Hashing Classification for charged particle tracking

Luiza Adelina Ciucu (ATLAS)

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UNIVERSITÉ
DE GENÈVE

FACULTY OF SCIENCE
Physics Section

Introduction

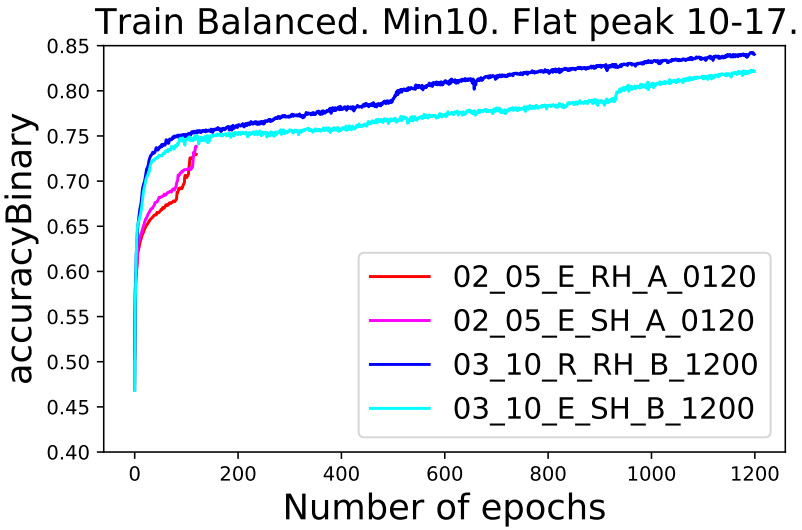
- 100 events. For each group of 10: 7 train, 3 test.
- If nbPositiveHit$<$10, set nbPositiveHit$=$0 and output made only of -1.
- For Train used Balanced (130k), for Test use Unbalanced (3.2M).
- Balancing Train in two steps, as shown last time.
  - Make peak flat between 10-17 (with value of 17).
  - Reduce nbPositiveHit$=$0 until 50% Pos, 50% Neg.
- Train in Balanced, evaluate in Test in Unbalanced.
- Last time showed how peak at 17 gives best results.
  - Many values at bin, and almost nothing at bins 1-9 (out of 21)
  - But problem that only a peak in 1-2 bins around bin 14.
- New studies today:
  - Tried other model settings.
  - Also added a dropout(0.2) layer at the end of the hidden layers.

