

Status report

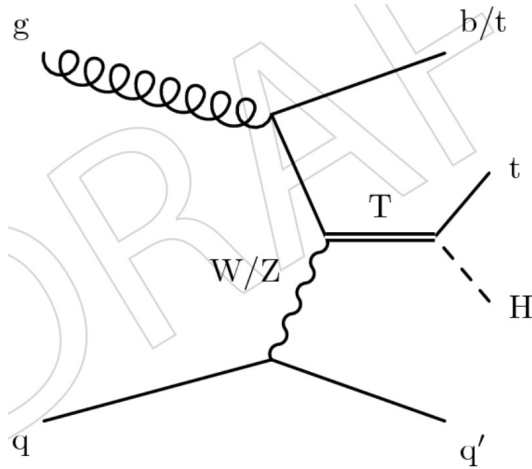
June 10, 2022

Jieun Choi

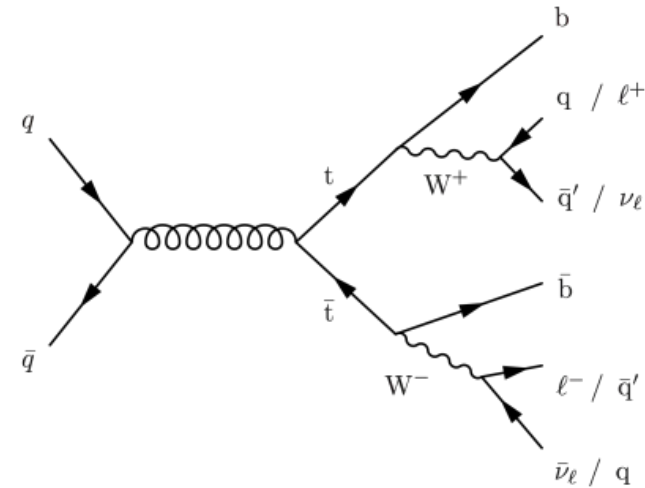
HYU / IP2I

NN From Scratch

Samples



TprimeBToTH_M-700



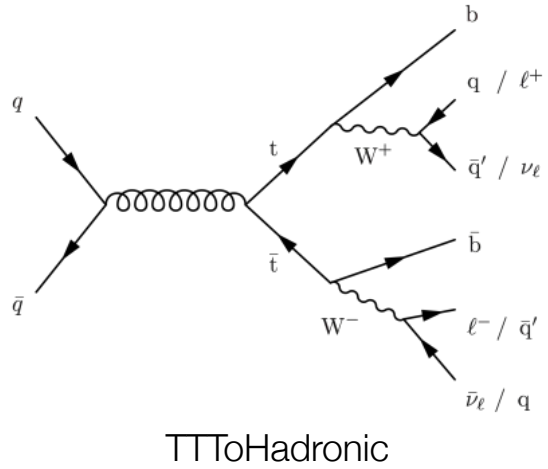
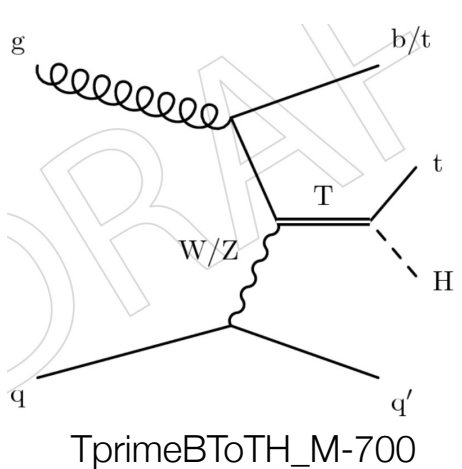
TToHadronic

Strategy

- Train on Tprime700 Hadronic + TToHadronic (1:1 training)
 - Selection: HLT + $n_{\text{jets}} \geq 6$ + $n_{\text{bjets}}(\text{DeepJet Medium}) \geq 3$
- Compare ROC curves with cutBased (signal efficiency vs background rejection)
 - Evaluate NN at the level of Cut 0

