

# Project 3: Eigen-faces

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```
In[3]:= dir = NotebookDirectory[];
```

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## Experiments

### I. Testing recognition with cropped class images

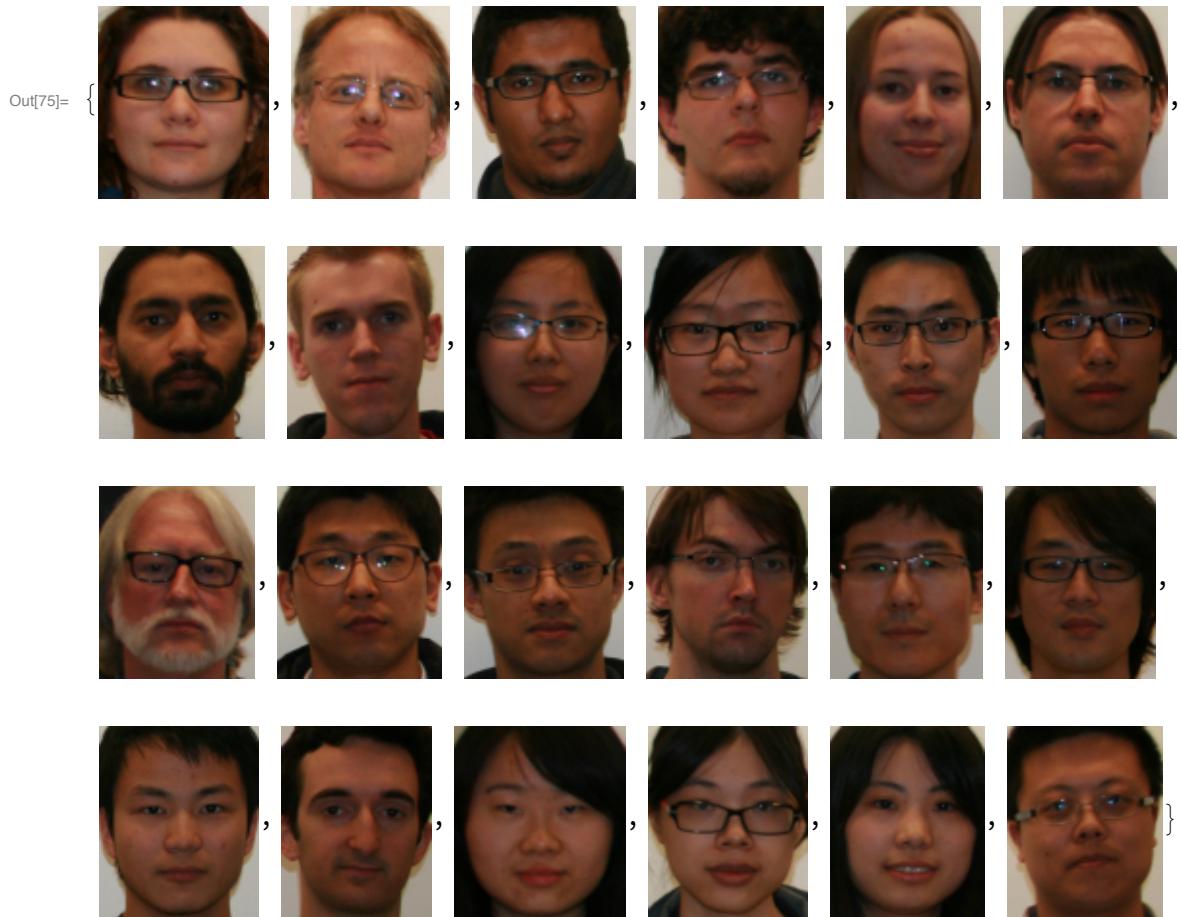
AverageFace

```
In[4]:= Import[dir <> "average_face.tga"]
```

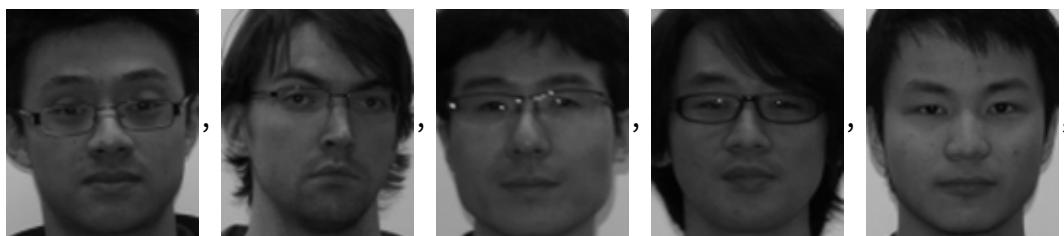
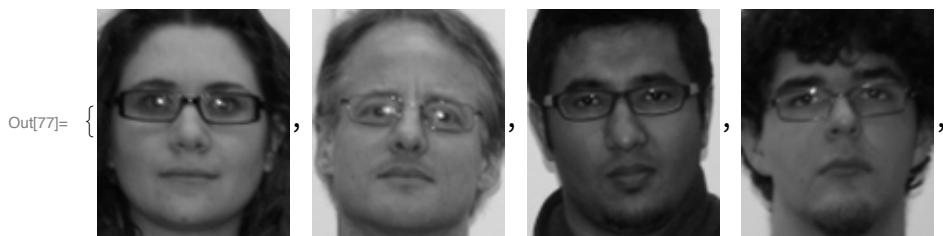
Out[4]=



```
