Status report on

DNNROI sigproc

Hokyeong Nam
Chung-Ang University

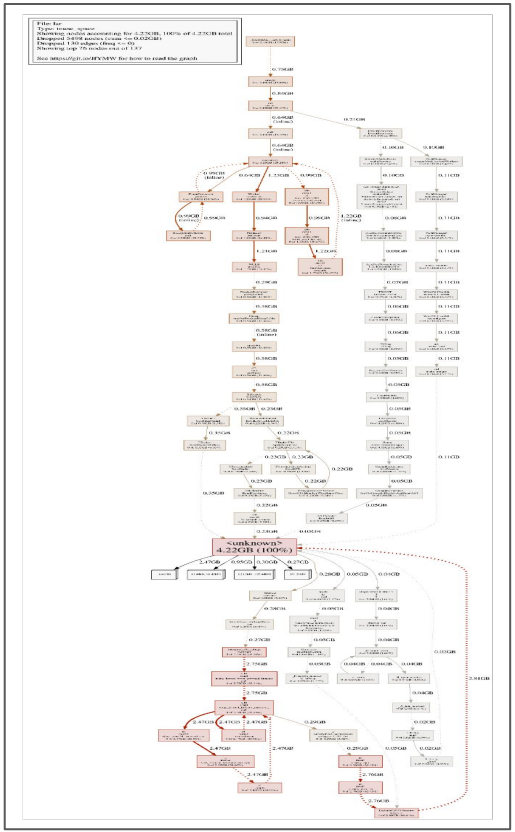
Profiling Memory usage for PD-HD data processing

```
Dumping heap profile to mem.prof.0033.heap (26182 MB allocated cumulatively, 2331 MB currently in use)
Dumping heap profile to mem.prof.0034.heap (27662 MB allocated cumulatively, 2858 MB currently in use)
Dumping heap profile to mem.prof.0035.heap (30621 MB allocated cumulatively, 3913 MB currently in use)
Dumping heap profile to mem.prof.0036.heap (31910 MB allocated cumulatively, 2741 MB currently in use)
Retagger: tagging trace set: dnnsp3 with 2560 traces, 1600 summary
Dumping heap profile to mem.prof.0037.heap (32934 MB allocated cumulatively, 1675 MB currently in use)
Dumping heap profile to mem.prof.0038.heap (33986 MB allocated cumulatively, 1764 MB currently in use)
Dumping heap profile to mem.prof.0039.heap (35010 MB allocated cumulatively, 1731 MB currently in use)
Dumping heap profile to mem.prof.0040.heap (36073 MB allocated cumulatively, 1879 MB currently in use)
Dumping heap profile to mem.prof.0041.heap (37097 MB allocated cumulatively, 1945 MB currently in use)
Dumping heap profile to mem.prof.0042.heap (38121 MB allocated cumulatively, 2064 MB currently in use)
Dumping heap profile to mem.prof.0043.heap (39145 MB allocated cumulatively, 2114 MB currently in use)
Dumping heap profile to mem.prof.0044.heap (40582 MB allocated cumulatively, 3221 MB currently in use)
Dumping heap profile to mem.prof.0045.heap (41812 MB allocated cumulatively, 2752 MB currently in use)
```

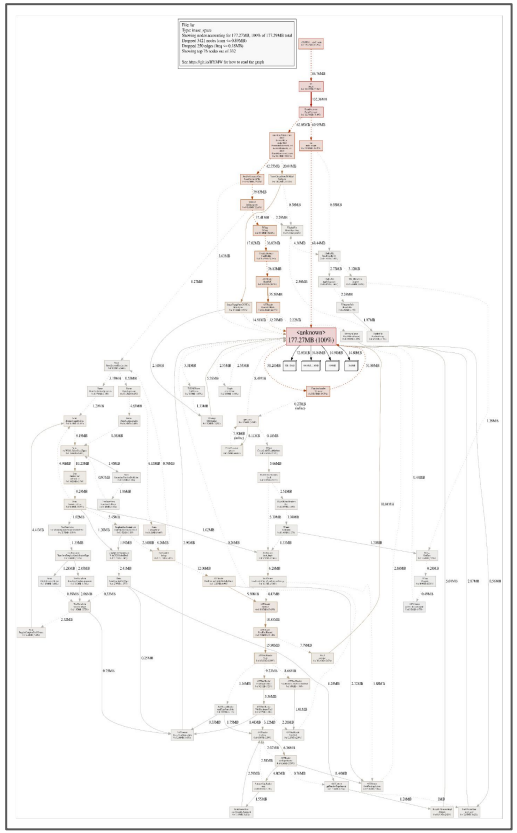
```
Program:    /cvmfs/larsoft.opensciencegrid.org/products/art/v3_14_04/slf7.x86_64.e26.prof/bin/lar
Config file:my_standard_reco_stage2_calibration_protodunehd_keepup_dnnroi.fcl
Input file: ../../data/stage1/run027673/np04hd_raw_run027673_0000_dataflow0_datawriter_0_20240704T050545_reco_stage1.root
Profiler:   /exp/dune/data/users/hnam/demo/gperftools/install/lib/libprofiler.so.0
TCMalloc:   /exp/dune/data/users/hnam/demo/gperftools/install/lib/libtcmalloc.so.4
Generating PDF reports using /exp/dune/data/users/hnam/demo/go/bin/pprof
Some binary filenames not available. Symbolization may be incomplete.
Try setting PPROF_BINARY_PATH to the search path for local binaries.
CPU profile report saved as cpu_profile.pdf
```

