```
from os import listdir
from os.path import isfile, join
from fr_model import *
from fr_utils import *
import numpy as np
```

## Load files and use model to calculate image vector

```
In [94]:

database = {}
FRModel = FaceRecognitionModel()
mypath='db'
for f in listdir(mypath):
    if (isfile(join(mypath, f))):
        person_id = os.path.splitext(f)[0]
        database[person_id] = FRModel.img_to_encoding_from_path(join(mypath,f))
```

# Calculate distances between all images and create dataframe

```
In [95]:

cols = []
data = []
for key1 in database:
    row = []
    cols.append(key1)
    for key2 in database:
        dist = np.linalg.norm(database[key1] - database[key2])
        row.append(dist)
        data.append(row)

df_dist = pd.DataFrame(data=data, index=cols, columns=cols)
```

# Perform dimensionality reduction with tsne and visualize

```
In [96]:
from sklearn.manifold import TSNE
import pandas as pd
```

#### In [97]:

```
feat_cols = [ "" + str(i) for i in range(128) ]
df = pd.DataFrame(list(map(np.ravel, database.values())),columns=feat_cols)
df['label'] = database.keys()
df['label'] = df['label'].str.extract('([a-zA-ZäüöÄÖÜ-]+)')
```

#### In [98]:

```
tsne = TSNE(n_components=2, verbose=1, perplexity=40, n_iter=300)
tsne_results = tsne.fit_transform(df.drop('label', axis=1),feat_cols)
[t-SNE] Computing 17 nearest neighbors...
[t-SNE] Indexed 18 samples in 0.000s...
```

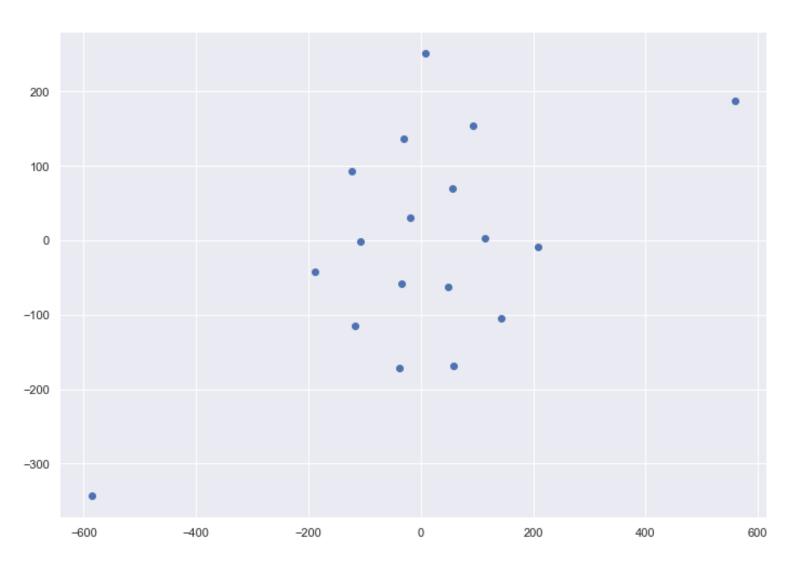
```
[t-SNE] Indexed 18 samples in 0.000s...
[t-SNE] Computed neighbors for 18 samples in 0.001s...
[t-SNE] Computed conditional probabilities for sample 18 / 18
[t-SNE] Mean sigma: 1125899906842624.000000
[t-SNE] KL divergence after 250 iterations with early exaggeration: 50.644001
[t-SNE] Error after 300 iterations: 0.691372
```

