ProtoDUNE Prompt Signal Processing

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Basic idea

Promptly

1. Read ProtoDUNE-II raw data in an *offline* context,
2. Apply noise filtering / data preparation,
3. Apply *signal-processing*,
4. Make results available.

Some motivations

- Feed an offline DQM to help online shifters.
- Enable new things (prompt high-level reco, ephemeral/test queues).
- R&D on FD issues (parallel file I/O, prompt SNB pointing processing).
- Prompt testing of DAQ+Offline compatibility after releases.
- A vehicle to bolster / coordinate US VD effort.

What does “prompt” mean?

Inherent dichotomy:

Lossy, real time Guarantee max latency, skip data to keep up.

Lossless, unbound latency All data, may wait arbitrary long for result.

Of course we may combine:

Hybrid, redo queue Lossy but move skipped data to 2^{nd} lossless queue.

What promptness do we need?

Depends on consumer

- DQM: lossy, $\mathcal{O}(10)$ minute?
- Release testing: lossy $\mathcal{O}(1)$ hour?
- SNB pointing strives for lossless 10 minute latency.

Where lossy may be acceptable, loss must not systematically hide problems.

Prompt queue management

Consider multiple queues with different strategies? *eg* use

- **real time** for prescaled or specific detector/APA/trigger.
- **hybrid** for some special trigger type.
- **lossless** for all detectors/triggers.

Consider supporting ad-hoc and/or ephemeral queues? *eg*

- DAQ updates data packer library, add a new prompt queue to test offline data unpackers.
- New offline software release, add new queue to test the release.

Result ordering

- Any queue likely consists of parallel jobs each processing some chunk.
- Results will be produced out-of-order in time and "space".
- Likely some consumers require results to be re-ordered.
- This necessarily introduces latency and loss trade-offs.

Hardware - resource estimate

Assumptions:

- 5 Hz trigger (PD-II has achieved 5 Hz, expects to go higher),
- 3ms readout, 2 MHz ADC, 4 APA (500 MB/s)

Per APA readout (20 Hz):

- Basic SP needs 30 CPU-sec, 600 core to keep up.
- DNNROI SP inference needs 12 CPU-sec or 0.25 GPU-sec
  - $\mathcal{O}(100)$ basic SP CPU threads to keep 1 GPU busy with DNNROI

Software - noise filtering

Do we continue to use “dataprep” (DP) or switch to WCT “noise filter” (NF)

- The DP developer has moved on to DES/astro
- Both DP and NF exist for ProtoDUNE Single-Phase
  - Effort needed to support for VD (maybe also HD if new noise)
- Using NF allows for “pure” WC job (DP is in an *art* module)
  - Opens door to novel file I/O methods eg as test bed for the parallel stream support needed by DUNE FD

Software - signal processing (basic)

- Produce and validate VD field response.
  - PDSP's maybe okay for HD?

Software - signal processing (DNNROI)

- Should retrain on HD and VD simulation.
  - I believe we have only ~~MicroBooNE's~~ ProtoDUNE-SP training.

FIN