In[75]:= faces = Flatten@{Import[dir <> "neutral/0" <> ToString[#[#] <> ".tga"] & /@ Range[9],  
Import[dir <> "neutral/" <> ToString[#[#] <> ".tga"] & /@ Drop[Range[24], 9]}
```



```
In[76]:= ImageListConvert[images_] := Flatten[ImageData[images], 1]
grayFaces = ImageResize[#, {100, 120}] &/@ (ColorConvert[#, "GrayScale"] &/@ faces)
```



Average face is

```
In[78]:= grayFaceData = ImageListConvert /@ grayFaces;
Image@Partition[Mean[grayFaceData], 100]
```

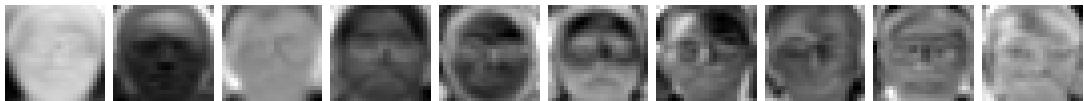


Out[79]=

## Eigenfaces

Here are first 10 eigen-faces:

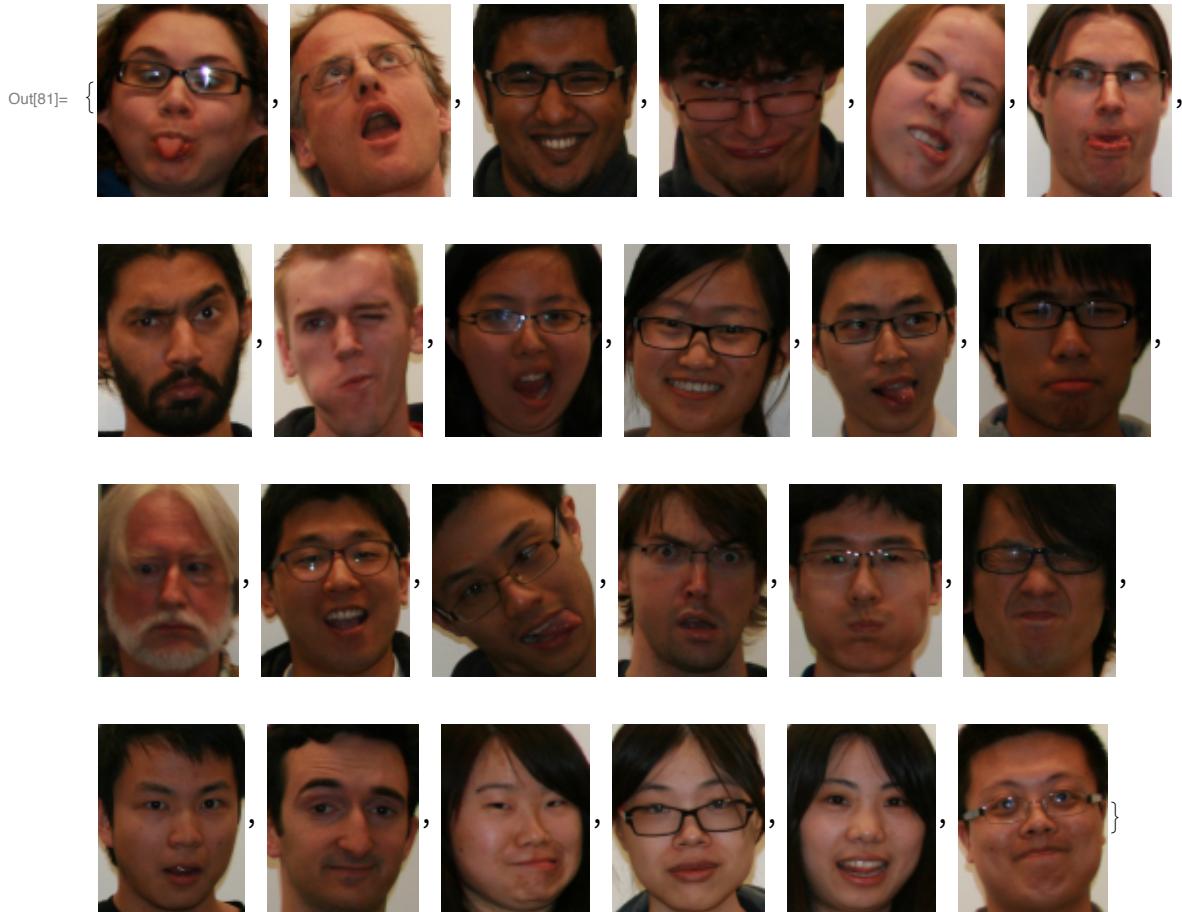
```
In[8]:= eigenFaces = Import[dir <> "eigen_face_" <> ToString[#[#] <> ".tga"] & /@ (Range[10] - 1);
GraphicsRow[eigenFaces]
```



Out[9]=

Have the program recognize the photos in the interesting images folder. You should expect only about 70% accuracy with 10 eigen-faces.

```
In[81]:= interestingFaces =
  Flatten@{Import[dir <> "interesting/0" <> ToString[#] <> ".tga"] & /@ (Range[9]),
