FACE DATASET

March 22, 2017

In [1]:
```
from __future__ import print_function
%matplotlib inline
from time import time
import logging
import matplotlib.pyplot as plt
from sklearn.metrics import accuracy_score, roc_curve, auc
from sklearn.cross_validation import train_test_split
from sklearn.datasets import fetch_lfw_people
from sklearn.grid_search import GridSearchCV
from sklearn.metrics import classification_report
from sklearn.metrics import confusion_matrix
from sklearn.decomposition import RandomizedPCA
from sklearn.svm import SVC
print(__doc__)

# Display progress logs on stdout
logging.basicConfig(level=logging.INFO, format='%(asctime)s %(message)s')


###############################################################################
# Download the data, if not already on disk and load it as numpy arrays

lfw_people = fetch_lfw_people(min_faces_per_person=70, resize=0.4)

# introspect the images arrays to find the shapes (for plotting)
n_samples, h, w = lfw_people.images.shape

# for machine learning we use the 2 data directly (as relative pixel
# positions info is ignored by this model)
X = lfw_people.data
n_features = X.shape[1]

# the label to predict is the id of the person
y = lfw_people.target
target_names = lfw_people.target_names
n_classes = target_names.shape[0]

print("Total dataset size:")
```

```
        print("n_samples: %d" % n_samples)
        print("n_features: %d" % n_features)
        print("n_classes: %d" % n_classes)
        ##############################################################################
        # Split into a training set and a test set using a stratified k fold

        # split into a training and testing set
        X_train, X_test, y_train, y_test = train_test_split(
            X, y, test_size=0.25, random_state=42)
        ##############################################################################
        # Compute a PCA (eigenfaces) on the face dataset (treated as unlabeled
        # dataset): unsupervised feature extraction / dimensionality reduction
        n_components = 150
        print("Extracting the top %d eigenfaces from %d faces"
              % (n_components, X_train.shape[0]))
        t0 = time()
        pca = RandomizedPCA(n_components=n_components, whiten=True).fit(X_train)
        print("done in %0.3fs" % (time() - t0))
        eigenfaces = pca.components_.reshape((n_components, h, w))
        print("Projecting the input data on the eigenfaces orthonormal basis")
        t0 = time()
        X_train_pca = pca.transform(X_train)
        X_test_pca = pca.transform(X_test)
        print("done in %0.3fs" % (time() - t0))
```

```
/Library/Frameworks/Python.framework/Versions/3.6/lib/python3.6/site-packages/sklearn/cross_vali
  "This module will be removed in 0.20.", DeprecationWarning)
/Library/Frameworks/Python.framework/Versions/3.6/lib/python3.6/site-packages/sklearn/grid_searc
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2017-03-22 23:04:40,068 Loading LFW people faces from /Users/salemameen/scikit_learn_data/lfw_ho
/Library/Frameworks/Python.framework/Versions/3.6/lib/python3.6/site-packages/sklearn/utils/depr
  warnings.warn(msg, category=DeprecationWarning)


Automatically created module for IPython interactive environment
Total dataset size:
n_samples: 1288
n_features: 1850
n_classes: 7
Extracting the top 150 eigenfaces from 966 faces
done in 0.157s
Projecting the input data on the eigenfaces orthonormal basis
done in 0.023s
```

```
In [2]: ##############################################################################
        # Qualitative evaluation of the predictions using matplotlib
        def plot_gallery(images, titles, h, w, n_row=3, n_col=4):
```

```
        """Helper function to plot a gallery of portraits"""
        plt.figure(figsize=(1.8 * n_col, 2.4 * n_row))
        plt.subplots_adjust(bottom=0, left=.01, right=.99, top=.90, hspace=.35)
        for i in range(n_row * n_col):
            plt.subplot(n_row, n_col, i + 1)
            plt.imshow(images[i].reshape((h, w)), cmap=plt.cm.gray)
            plt.title(titles[i], size=12)
            plt.xticks(())
            plt.yticks(())
    # plot the result of the prediction on a portion of the test set
    def title(y_pred, y_test, target_names, i):
        pred_name = target_names[y_pred[i]].rsplit(' ', 1)[-1]
        true_name = target_names[y_test[i]].rsplit(' ', 1)[-1]
        return 'predicted: %s\ntrue:      %s' % (pred_name, true_name)
```

In [3]:
```
from bokeh.layouts import row, gridplot
from bokeh.plotting import figure, output_notebook, show
from bokeh.models import Legend

##############################################################################################
TOOLS = 'box_zoom,box_select,crosshair,resize,reset,lasso_select,pan,save,poly_select,ta
output_notebook()
```

0.1 Neural Networks classifier

In [4]:
```
import seaborn as sns
import time
import numpy as np
from sklearn.cross_validation import train_test_split
from keras.models import Sequential
from keras.layers import Dense, Dropout
from keras.regularizers import l2

from keras.utils import np_utils
```

```
Using Theano backend.
```

In [5]:
```
labelsTrain = np_utils.to_categorical(y_train)
labelsTest = np_utils.to_categorical(y_test)

model = Sequential()
model.add(Dense(300,
                input_shape=(150,),
                activation="relu"))
model.add(Dropout(0.5))
model.add(Dense(7, activation="softmax"))

model.compile(loss='categorical_crossentropy',
```

