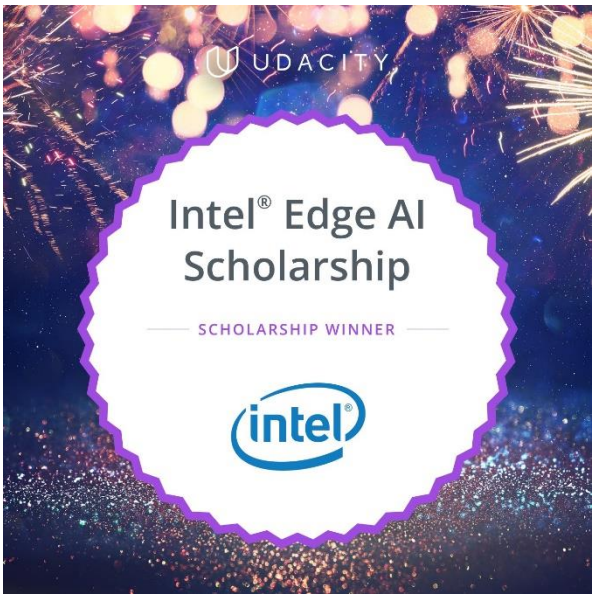


Intel® Edge AI for IoT Developers Nanodegree Program

Project #05 Computer Pointer Controller

Name: Marwan Saeed Alsharabbi

Date: 08-Jule-2020

Instructions

In this project, you will use a gaze detection model to control the mouse pointer of your computer. You will be using the Gaze Estimation model to estimate the gaze of the user's eyes and change the mouse pointer position accordingly. This project will demonstrate your ability to run multiple models in the same machine and coordinate the flow of data between those models.

How it works

You will be using the InferenceEngine API from Intel's OpenVino ToolKit to build the project. The **gaze estimation** model requires three inputs:

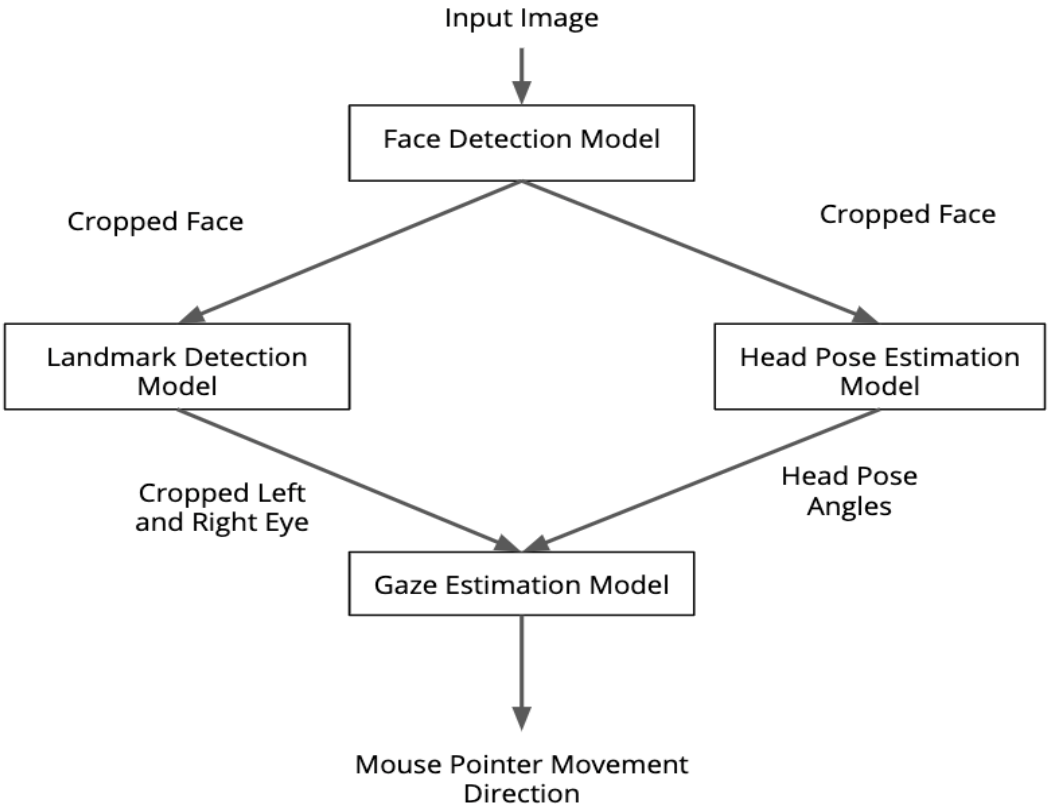
- The head pose
- The left eye image
- The right eye image.

To get these inputs, you will have to use three other OpenVino models:

- Face Detection
- Head Pose Estimation
- Facial Landmarks Detection.

The Pipeline

You will have to coordinate the flow of data from the input, and then amongst the different models and finally to the mouse controller. The flow of data will look like this:



While building the flow, you will need to make sure that you are aware of the input and output shapes of each model. If the shapes or data format are different for a particular model, you can account for this in the preprocessing methods (will go over this in more detail shortly).

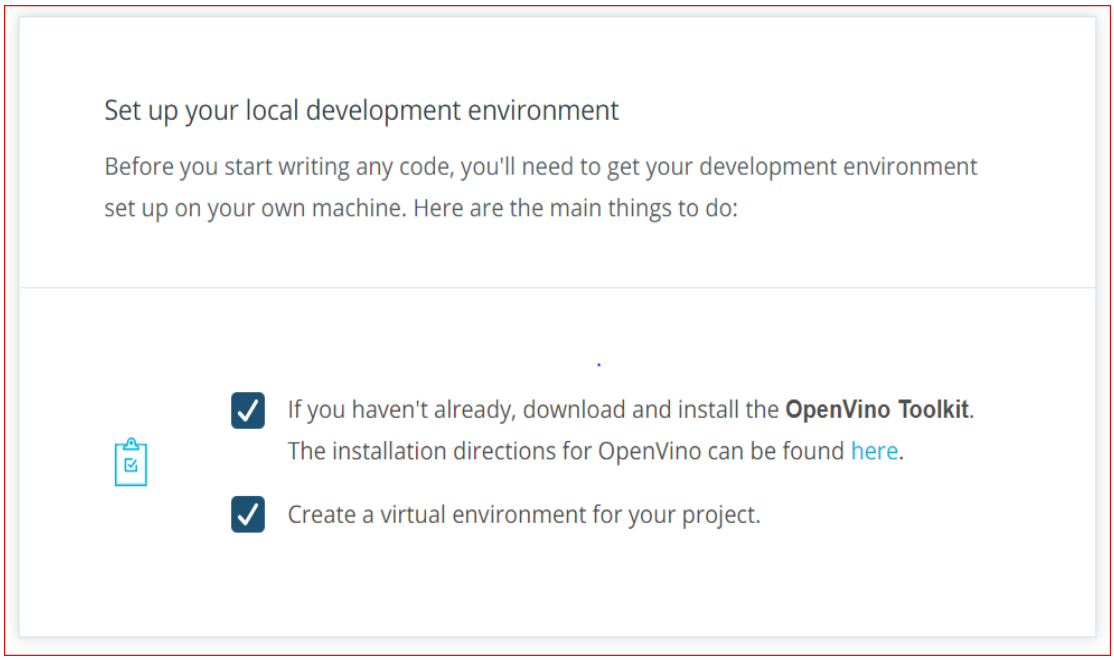
Useful Links

You may find these links useful to you when building your project:

- Inference Engine API Docs
- Model Documentation

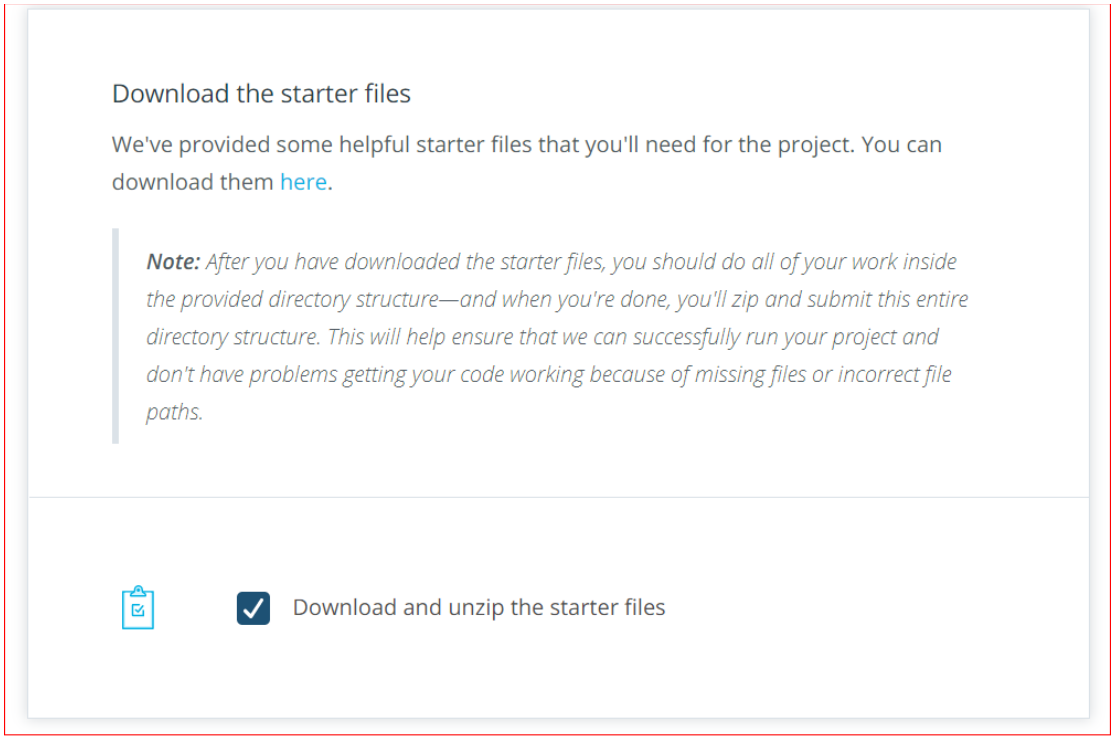
Step 1: Project Setup

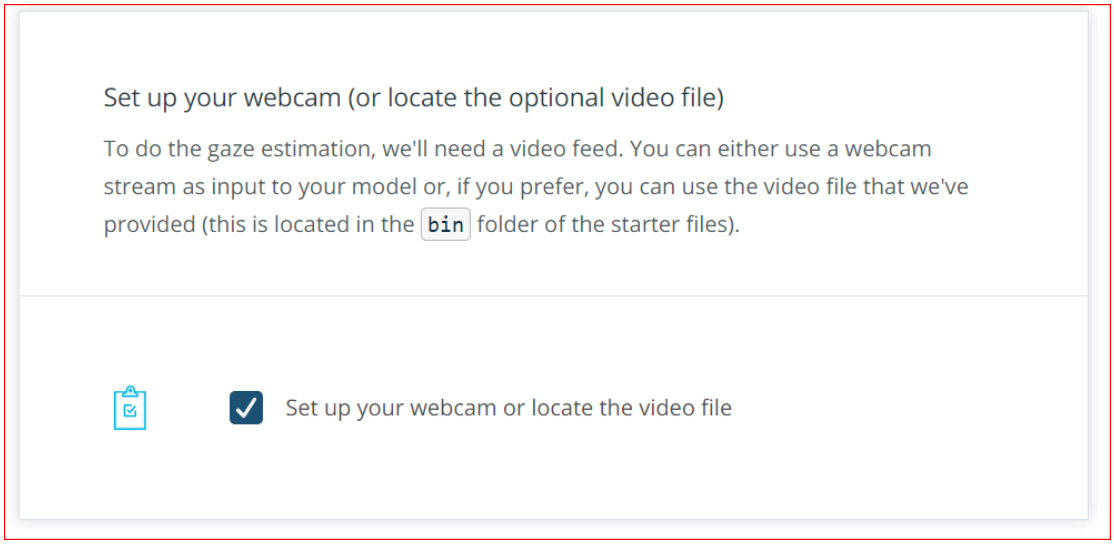
By the end of this task, you should have your dependencies installed and your project set up.

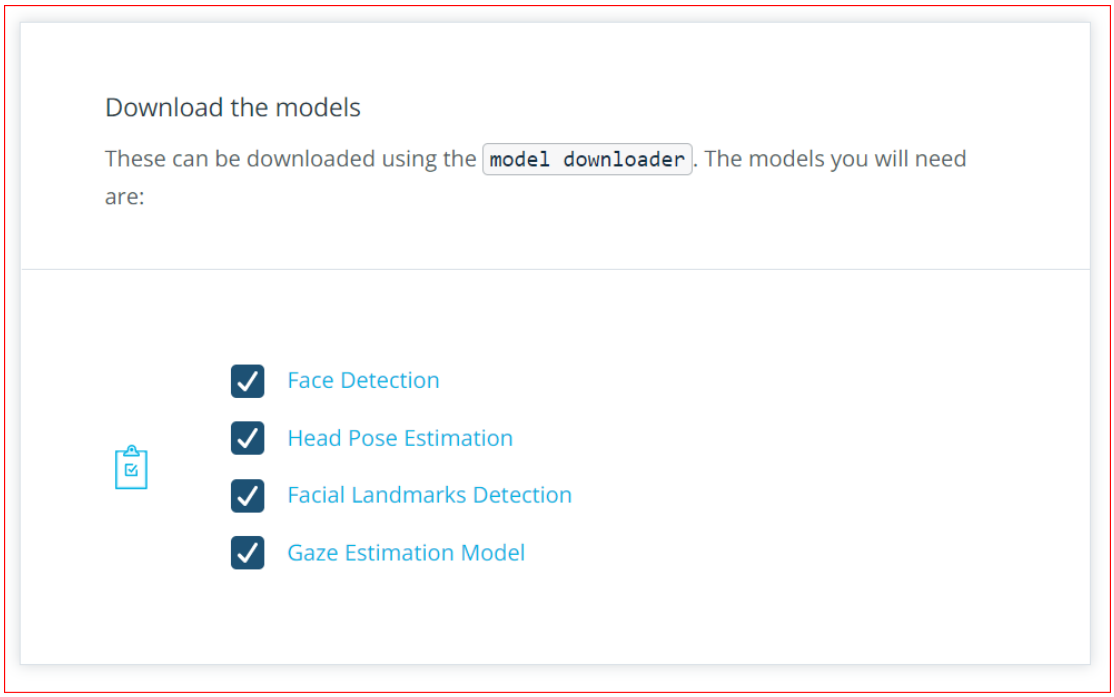


Download the starter files

We've provided some helpful starter files that you'll need for the project. You can download them here.







Step 2: Build the Inference Pipeline

Using the *Inference Engine API*, you will need to build a pipeline that runs inference on the models using the inputs. The starter code includes methods that will help you set up this pipeline.

Before you start writing any code, the first step is just to get familiar with the starter files and how they will be used to construct the inference pipeline. We'll go over each file in the video below. You should open up the copy you downloaded and follow along.

Get familiar with the starter code

Make sure you can locate each of these files—and that you have at least a basic understanding of how it will be used in the pipeline:

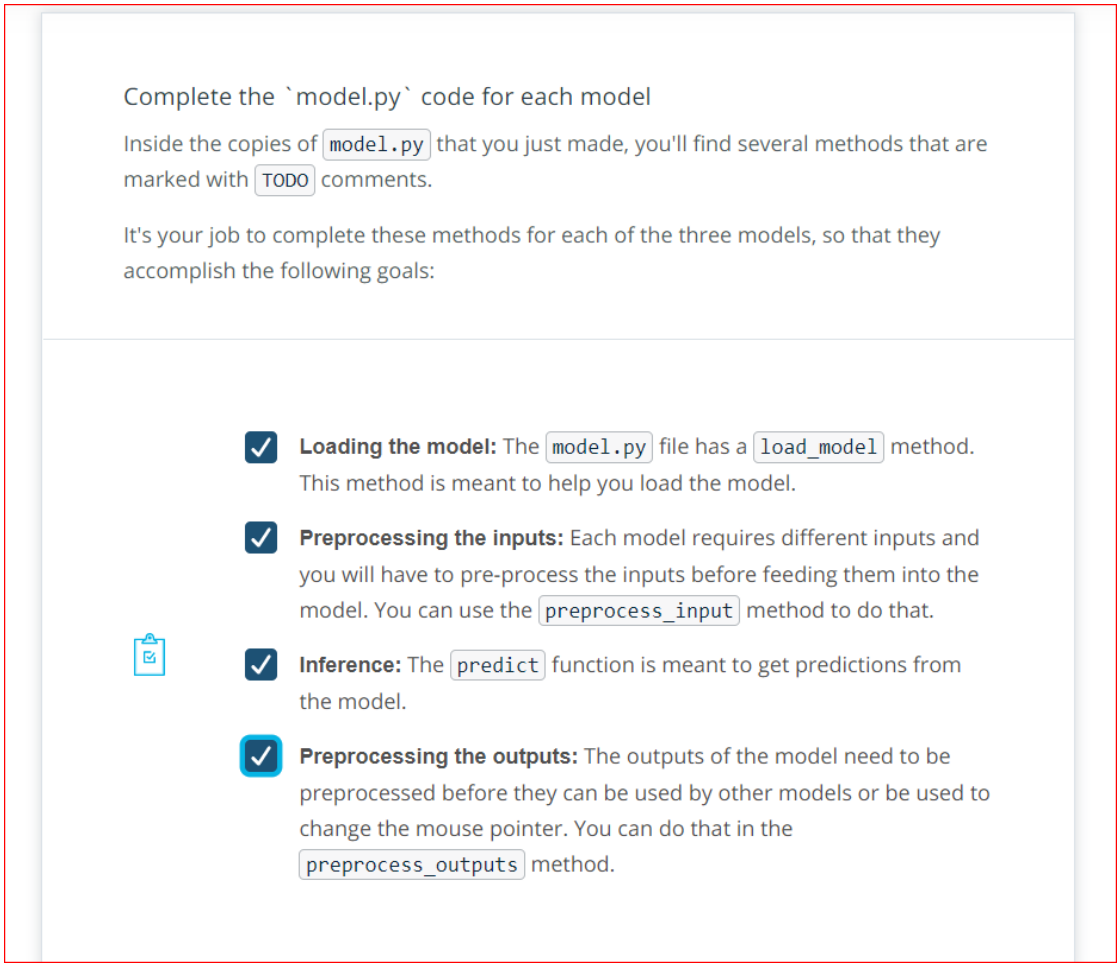
- [x] `model.py`
- [x] `mouse_controller.py`
- [x] `input_feeder.py`

Make copies of the `model.py` file

The `model.py` file contains a sample class for loading, checking, and running inference on a single model. It also has methods to pre-process the inputs and outputs to the model, but these are not yet finished—that will be your job.

Since each of the models has different requirements, you'll need to make a copy of `model.py` for each of the models. There are four models, so you should create four copies of `model.py` and rename them as follows:

- [x] `face_detection.py`
- [x] `head_pose_estimation.py`
- [x] `facial_landmarks_detection.py`
- [x] `gaze_estimation.py`



Step 3: Complete the README

An important part of your project is creating a README file that describes the project, explains how to set up and run the code, and describes your benchmarks and results. We've included a template in the starter files (that you downloaded earlier), with TODOs for each of the things you should include.