  Import[dir <> "interesting/" <> ToString[#] <> ".tga"] & /@ Drop[Range[24], 9]}
```



```
In[82]:= pairs = {{1, 1}, {2, 13}, {3, 14}, {4, 14}, {5, 5}, {6, 6}, {7, 24}, {8, 8}, {9, 9},
  {10, 10}, {11, 24}, {12, 12}, {13, 13}, {14, 14}, {15, 24}, {16, 12}, {17, 17},
  {18, 18}, {19, 15}, {20, 20}, {21, 21}, {22, 22}, {23, 23}, {24, 24}};
```

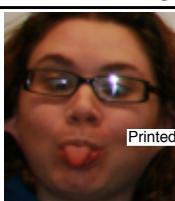
I only achieved 66.7% accuracy with 10 eigenfaces

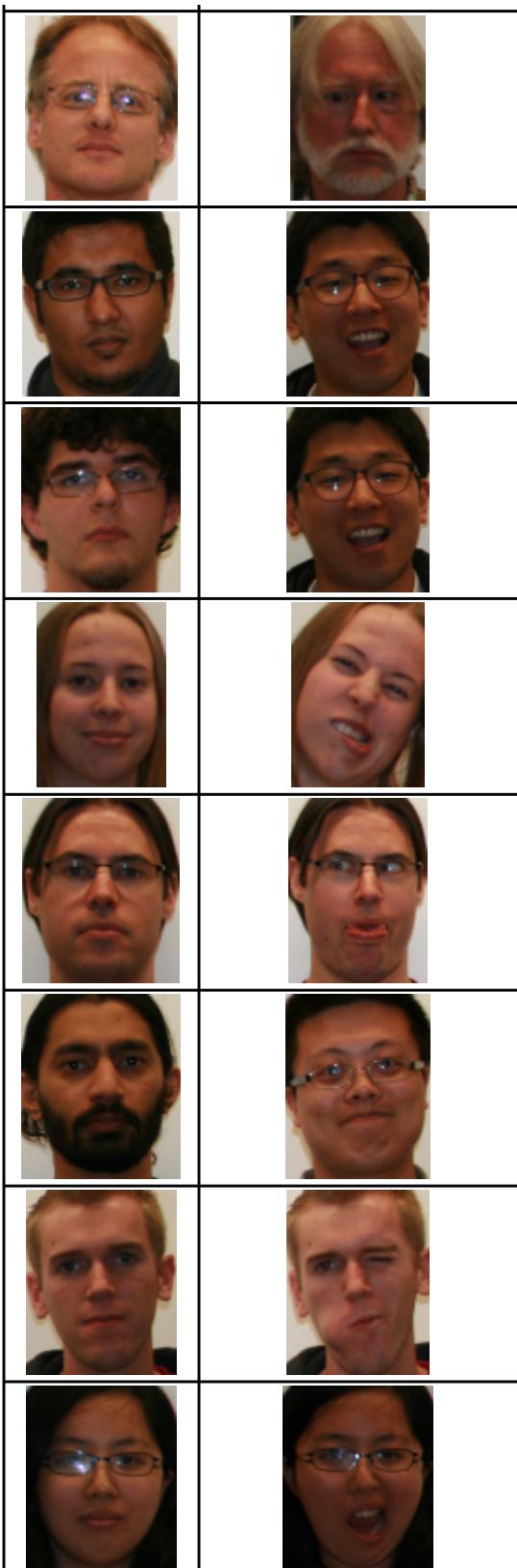
```
