------COMPTE RENDU MBODE JOSEPH INSTRU 2 -----------

--------TD TP3 APPRENTISSAGE NON SUPERVISE------------

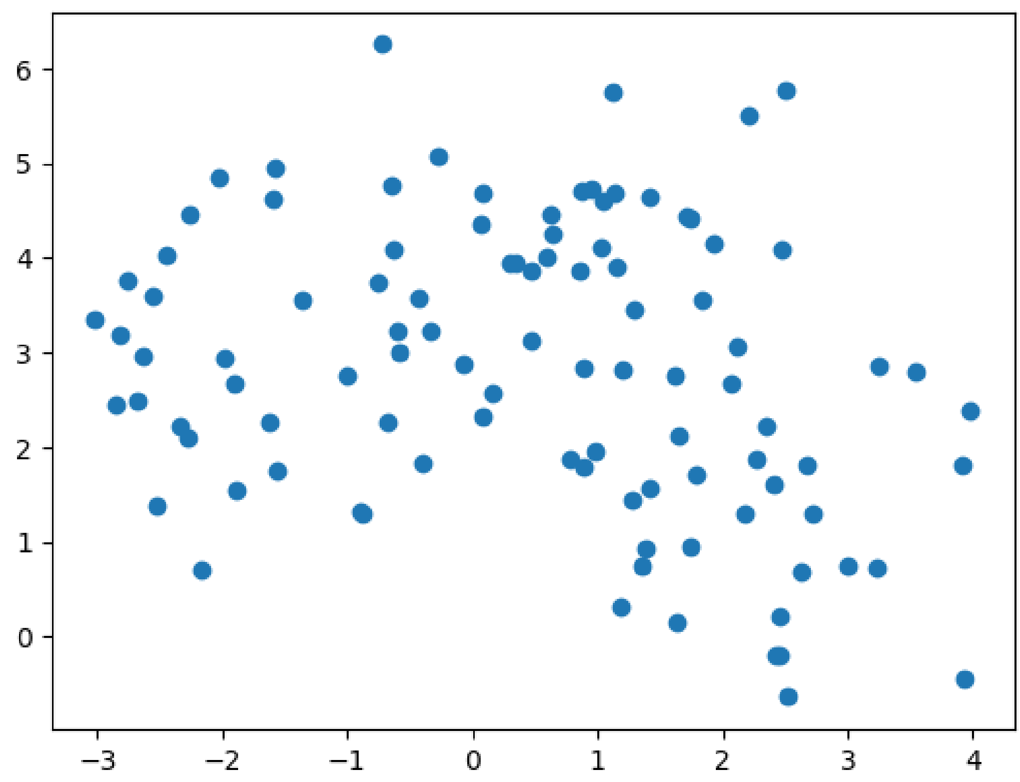
```
import matplotlib.pyplot as plt
import numpy as np
```

Exercice 1 : CLustering

```
from sklearn.datasets import make_blobs
```

1- Jeu de données

```
X,y = make_blobs(n_samples=100,centers=3,n_features = 2,
random_state=0)

plt.scatter(X[:,0],X[:,1])

<matplotlib.collections.PathCollection at 0x25c19ebbe50>
```



2-Modèle

```
#a) module pour former des clusters
from sklearn.cluster import KMeans
```

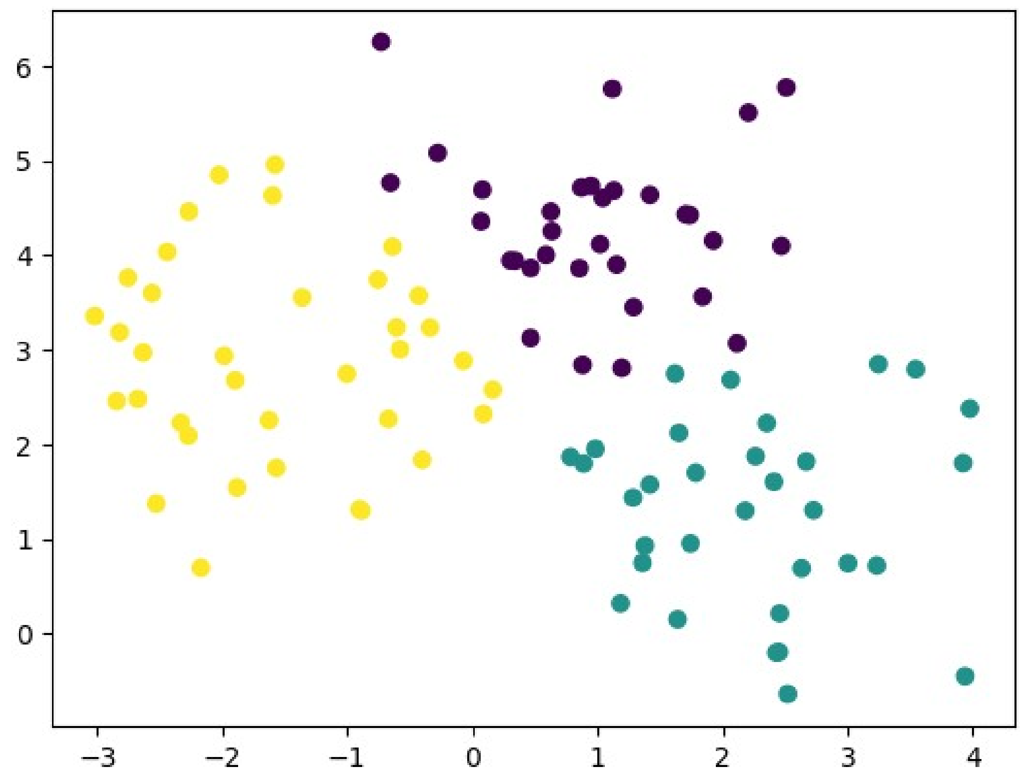
```
#b) Caractéristiques des hyperparamètres
model = KMeans(n_clusters=3)   #regroupement de 3 clusters
```

3- Entraiement

```
model.fit(X,y)

C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(

KMeans(n_clusters=3)
```

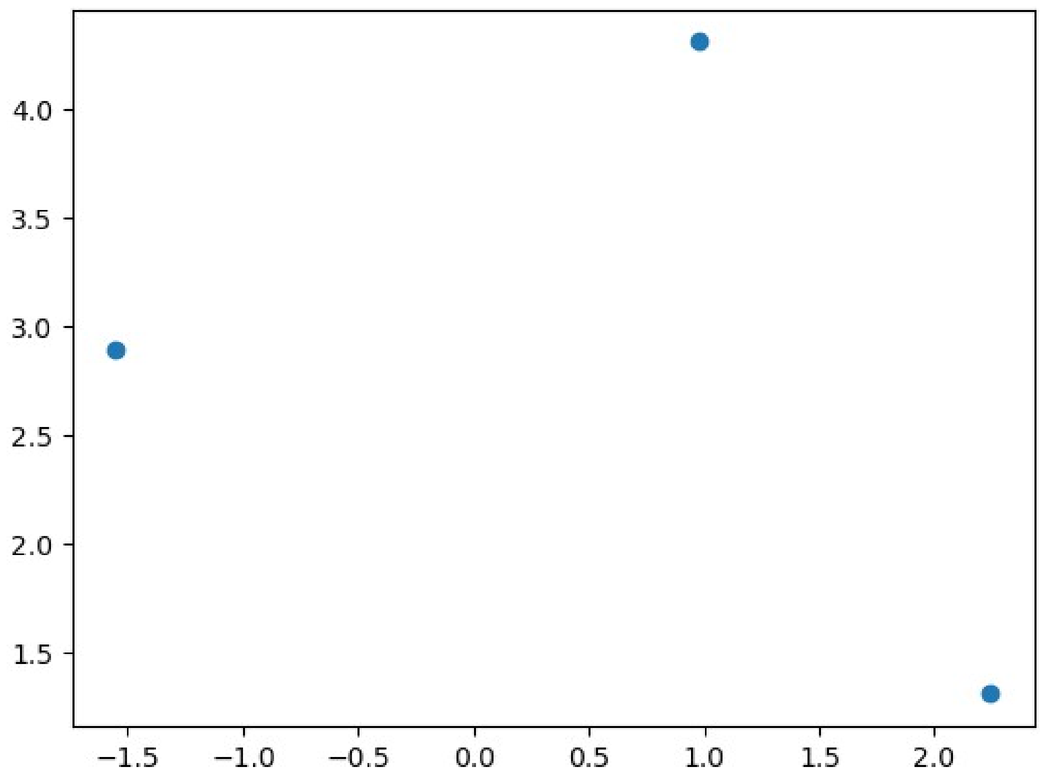
4- Prédiction du modèle

```
model.predict(X)

array([1, 0, 1, 2, 2, 0, 2, 2, 1, 0, 0, 0, 1, 0, 2, 1, 2, 2, 2, 2, 2,
2,
       2, 2, 1, 1, 1, 1, 2, 2, 0, 1, 1, 0, 2, 0, 0, 1, 1, 2, 2, 1, 1,
0,
       0, 0, 1, 1, 2, 2, 0, 1, 0, 1, 2, 2, 1, 1, 0, 1, 1, 2, 2, 2, 2,
1,
       0, 2, 1, 0, 2, 1, 2, 1, 0, 0, 0, 0, 2, 1, 0, 0, 1, 0, 0, 0, 0,
0,
       1, 0, 1, 1, 2, 2, 2, 2, 0, 0, 2, 2])

plt.scatter(X[:,0],X[:,1],c=model.predict(X))

<matplotlib.collections.PathCollection at 0x25c19f31dd0>
```



