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IEMS 5709: Emerging Topics in Information Engineering

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Lab 2 Report: AI on Edge DeepStream and YOLOv4

Note: This wouldn't work until running "sudo apt install nvidia-jetpack".

Deepstream image:

```
s1155160788@user-desktop:/home/user$ sudo docker images
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE
nvcr.io/nvidia/deepstream-14t  6.0-samples        1e08ebd4f227       5 months ago       1.78GB
s1155160788@user-desktop:/home/user$
```

Container running in docker ps:

Student ID: 1155160788, can be seen under name.

ls from within the container:

```
root@787600990af1:/opt/nvidia/deepstream/deepstream-6.0/sources/project# ls
configs  data
```

Config files:

```
root@787600990af1:/opt/nvidia/deepstream/deepstream/sources/project/configs# ls
deepstream basic.txt  deepstream bitrate 8000000.txt  deepstream cpu.txt  deepstream loop.txt  deepstream out file.txt  deepstream out rtsp.txt  model basic.txt
```

Deliverables:

Screenshot from Part 1: Step 4 before and after running DeepStream Application:

Before:

```
root@787600990af1:/opt/nvidia/deepstream/deepstream-6.0/sources/project# ls
configs  data
root@787600990af1:/opt/nvidia/deepstream/deepstream-6.0/sources/project#
```

After:

On next page.

There was warning messages but they disappeared after the Deepstream pipeline ran. It seems only the last few messages from the command show up.

```
**PERF: 82.66 (95.05)
**PERF: 82.78 (94.83)
**PERF: 89.11 (94.74)
**PERF: 90.97 (94.67)
**PERF: 83.12 (94.46)
**PERF: 77.20 (94.16)
**PERF: 80.98 (93.93)

**PERF: FPS 0 (Avg)
**PERF: 91.57 (93.90)
**PERF: 93.02 (93.88)
**PERF: 97.48 (93.93)
**PERF: 89.80 (93.87)
**PERF: 81.41 (93.68)
**PERF: 85.95 (93.54)
**PERF: 84.19 (93.41)
**PERF: 83.67 (93.27)
**PERF: 92.83 (93.25)
**PERF: 83.94 (93.12)
**PERF: 91.93 (93.08)
**PERF: 119.79 (93.49)
**PERF: 120.73 (93.88)
**PERF: 123.91 (94.28)
**PERF: 143.70 (94.94)
**PERF: 133.84 (95.48)
**PERF: 137.35 (96.01)
**PERF: 123.97 (96.38)
**PERF: 116.38 (96.65)
**PERF: 121.37 (96.95)

**PERF: FPS 0 (Avg)
**PERF: 124.53 (97.31)
**PERF: 111.54 (97.50)
**PERF: 108.44 (97.62)
**PERF: 117.19 (97.87)
**PERF: 131.80 (98.26)
**PERF: 102.75 (98.31)
**PERF: 104.19 (98.39)
**PERF: 108.01 (98.50)
**PERF: 116.36 (98.71)
**PERF: 130.07 (99.06)
**PERF: 123.58 (99.33)
**PERF: 112.92 (99.47)
**PERF: 106.13 (99.52)
** INFO: <bus_callback:217>: Received EOS. Exiting ...
```

Quitting

App run successful

root@787600990af1:/opt/nvidia/deepstream/deepstream/sources/project#

Deepstream application configuration files from Part 1: Step 5, saved to your home folder
~/deepstream-detectnet/configs:

See config files screenshot above, as well as the below.

Documentation reference: https://docs.nvidia.com/metropolis/deepstream/dev-guide/text/DS_ref_app_deepstream.html

All files are under the configs directory at: /home/s1155160788/deepstream-detectnet/configs

A. *deepstream_cpu.txt*

Changed process-mode from 2 to 0 under osd. Changes it from hardware (jetson only) to CPU.

