Week1: Getting Started with Jetson Nano Developer Kit

Edge Computing

C. García garsanca@ucm.es

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- "NVIDIA-Jetson: Hello AI World", https://github.com/dusty-nv/jetson-inference/blob/master/docs/aux-docker.md

Outline

Setup Jetson-Nano

- In theory SD Card has been flashed with a installation (see Slides **Week1-Setup_JetsonNano-install**)

Credentials

- User name: **nano**
- User password: **nano_pass**

Using Camera (CSI Camera)

- CSI camera is the Rpi Camera connected through ribbon cable
  - More info could be consulted in Jetson Nano 2GB Developer Kit User Guide
- To check CSI camera, you can run `nvgstcapture-1.0`, which will start capture and preview display it on the screen:

Terminal #1

```
nano@jetson-nano:~$ nvgstcapture-1.0
Encoder null, cannot set bitrate!
Encoder Profile = High
Supported resolutions in case of ARGUS Camera
  (2) : 640x480
  (3) : 1280x720
  (4) : 1920x1080
.....
```

Using Camera (CSI Camera)

- Check rotation
- This example command will rotate the image 180 degrees (vertical flip)

Terminal #1

```
nano@jetson-nano:~$ nvgstcapture-1.0 --orientation 2
.....
```

Take a picture and save to disk

1. Connect CSI camera
2. Execute in a shell the command *nvgstcapture-1.0 –automate –capture-auto*
3. Open File with *eog nvcamtest_XX.jpg*

Capture a video and save to disk

1. Connect CSI camera
2. Execute in a shell the command *nvgstcapture-1.0 –mode=2 –automate –capture-auto*
3. Application will record 10 seconds of video
4. Play File recorded with *totem nvcamtest_XX.mp4*

Intro

- There are several pre-configured containers to be able to use the Jetson-Nano board
- The most common are related to their use for artificial intelligence and machine learning

Machine Learning Containers for Jetson and JetPack

- Extracted from https://github.com/dusty-nv/jetson-containers
- Hosted on NVIDIA GPU Cloud (NGC) are the following Docker container images for machine learning on Jetson:
  - l4t-ml
  - l4t-pytorch
  - l4t-tensorflow

Machine Learning Container

- The **l4t-ml** docker image contains *TensorFlow*, *PyTorch*, *JupyterLab*, and other popular ML and data science frameworks such as scikit-learn, scipy, and Pandas pre-installed in a Python 3.6 environment
  - Latest `l4t-ml:r32.6.1-py3`
    - TensorFlow 1.15.5
    - PyTorch v1.9.0
    - torchvision v0.10.0
    - torchaudio v0.9.0
    - onnx 1.8.0
    - CuPy 9.2.0
    - numpy 1.19.5
    - numba 0.53.1
    - OpenCV 4.5.0 (with CUDA)
    - pandas 1.1.5
    - scipy 1.5.4

Pytorch Container

- The **l4t-pytorch** docker image contains *PyTorch* and *torchvision* pre-installed in a Python 3.6 environment
  - Lastest `l4t-pytorch:r32.6.1-pth1.9-py3`
    - PyTorch v1.9.0
    - torchvision v0.10.0
    - torchaudio v0.9.0

Running Docker Container

- Pre-built Docker container images for this project are hosted on DockerHub
- These containers use the l4t-pytorch base container, so support for transfer learning / re-training is already included

Inference instructions

- Follow the github `https://github.com/dusty-nv/jetson-inference/blob/master/docs/aux-docker.md`

Launching the Container

- It's recommended to use the script **docker/run.sh** script to run the container
  - `docker/run.sh` will automatically pull the correct container tag from DockerHub based on your currently-installed version of JetPack-L4T
  - It also mount the appropriate data directories and devices so that you can use cameras/display/ect from within the container
  - More DNN models available in https://github.com/dusty-nv/jetson-inference/blob/master/docs/building-repo-2.md#downloading-models

Launching the Container

- IMPORTANT: if you are using CSI (Rpi Camera): **–volume /tmp/argus_socket:/tmp/argus_socket**

Terminal #1

```
nano@jetson-nano:~$ git clone --recursive https://github.com/dusty-nv/jetson-inference
Cloning into jetson-inference...
remote: Enumerating objects: 20861, done.
....

nano@jetson-nano:~$ cd jetson-inference/
nano@jetson-nano:~/jetson-inference$ docker/run.sh --volume /tmp/argus_socket:/tmp/argus_socket
reading L4T version from /etc/nv_tegra_release
L4T BSP Version:  L4T R32.6.1
[sudo] password for nano:
size of data/networks:  79397 bytes
.....
```

