Annex 1 : Pre-Processing Code

November 30, 2018

```
In [2]: import numpy as np
        import matplotlib.pyplot as plt

In [62]: #loading images
         images_train = np.load('train_images.npy',encoding="latin1")
         print ("train images shape: ",images_train.shape)

         #loading labels
         train_labels= np.genfromtxt("train_labels.csv", names =True, delimiter =',',
                                     dtype=[('Id','i8'),('Category','S5')])
         print('train labels shape: ',train_labels.shape)
```

```
train images shape:  (10000, 2)
train labels shape:  (10000,)
```

1 Fonctions

Si on a une image 100X100, il suffit de rouler resize dessus pour produire en sortie un recadrage 40X40. Les 2 autres fonctions sont des helpers

```
In [40]: def PixelDensity(image):
             """ Clean an image by keeping only groups of pixels over a threshold density
                 The function sweep over the image, first checking for
                 verticals continuities, then horizontal continuities,
                 and consider the diagonal paths for each orientation.

                 Each pixels stores it's own continuity (sum over both direction) (lenght),
                 then it propagates it to its neighbours
                 in order to create "blob" of homogeneous continuity.
                 Finally, the image is crop around the blob with the maximum "density",
                 eliminating mos of the noise while still
                 keeping important features located around the chosen blob.

                 Return an 100X100 representation of the image with every pixels
                 carrying the total 'density' of the group of pixels
                 it is part of.
```

```
    """

test1 = (image>0) * np.ones((100,100))      # every non-zero pixels is given an ini
built1 = np.zeros(test1.shape)
built1[0]  = test1[0]
for line in range(1,len(test1)):
    built1[line]=test1[line]
    if built1[line][0] > 0 : built1[line][0] += max(built1[line-1][:2])
    for i in range(1,99):                                              # checkin
        if built1[line][i]>0:
            built1[line][i] += max(built1[line-1][i-1:i+2])
    if built1[line][-1]>0 : built1[line][-1]+= max(built1[line-1][-2:])

flip = test1.transpose()                    #doing the same horizontally
built2 = np.zeros(flip.shape)
built2[0] = flip[0]
for line in range(1,len(flip)):
    built2[line]=flip[line]
    if built2[line][0] >0 : built2[line][0] += max(built2[line-1][:2])
    for i in range(1,99):
        if built2[line][i]>0:
            built2[line][i] += max(built2[line-1][i-1:i+2])
    if built2[line][-1]>0 : built2[line][-1]  += max(built2[line-1][-2:])

built1 = built1 + built2.transpose()         #summing over the vertical and horizon

n=0
while n<10:

    #Here we homogenize the groups of pixels
    #propagating back the weights
    for line in range(-2,-len(test1),-1):
        if built1[line][0] > 0 : built1[line][0] = (np.maximum(
            built1[line][:2],built1[line+1][:2])).max()
        for i in range(1,99):
            if built1[line][i] >0 :
                built1[line][i] = (np.maximum(built1[line][i-1:i+2],
                                              built1[line+1][i-1:i+2])).max()
        if built1[line][-1]>0 : built1[line][-1] = (np.maximum(
            built1[line][-2:],built1[line+1][-2:])).max()

    for line in range(1,len(test1)):
        if built1[line][0] > 0 : built1[line][0] = (np.maximum(
            built1[line][:2],built1[line-1][:2])).max()
        for i in range(1,99):
            if built1[line][i] >0 :
                built1[line][i] = (np.maximum(built1[line][i-1:i+2],
                                              built1[line-1][i-1:i+2])).max()
```

```
            if built1[line][-1]>0 : built1[line][-1] = (np.maximum(
                built1[line][-2:],built1[line-1][-2:])).max()

        n +=1

    #plt.imshow(built1)        #remnants of testing
    #plt.show()

    #propagate back transpose                              Remnants
    """
    for line in range(-2,-len(flip),-1):
        if built2[line][0] > 0 : built2[line][0] = (np.maximum(built2[line][0],built2[l
        for i in range(1,99):
            if built2[line][i] >0 :
                built2[line][i] = (np.maximum(built2[line][i],built2[line+1][i])).max()
        if built2[line][-1]>0 : built2[line][-1] = (np.maximum(built2[line][-1],built2[

    return built1

def threshold(builder,param):
    """ Setting the threshold and cleaning the image
        Every group of pixels with total weight under the threshold is deleted
    """

    clean = (builder > param)*builder
    return clean

# Ok, now it is time to reshape around the image to keep as much details as we can:
# Note : They all seem to fit inside 40X40

def resize(image):
    """ function trying to resize around relevant data
        Since we are able to do a pretty nice cleaning, we simply recenter arounds the

        We return the original image cropped!

    """

    build = PixelDensity(image)
    ladder = build.max()
    to_project = threshold(build,ladder-4)

    project_x = to_project.sum(axis=0)
    project_y = to_project.sum(axis=1)

    inds_x = np.nonzero(project_x)[0]
    inds_y = np.nonzero(project_y)[0]
```

```
    off =0                                  # off >0 plante pour des pixels proche de la
                                                #anyway,non-nécessaire avec cette nouve

    if (inds_x[-1]-inds_x[0])>39: inds_x[-1]= (inds_x[0]+39)
    if (inds_y[-1]-inds_y[0])>39: inds_y[-1]= (inds_y[0]+39)

    crop = image[inds_y[0]-off:inds_y[-1]+off+1,inds_x[0]-off:inds_x[-1]+off+1]
    centered = np.zeros((40,40))
    x_off = (40-crop.shape[1])//2
    y_off = (40-crop.shape[0])//2

    centered[y_off:crop.shape[0]+y_off,x_off:crop.shape[1]+x_off] = crop

    return centered
```

