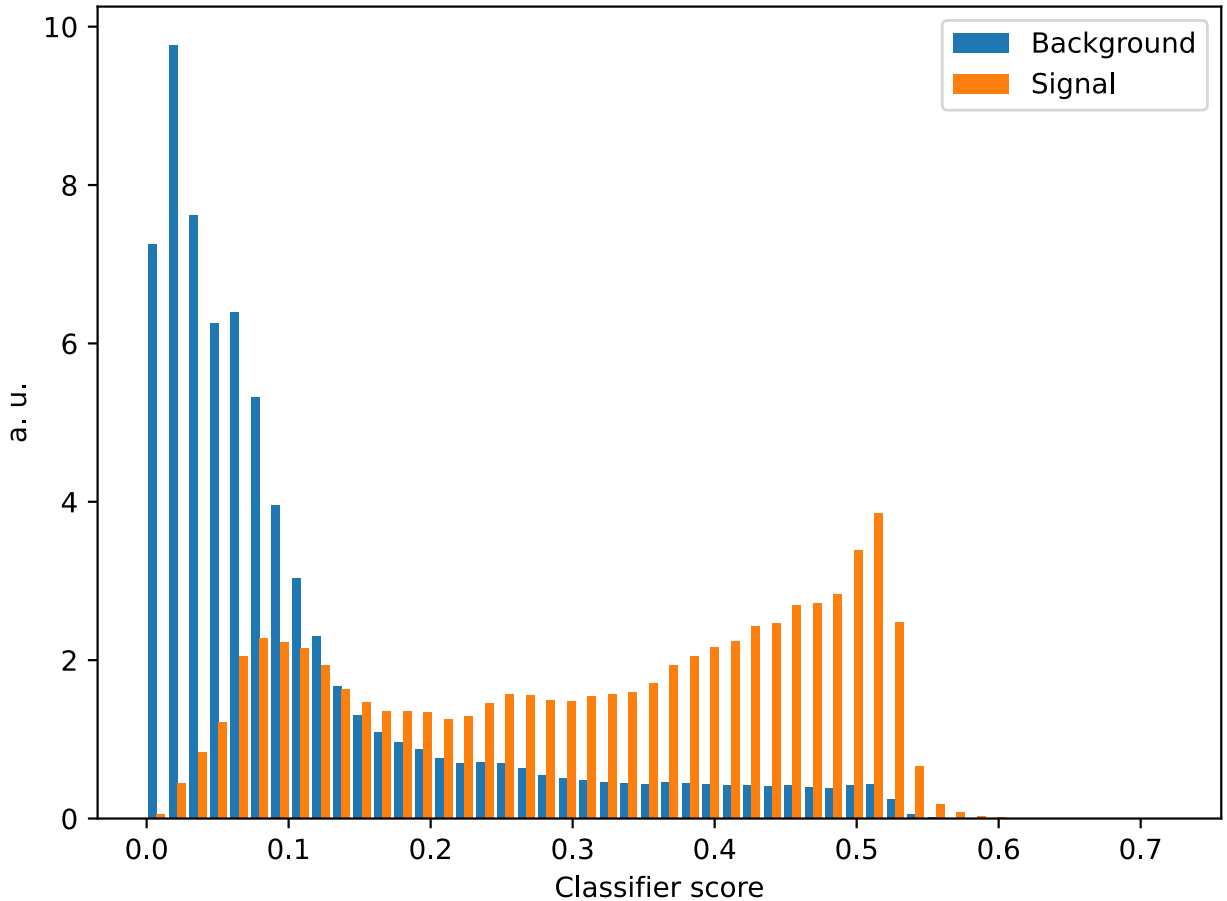


Classifier with redefined background



Clearly see good performance from AUC.

Classifier with redefined background



Signal and background well separated.