- Total # of 106 mem.prof file are generated
- Due to the warning, some of the nodes are appeared with name of “unknown”

Profiling Memory usage for PD-HD data processing



❑ 97th file



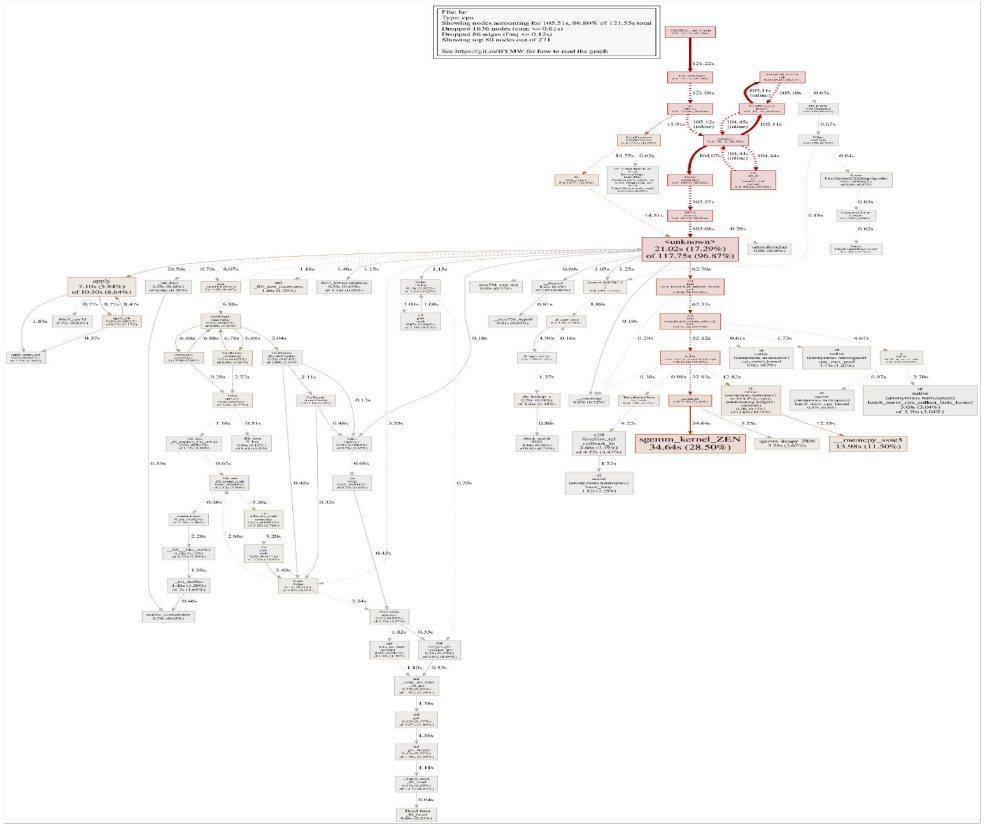
❑ 106th file

- Dumped into the pdf file
  - middle of dnn: 97th
  - at the end: 106th

Next

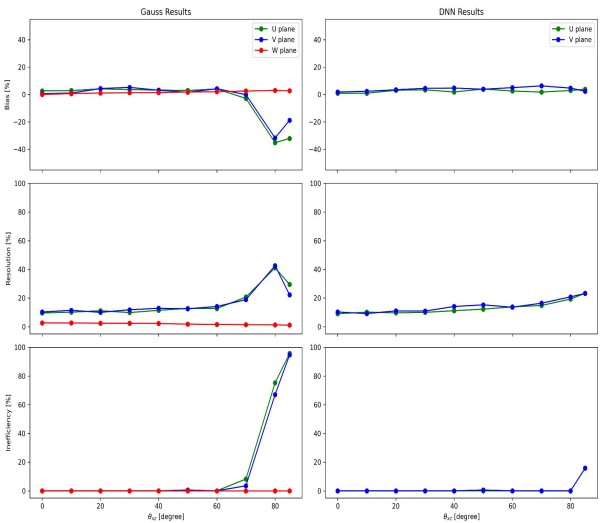
- How to solve warning?
- How to identify crucial nodes?