5- Affichage des Centroides

```
model.cluster_centers_
model.cluster_centers_[:,0]
model.cluster_centers_[:,1]
plt.scatter(model.cluster_centers_[:,0],model.cluster_centers_[:,1])

<matplotlib.collections.PathCollection at 0x25c1b1ee7d0>
```



6- Utilité des centroides

7- Coût engendré par le modèle

```
print('le coût engendré par ce modele est :',model.inertia_)

le coût engendré par ce modele est : 167.75875127963718
```

8-Evaluation du modèle

```
print('le score de ce model est de :',model.score(X))

le score de ce model est de : -167.7587512796372
```

9- <<'Elbow Method '>> : déterminons la zone de coude

```
inertia = [] #variable pour stocker les valeurs de l'inertie
K_range = range(1,20) #on va considérer maximiser le nbre de clusters
au fur et à mesure
for k in K_range: #pour chaque nombre de cluster
    model = KMeans(n_clusters=k).fit(X)#on entraine le modèle
    inertia.append(model.inertia_) #on stocke la valeur de l'inertie
dans la variable inertia
plt.plot(K_range,inertia) #on trace la fonction du nombre du cooût du
modèle (inertie) en focntion du nbre de clusters
```

```python
plt.xlabel('nombre de clusters')
plt.ylabel('cout du modèle(Inertia)')
```

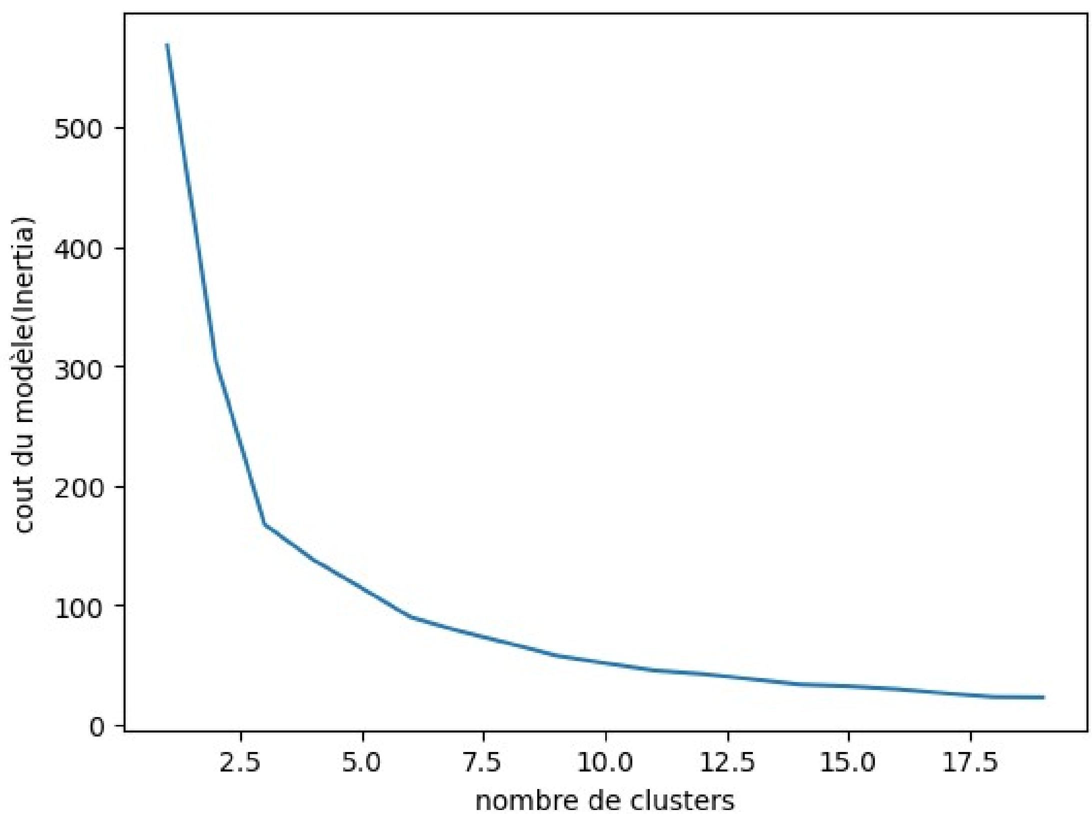
```
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
```

```
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
```

```
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
```

```
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
```

```
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:870: FutureWarning: The default value of `n_init` will
change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\cluster\
_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on
Windows with MKL, when there are less chunks than available threads.
You can avoid it by setting the environment variable
OMP_NUM_THREADS=1.
  warnings.warn(

Text(0, 0.5, 'cout du modèle(Inertia)')
```

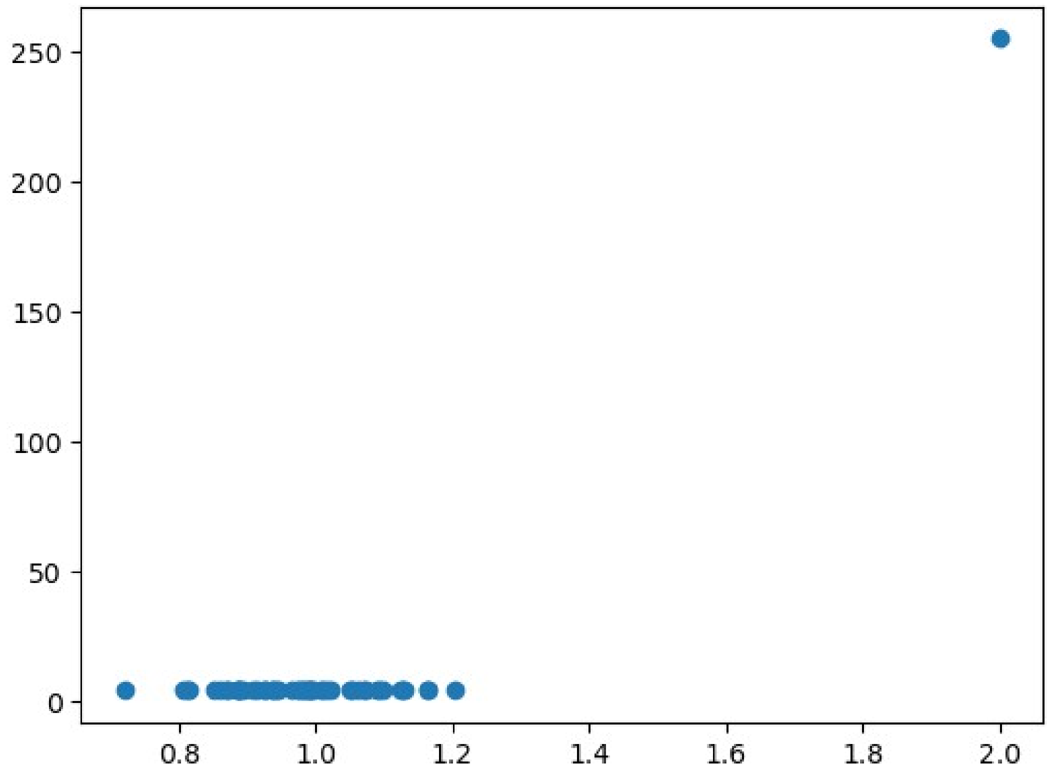


Exercice 2 : Détection d'anomalie (ISOLATION FOREST ALGORITHM)