Mount data volumes

- For reference, the following paths automatically get mounted from your host device into the container:
  - *jetson-inference/data* (stores the network models, serialized TensorRT engines, and test images)
  - *jetson-inference/python/training/classification /data* (stores classification training datasets)
  - *jetson-inference/python/training/classification/models* (stores classification models trained by PyTorch)
  - *jetson-inference/python/training/detection/ssd/data* (stores detection training datasets)
  - *jetson-inference/python/training/detection/ssd/models* (stores detection models trained by PyTorch)

Running applications

- Once the container is up and running, you can then run example programs from the tutorial like normal inside the container:

Terminal #1

```
root@jetson-nano:/jetson-inference# cd build/aarch64/bin
root@jetson-nano:/jetson-inference/build/aarch64/bin# ./video-viewer
root@jetson-nano:/jetson-inference/build/aarch64/bin# ./imagenet images/jellyfish.jpg images/tes
root@jetson-nano:/jetson-inference/build/aarch64/bin# ./detectnet images/peds_0.jpg images/test/
# (press Ctrl+D to exit the container)
```

Running applications

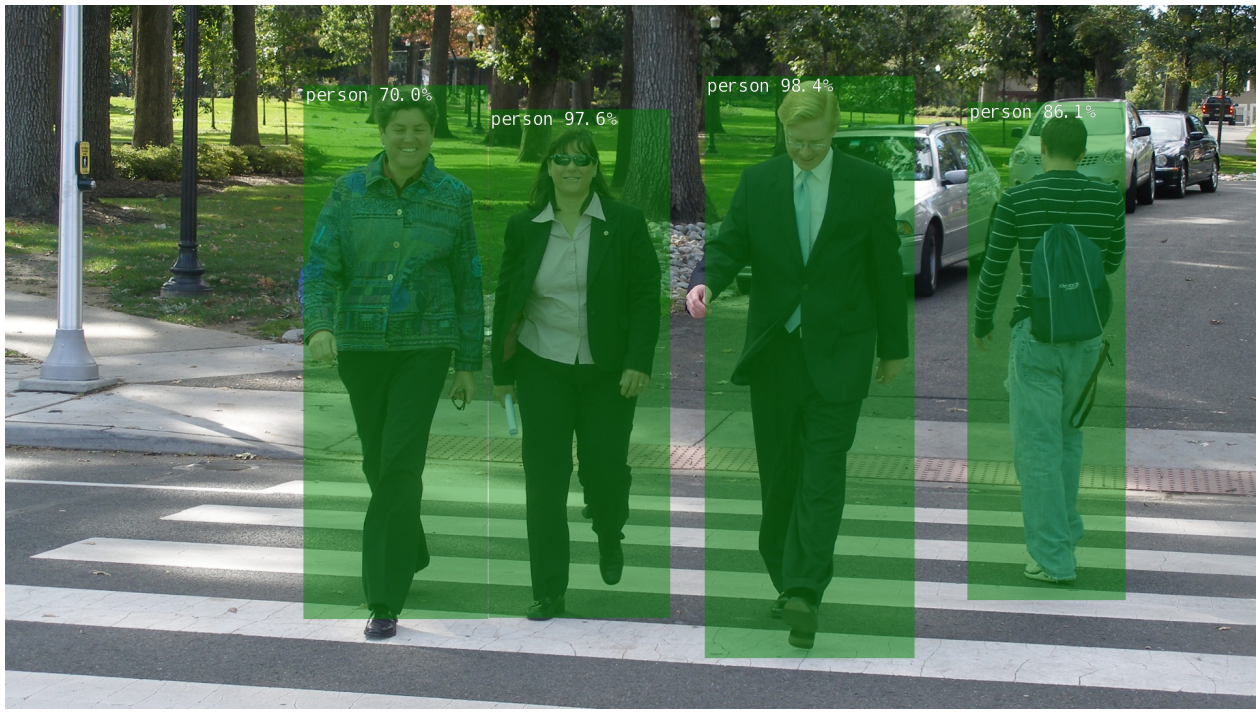
- Note that `video-viewer` catches the image from webcam

