CMPE 58Z BIOMETRICS

Homework II

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In this homework, my aim was to try face detection on different inputs I chose. This Project has been used during this homework: https://github.com/ageitgey/face_recognition . I have 13 different sized inputs.

I have tried 3 different values as "number_of_times_to_upsample" parameter of the model: 0,1 and 2. This way I could investigate the role of this parameter in face detection model we use. With this number we determine how many times we will upsample our input. By upsampling, we basically enlarge our inputs so it helps to our face detection model to find the faces more accurately. That's not suprising our correct decision count gets higher (yet in some examples our false positive count gets higher, too) when we increase this parameter. (Note: I couldn't try number_of_times_to_upsample=2 for the inputs "Avengers", "Halloween" and "Red Army" due to their size.)

I have also wrote the sizes of images to be able to interpret in results with a more appropriate approach. There is a relationship between the resolution of the image and the accuracy of the face detector. That's why upsampling helps us here. Also I used different size of the same picture (Avenger 3 and 4) with same upsampling parameter to see the size effect. You can see that with upsampling parameter=0, face detector cannot find any faces in lower sized image yet it can find faces in a bigger sized version of the same image.

1. Detected Faces & Facial Landmarks

Avengers (3840×2160)

Figure 1: Avengers. The one (which is the middle-rightest) couldn't be detected probably because of the combination of its skin color and the angle of its head.

Detected Faces (number_of_times_to_upsample=0)

Detected Faces (number_of_times_to_upsample=1)

Facial Landmarks

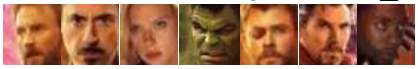
Avengers 2 (750×445)

Figure 2: Avengers 2. Two of them (which are middle-leftest man and 2nd upper-left woman) couldn't be detected probably because of the combination of his beard (form an) and the angle of their heads. Also they are more away from the camera compared to others.

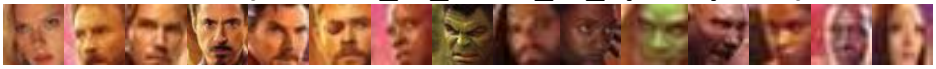
Detected Faces (number_of_times_to_upsample=0)

(No faces detected)

Detected Faces (number_of_times_to_upsample=1)



Detected Faces (number_of_times_to_upsample=2)



Facial Landmarks

Avengers 3 (1200×800)

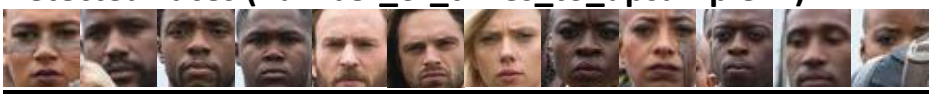
Figure 3: Avengers 3. All of the faces have been detected.

Detected Faces (number_of_times_to_upsample=0)

(No faces detected)

Detected Faces (number_of_times_to_upsample=1)

Detected Faces (number_of_times_to_upsample=2)



Facial Landmarks

Avengers 4 (1440×960)

Figure 4: Avengers 4. All of the faces have been detected.

Detected Faces (number_of_times_to_upsample=0)

Detected Faces (number_of_times_to_upsample=1)

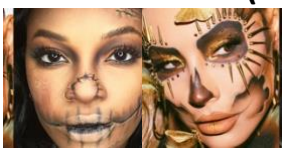
Detected Faces (number_of_times_to_upsample=2)

Facial Landmarks

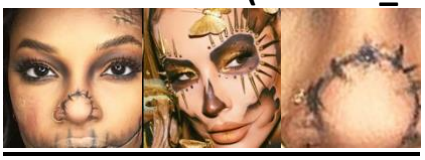
Halloween (4000×2000)

Figure 5: Halloween. The one in the middle couldn't been detected as a face probably because of the make up which covers her eyes and nose, and the angle of her head.

