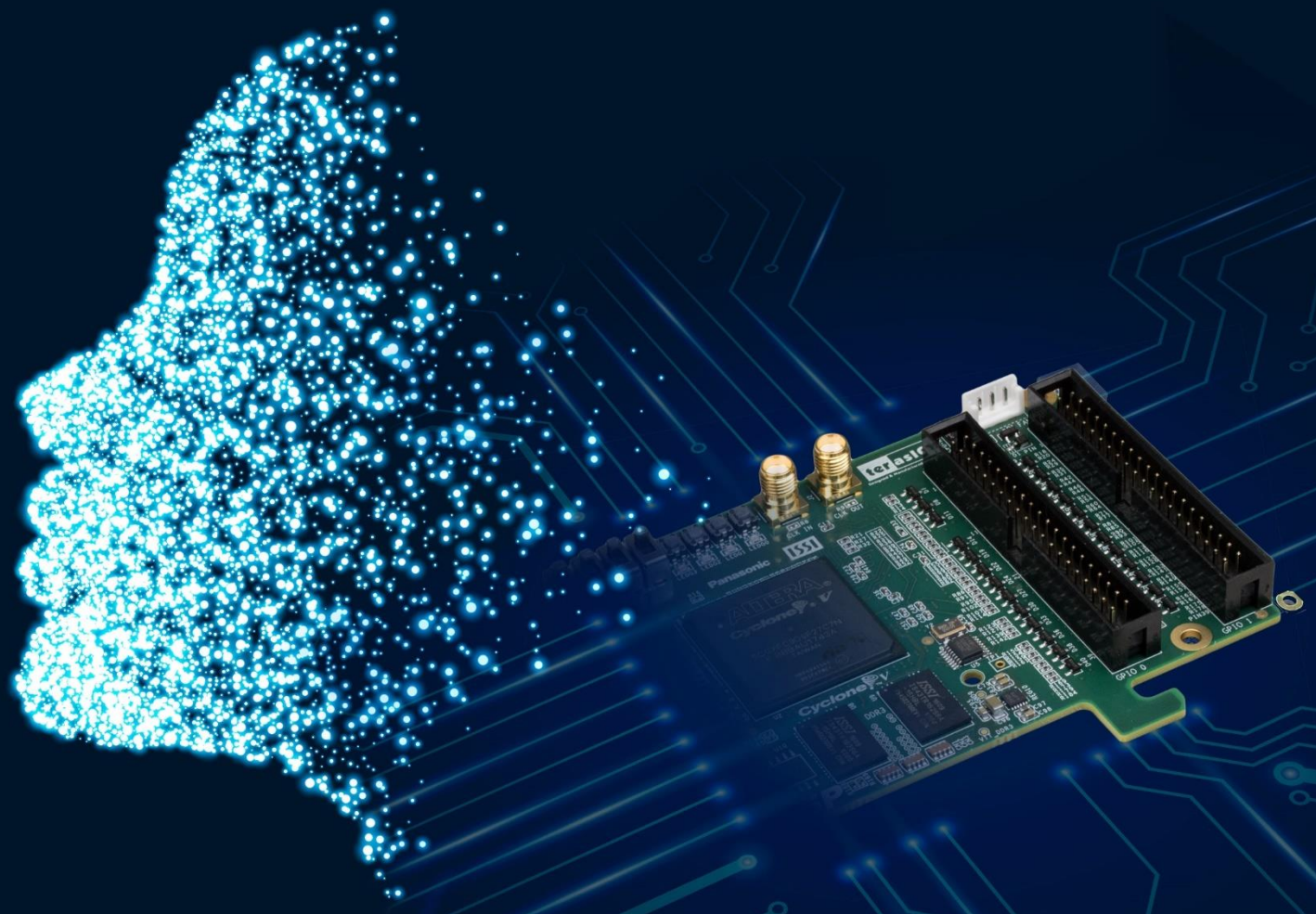
OpenVINO
Development Guide



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Chapter 1

OpenVINO Toolkit & Process Introduction

1.1 About the Guide

The OpenVINO (Open Visual Inference and Neural Network Optimization) development guide covers the workflow, Lab guide of OpenVINO Toolkit. The guide shows users how to deploy applications and solutions that emulate human vision with Intel OpenVINO Toolkit. It implements the CNN-based deep learning by using heterogeneous execution acceleration. With the easy-to-use functions library for computer vision, the OpenVINO Toolkit speeds up time-to-market for the products. This guide also shows users how to quickly setup the CNN-based deep learning applications running on FPGA.

This guide is created based on Terasic Starter Platform for OpenVINO™ Toolkit , user also can refer to this guide for DE5a-Net-DDR4 and DE5a-Net boards OpenVINO development, it includes the following contents:

- OpenVINO Toolkit Introduction
- OpenVINO Workflow
- Model Optimizer and Inference Engine
- Run demo on the Starter Platform for OpenVINO™ Toolkit
- Starter Platform for OpenVINO™ Toolkit Lab

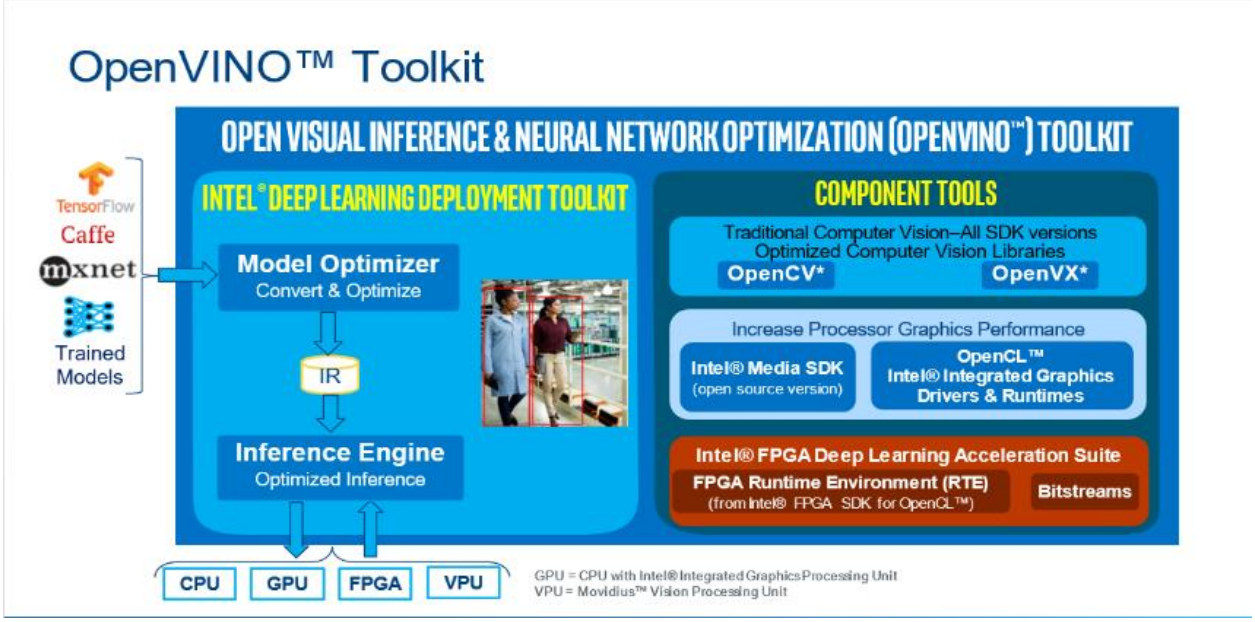
1.2 OpenVINO Toolkit Features

OpenVINO (Open Visual Inference and Neural Network Optimization) Toolkit can improve the performance of the Computer Vision, and shorten the time taken for product to market. It can help user to take the advantages of Terasic FPGA boards easily, including improving performance, reducing power consumption and significantly improving FPGA utilization. Users can achieve double efficiency with half effort and open new design possibilities. The main features are:

- Enable CNN-based deep learning inference on the edge
- Support heterogeneous execution across Intel's CV accelerators, using a common API for the CPU, Intel® Integrated Graphics, Intel® Movidius™ Neural Compute Stick, and FPGA
- Speed up time-to-market through an easy-to-use library of CV functions and pre-optimized kernels
- Include optimized calls for CV standards, including OpenCV*, OpenCL™, and OpenVX*

1.3 What's Inside OpenVINO Toolkit

OpenVINO Toolkit uses a common API, which is based on the general development standards such as OpenCL, OpenCV and OpenVX.



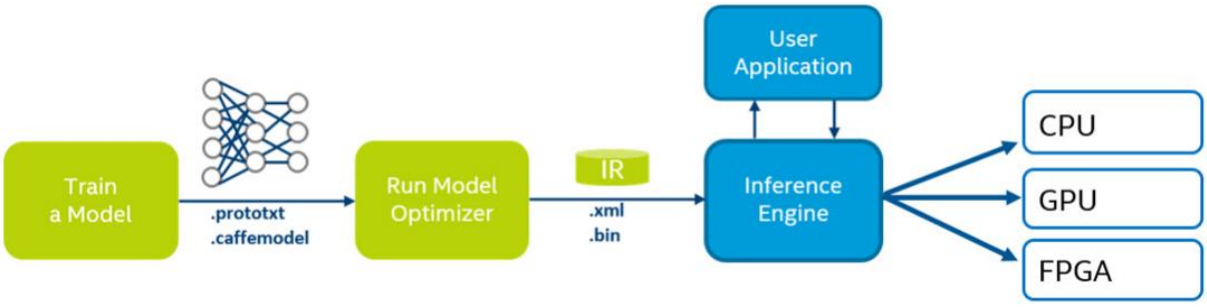
The Toolkit includes:

1. Deep Learning Deployment Toolkit, which comprises the following two components:
   - Model Optimizer: This Python*-based command line tool imports trained models from popular deep learning frameworks such as Caffe, TensorFlow, and Apache MXNet*. Input trained model, optimize topology, and convert it to an IR (IR, Intermediate Representation) file.
   - Inference Engine: This execution engine uses a common API to deliver inference solutions on the platform of your choice: CPU, GPU, VPU, or FPGA to work on heterogeneous processing and asynchronous execution to save the development time.
2. Optimized computer vision library for OpenCV, OpenVX, and image vision for CPU and GPU.
3. The improved performance of Intel processor graphics card components in Linux, including Intel Media SDK open source version, OpenCL graphics driver, and runtime environment.
4. The runtime environment (RTE) supports running OpenCL on FPGA and bitstreams for configuring FPGA.

1.4 OpenVINO Workflow

The steps for OpenVINO optimizing and deploying a trained model are:

1. Configure the Model Optimizer for your framework.
2. Convert a trained model to produce an optimized Intermediate Representation (IR) of the model based on the trained network topology, weights, and biases values.
3. Test the model in the Intermediate Representation format using the Inference Engine in the target environment by the Validation application or the sample applications.
4. Integrate the Inference Engine in your application to deploy the model in the target environment.

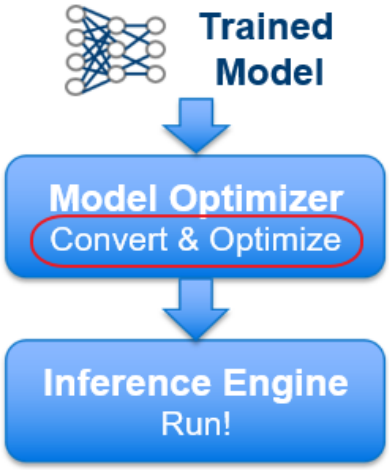


1.5 Model Optimizer

Model Optimizer is a cross-platform command-line tool that facilitates the transition between the training and deployment environment, performs static model analysis, and adjusts deep learning models for optimal execution on end-point target devices.

Model Optimizer produces an OpenVINO supported framework as a trained model input and an Intermediate Representation (IR) of the network as output. Intermediate Representation is a pair of files that describe the whole model:

- .xml: Describes the network topology
- .bin: Contains the weights and biases binary data



■ How the Model Optimizer Works

Model Optimizer loads a model into memory, followed by reading it and building the internal representation of the model. The Model Optimizer then optimizes it and produces the Intermediate Representation. The Intermediate Representation is the only format the Inference Engine accepts. Model Optimizer has two main purposes:

1) Produce a valid Intermediate Representation.

If this main conversion artifact is not valid, the Inference Engine cannot run. The primary responsibility of the Model Optimizer is to produce the two files that form the Intermediate Representation.

2) Produce an optimized Intermediate Representation.

Pre-trained models contain layers that are important for training such as the dropout layer. These layers are useless during inference and might increase the inference time.

In many cases, these layers can be automatically removed from the resulting Intermediate Representation. However, if a group of layers can be represented as one mathematical operation and thus a single layer, the Model Optimizer recognizes such patterns and replaces these layers with one layer. The result is an Intermediate Representation that has fewer layers than the original model. This reduces the inference time.

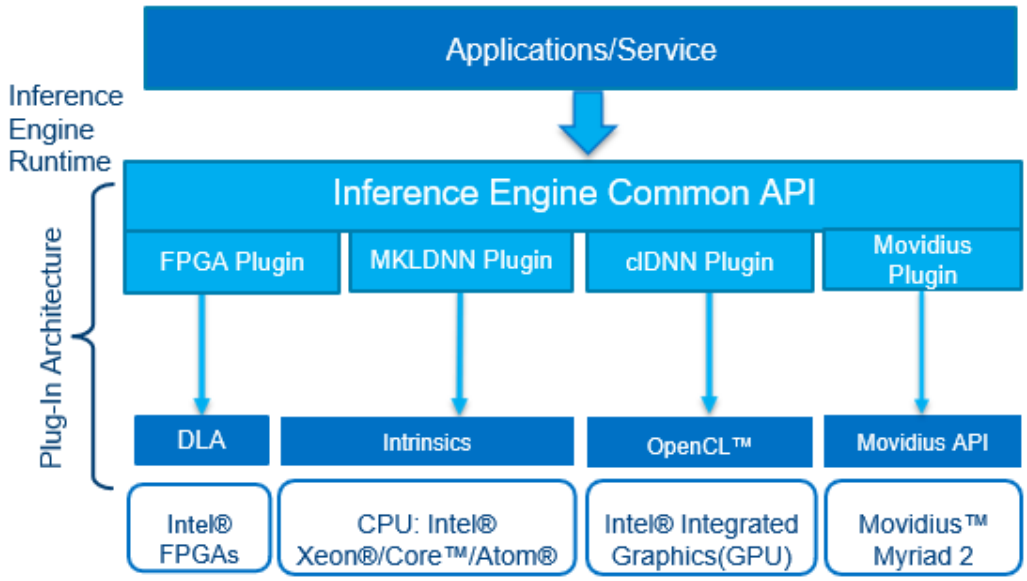
Many common layers exist across known frameworks and neural network topologies. Examples of these layers are Convolution, Pooling, and Activation. The Model Optimizer must be able to work with these layers to read the original model and produce the Intermediate Representation of a model, the layer list varies by framework. Please refer to the documentation of the Caffe*, TensorFlow* and MXNet* for the topologies supported by each of these frameworks. If your topology contains only layers from the list of layers, which is the case for the topologies used by most users, the Model Optimizer can easily create the Intermediate Representation. Users can proceed to work with the Inference Engine afterwards.

However, if you use a topology with layers that are not recognized by the Model Optimizer, please refer to Custom Layers in the Model Optimizer to learn how to work with custom layers.

1.6 Inference Engine

After an Intermediate Representation is created by the Model Optimizer, input data can be inferred by the Inference Engine.

The Inference Engine is a C++ library with a set of C++ classes to infer input data (images) and get a result. The C++ library provides an API to read the Intermediate Representation, set the input and output formats, and execute the model on devices.



Each supported target device has a plugin and each plugin is a DLL/shared library. The Heterogeneous plugin lets you distribute a calculation workload across devices. One needs to make sure those libraries are specified in the path of host PC or in the place pointed to the plugin loader. Additionally, the related library for each plugin must be included in the LD_LIBRARY_PATH. When the Inference Engine calls the FPGA-based DLA plug-in, the DLA runtime software layer is called to use the DLA API. These

APIs are converted to the corresponding modules executed on the FPGA device. This part would be executed in different levels of in-depth learning networks.

Common Workflow for Using the Inference Engine API:

1. Read the Intermediate Representation:
   Use the InferenceEngine::CNNNetReaderclass and read an Intermediate Representation file into a CNNNetwork class. This class represents the network in host memory.

2. Prepare inputs and outputs formats:
   After loading the network, specify input and output precision, and the layout on the network using CNNNetwork::getInputInfo() and CNNNetwork::getOutputInfo().

3. Select Plugin:
   Select the plugin to load your network. Create the plugin with the InferenceEngine:: PluginDispatcher load helper class. Pass per device loading configurations specific to this device and register extensions to this device.

4. Compile and Load:
   Use the plugin interface wrapper class InferenceEngine::InferencePlugin to call the LoadNetwork () API to compile and load the network on the device. Pass in the per-target load configuration for this compilation and load operation.

5. Set input data:
   There's an ExecutableNetwork object with the network loaded.

   Use this object to create an InferRequest in which you signal the input buffers to use for input and output. Specify a device-allocated memory and copy it into the device memory directly or tell the device to use your application memory to save a copy.

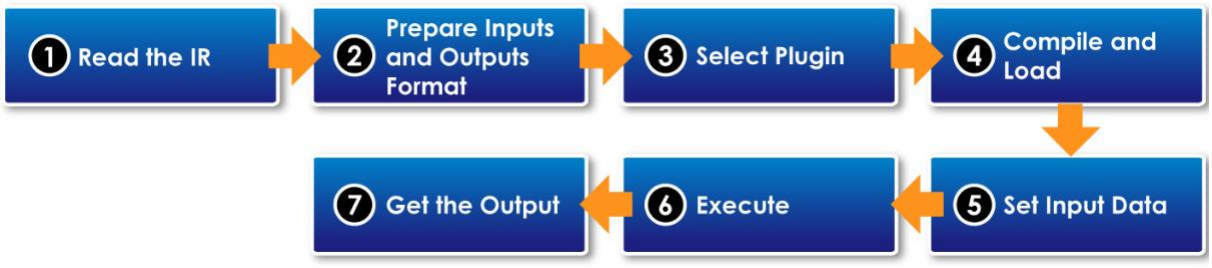
6. Execute:
   Choose the execution mode with the input and output memory defined:

   Synchronously - Infer() method. Block until inference finishes.

   Asynchronously - StartAsync() method. Check status with the wait() method (0 timeout), wait, or specify a completion callback.

7. Get the output:
   Get the output memory or read the memory provided earlier after inference is complete.

   This can be done with the InferRequest GetBlob API.



For more information about integrating the Inference Engine in your application, please refer to the Inference Engine Developer Guide.

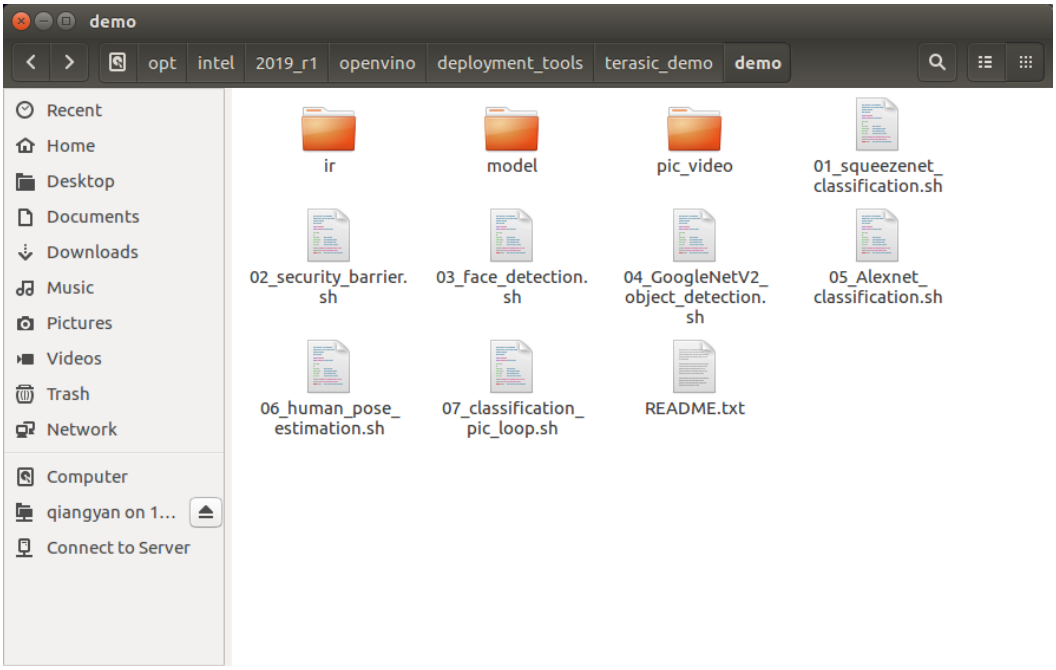
Chapter 2

Run the DEMO on the Starter Platform for OpenVINO™ Toolkit

This chapter describes how to run the demo on the Starter Platform for OpenVINO™ Toolkit and shows the execution result of the demo. Before running these demos, user needs to finish OpenVINO Development installation by referring to the manual "**OpenVINO_Installation_Guide**".

2.1 Introduction

As shown in the figure below, there are some shell scripts in the terasic_demo/demo folder.



Below is the brief introduction of the demo folder.

1. How to use these Shell script files

   Users can run any one of the shell script files with default parameters, and users can also use cpu , vpu or fpga to specify the target device to run the demo. There are also other parameters for using, users can run shell script file with '-h' for more details. And the default parameter is for cpu.

2. The images and video required by the demo are in the pic_video folder.

3. The Caffe model downloaded from internet is in the model folder.

   - alexnet
   - squeezenet1.1
   - GoogleNetV2
   - Users can add Caffe model by referring to the writing rule of the script. Please pay attention to the path and name.

- Please refer to OpenVINO-Using-TensorFlow to transfer the Tensorflow model

4. IR folder

   While running the demo, the corresponding model IR file will be generated automatically if it's needed.

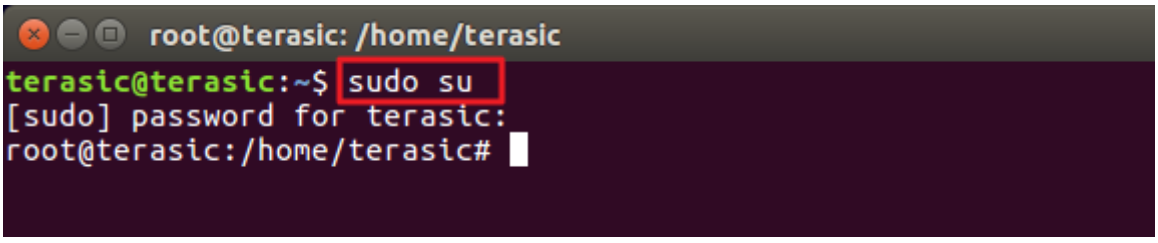
   - The model generated under FP16 folder is used for FPGA
   - The model generated under FP32 folder is used for CPU

2.2 Execute the Demo

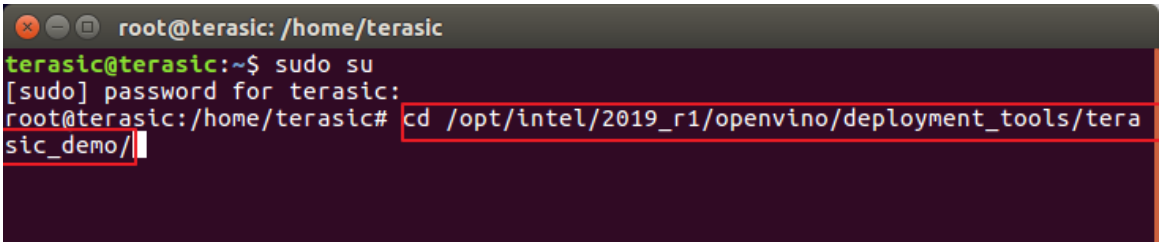
There are seven demos included in the OpenVINO Toolkit. To run these demos, users need to open a terminal and type sudo su, source the setup script, and prepare the running environment.

(login account: here, our username is terasic, password is terasic)

1. Right click on the desktop to open the Terminal, enter command "*sudo su*" to change user to root Super User, enter password "*terasic*"

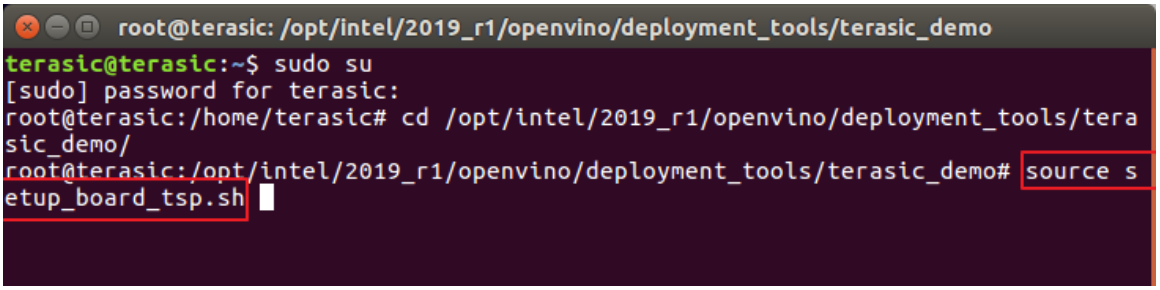


2. Enter "cd /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo" to switch to terasic_demo path.



3. Source setup_board_tsp.sh

   Note: User needs to setup the corresponding .sh file for the FPGA board, for example, source setup_board_tsp.sh for TSP GT Edition board or TSP GX Edition board, source setup_board_de5a_net_ddr4.sh for DE5a-Net-DDR4 board.