Changed enc-type under sink0 from 0 to 1. Changes it from NVENC hardware engine to CPU software encoder.

```
**PERF: 26.18 (32.05)
**PERF: 30.11 (32.05)
**PERF: 30.82 (32.04)
**PERF: 31.96 (32.04)
**PERF: 36.93 (32.06)
**PERF: 38.03 (32.08)
**PERF: 28.20 (32.07)
**PERF: 30.22 (32.06)
**PERF: 25.87 (32.04)

**PERF: FPS 0 (Avg)
**PERF: 31.88 (32.04)
**PERF: 34.77 (32.04)
**PERF: 33.32 (32.05)
**PERF: 29.26 (32.04)
**PERF: 33.61 (32.05)
**PERF: 31.43 (32.03)
**PERF: 26.52 (32.02)
**PERF: 26.83 (32.00)
**PERF: 28.88 (31.99)
**PERF: 25.68 (31.96)
**PERF: 32.79 (31.97)
**PERF: 27.32 (31.95)
**PERF: 30.03 (31.94)
**PERF: 25.85 (31.92)
**PERF: 28.53 (31.91)
**PERF: 27.63 (31.89)
**PERF: 32.10 (31.89)
**PERF: 31.82 (31.89)
**PERF: 25.85 (31.87)
**PERF: 26.92 (31.85)

**PERF: FPS 0 (Avg)
**PERF: 23.45 (31.82)
**PERF: 32.10 (31.81)
**PERF: 30.83 (31.82)
**PERF: 39.03 (31.85)
**PERF: 36.33 (31.86)
**PERF: 34.02 (31.87)
**PERF: 27.89 (31.86)
**PERF: 23.91 (31.83)
**PERF: 31.15 (31.83)
**PERF: 28.34 (31.79)
**PERF: 3.47 (31.69)
** INFO: <bus_callback:217>: Received EOS. Exiting ...

Quitting
App run successful
```

As expected, the performance is significantly worse because it is running only on the CPU instead of using the GPU. Performance drops from 100 fps to ~32.

B. Deepstream_out_file.txt

I changed nothing. The basic configuration should already be set for local file output, so I just used a copy of the basic text file.

The key parameters enabling this are under [sink0].

“type=3” means Encode + File Save (encoder + muxer + filesink), and this is in the base text.

Furthermore, the parameter output-file to specify the pathname of the output encoded file is only valid for type=3. Not only have we selected type 3, but there is also “output-file=out.mp4”. We can also confirm that this file based sink0 is enabled because enable=1.

```
Opening in BLOCKING MODE
0:00:00.336723005 129 0x2f3b9190 WARN nvinfer gstnvinfer.cpp:635:gst_nvinfer_logger:primary_gie> NvDsInferContext[UID 1]: Warning from NvDsInferContextImpl::initializ
e() <nvdsinfer_context_impl.cpp:1161> [UID = 1]: Warning, OpenCV has been deprecated. Using NMS for clustering instead of cv::groupRectangles with topK = 20 and NMS Threshold = 0.5
ERROR: Deserialize engine failed because file path: /opt/nvidia/deepstream/deepstream-6.0/sources/project/configs/./engines/resnet10.caffemodel_b30_gpu0.engine open error
0:00:01.516482235 129 0x2f3b9190 WARN nvinfer gstnvinfer.cpp:635:gst_nvinfer_logger:primary_gie> NvDsInferContext[UID 1]: Warning from NvDsInferContextImpl::deseriali
zeEngineAndBackend() <nvdsinfer_context_impl.cpp:1889> [UID = 1]: Deserialize engine from file :/opt/nvidia/deepstream/deepstream-6.0/sources/project/configs/./engines/resnet10.caffemodel_
b30_gpu0.engine failed
0:00:01.516833276 129 0x2f3b9190 WARN nvinfer gstnvinfer.cpp:635:gst_nvinfer_logger:primary_gie> NvDsInferContext[UID 1]: Warning from NvDsInferContextImpl::generateB
ackendContext() <nvdsinfer_context_impl.cpp:1996> [UID = 1]: Deserialize backend context from engine from file :/opt/nvidia/deepstream/deepstream-6.0/sources/project/configs/./engines/resn
et10.caffemodel_b30_gpu0.engine failed, try rebuild
0:00:01.516883772 129 0x2f3b9190 INFO nvinfer gstnvinfer.cpp:638:gst_nvinfer_logger:primary_gie> NvDsInferContext[UID 1]: Info from NvDsInferContextImpl::buildModel()
<nvdsinfer_context_impl.cpp:1914> [UID = 1]: Trying to create engine from model files
WARNING: [TRT]: Detected invalid timing cache, setup a local cache instead
```