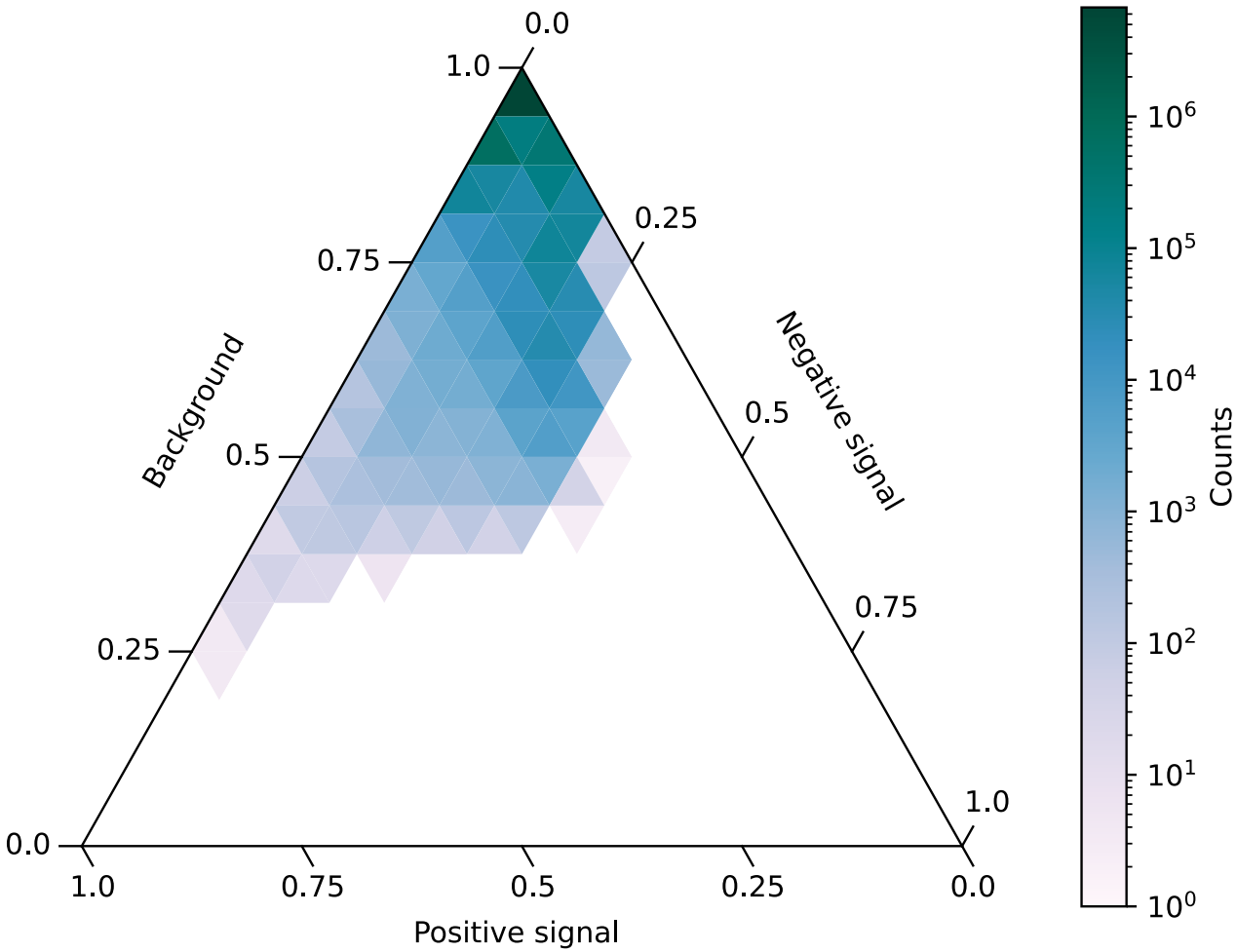
Classifier learning 3 classes

Can we also see the different parts of the signal?

- Define three regions:
  - Positive signal: signal events with positive weight
  - Negative signal: signal events with negative weight
  - Background: The rest (same as before)