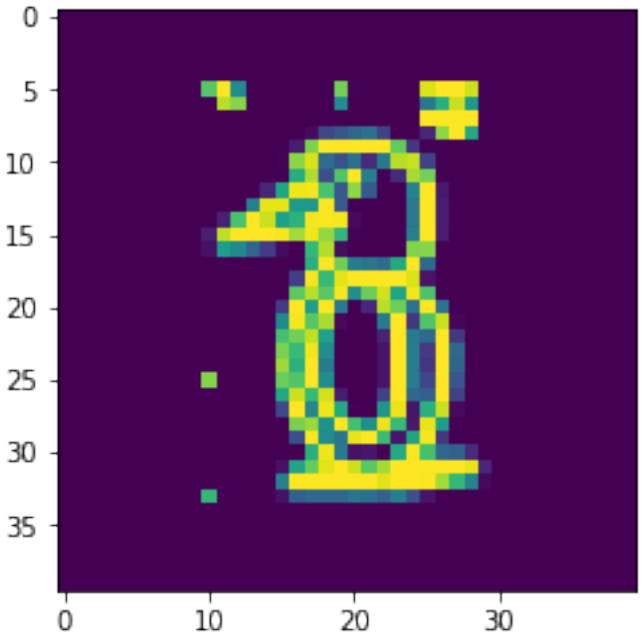
1.1 Exemple:

```
In [43]: tester = (images_train[119][1]).reshape(100,100)

         recadrage = resize(tester)
         plt.imshow(recadrage)

         #Not bad uh?
```

```
Out[43]: <matplotlib.image.AxesImage at 0x2b23eef3748>
```



1.2 Processing them all

Okay, maintenant on va process tout le train set et tout le test set. De cette façon, on va pouoir travailler avec les nouvelles images en mémoire.

```
In [44]: # train set

         to_store = np.zeros((10000,2),dtype=np.ndarray)

         for i in range(10000):
             to_store[i][0] = images_train[i][0]
             to_store[i][1] = (resize(images_train[i][1].reshape(100,100)))

             if i%200 == 0 : print(str(i)+" images de process")

         np.save("Processed_train_images.npy",to_store)
```

```
0 images de process
200 images de process
400 images de process
600 images de process
800 images de process
1000 images de process
1200 images de process
1400 images de process
1600 images de process
1800 images de process
2000 images de process
2200 images de process
2400 images de process
2600 images de process
2800 images de process
3000 images de process
3200 images de process
3400 images de process
3600 images de process
3800 images de process
4000 images de process
4200 images de process
4400 images de process
4600 images de process
4800 images de process
5000 images de process
5200 images de process
5400 images de process
5600 images de process
5800 images de process
6000 images de process
6200 images de process
```