Running applications

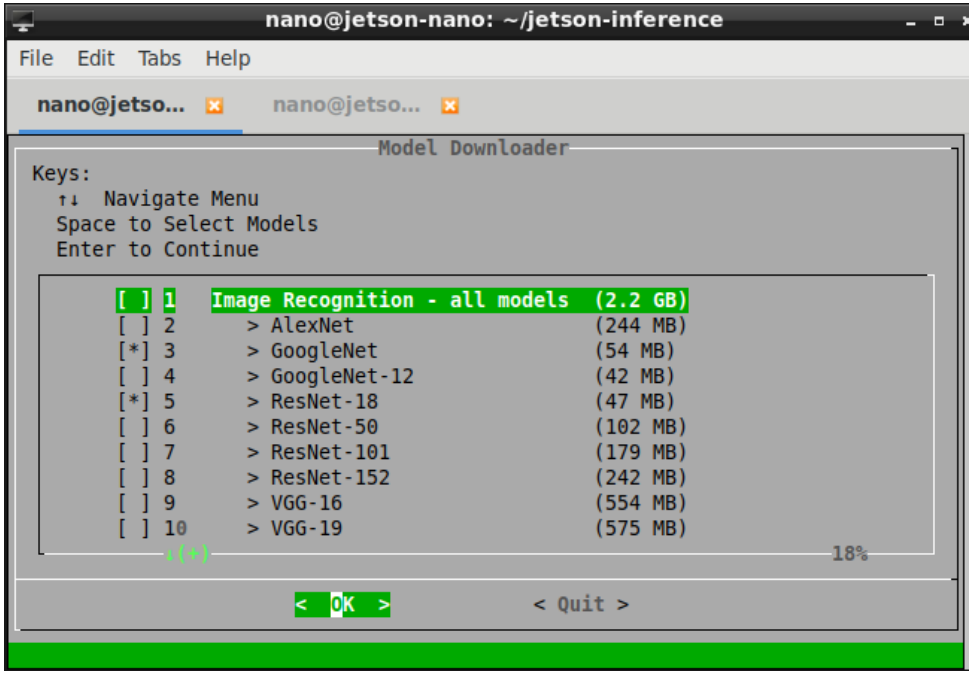
- Note that `imagenet` app **classifies** the image *jellyfish.jpg* as a **jellyfish** and store the image solution in the path *data/images/test* with a confidence of 99.85%

Running applications

- Note that `detectnet` app detects four persons with a confidence of 70.0%, 97.6%, 98.4% and 86.1% and store the image solution in path *data/images/test*



Download other models



Terminal #1

```
nano@jetson-nano:~$ cd jetson-inference/tools
nano@jetson-nano:~/jetson-inference$ ./download-models.sh
.....
```

Installing PyTorch

- If you are running the Docker Container, it should already be installed on your Jetson
- Otherwise you can install it

Terminal #1

```
nano@jetson-nano:~$ cd jetson-inference/build
nano@jetson-nano~/jetson-inference/build$ ./install-pytorch.sh
```

Verifying PyTorch

- Test the success PyTorch installation by executing the next commands from an interactive Python shell:

testing.py

```
import torch
print(torch.__version__)
print('CUDA available: ' + str(torch.cuda.is_available()))
a = torch.cuda.FloatTensor(2).zero_()
print('Tensor a = ' + str(a))
b = torch.randn(2).cuda()
print('Tensor b = ' + str(b))
c = a + b
print('Tensor c = ' + str(c))

import torchvisionhttps://developer.nvidia.com/embedded/learn/jetson-ai-
    certification-programs
print(torchvision.__version__)
```

Machine Learning Container

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    - numba 0.53.1
    - OpenCV 4.5.0 (with CUDA)
    - pandas 1.1.5
    - scipy 1.5.4

Running the Container

- First pull one of the **l4t-ml** container:

Terminal #1

```
nano@jetson-nano:~$ sudo docker pull nvcr.io/nvidia/l4t-ml:r32.6.1-py3
....
```

- Then to start an interactive session in the container, run the following command:

Terminal #1

```
nano@jetson-nano:~$ sudo docker run -it --gpus all -e DISPLAY=:0 -v /tmp/.X11-unix:/tmp/.X11-
unix --network host nvcr.io/nvidia/l4t-ml:r32.6.1-py3
```

Mounting Directories

- To mount scripts, data, ect. from your Jetson's filesystem to run inside the container, use Docker's -v flag when starting your Docker instance:

Terminal #1

```
nano@jetson-nano:~$ sudo docker run -it --rm --runtime nvidia --network host -
v /home/user/project:/location/in/container nvcr.io/nvidia/l4t-ml:r32.6.1-py3
```

- You should then be able to start a Python3 interpreter

Connecting to JupyterLab Server

- A JupyterLab server instance is automatically started along with the container.
- You can connect `http://localhost:8888` (or substitute the IP address of your Jetson device)
  - Password: **nvidia**