# inference

April 16, 2019

In [ ]:
```
import matplotlib.pyplot as plt
import matplotlib.image as mpimg
from PIL import Image
import os
import numpy as np
import pandas as pd
import cv2
import warnings
warnings.filterwarnings('ignore')

import torch
import torch.nn as nn
import torchvision
import torch.nn.functional as F
import torchvision.transforms as transforms
from torch.utils.data import Dataset, DataLoader
from torch.utils.data.sampler import SubsetRandomSampler
from torchvision import datasets, models
import torch.optim as optim

from network import Net, Net2
```

**Load model**

In [2]:
```
model = Net()
model2 = Net()
model3 = Net()
model4 = Net2()

model.load_state_dict(torch.load('saved_models/model2.pt', map_location='cpu'))
model2.load_state_dict(torch.load('saved_models/model2_128_bs.pt', map_location='cpu'))
model3.load_state_dict(torch.load('saved_models/model_weight_init_128_bs.pt', map_loca
model4.load_state_dict(torch.load('saved_models/model.pt', map_location='cpu'))

model.eval()
model2.eval()
model3.eval()
model4.eval()
```

```
        print("Model succefully loaded !")
```

```
Model succefully loaded !
```

### Prepare images

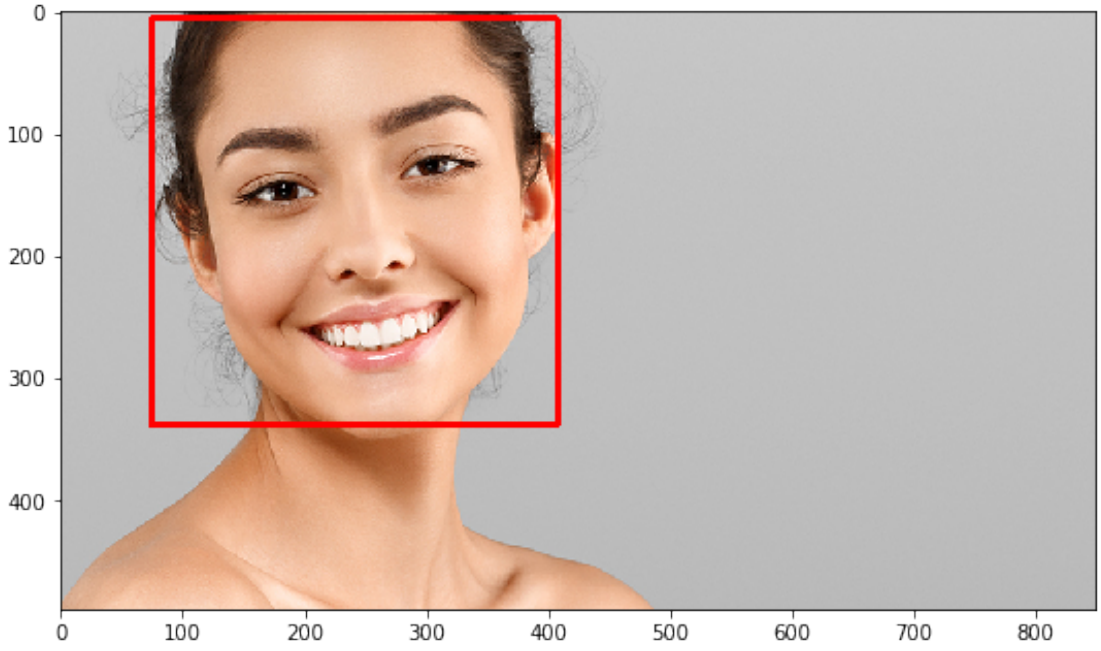
```
In [3]: def rescale_img(image, output_size):

            h, w = image.shape[:2]

            if isinstance(output_size, int):
                if h > w:
                    new_h, new_w = output_size * h / w, output_size
                else:
                    new_h, new_w = output_size, output_size * w / h
            else:
                new_h, new_w = output_size

            new_h, new_w = int(new_h), int(new_w)

            img = cv2.resize(image, (new_w, new_h))

            return img



        def normalize_img(image):
            image_copy = np.copy(image)
            image_copy = cv2.cvtColor(image, cv2.COLOR_RGB2GRAY)
            image_copy =  image_copy/255.0

            return image_copy



        def tensor_img(image):
            # if image has no grayscale color channel, add one
            if(len(image.shape) == 2):
                # add that third color dim
                image = image.reshape(image.shape[0], image.shape[1], 1)

            # swap color axis because
            # numpy image: H x W x C
            # torch image: C X H X W
            image = image.transpose((2, 0, 1))
```

```
        return torch.from_numpy(image)
```