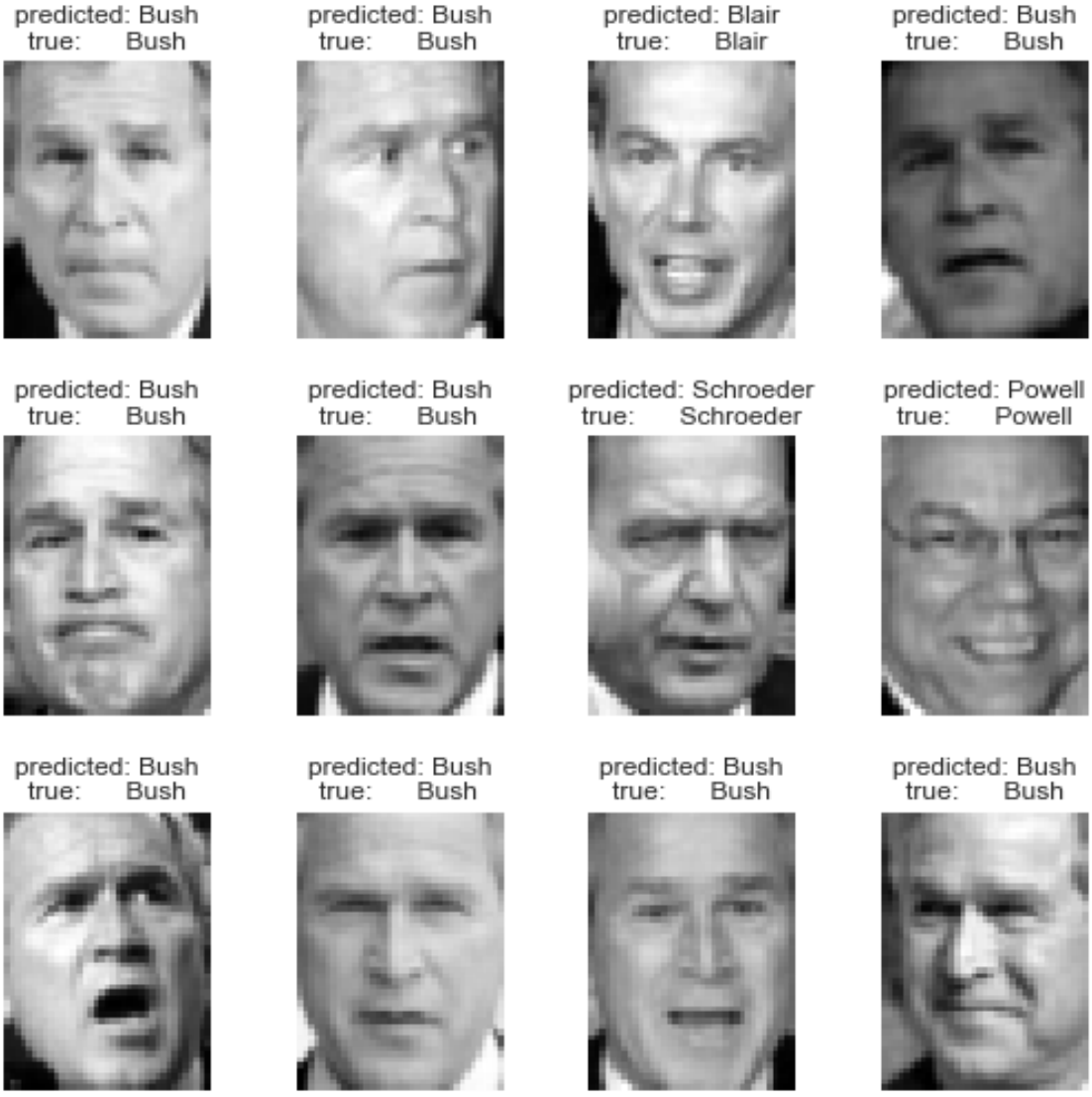
```
                    metrics=['accuracy'],
                    optimizer='adam')
        # Actual modelling
        start_time = time.time()
        model.fit(X_train_pca, labelsTrain, verbose=0, batch_size=100, nb_epoch=100)
        print("The time for training NN is  %s seconds " % (time.time() - start_time))
        score, accuracy = model.evaluate(X_test_pca, labelsTest, batch_size=100, verbose=0)
        print("Test fraction correct (NN-Score) = {:.2f}".format(score))
        print("Test fraction correct (NN-Accuracy) = {:.2f}".format(accuracy))
```

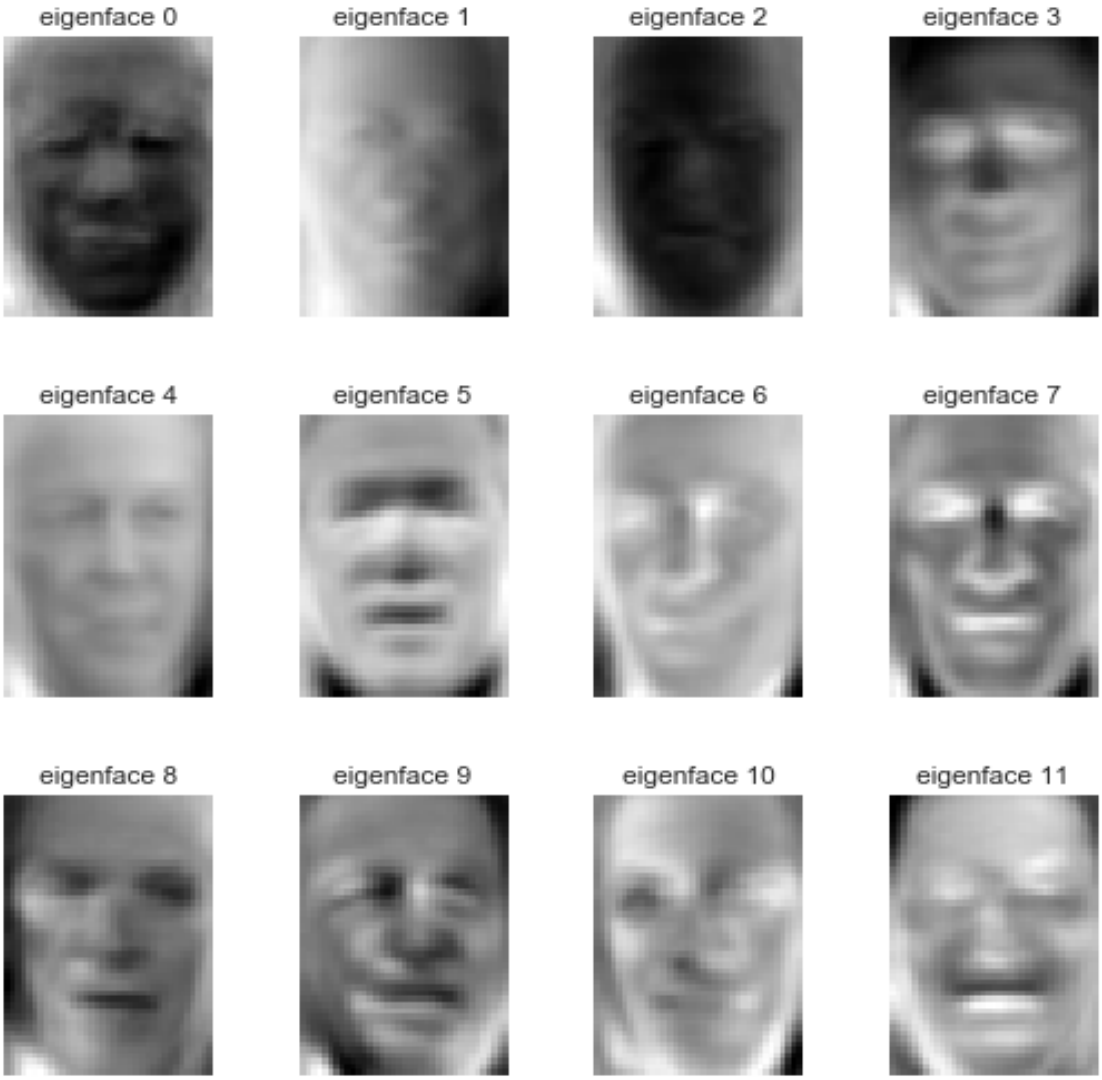
```
The time for training NN is  3.562169075012207 seconds
Test fraction correct (NN-Score) = 0.64
Test fraction correct (NN-Accuracy) = 0.87
```