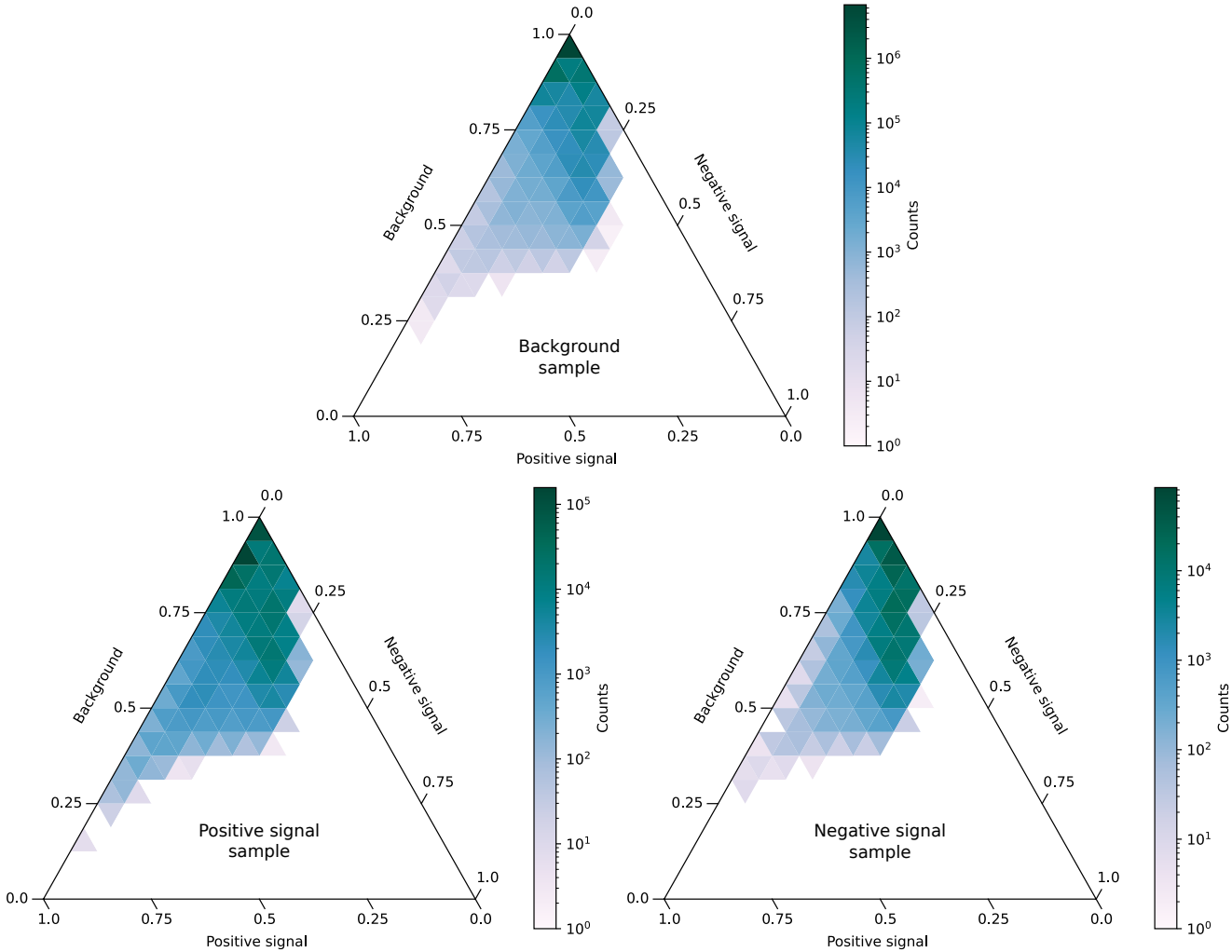
Classifier learning 3 classes

Ternary histogram for the classifier score of the background



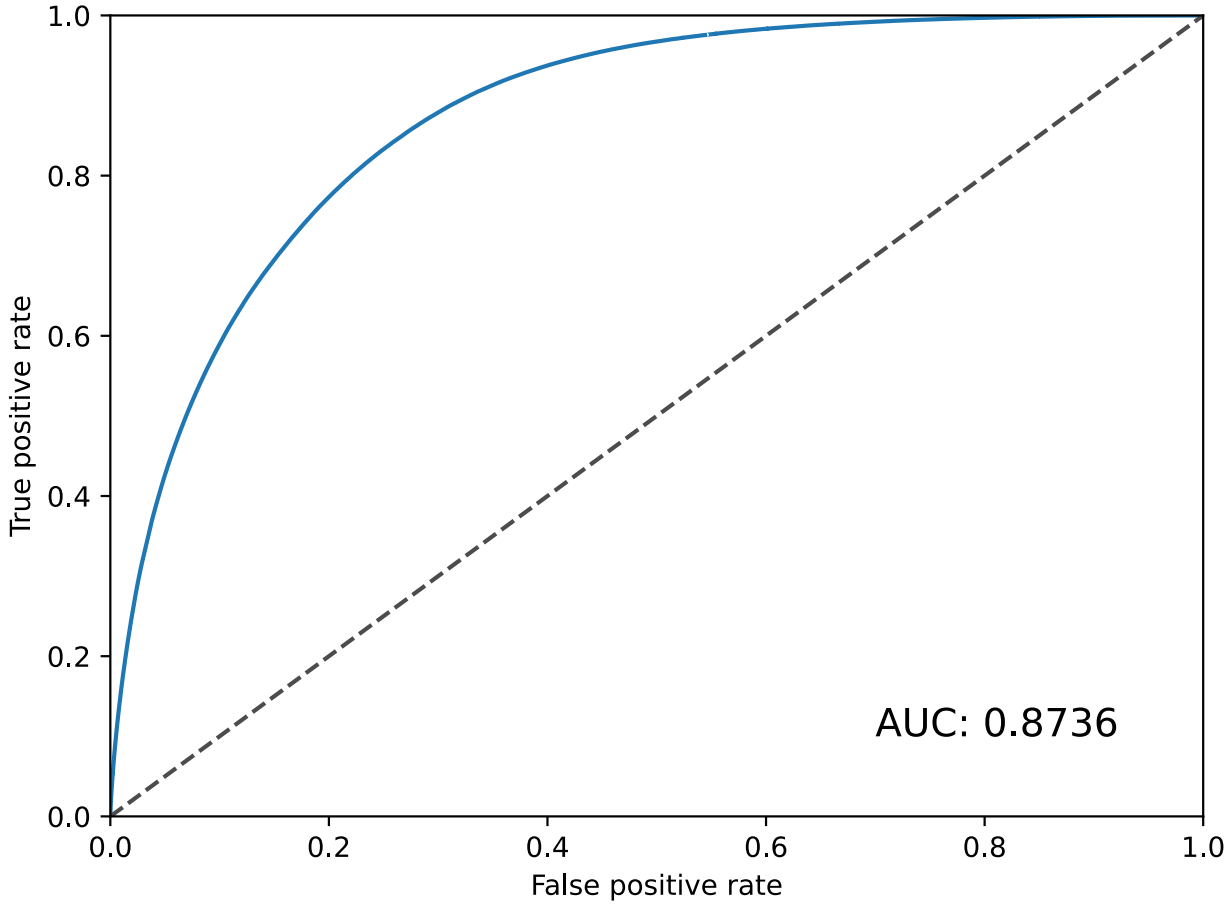
Classifier learning 3 classes

Ternary histogram for the classifier score



Classifier learning 3 classes