I finally managed to capture the warning messages that were present in all other config file runs of Deepstream.

```
Linux 3.10.0-1160.el7.x86_64 #1 SMP Tue Aug 14 22:03:11 UTC 2018; root@787600990af1:/opt/nvidia/deepstream/deepstream/sources/project#
**PERF: 85.50 (103.52)
**PERF: 88.71 (103.23)
**PERF: 89.31 (102.95)
**PERF: 92.27 (102.73)
**PERF: 83.98 (102.36)
**PERF: 80.74 (101.98)
**PERF: 91.59 (101.78)
**PERF: 88.44 (101.55)
**PERF: 95.54 (101.45)
**PERF: 95.52 (101.33)
**PERF: 82.55 (101.02)

**PERF: FPS 0 (Avg)
**PERF: 88.13 (100.80)
**PERF: 81.69 (100.49)
**PERF: 84.05 (100.22)
**PERF: 90.19 (100.06)
**PERF: 83.20 (99.79)
**PERF: 88.39 (99.62)
**PERF: 112.56 (99.81)
**PERF: 120.91 (100.11)
**PERF: 115.48 (100.36)
**PERF: 146.33 (101.01)
**PERF: 131.45 (101.45)
**PERF: 150.29 (102.15)
**PERF: 132.11 (102.57)
**PERF: 118.52 (102.79)
**PERF: 125.80 (103.11)
**PERF: 122.82 (103.37)
**PERF: 115.24 (103.53)
**PERF: 109.79 (103.58)
**PERF: 110.94 (103.69)
**PERF: 131.88 (104.04)

**PERF: FPS 0 (Avg)
**PERF: 107.08 (104.10)
**PERF: 97.33 (104.00)
**PERF: 100.98 (103.97)
**PERF: 115.51 (104.12)
**PERF: 127.24 (104.39)
**PERF: 119.74 (104.58)
**PERF: 110.56 (104.65)
**PERF: 107.91 (104.69)
**PERF: 107.91 (104.72)
** INFO: <bus_callback:217>: Received EOS. Exiting ...

Quitting
App run successful
root@787600990af1:/opt/nvidia/deepstream/deepstream/sources/project#
```

```
root@787600990af1:/opt/nvidia/deepstream/deepstream/sources/project# ls
configs  data  out.mp4
```

^ Proof there is local file output, but this is also present with the basic text and everything except the RTSP stream version, which is why I changed nothing from the basic configuration text.

C. *Deepstream_loop.txt*

Changed file-loop under [tests] from 0 to 1, indicating that input files should be looped infinitely.

I don't think I can actually run this because it will just continue forever until failure is experienced.

```
**PERF: 117.91 (104.77)
**PERF: 117.62 (104.84)
**PERF: 104.31 (104.84)
**PERF: 107.99 (104.86)
**PERF: 112.90 (104.90)
**PERF: 120.40 (104.99)
**PERF: 96.69 (104.94)
**PERF: 121.68 (105.04)

**PERF: FPS 0 (Avg)
**PERF: 132.37 (105.19)
**PERF: 117.94 (105.26)
^C** ERROR: <_intr_handler:140>: User Interrupted..

**PERF: 120.43 (105.34)
Quitting
App run successful
root@787600990af1:/opt/nvidia/deepstream/deepstream/sources/project#
```

Indeed it ran forever so I exited with ctrl+c eventually. There was no notice when the file finished the first time, it just loops silently. There is still an out.mp4 created.

