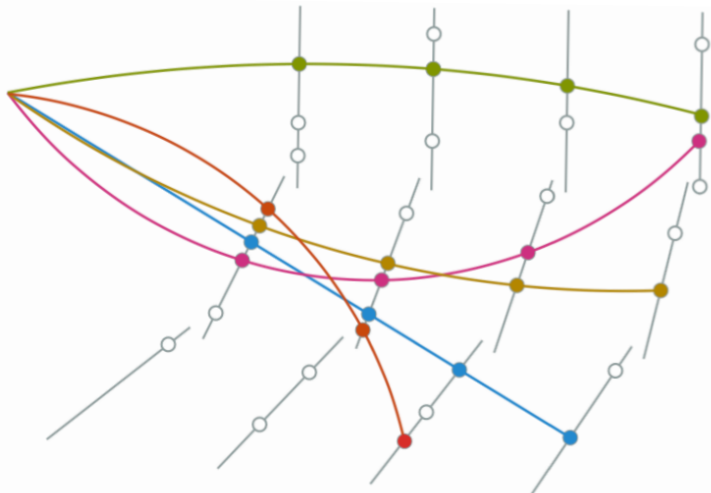
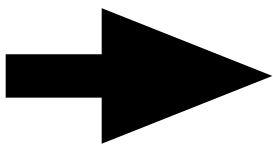


TrackFormers: Transformer-Based Models for High-Energy Physics Track Reconstruction

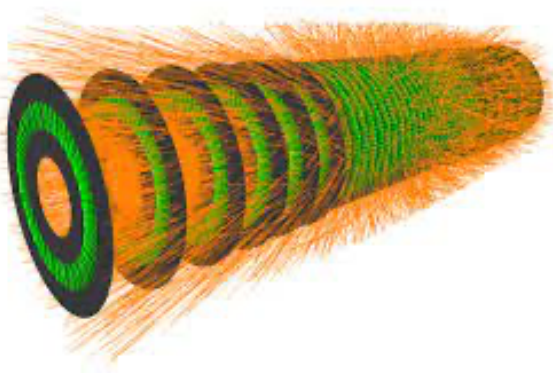
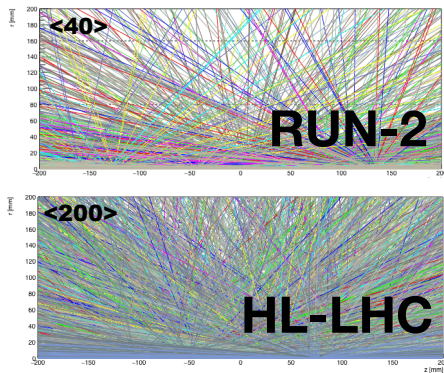


The task of **connecting detector hits into charged particle trajectories**

Introduction

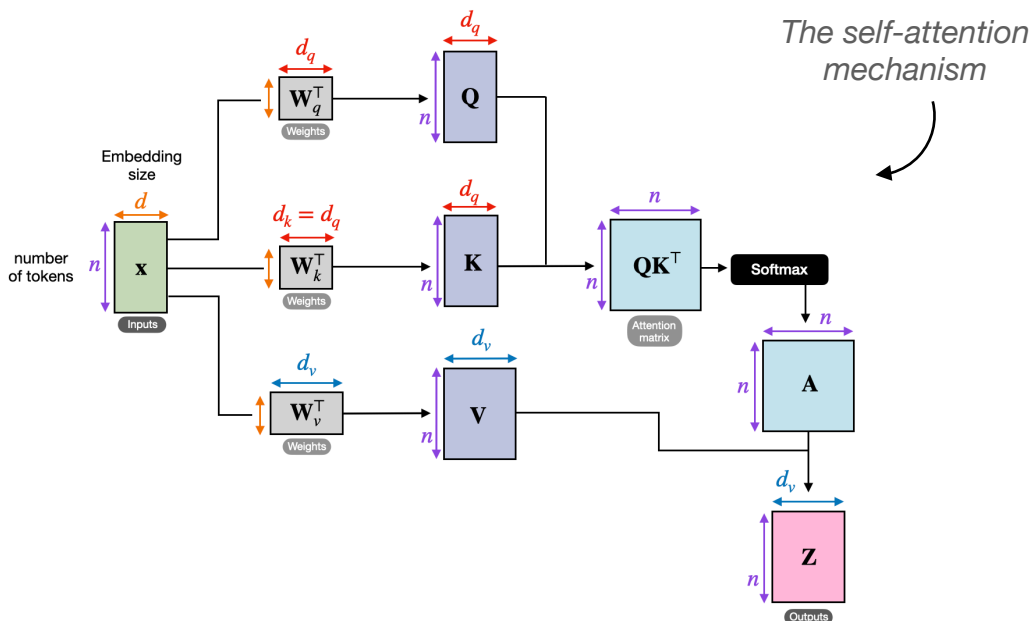


Why is this a challenge?