An important part of your project is creating a `README` file that describes the project, explains how to set up and run the code, and describes your benchmarks and results. We've included a template in the starter files (that you downloaded earlier), with `TODO` s for each of the things you should include.

> ***Note:*** *You'll see some optional `TODO` s for "standout suggestions". We'll go over these on the next page.*

- [x] Complete all of the required `TODO` s in the `README` template.

Part 4: Standout suggestions

If you've been having a good time with this project and want to take it further, here are some suggestions for a whole bunch of additional things you can do with it. If you want the additional practice or are wanting to turn this project into a nice portfolio piece, we recommend taking a shot at these—but note that these are all optional, so you can skip any (or all) of them and go straight to the project submission page.

For your reference, here's a summary of the standout suggestions:

- [x] **Can you improve your inference speed without significant drop in performance by changing the precision of some of the models?** In your README, include a short write-up that explains the procedure and the experiments you ran to find out the best combination of precision.
- [x] **Benchmark the running times of different parts of the preprocessing and inference pipeline and let the user specify a CLI argument if they want to see the benchmark timing.** Use the `get_perf_counts` API to print the time it takes for each layer in the model.

- [x] **Use the VTune Amplifier to find hotspots in your Inference Engine Pipeline.** Write a short write-up in the README about the hotspots in your system and how you solved them.
- [x] **There will be certain edge cases that will cause your system to not function properly.** Examples of this include: lighting changes, multiple people in the same input frame, and so on. Make changes in your preprocessing and inference pipeline to solve some of these issues. Write a short write-up in the README about the problem it caused and your solution.
- [x] **Add a toggle to the UI to shut off the camera feed and show stats only (as well as to toggle the camera feed back on).** Show how this affects performance and power as a short write up in the README file.
- [x] **Build an inference pipeline for both video file and webcam feed as input.** Allow the user to select their input option in the command line arguments.

Update your `README`

- [x] If you've done any of the above standout suggestions, document these in your `README` file.

Part 5: Check Your Work

Your reviewer will use the instructions you provide to run and test your project, so it's important to make sure your instructions are clear, that your code works, and that all necessary dependencies are included.

> ***Note:*** *The models themselves are large files and you do not need to include them in your submission (your reviewer will have a copy of these themselves).*

Before submitting, be sure you've done the following:

- [x] Make sure all of the files for your project are in the same directory.
- [x] Make sure the instructions for running your project are in your README.
- [x] Test the instructions to make sure your project runs!
- [x] Zip the entire directory containing your code and all required files/dependencies (except the model files). Make sure you've included everything that your reviewer will need to run your project.
- [x] To reduce the size of your submission, make sure the zip file does *not* include the model files. The final zip file should be no more than a few megabytes in size.
- [x] If you'd like to be especially thorough, you can have a look at the project rubric. This describes the exact requirements that your reviewer will be looking at when they go over your submission.

Computer Pointer Controller

This is the third project for the Udacity course Intel® Edge AI for IoT Developers. The purpose of this project is to use multiple deep learning models to move a mouse cursor on a screen using eye and head pose from a webcam or video.

When the program starts, a window showing the input video appears in the middle of the screen and the mouse pointer is automatically moved to the center of the screen also. As the person in the video moves their eyes and head, the mouse cursor will move in the same direction. Only one person must be in the frame for the mouse cursor to move.

The mouse controller is hardcoded for fast, high-precision movement but you will still see it moving very slowly.

The video and detections from model outputs are shown by default but they can be turned off using command line arguments.

Project Set Up and Installation

- Install OpenVINO for Windows,
- Source OpenVINO environment variables:
    - Windows:

```
"C:\Program Files (x86)\IntelSWTools\openvino\bin\setupvars.bat"
```

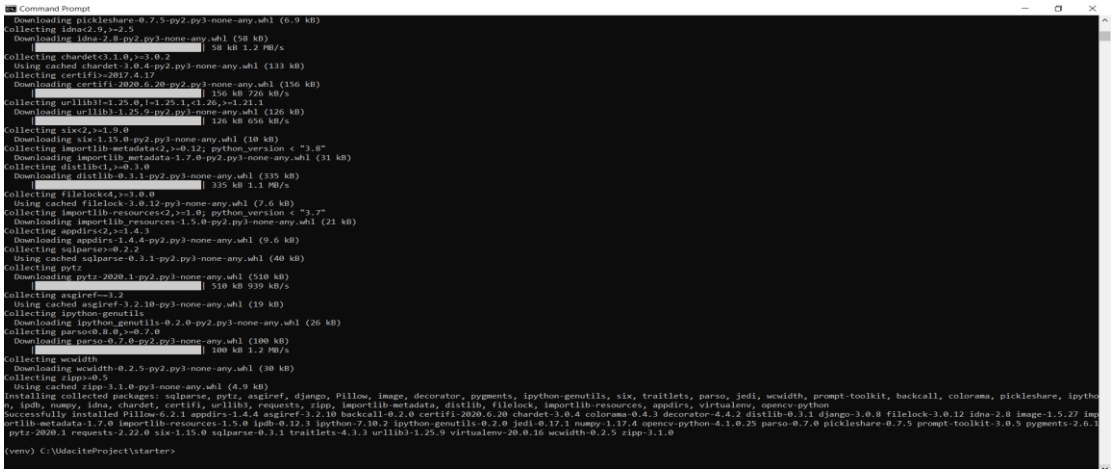
- Create Virtual Environment using command `virtualenv venv` in the command prompt

```
virtualenv [name of the virtual environmant. For example, my_project]
```

```
C:\Users\enmar>virtualenv venv
Using base prefix 'c:\\users\\enmar\\appdata\\local\\programs\\python\\python36'
New python executable in C:\Users\enmar\venv\Scripts\python.exe
Installing setuptools, pip, wheel...
done.
Overwriting C:\Users\enmar\venv\Scripts\activate.bat with new content
Overwriting C:\Users\enmar\venv\Scripts\deactivate.bat with new content
Overwriting C:\Users\enmar\venv\Scripts\activate.ps1 with new content
Overwriting C:\Users\enmar\venv\Scripts\activate with new content
Overwriting C:\Users\enmar\venv\Scripts\activate_this.py with new content
Overwriting C:\Users\enmar\venv\Scripts\activate.xsh with new content
```

```
C:\Users\enmar>virtualenv venv
Using base prefix 'c:\\users\\enmar\\appdata\\local\\programs\\python\\python36'
New python executable in C:\Users\enmar\venv\Scripts\python.exe
Installing setuptools, pip, wheel...
done.

C:\Users\enmar>cd venv/Scripts/

C:\Users\enmar\venv\Scripts>activate

(venv) C:\Users\enmar\venv\Scripts>cd C:\Program Files (x86)\IntelSWTools\openvino\bin\

(venv) C:\Program Files (x86)\IntelSWTools\openvino\bin>setupvars.bat
Python 3.6.5
ECHO is off.
PYTHONPATH=C:\Program Files (x86)\IntelSWTools\openvino\deployment_tools\open_model_zoo\tools\accuracy_checker;C:\Progra
m Files (x86)\IntelSWTools\openvino\python\python3.6;C:\Program Files (x86)\IntelSWTools\openvino\python\python3;C:\Prog
ram Files (x86)\IntelSWTools\openvino\deployment_tools\model_optimizer;
[setupvars.bat] OpenVINO environment initialized

(venv) C:\Program Files (x86)\IntelSWTools\openvino\bin>
```

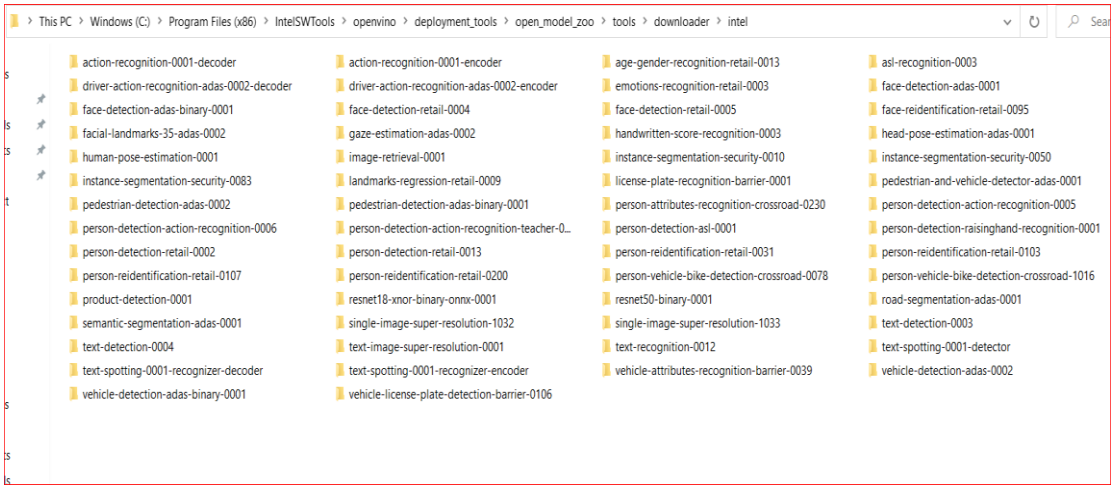
```
Source [my_Project]/bin/activate
pip3 install -r ../requirements.txt
```



- Install the project requirements by running

  `pip install -r requirements.txt`

- Download the pre-trained models in the `models/` folder by running `download_models.bat` from the root directory



I'm selected the models for project and copy the models and transfer to file project

To run this application locally, one needs to have openVINO toolkit installed.