**Select region of interest**

In [4]:
```
# Detect Face in an Image using Cascade File

image = cv2.imread('images/face.jpg')

image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)

img_detection = image.copy()


face_cascade = cv2.CascadeClassifier('detector_architectures/haarcascade_frontalface_d

faces = face_cascade.detectMultiScale(img_detection, scaleFactor=1.2, minNeighbors=2)


for (x,y,w,h) in faces:

    cv2.rectangle(img_detection,(x,y),(x+w,y+h),(255,0,0),3)


fig = plt.figure(figsize=(9,9))

plt.imshow(img_detection)
```

Out[4]: `<matplotlib.image.AxesImage at 0x7f6501942be0>`

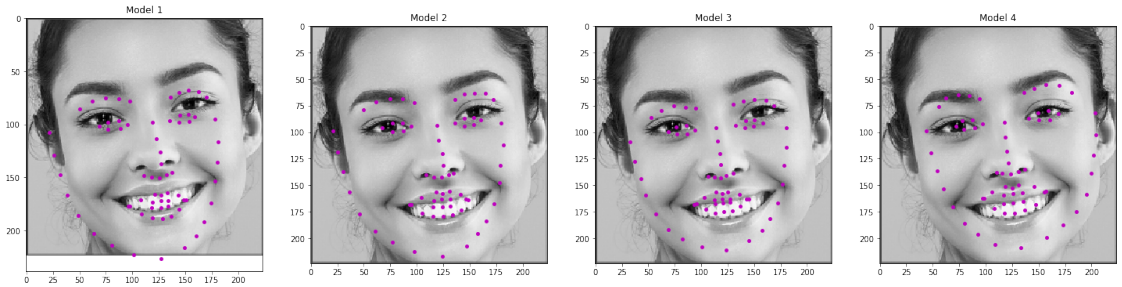


### Inference

In [6]:
```
plt.figure(figsize=(25,25))

        model.cpu()
        model2.cpu()
        model3.cpu()
        model4.cpu()

        # Loop over the detected faces
        # Keep the face part using cropping
        # Predict keypoint
        for (x,y,w,h) in faces:

            image_kpts = img_detection[y:y+h, x:x+w]

        image_kpts = cv2.resize(image_kpts, (224,224))

        image_kpts = normalize_img(image_kpts)

        image_kpts = tensor_img(image_kpts)


        # convert images to FloatTensors
        image_kpts = image_kpts.type(torch.FloatTensor)

        # forward pass to get model output
        with torch.no_grad():
            output_pts = model(image_kpts.unsqueeze(0))
            output_pts2 = model2(image_kpts.unsqueeze(0))
            output_pts3 = model3(image_kpts.unsqueeze(0))
            output_pts4 = model4(image_kpts.unsqueeze(0))

        # reshape to batch_size x 68 x 2 pts
        output_pts = output_pts.view(output_pts.size()[0], 68, -1)
        output_pts2 = output_pts2.view(output_pts2.size()[0], 68, -1)
        output_pts3 = output_pts3.view(output_pts3.size()[0], 68, -1)
        output_pts4 = output_pts4.view(output_pts4.size()[0], 68, -1)

        #unormalize images
        image_kpts = image_kpts.numpy()
        image_kpts = np.transpose(image_kpts, (1, 2, 0))


        #unormalize labels
```

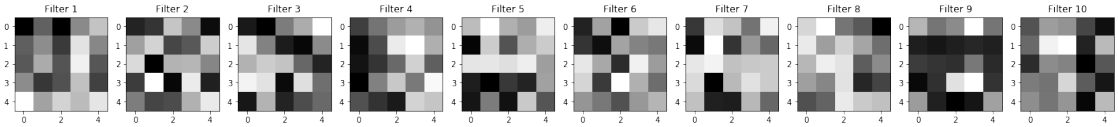
```
labels = output_pts.numpy()
labels = labels*50.0+100
labels = labels.reshape(-1, 2)

labels2 = output_pts2.numpy()
labels2 = labels2*50.0+100
labels2 = labels2.reshape(-1, 2)

labels3 = output_pts3.numpy()
labels3 = labels3*50.0+100
labels3 = labels3.reshape(-1, 2)

labels4 = output_pts4.numpy()
labels4 = labels4*50.0+100
labels4 = labels4.reshape(-1, 2)


plt.subplot(1,4,1)
plt.title('Model 1')
plt.imshow(np.squeeze(image_kpts), cmap='gray')
plt.scatter(labels[:, 0], labels[:, 1], s=60, marker='.', c='m')

plt.subplot(1,4,2)
plt.title('Model 2')
plt.imshow(np.squeeze(image_kpts), cmap='gray')
plt.scatter(labels2[:, 0], labels2[:, 1], s=60, marker='.', c='m')

plt.subplot(1,4,3)
plt.title('Model 3')
plt.imshow(np.squeeze(image_kpts), cmap='gray')
plt.scatter(labels3[:, 0], labels3[:, 1], s=60, marker='.', c='m')

plt.subplot(1,4,4)
plt.title('Model 4')
plt.imshow(np.squeeze(image_kpts), cmap='gray')
plt.scatter(labels4[:, 0], labels4[:, 1], s=60, marker='.', c='m')
```