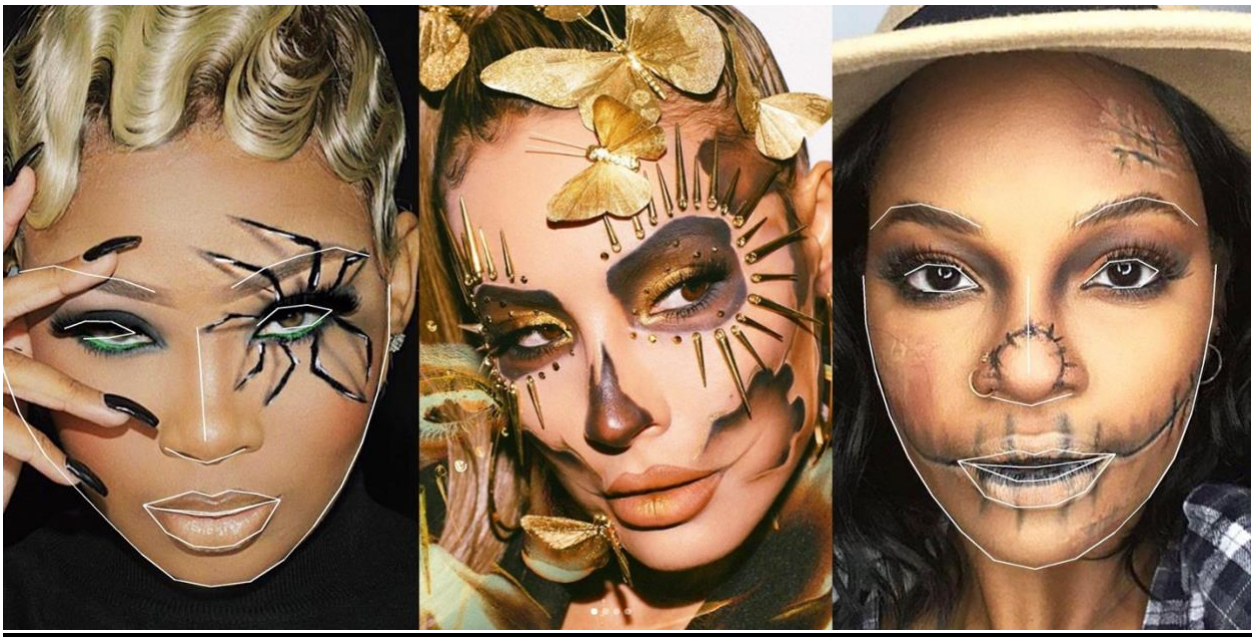
Detected Faces (number_of_times_to_upsample=0)



Detected Faces (number_of_times_to_upsample=1)



Facial Landmarks

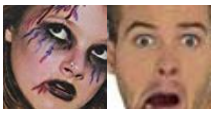


Halloween 2 (498×500)

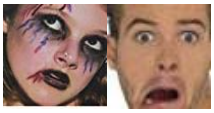
Figure 6: Halloween 2. The upper-right one couldn't been detected as a face probably because of the make up which covers all of his skin, and the angle of his head.

Detected Faces (number_of_times_to_upsample=0)

Detected Faces (number_of_times_to_upsample=1)



Detected Faces (number_of_times_to_upsample=2)

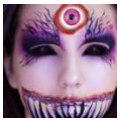


Facial Landmarks

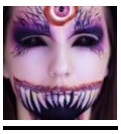
Halloween 3 (1500×1500)

Figure 7: Halloween 3. The face has been detected.

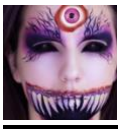
Detected Faces (number_of_times_to_upsample=0)



Detected Faces (number_of_times_to_upsample=1)



Detected Faces (number_of_times_to_upsample=2)



Facial Landmarks

Metrobus (900×599)

Figure 8: Metrobus. This was a hard example. With a higher upsample parameter, the model was able to find some of the faces. It's not suprising because there are lots of people in the picture and most of them doesn't look directly to the camera. Their orientations are different.