D. *Deepstream_bitrate_8000000.txt*

Changed bitrate under [sink0] from 4000000 to 8000000

Screenshot on next page.

```
**PERF: 85.09 (100.91)
**PERF: 87.08 (100.64)
**PERF: 90.39 (100.45)
**PERF: 91.44 (100.27)
**PERF: 84.48 (99.97)
**PERF: 80.33 (99.62)
**PERF: 87.00 (99.39)
**PERF: 89.92 (99.22)
**PERF: 95.66 (99.17)
**PERF: 95.18 (99.09)

**PERF: FPS 0 (Avg)
**PERF: 87.40 (98.89)
**PERF: 78.45 (98.56)
**PERF: 77.22 (98.21)
**PERF: 85.25 (98.00)
**PERF: 84.64 (97.79)
**PERF: 88.82 (97.66)
**PERF: 82.85 (97.43)
**PERF: 105.77 (97.53)
**PERF: 119.45 (97.89)
**PERF: 116.56 (98.15)
**PERF: 135.46 (98.69)
**PERF: 140.35 (99.25)
**PERF: 133.25 (99.76)
**PERF: 135.16 (100.24)
**PERF: 116.48 (100.43)
**PERF: 117.48 (100.68)
**PERF: 124.73 (101.00)
**PERF: 124.90 (101.31)
**PERF: 109.67 (101.43)
**PERF: 106.70 (101.48)

**PERF: FPS 0 (Avg)
**PERF: 124.02 (101.76)
**PERF: 122.18 (102.04)
**PERF: 99.76 (102.01)
**PERF: 97.86 (101.96)
**PERF: 109.61 (102.04)
**PERF: 116.87 (102.22)
**PERF: 121.44 (102.44)
**PERF: 119.86 (102.65)
**PERF: 109.94 (102.69)
**PERF: 106.49 (102.76)
** INFO: <bus_callback:217>: Received EOS. Exiting ...
```

Quitting

App run successful

root@787600990af1:/opt/nvidia/deepstream/deepstream/sources/project#

It appears the performance is not affected by doubling the bitrate.

Bonus:

E. Deepstream_out_rtsp.txt

Changed type under [sink0] from 3 to 4. This is the Encode + RTSP streaming type.

Deleted “output-file=out.mp4” line as this is only valid for type 3.

```
root@787600990afl:/opt/nvidia/deepstream/deepstream/sources/project# deepstream-app -c configs/deepstream_out_rtsp.txt

*** DeepStream: Launched RTSP Streaming at rtsp://localhost:8554/ds-test ***

Opening in BLOCKING MODE
0:00:00.323445791 235 0xbcf5580 WARN nvinfer gstnvinfer.cpp:635:gst_nvinfer_logger: <primary_gie> NVDSInferContext[UID 1]: Warning from NVDSInferContextImpl::initializ
e() <nvdsminfer_context_impl.cpp:1161> [UID = 1]: Warning, OpenCV has been deprecated. Using NMS for clustering instead of cv::groupRectangles with topK = 20 and NMS Threshold = 0.5
ERROR: Deserialize engine failed because file path: /opt/nvidia/deepstream/deepstream-6.0/sources/project/configs/./engines/resnet10.caffemodel_b30_gpu0.engine open error
0:00:01.496270416 235 0xbcf5580 WARN nvinfer gstnvinfer.cpp:635:gst_nvinfer_logger: <primary_gie> NVDSInferContext[UID 1]: Warning from NVDSInferContextImpl::deseriali
zeEngineBackend() <nvdsminfer_context_impl.cpp:1889> [UID = 1]: Deserialize engine from file :/opt/nvidia/deepstream/deepstream-6.0/sources/project/configs/./engines/resnet10.caffemodel_
b30_gpu0.engine failed
0:00:01.496399249 235 0xbcf5580 WARN nvinfer gstnvinfer.cpp:635:gst_nvinfer_logger: <primary_gie> NVDSInferContext[UID 1]: Warning from NVDSInferContextImpl::generateB
ackendContext() <nvdsminfer_context_impl.cpp:1996> [UID = 1]: Deserialize backend context from engine from file :/opt/nvidia/deepstream/deepstream-6.0/sources/project/configs/./engines/resn
et10.caffemodel_b30_gpu0.engine failed, try rebuild
0:00:01.496449409 235 0xbcf5580 INFO nvinfer gstnvinfer.cpp:638:gst_nvinfer_logger: <primary_gie> NVDSInferContext[UID 1]: Info from NVDSInferContextImpl::buildModel()
<nvdsminfer_context_impl.cpp:1914> [UID = 1]: Trying to create engine from model files
WARNING: [TRT]: Detected invalid timing cache, setup a local cache instead
```

In VLC, I went to Media -> Open Network Stream and tried rtsp://localhost:8554/ds-test but got errors. After using the real IP address of the edge node, it worked with:
rtsp://192.168.85.61:8554/ds-test