Out[6]: <matplotlib.collections.PathCollection at 0x7f64fbe69390>



### Visualize some filter in the first conv layer

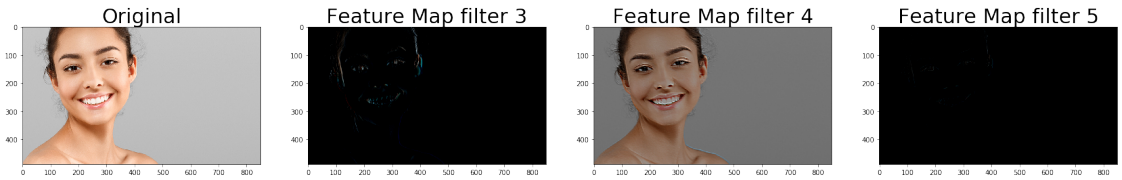
```
In [7]: plt.figure(figsize=(25,20))

        # weight of the first conv layer
        weights1 = model4.conv1.weight.data
        w = weights1.numpy()

        #plot the first 10 filters
        for i in range(10):
            #choose a filter
            num_filter = i
            filter_w = w[num_filter][0]

            plt.subplot(1, 10, i+1)
            plt.title(f"Filter {i+1}")

            plt.imshow(filter_w, cmap='gray')
```

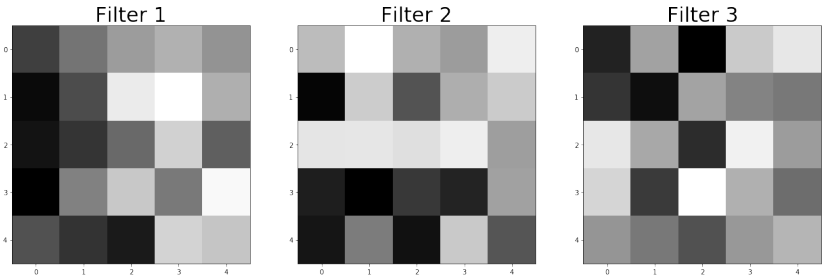



### Visualize some feature maps

```
In [11]: plt.figure(figsize=(29,20))

         img = image.copy()

         plt.subplot(2, 4, 1)
         plt.title('Original', fontsize=30)
         plt.imshow(img)

         # Let's visualize some features maps

         weights1 = model4.conv1.weight.data
         w = weights1.numpy()

         # Applying the image
         for i in range(3):
             num_filter = i+3
```