1- Jeu de données

```
X,y = make_blobs(n_samples=50, centers=1, cluster_std=0.1,
random_state=0)
X[-1,:]=np.array([2,255])
plt.scatter(X[:,0],X[:,1])
```

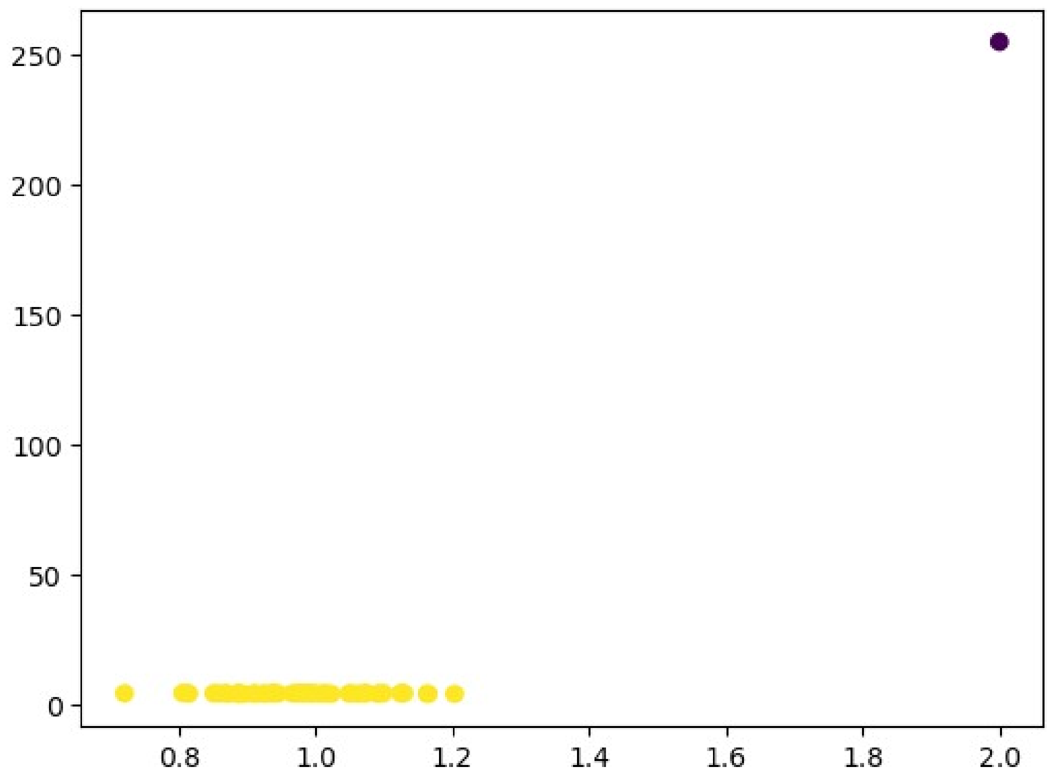
```
<matplotlib.collections.PathCollection at 0x25c1b4a71d0>
```



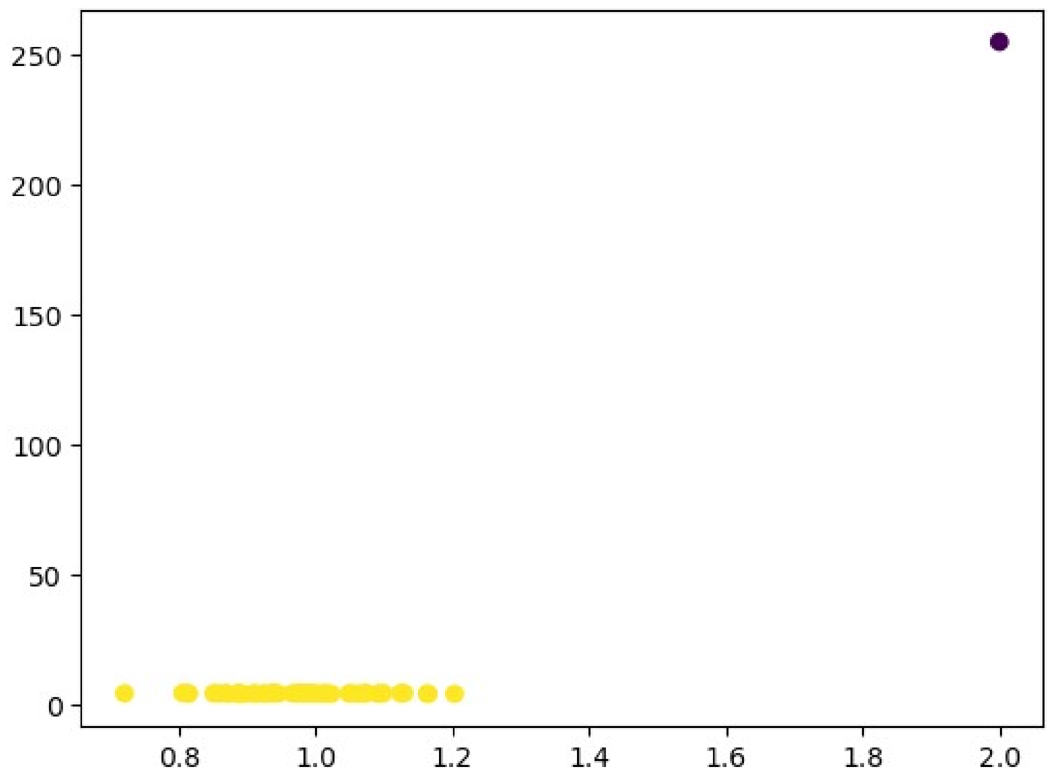
2 - Algoritme Isolation Forest

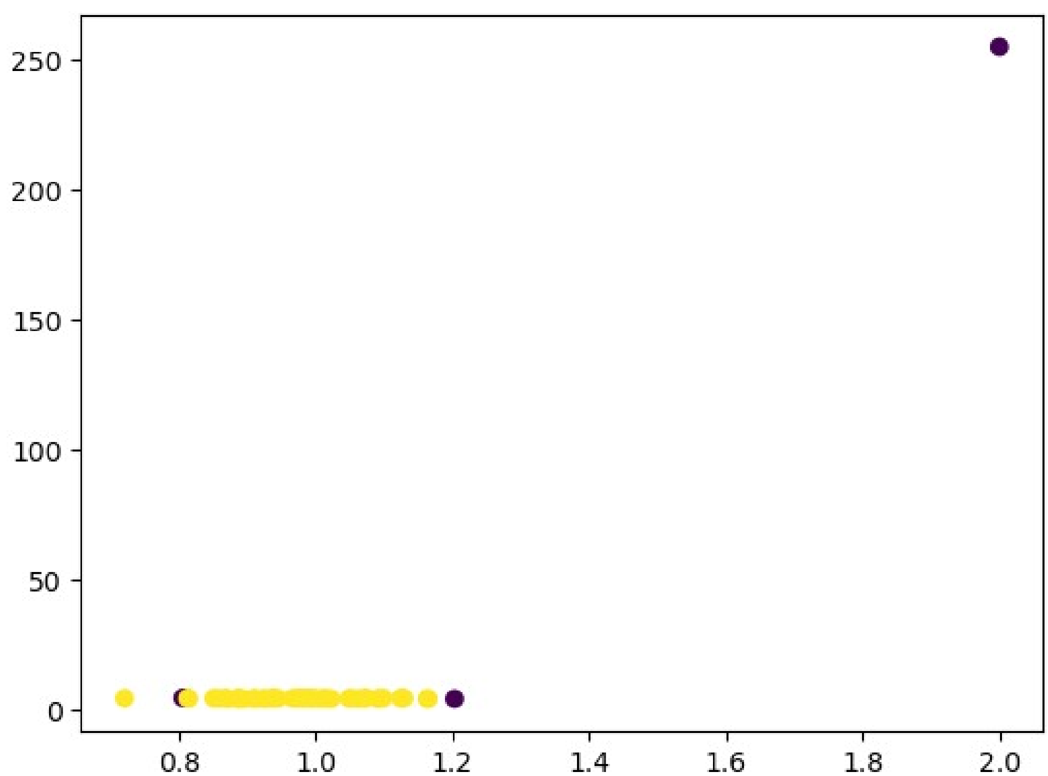
```
#a) Librairie
from sklearn.ensemble import IsolationForest

#b) Sélection du modèle
model = IsolationForest(contamination=0.01)

#c) Entraiement et prédiction du modèle
model.fit(X)
plt.scatter(X[:,0],X[:,1],c=model.predict(X))
```