Ana From Scratch

Samples

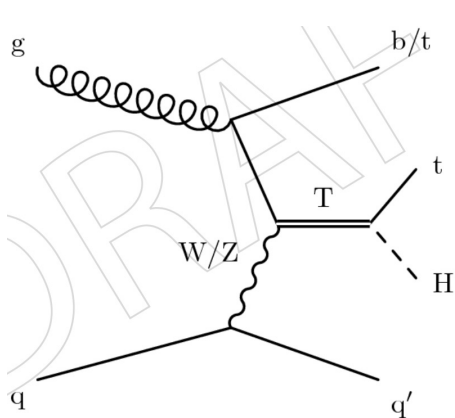


Recovering cut-based method

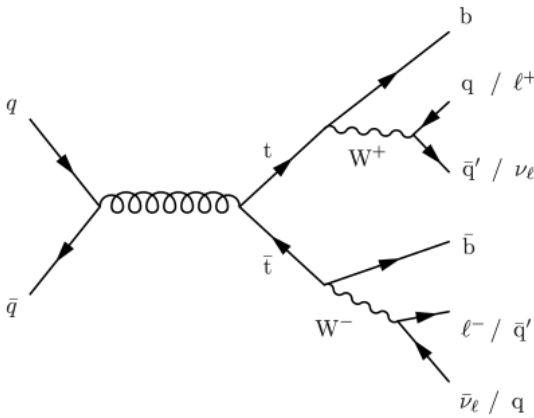
Basic Selection Criteria	Signal (M=700 GeV/c ²)	QCD_HT_700_1000	t $\bar{t}$
Trigger and p_T, η and $n_b^{DeepCSV} \geq 3$	4242	3326	83816
$j_{p_T}^1 > 170 \text{ GeV}/c, j_{p_T}^2 > 130 \text{ GeV}/c, j_{p_T}^3 > 80 \text{ GeV}/c$ and $H_T > 500 \text{ GeV}/c$	2577	1964	28779
$\chi^2 < 15$	933	407	10251
2nd Top Mass > 250 GeV/c ²	855	390	8617
Higgs Mass > 100 GeV/c ²	795	328	7492

year	2018UL						
Label	Cuts	Data	Signal M=600 GeV/c ²	Signal M=700 GeV/c ²	Signal M=900 GeV/c ²	Signal M=1100 GeV/c ²	t $\bar{t}$
Cut 0	Basic selection	23518	50.6 $\pm$ 1.1	41.8 $\pm$ 0.7	16.4 $\pm$ 0.2	5.0 $\pm$ 0.1	4459.0 $\pm$ 31.1
Cut 1	Relative $H_T > 0.4$	11505	38.5 $\pm$ 0.9	35.7 $\pm$ 0.7	14.7 $\pm$ 0.2	4.5 $\pm$ 0.1	2396.4 $\pm$ 23.0
Cut 2	Max(χ^2) < 3	4444	23.1 $\pm$ 0.7	23.8 $\pm$ 0.5	9.9 $\pm$ 0.2	3.0 $\pm$ 0.1	1234.9 $\pm$ 16.3
Cut 3	$\Delta R(b_{Higgs}, b_{Higgs}) < 1.1$	2328	15.5 $\pm$ 0.6	19.8 $\pm$ 0.5	9.1 $\pm$ 0.2	2.8 $\pm$ 0.1	595.0 $\pm$ 11.5
Cut 4	$\chi_{Higgs}^2 < 1.5$	1961	13.6 $\pm$ 0.6	17.6 $\pm$ 0.5	8.2 $\pm$ 0.2	2.5 $\pm$ 0.1	492.8 $\pm$ 10.5
Cut 5	$\Delta R(j_W, j_W) < 1.75$	1315	10.6 $\pm$ 0.5	15.2 $\pm$ 0.4	7.3 $\pm$ 0.2	2.3 $\pm$ 0.1	389.9 $\pm$ 9.3
Cut 6	$\Delta R(b_{Top}, W) < 1.2$	593	6.1 $\pm$ 0.4	11.4 $\pm$ 0.4	6.4 $\pm$ 0.1	2.0 $\pm$ 0.1	250.8 $\pm$ 7.5

Yield table (without normalization)



TprimeBToTH_M-700



TTToHadronic few files

Seletion steps	Signal (M=700 GeV)	TTToHadronic
No Cut	389500	26220000
Cut 0	9359	25656
Cut 1	8278	18230
Cut 2	5478 66 %	10098 55 %
Cut 3	4536	5929
Cut 4	4140	4893
Cut 5	3557	4112
Cut 6	2000	2201