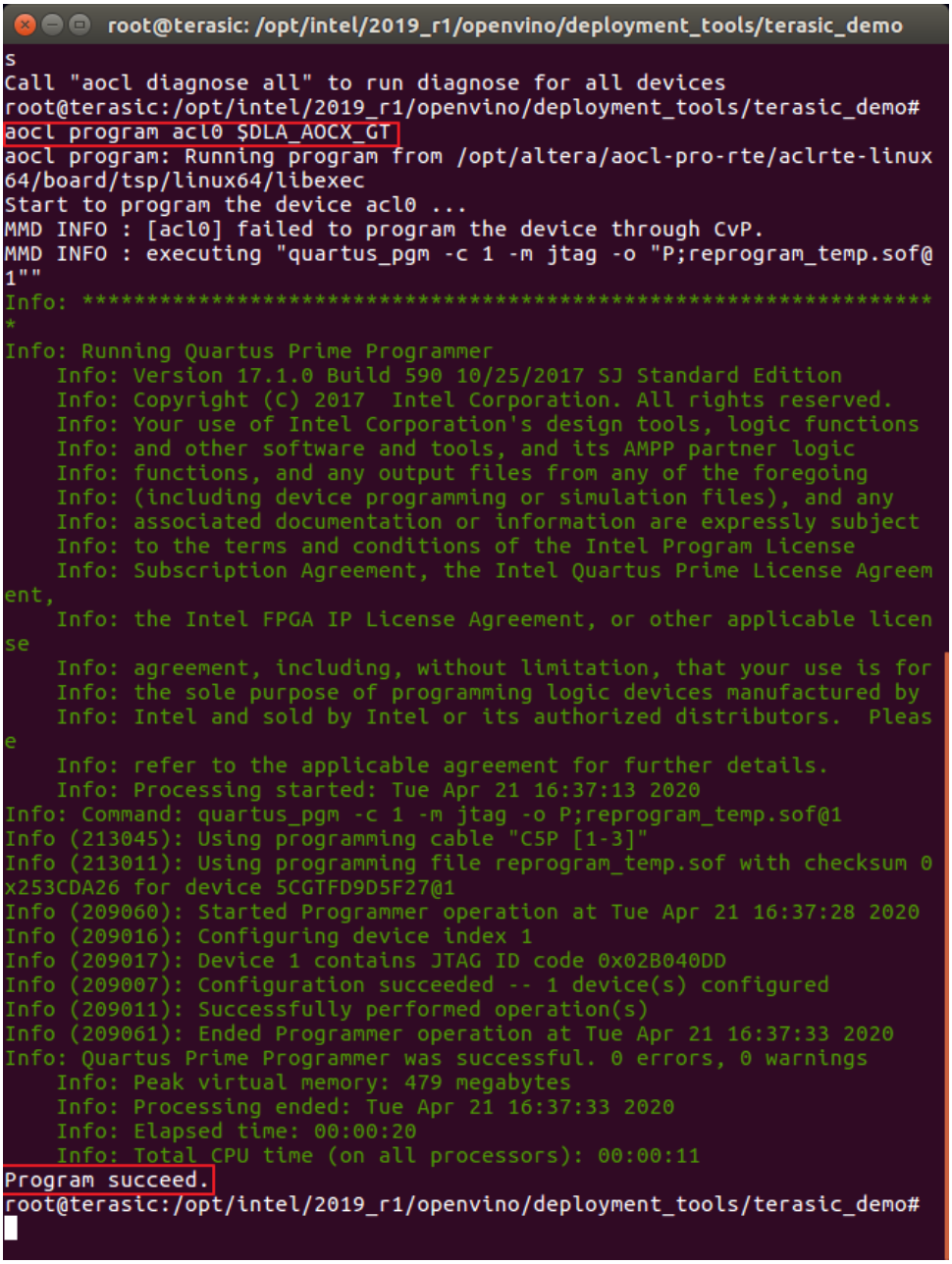
4. Type “y” to install.

```
root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo# source s
etup_board_tsp.sh
[setupvars.sh] OpenVINO environment initialized
INTELFPGAOCLSDKROOT is set to /opt/altera/aocl-pro-rte/aclrte-linux64. Using tha
t.

aoc was not found, but aocl was found. Assuming only RTE is installed.

AOCL_BOARD_PACKAGE_ROOT is set to /opt/altera/aocl-pro-rte/aclrte-linux64/board/
osk. Using that.
Adding /opt/altera/aocl-pro-rte/aclrte-linux64/bin to PATH
Adding /opt/altera/aocl-pro-rte/aclrte-linux64/host/linux64/lib to LD_LIBRARY_PA
TH
Adding /opt/altera/aocl-pro-rte/aclrte-linux64/board/tsp/linux64/lib to LD_LIBRA
RY_PATH
Do you want to install /opt/altera/aocl-pro-rte/aclrte-linux64/board/tsp? [y/n]
y
```

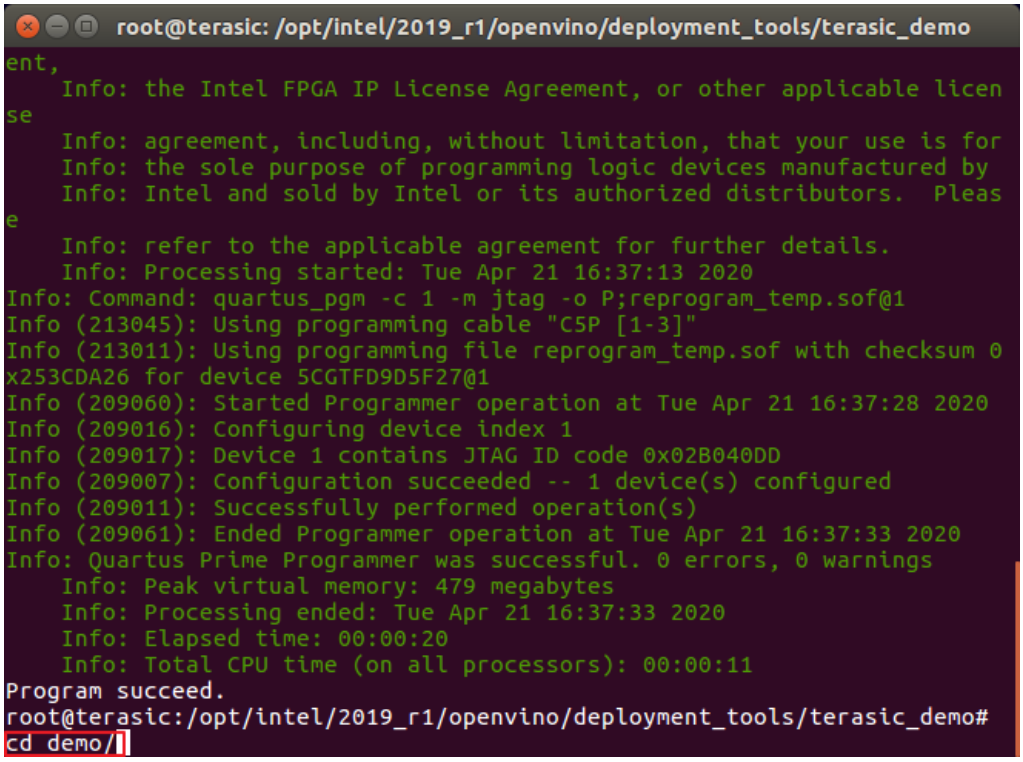
5. Enter *aocl diagnose* to check the environment, the “DIAGNOSTIC_PASSED” represents the environment setup is successful.

```
root@terasic: /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo
RY_PATH
root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo# aocl dia
gnose
------------------------------------------------------------
Warning:
No devices attached for package:
/opt/altera/aocl-pro-rte/aclrte-linux64/board/tsp
------------------------------------------------------------

Verified that the kernel mode driver is installed on the host machine.

Using board package from vendor: Terasic
Querying information for all supported devices that are installed on the host ma
chine ...


Device Name   Status   Information

acl0          Passed   Cyclone V HPC Reference Platform
                       PCIe dev_id = D800, bus:slot.func = 01:00.00, at Gen 2 wi
th 1 lanes


Found 1 active device(s) installed on the host machine. To perform a full diagno
stic on a specific device, please run
      aocl diagnose <device_name>

DIAGNOSTIC_PASSED
------------------------------------------------------------
```

6. Use an USB cable to connect the TSP USB Blaster II connector and PC. Enter “*aocl program acl0 $DLA_AOCX_GT*” (note: if user tests the OpenVINO examples for GX edition, please enter “*aocl program acl0 $DLA_AOCX_GX”* command) to program an .aocx file (click here to know how to program an .aocx file) to the FPGA.



7. Switch to the demo path.

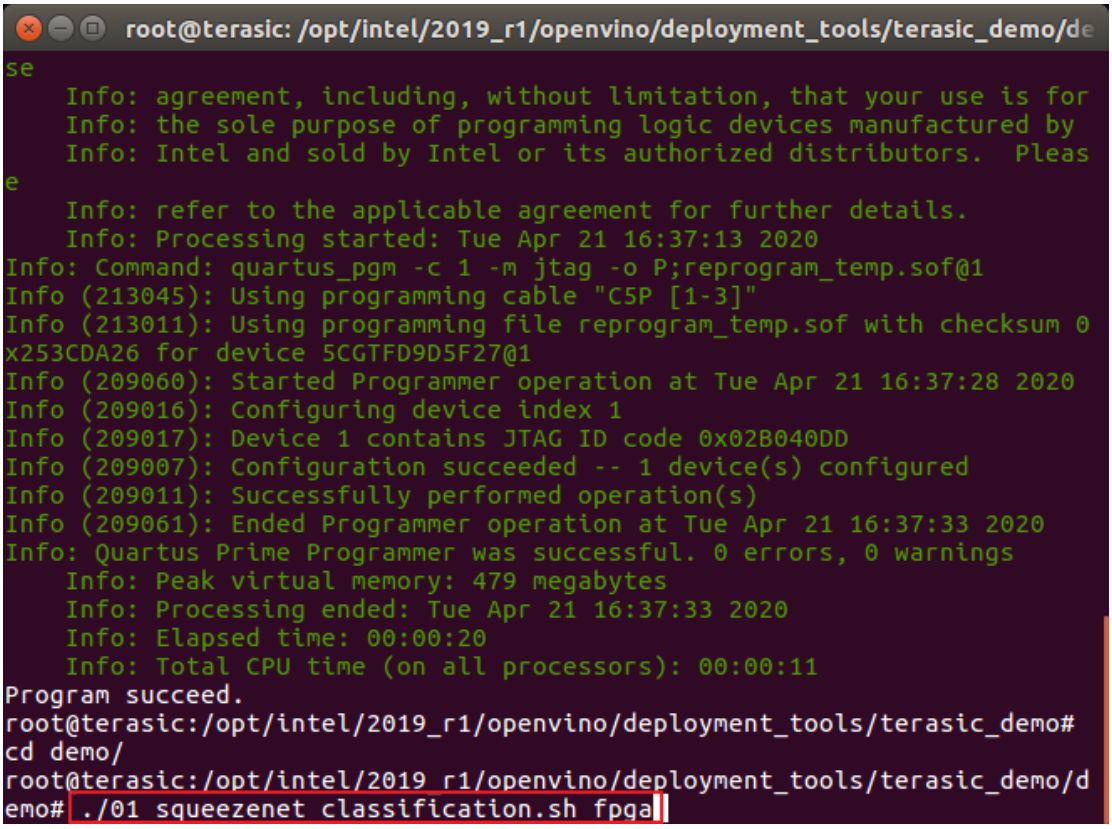


8. Execute the DEMOs:

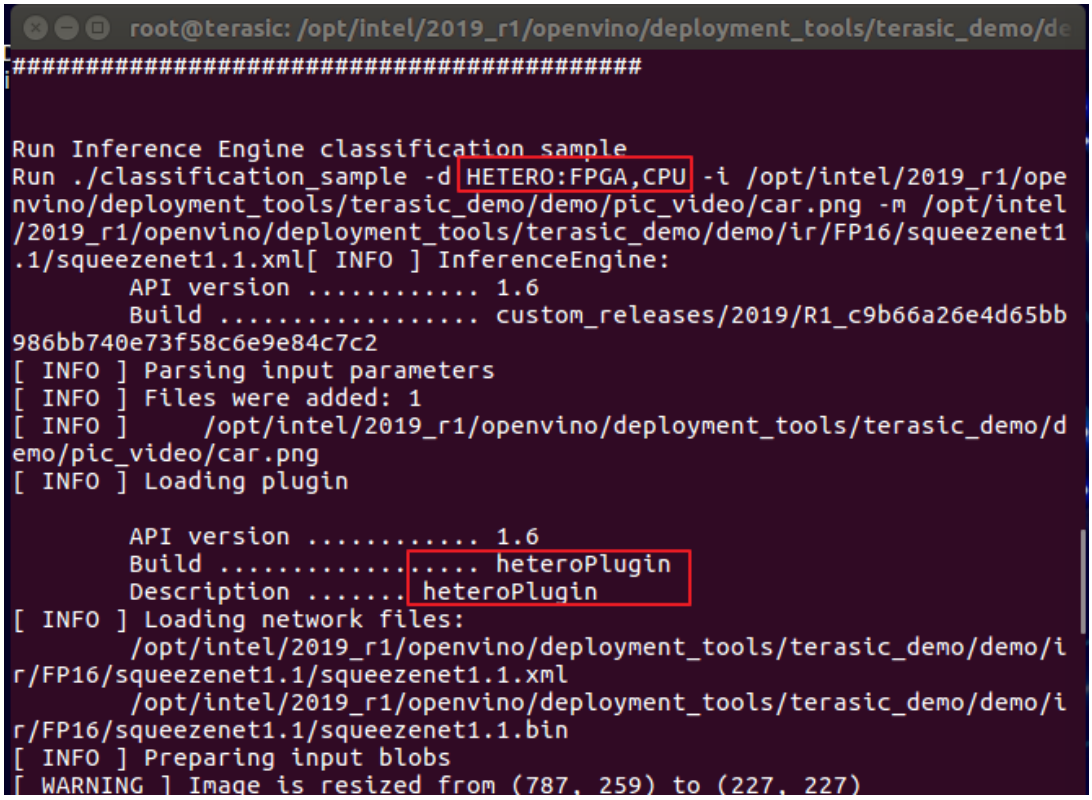
■ **01_squeezenet demo**

This demo can recognize the objects in the figure by using the squeezenet model

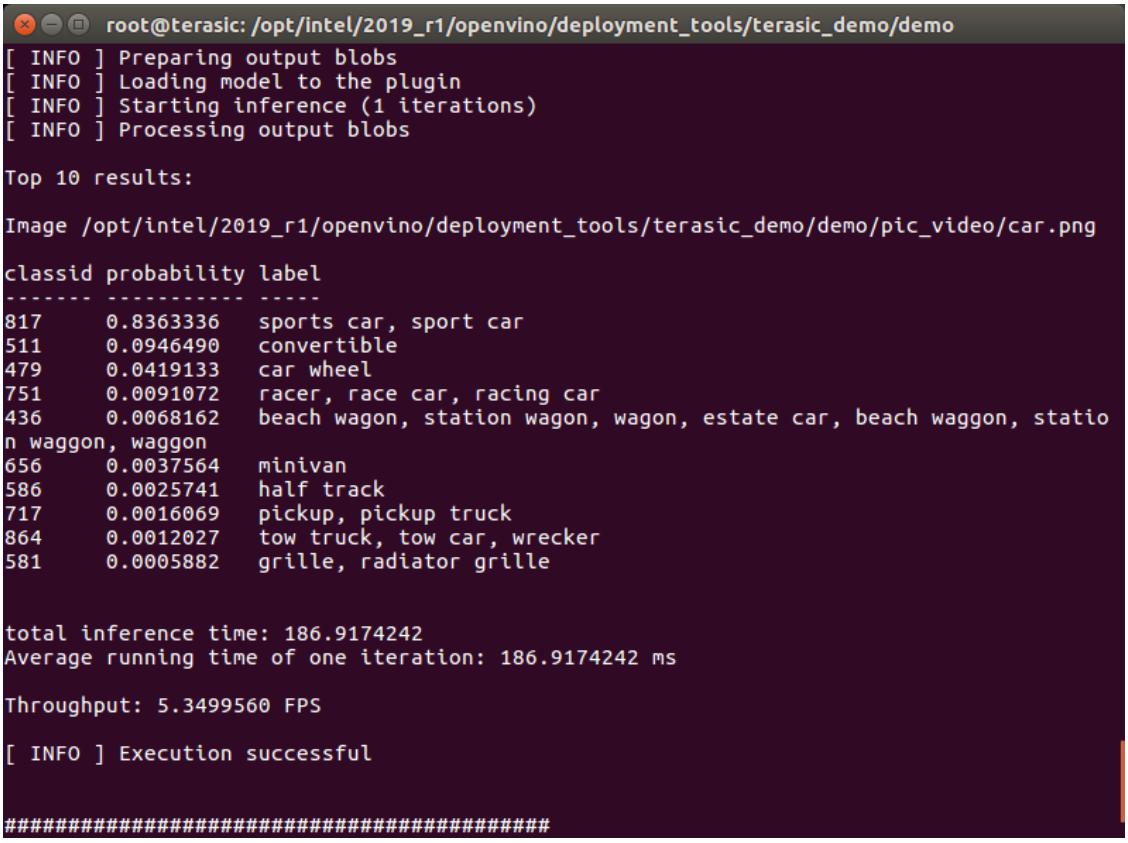
1) *./01_squeezenet_classification.sh fpga* (run demo with FPGA)



2) Users can see “HETERO:FPGA, CPU”, which prompts the DEMO is running on FPGA and CPU.



3) It prints out the top 10 results.



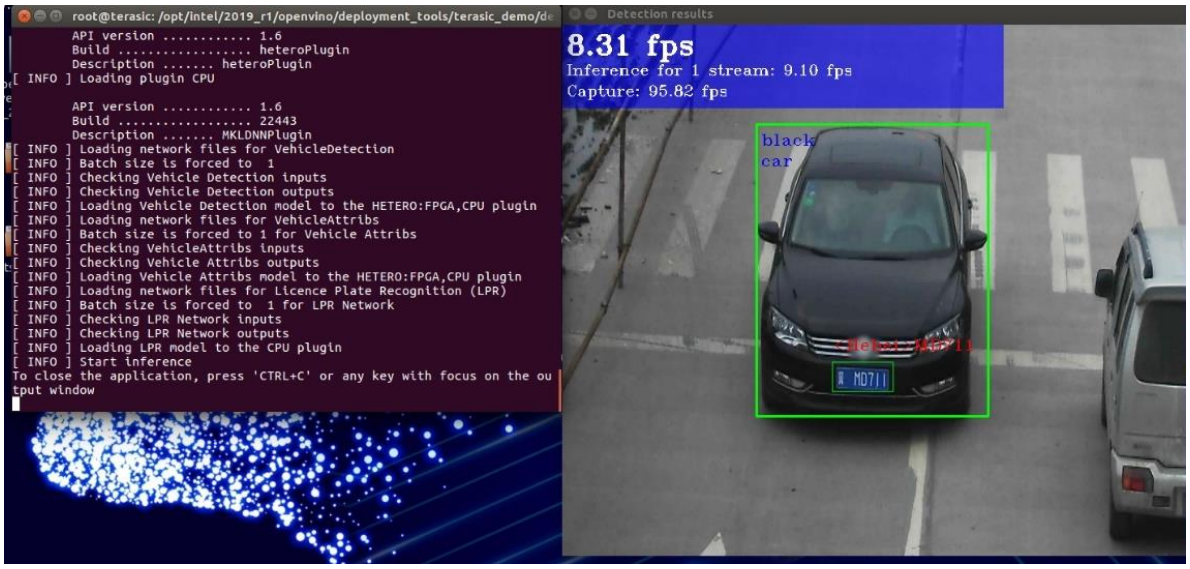
■ 02_security_barrier demo

This demo can recognize the car, car license number, and its location by using the three models.

1) *./02_security_barrier.sh fpga* (run the demo with FPGA)

```
root@terasic: /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/de
479     0.0168394   car wheel
436     0.0061949   beach wagon, station wagon, wagon, estate car, beach
 waggon, station waggon, waggon
751     0.0061949   racer, race car, racing car
656     0.0022790   minivan
864     0.0008384   tow truck, tow car, wrecker
717     0.0008384   pickup, pickup truck
586     0.0008384   half track
581     0.0003084   grille, radiator grille


total inference time: 85.2543712
Average running time of one iteration: 85.2543712 ms

Throughput: 11.7296038 FPS

[ INFO ] Execution successful


###########################################


Demo completed successfully.

root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/d
emo# ./02_security_barrier.sh fpga
```

2) The result is shown in the figure below. Enter Ctrl+C to close the Application.



■ 03_face_detection

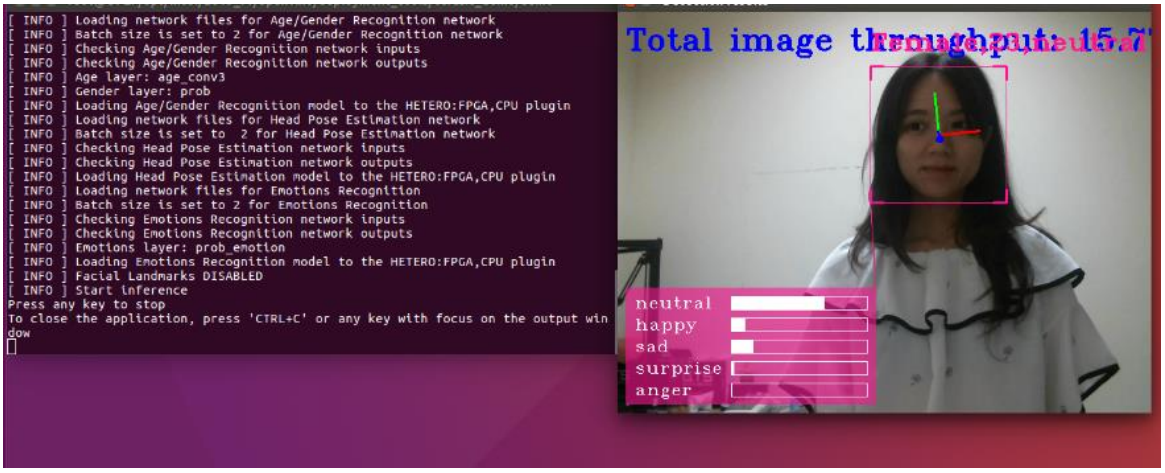
This demo uses four models and it can recognize human face position in the figure. It can also judge the human gender, age, expression, and head gesture according to the human face.

1) Plug a UVC USB camera to the host PC USB port.

2) Execute "*./03_face_detection.sh fpga*" to run the demo with FPGA.

```
root@terasic: /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/de
        Build ..................... heteroPlugin
        Description ....... heteroPlugin
[ INFO ] Loading plugin CPU

        API version ............ 1.6
        Build ..................... 22443
        Description ....... MKLDNNPlugin
[ INFO ] Loading network files for VehicleDetection
[ INFO ] Batch size is forced to  1
[ INFO ] Checking Vehicle Detection inputs
[ INFO ] Checking Vehicle Detection outputs
[ INFO ] Loading Vehicle Detection model to the HETERO:FPGA,CPU plugin
[ INFO ] Loading network files for VehicleAttribs
[ INFO ] Batch size is forced to 1 for Vehicle Attribs
[ INFO ] Checking VehicleAttribs inputs
[ INFO ] Checking Vehicle Attribs outputs
[ INFO ] Loading Vehicle Attribs model to the HETERO:FPGA,CPU plugin
[ INFO ] Loading network files for Licence Plate Recognition (LPR)
[ INFO ] Batch size is forced to  1 for LPR Network
[ INFO ] Checking LPR Network inputs
[ INFO ] Checking LPR Network outputs
[ INFO ] Loading LPR model to the CPU plugin
[ INFO ] Start inference
To close the application, press 'CTRL+C' or any key with focus on the ou
tput window
^Croot@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo
emo# ./03 face detection.sh fpga
```

3) The result is shown in the figure below, enter Ctrl+c to close the Application.



■ 04_GoogleNetV2_object_detection

This demo can recognize the target object by using GoogleNetV2. The object tags are shown in the figure below:

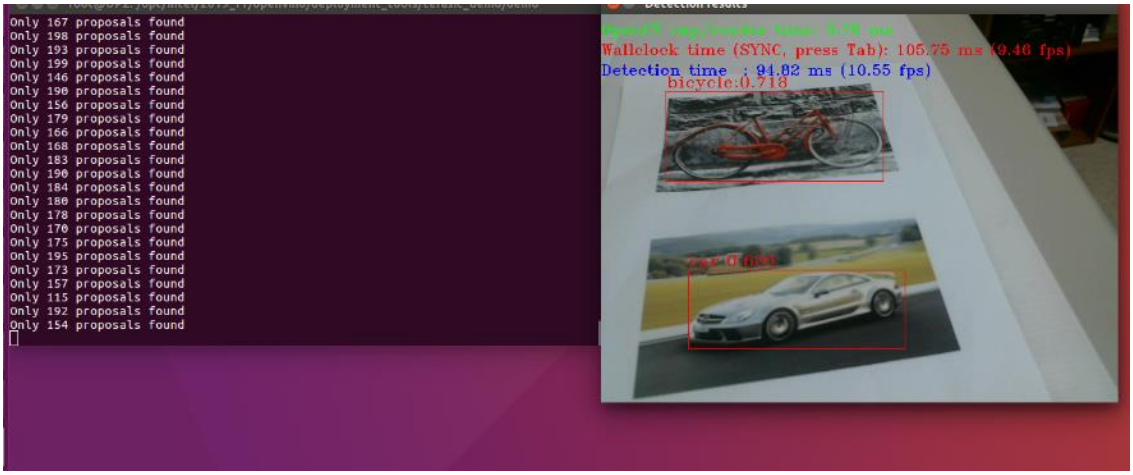
```
1  aeroplane
2  bicycle
3  bird
4  boat
5  bottle
6  bus
7  car
8  cat
9  chair
10 cow
11 diningtable
12 dog
13 horse
14 motorbike
15 person
16 pottedplant
17 sheep
18 sofa
19 train
20 tvmonitor
```

1) Plug the UVC USB camera to the host PC USB port

2) Execute "*./04_GoogleNetV2_object_detection.sh fpga*" to run the demo with FPGA

```
root@terasic: /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/de
[ INFO ] Batch size is set to 2 for Age/Gender Recognition network
[ INFO ] Checking Age/Gender Recognition network inputs
[ INFO ] Checking Age/Gender Recognition network outputs
[ INFO ] Age layer: age_conv3
[ INFO ] Gender layer: prob
[ INFO ] Loading Age/Gender Recognition model to the HETERO:FPGA,CPU plu
gin
[ INFO ] Loading network files for Head Pose Estimation network
[ INFO ] Batch size is set to  2 for Head Pose Estimation network
[ INFO ] Checking Head Pose Estimation network inputs
[ INFO ] Checking Head Pose Estimation network outputs
[ INFO ] Loading Head Pose Estimation model to the HETERO:FPGA,CPU plugi
n
[ INFO ] Loading network files for Emotions Recognition
[ INFO ] Batch size is set to 2 for Emotions Recognition
[ INFO ] Checking Emotions Recognition network inputs
[ INFO ] Checking Emotions Recognition network outputs
[ INFO ] Emotions layer: prob_emotion
[ INFO ] Loading Emotions Recognition model to the HETERO:FPGA,CPU plugi
n
[ INFO ] Facial Landmarks DISABLED
[ INFO ] Start inference
Press any key to stop
To close the application, press 'CTRL+C' or any key with focus on the ou
tput window
^Croot@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo
emo# ./04 GoogleNetV2 object detection.sh fpga
```

3) Recognize the figures with the camera. The results are shown in the figure below. Enter Ctrl+c to close the Detection results window.



■ 05_Alexnet_classification

This demo can recognize the target objects by using Alexnet model and print out the top 10 information (the recognized result in top 10 probabilities).

1) Execute "*./05_Alexnet_classification.sh fpga*" to run the demo with FPGA.

```
root@terasic: /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/de
        Build ..................... custom_releases/2019/R1_c9b66a26e4d65bb
986bb740e73f58c6e9e84c7c2
[ INFO ] Parsing input parameters
[ INFO ] Reading input
[ INFO ] Loading plugin

        API version ............ 1.6
        Build ..................... heteroPlugin
        Description ....... heteroPlugin
[ INFO ] Loading network files
[ INFO ] Batch size is forced to  1.
[ INFO ] Checking that the inputs are as the demo expects
[ INFO ] Checking that the outputs are as the demo expects
[ INFO ] Loading model to the plugin
[ INFO ] Start inference
To close the application, press 'CTRL+C' or any key with focus on the ou
tput window
^C

############################################



Demo completed successfully.

root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/d
emo# ./05_Alexnet_classification.sh fpga
```

2) The results are shown in the figure below.

```
root@terasic: /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/de
_video/car.png

classid probability label
------- ----------- -----
479     0.7904695   n02974003 car wheel
436     0.0648857   n02814533 beach wagon, station wagon, wagon, estate
car, beach waggon, station waggon, waggon
511     0.0648857   n03100240 convertible
817     0.0393552   n04285008 sports car, sport car
656     0.0238701   n03770679 minivan
661     0.0041480   n03777568 Model T
581     0.0032305   n03459775 grille, radiator grille
468     0.0025159   n02930766 cab, hack, taxi, taxicab
717     0.0019594   n03930630 pickup, pickup truck
751     0.0015260   n04037443 racer, race car, racing car


total inference time: 222.4984914
Average running time of one iteration: 222.4984914 ms

Throughput: 4.4944125 FPS

[ INFO ] Execution successful


###########################################
```

■ 06_human_pose_estimation

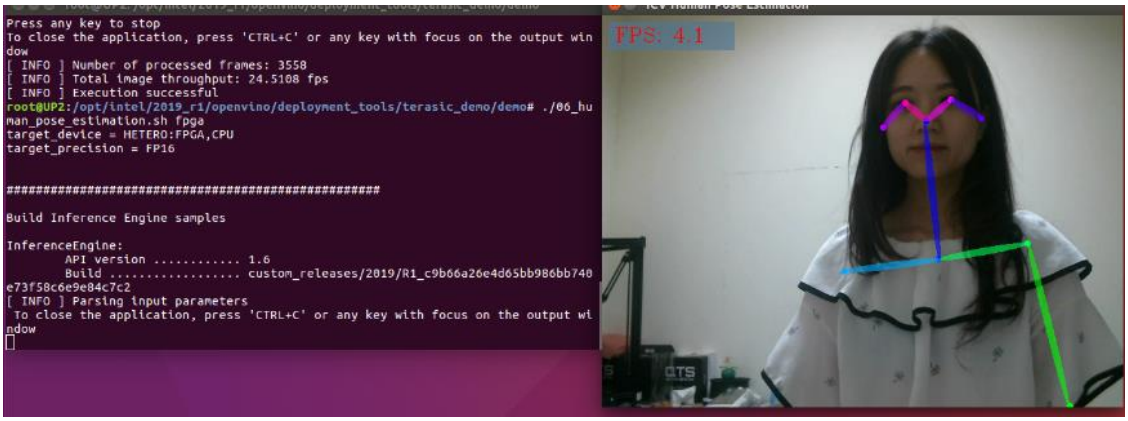
This demo can recognize human pose and display it.

1) Plug a UVC USB camera to the host PC USB port.

2) Execute "./06_human_pose_estimation.sh fpga" to run the demo with FPGA.

```
root@terasic: /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/de
car, beach waggon, station waggon, waggon
511     0.0648857   n03100240 convertible
817     0.0393552   n04285008 sports car, sport car
656     0.0238701   n03770679 minivan
661     0.0041480   n03777568 Model T
581     0.0032305   n03459775 grille, radiator grille
468     0.0025159   n02930766 cab, hack, taxi, taxicab
717     0.0019594   n03930630 pickup, pickup truck
751     0.0015260   n04037443 racer, race car, racing car


total inference time: 222.4984914
Average running time of one iteration: 222.4984914 ms

Throughput: 4.4944125 FPS

[ INFO ] Execution successful


###########################################



Demo completed successfully.

root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/d
emo# ./06_human_pose_estimation.sh fpga
```

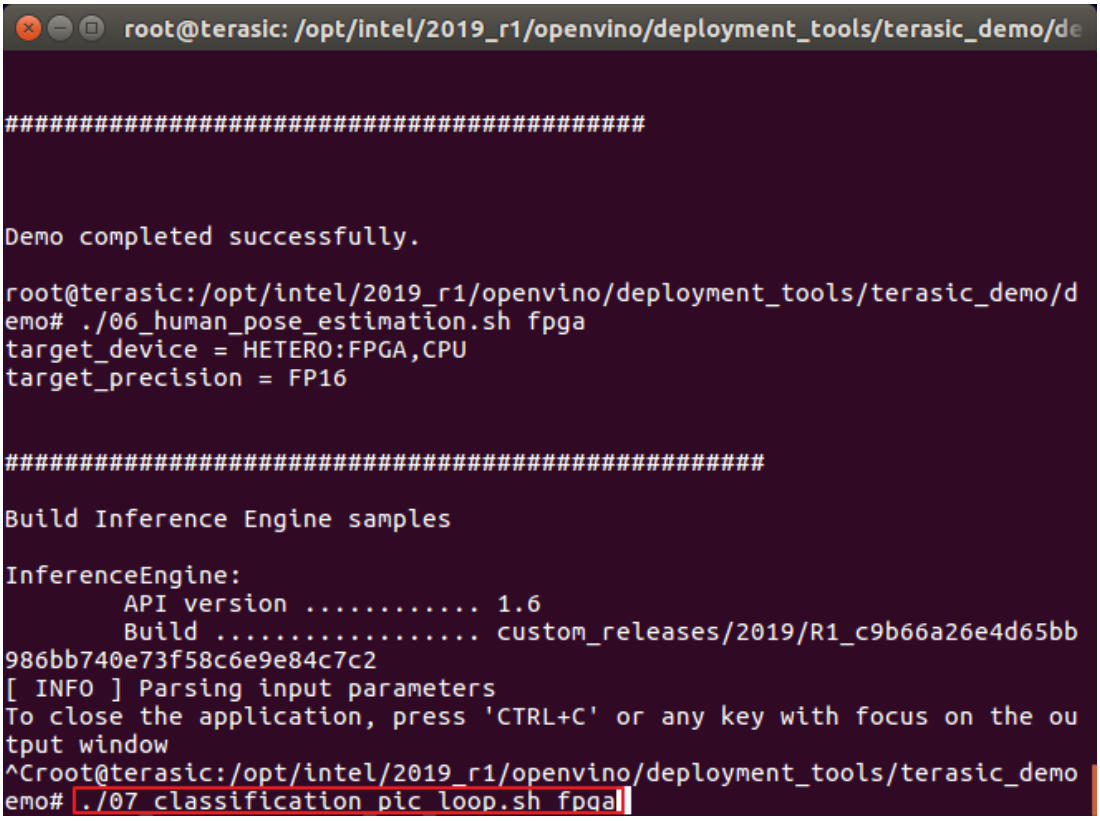
3) The result is shown in the figure below. Enter Ctrl+C to close the Application.