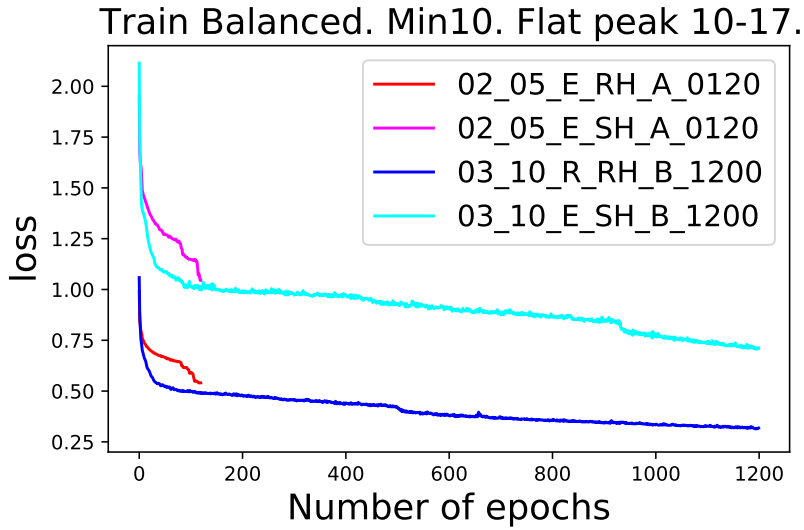
Model changes

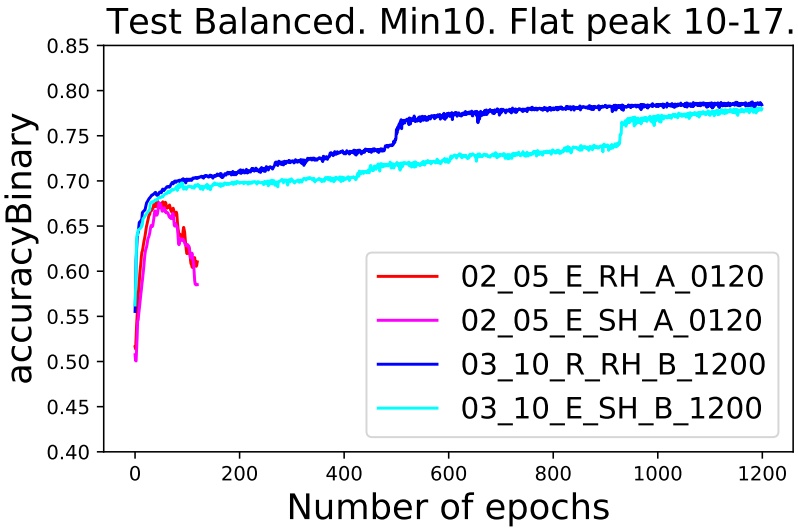
- Naming convention of model description, e,g. `02_05_E_RH_A_0120`.
  - 02 hidden layers
  - 05 x 20 nodes on the hidden layer.
    Input layer has 3 x 20 nodes, output layer has 1 x 20 nodes.
  - E = elu activation function for all nodes on all the hidden layers.
    Other options: R = relu.
  - RH = regular hinge loss function (power one).
    Other options: SH = squared hinge loss function (power two).
  - A = no dropout layer at the end of hidden layers.
    Option options: B = one dropout layer at the end of the hidden layers.
  - 0120 number of epochs, each with batch size of 50000.
    Other options: 600, 1200.
- Today they all have Tanh activation function on the output layer.
  Squared non linear and soft sign were not that good.
- Comparing best models from last week with the best models from this week.

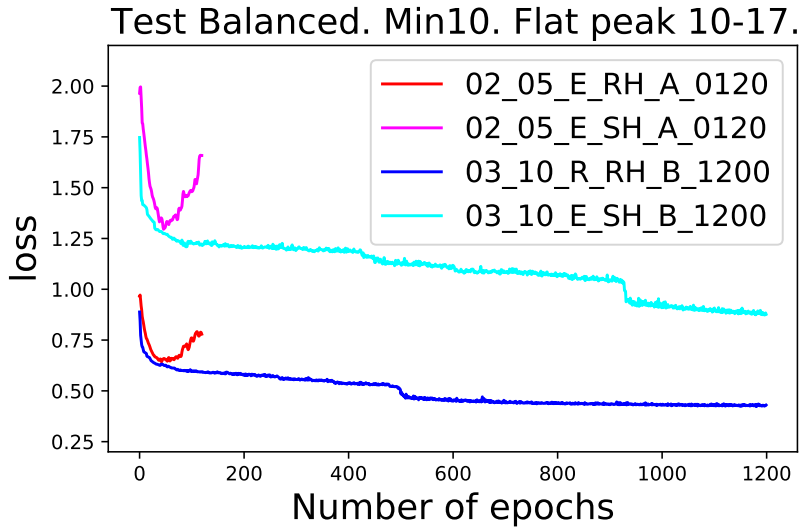
Accuracy and Loss from training

- For 120 epochs, Test shows unbalanced, for 1200 Test balanced.