Detected Faces (number_of_times_to_upsample=0)

(No faces detected)

Detected Faces (number_of_times_to_upsample=1)

(No faces detected)

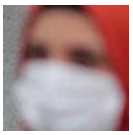
Detected Faces (number_of_times_to_upsample=2)

Facial Landmarks

Metrobus 2 (750×422)

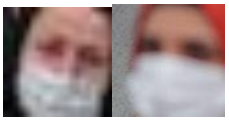
Figure 9: Metrobus 2. This was a hard example, too. Even if people's orientation is fine, they all wear masks. This makes it hard to find faces from this picture.

Detected Faces (number_of_times_to_upsample=0)



Detected Faces (number_of_times_to_upsample=1)

Detected Faces (number_of_times_to_upsample=2)



Facial Landmarks

Orcs (300×168)

Figure 10: Orcs. The rightest one couldn't be detected as a face. Probably it's because the head orientation and disformed face shape it has.

Detected Faces (number_of_times_to_upsample=0)
(No faces detected)
Detected Faces (number_of_times_to_upsample=1)

Detected Faces (number_of_times_to_upsample=2)

Facial Landmarks


Orcs 2 (1300×954)

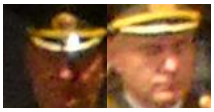
Figure 11: Orcs 2. None of their face has been detected. Probably it's because their faces are not similar to human faces.

Detected Faces (number_of_times_to_upsample=0)
(No faces detected)
Detected Faces (number_of_times_to_upsample=1)
(No faces detected)
Detected Faces (number_of_times_to_upsample=2)
(No faces detected)
Facial Landmarks

Red Army (3260×1544)

Figure 12: Red Army. With a higher upsample parameter, most of their faces has been detected. The ones which cannot be detected are have bad light and different head orientation.

Detected Faces (number_of_times_to_upsample=0)



Detected Faces (number_of_times_to_upsample=1)

Facial Landmarks

Tupac Gang (1080×711)