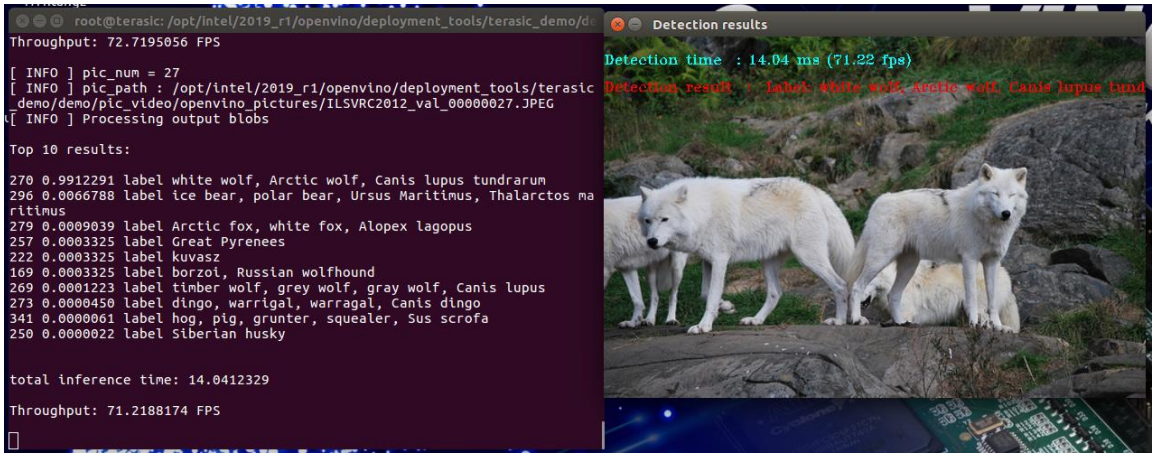
■ 07_classification_pic_loop

This demo bases demo 01_squeesnet_classification, and adds more pictures to run in a loop.

1) Execute "*./07_classification_pic_loop.sh fpga*" to run the demo with FPGA.



2) The result is shown in the figure below.



Note: Some demos execution result will show the frame rate, the result of these demos is depending on the performance of user's PC CPU and the FPGA device. The CPU grade is higher (I7 instead of I5), the result is better if user executes the demo on the DE5a-Net-DDR4 instead of TSP.

Chapter 3

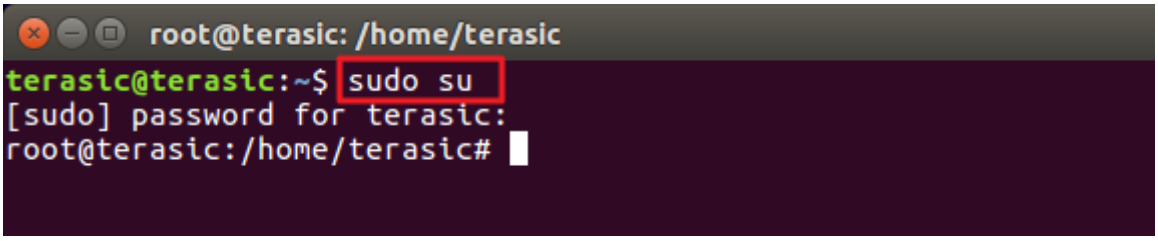
Starter Platform for OpenVINO™ Toolkit Lab

This chapter describes how to verify the experiment environment, implement the acceleration of users own AI demonstrations on the FPGA platform.

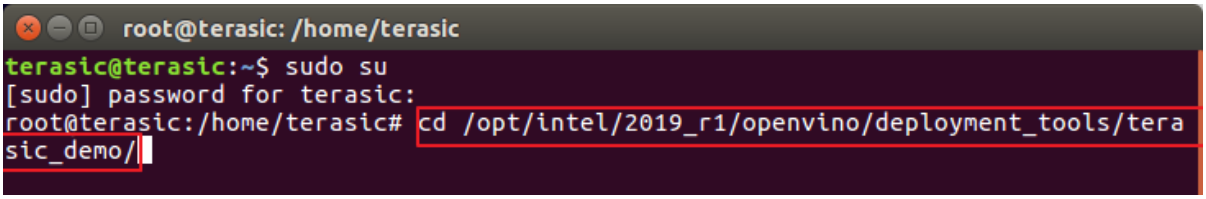
3.1 Verify the Environment of the Experiment

This section will show user how to verify the environment of the experiment by running the demo "02_security_barrier.sh" with CPU which is provided in terasic demo.

1. Open a terminal by right clicking on the Desktop.
2. Enter command "*sudo su*" to change the user to the root Super User, the password is terasic.

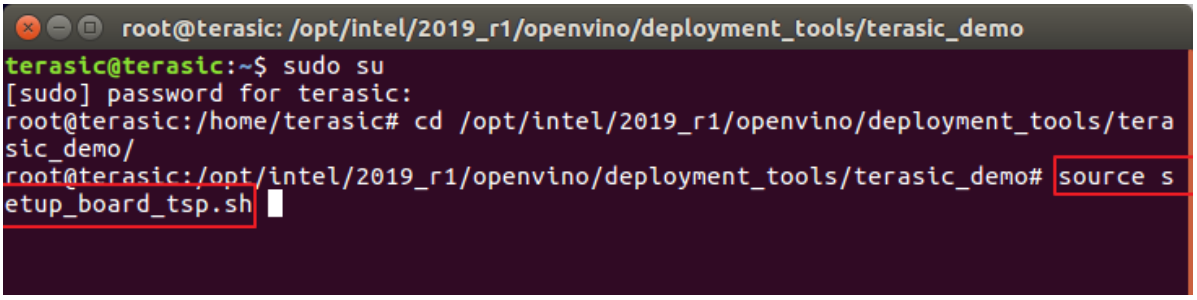


3. Enter "*cd /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo*" to switch the path.



4. Enter "*source setup_board_tsp.sh*".

   Note: User needs to setup the corresponding .sh file for the FPGA board, for example, source setup_board_tsp.sh for TSP GT Edition board or TSP GX Edition board, source setup_board_de5a_net_ddr4.sh for DE5a-Net-DDR4 board.



5. Enter "*y*" for the driver installation.

```
root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo# source s
etup_board_tsp.sh
[setupvars.sh] OpenVINO environment initialized
INTELFPGAOCLSDKROOT is set to /opt/altera/aocl-pro-rte/aclrte-linux64. Using tha
t.

aoc was not found, but aocl was found. Assuming only RTE is installed.

AOCL_BOARD_PACKAGE_ROOT is set to /opt/altera/aocl-pro-rte/aclrte-linux64/board/
osk. Using that.
Adding /opt/altera/aocl-pro-rte/aclrte-linux64/bin to PATH
Adding /opt/altera/aocl-pro-rte/aclrte-linux64/host/linux64/lib to LD_LIBRARY_PA
TH
Adding /opt/altera/aocl-pro-rte/aclrte-linux64/board/tsp/linux64/lib to LD_LIBRA
RY_PATH
Do you want to install /opt/altera/aocl-pro-rte/aclrte-linux64/board/tsp? [y/n]
y
```

6. Enter *cd /root/inference_engine_samples_build/*

```
root@terasic: /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo
terasic@terasic:~$ sudo su
[sudo] password for terasic:
root@terasic:/home/terasic# cd /opt/intel/2019_r1/openvino/deployment_tools/tera
sic_demo
root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo# source s
etup_board_tsp.sh
[setupvars.sh] OpenVINO environment initialized
INTELFPGAOCLSDKROOT is set to /opt/altera/aocl-pro-rte/aclrte-linux64. Using tha
t.

aoc was not found, but aocl was found. Assuming only RTE is installed.

AOCL_BOARD_PACKAGE_ROOT is set to /opt/altera/aocl-pro-rte/aclrte-linux64/board/
tsp. Using that.
Adding /opt/altera/aocl-pro-rte/aclrte-linux64/bin to PATH
Adding /opt/altera/aocl-pro-rte/aclrte-linux64/host/linux64/lib to LD_LIBRARY_PA
TH
Adding /opt/altera/aocl-pro-rte/aclrte-linux64/board/tsp/linux64/lib to LD_LIBRA
RY_PATH
root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo# cd /root
/inference_engine_samples_build/
```

7. Enter "*rm -rf CMakeCache.txt*"

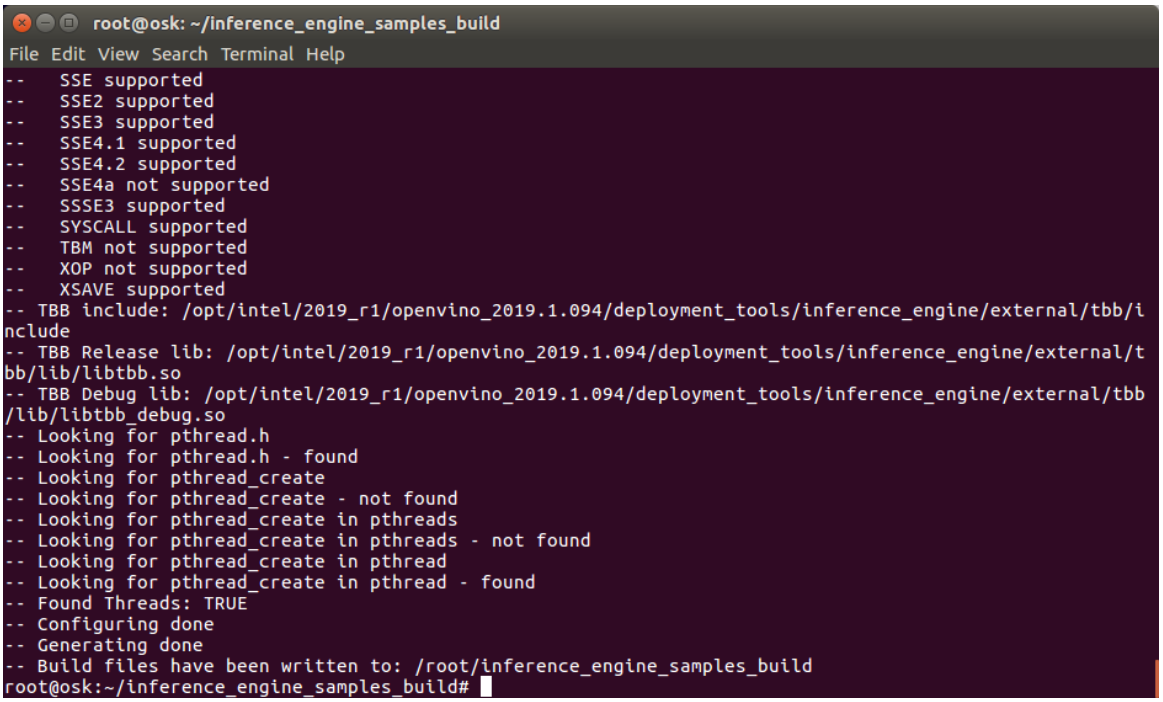
```
root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo# cd /root
/inference_engine_samples_build/
root@terasic:~/inference_engine_samples_build# rm -rf CMakeCache.txt
```

8. Enter "*cmake -DCMAKE_BUILD_TYPE=Release *

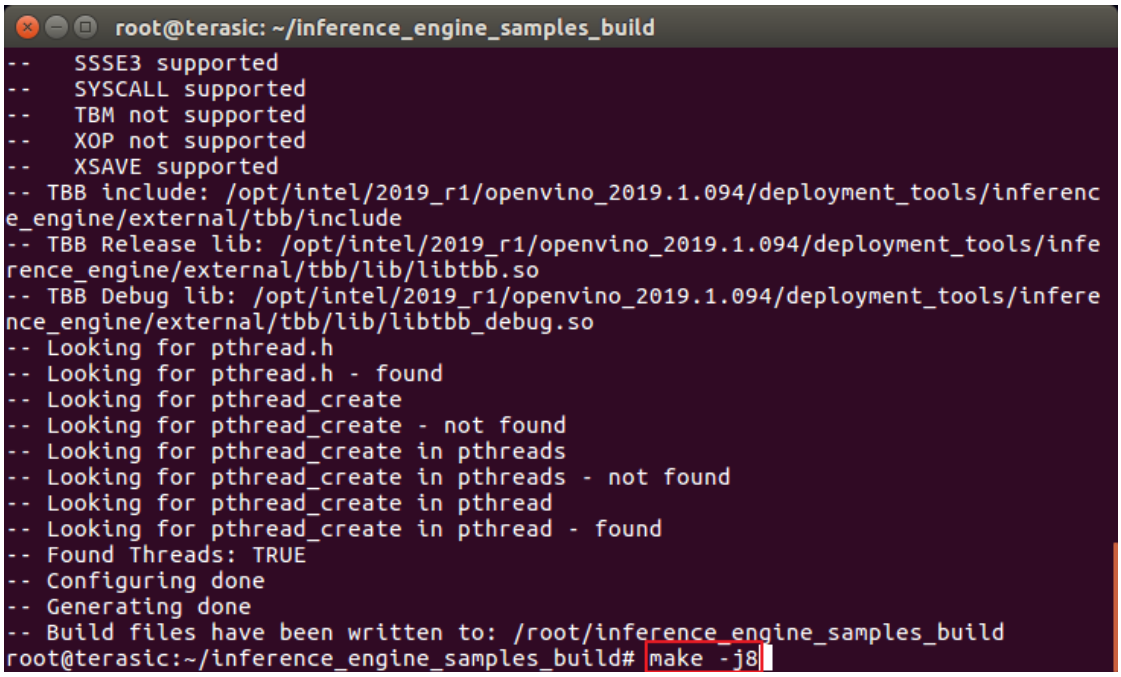
   /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples/".

```
root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo# cd /root
/inference_engine_samples_build/
root@terasic:~/inference_engine_samples_build# rm -rf CMakeCache.txt
root@terasic:~/inference_engine_samples_build# cmake -DCMAKE_BUILD_TYPE=Release
\
> /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples/
```

Then you can see the following messages.



9. Enter "*make -j8*"



10. Wait until the build process is finished.

```
root@terasic: ~/inference_engine_samples_build
pose-estimation-demo.dir/postprocess.cpp.o
[ 94%] Linking CXX executable ../intel64/Release/security_barrier_camera_demo
[ 95%] Building CXX object multichannel_demo/hpe/CMakeFiles/multi-channel-human-
pose-estimation-demo.dir/peak.cpp.o
[ 95%] Built target security_barrier_camera_demo
[ 95%] Building CXX object smart_classroom_demo/CMakeFiles/smart_classroom_demo.
dir/main.cpp.o
[ 96%] Building CXX object pedestrian_tracker_demo/CMakeFiles/pedestrian_tracker
_demo.dir/main.cpp.o
[ 97%] Building CXX object multichannel_demo/hpe/CMakeFiles/multi-channel-human-
pose-estimation-demo.dir/postprocessor.cpp.o
[ 97%] Building CXX object multichannel_demo/hpe/CMakeFiles/multi-channel-human-
pose-estimation-demo.dir/main.cpp.o
[ 98%] Linking CXX executable ../intel64/Release/calibration_tool
[ 98%] Built target calibration_tool
[ 98%] Linking CXX executable ../intel64/Release/pedestrian_tracker_demo
[ 98%] Built target pedestrian_tracker_demo
[ 99%] Linking CXX executable ../../intel64/Release/multi-channel-human-pose-est
imation-demo
[ 99%] Built target multi-channel-human-pose-estimation-demo
[100%] Linking CXX executable ../intel64/Release/smart_classroom_demo
[100%] Built target smart_classroom_demo
```

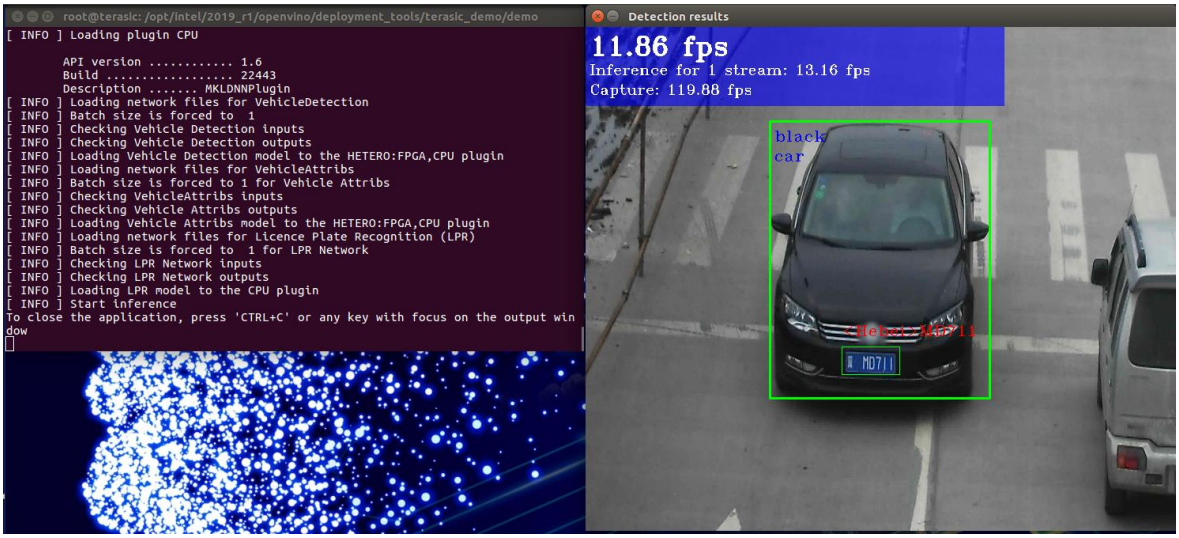
11. Enter "*cd /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo*" to switch the workspace.

```
root@terasic: ~/inference_engine_samples_build
pose-estimation-demo.dir/postprocess.cpp.o
[ 94%] Linking CXX executable ../intel64/Release/security_barrier_camera_demo
[ 95%] Building CXX object multichannel_demo/hpe/CMakeFiles/multi-channel-human-
pose-estimation-demo.dir/peak.cpp.o
[ 95%] Built target security_barrier_camera_demo
[ 95%] Building CXX object smart_classroom_demo/CMakeFiles/smart_classroom_demo.
dir/main.cpp.o
[ 96%] Building CXX object pedestrian_tracker_demo/CMakeFiles/pedestrian_tracker
_demo.dir/main.cpp.o
[ 97%] Building CXX object multichannel_demo/hpe/CMakeFiles/multi-channel-human-
pose-estimation-demo.dir/postprocessor.cpp.o
[ 97%] Building CXX object multichannel_demo/hpe/CMakeFiles/multi-channel-human-
pose-estimation-demo.dir/main.cpp.o
[ 98%] Linking CXX executable ../intel64/Release/calibration_tool
[ 98%] Built target calibration_tool
[ 98%] Linking CXX executable ../intel64/Release/pedestrian_tracker_demo
[ 98%] Built target pedestrian_tracker_demo
[ 99%] Linking CXX executable ../../intel64/Release/multi-channel-human-pose-est
imation-demo
[ 99%] Built target multi-channel-human-pose-estimation-demo
[100%] Linking CXX executable ../intel64/Release/smart_classroom_demo
[100%] Built target smart_classroom_demo
root@terasic:~/inference_engine_samples_build# cd /opt/intel/2019_r1/openvino/de
ployment_tools/terasic_demo/demo
```

12. Enter "*./02_security_barrier.sh fpga*".

```
root@terasic: /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo
[ 95%] Building CXX object multichannel_demo/hpe/CMakeFiles/multi-channel-human-
pose-estimation-demo.dir/peak.cpp.o
[ 95%] Built target security_barrier_camera_demo
[ 95%] Building CXX object smart_classroom_demo/CMakeFiles/smart_classroom_demo.
dir/main.cpp.o
[ 96%] Building CXX object pedestrian_tracker_demo/CMakeFiles/pedestrian_tracker
_demo.dir/main.cpp.o
[ 97%] Building CXX object multichannel_demo/hpe/CMakeFiles/multi-channel-human-
pose-estimation-demo.dir/postprocessor.cpp.o
[ 97%] Building CXX object multichannel_demo/hpe/CMakeFiles/multi-channel-human-
pose-estimation-demo.dir/main.cpp.o
[ 98%] Linking CXX executable ../intel64/Release/calibration_tool
[ 98%] Built target calibration_tool
[ 98%] Linking CXX executable ../intel64/Release/pedestrian_tracker_demo
[ 98%] Built target pedestrian_tracker_demo
[ 99%] Linking CXX executable ../../intel64/Release/multi-channel-human-pose-est
imation-demo
[ 99%] Built target multi-channel-human-pose-estimation-demo
[100%] Linking CXX executable ../intel64/Release/smart_classroom_demo
[100%] Built target smart_classroom_demo
root@terasic:~/inference_engine_samples_build# cd /opt/intel/2019_r1/openvino/de
ployment_tools/terasic_demo/demo
root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo# ./0
2_security_barrier.sh fpga
```

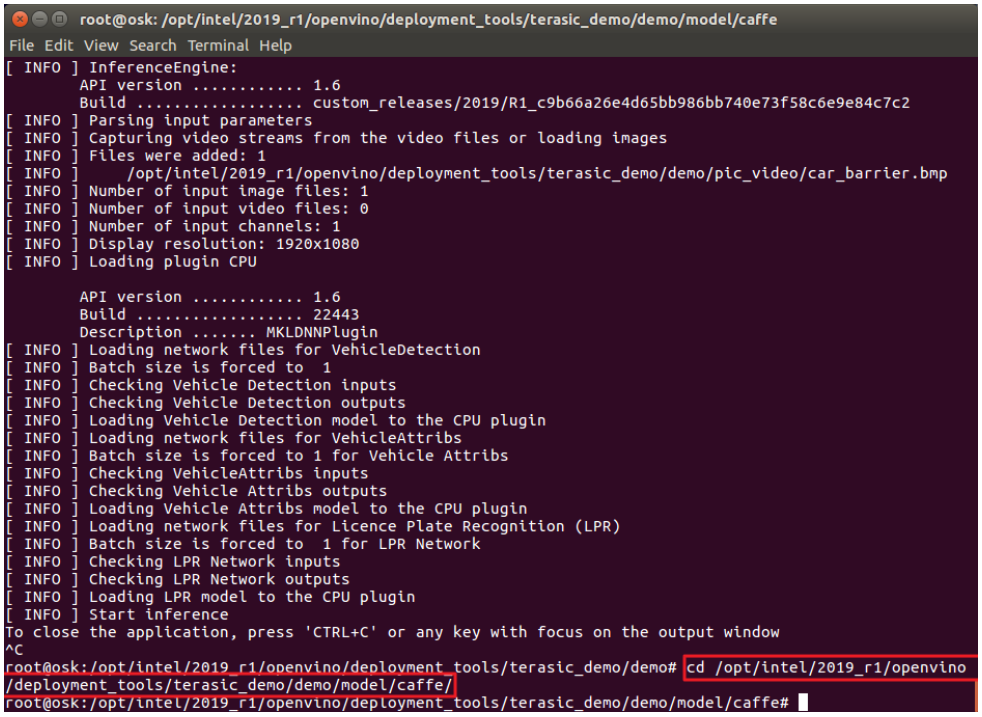
13. The result of the Demo is as shown below.



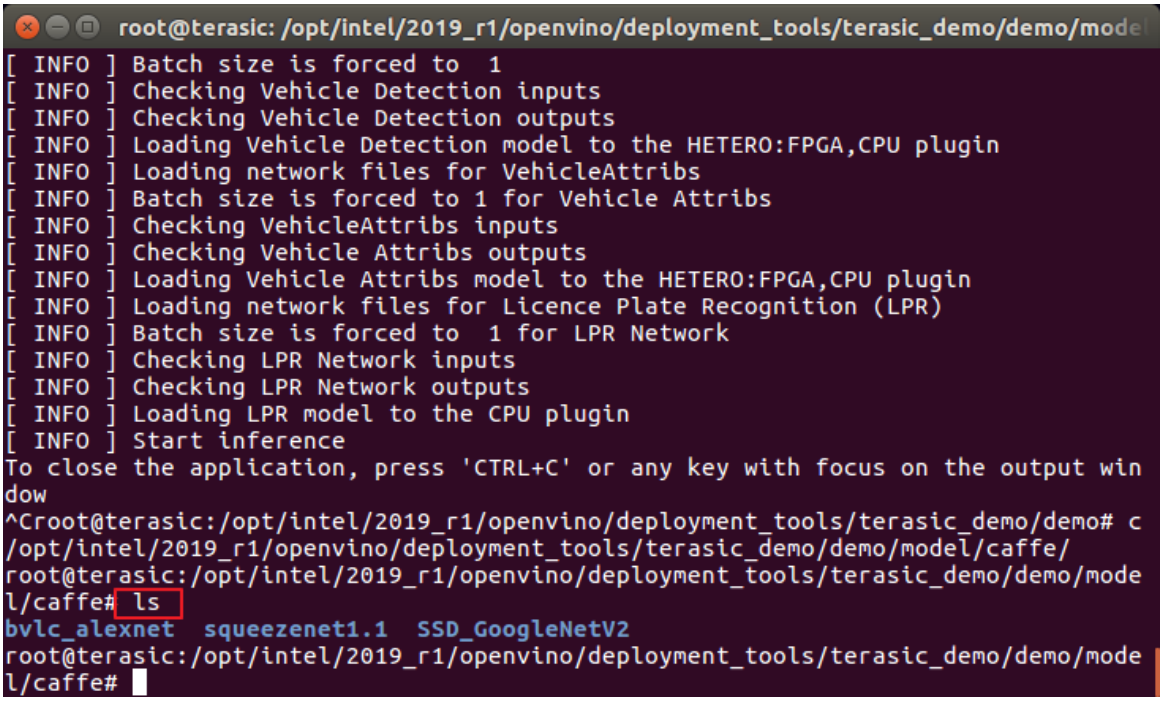
3.2 Lab 1. How to use the Model Optimizer to transform the Model?

This section will show user how to use the Model Optimizer tool to get the IR parameters from pre-downloaded caffe model file “squeesenet1.1” which will be used by Inference Engine app.

1. Enter “*cd /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/model/caffe/*” to switch the path to the pre-downloaded Model folder.