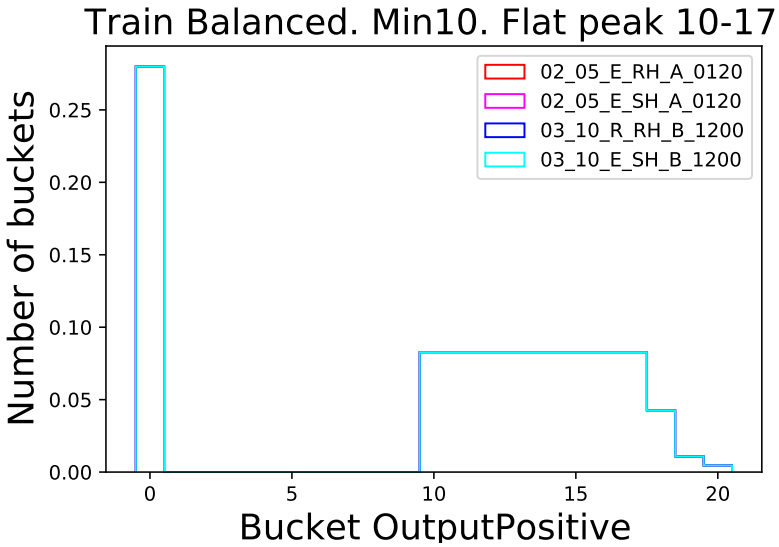


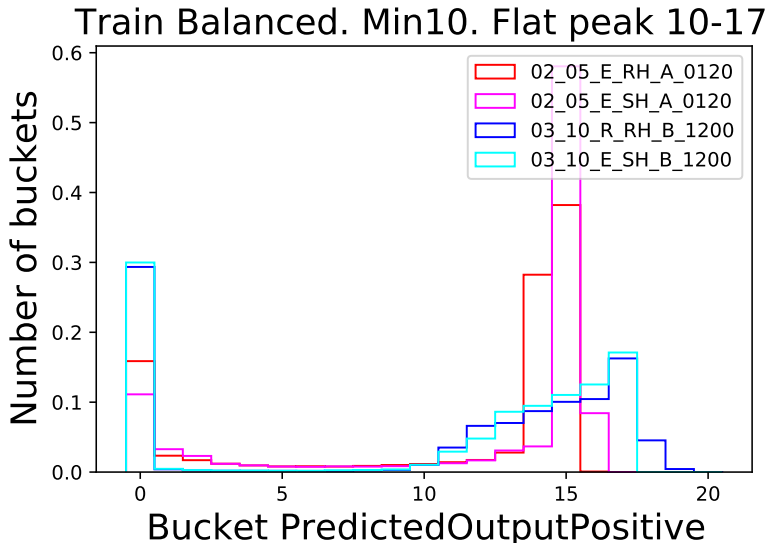


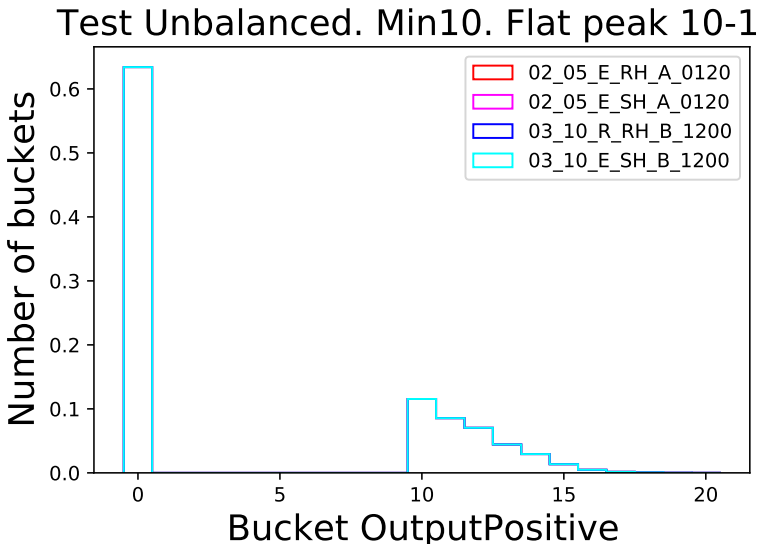


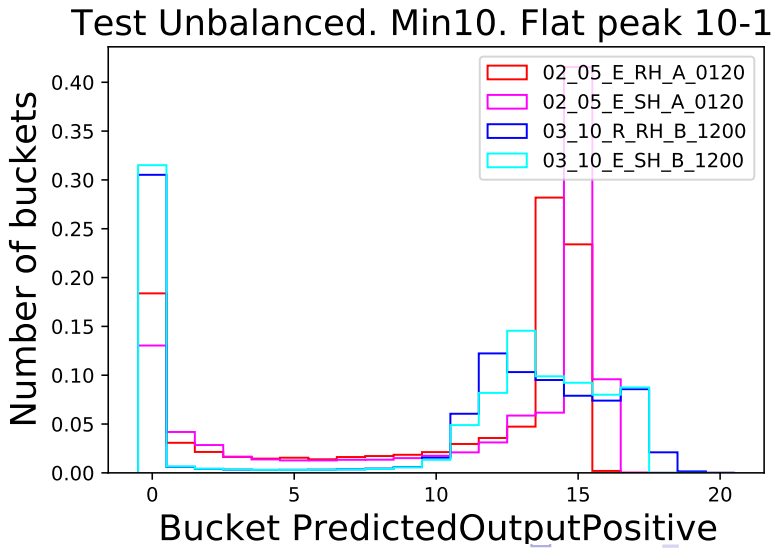
Output and output predicted 1D

- Older ones have a sharp peak, the new ones are more flat.



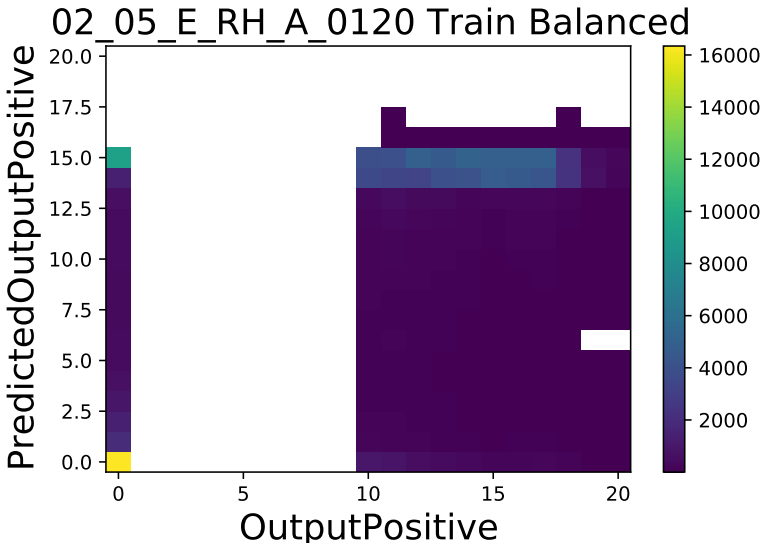


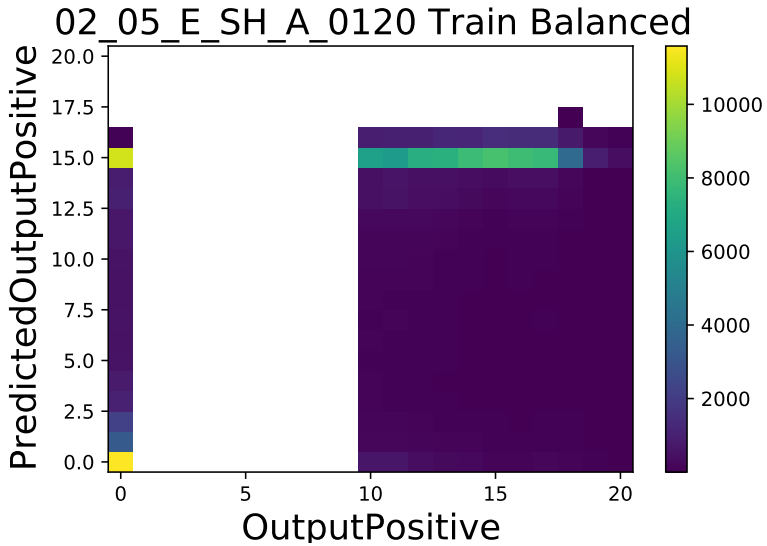


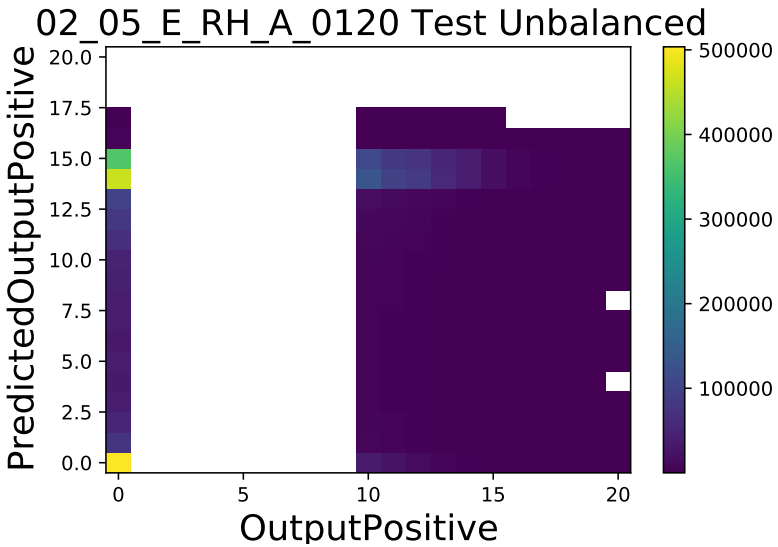


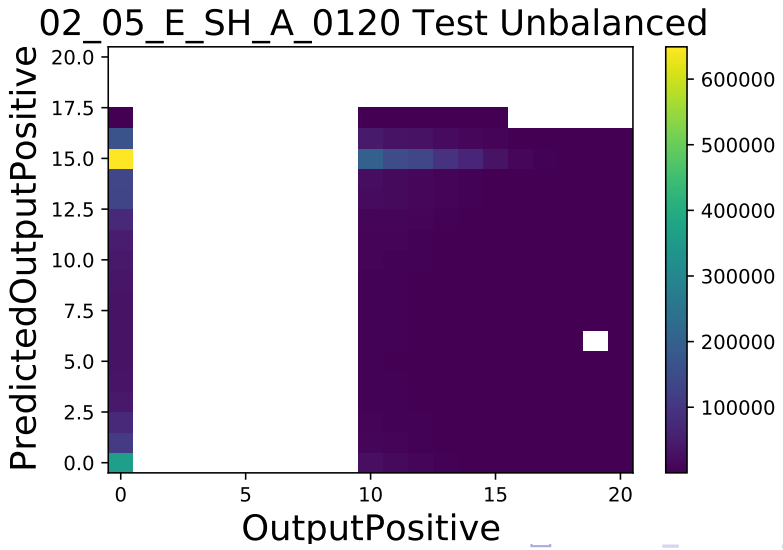
Output and output predicted 2D 1/2 - last week

- No diagonal in either Train or Test.



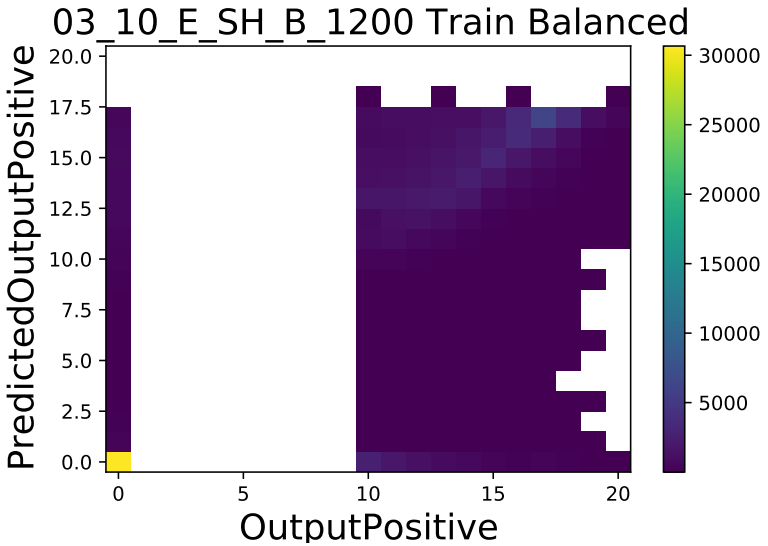


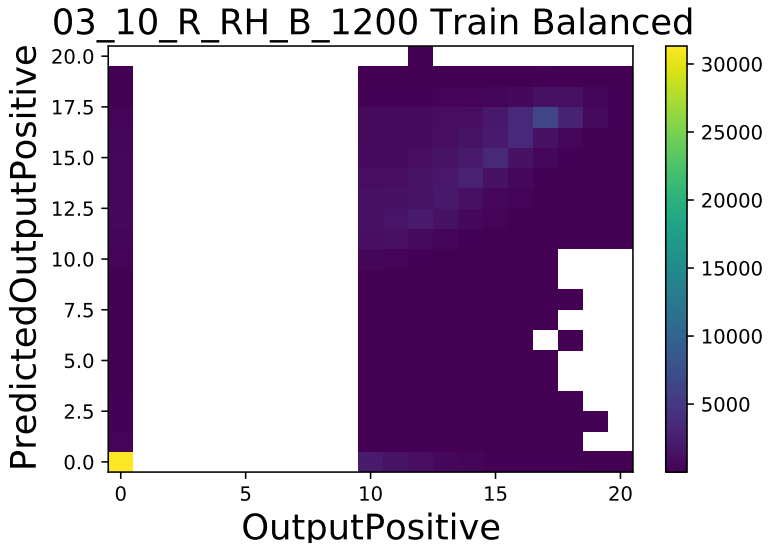


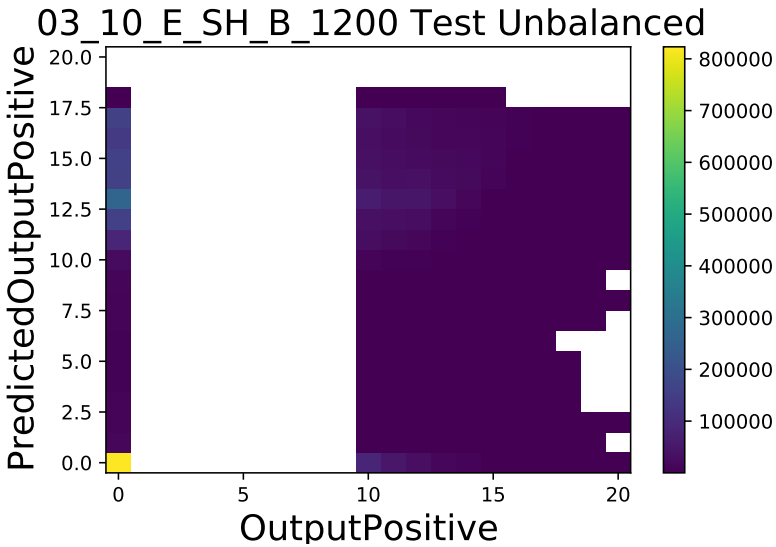