In [6]:
```
        ################################################################################
        # Quantitative evaluation of the model quality on the test set
        from time import time
        print("Predicting people's names on the test set")
        t0 = time()
        y_pred = model.predict_classes(X_test_pca)
        y_pred_NN = y_pred
        print("done in %0.3fs" % (time() - t0))

        print(classification_report(y_test, y_pred, target_names=target_names))
        print(confusion_matrix(y_test, y_pred, labels=range(n_classes)))

        prediction_titles = [title(y_pred, y_test, target_names, i)
                             for i in range(y_pred.shape[0])]

        plot_gallery(X_test, prediction_titles, h, w)

        # plot the gallery of the most significative eigenfaces
        eigenface_titles = ["eigenface %d" % i for i in range(eigenfaces.shape[0])]
        plot_gallery(eigenfaces, eigenface_titles, h, w)

        plt.show()
```

```
Predicting people's names on the test set
 32/322 [=>...] - ETA: 0sdone in 0.080s
                   precision    recall  f1-score   support

     Ariel Sharon       0.82      0.69      0.75        13
     Colin Powell       0.80      0.87      0.83        60
  Donald Rumsfeld       0.81      0.78      0.79        27
    George W Bush       0.92      0.96      0.94       146
Gerhard Schroeder       0.81      0.84      0.82        25
      Hugo Chavez       0.90      0.60      0.72        15
```

```
       Tony Blair       0.84      0.75      0.79        36

      avg / total       0.87      0.87      0.86       322

[[  9   1   2   0   0   0   1]
 [  2  52   0   3   0   1   2]
 [  0   2  21   3   1   0   0]
 [  0   4   2 140   0   0   0]
 [  0   2   0   1  21   0   1]
 [  0   3   0   1   1   9   1]
 [  0   1   1   4   3   0  27]]
```





import sys path = ’./face/’ sys.path.append("./face") model.save_weights(’faceModelbest.hdf5’,overwrite=Tr

1 Multi Armed Bandit

```
In [7]: import sys
        #execfile("/Users/salemameen/Desktop/banditsbook/python_face/core.py")
        exec(open("core.py").read())  # pyhton 3x
```

1.1 Run UCB1 pruning Algorithm

```
In [8]: algo = UCB1([], [])
        Alg_name = 'UCB1 Algorithm'
        path = './UCB1/'
```

```
        sys.path.append("./UCB1")
        exec(open("mnist_cnnFORTESTING.py").read())
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Test fraction correct (NN-Score) = 0.96
Test fraction correct (NN-Accuracy) = 0.80
The time for running this method is 2.354188919067383 seconds
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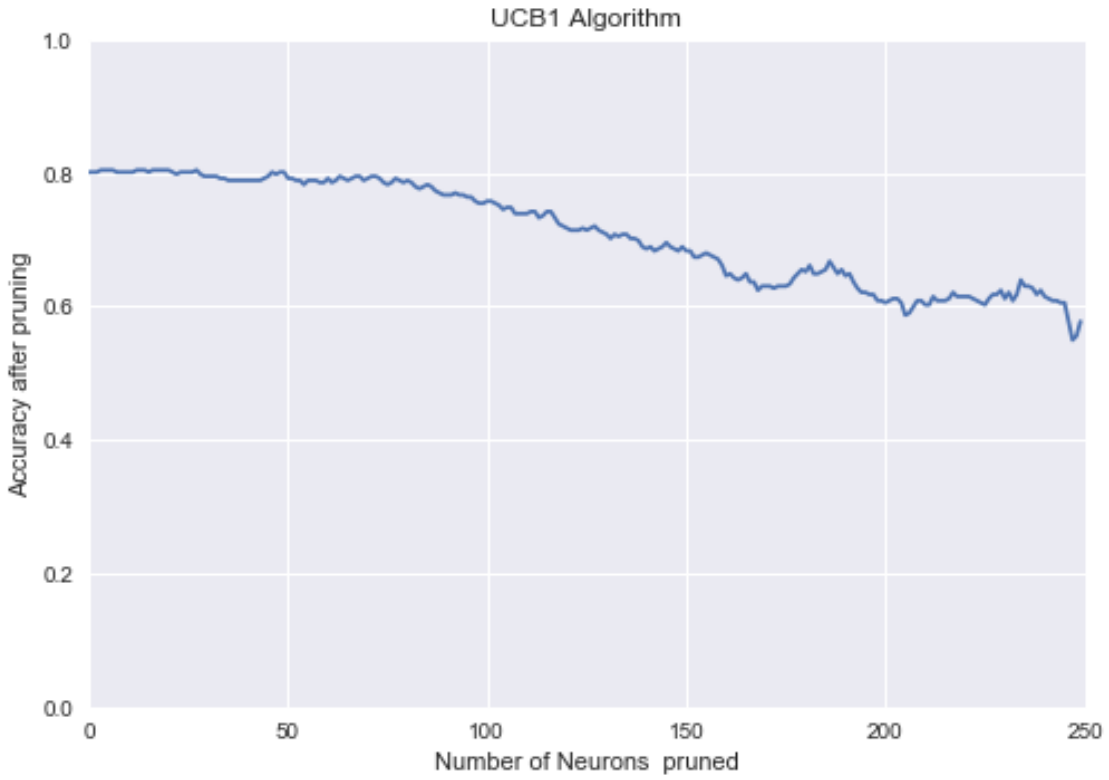

1.2 Run epsilon greedy pruning Algorithm

```
In [9]: epsilon = 0.9 # epsilon = (0,1)
        algo = EpsilonGreedy(epsilon, [], [])
```

```
        Alg_name = 'Epsilon Greedy Algorithm'
        path = './EpsilonGreedy/'
        sys.path.append("./AnnealingEpsilonGreedy")
        exec(open("mnist_cnnFORTESTING.py").read())
```

```
Test fraction correct (NN-Score) = 0.96
Test fraction correct (NN-Accuracy) = 0.80
The time for running this method is 2.2120320796966553 seconds
Finsh playing start pruining:
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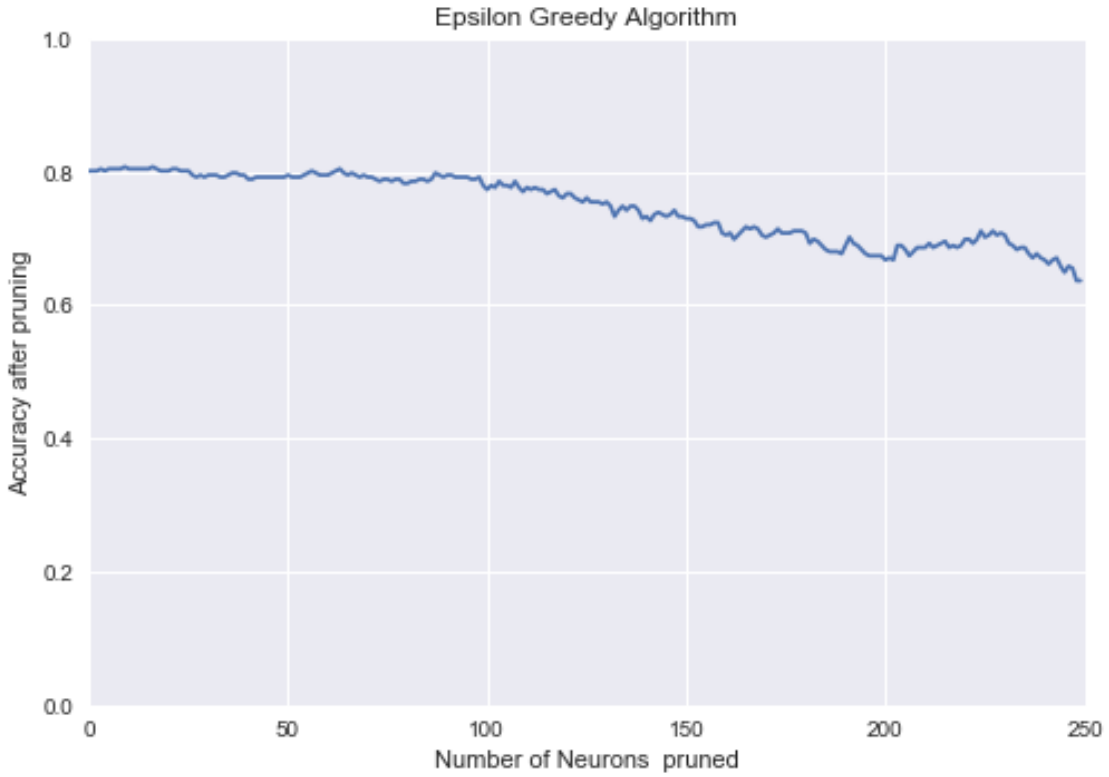