2. Enter "*ls*" to see the folder information, which includes bvlc_alexnet, squeezent1.1, and SSD_GoogleNetV2 models.



3. Enter "*cd squeezenet1.1*" to select the corresponding Model folder.

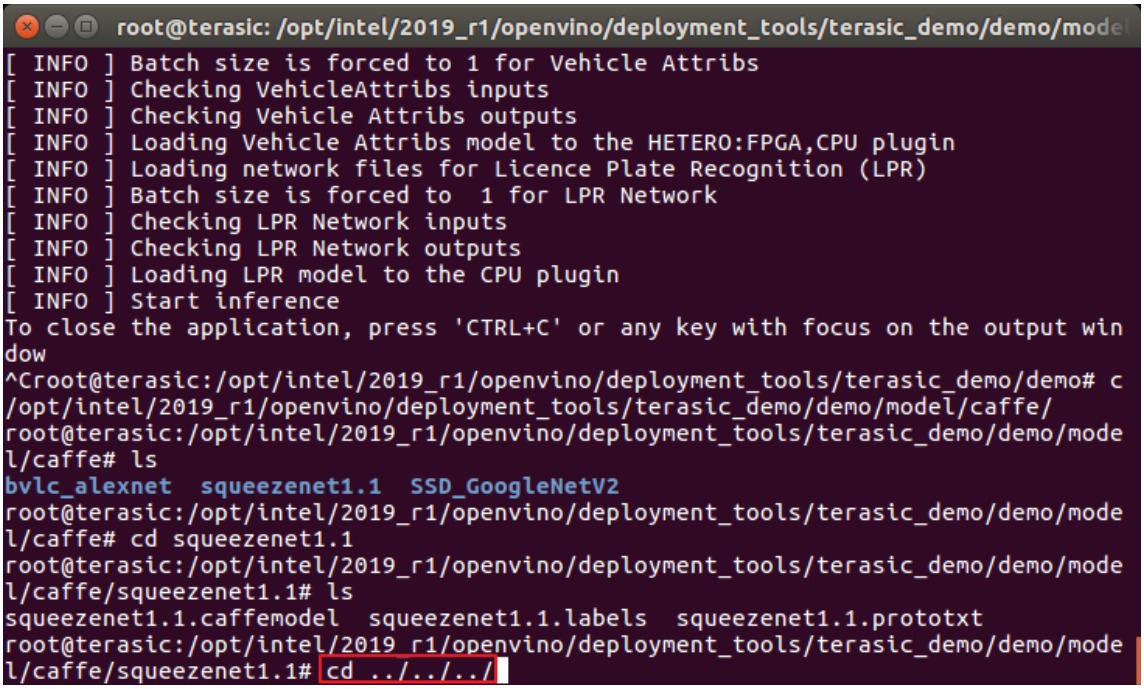
```
root@terasic: /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/model
[ INFO ] Batch size is forced to  1
[ INFO ] Checking Vehicle Detection inputs
[ INFO ] Checking Vehicle Detection outputs
[ INFO ] Loading Vehicle Detection model to the HETERO:FPGA,CPU plugin
[ INFO ] Loading network files for VehicleAttribs
[ INFO ] Batch size is forced to 1 for Vehicle Attribs
[ INFO ] Checking VehicleAttribs inputs
[ INFO ] Checking Vehicle Attribs outputs
[ INFO ] Loading Vehicle Attribs model to the HETERO:FPGA,CPU plugin
[ INFO ] Loading network files for Licence Plate Recognition (LPR)
[ INFO ] Batch size is forced to  1 for LPR Network
[ INFO ] Checking LPR Network inputs
[ INFO ] Checking LPR Network outputs
[ INFO ] Loading LPR model to the CPU plugin
[ INFO ] Start inference
To close the application, press 'CTRL+C' or any key with focus on the output win
dow
^Croot@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo# c
/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/model/caffe/
root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/mode
l/caffe# ls
bvlc_alexnet  squeezenet1.1  SSD_GoogleNetV2
root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/mode
l/caffe# cd squeezenet1.1
```

4. Enter "*ls*" to see the composition of the model, there are 3 files:

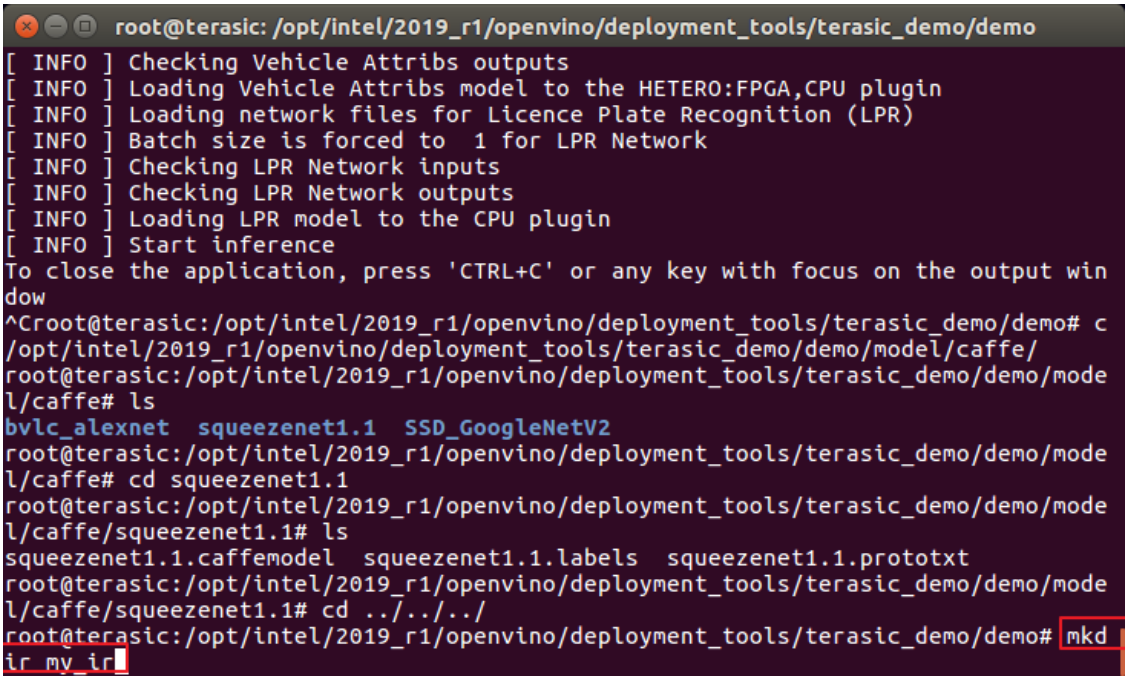
   - squeezenet1.1.caffemodel is the file to describe the adjusted weights and biases for the trained model.
   - squeezenet1.1.labels is the label file for classification model.
   - squeezenet1.1.prototxt is the description file for the model structure.

```
root@terasic: /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/model
[ INFO ] Batch size is forced to 1 for Vehicle Attribs
[ INFO ] Checking VehicleAttribs inputs
[ INFO ] Checking Vehicle Attribs outputs
[ INFO ] Loading Vehicle Attribs model to the HETERO:FPGA,CPU plugin
[ INFO ] Loading network files for Licence Plate Recognition (LPR)
[ INFO ] Batch size is forced to  1 for LPR Network
[ INFO ] Checking LPR Network inputs
[ INFO ] Checking LPR Network outputs
[ INFO ] Loading LPR model to the CPU plugin
[ INFO ] Start inference
To close the application, press 'CTRL+C' or any key with focus on the output win
dow
^Croot@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo# c
/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/model/caffe/
root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/mode
l/caffe# ls
bvlc_alexnet  squeezenet1.1  SSD_GoogleNetV2
root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/mode
l/caffe# cd squeezenet1.1
root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/mode
l/caffe/squeezenet1.1# ls
squeezenet1.1.caffemodel  squeezenet1.1.labels  squeezenet1.1.prototxt
root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/mode
l/caffe/squeezenet1.1#
```

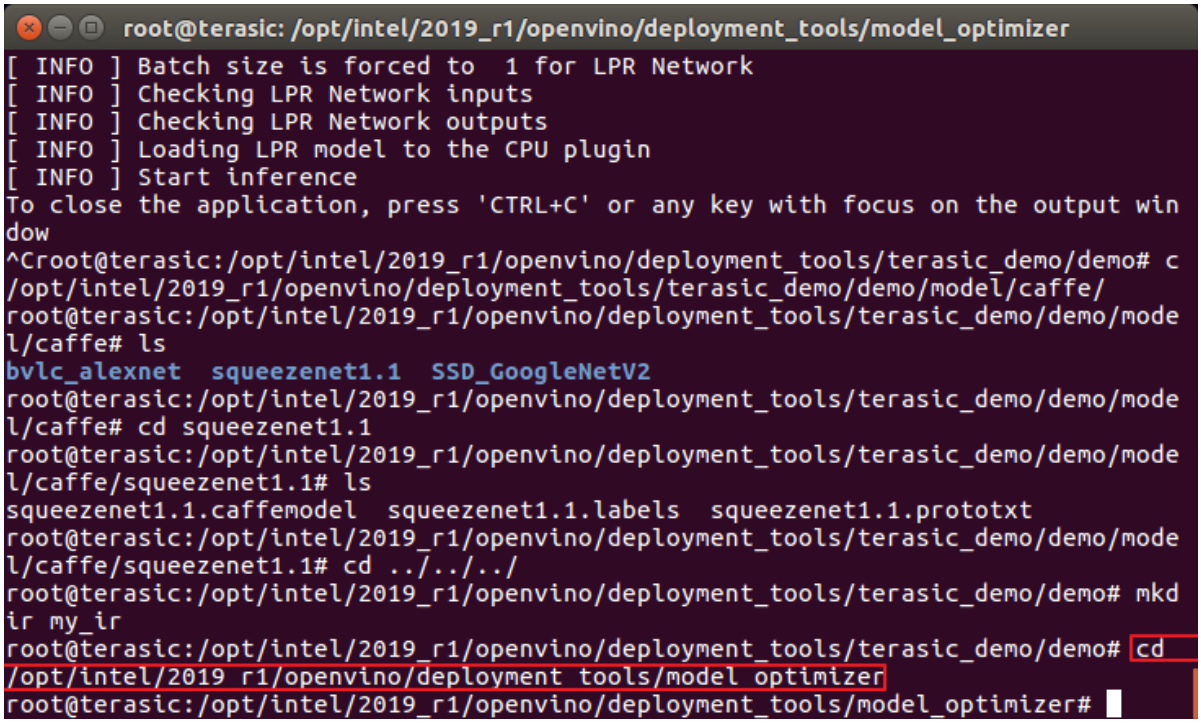
5. Enter "*cd ../../../*" to go back to the demo folder.



6. Enter "*mkdir my_ir*" to create a new folder for saving IR files.



7. Enter "*cd /opt/intel/2019_r1/openvino/deployment_tools/model_optimizer*" to switch the workspace to the Model Optimizer folder.



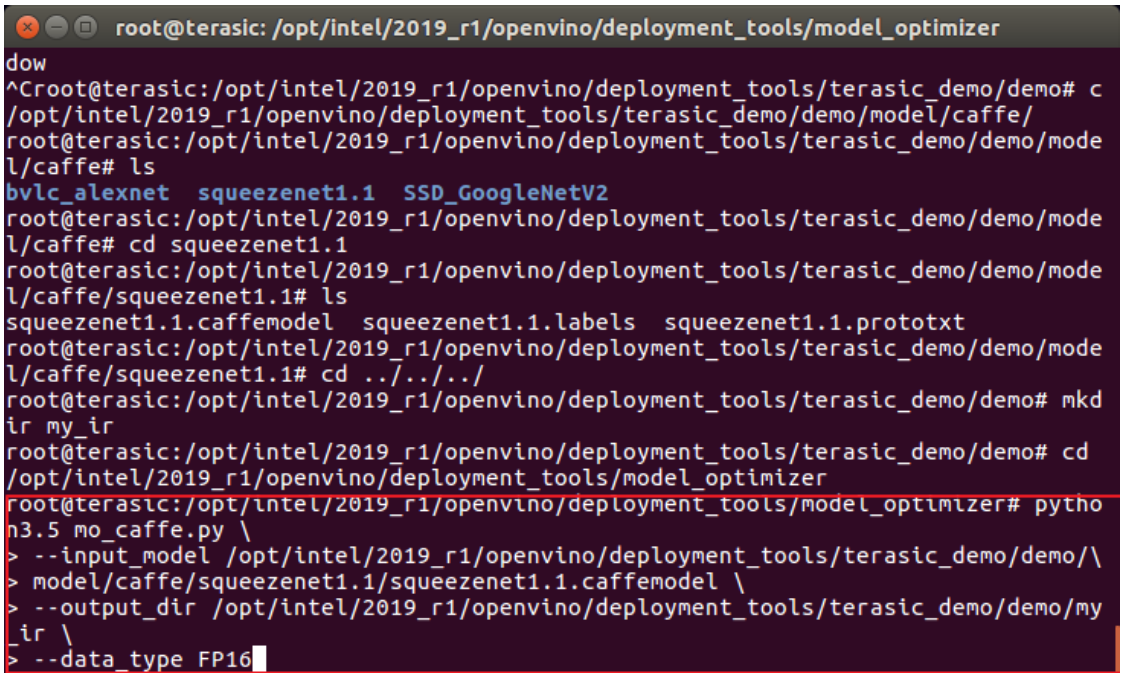
8. Enter "*python3.5 mo_caffe.py* \

   --input_model /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/\

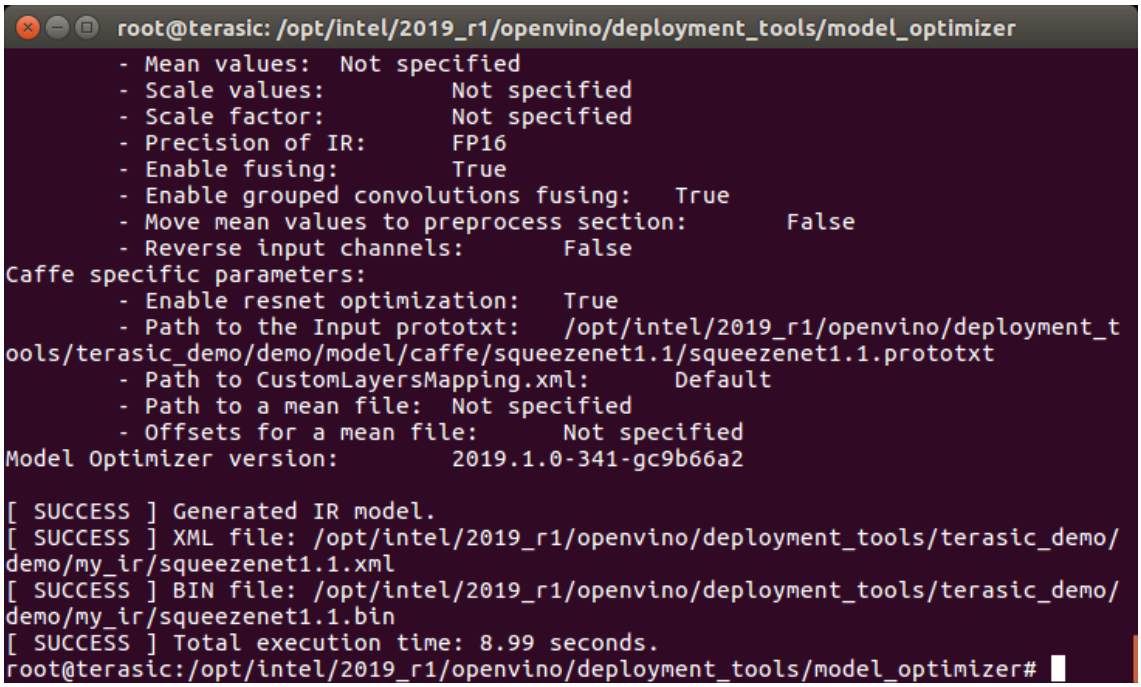
   model/caffe/squeezenet1.1/squeezenet1.1.caffemodel \

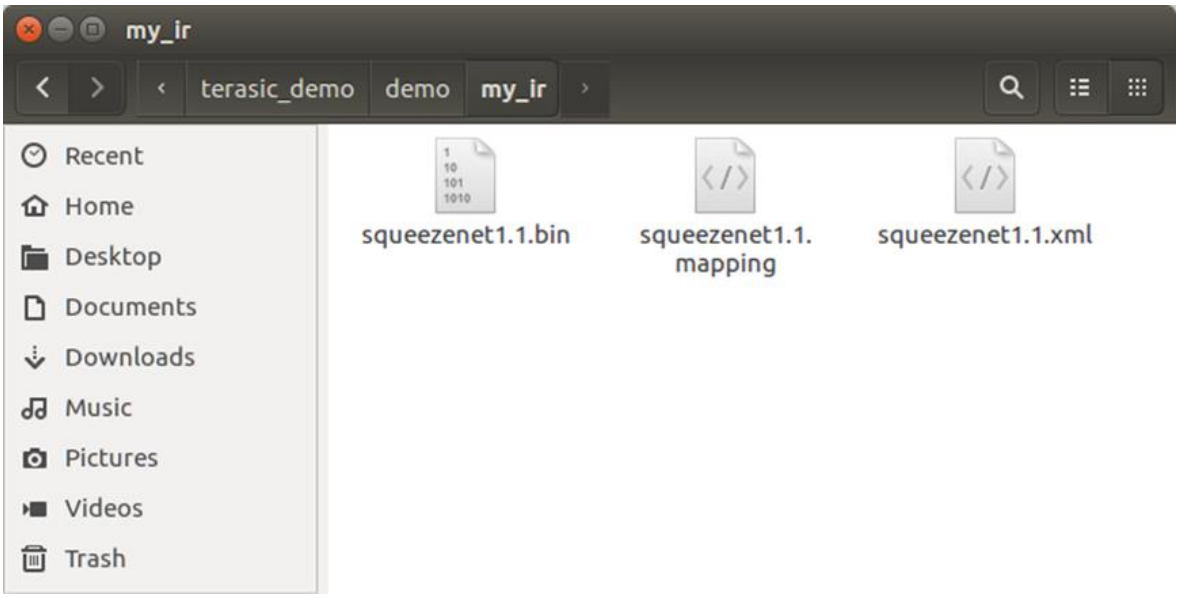
   --output_dir /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/my_ir \

   --data_type FP16".



9. The corresponding IR files are generated in the my_ir folder.



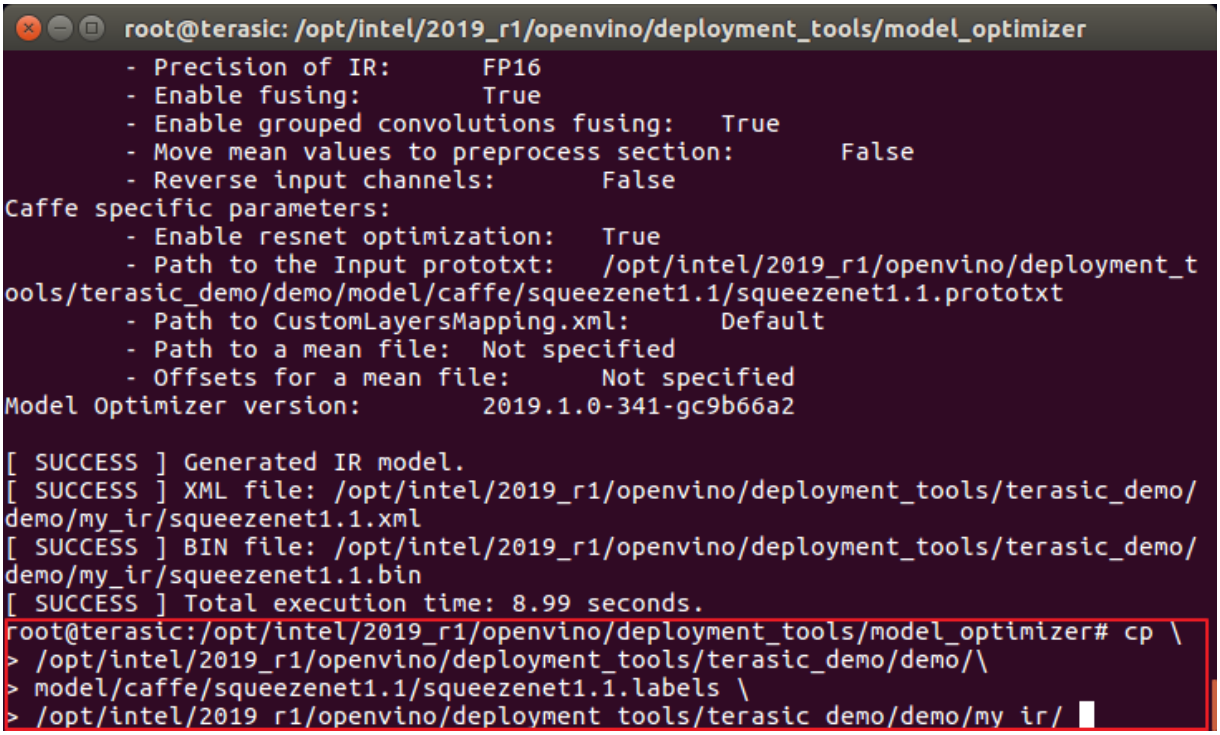


10. Copy the .label file from Model folder to the my_ir folder by entering

    "*cp *

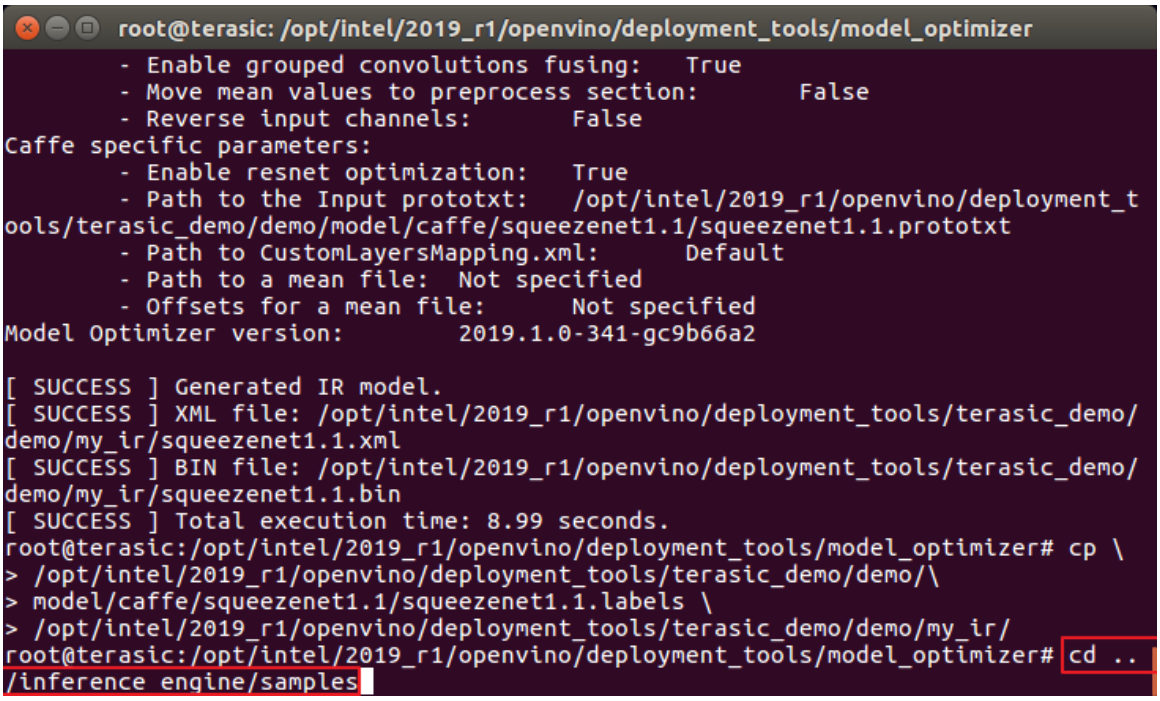
    /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/

    *model/caffe/squeezenet1.1/squeezenet1.1.labels *
    /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/my_ir/ ".

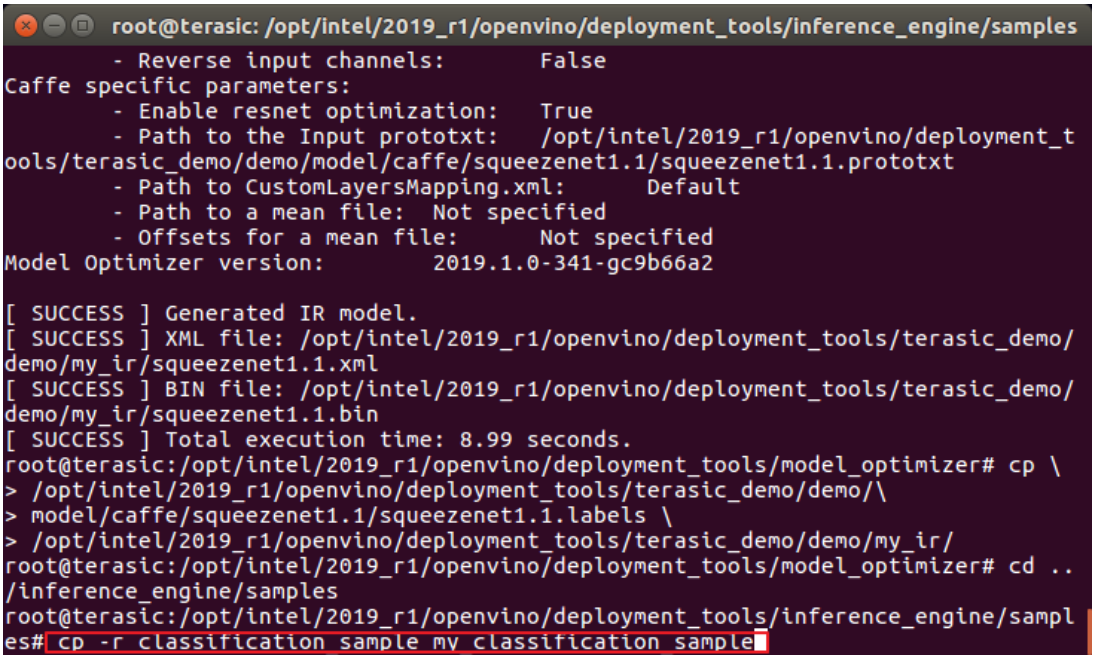


3.3 Lab 2. How to compile an Inference Engine app?

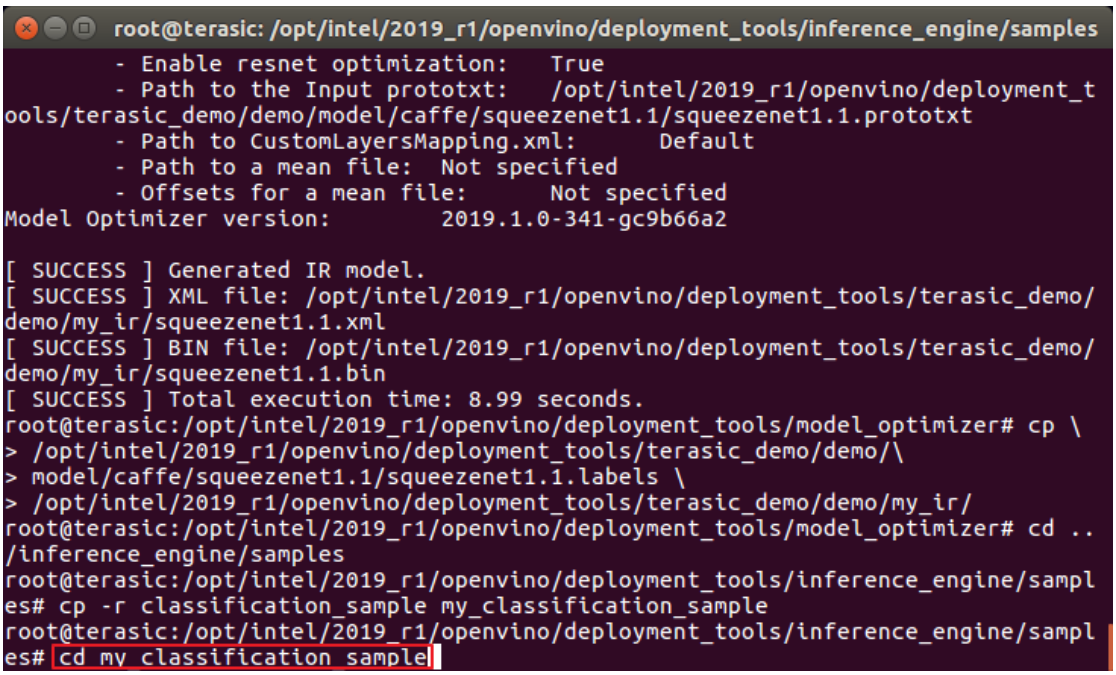
1. As the time is limited, we directly copy an existed application, rename it, and make a compilation.
2. Enter "*cd ../inference_engine/samples*" to switch the workspace to the Inference Engine samples folder.



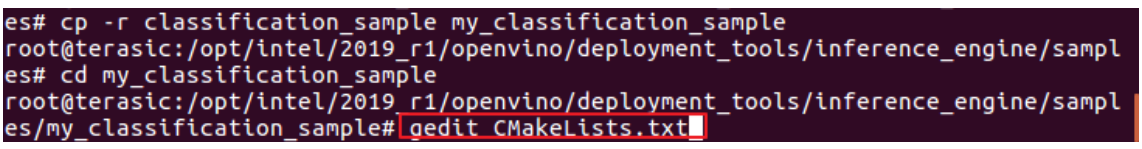
3. Enter "*cp -r classification_sample my_classification_sample*".