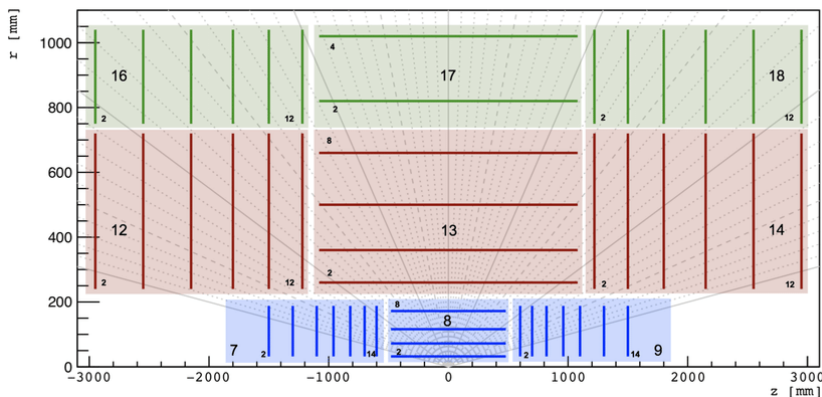
The HL-LHC will experience ~200 simultaneous interactions per bunch crossing, creating highly complex tracking environments.

Transformers



The self-attention mechanism

Dataset



Using the **TrackML dataset**, originally made for a Kaggle competition, remains the benchmark dataset in literature

Generalised representation of LHC tracker

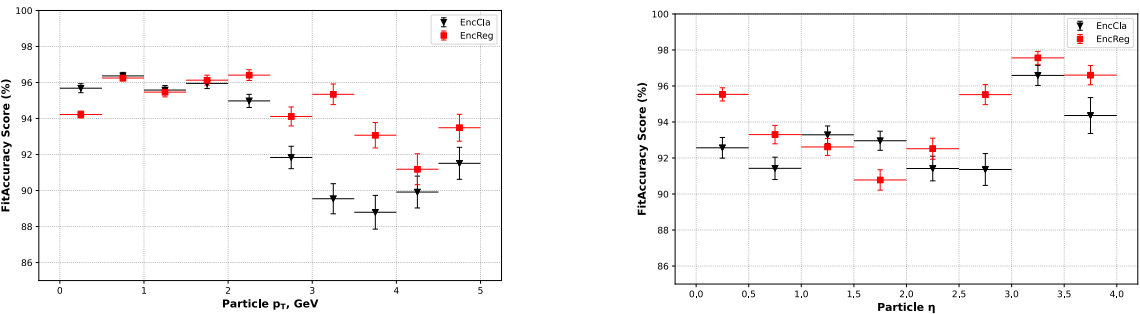
Reduce dataset to multiple complexities for proof-of-concept approach

results

Inference times and TrackML scores on 200-500 tracks dataset

Model	CPU Inference (ms)	GPU Inference (ms)	FitAccuracy (%)
EncCla	0.1	7.0	78%
EncReg	70.5	31.9	70%

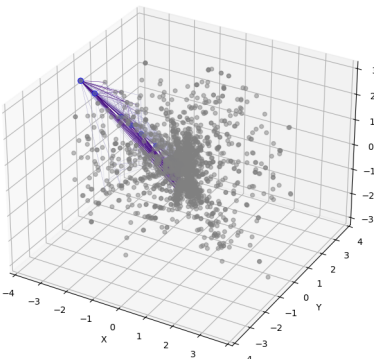
TrackML scores on 10-50 tracks dataset



Ongoing work

Problem: attention matrix grows significantly with more hits (n by n)

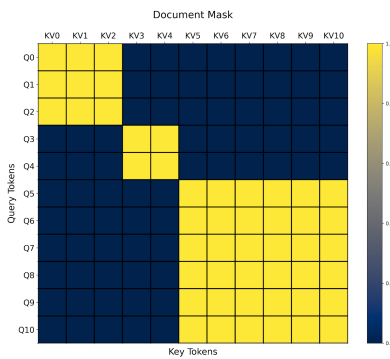
Idea: Maybe we do not need to use all relationships. Can we use localised attention mechanism?



Trained attention scores



Yes! We now need localised attention



Masked attention matrix (FlexAttention)

Strategy: Define appropriate “locality” for FlexAttention mechanism, and implement it in model for full TrackML dataset