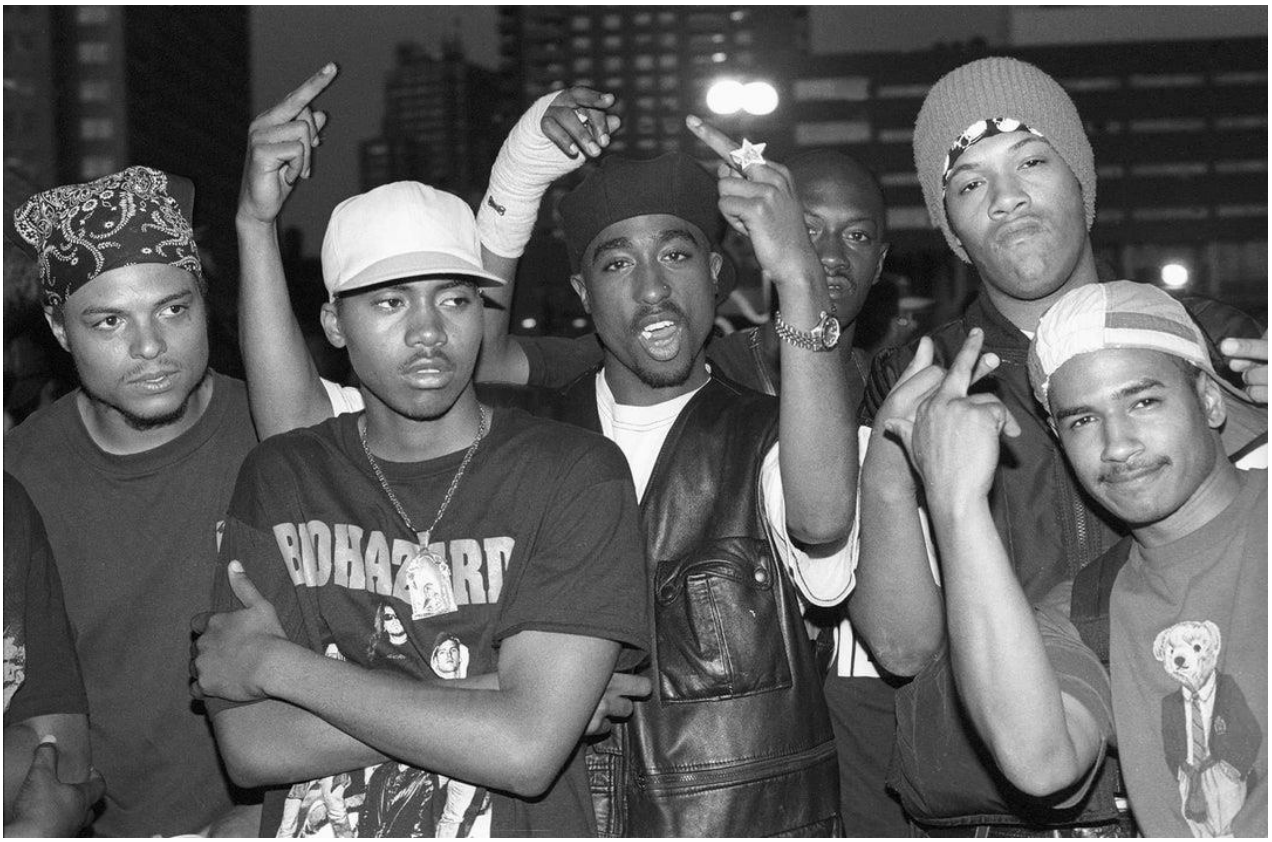
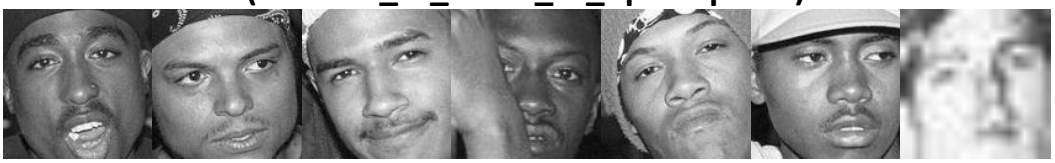


Figure 13: Tupac Gang. All of the faces have been detected.