#### In [99]:

```
import matplotlib.pyplot as plt
plt.scatter(tsne_results[0:,0] , tsne_results[0:,1])
```

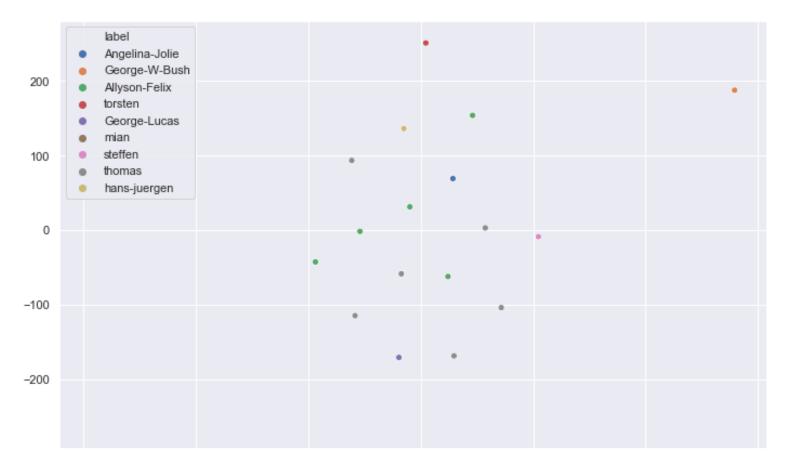
#### Out[99]:

<matplotlib.collections.PathCollection at 0x1a4faeeb70>



```
In [100]:
```

```
import seaborn as sns; sns.set(rc={'figure.figsize':(11.7,8.27)})
ax = sns.scatterplot(x=tsne_results[0:,0], y=tsne_results[0:,1],hue=df['label'])
```

