

Progress Update

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UofT Neutrino/DM Meeting
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Notes from Collaboration Meeting

- Plenary talk went well
 - No major comments/critiques
 - Some confusion over how I defined efficiency
 - Make it more clear in future plenary talks
 - Mark Hartz mentioned that $1e$ events (i.e. ν_e CCQE-like) events should be classified as signal
 - I have some reservations about that
- Pre-meeting also went well
 - Cris: Might want to see difference in output of BDT when training on two different samples (i.e. split training sample it 2)
 - Mike: Selection might benefit from “stacked” BDTs to remove specific backgrounds
 - ex. first BDT removes $NC1\pi^0$ background, next BDT deals with some other background, and last BDT selects for final sample

Reminder: BDT v1 Trial 8

- Preliminary cuts:
 - FCFV
 - possible 2Repi
 - v1:
 - 0 de: 2Re π , 2R π e, and 3Re $\pi\pi$ sub-samples
 - 1 de: 1Re, 2Ree, 2Re π , 2R π e, 2R μ e, and 3Re $\pi\pi$ sub-samples
 - 1/2 sub-events
 - separate samples
 - $E_{rec}(1e,1\pi) < 1.5$ GeV

| | BDT variables | | | | | | | | |
|---------|---------------|-------------|-------------|-------------|-------------|-------------|------------------|---|----------------------|
| | 1R v 1R nll | 1R v 2R nll | 2R v 2R nll | 2R v 3R nll | 3R v 3R nll | 3R v 4R nll | 1R+2R kinematics | E_{rec} , towall e, towall π , p_{low} , $m_{\pi 0}$, ($d2se$) | 1R+2R+3R fit indices |
| Trial 8 | ■ | ■ | ■ | ■ | ■ | | ■ | ■ | ■ |

BDT Grid Search Results (v1 trial 8)

MinNodeSize = 5, NCuts = 20

| MaxDepth | 2 | 3 | 4 | 5 | 6 | 7 | NTrees |
|-----------|-------|-------|-------|-------|-------|-------|--------|
| 0 decay e | 0.479 | 0.502 | 0.507 | 0.507 | 0.515 | 0.513 | 10 |
| | 0.519 | 0.559 | 0.547 | 0.562 | 0.570 | 0.567 | 100 |
| | 0.557 | 0.570 | 0.570 | 0.580 | 0.583 | 0.580 | 850 |
| | 0.555 | 0.567 | 0.572 | 0.585 | 0.584 | 0.577 | 1500 |
| | 0.554 | 0.562 | 0.565 | 0.565 | 0.565 | 0.561 | 10000 |

| MaxDepth | 2 | 3 | 4 | 5 | 6 | 7 | NTrees |
|-----------|-------|-------|-------|-------|-------|-------|--------|
| 1 decay e | 1.053 | 1.067 | 1.079 | 1.107 | 1.124 | 1.124 | 10 |
| | 1.114 | 1.163 | 1.164 | 1.178 | 1.197 | 1.182 | 100 |
| | 1.171 | 1.197 | 1.190 | 1.188 | 1.196 | 1.189 | 850 |
| | 1.174 | 1.195 | 1.186 | 1.193 | 1.189 | 1.192 | 1500 |
| | 1.171 | 1.163 | 1.167 | 1.163 | 1.163 | 1.165 | 10000 |

BDT Grid Search Results (v1 trial 8)

MaxDepth = 5, NTrees = 1500

| MinNode Size | 0.05 | 0.5 | 1 | 5 | NCuts |
|--------------|-------|-------|--------------|-------|-------|
| 0 decay e | 0.581 | 0.590 | 0.584 | 0.565 | 10 |
| | 0.603 | 0.599 | 0.603 | 0.585 | 20 |
| | 0.605 | 0.620 | 0.604 | 0.593 | 50 |
| | 0.604 | 0.612 | 0.622 | 0.591 | 100 |

| MinNode Size | 0.05 | 0.5 | 1 | 5 | NCuts |
|--------------|--------------|-------|-------|-------|-------|
| 1 decay e | 1.193 | 1.203 | 1.197 | 1.179 | 10 |
| | 1.193 | 1.202 | 1.193 | 1.193 | 20 |
| | 1.209 | 1.230 | 1.218 | 1.187 | 50 |
| | 1.233 | 1.217 | 1.220 | 1.196 | 100 |

MinNodeSize: Minimum percentage of training events in a leaf node

NCuts: Number of grid points in variable range used in finding optimal cut in node splitting

Other Notes

- Spent some more time on loose cuts to improve efficiency of BDT pre-selection
 - Again, no success – my cuts were slightly more efficient than “v1”, but significantly less pure, resulting in a poorer-performing BDT
- Now trying to figure out why my BDT code uses so much memory
 - ROOT Tree file sizes seem to be very large relative to the number/size of the variables that they are storing
 - Would be nice to have this issue dealt with to more liberally explore BDT performance