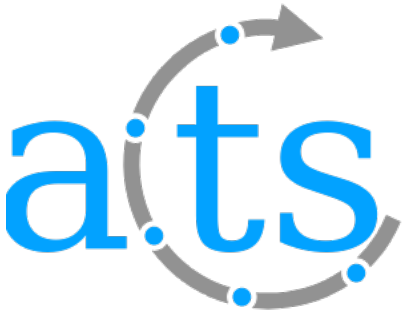
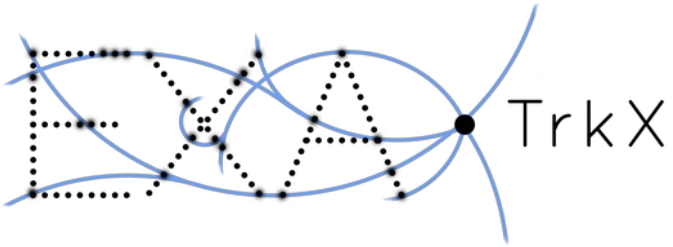


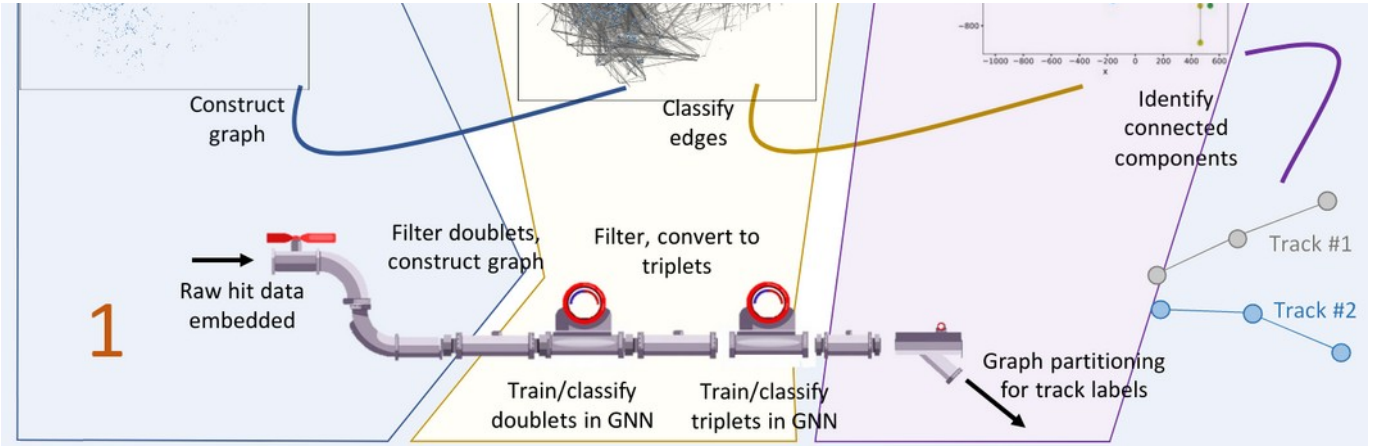


GNN integration in Acts

Status update

Benjamin Huth (acts)
Corentin Allaire (acts)
Xiangyang Ju (EXA.TrkX)

Overview



- GNN-based pipeline for track finding
- Project Goals:
  - Provide a good integration into the ACTS plugin system
  - Prepare a full chain example within ACTS which either uses CKF or the EXA.TrkX module