First enable the virtual environment:
`cd C:\Program Files (x86)\IntelSWTools\openvino\bin\setupvars.sh`
Secondly, activate the python virtual environment. To install it, run the following commands in your terminal:

I have checked `Inference Time, Model Loading Time, and Frames per Second model for FP16, FP32, and FP32-INT8 of all the models except Face Detection Model .Face Detection Model was only available on FP32-INT1 precision.

You can use below commands to get outcomes for respective precisions,.

Device CPU – Model - FP32-INT8

python main.py -fdm C:/UdaciteProject/starter/models/face-detection-adas-0001/FP32-INT8/face-detection-adas-0001.xml

-lrm C:/UdaciteProject/starter/models/landmarks-regression-retail-0009/FP32-INT8/landmarks-regression-retail-0009.xml

-hpm C:/UdaciteProject/starter/models/head-pose-estimation-adas-0001/FP32-INT8/head-pose-estimation-adas-0001.xml -gem C:/UdaciteProject/starter/models/gaze-estimation-adas-0002/FP32-INT8/gaze-estimation-adas-0002.xml -inp C:/UdaciteProject/starter/bin/demo.mp4 -d CPU -o C:/UdaciteProject/starter/outcomes_CPU/FP32-INT8/ -flags face_frame face_eyes

```
(venv) C:\UdaciteProject\starter\src>python main.py -fdm C:/UdaciteProject/starter/models/face-detection-adas-0001/FP32-
INT8/face-detection-adas-0001.xml -lrm C:/UdaciteProject/starter/models/landmarks-regression-retail-0009/FP32-INT8/landm
arks-regression-retail-0009.xml -hpm C:/UdaciteProject/starter/models/head-pose-estimation-adas-0001/FP32-INT8/head-pose
-estimation-adas-0001.xml -gem C:/UdaciteProject/starter/models/gaze-estimation-adas-0002/FP32-INT8/gaze-estimation-adas
-0002.xml -inp C:/UdaciteProject/starter/bin/demo.mp4 -d CPU -o C:/UdaciteProject/starter/outcomes_CPU/FP32-INT8/ -flags
 face_frame face_eyes
MFX: Unsupported extension: C:/UdaciteProject/starter/bin/demo.mp4
MFX: Unsupported FourCC: avc1 (0x31637661)
[WinError 183] Cannot create a file when that file already exists: 'C:/UdaciteProject/starter/outcomes_CPU/FP32-INT8/'
Total time: 32.02290606498718 s
Total inference time: 32.0 s
Total model load time,  2.662998914718628 s
FPS: 1.84375 frames/s
```

CPU – Model -FP16

python main.py -fdm C:/UdaciteProject/starter/models/face-detection-adas-0001/FP16/face-detection-adas-0001.xml
-lrm C:/UdaciteProject/starter/models/landmarks-regression-retail-0009/FP16/landmarks-regression-retail-0009.xml -hpm C:/UdaciteProject/starter/models/head-pose-estimation-adas-0001/FP16/head-pose-estimation-adas-0001.xml
-gem C:/UdaciteProject/starter/models/gaze-estimation-adas-0002/FP16/gaze-estimation-adas-0002.xml
-inp C:/UdaciteProject/starter/bin/demo.mp4 -d CPU -o C:/UdaciteProject/starter/outcomes_CPU/FP16/ -flags face_frame face_eyes

```
(venv) C:\UdaciteProject\starter\src>python main.py -fdm C:/UdaciteProject/starter/models/face-detection-adas-0001/FP16/
face-detection-adas-0001.xml -lrm C:/UdaciteProject/starter/models/landmarks-regression-retail-0009/FP16/landmarks-regre
ssion-retail-0009.xml -hpm C:/UdaciteProject/starter/models/head-pose-estimation-adas-0001/FP16/head-pose-estimation-ada
s-0001.xml -gem C:/UdaciteProject/starter/models/gaze-estimation-adas-0002/FP16/gaze-estimation-adas-0002.xml -inp C:/Ud
aciteProject/starter/bin/demo.mp4 -d CPU -o C:/UdaciteProject/starter/outcomes_CPU/FP16/ -flags face_frame face_eyes
MFX: Unsupported extension: C:/UdaciteProject/starter/bin/demo.mp4
MFX: Unsupported FourCC: avc1 (0x31637661)
[WinError 183] Cannot create a file when that file already exists: 'C:/UdaciteProject/starter/outcomes_CPU/FP16/'
Total time: 31.845104932785034 s
Total inference time: 31.8 s
Total model load time,  1.1650731563568115 s
FPS: 1.8553459119496856 frames/s
```

CPU – Model –FP32

python main.py -fdm C:/UdaciteProject/starter/models/face-detection-adas-0001/FP32/face-detection-adas-0001.xml
-lrm C:/UdaciteProject/starter/models/landmarks-regression-retail-0009/FP32/landmarks-regression-retail-0009.xml -hpm C:/UdaciteProject/starter/models/head-pose-estimation-adas-0001/FP32/head-pose-estimation-adas-0001.xml
-gem C:/UdaciteProject/starter/models/gaze-estimation-adas-0002/FP32/gaze-estimation-adas-0002.xml
-inp C:/UdaciteProject/starter/bin/demo.mp4 -d CPU -o C:/UdaciteProject/starter/outcomes_CPU/FP32/ -flags face_frame face_eyes

```
(venv) C:\UdaciteProject\starter\src>python main.py -fdm C:/UdaciteProject/starter/models/face-detection-adas-0001/FP32/
face-detection-adas-0001.xml -lrm C:/UdaciteProject/starter/models/landmarks-regression-retail-0009/FP32/landmarks-regre
ssion-retail-0009.xml -hpm C:/UdaciteProject/starter/models/head-pose-estimation-adas-0001/FP32/head-pose-estimation-ada
s-0001.xml -gem C:/UdaciteProject/starter/models/gaze-estimation-adas-0002/FP32/gaze-estimation-adas-0002.xml -inp C:/Ud
aciteProject/starter/bin/demo.mp4 -d CPU -o C:/UdaciteProject/starter/outcomes_CPU/FP32/ -flags face_frame face_eyes
MFX: Unsupported extension: C:/UdaciteProject/starter/bin/demo.mp4
MFX: Unsupported FourCC: avc1 (0x31637661)
[WinError 183] Cannot create a file when that file already exists: 'C:/UdaciteProject/starter/outcomes_CPU/FP32/'
Total time: 31.645941972732544 s
Total inference time: 31.6 s
Total model load time,  0.9303081035614014 s
FPS: 1.8670886075949367 frames/s
```

Device GPU – Model - FP32-INT8

python main.py -fdm C:/UdaciteProject/starter/models/face-detection-adas-0001/FP32-INT8/face-detection-adas-0001.xml
-lrm C:/UdaciteProject/starter/models/landmarks-regression-retail-0009/FP32-INT8/landmarks-regression-retail-0009.xml
-hpm C:/UdaciteProject/starter/models/head-pose-estimation-adas-0001/FP32-INT8/head-pose-estimation-adas-0001.xml -gem C:/UdaciteProject/starter/models/gaze-estimation-adas-0002/FP32-INT8/gaze-estimation-adas-0002.xml
-inp C:/UdaciteProject/starter/bin/demo.mp4 -d GPU -o C:/UdaciteProject/starter/outcomes_GPU/FP32-INT8/ -flags face_frame face_eyes

```
(venv) C:\UdaciteProject\starter\src>python main.py -fdm C:/UdaciteProject/starter/models/face-detection-adas-0001/FP32-INT8/face-detection-adas-0001.xml -lrm C:/UdaciteProject/starter/models/landmarks-regression-retail-0009/FP32-INT8/landmarks-regression-retail-0009.xml -hpm C:/UdaciteProject/starter/models/head-pose-estimation-adas-0001/FP32-INT8/head-pose-estimation-adas-0001.xml -gem C:/UdaciteProject/starter/models/gaze-estimation-adas-0002/FP32-INT8/gaze-estimation-adas-0002.xml -inp C:/UdaciteProject/starter/bin/demo.mp4 -d GPU -o C:/UdaciteProject/starter/outcomes_GPU/FP32-INT8/ -flags face_frame face_eyes
MFX: Unsupported extension: C:/UdaciteProject/starter/bin/demo.mp4
MFX: Unsupported FourCC: avc1 (0x31637661)
[WinError 183] Cannot create a file when that file already exists: 'C:/UdaciteProject/starter/outcomes_GPU/FP32-INT8/'
Total time: 34.146677017211914 s
Total inference time: 34.1 s
Total model load time,  47.70037484169006 s
FPS: 1.7302052785923754 frames/s
```

