Heterogeneity in Graph Neural Networks for Track Reconstruction in the ATLAS Upgrade ITk Detector and other improvements in ACORN

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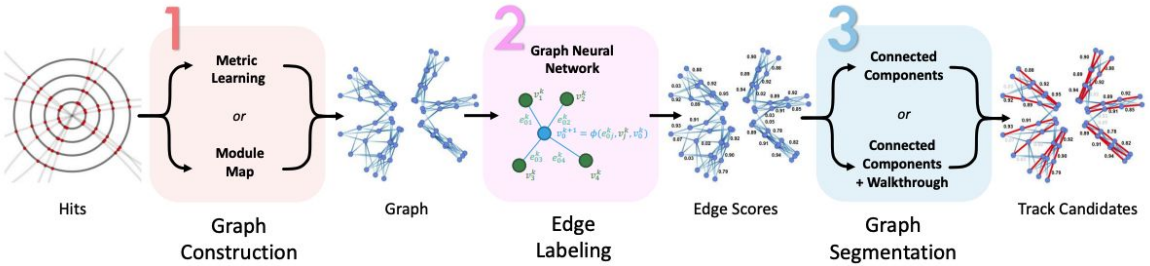
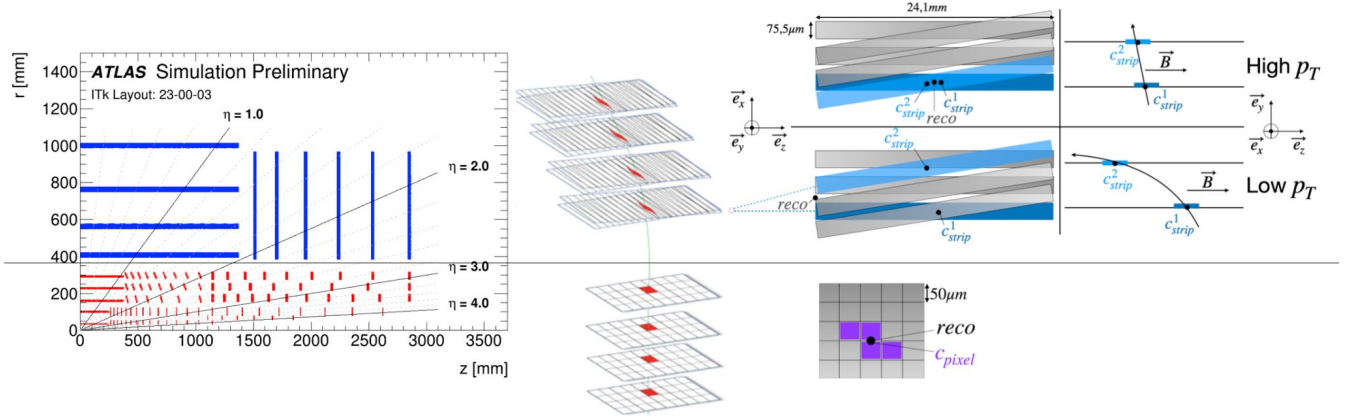
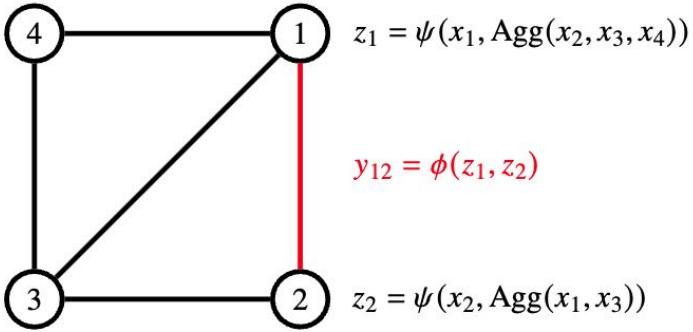


Challenges of a GNN track finding chain

- Imperfect graph construction produces graph with a large number of fake edges.
  - Difficult to train a deep GNN edge classifier due to memory constraint.
  - Pose more challenge to GNN because of skewed balance between fake and true.
  - Increased GNN inference time, and might also affect downstream tracking performance.
- Reconstructed space point coordinates have different spatial resolution between pixel and strip sub-detectors.
  - Affect the purity in the barrel when GNN is trained exclusively with space point coordinates.



Approaches to tackle these challenges



- Filter the graph using a shallow GNN with efficiency message passing to reduce fake before submitting to GNN edge classification.
- Use heterogeneous data and heterogeneous GNN model architecture.