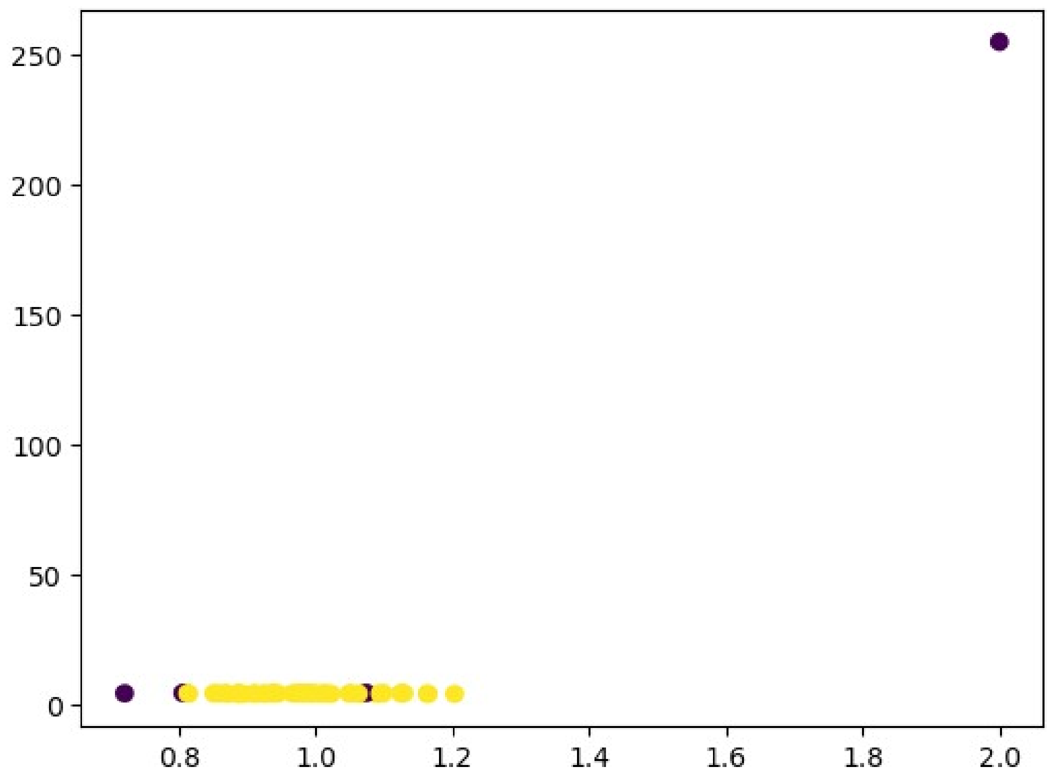
```
<matplotlib.collections.PathCollection at 0x25c19f921d0>
```



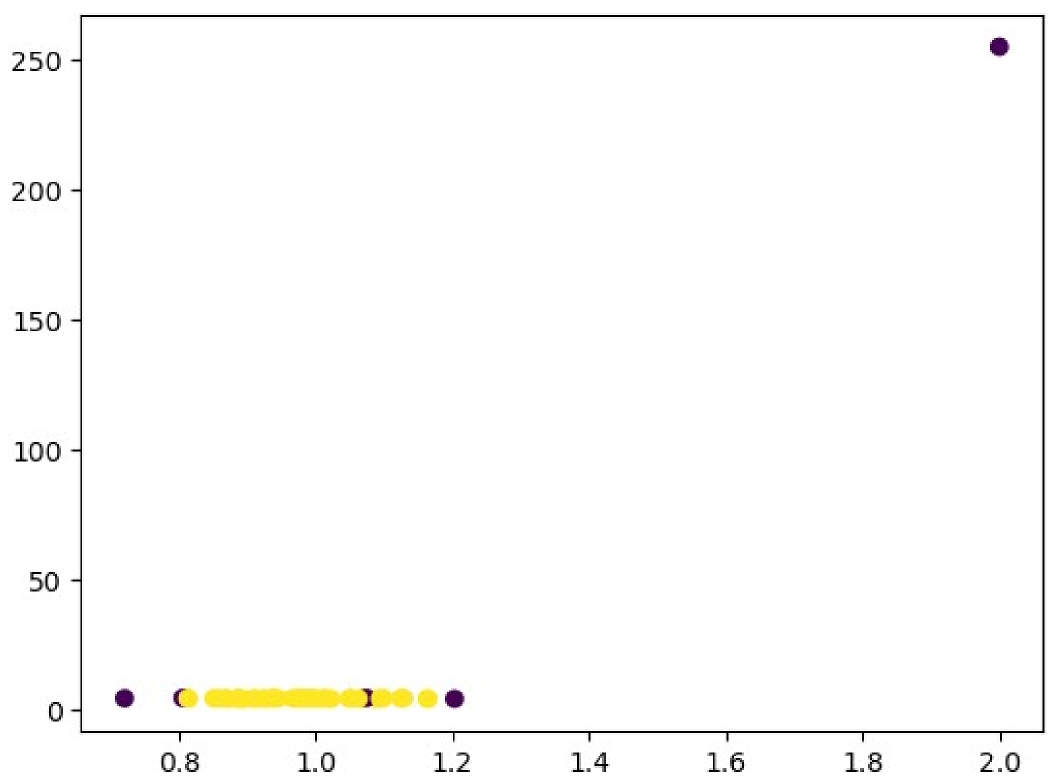

```
#d) modification de l'hyperparamètre
taux = [0.01, 0.05, 0.07,0.1, 0.15, 0.2]
for i in taux:
    model = IsolationForest(contamination=i)
    model.fit(X)
    plt.scatter(X[:,0],X[:,1],c=model.predict(X))
    plt.show()
```


