

Update on (Optimal Transport) Displaced Track Classification

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SLAC-Yale Weekly Meeting
4/23/24



Phase 0: Track-by-track
BDT (XGBoost)

Parameters

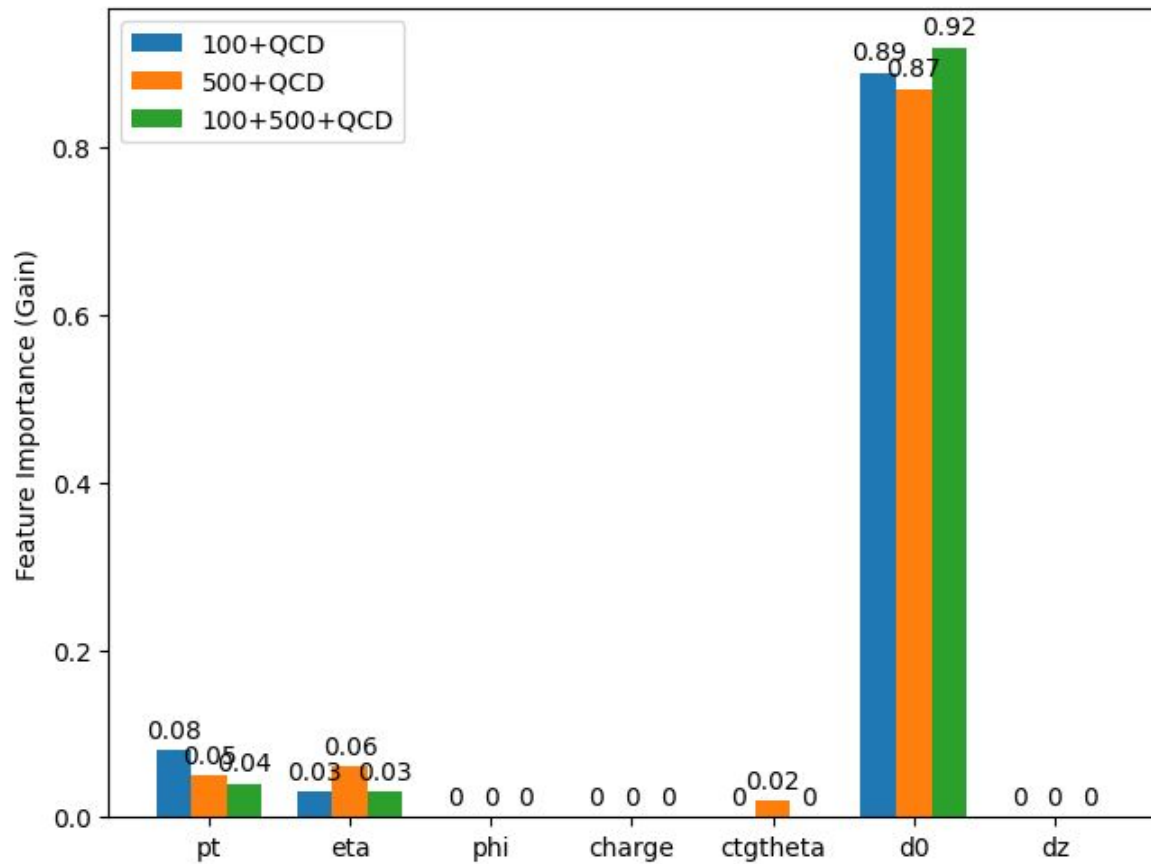
n_estimators=2

max_depth=4

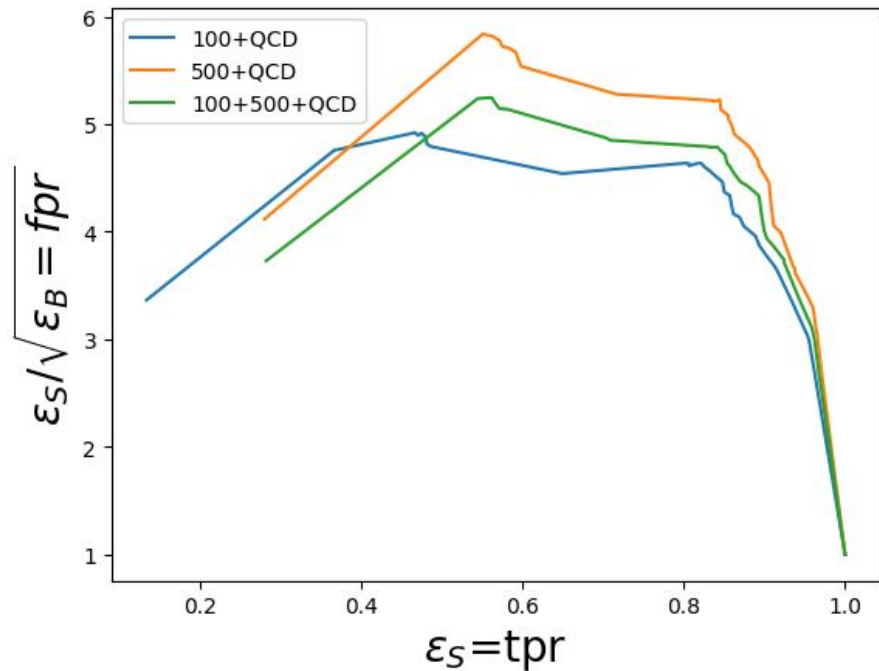
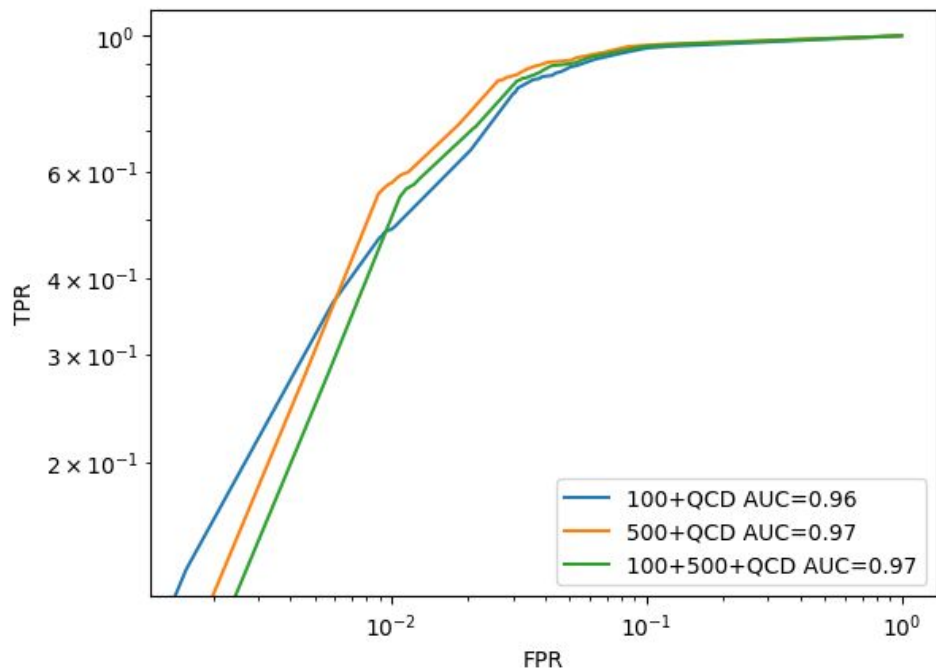
learning_rate=0.5

objective='binary:logistic'

```
▼ XGBClassifier
XGBClassifier(base_score=None, booster=None, callbacks=None,
               colsample_bylevel=None, colsample_bynode=None,
               colsample_bytree=None, device=None, early_stopping_rounds=None,
               enable_categorical=False, eval_metric=None, feature_types=None,
               gamma=None, grow_policy=None, importance_type=None,
               interaction_constraints=None, learning_rate=0.5, max_bin=None,
               max_cat_threshold=None, max_cat_to_onehot=None,
               max_delta_step=None, max_depth=4, max_leaves=None,
               min_child_weight=None, missing=nan, monotone_constraints=None,
               multi_strategy=None, n_estimators=2, n_jobs=None,
               num_parallel_tree=None, random_state=None, ...)
```