Yield table (without normalization)

year	2018UL				
Label	Cuts	Data	Signal M=600 GeV/c ²	Signal M=700 GeV/c ²	t $\bar{t}$
Cut 0	Basic selection	23518	50.6 ± 1.1	41.8 ± 0.7	4459.0 ± 31.1
Cut 1	Relative $H_T > 0.4$	11505	38.5 ± 0.9	35.7 ± 0.7	2396.4 ± 23.0
Cut 2	Max(χ^2) < 3	4444	23.1 ± 0.7	23.8 ± 0.5	1234.9 ± 16.3
Cut 3	$\Delta R(b_{Higgs}, b_{Higgs}) < 1.1$	2328	15.5 ± 0.6	19.8 ± 0.5	595.0 ± 11.5
Cut 4	$\chi^2_{Higgs} < 1.5$	1961	13.6 ± 0.6	17.6 ± 0.5	492.8 ± 10.5
Cut 5	$\Delta R(j_W, j_W) < 1.75$	1315	10.6 ± 0.5	15.2 ± 0.4	389.9 ± 9.3
Cut 6	$\Delta R(b_{Top}, W) < 1.2$	593	6.1 ± 0.4	11.4 ± 0.4	250.8 ± 7.5

Seletion steps	Signal (M=700 GeV)	TTToHadronic
No Cut	389500	26220000
Cut 0	9359	25656
Cut 1	8278	18230
Cut 2	5478	10098
Cut 3	4536	5929
Cut 4	4140	4893
Cut 5	3557	4112
Cut 6	2000	2201

Cumulative efficiencies after basic selection

Label	Cuts	Signal (M=700 GeV/ c^2)	Multijet	$t\bar{t}$	$t\bar{t}$ H	single top	V+jets
Basic selection (number of events)		23.1 [100%]	9356.1 [100%]	2612.2 [100%]	116.6 [100%]	108.3 [100%]	127.8 [100%]
Cut 1	Relative $H_T > 0.4$	81.4%	42.8%	51.9%	53.6%	47.8%	53.3%
Cut 2	$\text{Max}(\chi^2) < 3$	54.3%	14.1%	25.1%	31.1%	23.2%	8.1%
Cut 3	$\Delta R(b_{Higgs}, b_{Higgs}) < 1.1$	44.4%	7.5%	11.9%	16.4%	7.8%	2.6%
Cut 4	$\chi^2_{Higgs} < 1.5$	39.8%	4.9%	9.3%	14.0%	6.8%	< 2.6%
Cut 5	$\Delta R(j_W, j_W) < 1.75$	33.7%	3.2%	7.2%	11.1%	3.4%	< 2.6%
Cut 6	$\Delta R(b_{Top}, W) < 1.2$	25.7%	1.9%	4.5%	6.9%	1.2%	< 2.6%

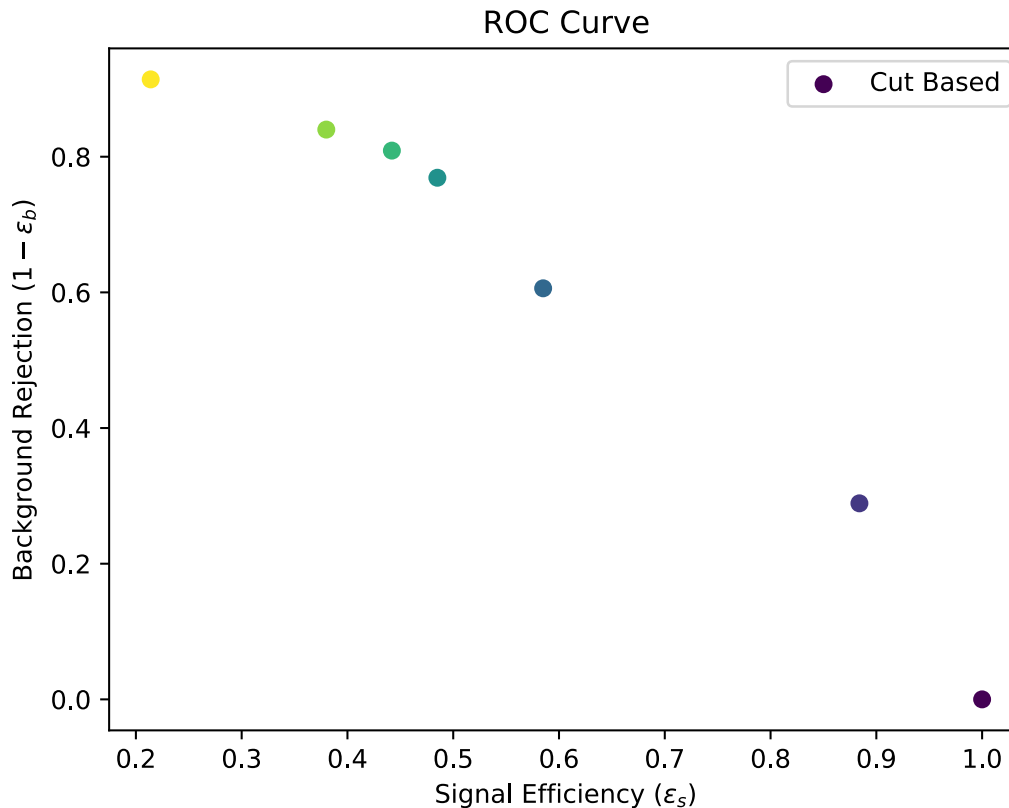
Selelction steps	Signal (M=700 GeV) (%)	TTToHadronic (%)
Cut 0	100	100
Cut 1	88.4	71.1
Cut 2	58.5	39.4
Cut 3	48.5	23.1
Cut 4	44.2	19.1
Cut 5	38	16
Cut 6	21.4	8.6