1.3 Run decay epsilon greedy pruning Algorithm

```
In [10]: algo = AnnealingEpsilonGreedy([], [])
         Alg_name = 'Annealing Epsilon Greedy Algorithm'
         path = './AnnealingEpsilonGreedy/'
         sys.path.append("./AnnealingEpsilonGreedy")
         exec(open("mnist_cnnFORTESTING.py").read())
```

```
Test fraction correct (NN-Score) = 0.96
Test fraction correct (NN-Accuracy) = 0.80
The time for running this method is 2.380237102508545 seconds
Finsh playing start pruining:
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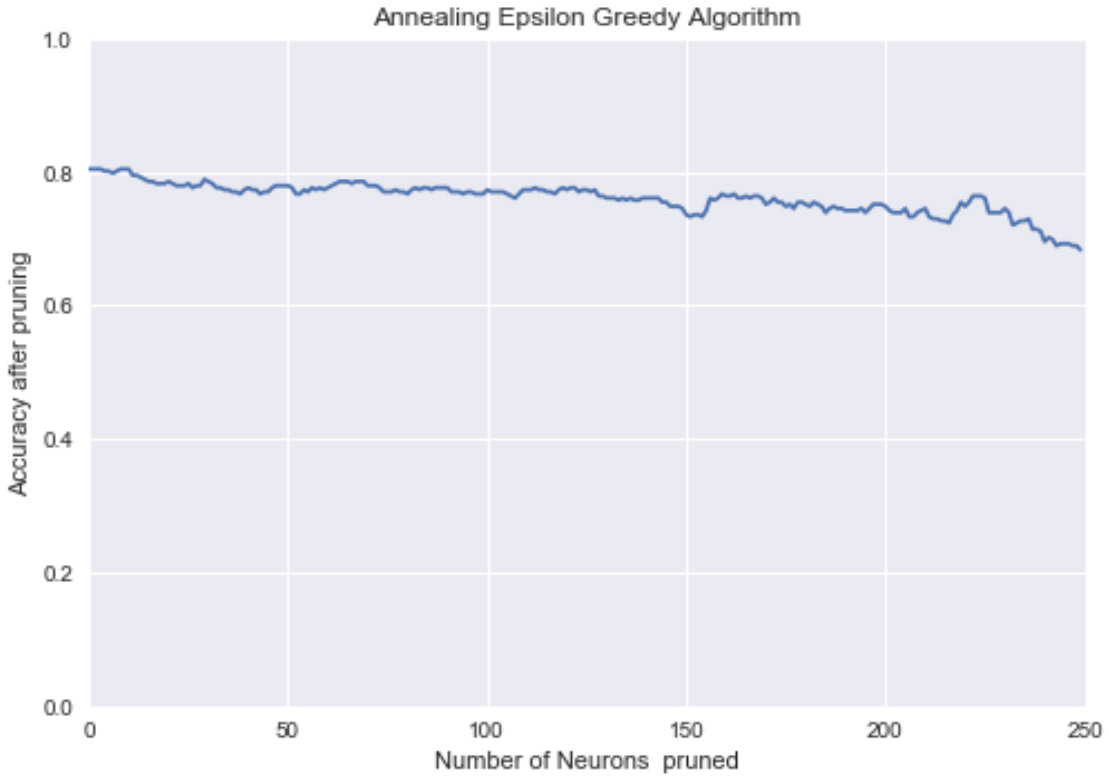

1.4 Run softmax pruning Algorithm

```
In [11]: temperature = 0.9
         algo = Softmax(temperature, [], [])
         Alg_name = 'Softmax Algorithm'
         path = './Softmax/'
         sys.path.append("./Softmax")
         exec(open("mnist_cnnFORTESTING.py").read())
```

```
Test fraction correct (NN-Score) = 0.96
Test fraction correct (NN-Accuracy) = 0.80
The time for running this method is 2.4838831424713135 seconds
Finsh playing start pruining:
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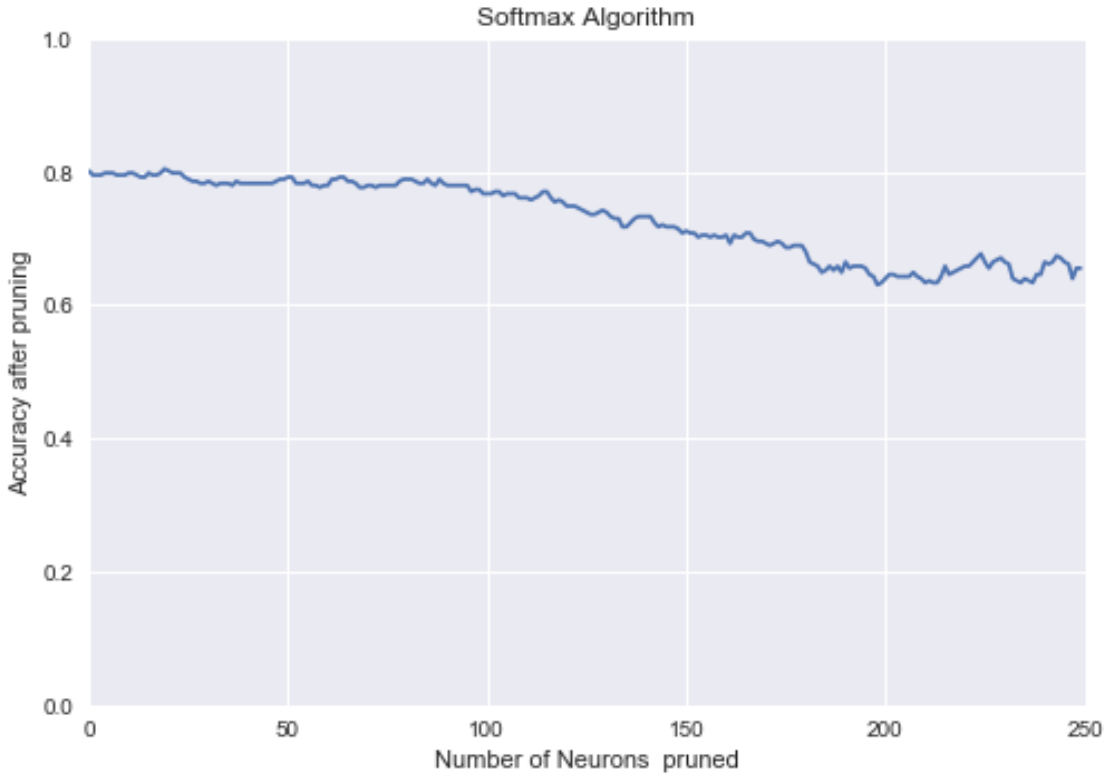