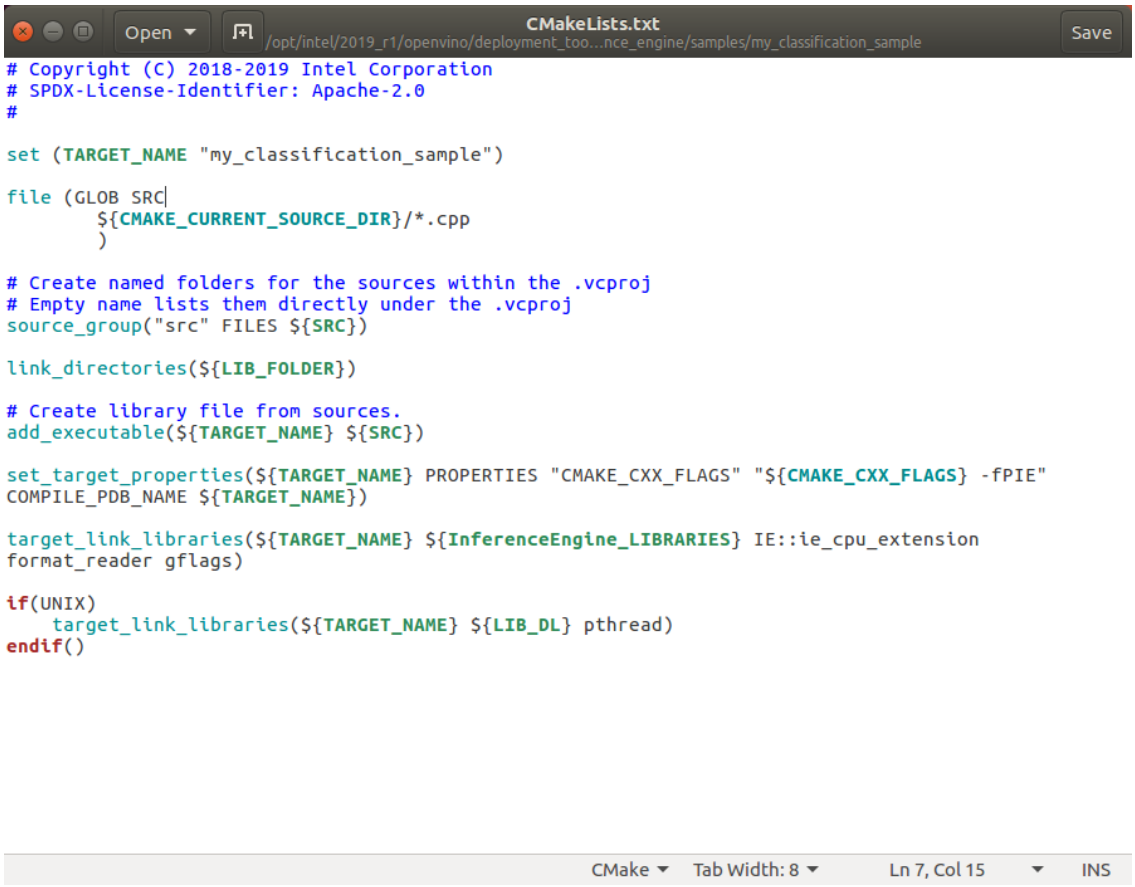


4. Enter "*cd my_classification_sample*" to switch the workspace to the new app folder.

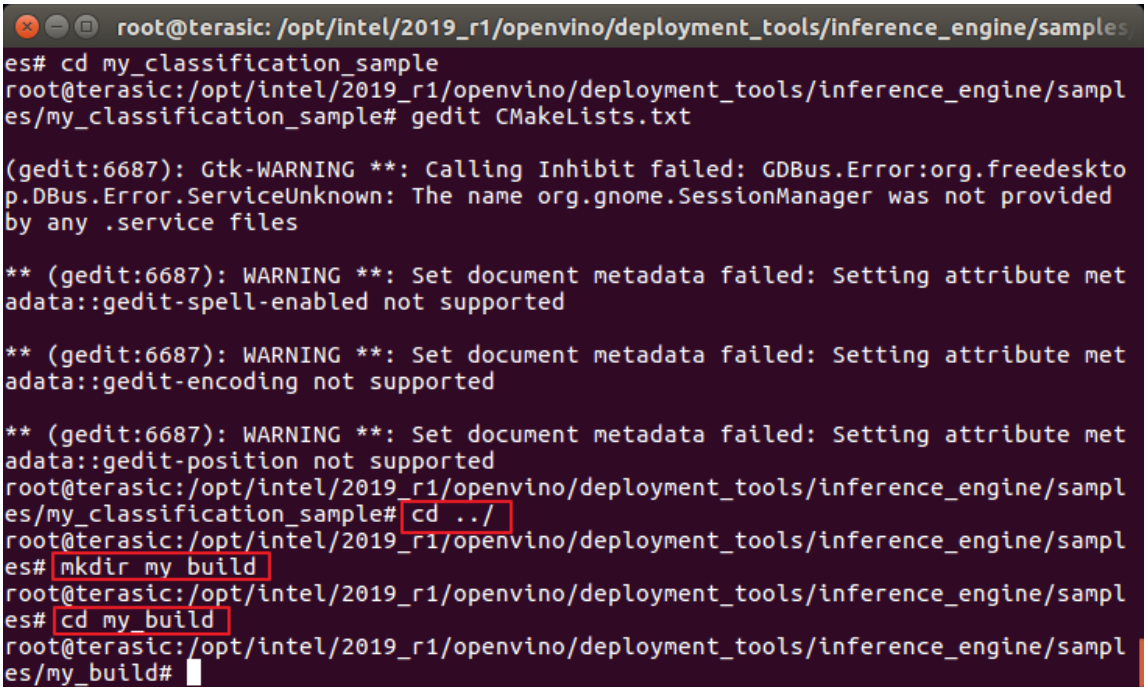


5. Enter "*gedit CMakeLists.txt*" to open the file, re-name the target_name to my_classification_sample, save and close the file.

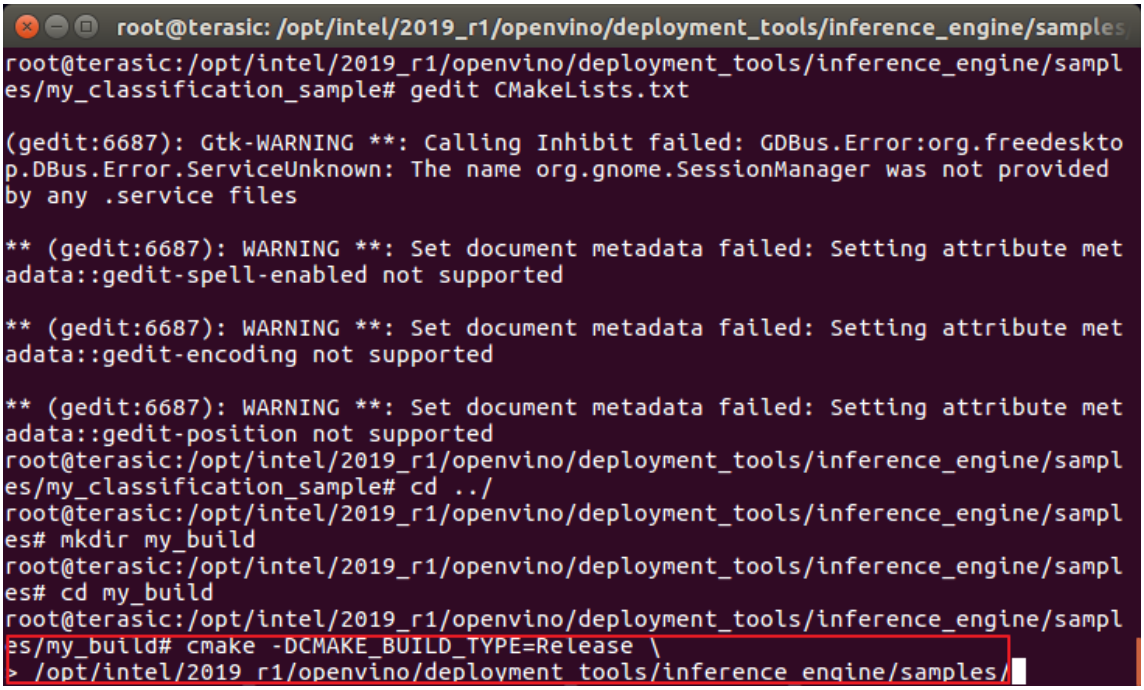




6. Enter “cd ../” to go back to the sample folder.
7. Enter “*mkdir my_build*” to create a new folder for saving the generated executable program.
8. Enter “*cd my_build*” to switch to the working directory.

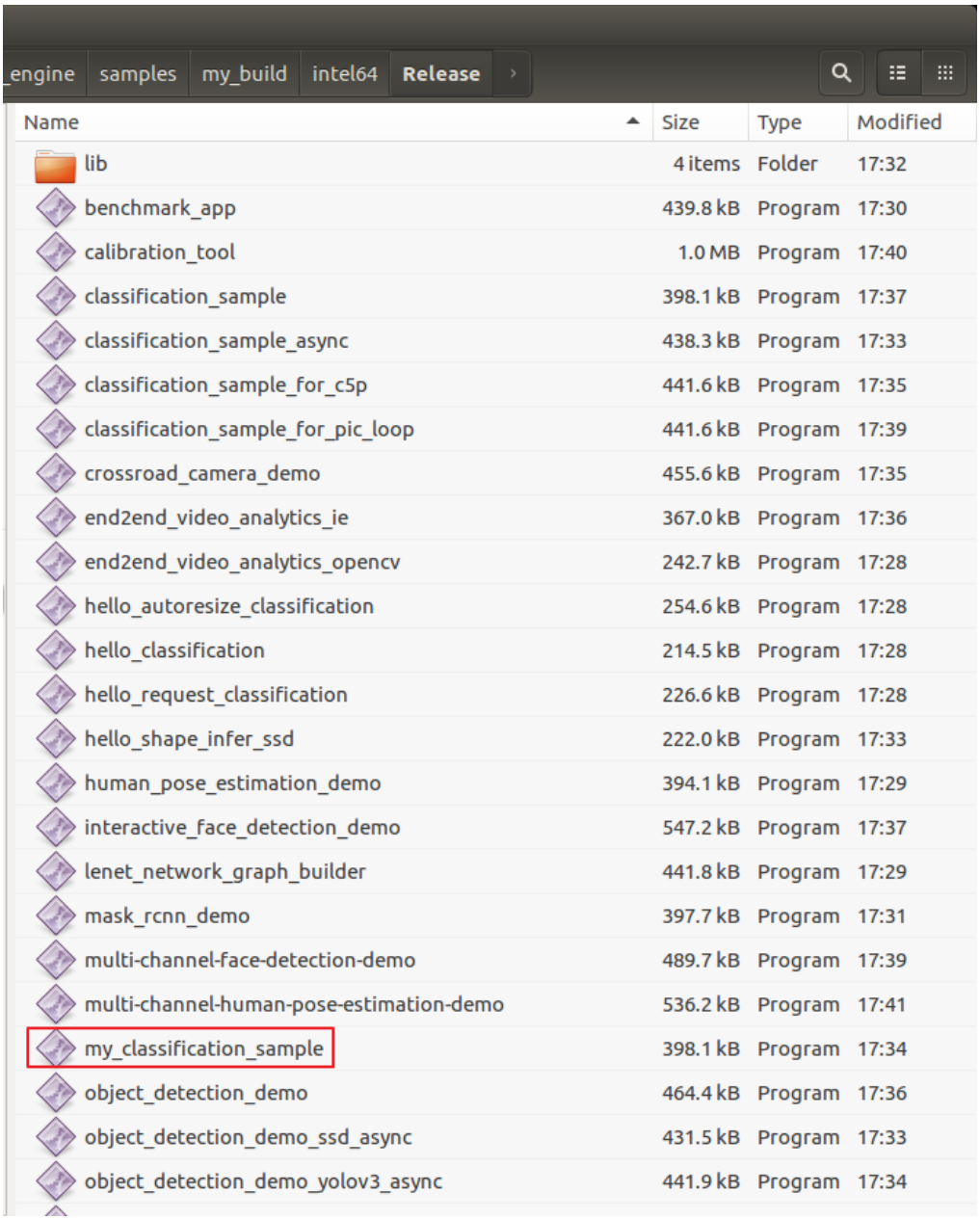


9. Enter “*cmake -DCMAKE_BUILD_TYPE=Release \ /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples/*” to copy the file automatically into the directory-my_build, and it will generate a makefile for the code compilation.



10. Enter "*make -j8*" to compile the application program, please be patient for the compilation process. Current settings of compilation will compile all the applications in samples folder to executable program.

11. Under the path: my_build/intel64/Release/, the corresponding my_classification_sample executable program is generated, and the application is created.



For more information of Inference Engine API, user can refer to following link:

https://docs.openvinotoolkit.org/latest/annotated.html

https://docs.openvinotoolkit.org/latest/_docs_IE_DG_Integrate_with_customer_application_new_API.html

3.4 Lab 3. Execute the created application file, use the Inference Engine for the classification predication.

1. In the previous steps, we have transformed the model to the IR files which are used by the inference engine, and generated the corresponding executable file. Before executing the file, let's have a general understanding of the operations in the application program.

2. Open the file: classification_sample.h, there is a parameter "showUsage" for executing the app, -h

is for help, -i is for the path to a folder with images or the camera parameters, -m is for the path of a trained Model (IR Path), -d is for the target device.

classification_sample.h [Read-Only] (/opt/intel/2019_r1/openvino/deployment...e_engine/

Open Save

```
/// @brief Absolute path to CPU library with user layers <br>
/// It is a optional parameter
DEFINE_string(l, "", custom_cpu_library_message);

/// @brief Iterations count (default 1)
DEFINE_uint32(ni, 1, iterations_count_message);

/// @brief Enable plugin messages
DEFINE_bool(p_msg, false, plugin_message);

/**
* @brief This function show a help message
*/
static void showUsage() {
    std::cout << std::endl;
    std::cout << "classification_sample [OPTION]" << std::endl;
    std::cout << "Options:" << std::endl;
    std::cout << std::endl;
    std::cout << "    -h                      " << help_message << std::endl;
    std::cout << "    -i \"<path>\"             " << image_message << std::endl;
    std::cout << "    -m \"<path>\"             " << model_message << std::endl;
    std::cout << "      -l \"<absolute_path>\"    " << custom_cpu_library_message
<< std::endl;
    std::cout << "          Or" << std::endl;
    std::cout << "      -c \"<absolute_path>\"    " << custom_cldnn_message <<
std::endl;
    std::cout << "    -pp \"<path>\"            " << plugin_path_message <<
std::endl;
    std::cout << "    -d \"<device>\"           " << target_device_message <<
std::endl;
    std::cout << "    -nt \"<integer>\"         " << ntop_message << std::endl;
    std::cout << "    -ni \"<integer>\"         " << iterations_count_message <<
std::endl;
    std::cout << "    -pc                     " << performance_counter_message <<
std::endl;
    std::cout << "    -p_msg                  " << plugin_message << std::endl;
}
```

C/C++/ObjC Header Tab Width: 8 Ln 24, Col 1 INS

3. Open the main.cpp in the folder: inference_engine/samples/my_classification_sample, there are explanations:

   - Step1, Load Plugin for inference engine, for this lab, the plugin is hetero plugin for FPGA and CPU.

```
// ------------------------------ Parsing and validation of input args ---------------------------------
if (!ParseAndCheckCommandLine(argc, argv)) {
    return 0;
}

/** This vector stores paths to the processed images **/
std::vector<std::string> imageNames;
parseImagesArguments(imageNames);
if (imageNames.empty()) throw std::logic_error("No suitable images were found");
// ---------------------------------------------------------------------------------------------------

// --------------------------- 1. Load Plugin for inference engine ---------------------------------
slog::info << "Loading plugin" << slog::endl;
InferencePlugin plugin = PluginDispatcher({ FLAGS_pp, "../../../lib/intel64" , "" }).getPluginByDevice(FLAGS_d);

/** Loading default extensions **/
if (FLAGS_d.find("CPU") != std::string::npos) {
    /**
     * cpu_extensions library is compiled from "extension" folder containing
     * custom MKLDNNPlugin layer implementations. These layers are not supported
     * by mkldnn, but they can be useful for inferring custom topologies.
    **/
    plugin.AddExtension(std::make_shared<Extensions::Cpu::CpuExtensions>());
}

if (!FLAGS_l.empty()) {
    // CPU(MKLDNN) extensions are loaded as a shared library and passed as a pointer to base extension
    auto extension_ptr = make_so_pointer<IExtension>(FLAGS_l);
    plugin.AddExtension(extension_ptr);
    slog::info << "CPU Extension loaded: " << FLAGS_l << slog::endl;
}
if (!FLAGS_c.empty()) {
    // clDNN Extensions are loaded from an .xml description and OpenCL kernel files
    plugin.SetConfig({{PluginConfigParams::KEY_CONFIG_FILE, FLAGS_c}});
    slog::info << "GPU Extension loaded: " << FLAGS_c << slog::endl;
}

/** Setting plugin parameter for collecting per layer metrics **/
if (FLAGS_pc) {
    plugin.SetConfig({ { PluginConfigParams::KEY_PERF_COUNT, PluginConfigParams::YES } });
}

/** Printing plugin version **/
printPluginVersion(plugin, std::cout);
// ---------------------------------------------------------------------------------------------------
```

- Step2, Read the IR Generated by Model Optimizer (.xml and .bin files).

  For this lab, the xml file is squeezenet1.1.xml.

```
// ---------------------------- 2. Read IR Generated by ModelOptimizer (.xml and .bin files) ---
std::string binFileName = fileNameNoExt(FLAGS_m) + ".bin";
slog::info << "Loading network files:"
        "\n\t" << FLAGS_m <<
        "\n\t" << binFileName <<
slog::endl;

CNNNetReader networkReader;
/** Reading network model **/
networkReader.ReadNetwork(FLAGS_m);

/** Extracting model name and loading weights **/
networkReader.ReadWeights(binFileName);
CNNNetwork network = networkReader.getNetwork();
// ---------------------------------------------------------------------------------------------------
```

- Step3, configure the input & output, prepare the input blobs, read the input size information, read the images path, set batch size, prepare the output blobs.

```
// --------------------------- 3. Configure input & output ---------------------------------

// --------------------------- Prepare input blobs -----------------------------------------
slog::info << "Preparing input blobs" << slog::endl;

/** Taking information about all topology inputs **/
InputsDataMap inputInfo = network.getInputsInfo();

if (inputInfo.size() != 1) throw std::logic_error("Sample supports topologies only with 1 input");
auto inputInfoItem = *inputInfo.begin();

/** Specifying the precision and layout of input data provided by the user.
 * This should be called before load of the network to the plugin **/
inputInfoItem.second->setPrecision(Precision::U8);
inputInfoItem.second->setLayout(Layout::NCHW);

std::vector<std::shared_ptr<unsigned char>> imagesData;
for (auto & i : imageNames) {
    FormatReader::ReaderPtr reader(i.c_str());
    if (reader.get() == nullptr) {
        slog::warn << "Image " + i + " cannot be read!" << slog::endl;
        continue;
    }
    /** Store image data **/
    std::shared_ptr<unsigned char> data(
            reader->getData(inputInfoItem.second->getTensorDesc().getDims()[3],
                            inputInfoItem.second->getTensorDesc().getDims()[2]));
    if (data.get() != nullptr) {
        imagesData.push_back(data);
    }
}
if (imagesData.empty()) throw std::logic_error("Valid input images were not found!");

/** Setting batch size using image count **/
network.setBatchSize(imagesData.size());
size_t batchSize = network.getBatchSize();
slog::info << "Batch size is " << std::to_string(batchSize) << slog::endl;
```

- Step4, Loading model to the plugin.

```
// --------------------------- 4. Loading model to the plugin --------------
slog::info << "Loading model to the plugin" << slog::endl;

ExecutableNetwork executable_network = plugin.LoadNetwork(network, {});
inputInfoItem.second = {};
outputInfo = {};
network = {};
networkReader = {};
// -------------------------------------------------------------------------
```

- Step5, create infer request.

```
// --------------------------- 5. Create infer request -----------------
InferRequest infer_request = executable_network.CreateInferRequest();
// -------------------------------------------------------------------
```

- Step6, Prepare input.

```
// --------------------------- 6. Prepare input ------------------------------------------------------
/** Iterate over all the input blobs **/
for (const auto & item : inputInfo) {
    /** Creating input blob **/
    Blob::Ptr input = infer_request.GetBlob(item.first);

    /** Filling input tensor with images. First b channel, then g and r channels **/
    size_t num_channels = input->getTensorDesc().getDims()[1];
    size_t image_size = input->getTensorDesc().getDims()[2] * input->getTensorDesc().getDims()[3];

    auto data = input->buffer().as<PrecisionTrait<Precision::U8>::value_type*>();

    /** Iterate over all input images **/
    for (size_t image_id = 0; image_id < imagesData.size(); ++image_id) {
        /** Iterate over all pixel in image (b,g,r) **/
        for (size_t pid = 0; pid < image_size; pid++) {
            /** Iterate over all channels **/
            for (size_t ch = 0; ch < num_channels; ++ch) {
                /**         [images stride + channels stride + pixel id ] all in bytes            **/
                data[image_id * image_size * num_channels + ch * image_size + pid ] = imagesData.at(image_id).get()[pid*num_channels + ch];
            }
        }
    }
}
inputInfo = {};
// -----------------------------------------------------------------------------------------------------
```

- Step7, Do the inference, send data to FPGA for processing, and send the result to CPU.

```
// --------------------------- 7. Do inference -------------------------------------------------------
slog::info << "Starting inference (" << FLAGS_ni << " iterations)" << slog::endl;

typedef std::chrono::high_resolution_clock Time;
typedef std::chrono::duration<double, std::ratio<1, 1000>> ms;
typedef std::chrono::duration<float> fsec;

double total = 0.0;
/** Start inference & calc performance **/
for (int iter = 0; iter < FLAGS_ni; ++iter) {
    auto t0 = Time::now();
    infer_request.Infer();
    auto t1 = Time::now();
    fsec fs = t1 - t0;
    ms d = std::chrono::duration_cast<ms>(fs);
    total += d.count();
}

/** Show performance results **/
slog::info << "Average running time of one iteration: " << total / static_cast<double>(FLAGS_ni) << " ms" << slog::endl;

if (FLAGS_pc) {
    printPerformanceCounts(infer_request, std::cout);
}
// -----------------------------------------------------------------------------------------------------
```

- Step8, Process output, process the result and compare with the label file, the last printf the result and the average inference time.

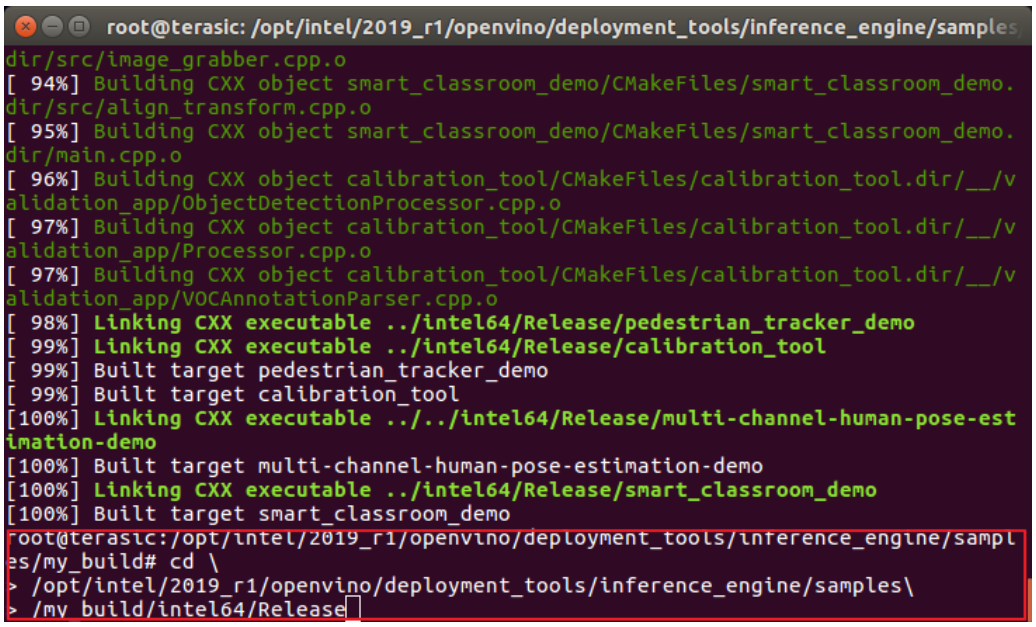
```
// --------------------------- 8. Process output -----------------------------------------------------
slog::info << "Processing output blobs" << slog::endl;

const Blob::Ptr output_blob = infer_request.GetBlob(firstOutputName);
auto output_data = output_blob->buffer().as<PrecisionTrait<Precision::FP32>::value_type*>();

/** Validating -nt value **/
const int resultsCnt = output_blob->size() / batchSize;
if (FLAGS_nt > resultsCnt || FLAGS_nt < 1) {
    slog::warn << "-nt " << FLAGS_nt << " is not available for this network (-nt should be less than " \
               << resultsCnt+1 << " and more than 0)\n            will be used maximal value : " << resultsCnt;
    FLAGS_nt = resultsCnt;
}

/** This vector stores id's of top N results **/
std::vector<unsigned> results;
TopResults(FLAGS_nt, *output_blob, results);

std::cout << std::endl << "Top " << FLAGS_nt << " results:" << std::endl << std::endl;

/** Read labels from file (e.x. AlexNet.labels) **/
bool labelsEnabled = false;
std::string labelFileName = fileNameNoExt(FLAGS_m) + ".labels";
std::vector<std::string> labels;

std::ifstream inputFile;
inputFile.open(labelFileName, std::ios::in);
if (inputFile.is_open()) {
    std::string strLine;
    while (std::getline(inputFile, strLine)) {
        trim(strLine);
        labels.push_back(strLine);
    }
    labelsEnabled = true;
}
```

4. Now, we are clear about the operations executed in the application, next, let us run the executable file we generated before.

5. Enter "*cd* \

   /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples\

   /my_build/intel64/Release" to switch the directory to application folder.

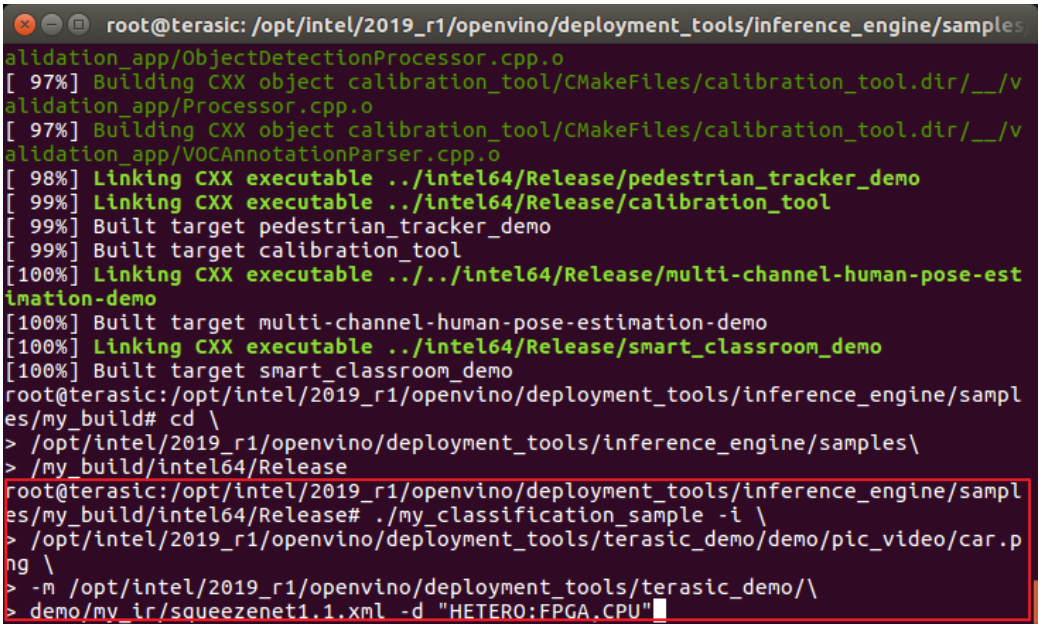


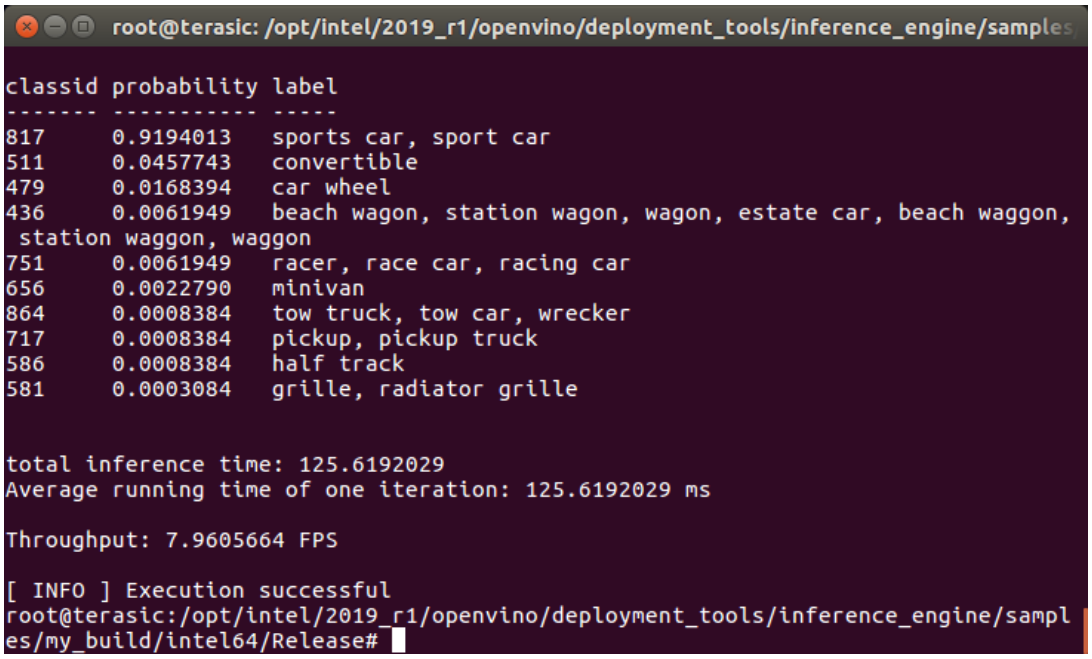
6. Enter "*./my_classification_sample -i* \

   /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/pic_video/car.png \

   -m /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/\

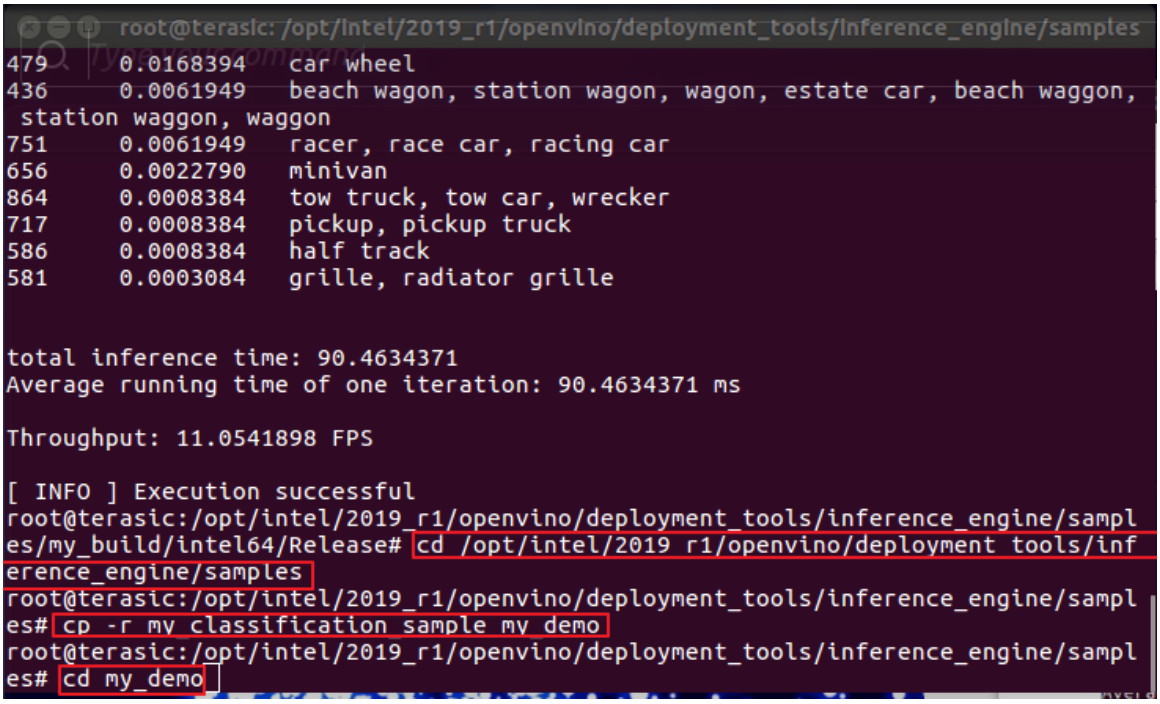
   demo/my_ir/squeezenet1.1.xml -d "HETERO:FPGA,CPU" " to execute the Inference Engine.



