Higgs Challenge



Jan Küchler (BUW)Higgs Challenge26th June 2016

Classifier



- main part: deep neural network
 - 5 dense layers, 700 neurons each
 - batch_norm
 - dropout (p = 0.15)
 - trained using adadelta on minibatches of 2000 events
 - all features (provided + custom ones)
- ⊕ XGBoost boosted decision tree
 - weighted mean, 10% from the BDT, 90% NN
 - 6-fold CV
 - hyperparameters optimised via grid search
 - 50 most important features
- ⊕ feature engineering

Feature importance



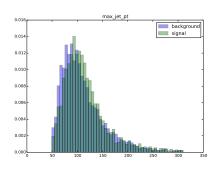
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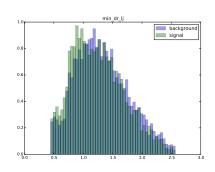
	Feature	XGBoost ranking		
1	m_bb	2268		
2	lepton_pt	2212		
3	m_jjj	1986		
4	m_jlv	1965		
5	m_wwbb	1891		
6	m_jj	1862		
7	mem_pt	1808		
8	m_wbb	1646		
9	max_jet_pt	1558		
10	min_dr_lj	1281		
11	delta_m	1219		
12	m_lv	1154		
13	rt	1144		
14	ht	1111		
15	max dr li	1063		

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Feature Engineering





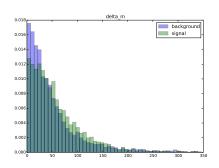


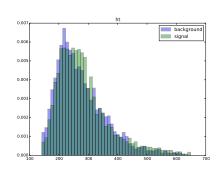
- $\max(p_{T,iet})$

•
$$\min \left(\Delta R \left(\ell, j \right) \right)$$
 $\Delta R(\ell, j) = \sqrt{\left(\eta_{\ell} - \eta_{j} \right)^{2} + \left(\phi_{\ell} - \phi_{j} \right)^{2}}$

Feature Engineering



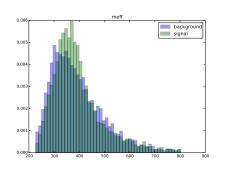


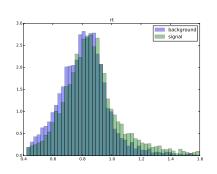


- $H_{\rm T} = \sum p_{\rm T,jet}$

Feature Engineering



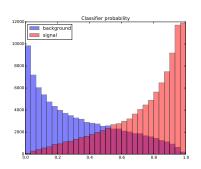


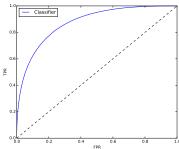


- $m_{\rm eff} = \sum p_{\rm T,jet} + p_{\rm T,\ell} + E_{\rm T}^{\rm miss}$
- $R_{\rm T} = m_{\rm eff}/m_{WWbb}$

Classifier and ROC curve







- Jupyter notebooks:
 - [Features and BDT]
 - [Neural Network]
 - [Combination and final evaluation]
 - ⇒ https://github.com/JanKuechler/mlhep2016/tree/master/ higgs_kaggle