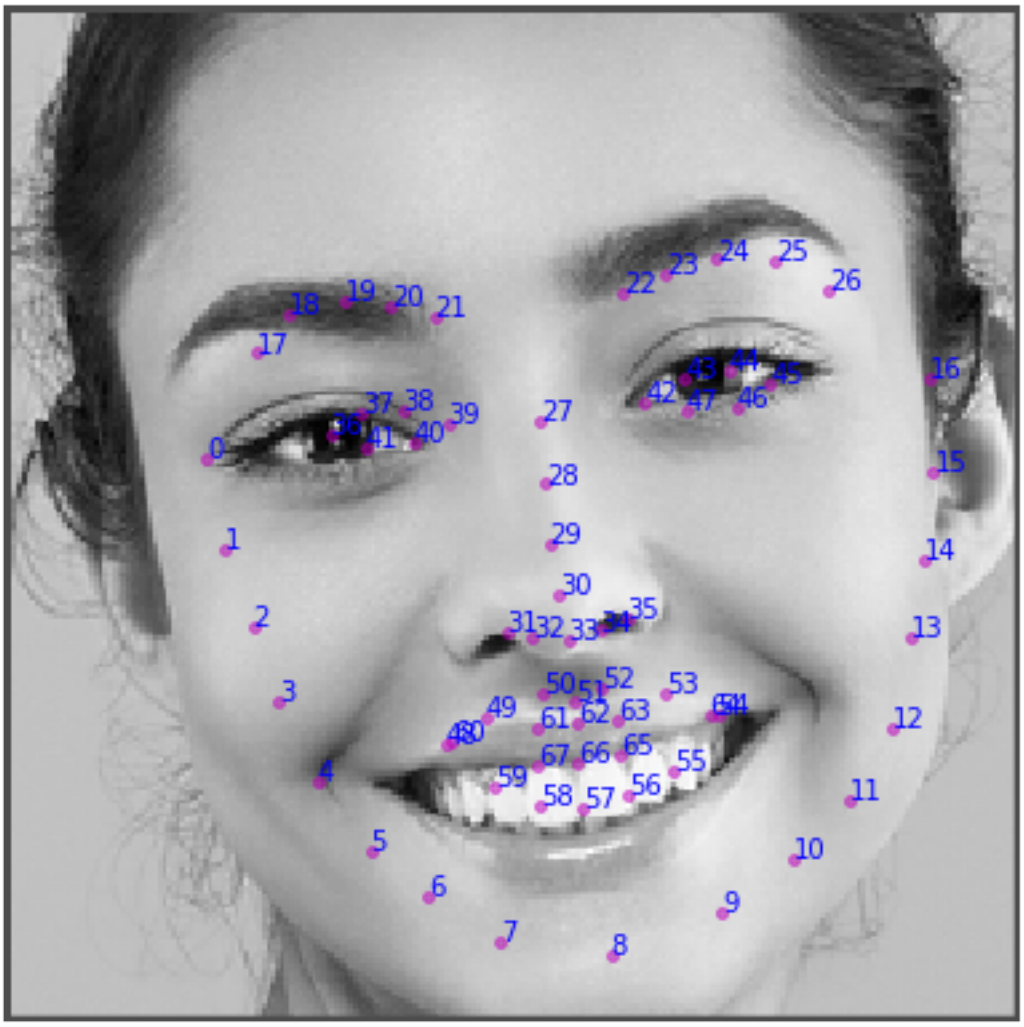
```
    filtered = cv2.filter2D(img, -1, w[num_filter][0])

    plt.subplot(2, 4, i+2)
    plt.title(f"Feature Map filter {i+3}", fontsize=30)
    plt.imshow(filtered)


    filter_w = w[num_filter][0]

    plt.subplot(2, 4, 6+i)
    plt.title(f"Filter {i+1}", fontsize=30)
    plt.imshow(filter_w, cmap='gray')
```




**Try some funny stuff**

```
In [12]: # Keypoints position
         plt.figure(figsize=(7,7))

         plt.axis('off')
         plt.imshow(np.squeeze(image_kpts), cmap='gray')
         plt.scatter(labels4[:, 0], labels4[:, 1], s=60, marker='.', c='m', alpha = 0.5)

         for i in range(labels4.shape[0]):
             plt.text(labels4[i,0], labels4[i,1], str(i), color='blue')
```



In [13]:
```
# load in sunglasses image with cv2 and IMREAD_UNCHANGED because we want to read the
sunglasses = cv2.imread('images/sunglasses.png', cv2.IMREAD_UNCHANGED)

plt.subplot(1,2,1)
plt.axis('off')
plt.imshow(sunglasses)
print('Image shape: ', sunglasses.shape)

# print out the sunglasses transparency (alpha) channel
alpha_channel = sunglasses[:,:,3]

plt.subplot(1,2,2)
plt.axis('off')
plt.imshow(alpha_channel, cmap='gray')
```

```
Image shape:  (1123, 3064, 4)
```

Out[13]: <matplotlib.image.AxesImage at 0x7f64fae0a390>

In [14]:
```
img = np.squeeze(image_kpts)
img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)


# point (x,y) representant la pointe du sourcil gauche
x = int(labels4[17, 0])
y = int(labels4[17, 1])


# h and w that we want for the sunglasse
h = int(abs(labels4[27,1] - labels4[34,1]))
w = int(abs(labels4[17,0] - labels4[26,0]))


new_sunglasses =  cv2.resize(sunglasses, (w, h), interpolation = cv2.INTER_CUBIC)

# get region of interest on the face to change
roi_color = img[y:y+h,x:x+w]

plt.imshow(roi_color)
```

Out[14]: <matplotlib.image.AxesImage at 0x7f64fb00d1d0>