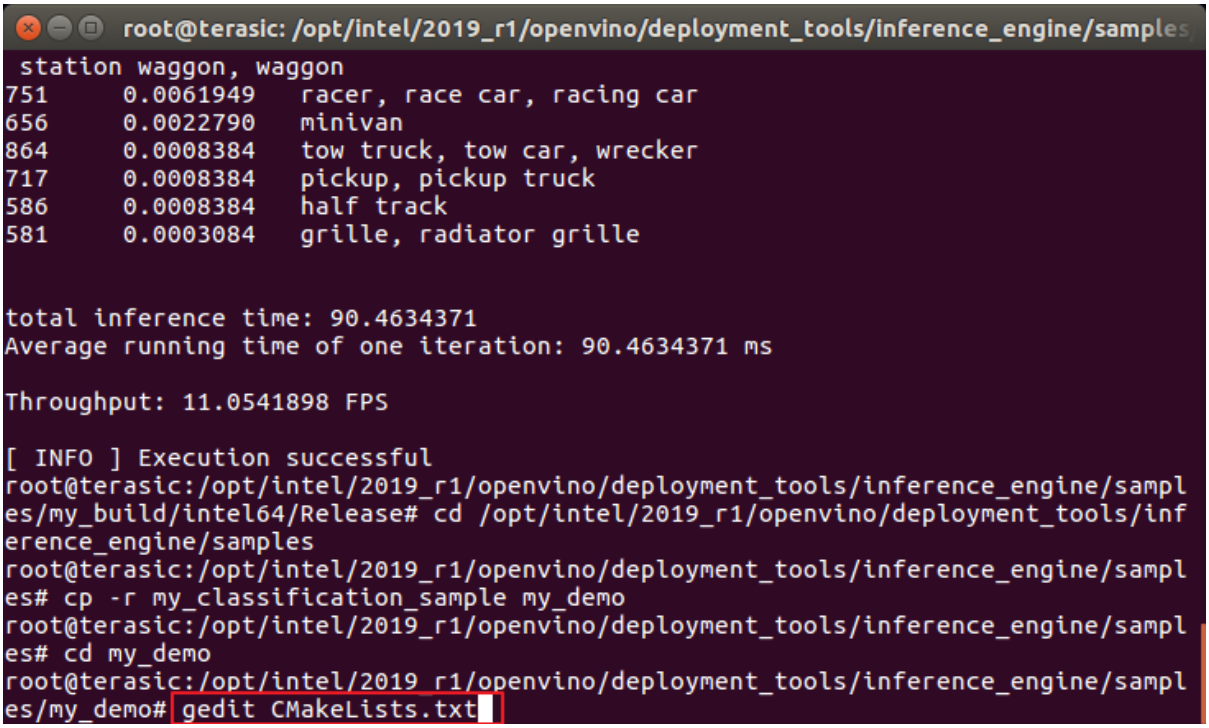


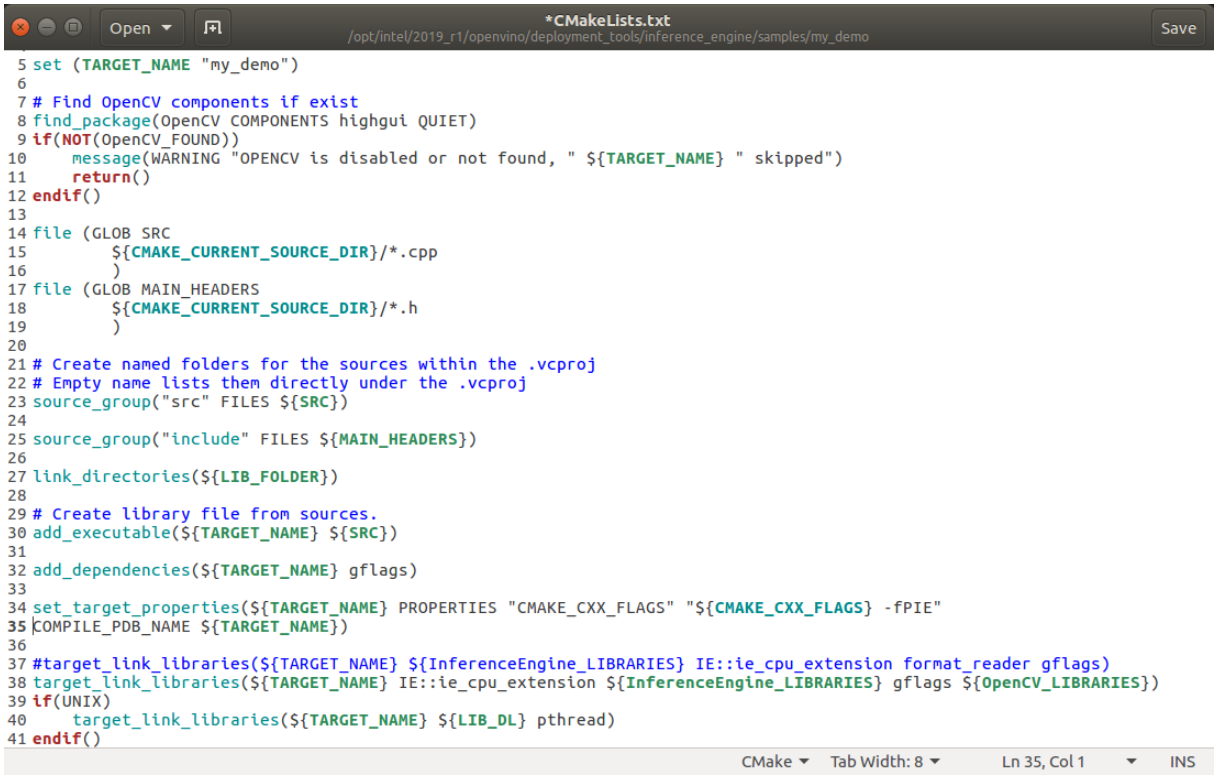
3.5 Advanced Experiment

1. In the previous steps, we already know how to convert the model to IR, and how to make executable files which can be used by the inference engine. Next, let's make a new demo.
2. Since the IR files have been generated already, no need to regenerate it, we continue to use the previously generated squeezenet1.1.xml and the corresponding bin file.
3. Enter "*cd /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples*" to switch the workspace to Inference Engine samples folder.
4. Enter "*cp -r my_classification_sample my_demo*" to copy the files generated in the previous experiment, and we will modify them to be used in my_demo.
5. Enter "*cd my_demo*" to switch to the new copied samples folder.



6. Enter "*gedit CMakeLists.txt*" to open the file. Modify the file as follow:



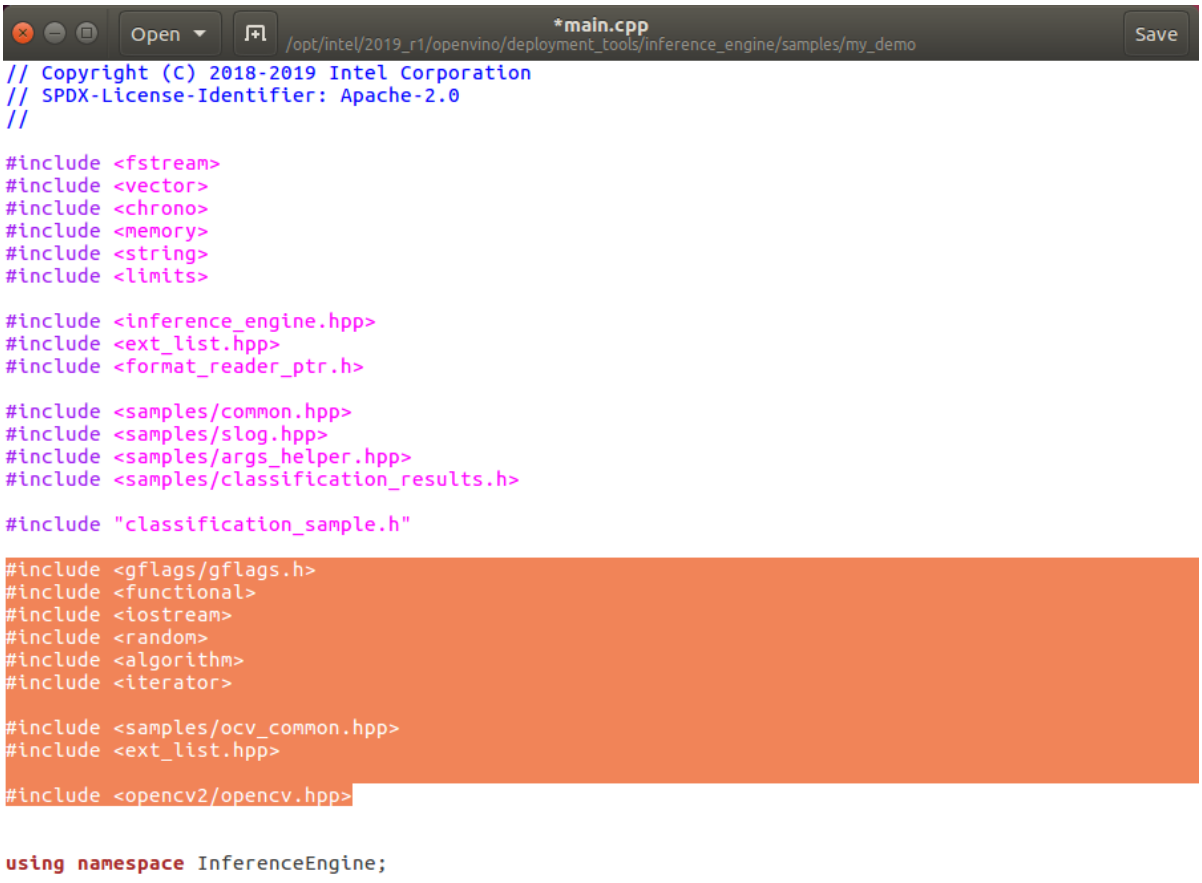



```
set (TARGET_NAME "my_demo")

# Find OpenCV components if exist
find_package(OpenCV COMPONENTS highgui QUIET)
if(NOT(OpenCV_FOUND))
    message(WARNING "OPENCV is disabled or not found, " ${TARGET_NAME} " skipped")
    return()
endif()

file (GLOB MAIN_SRC
        ${CMAKE_CURRENT_SOURCE_DIR}/*.cpp
        )
file (GLOB MAIN_HEADERS
        ${CMAKE_CURRENT_SOURCE_DIR}/*.h
        )

# Create named folders for the sources within the .vcproj
# Empty name lists them directly under the .vcproj
source_group("src" FILES ${MAIN_SRC})
source_group("include" FILES ${MAIN_HEADERS})
```

```
link_directories(${LIB_FOLDER})


# Create library file from sources.
add_executable(${TARGET_NAME} ${MAIN_SRC} ${MAIN_HEADERS})
add_dependencies(${TARGET_NAME} gflags)
set_target_properties(${TARGET_NAME} PROPERTIES "CMAKE_CXX_FLAGS"
"${CMAKE_CXX_FLAGS} -fPIE"
COMPILE_PDB_NAME ${TARGET_NAME})


#target_link_libraries(${TARGET_NAME} ${InferenceEngine_LIBRARIES} IE::ie_cpu_extension
format_reader gflags)
target_link_libraries(${TARGET_NAME} IE::ie_cpu_extension ${InferenceEngine_LIBRARIES} gflags
${OpenCV_LIBRARIES})
if(UNIX)
    target_link_libraries(${TARGET_NAME} ${LIB_DL} pthread)
endif()
```

7. Enter "*gedit main.cpp*" to open the file for application modification. The host application generated in the previous steps is for the classification of entering a single picture. Next, we will modify the application to support the classification display on multiply picture entering for loop.

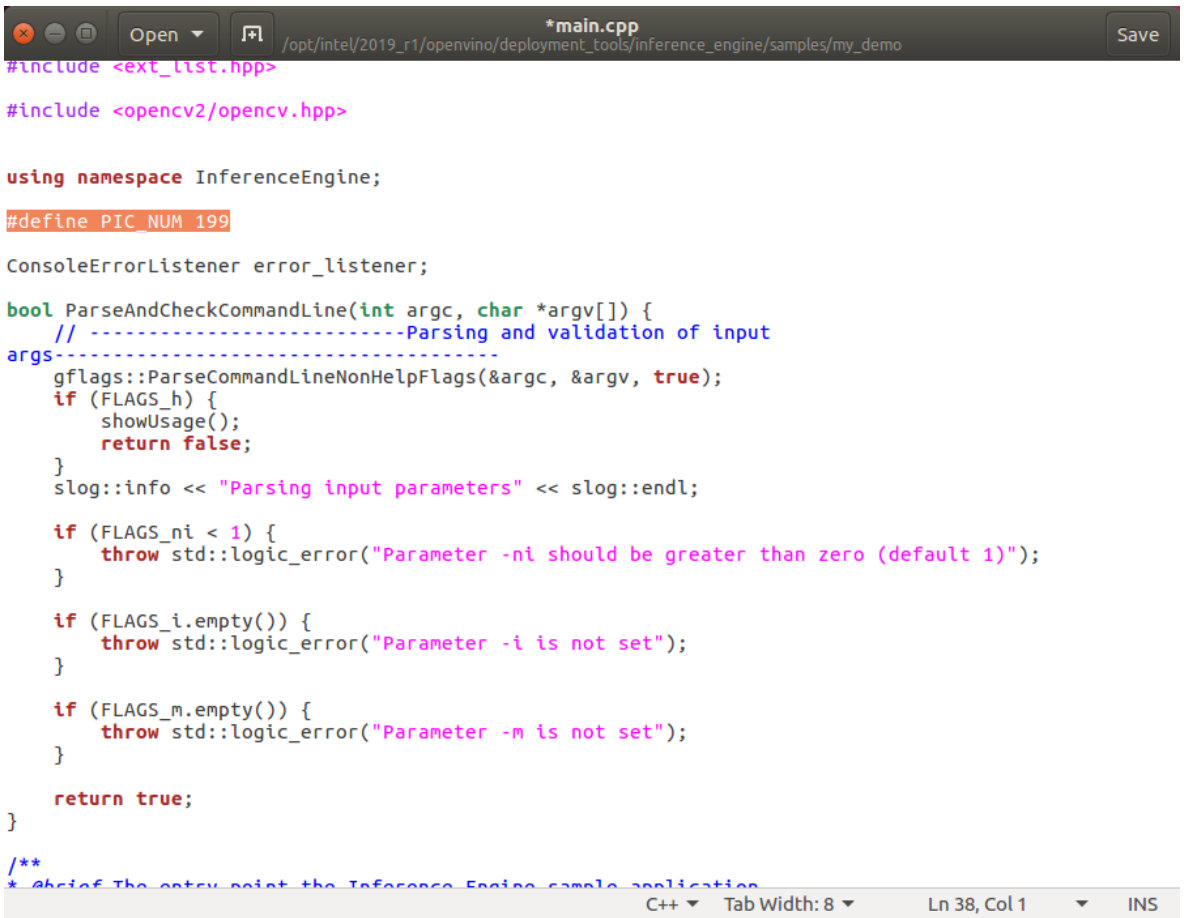
   ➢ Setp1, add a header file for opencv and video operation.



```
#include <gflags/gflags.h>
#include <functional>
#include <iostream>
#include <random>
#include <algorithm>
#include <iterator>

#include <samples/ocv_common.hpp>
#include <ext_list.hpp>

#include <opencv2/opencv.hpp>
```

- Step2, define a macro for picture number.

```
#define PIC_NUM 199
```



- Step3, delete the imageNames, because we don't use it anymore

  Before:

```
Open   *main.cpp   /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples/my_demo   Save

        // ------------------------------ Parsing and validation of input args
---------------------------------
        if (!ParseAndCheckCommandLine(argc, argv)) {
            return 0;
        }

        /** This vector stores paths to the processed images **/
        std::vector<std::string> imageNames;
        parseInputFilesArguments(imageNames);
        if (imageNames.empty()) throw std::logic_error("No suitable images were found");
        //
---------------------------------------------------------------------------------------------------

        // --------------------------- 1. Load Plugin for inference engine
-------------------------------------
        slog::info << "Loading plugin" << slog::endl;
        InferencePlugin plugin = PluginDispatcher({ FLAGS_pp }).getPluginByDevice(FLAGS_d);
        if (FLAGS_p_msg) {
            static_cast<InferenceEngine::InferenceEnginePluginPtr>(plugin)->SetLogCallback
(error_listener);
        }

        /** Loading default extensions **/
        if (FLAGS_d.find("CPU") != std::string::npos) {
            /**
             * cpu_extensions library is compiled from "extension" folder containing
             * custom MKLDNNPlugin layer implementations. These layers are not supported
             * by mkldnn, but they can be useful for inferring custom topologies.
            **/
            plugin.AddExtension(std::make_shared<Extensions::Cpu::CpuExtensions>());
        }

        if (!FLAGS_l.empty()) {
            // CPU(MKLDNN) extensions are loaded as a shared library and passed as a pointer to
base extension
            auto extension_ptr = make_so_pointer<IExtension>(FLAGS_l);
                                                C++   Tab Width: 8   Ln 83, Col 89   INS
```

After:

```
Open   *main.cpp   /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples/my_demo   Save

/**
* @brief The entry point the Inference Engine sample application
* @file classification_sample/main.cpp
* @example classification_sample/main.cpp
*/
int main(int argc, char *argv[]) {
    try {
        slog::info << "InferenceEngine: " << GetInferenceEngineVersion() << slog::endl;

        // ------------------------------ Parsing and validation of input args
---------------------------------
        if (!ParseAndCheckCommandLine(argc, argv)) {
            return 0;
        }

        //
---------------------------------------------------------------------------------------------------

        // --------------------------- 1. Load Plugin for inference engine
-------------------------------------
        slog::info << "Loading plugin" << slog::endl;
        InferencePlugin plugin = PluginDispatcher({ FLAGS_pp }).getPluginByDevice(FLAGS_d);
        if (FLAGS_p_msg) {
            static_cast<InferenceEngine::InferenceEnginePluginPtr>(plugin)->SetLogCallback
(error_listener);
        }

        /** Loading default extensions **/
        if (FLAGS_d.find("CPU") != std::string::npos) {
            /**
             * cpu_extensions library is compiled from "extension" folder containing
             * custom MKLDNNPlugin layer implementations. These layers are not supported
             * by mkldnn, but they can be useful for inferring custom topologies.
            **/
            plugin.AddExtension(std::make_shared<Extensions::Cpu::CpuExtensions>());
                                                C++   Tab Width: 8   Ln 80, Col 8   INS
```

- Step4, delete the imagesData, because it's used with imageNames.

  Before:

Open *main.cpp /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples/my_demo Save

```
        /** Taking information about all topology inputs **/
        InputsDataMap inputInfo = network.getInputsInfo();
        if (inputInfo.size() != 1) throw std::logic_error("Sample supports topologies only with 1
input");

        auto inputInfoItem = *inputInfo.begin();

        /** Specifying the precision and layout of input data provided by the user.
         * This should be called before load of the network to the plugin **/
        inputInfoItem.second->setPrecision(Precision::U8);
        inputInfoItem.second->setLayout(Layout::NCHW);

        std::vector<std::shared_ptr<unsigned char>> imagesData;
        for (auto & i : imageNames) {
            FormatReader::ReaderPtr reader(i.c_str());
            if (reader.get() == nullptr) {
                slog::warn << "Image " + i + " cannot be read!" << slog::endl;
                continue;
            }
            /** Store image data **/
            std::shared_ptr<unsigned char> data(
                    reader->getData(inputInfoItem.second->getTensorDesc().getDims()[3],
                                    inputInfoItem.second->getTensorDesc().getDims()[2]));
            if (data.get() != nullptr) {
                imagesData.push_back(data);
            }
        }
        if (imagesData.empty()) throw std::logic_error("Valid input images were not found!");

        /** Setting batch size using image count **/
        network.setBatchSize(imagesData.size());
        size_t batchSize = network.getBatchSize();
        slog::info << "Batch size is " << std::to_string(batchSize) << slog::endl;

        // ------------------------------ Prepare output blobs
-----------------------------------------------
        slog::info << "Preparing output blobs" << slog::endl;
```

C++ Tab Width: 8 Ln 168, Col 94 INS

After:

Open *main.cpp /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples/my_demo Save

```
        /** Taking information about all topology inputs **/
        InputsDataMap inputInfo = network.getInputsInfo();
        if (inputInfo.size() != 1) throw std::logic_error("Sample supports topologies only with 1
input");

        auto inputInfoItem = *inputInfo.begin();

        /** Specifying the precision and layout of input data provided by the user.
         * This should be called before load of the network to the plugin **/
        inputInfoItem.second->setPrecision(Precision::U8);
        inputInfoItem.second->setLayout(Layout::NCHW);

        |
        /** Setting batch size using image count **/
        network.setBatchSize(imagesData.size());
        size_t batchSize = network.getBatchSize();
        slog::info << "Batch size is " << std::to_string(batchSize) << slog::endl;

        // ------------------------------ Prepare output blobs
-----------------------------------------------
        slog::info << "Preparing output blobs" << slog::endl;

        OutputsDataMap outputInfo(network.getOutputsInfo());
        // BlobMap outputBlobs;
        std::string firstOutputName;

        for (auto & item : outputInfo) {
            if (firstOutputName.empty()) {
                firstOutputName = item.first;
            }
            DataPtr outputData = item.second;
            if (!outputData) {
                throw std::logic_error("output data pointer is not valid");
            }

            item.second->setPrecision(Precision::FP32);
        }
```

C++ Tab Width: 8 Ln 153, Col 9 INS

- Step5, Change network.setBatchSize(imagesData.size()) to network.setBatchSize(1).

Before:

Open *main.cpp /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples/my_demo Save

```
        auto inputInfoItem = *inputInfo.begin();

        /** Specifying the precision and layout of input data provided by the user.
         * This should be called before load of the network to the plugin **/
        inputInfoItem.second->setPrecision(Precision::U8);
        inputInfoItem.second->setLayout(Layout::NCHW);


        /** Setting batch size using image count **/
        network.setBatchSize(imagesData.size());
        size_t batchSize = network.getBatchSize();
        slog::info << "Batch size is " << std::to_string(batchSize) << slog::endl;

        // ------------------------------ Prepare output blobs
-------------------------------------------------
        slog::info << "Preparing output blobs" << slog::endl;

        OutputsDataMap outputInfo(network.getOutputsInfo());
        // BlobMap outputBlobs;
        std::string firstOutputName;

        for (auto & item : outputInfo) {
            if (firstOutputName.empty()) {
                firstOutputName = item.first;
            }
            DataPtr outputData = item.second;
            if (!outputData) {
                throw std::logic_error("output data pointer is not valid");
            }

            item.second->setPrecision(Precision::FP32);
        }

        const SizeVector outputDims = outputInfo.begin()->second->getDims();

        bool outputCorrect = false;
```

C++ Tab Width: 8 Ln 155, Col 49 INS

After:

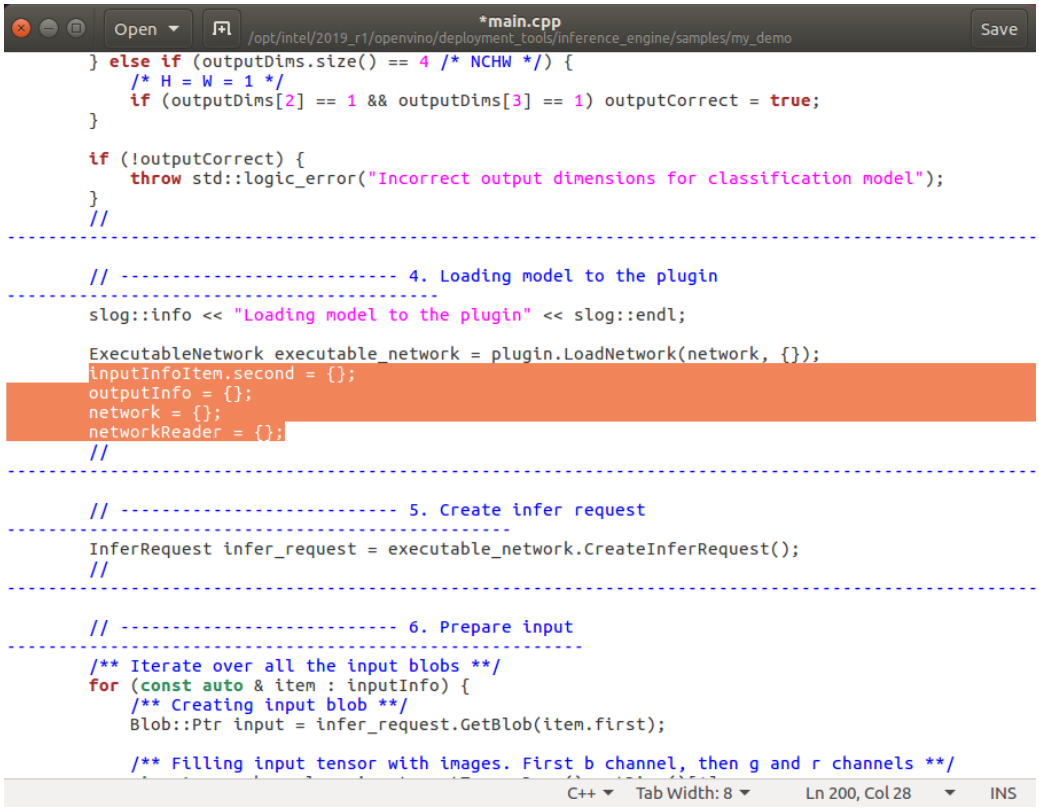
Open *main.cpp /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples/my_demo Save

```
        auto inputInfoItem = *inputInfo.begin();

        /** Specifying the precision and layout of input data provided by the user.
         * This should be called before load of the network to the plugin **/
        inputInfoItem.second->setPrecision(Precision::U8);
        inputInfoItem.second->setLayout(Layout::NCHW);


        /** Setting batch size using image count **/
        network.setBatchSize(1);
        size_t batchSize = network.getBatchSize();
        slog::info << "Batch size is " << std::to_string(batchSize) << slog::endl;

        // ------------------------------ Prepare output blobs
-------------------------------------------------
        slog::info << "Preparing output blobs" << slog::endl;

        OutputsDataMap outputInfo(network.getOutputsInfo());
        // BlobMap outputBlobs;
        std::string firstOutputName;

        for (auto & item : outputInfo) {
            if (firstOutputName.empty()) {
                firstOutputName = item.first;
            }
            DataPtr outputData = item.second;
            if (!outputData) {
                throw std::logic_error("output data pointer is not valid");
            }

            item.second->setPrecision(Precision::FP32);
        }

        const SizeVector outputDims = outputInfo.begin()->second->getDims();

        bool outputCorrect = false;
```

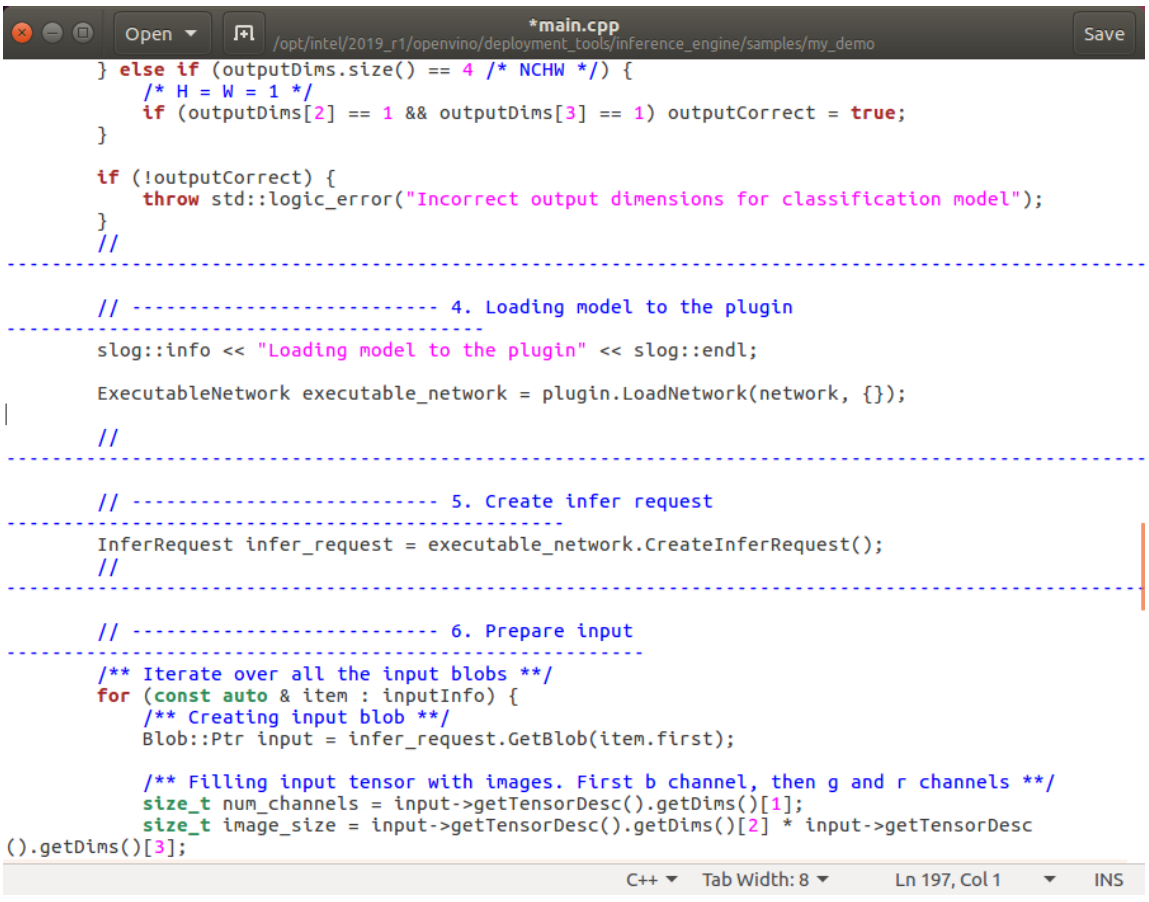
C++ Tab Width: 8 Ln 155, Col 31 INS

➢ Step6, Delete the highlighted code as below

Before:



After:



➢ Step7, delete operation of "step 6, Prepare input"

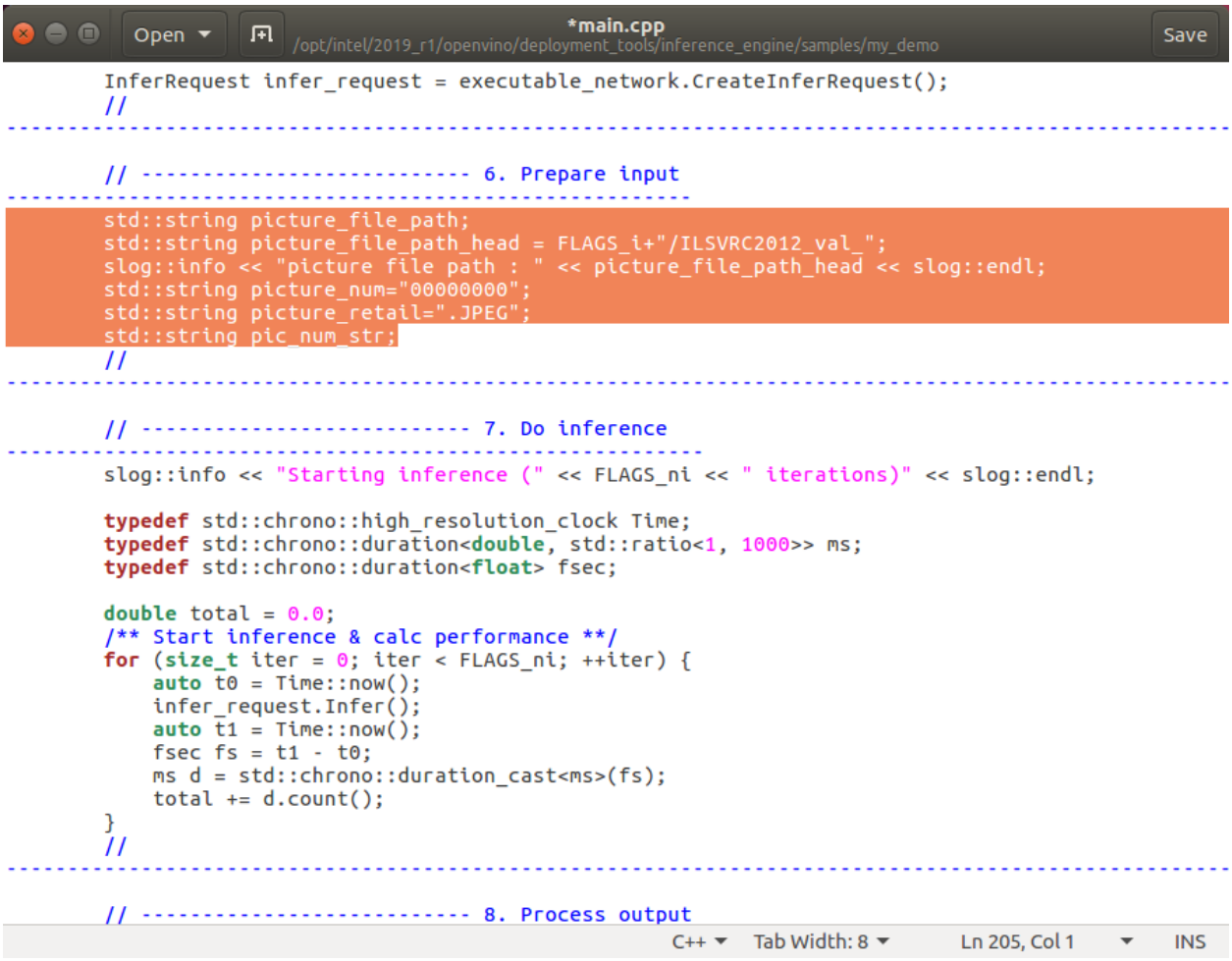
Before:

```
Open  *main.cpp  /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples/my_demo  Save

        InferRequest infer_request = executable_network.CreateInferRequest();
        //
-------------------------------------------------------------------------------------------------------

        // --------------------------- 6. Prepare input
-------------------------------------------------------
        /** Iterate over all the input blobs **/
        for (const auto & item : inputInfo) {
            /** Creating input blob **/
            Blob::Ptr input = infer_request.GetBlob(item.first);

            /** Filling input tensor with images. First b channel, then g and r channels **/
            size_t num_channels = input->getTensorDesc().getDims()[1];
            size_t image_size = input->getTensorDesc().getDims()[2] * input->getTensorDesc
().getDims()[3];

            auto data = input->buffer().as<PrecisionTrait<Precision::U8>::value_type*>();

            /** Iterate over all input images **/
            for (size_t image_id = 0; image_id < imagesData.size(); ++image_id) {
                /** Iterate over all pixel in image (b,g,r) **/
                for (size_t pid = 0; pid < image_size; pid++) {
                    /** Iterate over all channels **/
                    for (size_t ch = 0; ch < num_channels; ++ch) {
                        /**         [images stride + channels stride + pixel id ] all in
bytes            **/
                        data[image_id * image_size * num_channels + ch * image_size + pid ] =
imagesData.at(image_id).get()[pid*num_channels + ch];
                    }
                }
            }
        }
        inputInfo = {};
        //
-------------------------------------------------------------------------------------------------------

        // --------------------------- 7. Do inference

C++  Tab Width: 8  Ln 228, Col 24  INS
```

After:

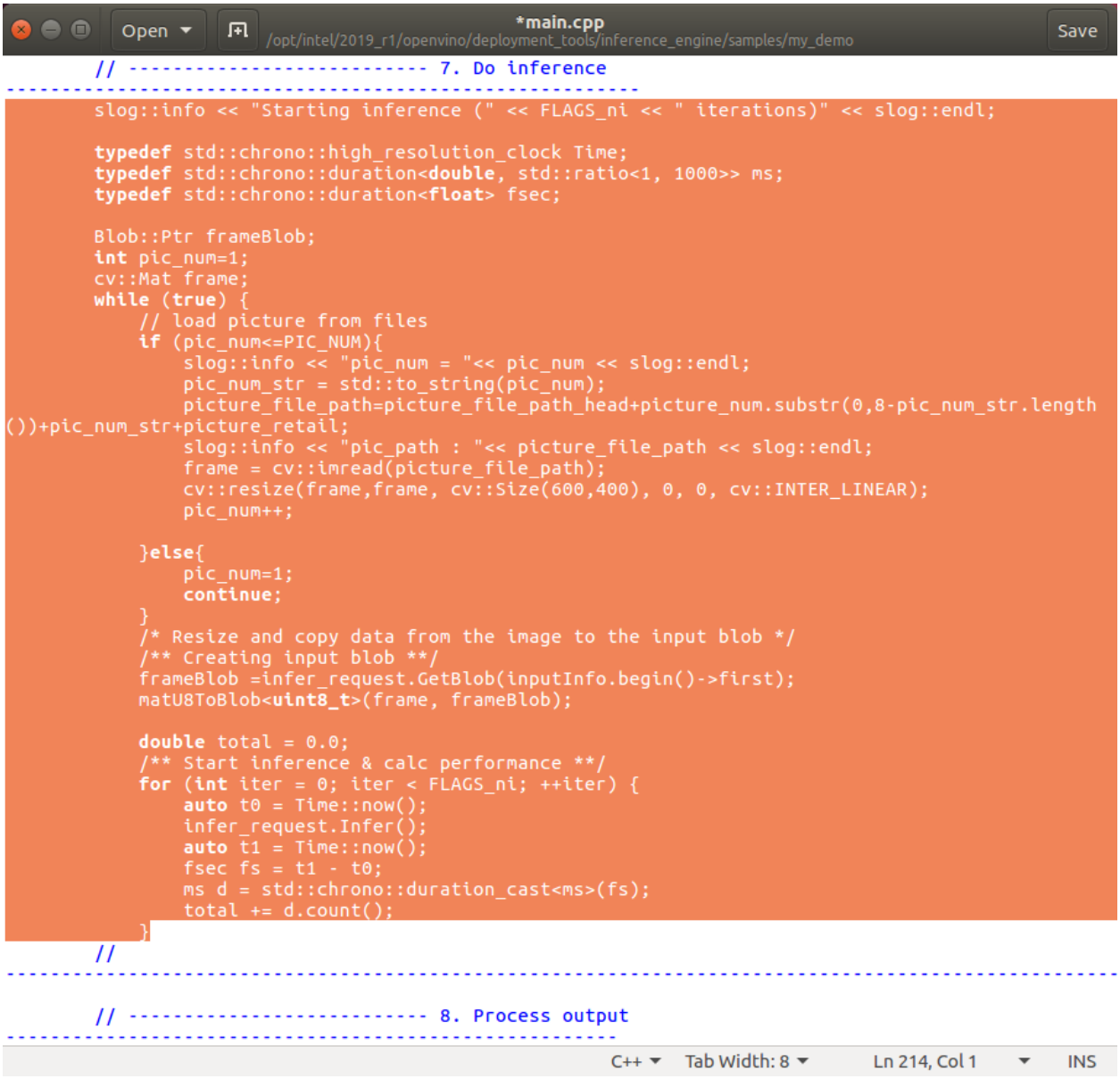
```
Open  *main.cpp  /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples/my_demo  Save

        InferRequest infer_request = executable_network.CreateInferRequest();
        //
-------------------------------------------------------------------------------------------------------

        // --------------------------- 6. Prepare input
-------------------------------------------------------
        |
        //
-------------------------------------------------------------------------------------------------------

        // --------------------------- 7. Do inference
-------------------------------------------------------
        slog::info << "Starting inference (" << FLAGS_ni << " iterations)" << slog::endl;

        typedef std::chrono::high_resolution_clock Time;
        typedef std::chrono::duration<double, std::ratio<1, 1000>> ms;
        typedef std::chrono::duration<float> fsec;

        double total = 0.0;
        /** Start inference & calc performance **/
        for (size_t iter = 0; iter < FLAGS_ni; ++iter) {
            auto t0 = Time::now();
            infer_request.Infer();
            auto t1 = Time::now();
            fsec fs = t1 - t0;
            ms d = std::chrono::duration_cast<ms>(fs);
            total += d.count();
        }
        //
-------------------------------------------------------------------------------------------------------

        // --------------------------- 8. Process output
-------------------------------------------------------
        slog::info << "Processing output blobs" << slog::endl;

        const Blob::Ptr output_blob = infer_request.GetBlob(firstOutputName);

C++  Tab Width: 8  Ln 205, Col 9  INS
```

➢ Step8, add pictures relative information in "step 6, Prepare input"




```
std::string picture_file_path;
std::string picture_file_path_head = FLAGS_i+"/ILSVRC2012_val_";
slog::info << "picture file path : " << picture_file_path_head << slog::endl;
std::string picture_num="00000000";
std::string picture_retail=".JPEG";
std::string pic_num_str;
```

➢ Step9, modify “step 7, Do inference”




```
slog::info << "Starting inference (" << FLAGS_ni << " iterations)" << slog::endl;

        typedef std::chrono::high_resolution_clock Time;
        typedef std::chrono::duration<double, std::ratio<1, 1000>> ms;
        typedef std::chrono::duration<float> fsec;

Blob::Ptr frameBlob;
int pic_num=1;
cv::Mat frame;
while (true) {
    // load picture from files
    if (pic_num<=PIC_NUM){
    slog::info << "pic_num = "<< pic_num << slog::endl;
```

```
        pic_num_str = std::to_string(pic_num);
        picture_file_path=picture_file_path_head+picture_num.substr(0,8-
    pic_num_str.length())+pic_num_str+picture_retail;
        slog::info << "pic_path : "<< picture_file_path << slog::endl;
        frame = cv::imread(picture_file_path);
        cv::resize(frame,frame, cv::Size(600,400), 0, 0, cv::INTER_LINEAR);
        pic_num++;

        }else{
        pic_num=1;
        continue;
        }
        /* Resize and copy data from the image to the input blob */
                /** Creating input blob **/
                frameBlob =infer_request.GetBlob(inputInfo.begin()->first);
        matU8ToBlob<uint8_t>(frame, frameBlob);

        double total = 0.0;
        /** Start inference & calc performance **/
        for (unsigned int iter = 0; iter < FLAGS_ni; ++iter) {
        auto t0 = Time::now();
        infer_request.Infer();
        auto t1 = Time::now();
        fsec fs = t1 - t0;
        ms d = std::chrono::duration_cast<ms>(fs);
        total += d.count();
        }
```

- Step10, modify “step 8, Process output”

  Add the code as below:

Open *main.cpp /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples/my_demo Save

```
        //
----------------------------------------------------------------------------------------------------

        // --------------------------- 8. Process output
-------------------------------------------------------
        slog::info << "Processing output blobs" << slog::endl;

        const Blob::Ptr output_blob = infer_request.GetBlob(firstOutputName);
        auto output_data = output_blob->buffer().as<PrecisionTrait<Precision::FP32>::value_type*>
();
        /** Validating -nt value **/
        const size_t resultsCnt = output_blob->size() / batchSize;
        if (FLAGS_nt > resultsCnt || FLAGS_nt < 1) {
            slog::warn << "-nt " << FLAGS_nt << " is not available for this network (-nt should be
less than " \
                       << resultsCnt+1 << " and more than 0)\n            will be used maximal
value : " << resultsCnt;
            FLAGS_nt = resultsCnt;
        }

        /** Read labels from file (e.x. AlexNet.labels) **/
        std::string labelFileName = fileNameNoExt(FLAGS_m) + ".labels";
        std::vector<std::string> labels;

        std::ifstream inputFile;
        inputFile.open(labelFileName, std::ios::in);
        if (inputFile.is_open()) {
            std::string strLine;
            while (std::getline(inputFile, strLine)) {
                trim(strLine);
                labels.push_back(strLine);
            }
        }

        ClassificationResult classificationResult(output_blob, imageNames,
                                                  batchSize, FLAGS_nt,
                                                  labels);
        classificationResult.print();

        //
----------------------------------------------------------------------------------------------------
        if (std::fabs(total) < std::numeric_limits<double>::epsilon()) {
            throw std::logic_error("total can't be equal to zero");
        }
        std::cout << std::endl << "total inference time: " << total << std::endl;
        std::cout << "Average running time of one iteration: " << total / static_cast<double>
(FLAGS_ni) << " ms" << std::endl;
```

C++ Tab Width: 8 Ln 259, Col 101 INS

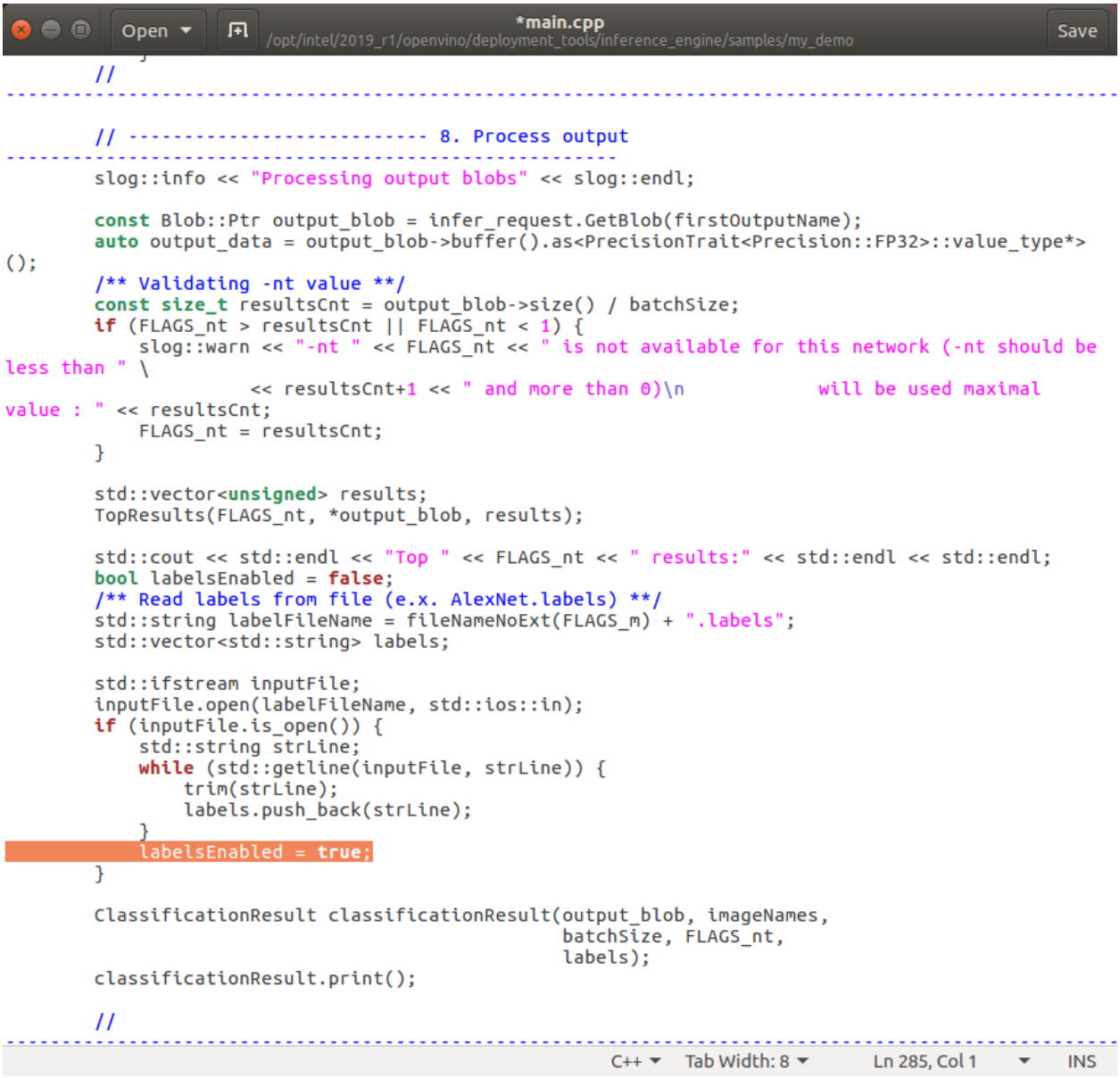
auto output_data = output_blob->buffer().**as**<PrecisionTrait<Precision::FP32>::value_**type***>();

Add the code as below:

```
std::vector<unsigned> results;
TopResults(FLAGS_nt, *output_blob, results);

std::cout << std::endl << "Top " << FLAGS_nt << " results:" << std::endl << std::endl;
bool labelsEnabled = false;
```

Add the code as below:

```
labelsEnabled = true;
```

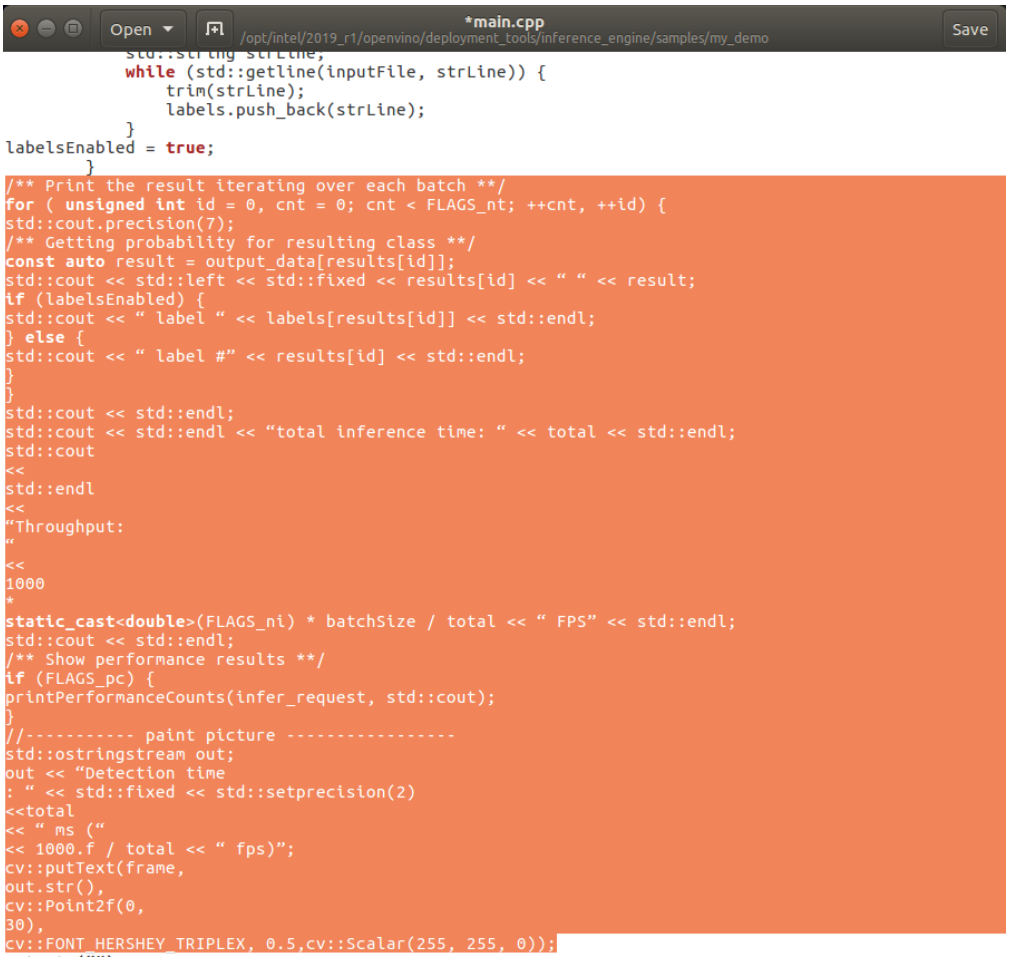



```
        //
----------------------------------------------------------------------------------------------------

        // --------------------------- 8. Process output
-------------------------------------------------------
        slog::info << "Processing output blobs" << slog::endl;

        const Blob::Ptr output_blob = infer_request.GetBlob(firstOutputName);
        auto output_data = output_blob->buffer().as<PrecisionTrait<Precision::FP32>::value_type*>
();
        /** Validating -nt value **/
        const size_t resultsCnt = output_blob->size() / batchSize;
        if (FLAGS_nt > resultsCnt || FLAGS_nt < 1) {
            slog::warn << "-nt " << FLAGS_nt << " is not available for this network (-nt should be
less than " \
                       << resultsCnt+1 << " and more than 0)\n            will be used maximal
value : " << resultsCnt;
            FLAGS_nt = resultsCnt;
        }

        std::vector<unsigned> results;
        TopResults(FLAGS_nt, *output_blob, results);

        std::cout << std::endl << "Top " << FLAGS_nt << " results:" << std::endl << std::endl;
        bool labelsEnabled = false;
        /** Read labels from file (e.x. AlexNet.labels) **/
        std::string labelFileName = fileNameNoExt(FLAGS_m) + ".labels";
        std::vector<std::string> labels;

        std::ifstream inputFile;
        inputFile.open(labelFileName, std::ios::in);
        if (inputFile.is_open()) {
            std::string strLine;
            while (std::getline(inputFile, strLine)) {
                trim(strLine);
                labels.push_back(strLine);
            }
            labelsEnabled = true;
        }

        ClassificationResult classificationResult(output_blob, imageNames,
                                                  batchSize, FLAGS_nt,
                                                  labels);
        classificationResult.print();

        //
----------------------------------------------------------------------------------------------------
```

Delete the following code:

```
Open   *main.cpp   Save
/opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples/my_demo

        /** Read labels from file (e.x. AlexNet.labels) **/
        std::string labelFileName = fileNameNoExt(FLAGS_m) + ".labels";
        std::vector<std::string> labels;

        std::ifstream inputFile;
        inputFile.open(labelFileName, std::ios::in);
        if (inputFile.is_open()) {
            std::string strLine;
            while (std::getline(inputFile, strLine)) {
                trim(strLine);
                labels.push_back(strLine);
            }
            labelsEnabled = true;
        }

        ClassificationResult classificationResult(output_blob, imageNames,
                                                  batchSize, FLAGS_nt,
                                                  labels);
        classificationResult.print();

        //
--------------------------------------------------------------------------------------------------------
        if (std::fabs(total) < std::numeric_limits<double>::epsilon()) {
            throw std::logic_error("total can't be equal to zero");
        }
        std::cout << std::endl << "total inference time: " << total << std::endl;
        std::cout << "Average running time of one iteration: " << total / static_cast<double>
(FLAGS_ni) << " ms" << std::endl;
        std::cout << std::endl << "Throughput: " << 1000 * static_cast<double>(FLAGS_ni) *
batchSize / total << " FPS" << std::endl;
        std::cout << std::endl;

        /** Show performance results **/
        if (FLAGS_pc) {
            printPerformanceCounts(infer_request, std::cout);
        }
    }
    catch (const std::exception& error) {
        slog::err << "" << error.what() << slog::endl;
        return 1;
    }
    catch (...) {
        slog::err << "Unknown/internal exception happened." << slog::endl;
        return 1;
    }

    slog::info << "Execution successful" << slog::endl;
C++   Tab Width: 8   Ln 306, Col 6   INS
```

- Step11, add picture display code as below.

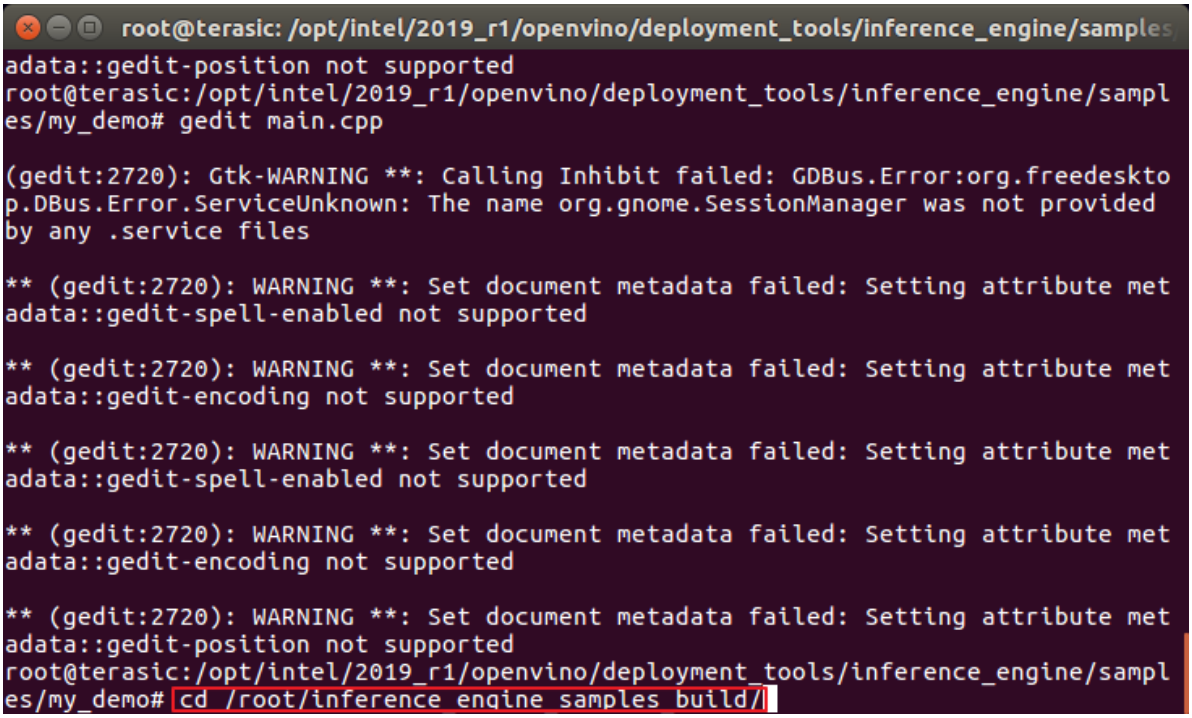



```
/** Print the result iterating over each batch **/
            for (unsigned int id = 0, cnt = 0; cnt < FLAGS_nt; ++cnt, ++id) {
                std::cout.precision(7);
                /** Getting probability for resulting class **/
                const auto result = output_data[results[id]];
                std::cout << std::left << std::fixed << results[id] << " " << result;
                if (labelsEnabled) {
                    std::cout << " label " << labels[results[id]] << std::endl;
                } else {
                    std::cout << " label #" << results[id] << std::endl;
                }
            }
            std::cout << std::endl;

        std::cout << std::endl << "total inference time: " << total << std::endl;
            std::cout << std::endl << "Throughput: " << 1000 * static_cast<double>(FLAGS_ni)
* batchSize / total << " FPS" << std::endl;
            std::cout << std::endl;
```

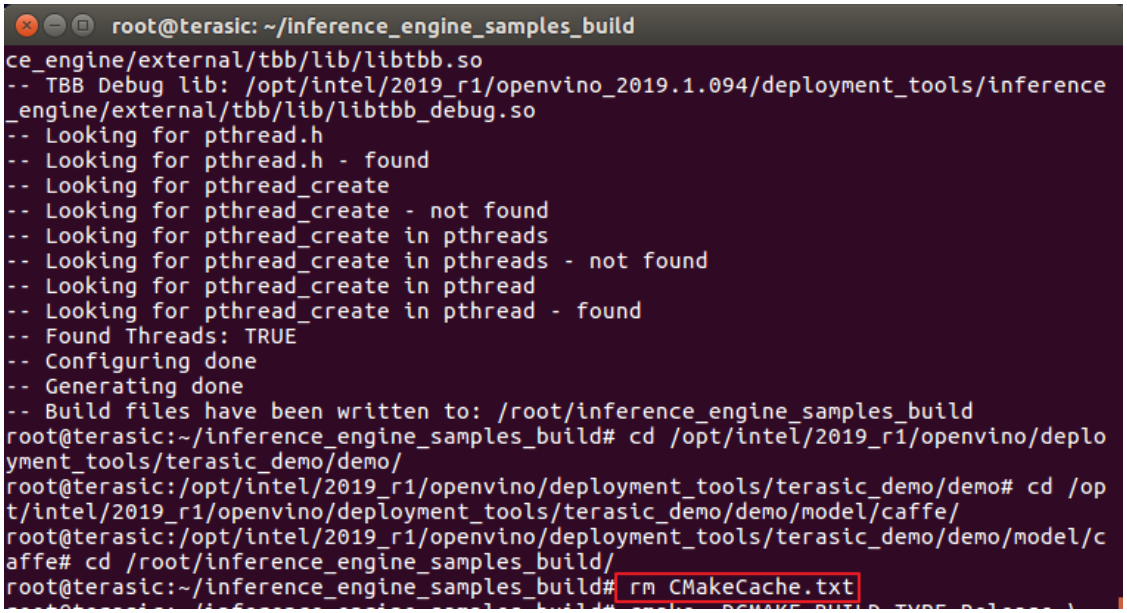
```
            /** Show performance results **/
            if (FLAGS_pc) {
                printPerformanceCounts(infer_request, std::cout);
            }

        //---------- paint picture ----------------
        std::ostringstream out;
            out << "Detection time   : " << std::fixed << std::setprecision(2) <<total
                << " ms ("
                << 1000.f / total << " fps)";
            cv::putText(frame, out.str(), cv::Point2f(0, 30), cv::FONT_HERSHEY_TRIPLEX,
0.5,
                        cv::Scalar(255, 255, 0));
        out.str("");
        out << "Detection result   : " << std::fixed << std::setprecision(2) << " Label: " <<
labels[results[0]] << " "<< output_data[results[0]];
            cv::putText(frame, out.str(), cv::Point2f(0, 60), cv::FONT_HERSHEY_TRIPLEX,
0.5,
                        cv::Scalar(0, 0, 255));

        //---------------- picture display ------------------
        cv::imshow("Detection results", frame);
        const int key = cv::waitKey(1000);
        if (27 == key)   // Esc
                break;
    }
  }
```

- Step12, After the modifying, save it as main.cpp.