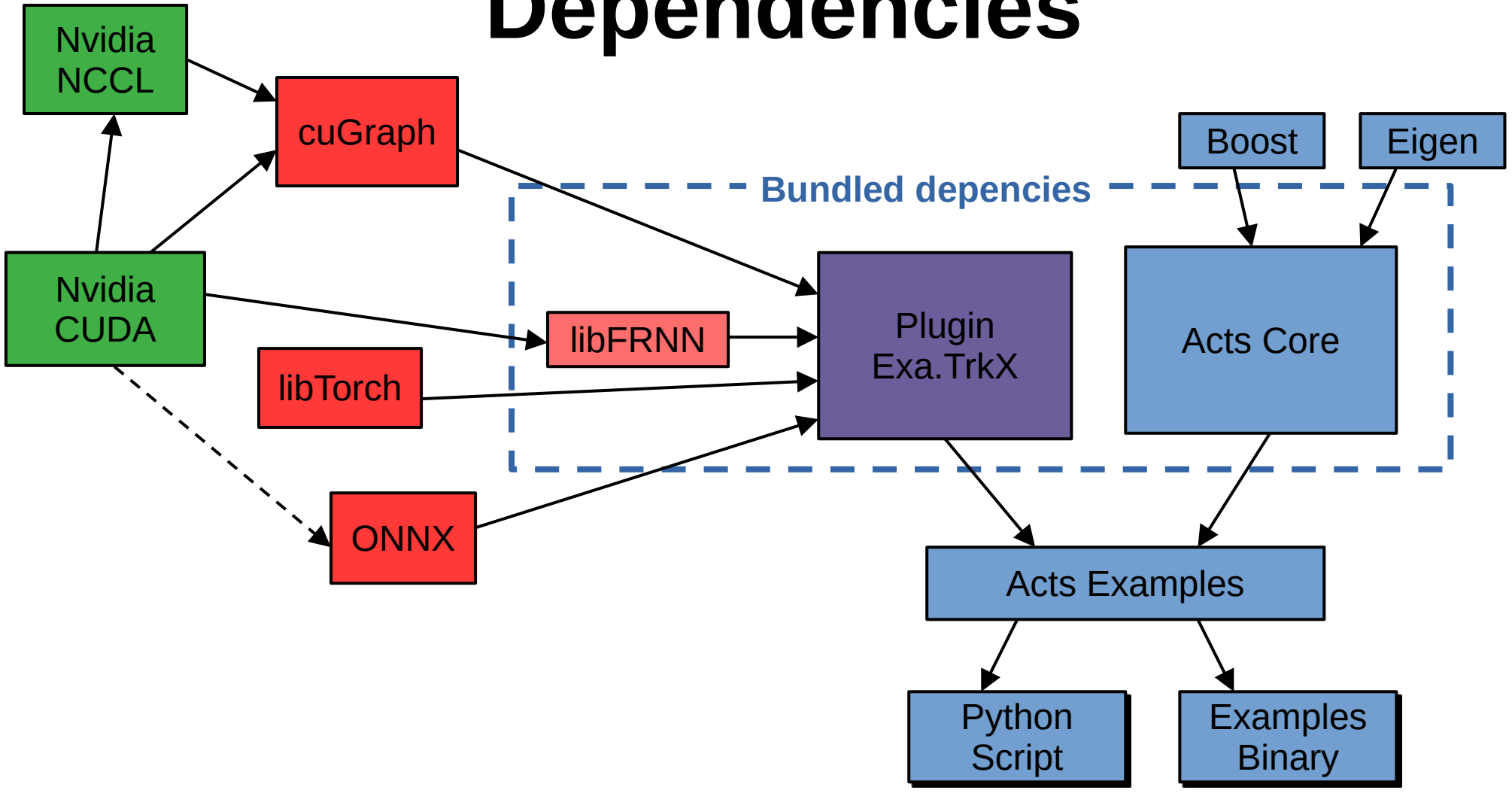
Current Status

- ☑ add python binding
- ☑ integrate properly into ACTS build system (cmake, dependencies...)

```
cmake ..
  -D CMAKE_PREFIX_PATH=<paths-to-dependencies>
  -D ACTS_BUILD_PLUGIN_EXATRKX=ON
  -D ACTS_BUILD_EXAMPLES=ON
  -D ACTS_BUILD_EXAMPLES_PYTHONBINDINGS=ON
  -D ACTS_BUILD_EXAMPLES_EXATRKX=ON
```

Code at: https://github.com/benjaminhuth/acts/tree/plugin/exatrkx

Dependencies



Python Script

- Runs without runtime-errors

```
# Setup the track finding algorithm with ExaTrkX
# It takes all the source links created from truth hit smearing, seeds from
# truth particle smearing and source link selection config
exaTrkxFinding = acts.examples.ExaTrkXTrackFinding(
    inputMLModuleDir="/home/benjamin/Documents/acts_project/gnn_integration/run/onnx_models",
    spacepointFeatures=3,
    embeddingDim=8,
    rVal=1.6,
    knnVal=500,
    filterCut=0.21
)

trackFinderAlg = acts.examples.TrackFindingMLBasedAlgorithm(
    level=acts.logging.INFO,
    inputSpacePoints="spacepoints",
    outputProtoTracks="protoTracks",
    trackFinderML=exaTrkxFinding
)
s.addAlgorithm(trackFinderAlg)
```

However, these models do not work propperly due to a ONNX bug

Next steps

- Create an example that allows comparisons between ML-based track finding alg with CKF. One possible way is to downgrade the tracks from CKF to a list of track candidates (i.e. no associated track parameters). **[Corentin]**
- Add a unit test for Exa.TrkX plugin to make sure each step works correctly. **[Xiangyang]**
- Add a benchmark for comparing ML-based alg. with CKF alg.
- Revisit the hack in TrackParamsEstimationAlgorithm so that it can be easily configured for fitting triplets or complete track candidates. **[Benjamin]**
- Make sure cluster objects, accessible after the geometry-based digitization algorithm via the whiteboard, are properly linked to measurements and spacepoints so that they can be readily used in track finding.

Biggest Showstopper: A working ONNX model is needed to get any reasonable results.