GPU – Model – FP16

python main.py -fdm C:/UdaciteProject/starter/models/face-detection-adas-0001/FP16/face-detection-adas-0001.xml
-lrm C:/UdaciteProject/starter/models/landmarks-regression-retail-0009/FP16/landmarks-regression-retail-0009.xml -hpm C:/UdaciteProject/starter/models/head-pose-estimation-adas-0001/FP16/head-pose-estimation-adas-0001.xml
-gem C:/UdaciteProject/starter/models/gaze-estimation-adas-0002/FP16/gaze-estimation-adas-0002.xml
-inp C:/UdaciteProject/starter/bin/demo.mp4 -d GPU -o C:/UdaciteProject/starter/outcomes_GPU/FP16/ -flags face_frame face_eyes

```
(venv) C:\UdaciteProject\starter\src>python main.py -fdm C:/UdaciteProject/starter/models/face-detection-adas-0001/FP16/face-detection-adas-0001.xml -lrm C:/UdaciteProject/starter/models/landmarks-regression-retail-0009/FP16/landmarks-regression-retail-0009.xml -hpm C:/UdaciteProject/starter/models/head-pose-estimation-adas-0001/FP16/head-pose-estimation-adas-0001.xml -gem C:/UdaciteProject/starter/models/gaze-estimation-adas-0002/FP16/gaze-estimation-adas-0002.xml -inp C:/UdaciteProject/starter/bin/demo.mp4 -d GPU -o C:/UdaciteProject/starter/outcomes_GPU/FP16/ -flags face_frame face_eyes
MFX: Unsupported extension: C:/UdaciteProject/starter/bin/demo.mp4
MFX: Unsupported FourCC: avc1 (0x31637661)
[WinError 183] Cannot create a file when that file already exists: 'C:/UdaciteProject/starter/outcomes_GPU/FP16/'
Total time: 32.57253837585449 s
Total inference time: 32.6 s
Total model load time,  34.921903133392334 s
FPS: 1.8098159509202454 frames/s
```

GPU – Model – FP32

python main.py -fdm C:/UdaciteProject/starter/models/face-detection-adas-0001/FP32/face-detection-adas-0001.xml
lrm C:/UdaciteProject/starter/models/landmarks-regression-retail-0009/FP32/landmarks--regression-retail-0009.xml -hpm C:/UdaciteProject/starter/models/head-pose-estimation-adas-0001/FP32/head-pose-estimation-adas-0001.xml

gem C:/UdaciteProject/starter/models/gaze-estimation-adas-0002/FP32/gaze-estimation--adas-0002.xml
-inp C:/UdaciteProject/starter/bin/demo.mp4 -d GPU -o C:/UdaciteProject/starter/outcomes_GPU/FP32/ -flags face_frame face_eyes

```
(venv) C:\UdaciteProject\starter\src>python main.py -fdm C:/UdaciteProject/starter/models/face-detection-adas-0001/FP32/face-detection-adas-0001.xml -lrm C:/UdaciteProject/starter/models/landmarks-regression-retail-0009/FP32/landmarks-regression-retail-0009.xml -hpm C:/UdaciteProject/starter/models/head-pose-estimation-adas-0001/FP32/head-pose-estimation-adas-0001.xml -gem C:/UdaciteProject/starter/models/gaze-estimation-adas-0002/FP32/gaze-estimation-adas-0002.xml -inp C:/UdaciteProject/starter/bin/demo.mp4 -d GPU -o C:/UdaciteProject/starter/outcomes_GPU/FP32/ -flags face_frame face_eyes
MFX: Unsupported extension: C:/UdaciteProject/starter/bin/demo.mp4
MFX: Unsupported FourCC: avc1 (0x31637661)
[WinError 183] Cannot create a file when that file already exists: 'C:/UdaciteProject/starter/outcomes_GPU/FP32/'
Total time: 32.82218098640442 s
Total inference time: 32.8 s
Total model load time,  33.834617137908936 s
FPS: 1.7987804878048783 frames/s
```

Command Line Arguments for Running the app

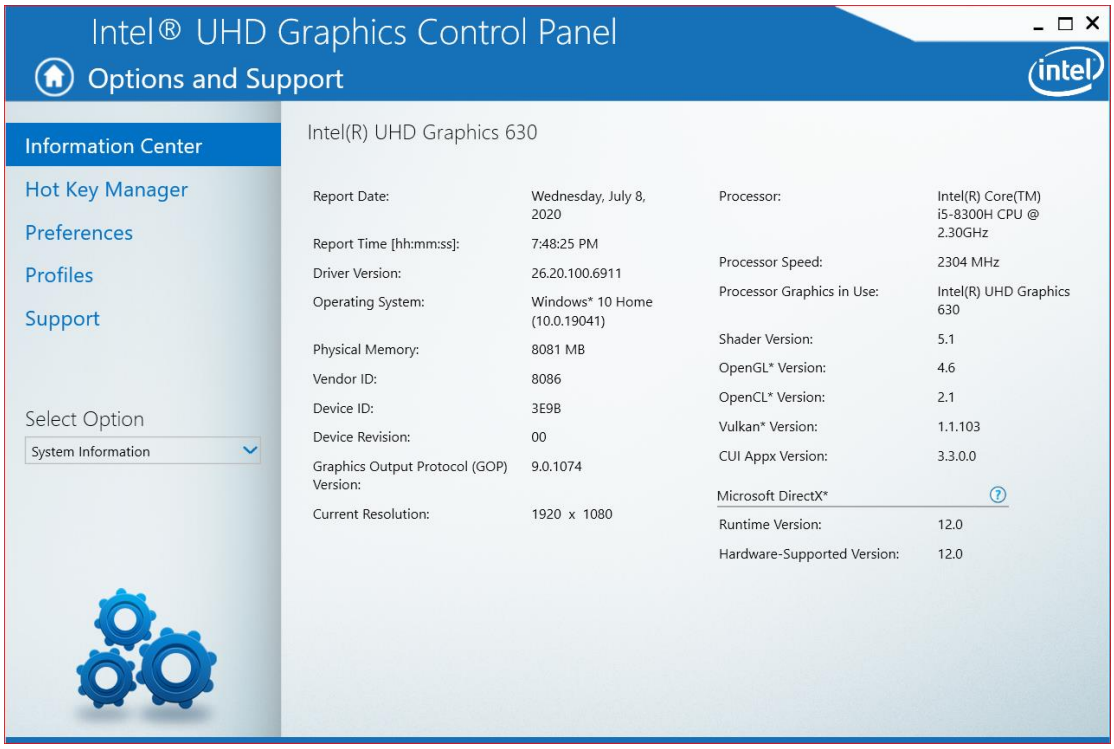
Following are commanda line arguments that can use for while running the main.py file `python main.py`:-

1. -h (required) : Get the information about all the command line arguments
2. -fdm (required) : Specify the path of Face Detection model's xml file
3. lrm : Specify path of xml file of landmark regression model
4. -hpm (required) : Specify the path of Head Pose Estimation model's xml file
5. -gem (required) : Specify the path of Gaze Estimation model's xml file
6. -inp (required) : Specify the path of input video file or enter cam for taking input video from webcam
7. -prob (optional) : Specify the probability threshold for face detection model to detect the face accurately from video frame.
8. -flags (optional): Specify the flags from face_frame, face_eyes frame, hp, ge if you want to visualize the output of corresponding models of each frame (write flags with space seperation. Ex:- -flags fd fld hp).
9. - d (Optional): Specify Device for inference, the device can be CPU, GPU, FPGU, MYRID
10. - o : Specify path of output folder where we will store results

```
usage: main.py [-h] -fdm FACEDETECTIONMODEL -lrm LANDMARKREGRESSIONMODEL -hpm
               HEADPOSEESTIMATIONMODEL -gem GAZEESTIMATIONMODEL -inp INPUT
               [-flags PREVIEWFLAGS [PREVIEWFLAGS ...]] [-prob PROB_THRESHOLD]
               [-d DEVICE] [-o OUTPUT_PATH]

optional arguments:
  -h, --help            show this help message and exit
  -fdm FACEDETECTIONMODEL, --faceDetectionModel FACEDETECTIONMODEL
                        Specify path of xml file of face detection model
  -lrm LANDMARKREGRESSIONMODEL, --landmarkRegressionModel LANDMARKREGRESSIONMODEL
                        Specify path of xml file of landmark regression model
  -hpm HEADPOSEESTIMATIONMODEL, --headPoseEstimationModel HEADPOSEESTIMATIONMODEL
                        Specify path of xml file of Head Pose Estimation model
  -gem GAZEESTIMATIONMODEL, --gazeEstimationModel GAZEESTIMATIONMODEL
                        Specify path of xml file of Gaze Estimation model
  -inp INPUT, --input INPUT
                        Specify path of input Video file or cam for webcam
  -flags PREVIEWFLAGS [PREVIEWFLAGS ...], --previewFlags PREVIEWFLAGS [PREVIEWFLAGS ...]
                        Specify flag from ff, fl like -flags ff fl(Space
                        separated if multiple values)face_frame for
                        faceDetectionModel, face_eyes for
                        landmarkRegressionModel
  -prob PROB_THRESHOLD, --prob_threshold PROB_THRESHOLD
                        Specify probability threshold for face detection model
  -d DEVICE, --device DEVICE
                        Specify Device for inferenceIt can be CPU, GPU, FPGU,
                        MYRID
  -o OUTPUT_PATH, --output_path OUTPUT_PATH
```

Benchmarks

I ran the model inference on CPU and GPU device on local machine given same input video and same virtual environment. Listed below are hardware versions:

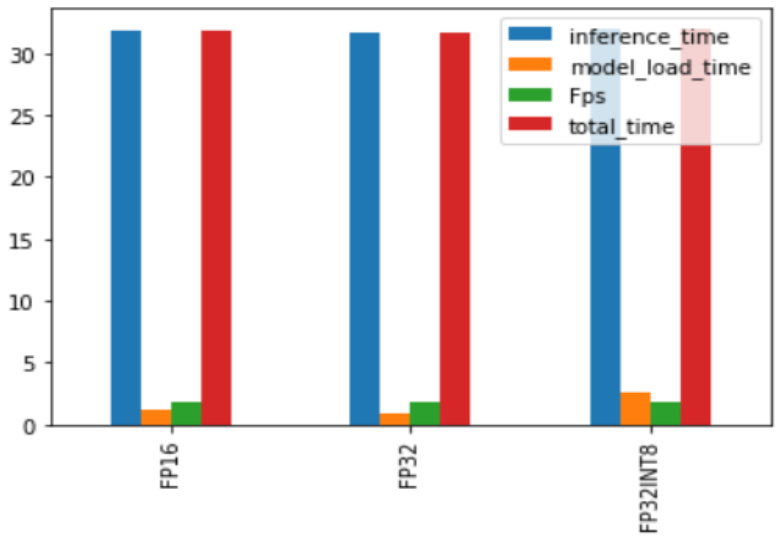


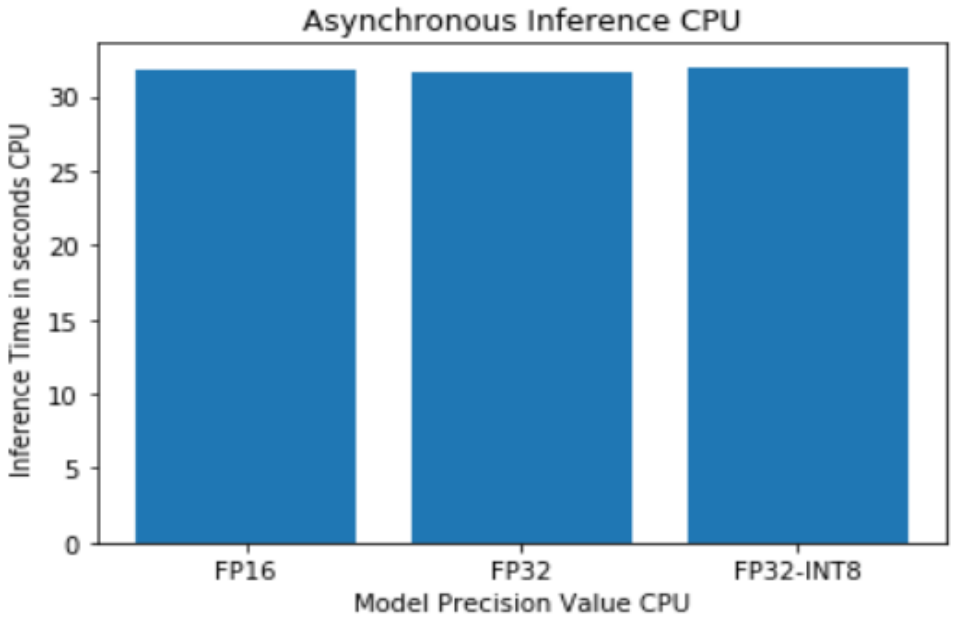
Due to non-availability of FPGA and VPU in local machine, I did not run inference for these device types

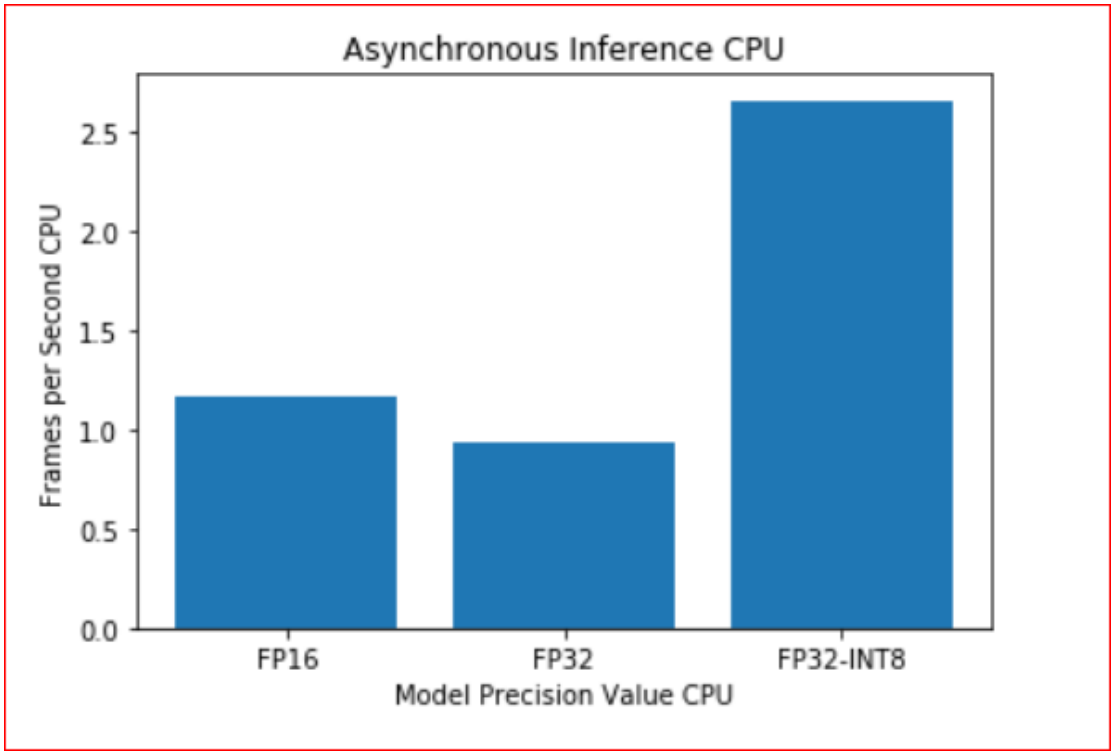
Benchmark results of the model. CPU

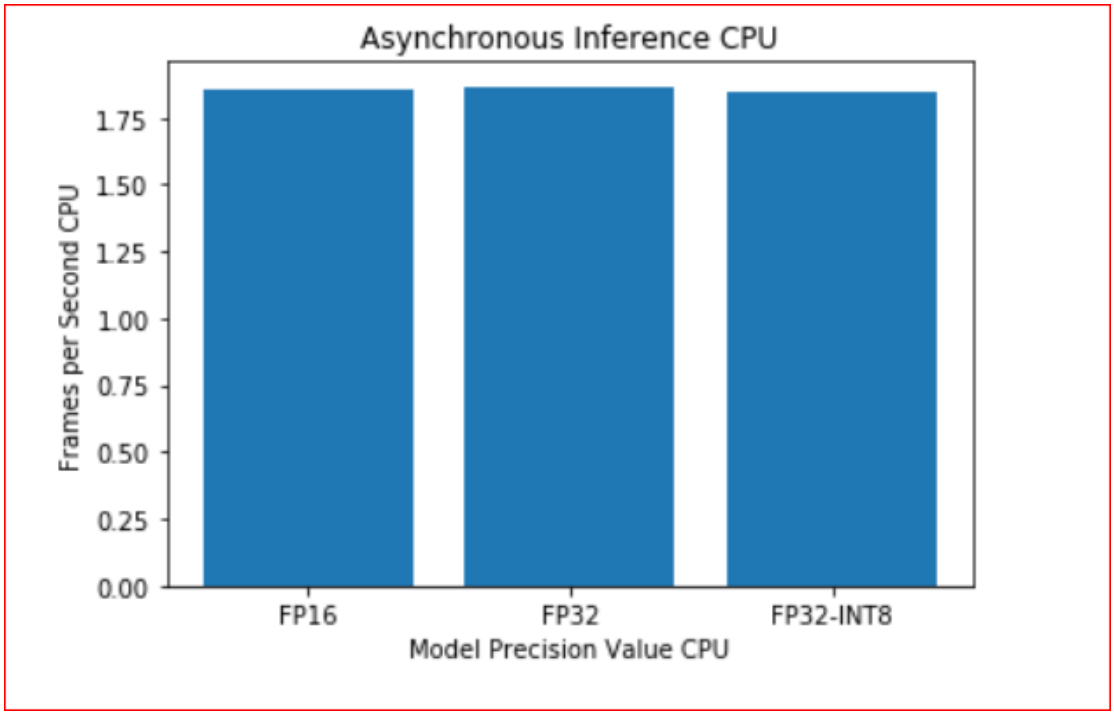
	inference_time	model_load_time	Fps	total_time
FP16	31.8	1.165073	1.855346	31.845105
FP32	31.6	0.930308	1.867089	31.645942
FP32INT8	32.0	2.662999	1.843750	32.022906

[8]:
```
result_transposed.plot.bar();
```






Asynchronous Inference CPU
Frames per Second CPU
2.5
2.0
1.5
1.0
0.5
0.0
FP16
FP32
FP32-INT8
Model Precision Value CPU

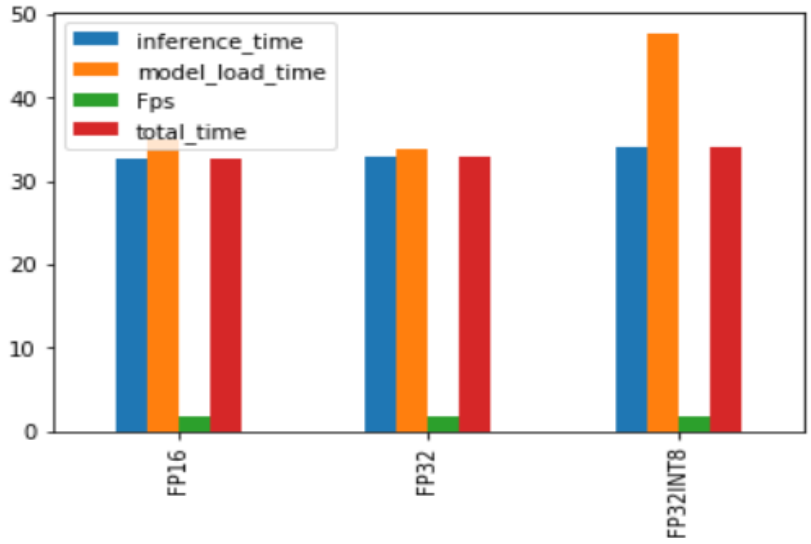

Asynchronous Inference CPU
Frames per Second CPU
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
FP16
FP32
FP32-INT8
Model Precision Value CPU

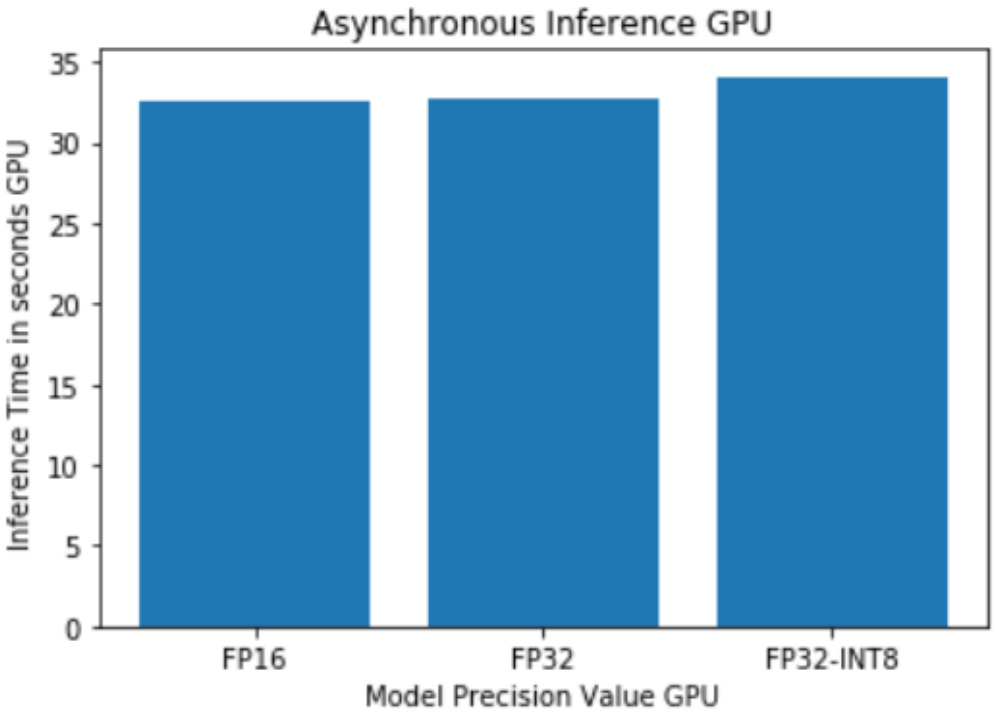
Benchmark results of the model. GPU

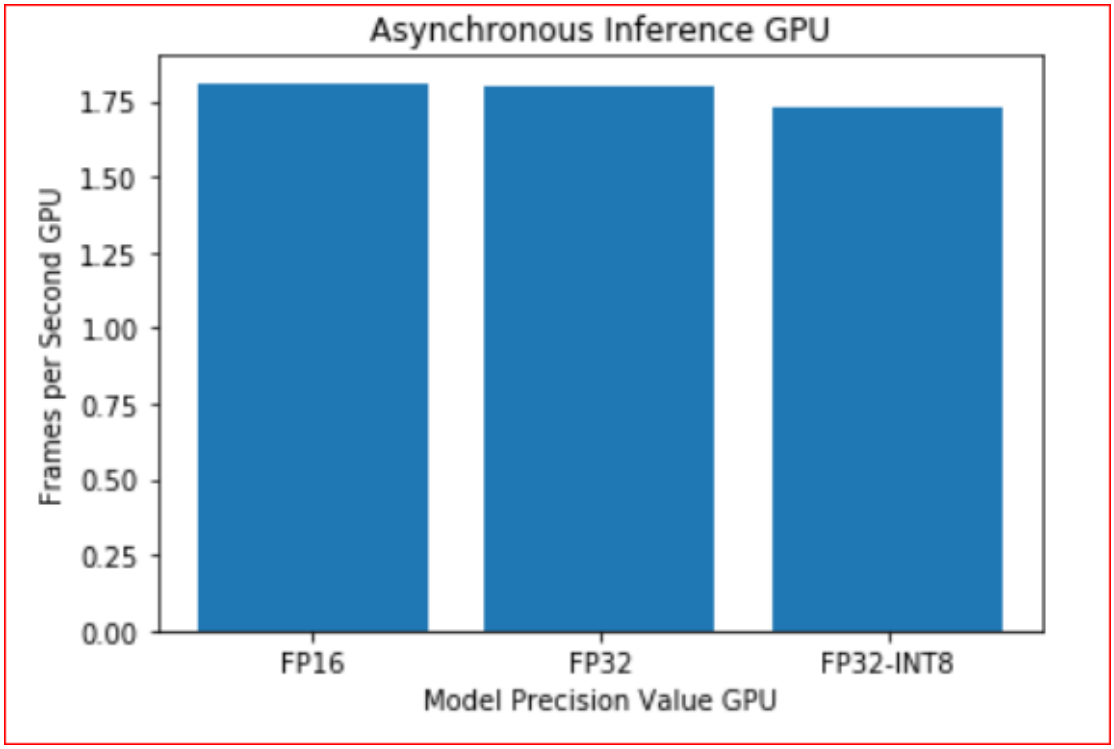
[18]:

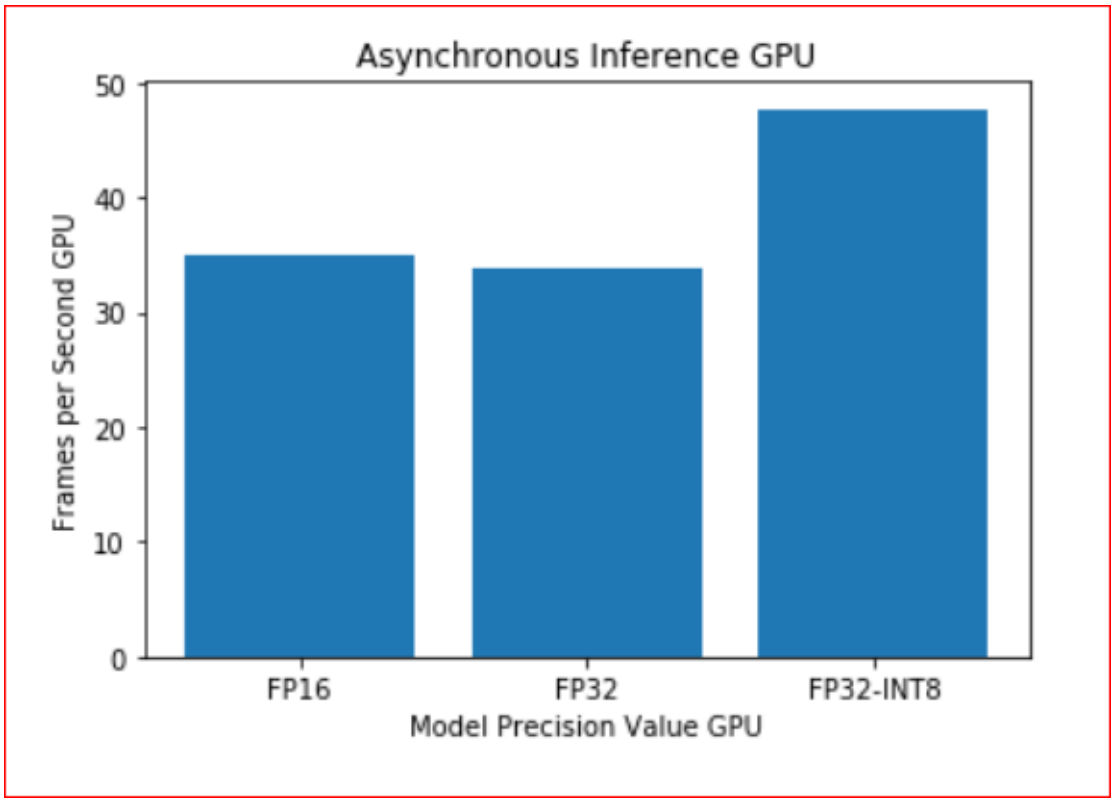
	inference_time	model_load_time	Fps	total_time
FP16	32.6	34.921903	1.809816	32.572538
FP32	32.8	33.834617	1.798780	32.822181
FP32INT8	34.1	47.700375	1.730205	34.146677

[19]:
```
result_transposed.plot.bar();
```






Asynchronous Inference GPU
Frames per Second GPU
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
FP16
FP32
FP32-INT8
Model Precision Value GPU


Asynchronous Inference GPU
Frames per Second GPU
50
40
30
20
10
0
FP16
FP32
FP32-INT8
Model Precision Value GPU

Some of the observations from benchmark results:

- Model load time significantly increases when device is switch from CPU to GPU as expected. Model takes considerably longer to load in GPU as we analyzed from prior project study.
- Model load time is reduced when preicison is changed from FP32 to FP16 to INT8. This is because as weight are quantized and reduced in size then load time is also reduced.
- Model inference time is slighly improved when changing precision from FP32 to FP16 and from FP32 to INT8. This is expected as accuracy decrease performance improves. There is slight increase in inference time when changing precision from FP16 to INT8.
- Model inference time is increased when changing device from CPU to GPU. Here we can get better performance only when batch inferencing is done on GPU to leverage full compute capacity of GPU.
- Frames per second is pretty consistent irrespective of precision but it slightly reduces as device is changed from CPU to GPU. Here again fps can be increased on GPU device if batch inferencing is done.
- For `Inference Time` and `FPS`, `FP32` give slightly better results. There is not much difference for this three different models for this two parameters.
- I have tested model for Asynchronous Inference and Synchronous Inference, Asynchronous Inference has better results it has slight improvement in `inference time` and `FPS`