1.5 Run Decay softmax pruning Algorithm

In [12]:
```python
algo = AnnealingSoftmax([], [])
Alg_name = 'Annealing Softmax Algorithm'
path = './AnnealingSoftmax/'
sys.path.append("./AnnealingSoftmax")
exec(open("mnist_cnnFORTESTING.py").read())
```

```
Test fraction correct (NN-Score) = 0.96
Test fraction correct (NN-Accuracy) = 0.80
The time for running this method is 2.429738998413086 seconds
Finsh playing start pruining:
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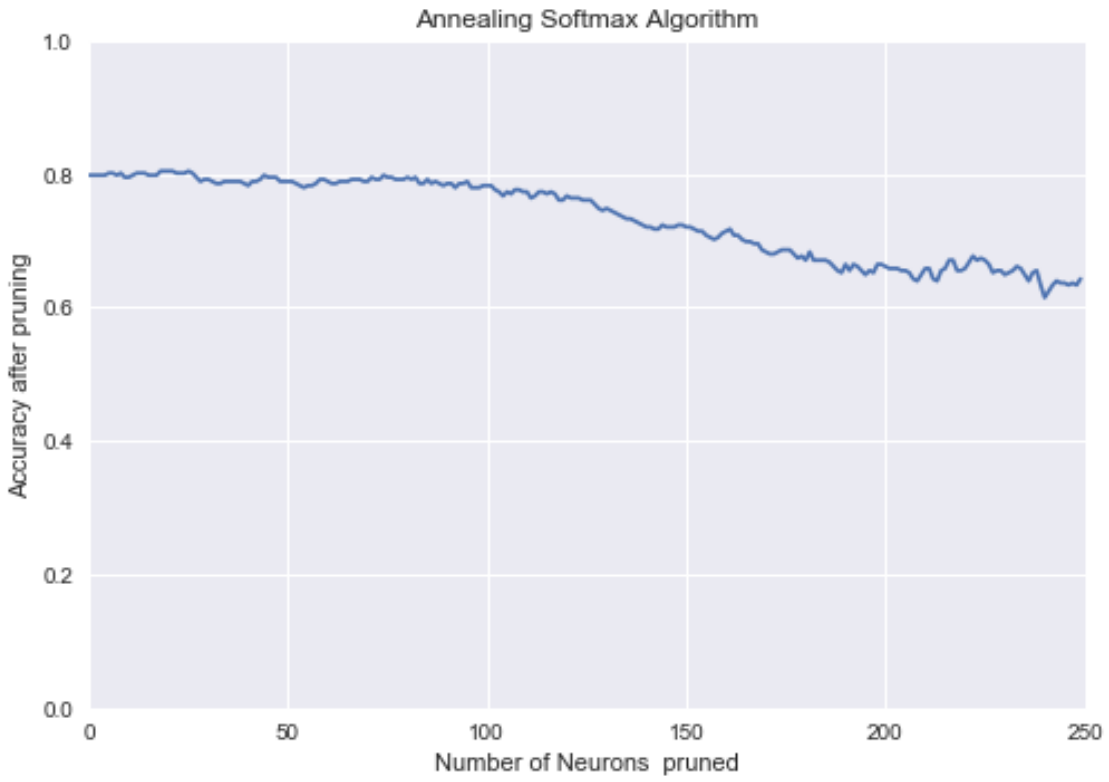

1.6 Run thompson sampling pruning Algorithm

```
In [13]: algo = Thompson_Sampling([], [])
         Alg_name = 'Thompson_Sampling Algorithm'
         path = './Thompson_Sampling/'
         sys.path.append("./Thompson_Sampling")
         exec(open("mnist_cnnFORTESTING.py").read())
```

```
Test fraction correct (NN-Score) = 0.96
Test fraction correct (NN-Accuracy) = 0.80
The time for running this method is 2.5475471019744873 seconds
Finsh playing start pruining:
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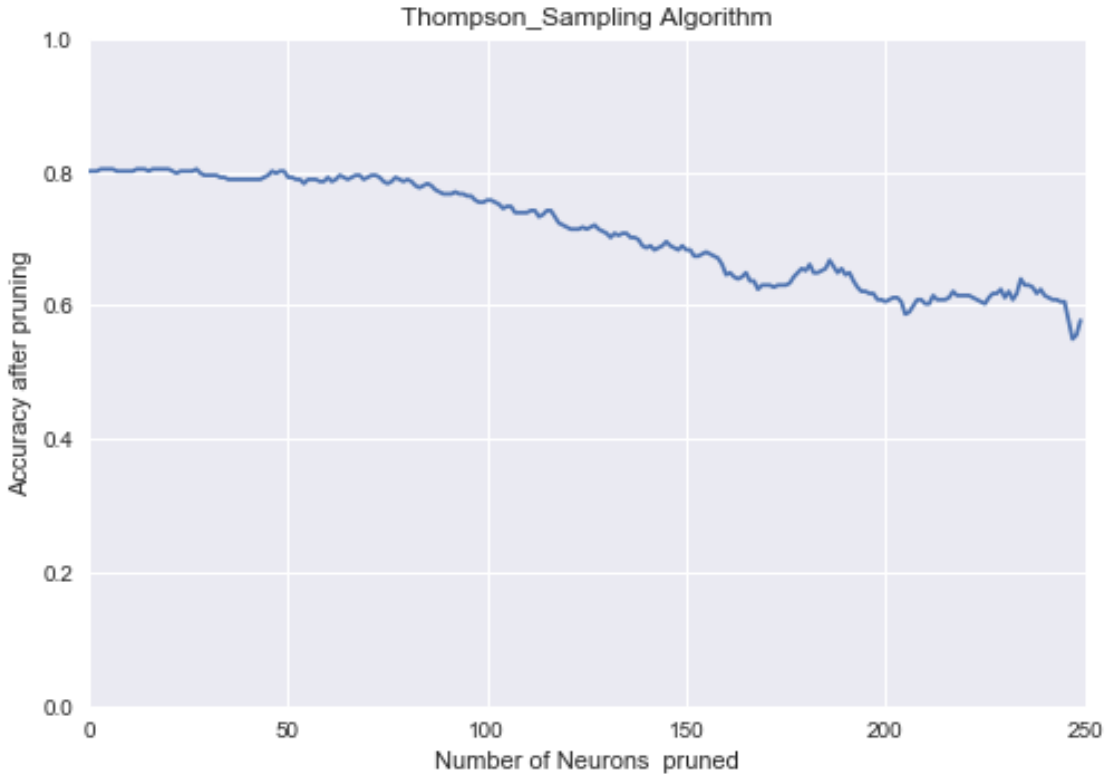