In[95]:= Length@Select[pairs, #[[1]] == #[[2]] &] / Length[pairs]
```

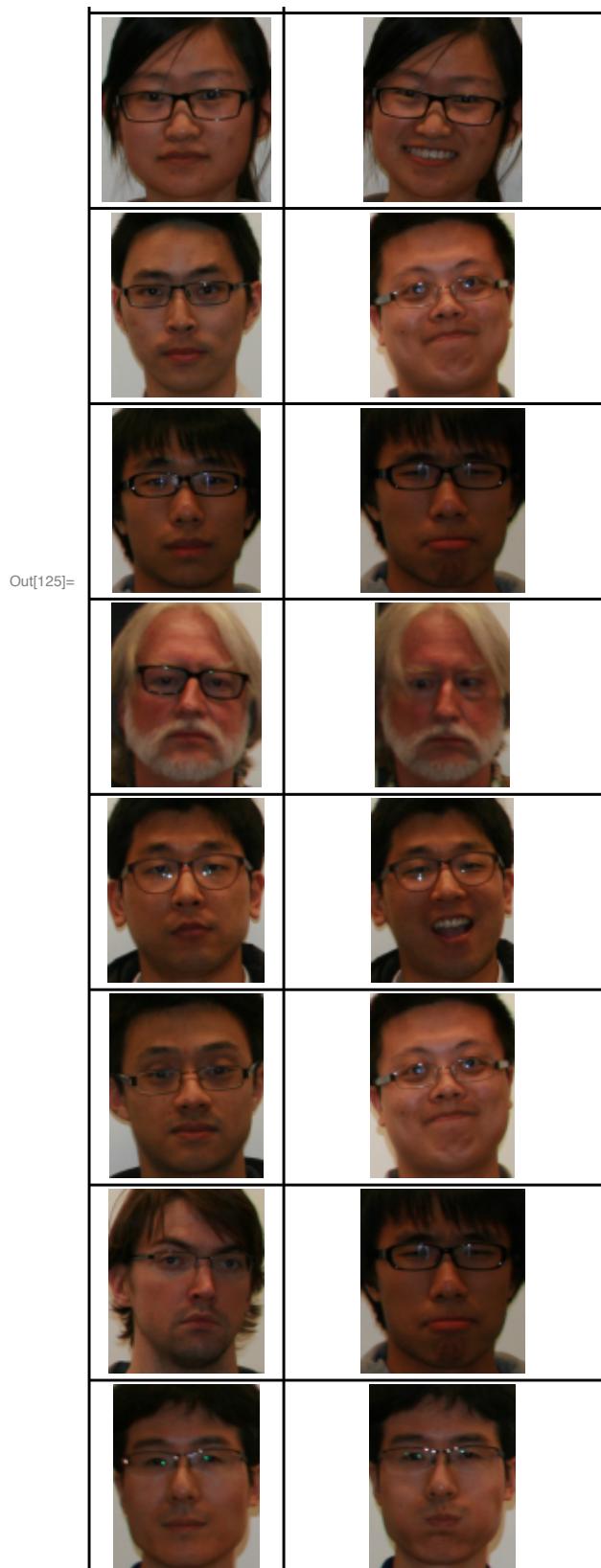
$$\frac{2}{3}$$

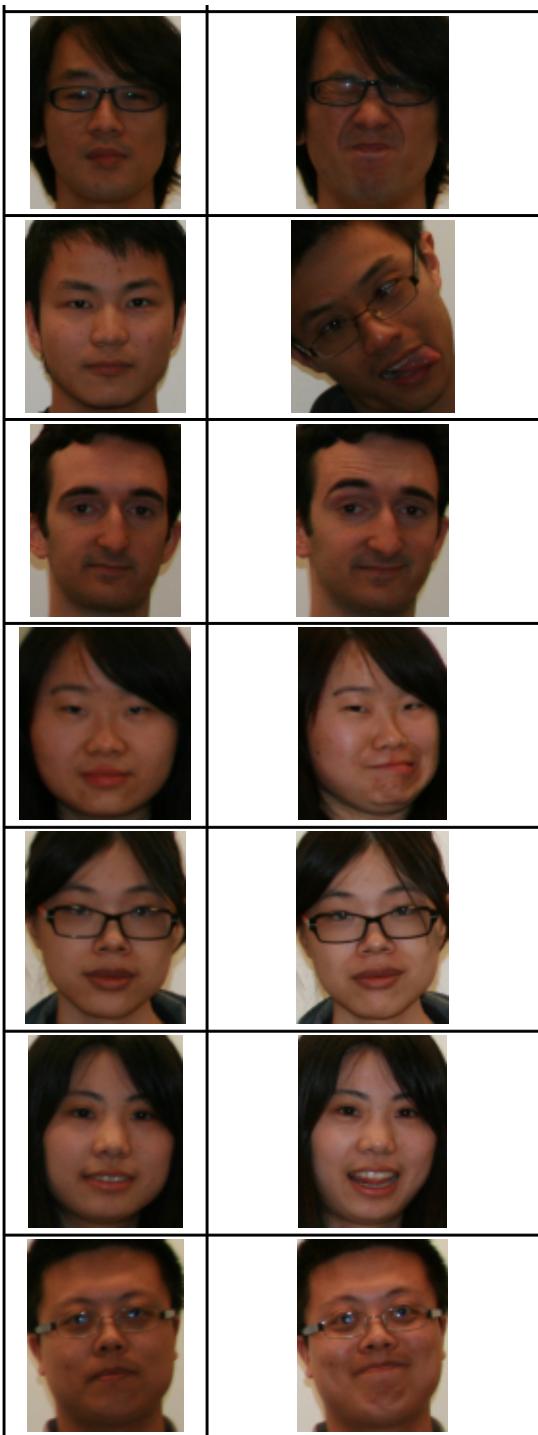
Out[95]=

```
In[124]:= comparison = {faces[[#[[1]]]], interestingFaces[[#[[2]]]]} & /@ pairs;
Grid[Prepend[comparison, {"Matched Face", "Test Interesting Face"}], Frame -> All]
```

Matched Face	Test Interesting Face
	

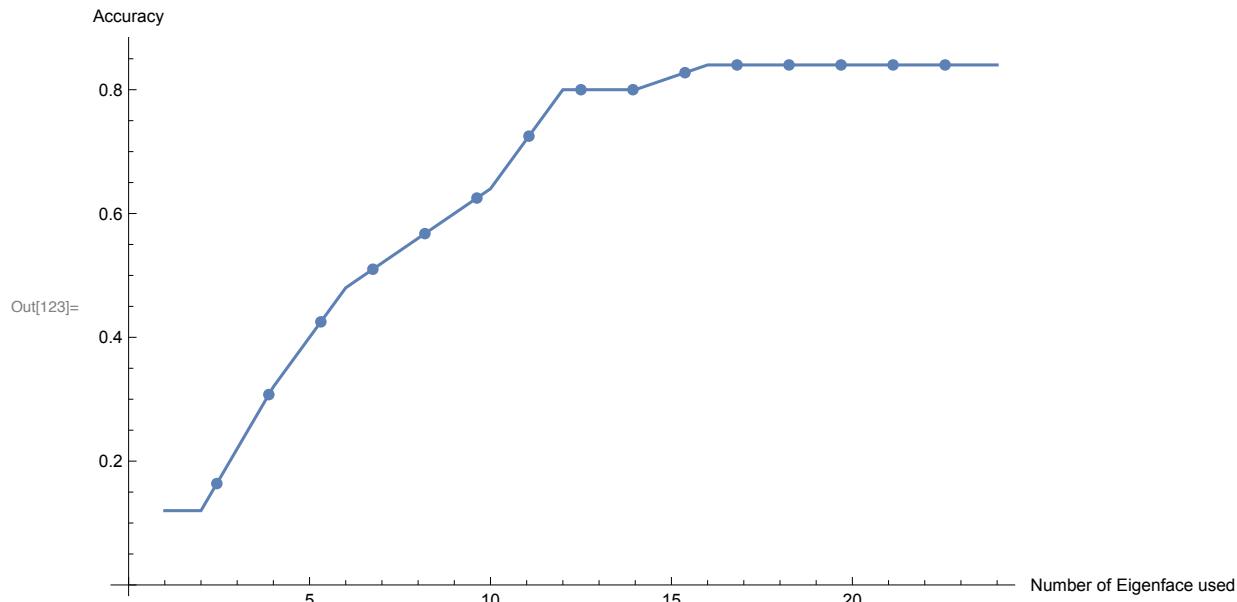






## Eigenface Experiment

```
In[121]:= accuracyData = {{1, 3}, {2, 3}, {4, 8}, {6, 12}, {8, 14}, {10, 16},
{12, 20}, {14, 20}, {16, 21}, {18, 21}, {20, 21}, {22, 21}, {24, 21}};
accuracy = Transpose[{accuracyData[[All, 1]], accuracyData[[All, 2]]/25}];
ListPlot[accuracy, Joined → True, Mesh → True,
AxesLabel → {"Number of Eigenface used", "Accuracy"}]
```



The accuracy increased very fast from 1 to 10, but after 12, the accuracy remains the same. Which means the accuracy doesn't depend on the number of eigenfaces completely. It's not the more, the better.