250
200
150
100
50
0
0.8
1.0
1.2
1.4
1.6
1.8
2.0

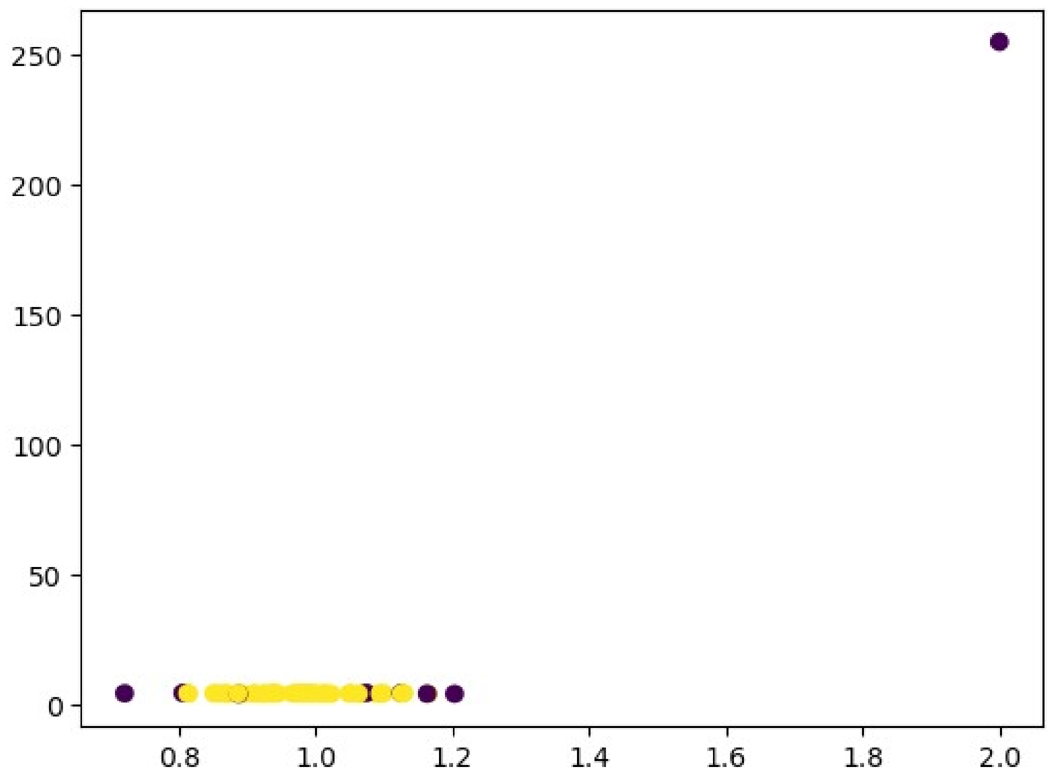

250
200
150
100
50
0
0.8
1.0
1.2
1.4
1.6
1.8
2.0

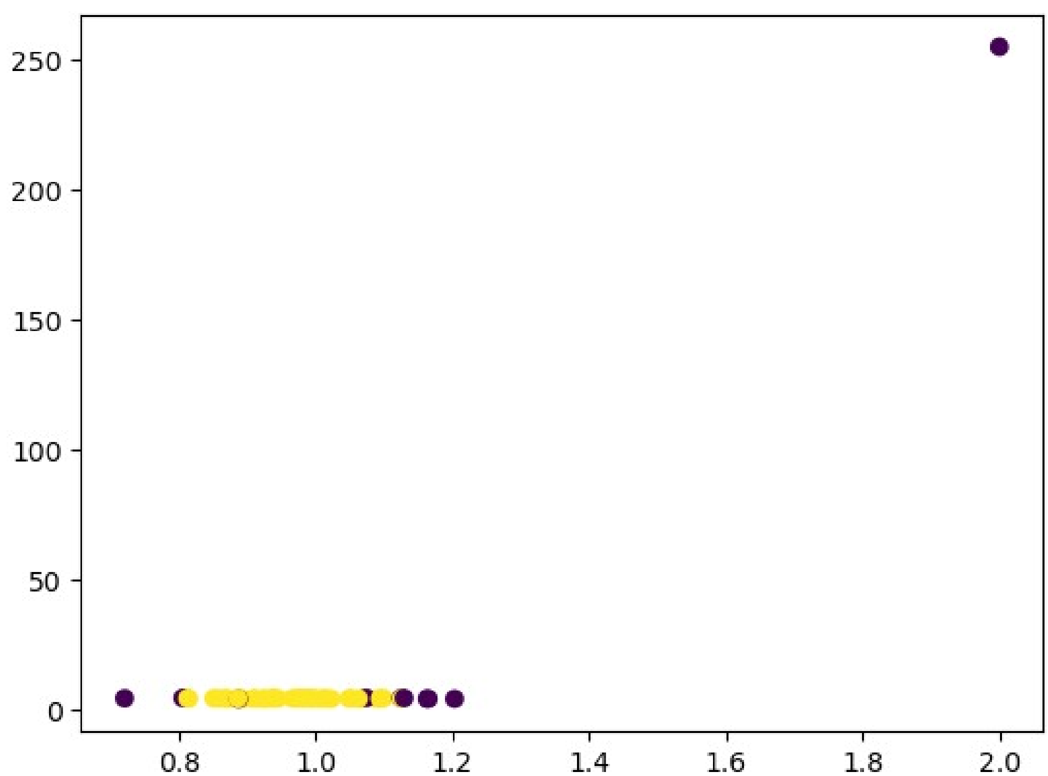


250
200
150
100
50
0
0.8
1.0
1.2
1.4
1.6
1.8
2.0



250
200
150
100
50
0
0.8
1.0
1.2
1.4
1.6
1.8
2.0


0
50
100
150
200
250
0.8
1.0
1.2
1.4
1.6
1.8
2.0


0
50
100
150
200
250
0.8
1.0
1.2
1.4
1.6
1.8
2.0

Exercice 3 : DETECTION DES CHIFFRES MALS ECRITS DANS LA BASE "DIGITS" (ISOLATION FOREST ALGORITHM)

Le but ici sera de rétirer les chiffres mals écrits dans cette base

1- Librairie du jeu

```
from sklearn.datasets import load_digits
```

2- Jeu de données des chiffres manuscrits représentés en image

```
digits = load_digits()
Images = digits.images
```

3- Images et target

```
X=digits.data
y=digits.target
```

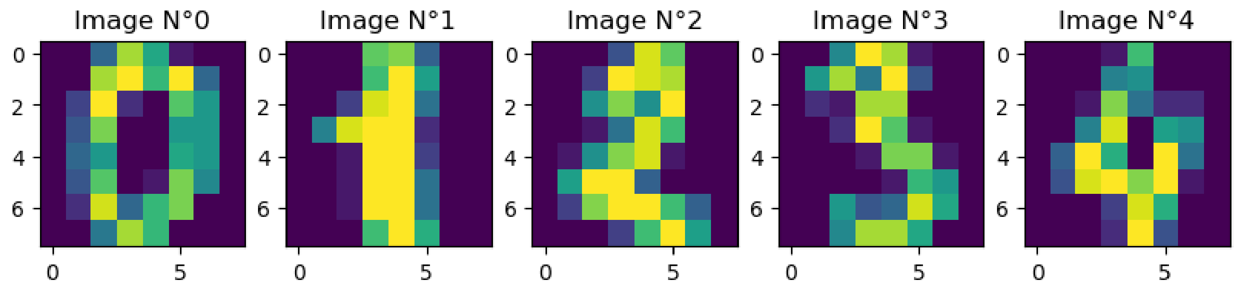
4- d'après print(X.shape)

```
print(X.shape)
```

```
(1797, 64)
```

```
#a) taille de X
print('X est une matrice 1797 images et 64 pixels')

#b)taille de l'image
print("l'image devrait être une matrice 8 lignes et 8 colonnes")

#c)visaulisation de quelques images
#plt.imshow(Images[1])
plt.figure(figsize=(10, 5))
for i in range(5):
    plt.subplot(1,5,i+1)
    plt.imshow(Images[i])
    plt.title('Image N°{}'.format(i))
```

```
X est une matrice 1797 images et 64 pixels
l'image devrait être une matrice 8 lignes et 8 colonnes
```



5 -Modèle FOREST

```
model = IsolationForest(random_state=0,contamination=0.02)
```

6-Entrainement du modèle

```
model.fit(X)
```

```
IsolationForest(contamination=0.02, random_state=0)
```

7- Evaluation du modèle

```
model.predict(X)
```

```
array([1, 1, 1, ..., 1, 1, 1])
```

8- Filtrage prédictions = -1

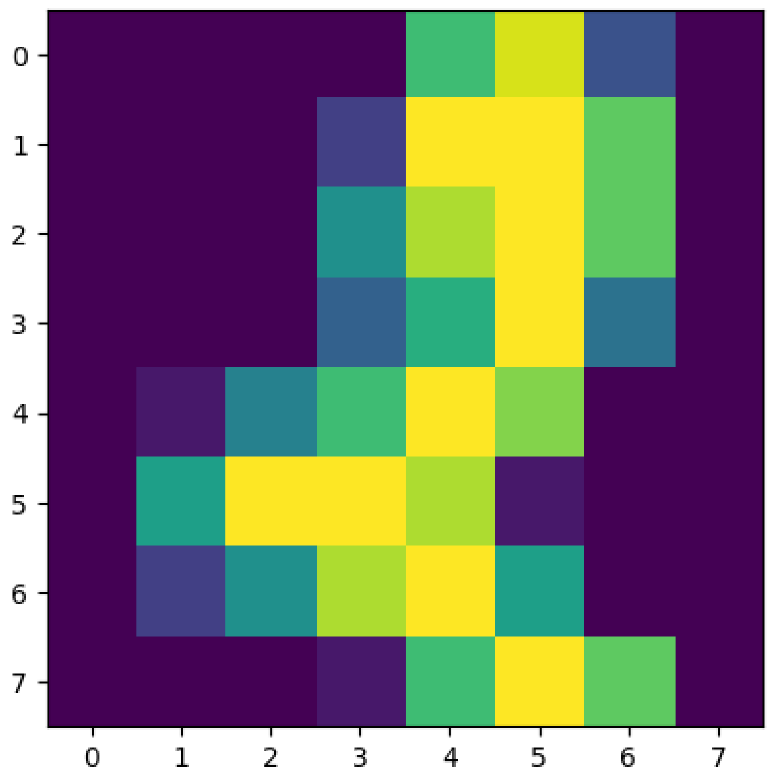
```
outliers = model.predict(X)==-1

#analyse du contenu
nbre_err = 0
for i in range(len(outliers)):
    if outliers[i]==True:
        nbre_err+=1
print('On trouve finalement {} de digits incorrects dans 
outliers'.format(nbre_err))
```

```
On trouve finalement 36 de digits incorrects dans outliers
```