ROC curve

Status

Label	Cuts
Cut 0	Basic selection
Cut 1	Relative $H_T > 0.4$
Cut 2	$\text{Max}(\chi^2) < 3$
Cut 3	$\Delta R(b_{Higgs}, b_{Higgs}) < 1.1$
Cut 4	$\chi^2_{Higgs} < 1.5$
Cut 5	$\Delta R(j_W, j_W) < 1.75$
Cut 6	$\Delta R(b_{Top}, W) < 1.2$

Basic Selection Criteria
Trigger and p_T, η and $n_b^{DeepCSV} \geq 3$
$j_{p_T}^1 > 170 \text{ GeV}/c, j_{p_T}^2 > 130 \text{ GeV}/c, j_{p_T}^3 > 80 \text{ GeV}/c$ and $H_T > 500 \text{ GeV}/c$
$\chi^2 < 15$
2nd Top Mass $> 250 \text{ GeV}/c^2$
Higgs Mass $> 100 \text{ GeV}/c^2$



Train on Tprime700 Hadronic + TTToHadronic (1:1 training)

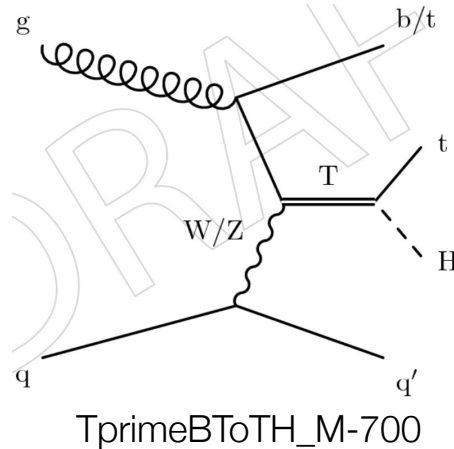
✓ Selection: HLT + njets ≥ 6 + nbjets (DeepJet Medium) ≥ 3

✓ Compare ROC curves with cutBased (signal efficiency vs background rejection)

○ Evaluate NN at the level of Cut 0

BACKUP

Yield table (without normalization)



Selelton steps	Inclusive	After genHadronic
No Cut	389500	152099
Cut 0	9359	7848
Cut 1	8278	7082
Cut 2	5478	4961
Cut 3	4536	4126
Cut 4	4140	3769
Cht 5	3557	3301
Cut 6	2000	1868

Cumulative efficiencies after basic selection

Label	Cuts	Signal (M=700 GeV/c ²)	Multijet	t $\bar{t}$	t $\bar{t}$ H	single top	V+jets
Basic selection (number of events)		23.1 [100%]	9356.1 [100%]	2612.2 [100%]	116.6 [100%]	108.3 [100%]	127.8 [100%]
Cut 1	Relative $H_T > 0.4$	81.4%	42.8%	51.9%	53.6%	47.8%	53.3%
Cut 2	$\text{Max}(\chi^2) < 3$	54.3%	14.1%	25.1%	31.1%	23.2%	8.1%
Cut 3	$\Delta R(b_{Higgs}, b_{Higgs}) < 1.1$	44.4%	7.5%	11.9%	16.4%	7.8%	2.6%
Cut 4	$\chi^2_{Higgs} < 1.5$	39.8%	4.9%	9.3%	14.0%	6.8%	< 2.6%
Cut 5	$\Delta R(j_W, j_W) < 1.75$	33.7%	3.2%	7.2%	11.1%	3.4%	< 2.6%
Cut 6	$\Delta R(b_{Top}, W) < 1.2$	25.7%	1.9%	4.5%	6.9%	1.2%	< 2.6%

Selelction steps	Inclusive (%)	After genHadronic (%)
Cut 0	100	100
Cut 1	88.4	90.2
Cut 2	58.5	63.2
Cut 3	48.5	52.6
Cut 4	44.2	48.0
Cut 5	38	42.1
Cut 6	21.4	23.8