1.7 Run Hedge pruning Algorithm

```
In [14]: eta = 0.9  # eta in [.5, .8, .9, 1, 2]
         algo = Hedge(eta, [], [])
         Alg_name = 'Hedge Algorithm'
         path = './Hedge/'
         sys.path.append("./Hedge")
         exec(open("mnist_cnnFORTESTING.py").read())
```

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Test fraction correct (NN-Score) = 0.96
Test fraction correct (NN-Accuracy) = 0.80
The time for running this method is 2.3185689449310303 seconds
Finsh playing start pruining:
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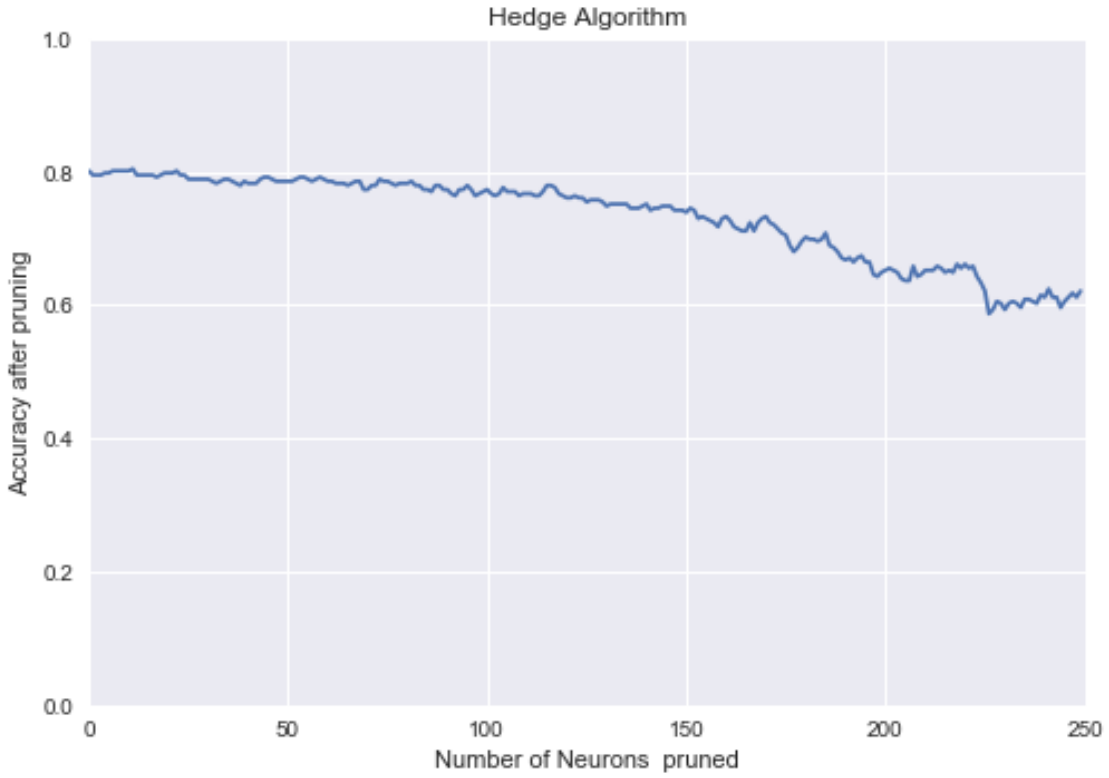

