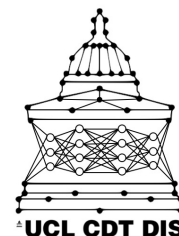


Language-inspired neural networks for multi-jets at the LHC

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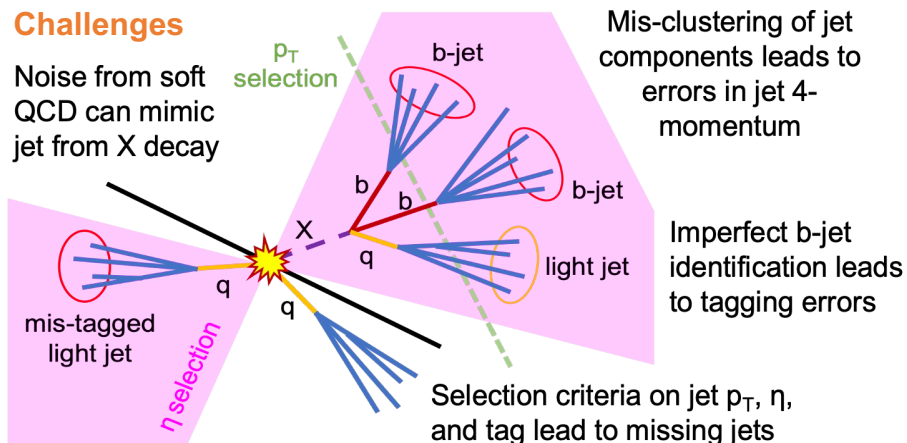


Introduction

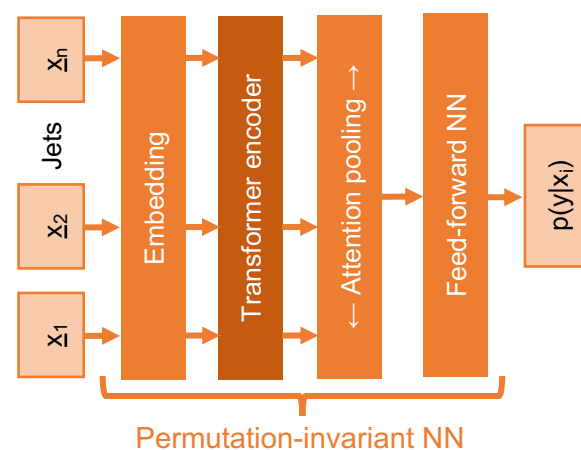
Jets are collimated sprays of particles produced by energetic quarks and gluons. Studying multi-jets may hold the key to new physics discovery as the heaviest Standard Model particles (the top quark, W, Z and Higgs bosons) often decay to jet-only final states. However multi-jet final states are largely unexplored due to high backgrounds and the unique challenges posed by object reconstruction and classification.

Challenges

Noise from soft QCD can mimic jet from X decay



Neural network architecture

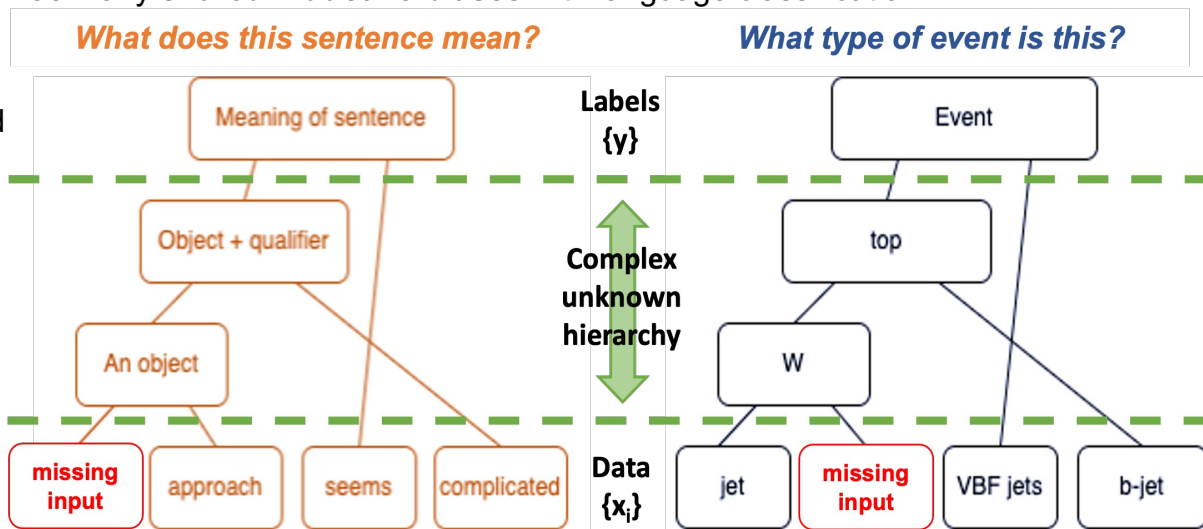


Parallels with language

Event classification has many **shared inductive biases** with language classification!

“Semantic” understanding of the input is needed

The **diverse** underlying **event structure** and **missing information** demands the neural network be **permutation-invariant**



→ **Attention & transformers!** Vaswani et al, “Attention is all you need”

Results

- ATLAS non-resonant $HH \rightarrow 4b$ analysis attempts to measure λ , the rate of **Higgs boson pair-production**
- λ is key to understanding how particles gain mass!
- Seek to **classify** Higgs boson pairs decaying into 4 b-jets from the main processes that imitate our signal – **multi-jet QCD** and **top-quark pairs**
- Transformer-based neural network (NN) is benchmarked against current variable X_{Wt}
- X_{Wt} **assumes** all jets are **reconstructed** and **correctly tagged!**
- **NN makes none of these assumptions!**