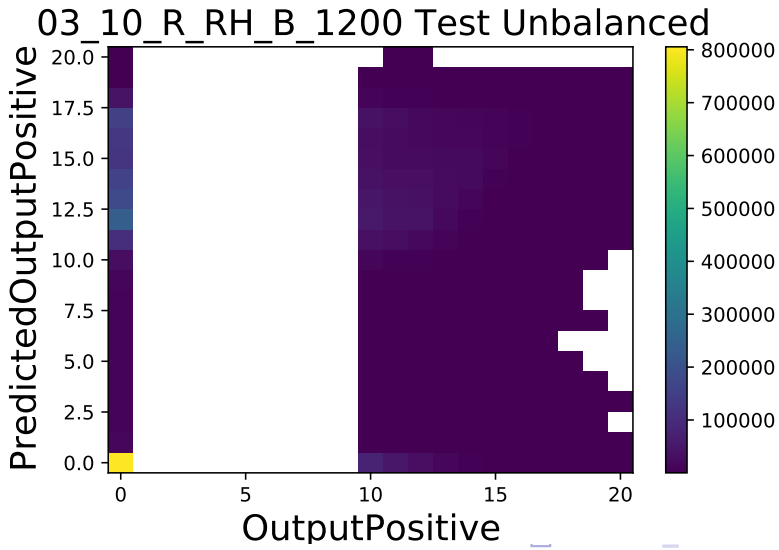
Output and output predicted 2D 2/2 - new models

- In Train balanced, a diagonal is seen. In Test unbalanced it's harder.