We need to pick sufficient eigenfaces to construct a face. I think 10 - 12 eigenfaces should be enough.

## Some Error

```
In[126]:= comparison[[3]]
```



```
In[127]:= comparison[[9]]
```



I think wearing glasses will cause a great noise. The mistake is reasonable to me, in both errors, the two people have similar skin tone, similar hair style, and both wear classes.

## 2. Cropping and finding faces

### Cropping

I used a portrait of my boyfriend childhood.

Input Image



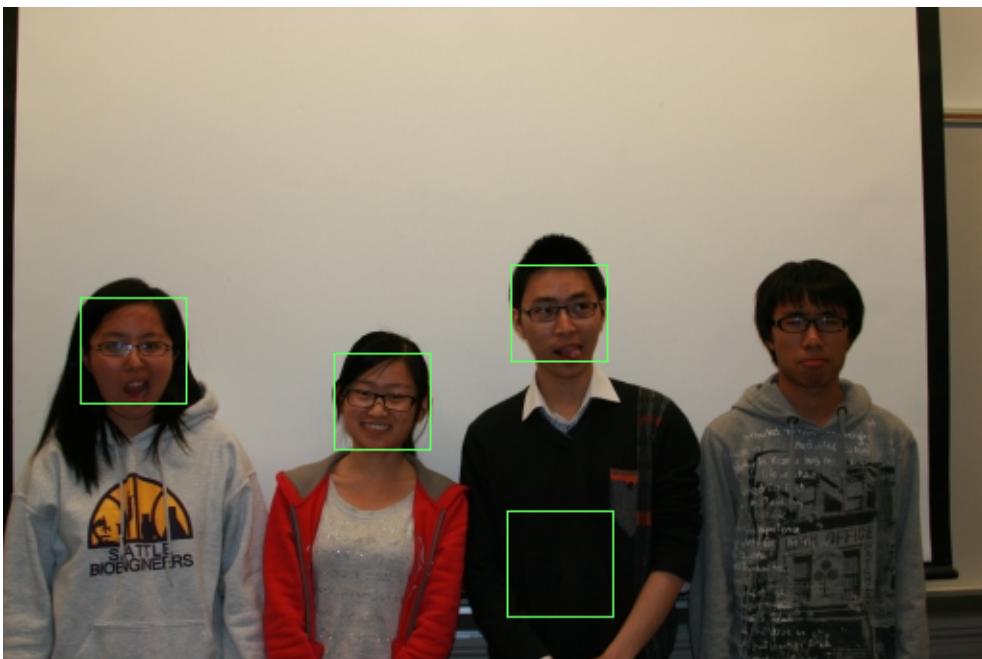
Out[200]=

Cropped image