9-Images des Outliers

```
plt.imshow(Images[outliers][0])
```

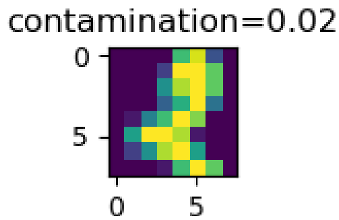
```
<matplotlib.image.AxesImage at 0x25c1faebfd0>
```

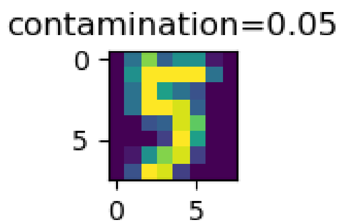


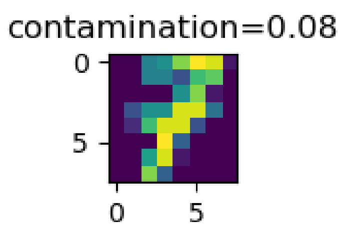
10- Modif de l'hyperparamètre contamination et impact

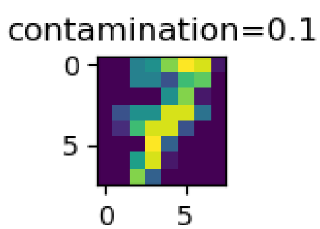
```
contamination_ = [0.02, 0.05, 0.08, 0.1, 0.3, 0.5]
for i in range(len(contamination_)):
    model =
IsolationForest(random_state=0,contamination=contamination_[i])
    model.fit(X)
    model.predict(X)
    outliers = model.predict(X)==-1
    nbre_err = 0
    for j in range(len(outliers)):
        if outliers[j]==True:
            nbre_err+=1
    print('On trouve finalement {} de digits incorrects dans
outliers'.format(nbre_err))
#print('Affichage des premières images fausses pour chaque valeur de
la contamination')
    plt.figure(figsize=(10,6))
    plt.subplot(6,1,i+1)
    plt.title('contamination={}'.format(contamination_[i]))
    plt.imshow(Images[outliers][0])


On trouve finalement 36 de digits incorrects dans outliers
On trouve finalement 90 de digits incorrects dans outliers
On trouve finalement 144 de digits incorrects dans outliers
```

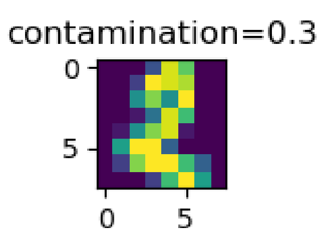
```
On trouve finalement 180 de digits incorrects dans outliers
On trouve finalement 539 de digits incorrects dans outliers
On trouve finalement 898 de digits incorrects dans outliers
```

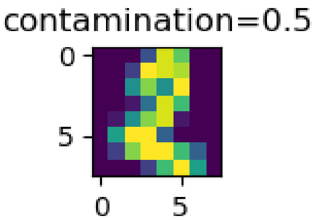












Exercice 4 : REDUCTION DE LA DIMMENSIONNALITE(ANALYSE DES COMPOSANTES PRINCIPALES, (PCA POUR PRINCIPAL COMPONENTS ANALYSIS))

A) Telechargement du jeu de données

1-Importation Librairie

```
from sklearn.datasets import load_digits
```

2- Images représentantes les chiffres manuscrits

```
digits = load_digits()
images = digits.images
```

3-Récuperation des images et targets

```
X=digits.data
y=digits.target
```

4-Dimension du jeu

```
print(X.shape)
```

```
(1797, 64)
```

```
print('on a 1797 images et chacune a 64 variables')
```

```
on a 1797 images et chacune a 64 variables
```

B) Visualisation des données

1- Chargement du PCA

```
from sklearn.decomposition import PCA
```

2- Modèle PCA

```python
model = PCA(n_components=2)
```

3- Entrainement

```python
X_reduced = model.fit_transform(X)
```

4- Dimension du tableau

```python
X_reduced.shape
```

```
(1797, 2)
```

```python
X_reduced
```

```
array([[ -1.25946729,  21.27488561],
       [  7.95760999, -20.76869199],
       [  6.99192474,  -9.95599289],
       ...,
       [ 10.8012844 ,  -6.96025286],
       [ -4.87210066,  12.42395721],
       [ -0.34438821,   6.36554304]])
```

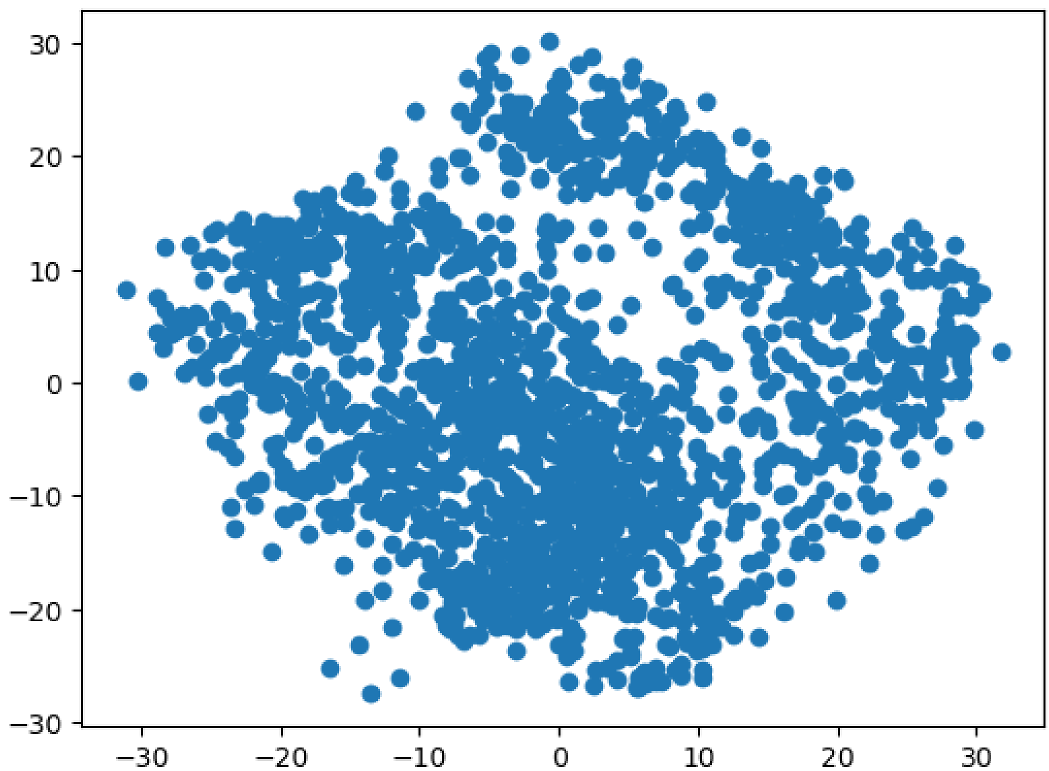
```python
print("1797 lignes:images et 2 colonnes d'images: variables")
```

```
1797 lignes:images et 2 colonnes d'images: variables
```

5- Composantes de X_reduced

```python
plt.scatter(X_reduced[:,0],X_reduced[:,1])
```