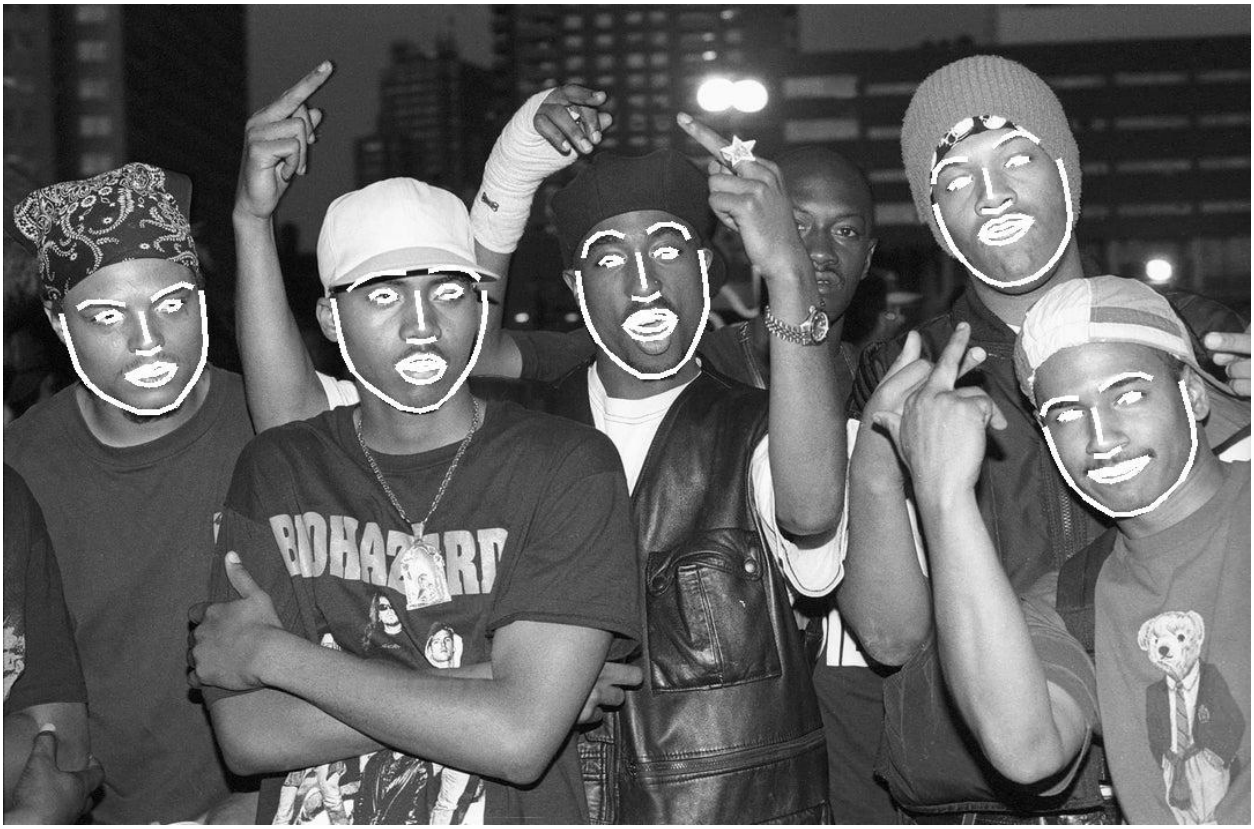
Detected Faces (number_of_times_to_upsample=0)

Detected Faces (number_of_times_to_upsample=1)

Detected Faces (number_of_times_to_upsample=2)



Facial Landmarks



2. Accuracy Results

A. number_of_times_to_upsample=0

File	#Faces	Correct Detections	False Positives	False Negatives
Avengers	18	2	0	16
Avengers 2	17	0	0	17
Avengers 3	12	0	0	12
Avengers 4	12	5	0	7
Halloween	3	2	0	1
Halloween 2	3	2	0	1
Halloween 3	1	1	0	0
Metrobus	50	0	0	20
Metrobus 2	23	1	0	22
Orcs	3	0	0	3
Orcs 2	3	0	0	3
Red Army	52	2	0	50
Tupac Gang	6	6	0	0

B. number_of_times_to_upsample=1

File	#Faces	Correct Detections	False Positives	False Negatives
Avengers	18	17	0	1
Avengers 2	17	7	0	10
Avengers 3	12	12	0	0
Avengers 4	12	12	0	0
Halloween	3	2	1	1
Halloween 2	3	2	0	1
Halloween 3	1	1	0	0
Metrobus	50	0	0	20
Metrobus 2	23	1	0	22
Orcs	3	1	0	2
Orcs 2	3	0	0	3
Red Army	52	48	0	4
Tupac Gang	6	6	0	0

C. number_of_times_to_upsample=2

File	#Faces	Correct Detections	False Positives	False Negatives
Avengers 2	17	15	0	2
Avengers 3	12	12	0	0
Avengers 4	12	12	0	0
Halloween 2	3	2	0	1
Halloween 3	1	1	0	0
Metrobus	50	32	0	18
Metrobus 2	23	2	0	21
Orcs	3	2	0	1
Orcs 2	3	0	0	3
Tupac Gang	6	6	1	0