1.8 Run EXP3 pruning Algorithm

```
In [15]: exp3_gamma = 0.2 #exp3_gamma in [0.1, 0.2, 0.3, 0.4, 0.5]
         algo = Exp3(exp3_gamma, [])
         Alg_name = 'Exp3 Algorithm'
         path = './Exp3/'
         sys.path.append("./EpsilonGreedy")
         exec(open("mnist_cnnFORTESTING.py").read())
```

```
Test fraction correct (NN-Score) = 0.96
Test fraction correct (NN-Accuracy) = 0.80
The time for running this method is 2.4208500385284424 seconds
Finsh playing start pruining:
Test after pruning= 0.80
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Test after pruning= 0.72
Test after pruning= 0.72
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Test after pruning= 0.73
Test after pruning= 0.74
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Test after pruning= 0.73
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Test after pruning= 0.73
Test after pruning= 0.73
Test after pruning= 0.72
Test after pruning= 0.71
Test after pruning= 0.71
Test after pruning= 0.70
Test after pruning= 0.71
Test after pruning= 0.70
Test after pruning= 0.70
Test after pruning= 0.70
Test after pruning= 0.71
Test after pruning= 0.69
Test after pruning= 0.69
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Test after pruning= 0.70
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Test after pruning= 0.70
Test after pruning= 0.70
Test after pruning= 0.71
Test after pruning= 0.70
Test after pruning= 0.69
Test after pruning= 0.68
Test after pruning= 0.67
Test after pruning= 0.67
Test after pruning= 0.67
Test after pruning= 0.67
Test after pruning= 0.67
Test after pruning= 0.67
Test after pruning= 0.67
Test after pruning= 0.69
Test after pruning= 0.69
```

```
Test after pruning= 0.67
Test after pruning= 0.66
Test after pruning= 0.65
Test after pruning= 0.66
Test after pruning= 0.66
Test after pruning= 0.66
Test after pruning= 0.66
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Test after pruning= 0.62
Test after pruning= 0.61
Test after pruning= 0.63
Test after pruning= 0.63
Test after pruning= 0.64
Test after pruning= 0.63
Test after pruning= 0.62
Test after pruning= 0.62
```

```
Test after pruning= 0.62
Test after pruning= 0.63
Test after pruning= 0.63
Test after pruning= 0.63
Test after pruning= 0.62
Test after pruning= 0.61
Test after pruning= 0.61
Test after pruning= 0.61
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Test after pruning= 0.59
Test after pruning= 0.61
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.61
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.61
Test after pruning= 0.60
Test after pruning= 0.61
Test after pruning= 0.61
```
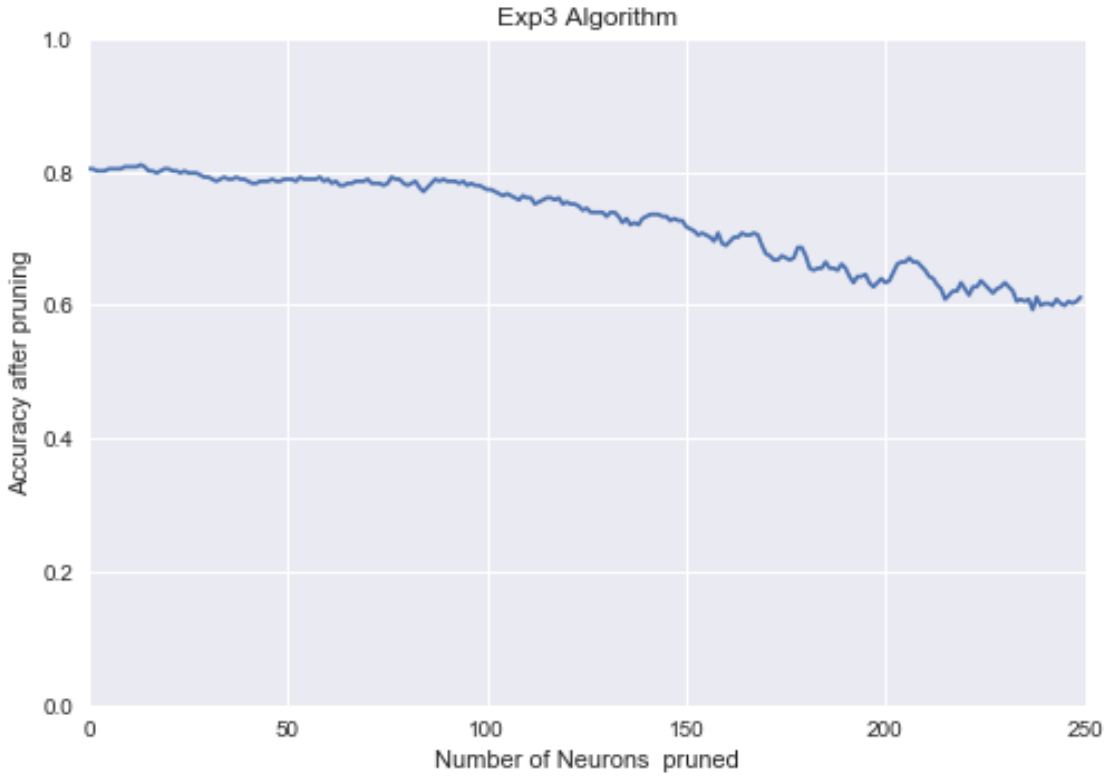
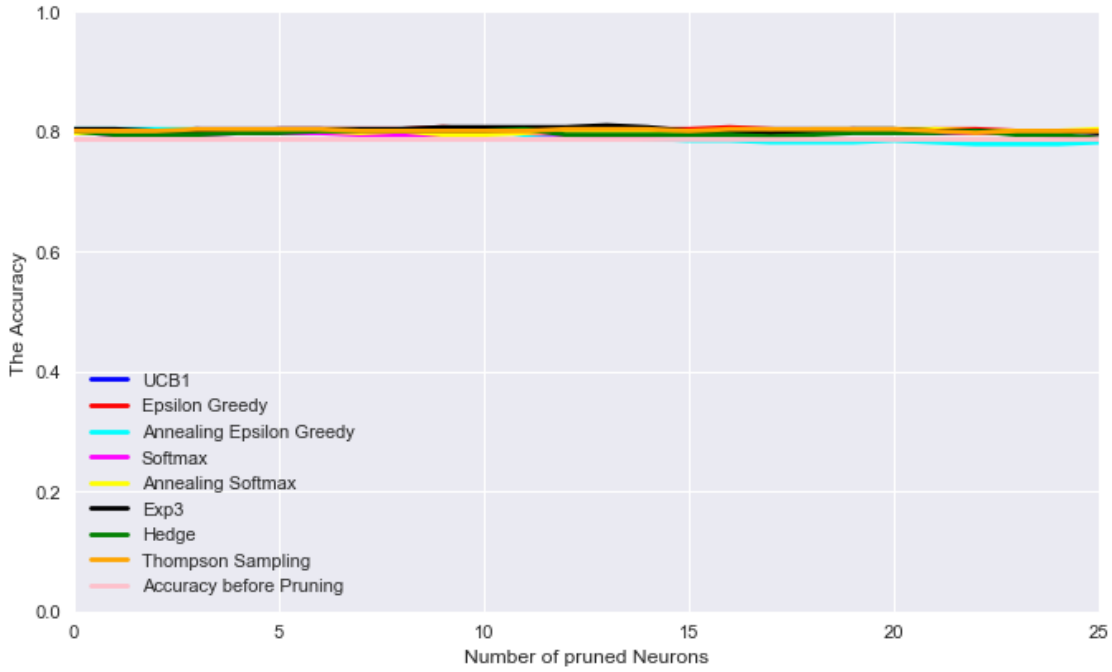



2 Compare the accuracy of the models

```
In [16]: ucb1 = np.load('./UCB1/AccuracyAftrerPrune.npy')
         EpsilonGreedy = np.load('./EpsilonGreedy/AccuracyAftrerPrune.npy')
         AnnealingEpsilonGreedy = np.load('./AnnealingEpsilonGreedy/AccuracyAftrerPrune.npy')
         Softmax = np.load('./Softmax/AccuracyAftrerPrune.npy')
         AnnealingSoftmax = np.load('./AnnealingSoftmax/AccuracyAftrerPrune.npy')
         Exp3 = np.load('./Exp3/AccuracyAftrerPrune.npy')
         Hedge = np.load('./Hedge/AccuracyAftrerPrune.npy')
         ThompsonSampling = np.load('./Thompson_Sampling/AccuracyAftrerPrune.npy')
         Accuracy = np.load('AccuracyBeforePruning.npy')
```

2.1 Comparing All algorithms with the model before pruning

```
In [17]: fig = plt.figure(figsize=(10, 6), dpi=80)
         ax = fig.add_subplot(111)
         N = len(ucb1)
         Acc = [Accuracy for col in range(N)]
         ## necessary variables
         ind = np.arange(N)                # the x locations for the groups
         plt.plot(ind , ucb1 , color="blue", linewidth=2.5, linestyle="-", label="UCB1")
         plt.plot(ind , EpsilonGreedy, color="red", linewidth=2.5, linestyle="-", label="Epsilon
         plt.plot(ind , AnnealingEpsilonGreedy, color="cyan", linewidth=2.5, linestyle="-", labe
         plt.plot(ind , Softmax, color="magenta", linewidth=2.5, linestyle="-", label="Softmax")
         plt.plot(ind , AnnealingSoftmax, color="yellow", linewidth=2.5, linestyle="-", label="A
         plt.plot(ind , Exp3, color="black", linewidth=2.5, linestyle="-", label="Exp3")
         plt.plot(ind , Hedge, color="green", linewidth=2.5, linestyle="-", label="Hedge")
         plt.plot(ind , ThompsonSampling, color="orange", linewidth=2.5, linestyle="-", label="T
         plt.plot(ind , Acc, color="pink", linewidth=2.5, linestyle="-", label="Accuracy before
         plt.legend(loc = 3)
         plt.axis([0, 25, 0, 1])
         plt.xlabel('Number of pruned Neurons')
         plt.ylabel('The Accuracy')
         plt.grid(True)
         plt.show()
```