Profiling CPU usage for PD-HD data processing

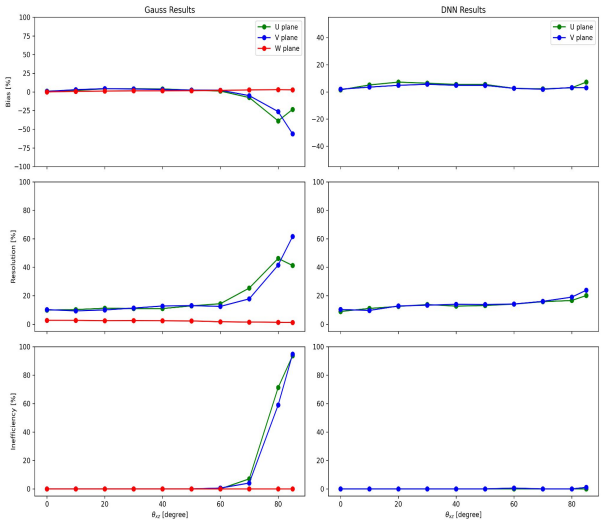


- cpu_profile

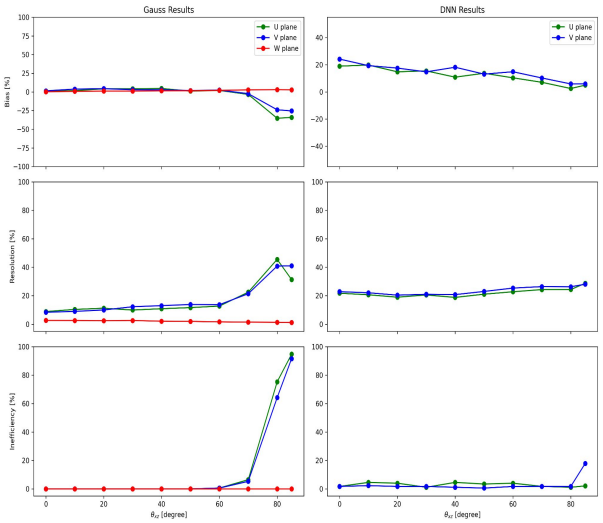
DNN ROI evaluation w/ UNet and MobileNetV2



❑ unet-cosmic390-newwc-depofluxsplat-pdhd.ts



❑ UNet trained by Hokyeong (rebin: 10)

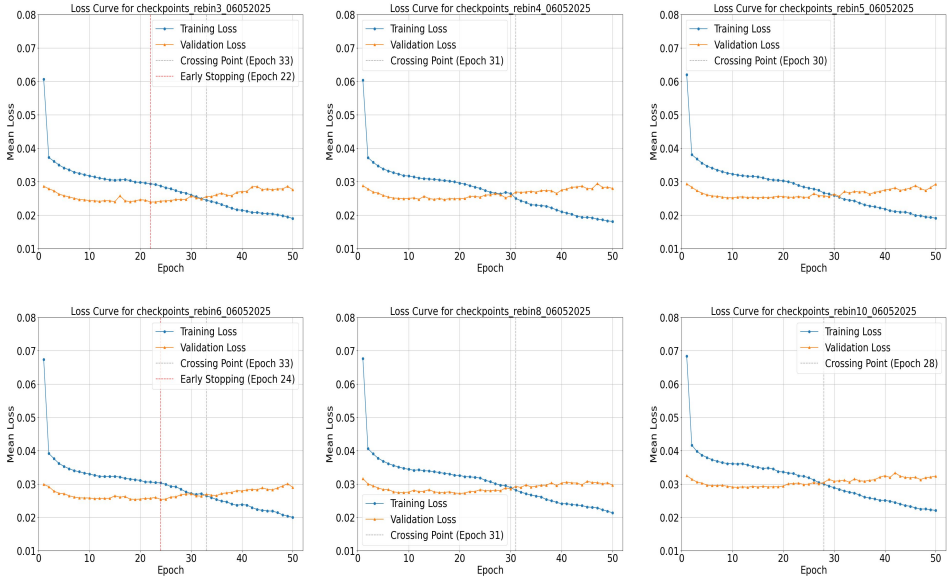


❑ MobileNetV2 trained by Hokyeong (rebin: 10)

- The UNet I trained showed consistency with the model have been used
- The MobileNetV2 has bias about 10 - 20% across the Theta XZ angles