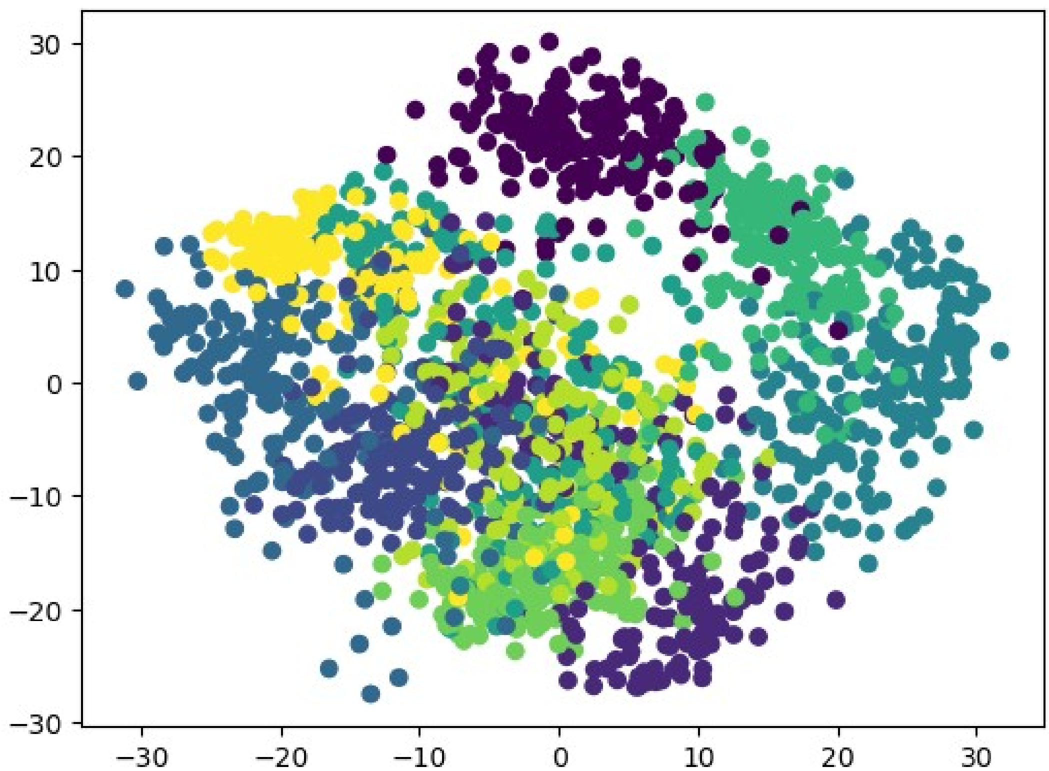
```
<matplotlib.collections.PathCollection at 0x25c20916390>
```



6- Ajout des couleurs au graphique

```
plt.scatter(X_reduced[:,0],X_reduced[:,1],c=y)
```

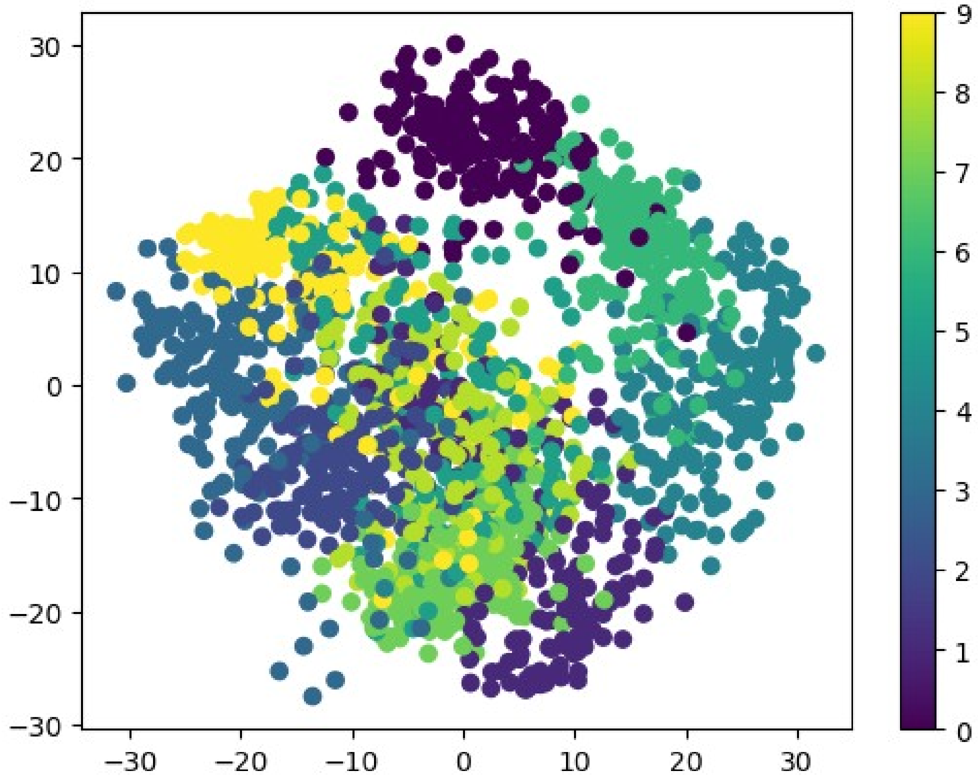
```
<matplotlib.collections.PathCollection at 0x25c204102d0>
```



7- Visualisation avec Barre de couleur

```
plt.scatter(X_reduced[:,0],X_reduced[:,1],c=y)
plt.colorbar()
```

```
<matplotlib.colorbar.Colorbar at 0x25c2043a8d0>
```



8-Interpretation

9-Signification des axes

10- Analyse des composantes

```
model.components_.shape
```

```
(2, 64)
```

C) Compressions de données

1-Entrainement du modèle sur le même nombre de dimension que X

```
d=X.shape[1]
model = PCA(n_components=d)
```

2-Entrainement

```
X_reduced=model.fit_transform(X)
```

3- Pourcentage de variance à préserver

```
print('pour chacune des 64 composantes, on a ces pourcentages de
variance {}'.format(model.explained_variance_ratio_))
```

```
pour chacune des 64 composantes, on a ces pourcentages de variance
[1.48905936e-01 1.36187712e-01 1.17945938e-01 8.40997942e-02
 5.78241466e-02 4.91691032e-02 4.31598701e-02 3.66137258e-02
 3.35324810e-02 3.07880621e-02 2.37234084e-02 2.27269657e-02
 1.82186331e-02 1.77385494e-02 1.46710109e-02 1.40971560e-02
 1.31858920e-02 1.24813782e-02 1.01771796e-02 9.05617439e-03
 8.89538461e-03 7.97123157e-03 7.67493255e-03 7.22903569e-03
 6.95888851e-03 5.96081458e-03 5.75614688e-03 5.15157582e-03
 4.89539777e-03 4.28887968e-03 3.73606048e-03 3.53274223e-03
 3.36683986e-03 3.28029851e-03 3.08320884e-03 2.93778629e-03
 2.56588609e-03 2.27742397e-03 2.22277922e-03 2.11430393e-03
 1.89909062e-03 1.58652907e-03 1.51159934e-03 1.40578764e-03
 1.16622290e-03 1.07492521e-03 9.64053065e-04 7.74630271e-04
 5.57211553e-04 4.04330693e-04 2.09916327e-04 8.24797098e-05
 5.25149980e-05 5.05243719e-05 3.29961363e-05 1.24365445e-05
 7.04827911e-06 3.01432139e-06 1.06230800e-06 5.50074587e-07
 3.42905702e-07 9.50687638e-34 9.50687638e-34 9.36179501e-34]
```