8. Enter "*cd /root/inference_engine_samples_build/*" to go to the sample build folder.



9. Enter "*rm CMakeCache.txt*" to clean the build cache.



10. Enter "*cmake -DCMAKE_BUILD_TYPE=Release \ /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples*" to copy the file to the samples build directory.

```
root@terasic: ~/inference_engine_samples_build
ce_engine/external/tbb/lib/libtbb.so
-- TBB Debug lib: /opt/intel/2019_r1/openvino_2019.1.094/deployment_tools/inference
_engine/external/tbb/lib/libtbb_debug.so
-- Looking for pthread.h
-- Looking for pthread.h - found
-- Looking for pthread_create
-- Looking for pthread_create - not found
-- Looking for pthread_create in pthreads
-- Looking for pthread_create in pthreads - not found
-- Looking for pthread_create in pthread
-- Looking for pthread_create in pthread - found
-- Found Threads: TRUE
-- Configuring done
-- Generating done
-- Build files have been written to: /root/inference_engine_samples_build
root@terasic:~/inference_engine_samples_build# cd /opt/intel/2019_r1/openvino/deplo
yment_tools/terasic_demo/demo/
root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo# cd /op
t/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/model/caffe/
root@terasic:/opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/model/c
affe# cd /root/inference_engine_samples_build/
root@terasic:~/inference_engine_samples_build# rm CMakeCache.txt
root@terasic:~/inference_engine_samples_build# cmake -DCMAKE_BUILD_TYPE=Release \
> /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples
```

```
root@osk:/opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples/my_demo# cd /root/infere
nce_engine_samples_build/
root@osk:~/inference_engine_samples_build# rm CMakeCache.txt
root@osk:~/inference_engine_samples_build# cmake -DCMAKE_BUILD_TYPE=Release \
> /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples
```

11. Enter "*make -j8 my_demo*" to compile the application program, please be patient for the compilation process.

```
root@osk: ~/inference_engine_samples_build
--    SHA supported
--    SSE supported
--    SSE2 supported
--    SSE3 supported
--    SSE4.1 supported
--    SSE4.2 supported
--    SSE4a not supported
--    SSSE3 supported
--    SYSCALL supported
--    TBM not supported
--    XOP not supported
--    XSAVE supported
-- TBB include: /opt/intel/2019_r1/openvino_2019.1.094/deployment_tools/inference_engine/
external/tbb/include
-- TBB Release lib: /opt/intel/2019_r1/openvino_2019.1.094/deployment_tools/inference_eng
ine/external/tbb/lib/libtbb.so
-- TBB Debug lib: /opt/intel/2019_r1/openvino_2019.1.094/deployment_tools/inference_engin
e/external/tbb/lib/libtbb_debug.so
-- Looking for pthread.h
-- Looking for pthread.h - found
-- Looking for pthread_create
-- Looking for pthread_create - not found
-- Looking for pthread_create in pthreads
-- Looking for pthread_create in pthreads - not found
-- Looking for pthread_create in pthread
-- Looking for pthread_create in pthread - found
-- Found Threads: TRUE
-- Configuring done
-- Generating done
-- Build files have been written to: /root/inference_engine_samples_build
root@osk:~/inference_engine_samples_build# make -j8 my_demo
```

```
root@terasic: ~/inference_engine_samples_build
--    SSSE3 supported
--    SYSCALL supported
--    TBM not supported
--    XOP not supported
--    XSAVE supported
-- TBB include: /opt/intel/2019_r1/openvino_2019.1.094/deployment_tools/inference_e
ngine/external/tbb/include
-- TBB Release lib: /opt/intel/2019_r1/openvino_2019.1.094/deployment_tools/inferen
ce_engine/external/tbb/lib/libtbb.so
-- TBB Debug lib: /opt/intel/2019_r1/openvino_2019.1.094/deployment_tools/inference
_engine/external/tbb/lib/libtbb_debug.so
-- Looking for pthread.h
-- Looking for pthread.h - found
-- Looking for pthread_create
-- Looking for pthread_create - not found
-- Looking for pthread_create in pthreads
-- Looking for pthread_create in pthreads - not found
-- Looking for pthread_create in pthread
-- Looking for pthread_create in pthread - found
-- Found Threads: TRUE
-- Configuring done
-- Generating done
-- Build files have been written to: /root/inference_engine_samples_build
root@terasic:~/inference_engine_samples_build# make -j8 my_demo
```

12. Enter "*cd intel64/Release*" to switch to app directory, then enter "ls", under this folder, the corresponding executable file for my_demo is generated, a new application is completed

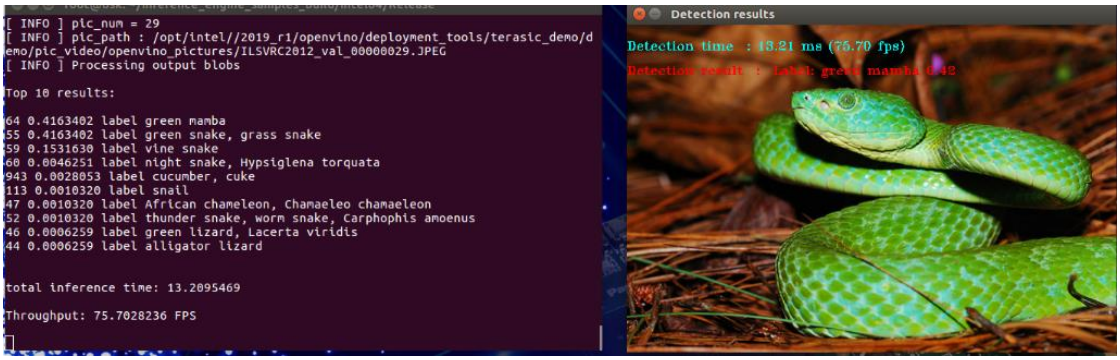
```
root@terasic: ~/inference_engine_samples_build
-- TBB Release lib: /opt/intel/2019_r1/openvino_2019.1.094/deployment_tools/inferen
ce_engine/external/tbb/lib/libtbb.so
-- TBB Debug lib: /opt/intel/2019_r1/openvino_2019.1.094/deployment_tools/inference
_engine/external/tbb/lib/libtbb_debug.so
-- Looking for pthread.h
-- Looking for pthread.h - found
-- Looking for pthread_create
-- Looking for pthread_create - not found
-- Looking for pthread_create in pthreads
-- Looking for pthread_create in pthreads - not found
-- Looking for pthread_create in pthread
-- Looking for pthread_create in pthread - found
-- Found Threads: TRUE
-- Configuring done
-- Generating done
-- Build files have been written to: /root/inference_engine_samples_build
root@terasic:~/inference_engine_samples_build# make -j8 my_demo
[  7%] Built target gflags_nothreads_static
[ 92%] Built target ie_cpu_extension
Scanning dependencies of target my_demo
[ 96%] Building CXX object my_demo/CMakeFiles/my_demo.dir/main.cpp.o
[100%] Linking CXX executable ../intel64/Release/my_demo
[100%] Built target my_demo
root@terasic:~/inference_engine_samples_build# cd intel64/Release/
```

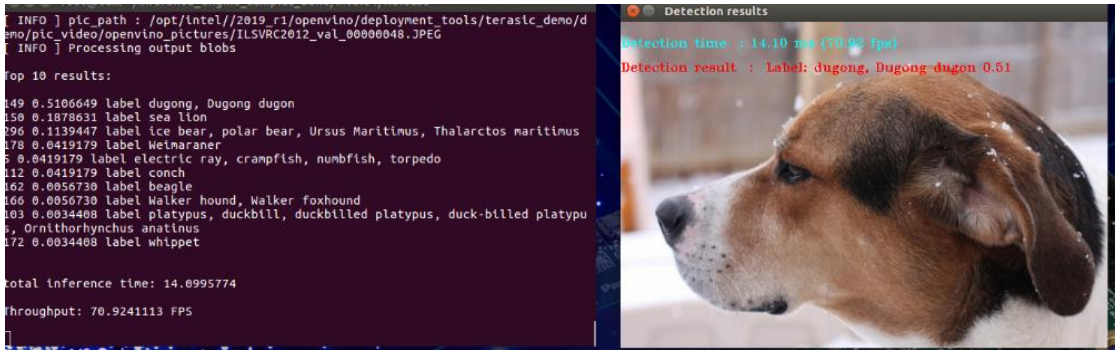
```
root@terasic:~/inference_engine_samples_build/intel64/Release# ls
benchmark_app                       multi-channel-face-detection-demo
calibration_tool                    multi-channel-human-pose-estimation-demo
classification_sample               my_demo
classification_sample_async         object_detection_demo
classification_sample_for_c5p       object_detection_demo_ssd_async
classification_sample_for_pic_loop  object_detection_demo_yolov3_async
crossroad_camera_demo               object_detection_sample_ssd
end2end_video_analytics_ie          pedestrian_tracker_demo
end2end_video_analytics_opencv      perfcheck
hello_autoresize_classification     security_barrier_camera_demo
hello_classification                segmentation_demo
hello_request_classification        smart_classroom_demo
hello_shape_infer_ssd               speech_sample
human_pose_estimation_demo          style_transfer_sample
interactive_face_detection_demo     super_resolution_demo
lenet_network_graph_builder         text_detection_demo
lib                                 validation_app
mask_rcnn_demo
root@terasic:~/inference_engine_samples_build/intel64/Release#
```

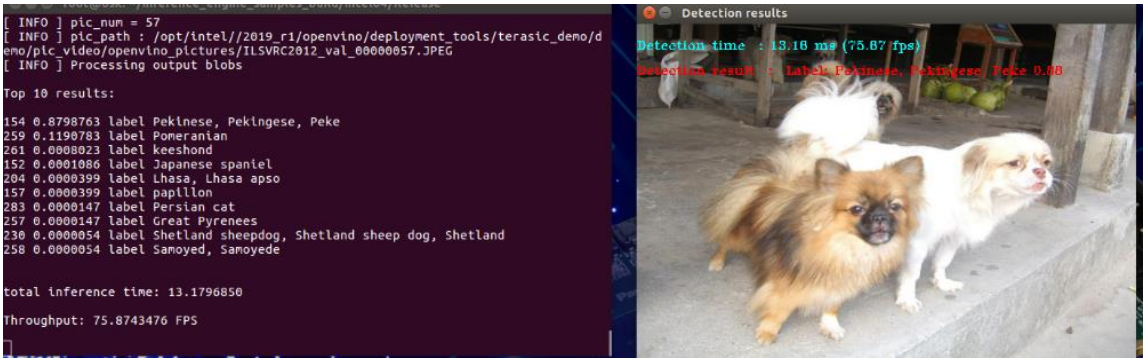
13. Enter "*./my_demo -d "HETERO:FPGA,CPU" -i \ /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/\ pic_video/openvino_pictures -m \ /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/ir/\ FP16/squeezenet1.1/squeezenet1.1.xml*" to execute the host app.

```
root@terasic:~/inference_engine_samples_build/intel64/Release# ls
benchmark_app                       multi-channel-face-detection-demo
calibration_tool                    multi-channel-human-pose-estimation-demo
classification_sample               my_demo
classification_sample_async         object_detection_demo
classification_sample_for_c5p       object_detection_demo_ssd_async
classification_sample_for_pic_loop  object_detection_demo_yolov3_async
crossroad_camera_demo               object_detection_sample_ssd
end2end_video_analytics_ie          pedestrian_tracker_demo
end2end_video_analytics_opencv      perfcheck
hello_autoresize_classification     security_barrier_camera_demo
hello_classification                segmentation_demo
hello_request_classification        smart_classroom_demo
hello_shape_infer_ssd               speech_sample
human_pose_estimation_demo          style_transfer_sample
interactive_face_detection_demo     super_resolution_demo
lenet_network_graph_builder         text_detection_demo
lib                                 validation_app
mask_rcnn_demo
root@terasic:~/inference_engine_samples_build/intel64/Release# ./my_demo -d "HETERO
:FPGA,CPU" -i /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/pic_vi
deo/openvino_pictures -m /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/
demo/ir/FP16/squeezenet1.1/squeezenet1.1.xml
```

14. The results are as below:



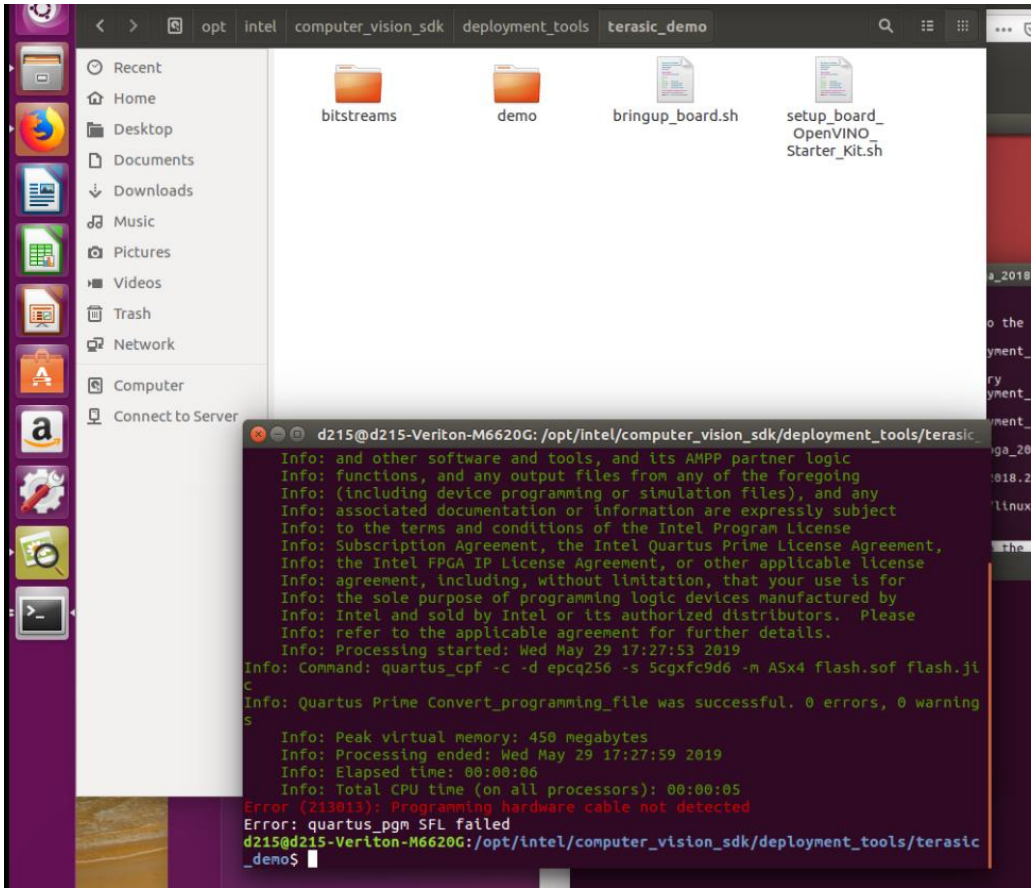




If you test all of these demos successfully, you will find the result is the same as demo 07_classification_pic_loop.sh.

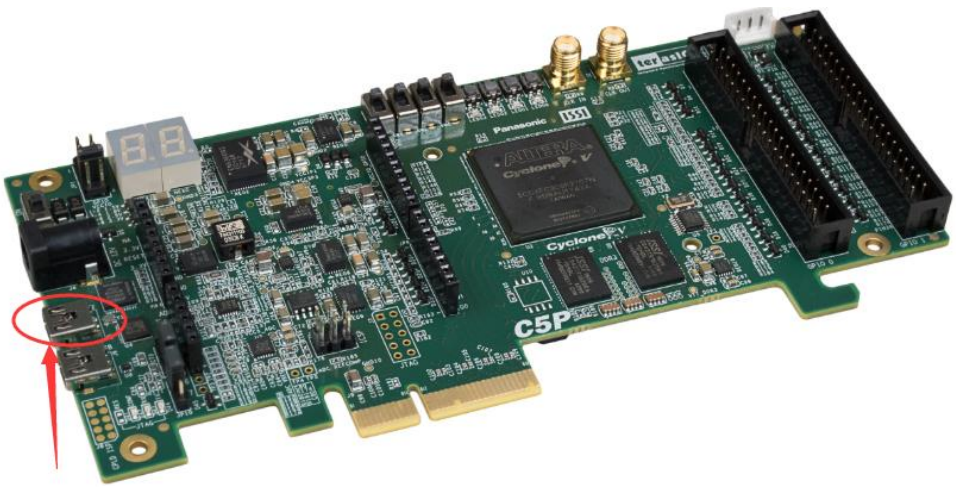
FAQ

1. **Q**: When executing ./bringup_board.sh command, it reports "Error (213013): Programming hardware cable not detected Error: quartus_pgm SFL failed" as the picture below:



A: Please make sure the USB cable is connected to the UB2 (USB Blaster II) port correctly (the UB2 port is shown in the following picture).

Using the command "lsusb" to double check if the PC detects the hardware or not.



2. **Q:** Which Nets can the OpenVINO Model Optimizer support?

   A: Please refer to Intel website:

   https://docs.openvinotoolkit.org/latest/_docs_MO_DG_Deep_Learning_Model_Optimizer_DevGuide.html for the more information.

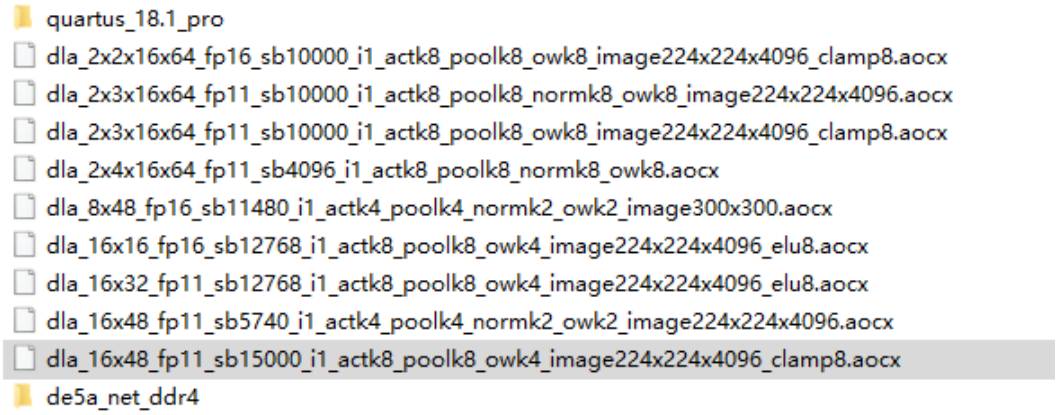
   So far, we have tested GoogleNet V2 and ResNet.

3. **Q:** How to program different aocx file for one FPGA board?

   A: Please refer to below command:

   aocl program acl0 <*terasic_demo path*>/bitstreams/<*board name*>/<*aocx name*>

   User needs to enter the right **terasic_demo path**, **board name** and **aocx name** to the command, for example, we use DE5a-Net-DDR4 board, we provide below aocx files for DE5a-Net-DDR4:



   Below is the command that we use to program one aocx file:

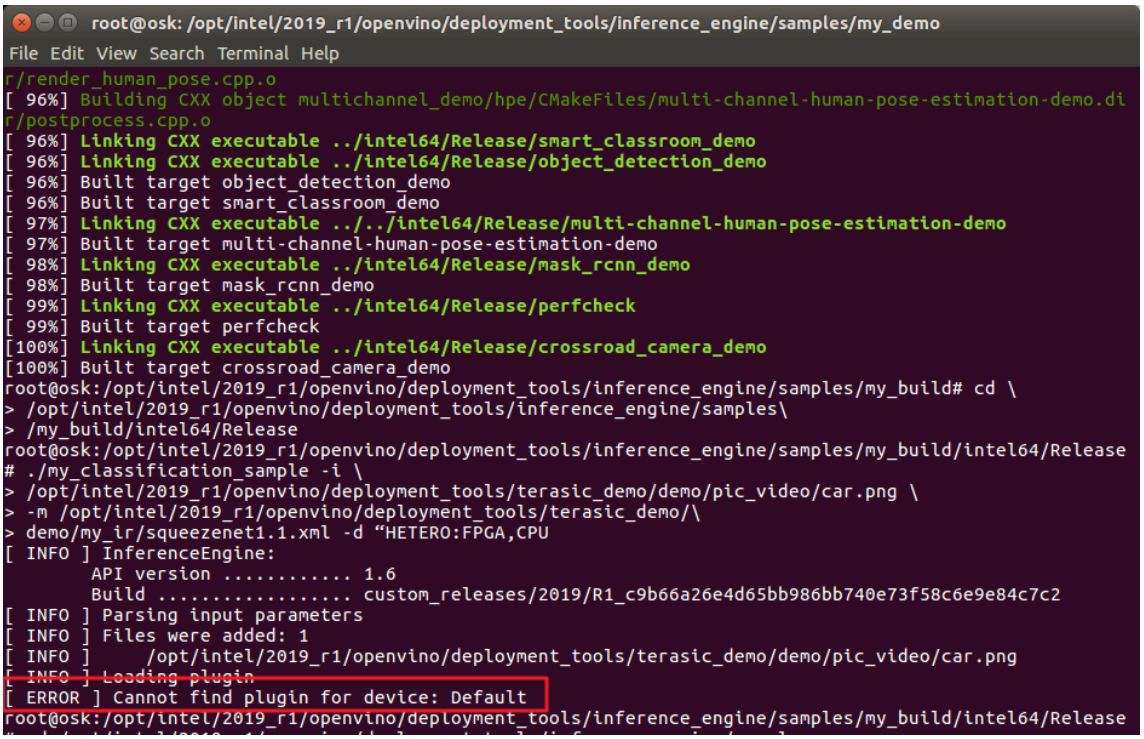
   aocl program *acl0 /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo*/bitstreams/*de5a_net_ddr4/dla_16x48_fp11_sb15000_i1_actk8_poolk8_owk4_image224x224x4096_clamp8.aocx*

4. **Q:** After entering the command "./my_classification_sample -i \

   /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/demo/pic_video/car.png \

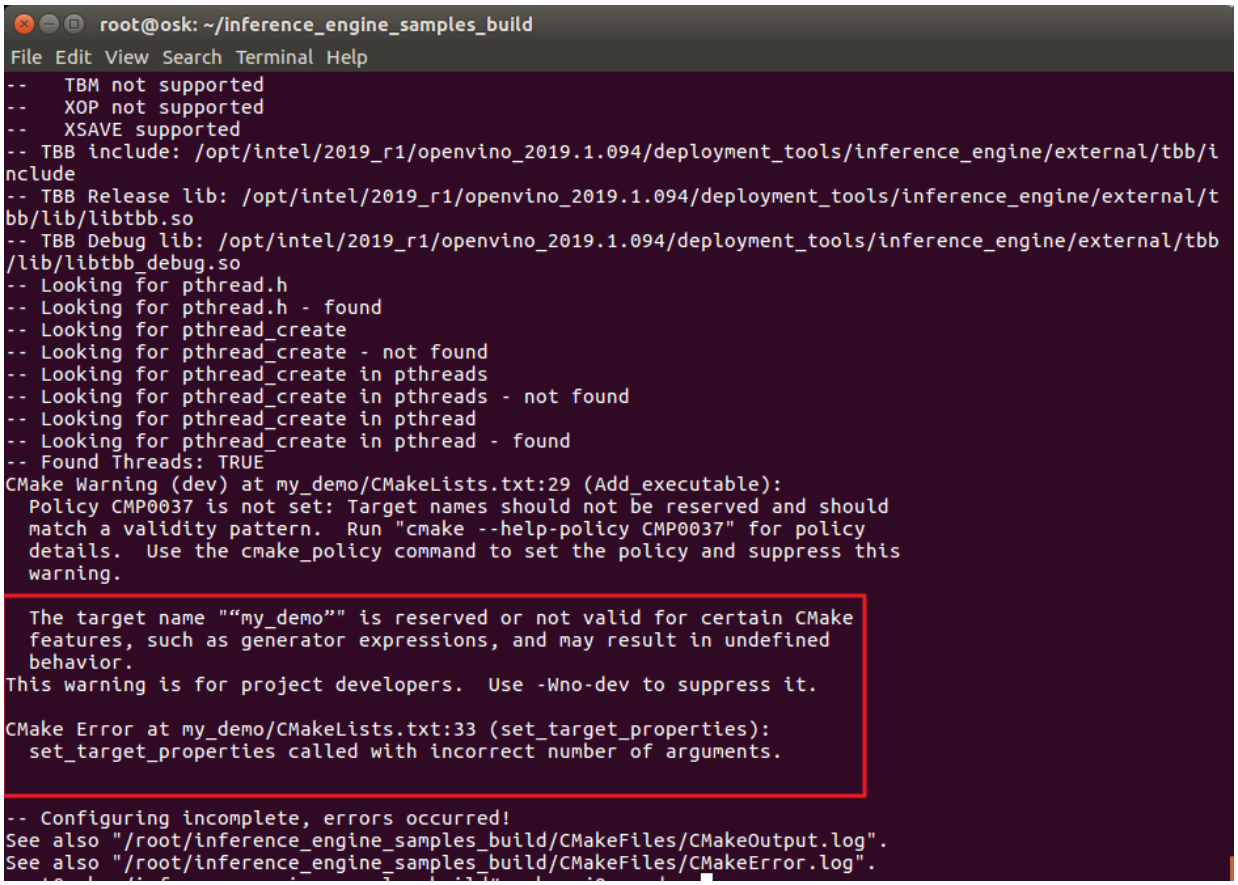
   -m /opt/intel/2019_r1/openvino/deployment_tools/terasic_demo/\

   demo/my_ir/squeezenet1.1.xml -d "HETERO:FPGA,CPU"" to execute the Inference Engine, why does it report the error "Cannot find plugin for device: Default"?



A: Please make sure the syntax of quotation marks in the command is entered correctly

5. **Q:** After entering the command “cmake -DCMAKE_BUILD_TYPE=Release \ /opt/intel/2019_r1/openvino/deployment_tools/inference_engine/samples” to copy the file to the samples build directory, it reports the error as the following picture, why?



Q: There may be syntax errors in the CMakeLists.txt file you have modified. Please double check the syntax (especially the syntax of symbols) in the code you added and correct it. And we also suggest you to double check the syntax in the main.cpp file you modified to prevent errors after entering “make -j8 my_demo” to compile the application program.

Contact Terasic

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Revision History

Version	Changes Log
V1.0	Initial Version
V2.0	Modified for 2019R1
V2.1	Update figures and operation describe for TDK
V2.2	Following this guide to test DE5a-Net-DDR4 OpenVINO 2019R1
V2.3	Following this guide to test TSP GT Edition OpenVINO 2019R1, and update the figures

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