

Here is a list of topics I will aim to cover in the course. This list is incomplete and approximate. Note it is not a syllabus! In particular the order of topics might be different in the course.

- Collider physics basics
  - Detector components
  - Coordinates ( $p_T$ ,  $\eta$ ,  $\phi$ )
  - Objects (tracks vs towers; electrons, photons, muons, jets, ...)
  - Events
- Some stats basics:
  - Maximum likelihood estimation
  - Likelihood ratio
  - Neyman-Pearson lemma
  - Bayesian statistics
- What is Machine Learning
- What are common problems solved by Machine Learning
  - Classification
  - Regression
  - Generation
  - Anomaly Detection
  - ...
- Why Neural Networks
  - Universal approximation theorem
- What are Neural Networks
  - Hidden layers
  - Activations
  - ...

- How do we train Neural Networks
  - SGD
  - Backprop
  - Differentiable programming
  - GPUs
  - Overfitting
  - Validation
  - ...
- Some popular Neural Network architectures
  - DNN
  - CNN
  - RNN, LSTM, ...
  - GAN
  - Autoencoder, VAE, ...
  - Flows (density estimation)
- Some important applications to HEP:
  - Classification: CNNs, RNNs, ...
  - Decorrelation: Adversarial, DisCo, ...
  - Generation: CaloGAN
  - Anomaly Detection: CWoLa, ANODE, Autoencoders, ...
  - Regression:
  - ...