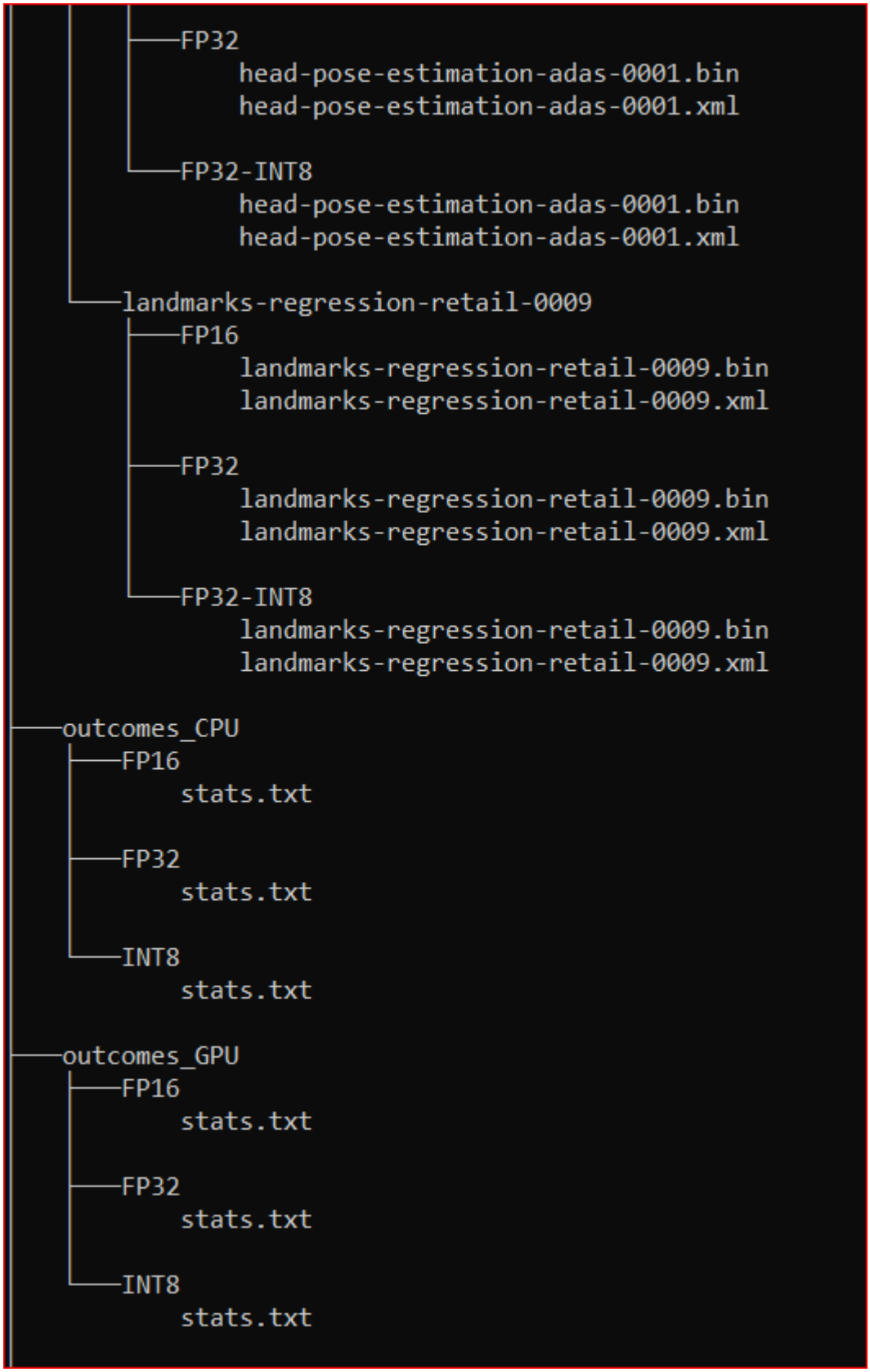
Edge Cases

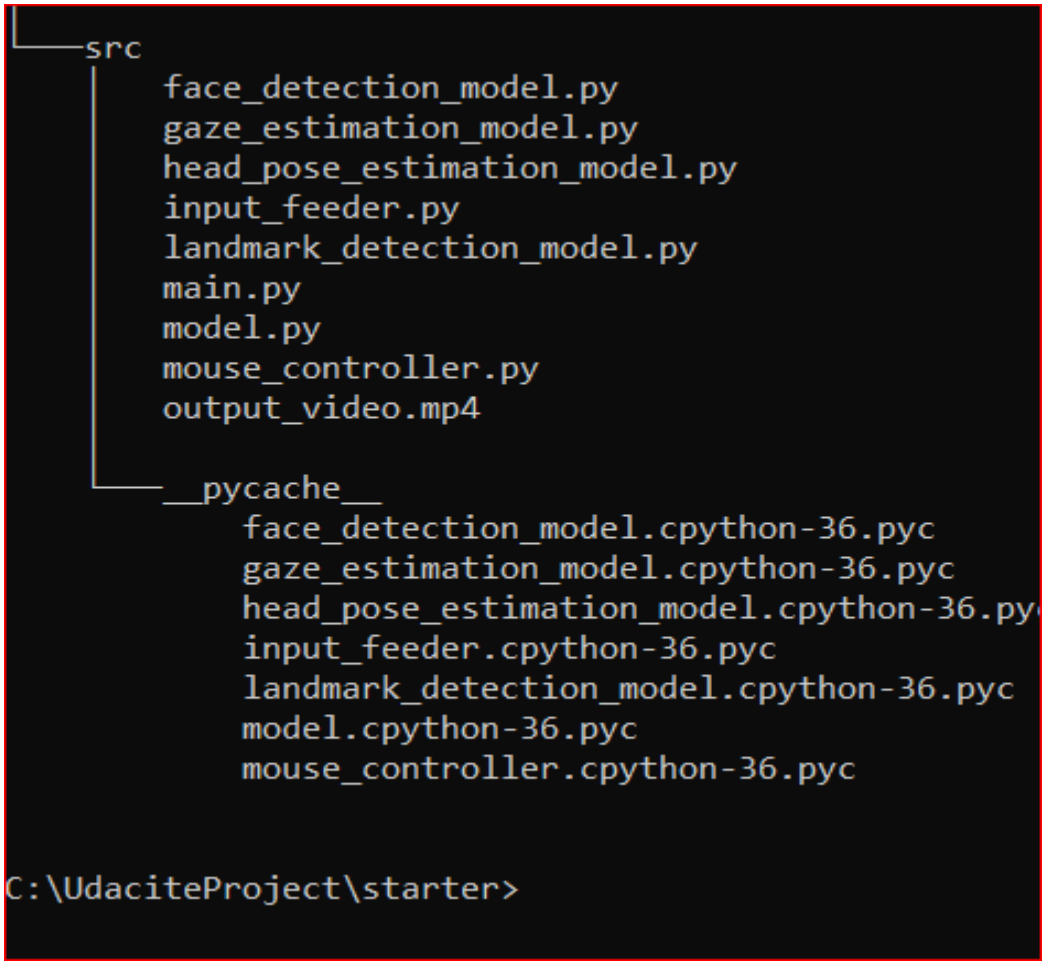
1. The lighting matters greatly for the video feed, so sometimes models does not clearly views the gaze.

2. If for some reason model can not detect the face then it throws off track and pointer continues in same direction.

3. If there are more than one face detected in the frame then model takes the first detected face for control the mouse pointer.

```
C:\UdaciteProject\starter>tree /F
Folder PATH listing for volume Windows
Volume serial number is EA48-9AD9
C:.
    Commend Run the project.txt
    Intel(R) UHD Graphics 630 Sunday, July 5, 2020.txt
    P05 Computer Pointer Controller.pdf
    requirements.txt

---Analysis Project
        OpenVino Compute Pointer Controller .html
        OpenVino Compute Pointer Controller .ipynb

---bin
        demo.mp4
        output_video.mp4

---models
    ---face-detection-adas-0001
        ---FP16
                face-detection-adas-0001.bin
                face-detection-adas-0001.xml

        ---FP32
                face-detection-adas-0001.bin
                face-detection-adas-0001.xml

        ---FP32-INT8
                face-detection-adas-0001.bin
                face-detection-adas-0001.xml

    ---gaze-estimation-adas-0002
        ---FP16
                gaze-estimation-adas-0002.bin
                gaze-estimation-adas-0002.xml

        ---FP32
                gaze-estimation-adas-0002.bin
                gaze-estimation-adas-0002.xml

        ---FP32-INT8
                gaze-estimation-adas-0002.bin
                gaze-estimation-adas-0002.xml

    ---head-pose-estimation-adas-0001
        ---FP16
                head-pose-estimation-adas-0001.bin
                head-pose-estimation-adas-0001.xml
```


FP32
head-pose-estimation-adas-0001.bin
head-pose-estimation-adas-0001.xml
FP32-INT8
head-pose-estimation-adas-0001.bin
head-pose-estimation-adas-0001.xml
landmarks-regression-retail-0009
FP16
landmarks-regression-retail-0009.bin
landmarks-regression-retail-0009.xml
FP32
landmarks-regression-retail-0009.bin
landmarks-regression-retail-0009.xml
FP32-INT8
landmarks-regression-retail-0009.bin
landmarks-regression-retail-0009.xml
outcomes_CPU
FP16
stats.txt
FP32
stats.txt
INT8
stats.txt
outcomes_GPU
FP16
stats.txt
FP32
stats.txt
INT8
stats.txt



I hope to be home to the project requirements despite the valuable information that we learned from the lessons and also the project, but we do not know the exact correct result

Help resources Forums :https://knowledge.udacity.com
https://github.com/

I wish success to all.

M*arwan Saeed Alsharabbi*