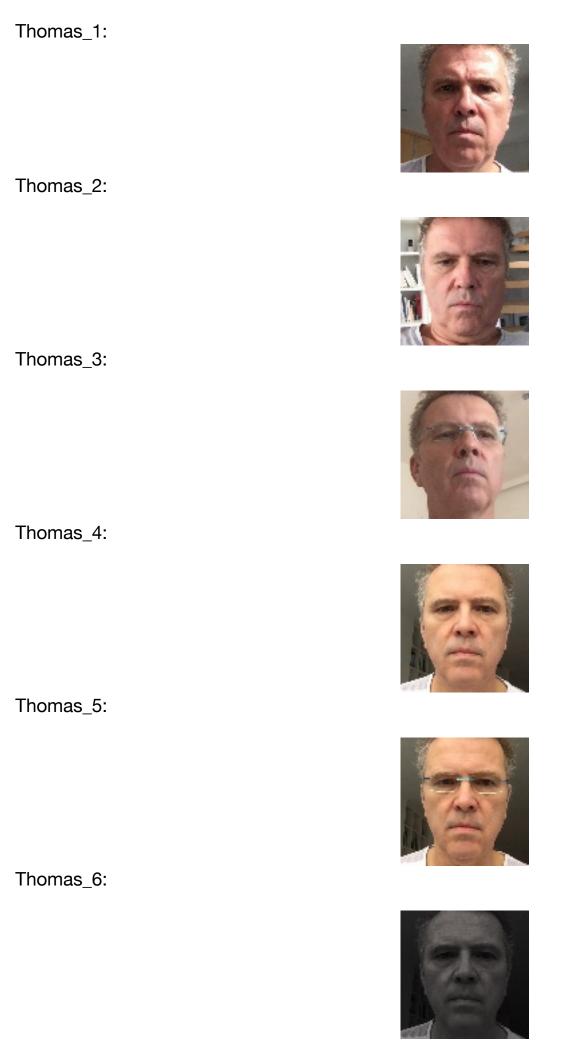


# Display distance between all images

## In [101]:

## ax = sns.heatmap(df\_dist,annot=True)

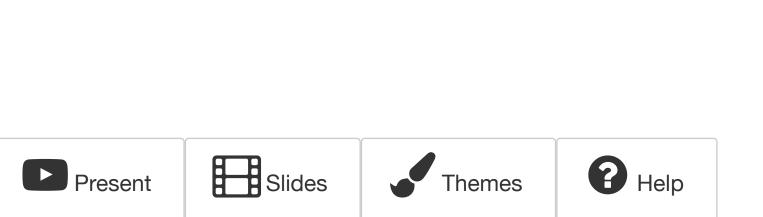
Angelina-Jolie	0	0.84	0.98	1	0.91	1.1	0.74	0.81	0.84	1.3	1.3	1.2	1.1	1.1	1.2	0.9	1.1	0.8		4.05
George-W-Bush	0.84	0	0.64	0.87	0.78	1	0.75	0.72	0.73	1.2	1.1	0.97	0.95	1.1	1		1.2			1.25
Allyson-Felix_1	0.98	0.64	0	0.72	0.76	0.94	0.69	0.88	0.7	0.89	0.77	0.92	0.77	0.78	0.96	0.82	1	0.83		
Allyson-Felix_3	1	0.87	0.72	0	0.62	0.75	1	0.99	0.77	1.1	0.94	0.8	1.1	0.85	0.9	0.89	0.85	0.77		
Allyson-Felix_2	0.91	0.78	0.76	0.62	0	0.62	0.9	0.7	0.54	1.2	0.97	0.8	1.1		0.91	0.92	0.85	0.88	-	1.00
torsten	1.1	1	0.94	0.75	0.62	0	1.1	0.94	0.81	1.1	0.78	0.69	1.3	0.74	0.66	0.95	0.71	0.85		
Allyson-Felix_5	0.74	0.75	0.69	1	0.9	1.1	0	0.73	0.71	1.1	1.2	1.1	0.72	1.1	1.1	0.79	1.2	0.85		
George-Lucas	0.81	0.72	0.88	0.99	0.7	0.94	0.73	0	0.76	1.3	1.2	1	1.1	1.2	1.1	1	1.1		_	0.75
Allyson-Felix_4	0.84	0.73	0.7	0.77	0.54	0.81	0.71	0.76	0	1.3	1	0.85	0.95	1	0.88	0.81	0.91	0.85		
mian	1.3	1.2	0.89	1.1	1.2	1.1	1.1	1.3	1.3	0	0.75	1.1		0.63	1.1	1.1	1.2	1.1		
steffen	1.3	1.1	0.77	0.94	0.97	0.78	1.2	1.2	1	0.75	0	0.88	1.1	0.63	0.9	1.1	1.1	1.1		
thomas_2	1.2	0.97	0.92	0.8	0.8	0.69	1.1	1	0.85	1.1	0.88	0	0.99	0.76	0.41	0.83	0.67	0.88	-	0.50
thomas_3	1.1	0.95	0.77	1.1	1.1	1.3	0.72	1.1	0.95		1.1	0.99	0	0.96	1	0.75	1.1	0.91		
hans-juergen	1.1	1.1	0.78	0.85		0.74	1.1	1.2	1	0.63	0.63	0.76	0.96	0	0.71	0.89	0.9	0.85		
thomas_1	1.2	1	0.96	0.9	0.91	0.66	1.1	1.1	0.88	1.1	0.9	0.41	1	0.71	0	0.8	0.65	0.85	_	0.25
thomas_4	0.9		0.82	0.89	0.92	0.95	0.79	1	0.81	1.1	1.1	0.83	0.75	0.89	8.0	0	0.58	0.36		
thomas_5	1.1	1.2	1	0.85	0.85	0.71	1.2	1.1	0.91	1.2	1.1	0.67	1.1	0.9	0.65	0.58	0	0.64		
thomas_6	0.8	1	0.83	0.77	0.88	0.85	0.85		0.85	1.1	1.1	0.88	0.91	0.85	0.85	0.36	0.64	0		0.00
	Angelina-Jolie	George-W-Bush	Allyson-Felix_1	Allyson-Felix_3	Allyson-Felix_2	torsten	Allyson-Felix_5	George-Lucas	Allyson-Felix_4	mian	steffen	thomas_2	thomas_3	hans-juergen	thomas_1	thomas_4	thomas_5	thomas_6		0.00



Note the rather low distance of thomas\_4 and thomas\_6. Thomas\_6 has been created from thomas\_4 by de-saturating and darkening the image.

Thomas\_4 and Thomas\_5 have been taken under same light conditions. Difference are the glasses. Glasses and just changes in brightness seem not have to high impact.

However, looking at thomas\_3 where the face is tilted upwards creates a large distance.



In [ ]: