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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-l4t   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

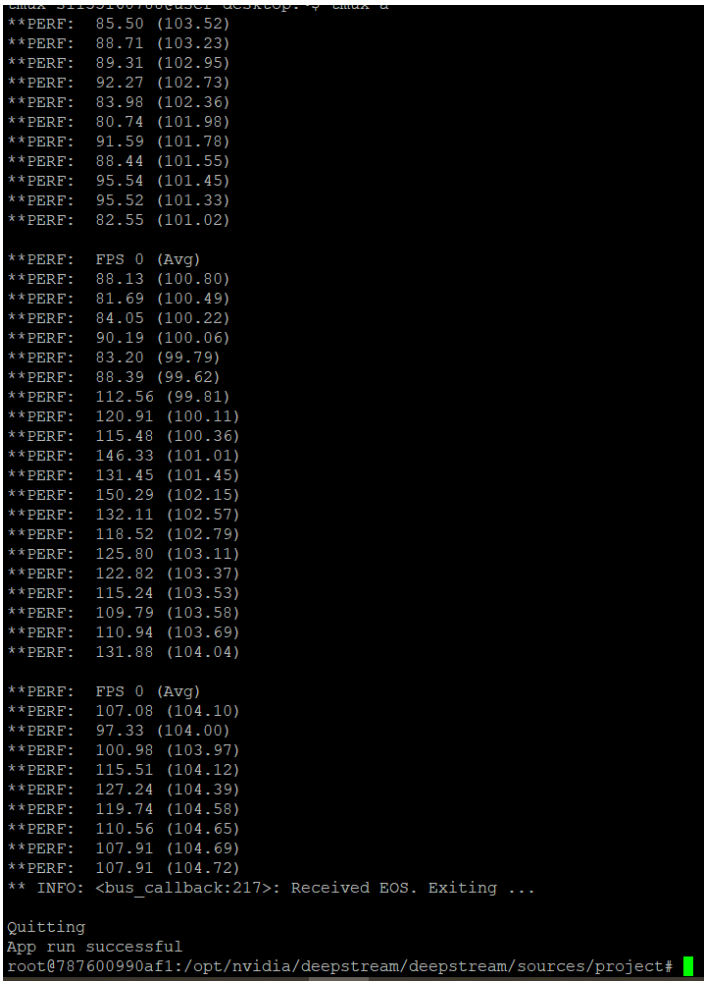
I changed nothing. The basic configuration should already be set for local file output, so I just used a copy of the basic text file.

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.

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



```
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.

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