4- Somme cumulée des variances

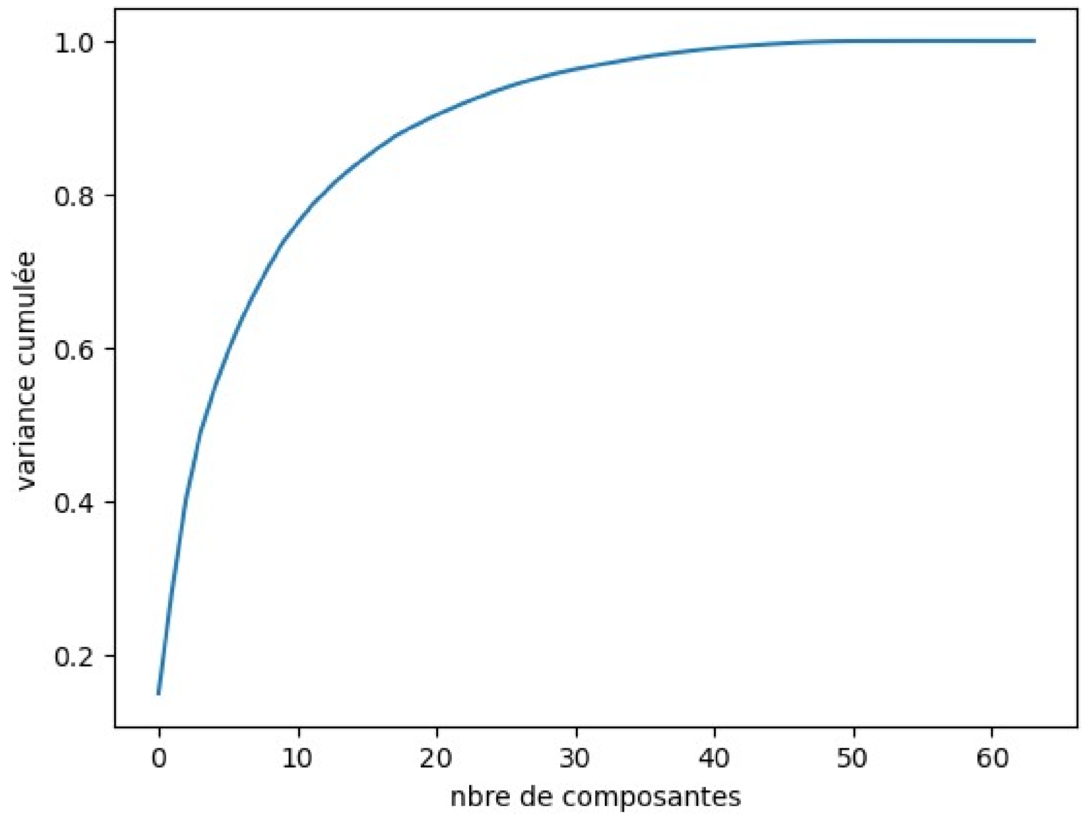
```
np.cumsum(model.explained_variance_ratio_)
```

```
array([0.14890594, 0.28509365, 0.40303959, 0.48713938, 0.54496353,
       0.59413263, 0.6372925 , 0.67390623, 0.70743871, 0.73822677,
       0.76195018, 0.78467714, 0.80289578, 0.82063433, 0.83530534,
       0.84940249, 0.86258838, 0.87506976, 0.88524694, 0.89430312,
       0.9031985 , 0.91116973, 0.91884467, 0.9260737 , 0.93303259,
       0.9389934 , 0.94474955, 0.94990113, 0.95479652, 0.9590854 ,
       0.96282146, 0.96635421, 0.96972105, 0.97300135, 0.97608455,
       0.97902234, 0.98158823, 0.98386565, 0.98608843, 0.98820273,
       0.99010182, 0.99168835, 0.99319995, 0.99460574, 0.99577196,
       0.99684689, 0.99781094, 0.99858557, 0.99914278, 0.99954711,
       0.99975703, 0.99983951, 0.99989203, 0.99994255, 0.99997555,
       0.99998798, 0.99999503, 0.99999804, 0.99999911, 0.99999966,
       1.        , 1.        , 1.        , 1.        ])
```

5- Tracé du % de variance cumulée en fonction du nombre de composantes

```
plt.plot(np.cumsum(model.explained_variance_ratio_))
plt.xlabel('nbre de composantes')
plt.ylabel('variance cumulée')
```

```
Text(0, 0.5, 'variance cumulée')
```



6-Nombre de composantes pour avoir les 90%

7-Composante poutr avoir les 99%

```
print('{} composantes ont une variance
>=99%'.format(np.argmax(np.cumsum(model.explained_variance_ratio_)>=0.
99)+1))
```

```
41 composantes ont une variance >=99%
```

8-Nouvel entrainement pour 41 composantes

```
model = PCA(n_components=41)
X_reduced=model.fit_transform(X)
```

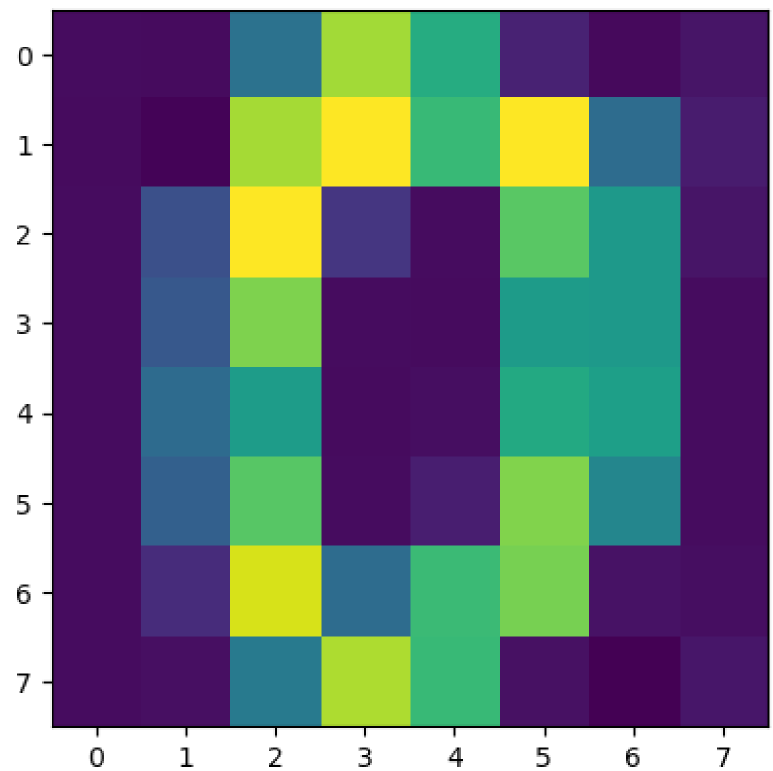
9- Decompression des images

```
X_recovered = model.inverse_transform(X_reduced)
```

10-Affichage d'une image

```
plt.imshow(X_recovered[0].reshape((8,8)))
```

```
<matplotlib.image.AxesImage at 0x25c2ae0c350>
```



on a une baisse de la qualité de l'imaage

11-Vérification du nombres de composantes utilisés

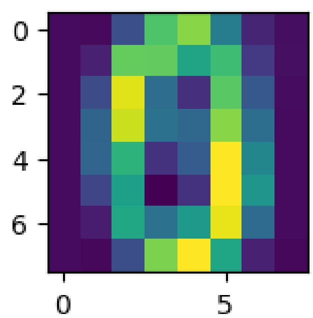
```
from sklearn.preprocessing import MinMaxScaler
from sklearn.decomposition import PCA

scaler = MinMaxScaler()
data_resscaled = scaler.fit_transform(X)

pca = PCA(n_components=0.4)
pca.fit(data_resscaled)
reduced = pca.transform(data_resscaled)
print('nombre de composant utilisées est de {}% de la variance
totale'.format(pca.n_components))
print('Autrement dit {}
composantes'.format(np.argmax(np.cumsum(pca.explained_variance_ratio_)
>= 0.4) + 1))

nombre de composant utilisées est de 0.4% de la variance totale
Autrement dit 3 composantes
```

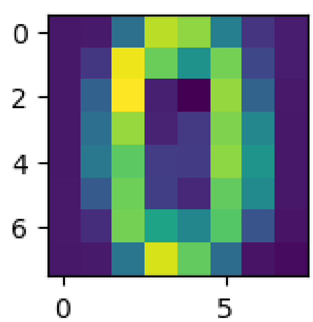
12- Impact de la réduction du nombre de composante

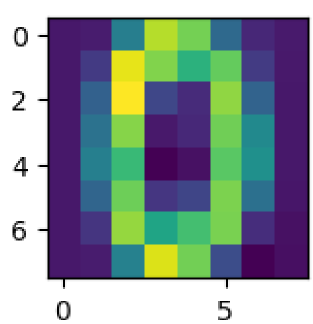
```
variances = [0.3, 0.5, 0.7, 0.9]
```

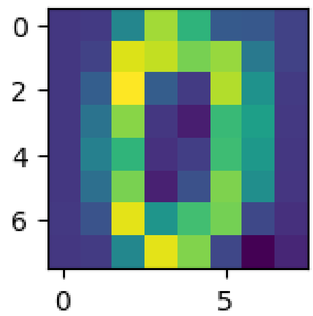
```
for j in range(len(variances)):
    pca = PCA(n_components=variances[j])
    pca.fit(X)

    X_reduced = pca.transform(X) #trabnfromation
    X_recovered = pca.inverse_transform(X_reduced) #réduction

    print("Nombre de composantes :", pca.n_components_)
    plt.figure(figsize=(12,8))
    plt.subplot(4,1,j+1)
    plt.imshow(X_recovered[0].reshape(8,8))
```

```
Nombre de composantes : 3
Nombre de composantes : 5
Nombre de composantes : 9
Nombre de composantes : 21
```









0
2
4
6
0
5