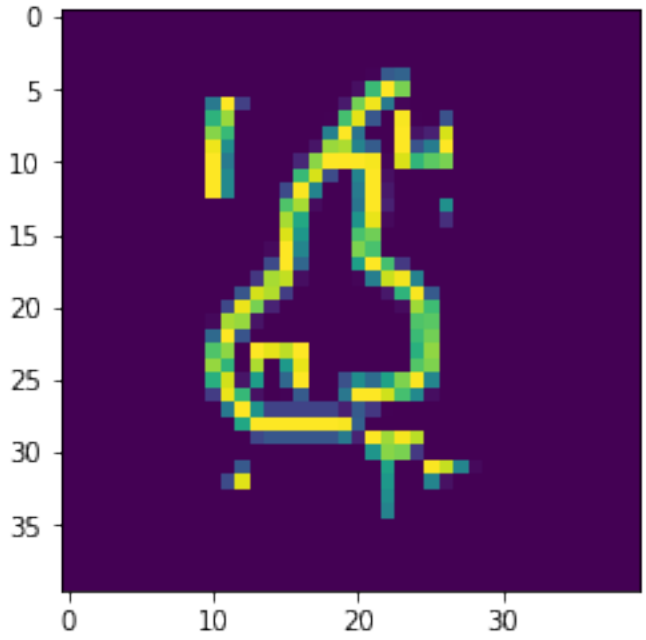
```
6400 images de process
6600 images de process
6800 images de process
7000 images de process
7200 images de process
7400 images de process
7600 images de process
7800 images de process
8000 images de process
8200 images de process
8400 images de process
8600 images de process
8800 images de process
9000 images de process
9200 images de process
9400 images de process
9600 images de process
9800 images de process
```

```
In [3]: # Trying le loading des nouvelles donnés
        #loading images
        new_images_train = np.load('Processed_train_images.npy')
        print ("train images shape: ",new_images_train.shape)
```

```
train images shape:  (10000, 2)
```

```
In [4]: #testing the access
        ddata = new_images_train[9876][1].reshape(40,40)
        plt.imshow(ddata)
```

```
Out[4]: <matplotlib.image.AxesImage at 0x19771374ac8>
```



In [51]:
```
# Même chose mais pour le test set
#loading images
images_test = np.load('test_images.npy',encoding="latin1")
print ("test images shape: ",images_test.shape)
```

```
test images shape:  (10000, 2)
```

In [52]:
```
# test set

to_store2 = np.zeros((10000,2),dtype=np.ndarray)

for i in range(10000):
    to_store2[i][0] = images_test[i][0]
    to_store2[i][1] = (resize(images_test[i][1].reshape(100,100)))

    if i%200 == 0 : print(str(i)+" images de process")

np.save("Processed_test_images.npy",to_store2)
```

```
0 images de process
200 images de process
400 images de process
600 images de process
800 images de process
1000 images de process
```

```
1200 images de process
1400 images de process
1600 images de process
1800 images de process
2000 images de process
2200 images de process
2400 images de process
2600 images de process
2800 images de process
3000 images de process
3200 images de process
3400 images de process
3600 images de process
3800 images de process
4000 images de process
4200 images de process
4400 images de process
4600 images de process
4800 images de process
5000 images de process
5200 images de process
5400 images de process
5600 images de process
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7200 images de process
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7600 images de process
7800 images de process
8000 images de process
8200 images de process
8400 images de process
8600 images de process
8800 images de process
9000 images de process
9200 images de process
9400 images de process
9600 images de process
9800 images de process
```

```
In [2]: # Trying le loading des nouvelles donnés
        #loading images
```

```
        new_images_test = np.load('Processed_test_images.npy')
        print ("test images shape: ",new_images_test.shape)
```

```
test images shape:  (10000, 2)
```

In [8]:
```
        #Voici une section qui permet de loader plusieurs images à la fois.
        #De cette façon on a pu explorer manuellement si les résultats étaient satisafaisant.
        #En pratique, l'exploration manuelle d'un millier d'images sans trouver d'erreur nous a
        #ce nouveau data set processed.

        starter = 1040
        to_print=30
        lenght = (to_print//4)*5

        plt.figure('testing',figsize=(15,lenght))
        for i in range(to_print):
            to_graph=new_images_test[starter+i][1].reshape(40,40)

            plt.subplot((to_print//3)+1,4,i+1)
            plt.imshow(to_graph)
            #plt.title("image number : " + str(i+starter)+'\n label:'+str(train_labels[i+starter

        plt.tight_layout()
        plt.show()
```