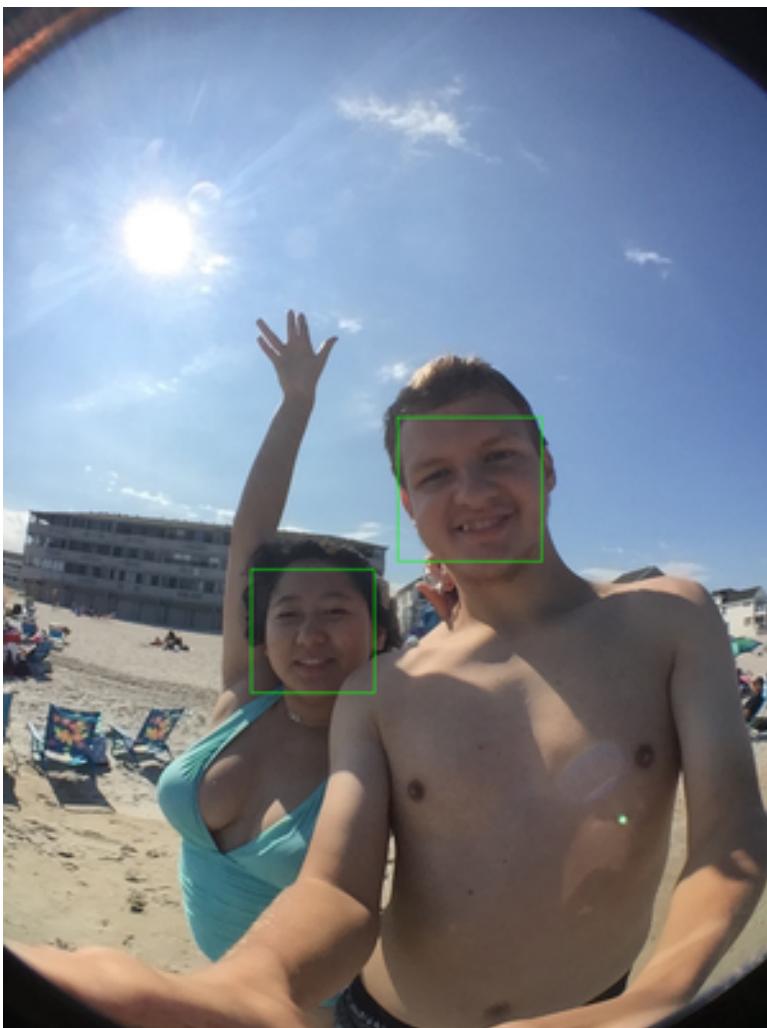


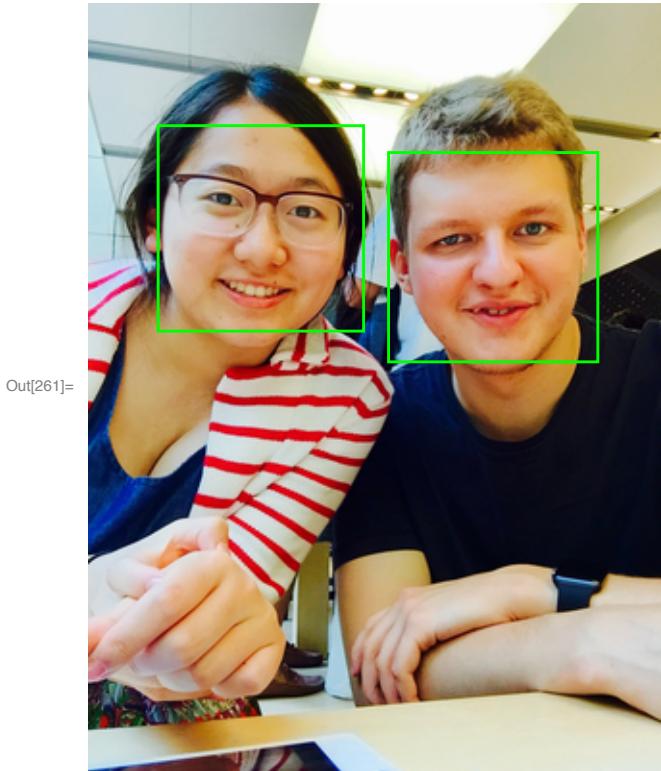
### Finding faces

Out[201]=



Out[265]=





## Verify

neutral	01	02	03	04	05	06	07	08
interesting 01	11734.2	290258	268852	353663	42838.8	263818	342473	2875
interesting 02	195646	142295	203539	277422	89409.6	197768	206831	1214
interesting 03	237326	227798	144010	200079	184369	200861	15292	1511
interesting 04	373668	310612	58852.2	143492	319705	275807	268348	2224
□	□	□	□	□	□	□	□	□
□	□	□	□	□	□	□	□	□
□	□	□	□	□	□	□	□	□
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□	□	□	□	□	□	□	□	□
□	□	□	□	□	□	□	□	□