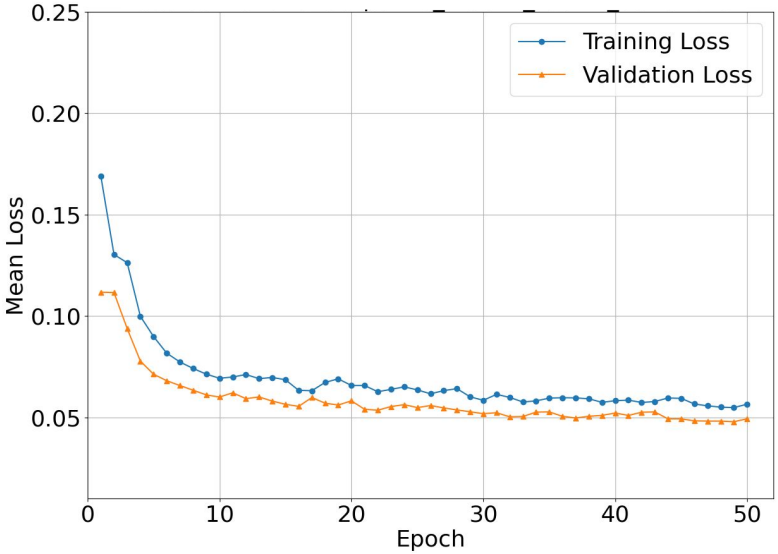
Back Up

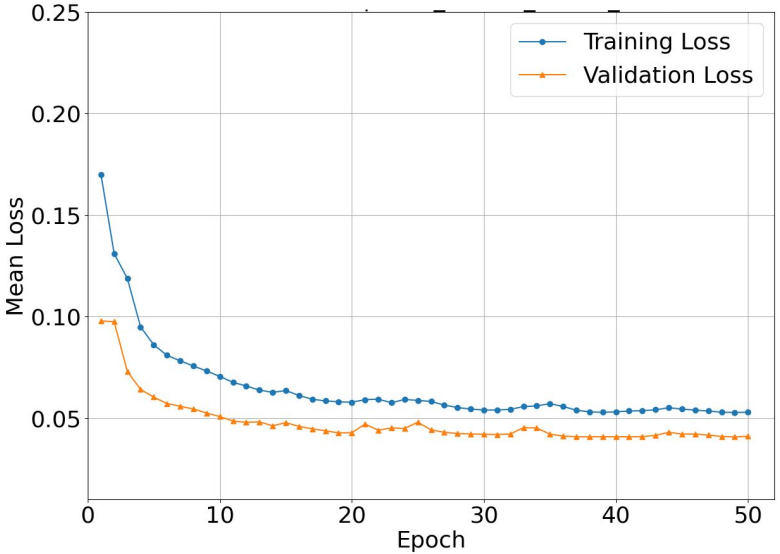
DNN Training with rebining - UNet



- Re-trained the UNet with rebinning in time tick
- High resolution in time (y-axis) contributes better training loss: 0.0299 → 0.0245
- Loss: Binary Cross-Entropy, Epoch = 50, Learning Rate = 0.1, Momentum = 0.9, train vs val split = 90:10

DNN Training with rebining - MobileNetV2





- Rebinning in time tick: 10 → 4
- Loss at the last epoch is slightly improved: ~ 0.05 (previously ~ 0.06)
- Loss: Binary Cross-Entropy, Epoch = 50, Learning Rate = 0.1, Momentum = 0.9, train vs val split = 90:10

Memory and Time consumption on the WC cluster

Server	WCT	Resource	DNN ROI	Mem (MB)	Time (s)	Mem Ratio	Time Ratio
WC cluster	dunesw	None	None	1891.54	40.41	1.00	1.00
WC cluster	dunesw	CPU	UNet	7419.03	91.45	3.92	2.26
WC cluster	dunesw	CPU	MobileNetV2	4593.25	54.51	2.43	1.35
WC cluster	Built	None	None	1890.80	40.97	0.99	1.01
WC cluster	Built	CPU	UNet	5208.58	53.64	2.75	1.33
WC cluster	Built	CPU	MobileNetV2	4853.49	45.41	2.56	1.12
WC cluster	Built	GPU	UNet	5105.16	46.18	2.70	1.14
WC cluster	Built	GPU	MobileNetV2	5110.95	45.33	2.70	1.12

- Model file used: unet-cosmic390-newwc-depofluxsplat-pdhd.ts
- Signal Processing only & All measurements are averaged over 5 PD-HD data files
  - run026763_0008, run027673_0000, run027673_0001, run027673_0002, run028588_0019
- Using the custom-built WCT reduced the CPU inference time from 91.45 s to 53.64 s: ~41% improvement