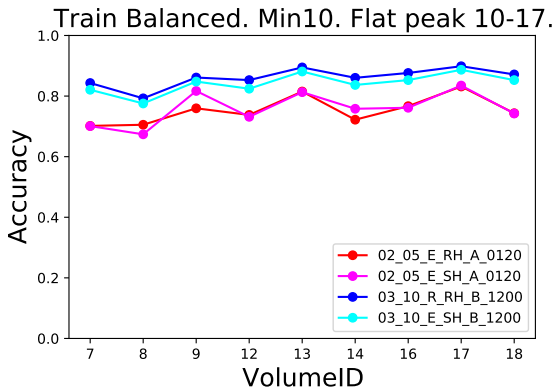


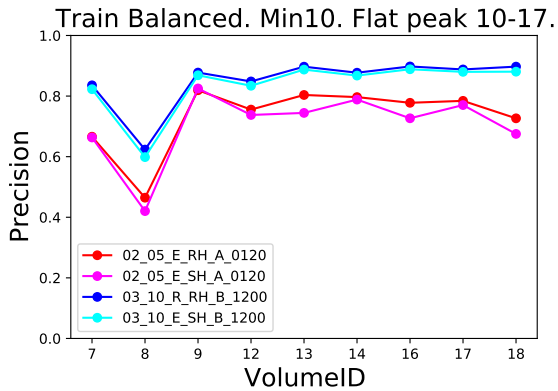


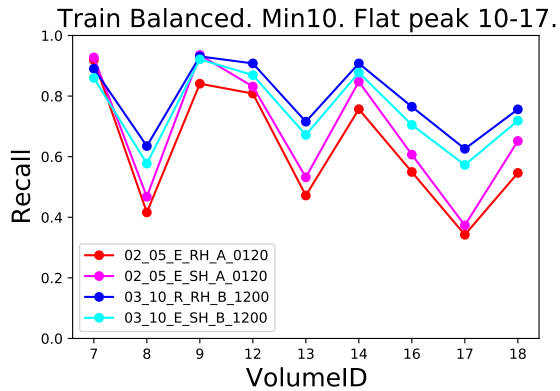
Metrics for each VolumeID.

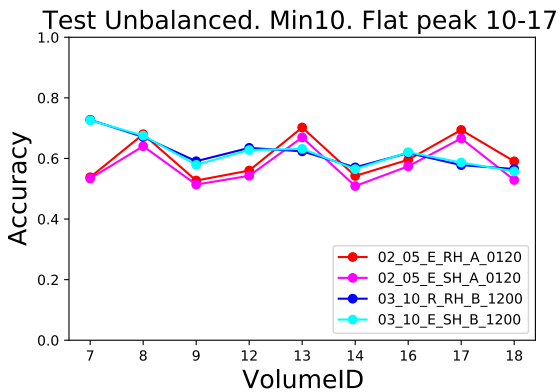
- The new ones (bluish) have a clearly better Train Balance and only a slightly better Test Unbalanced than the old ones (reddish).

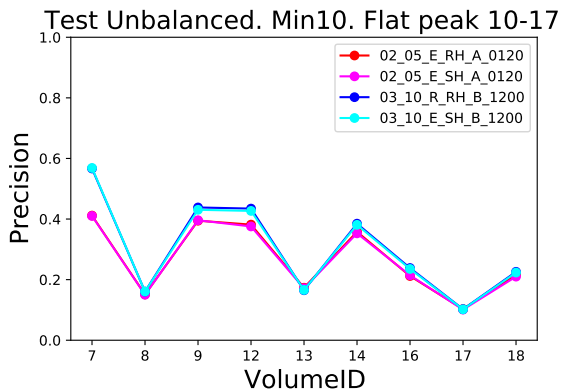
Accuracy	Precision	Recall
$\frac{TP+TN}{TP+FP+FN+TN}$	$\frac{TP}{TP+FP}$	$\frac{TP}{TP+FN}$

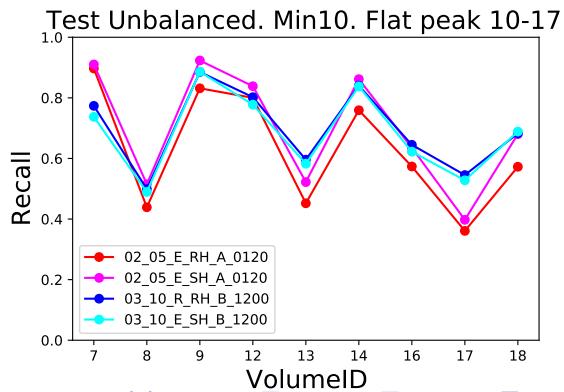












Conclusion

- Improved model from last week.
- In balanced dataset (Train and Test) a diagonal can be nicely seen.
- In Test unbalanced it is harder to see,
  but still values look relatively flat in 1D.
- Changes to the model for the best choice:
  `02_05_E_SH_A_0120` $\rightarrow$ `03_10_R_RH_B_1200`.
  - 02 $\rightarrow$ 03 hidden layers
  - 05 x 20 $\rightarrow$ 10 x 20 nodes on each hidden layer.
    Input layer has 3 x 20 nodes, output layer has 1 x 20 nodes.
  - Elu $\rightarrow$ Relu activation function for all nodes on all the hidden layers.
  - Squared Hinge $\rightarrow$ Regular Hinge as loss function.
  - Added one dropout layer (0.2) at the end of the hidden layers.
  - 120 $\rightarrow$ 1200 epochs, each with batch size of 50000.
  - Kept Tanh activation function on the output layer.
- This model seems good enough.
- Next step: add these results in the thesis.