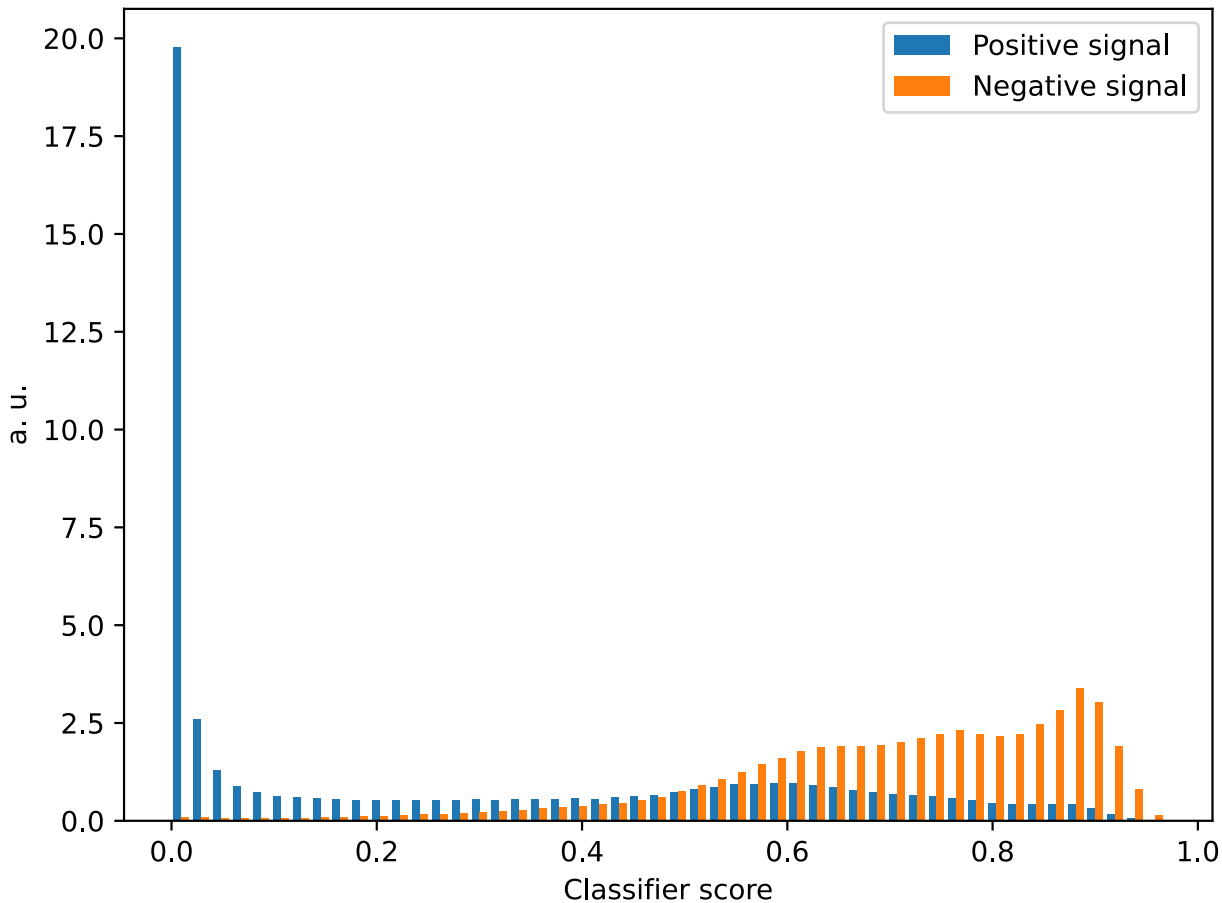
Projecting onto the vertical axis to get previous binary classifier.



Can reproduce results this way.

Classifier learning 3 classes

Projection onto the horizontal axis



Now separating negative and positive signal.

Thank you