Feature Importance



Phase 1: Track-by-track Transformer (ABCNet)

Architecture

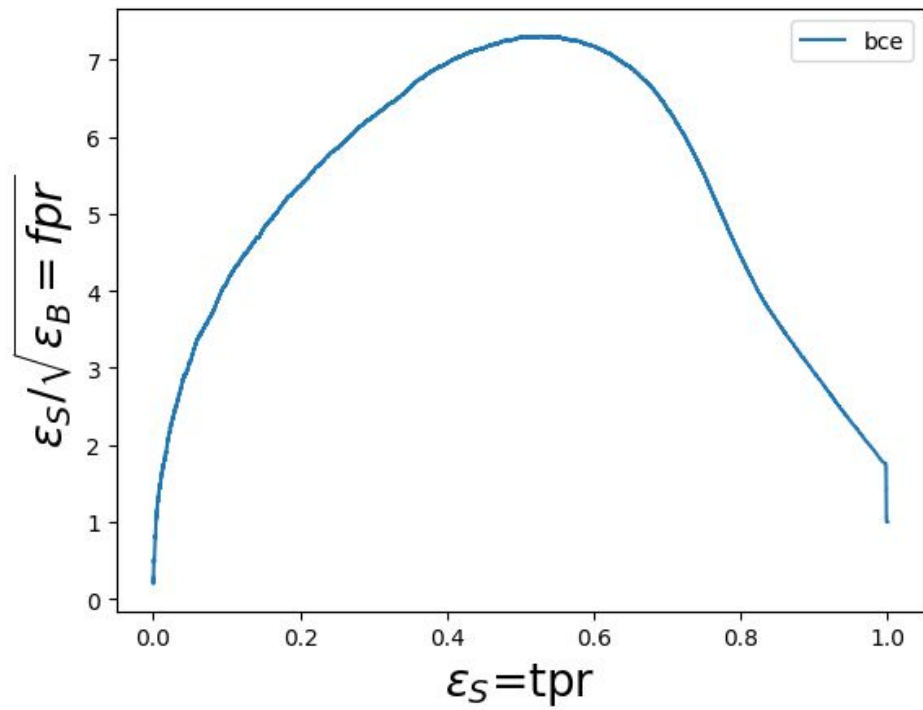
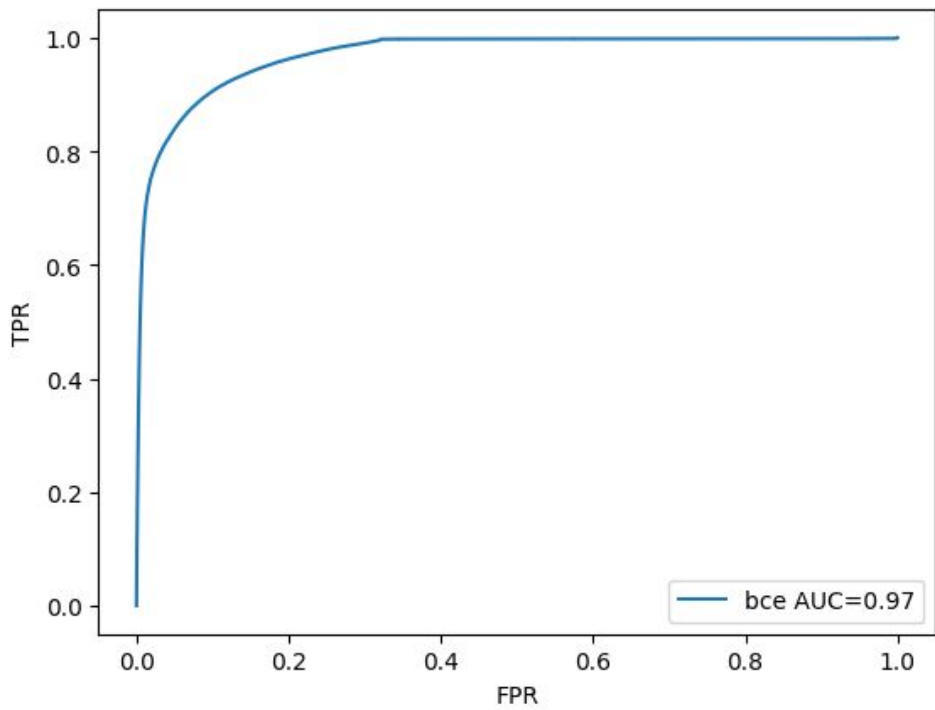
<https://github.com/ViniciusMikuni/ABCNet/tree/master>

Total params: 160,117

Trainable params: 159,021

Non-trainable params: 1,096

[Trained using full data without pileup]



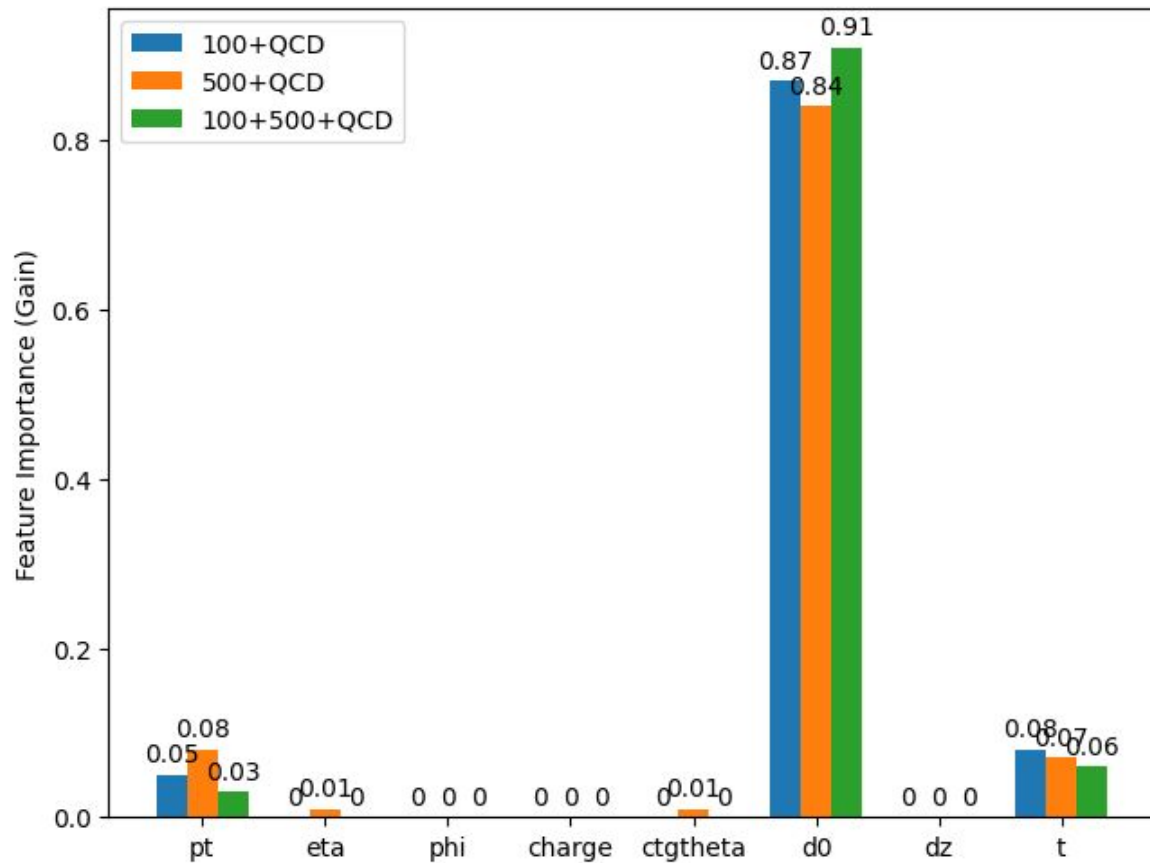
Thoughts

- BDT
 - Overall, task seems (more than) viable
 - Results generalize well for more signals so far
- Supervised Transformer
 - Similar results found to the BDT
 - Are the displaced tracks themselves distinct enough that context is unnecessary for discrimination?
 - Is the current signal too easy to perform track-by-track classification?

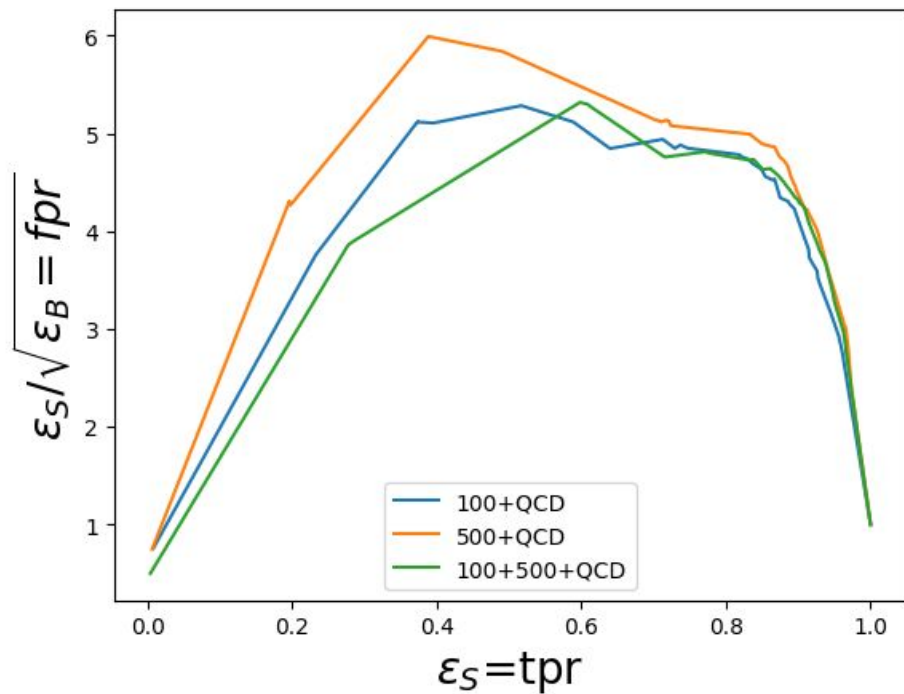
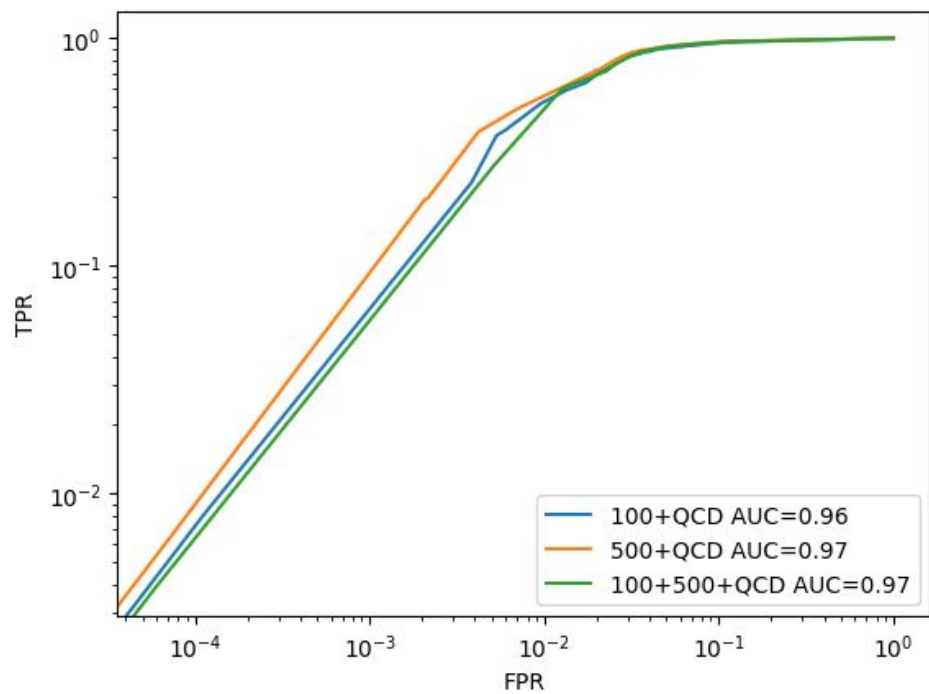
Tasks

- Data
 - Finish adjusting root->h5 pipeline
 - Reconfigure saving of truth information for dark photon samples
- Training
 - Autoencoder
 - Recheck autoencoder implementation
 - OT
 - Retrain with normalized inputs
- Logistics
 - Draft abstract for ATLAS ML workshop?

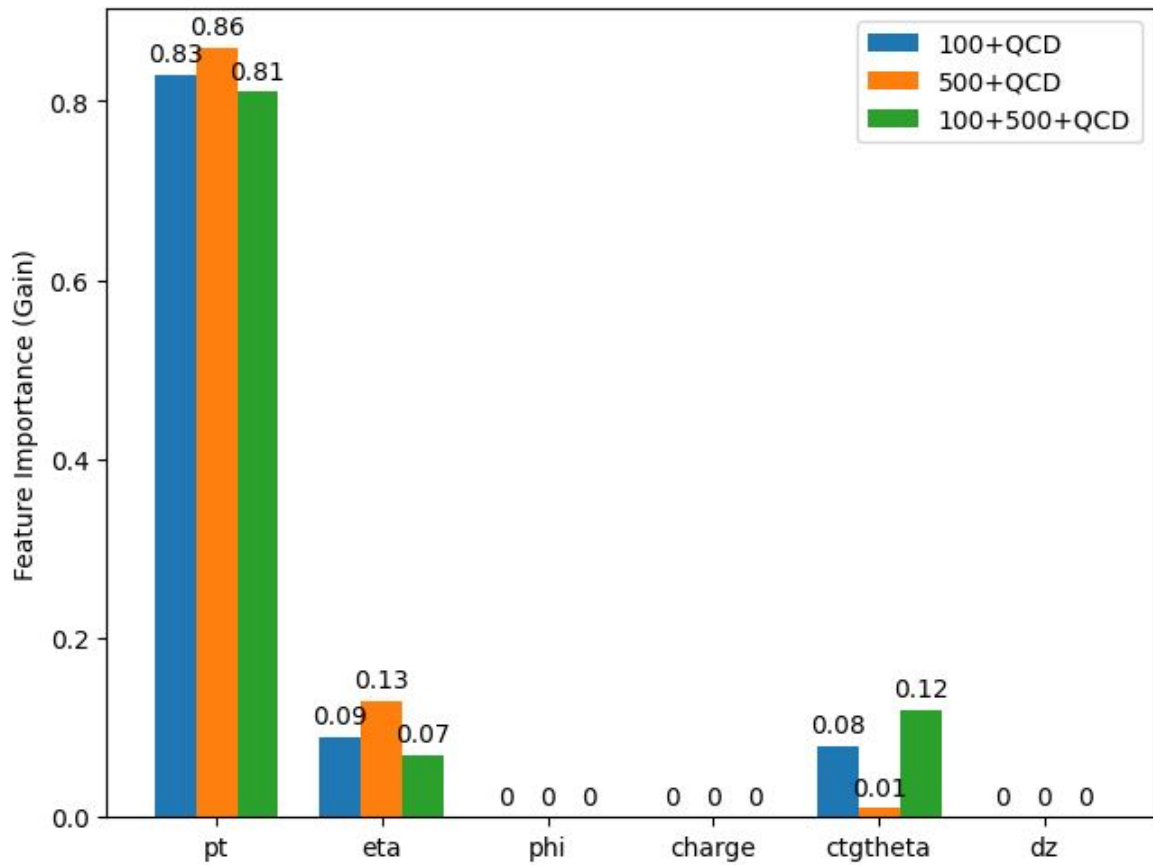
Backup Slides



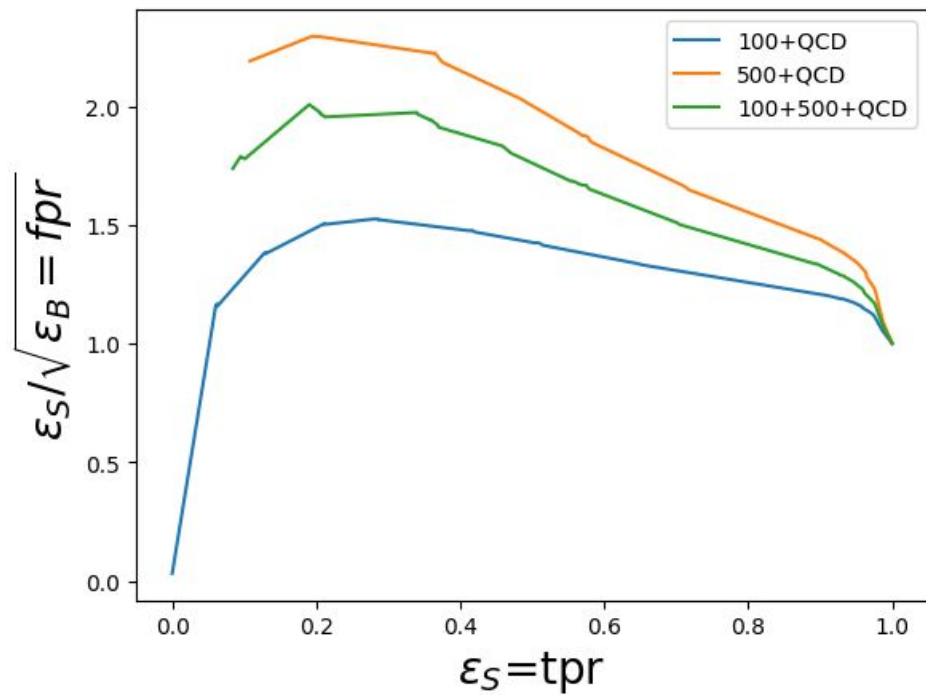
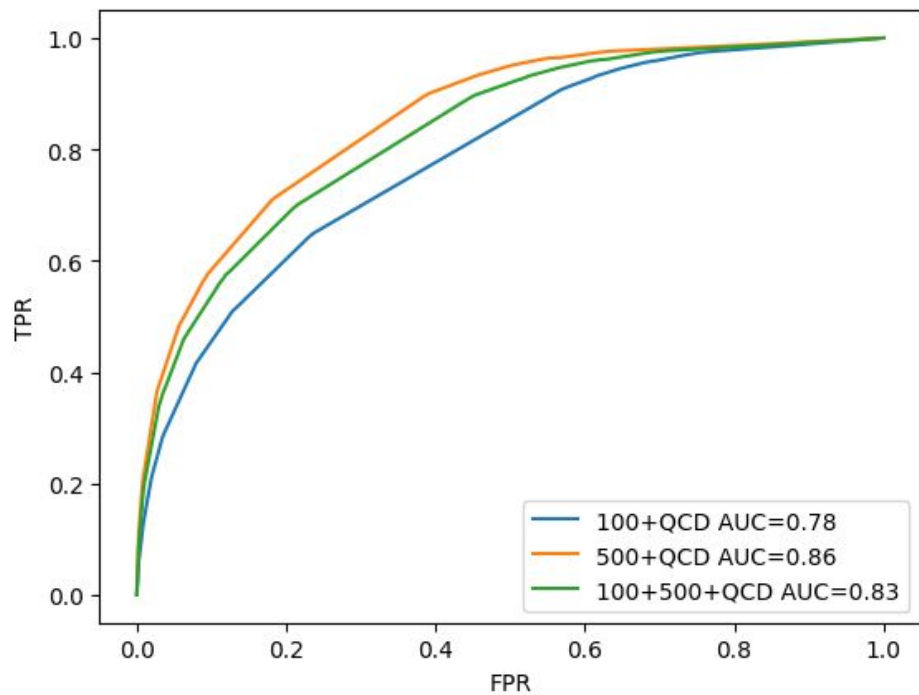
Feature Importance (with t)



Inclusion of Timing Feature



Feature Importance (without Do)



Removal of DO Feature