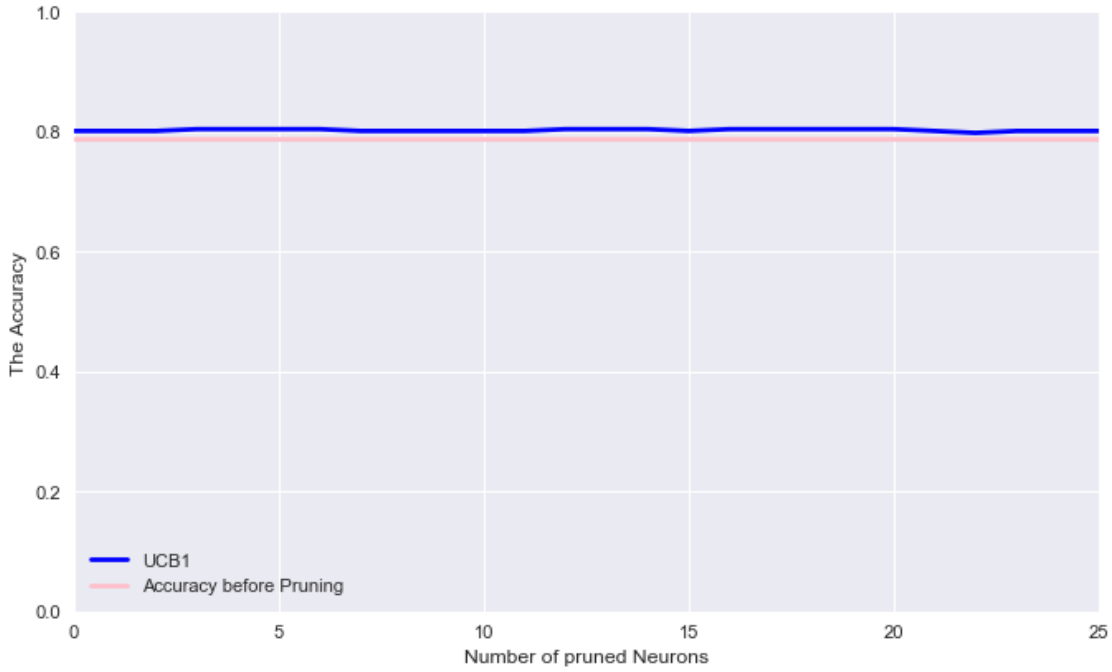


In [18]:
```
p1 = figure(title="The Performance over the number of neurons' pruned", tools=TOOLS)


#p1.circle(ind, ucb1, legend="ucb1", color="orange")
p1.line(ind, ucb1, legend="ucb1", line_color="orange", line_width=2)

#p1.square(ind, EpsilonGreedy, legend="Epsilon Greedy", fill_color=None, line_color="re
p1.line(ind, EpsilonGreedy, legend="Epsilon Greedy", line_color="red", line_width=2)

#p1.ellipse(ind, AnnealingEpsilonGreedy, legend="Annealing Epsilon Greedy", line_color=
p1.line(ind, AnnealingEpsilonGreedy, legend="Annealing Epsilon Greedy", line_color="blu

#p1.diamond(ind, Softmax, legend="Softmax", line_color="green")
p1.line(ind, Softmax, legend="Softmax", line_color="green", line_width=2)

#p1.arc(ind, AnnealingSoftmax, legend="Annealing Softmax", line_color="grey", end_angle
p1.line(ind, AnnealingSoftmax, legend="Annealing Softmax", line_color="grey", line_widt

#p1.oval(ind, Exp3, legend="Exp3", line_color="black", height=0.01, width=0.01)
p1.line(ind, Exp3, legend="Exp3", line_color="black", line_width=2)

#p1.arc(ind, Hedge, legend="Hedge", line_color="yellow")
#p1.triangle(ind, Hedge, legend="Hedge", line_color="yellow")
p1.line(ind, Hedge, legend="Hedge", line_color="yellow", line_width=2)
```

```
#p1.square_cross(ind, ThompsonSampling, legend="Thompson Sampling", line_color="pink")
p1.line(ind, ThompsonSampling, legend="Thompson Sampling", line_color="pink", line_widt


p1.line(ind, Acc, legend="Accuracy", line_dash=(4, 4), line_color="orange", line_width=
#p1.square(ind, Hedge, legend="3*sin(x)", fill_color=None, line_color="brown")
p1.title.align = "center"


show(p1)
#show(gridplot(p1, p2, ncols=2, plot_width=400, plot_height=400))  # open a browser
```

2.2 UCB1

In [19]:
```
fig = plt.figure(figsize=(10, 6), dpi=80)
ax = fig.add_subplot(111)
N = len(ucb1)
Acc = [Accuracy for col in range(N)]
## necessary variables
ind = np.arange(N)                # the x locations for the groups
plt.plot(ind , ucb1 , color="blue", linewidth=2.5, linestyle="-", label="UCB1")
plt.plot(ind , Acc, color="pink", linewidth=2.5, linestyle="-", label="Accuracy before
plt.legend(loc = 3)
plt.axis([0, 25, 0, 1])
plt.xlabel('Number of pruned Neurons')
plt.ylabel('The Accuracy')
plt.grid(True)
plt.show()
```

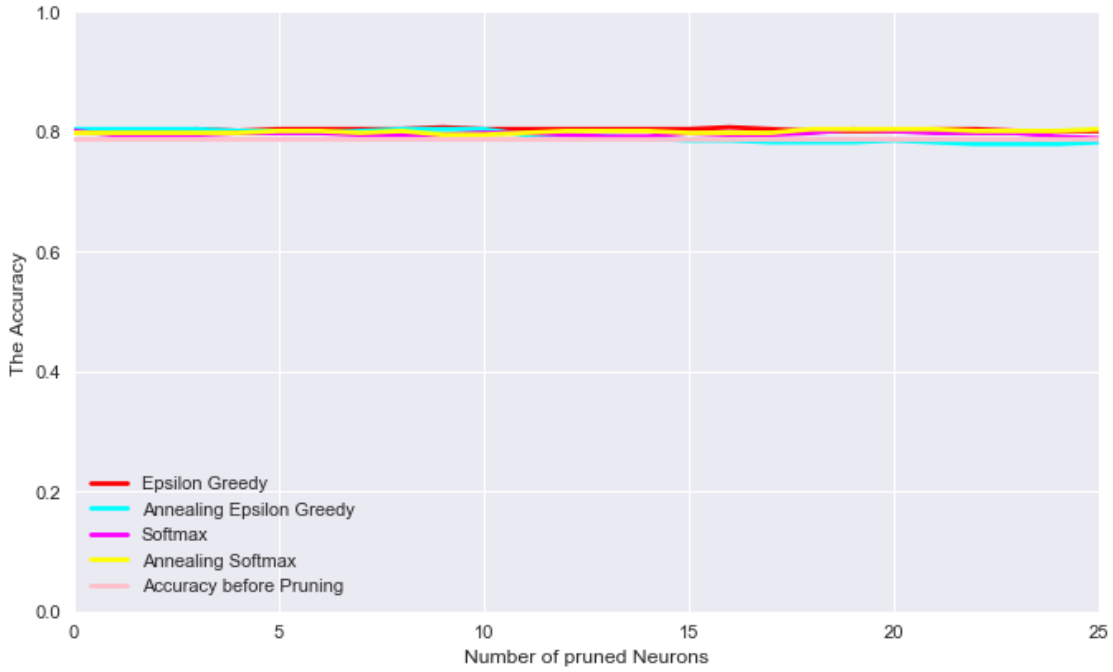



```
In [20]: p1 = figure(title="The Performance over the number of neurons' pruned", tools=TOOLS)


         #p1.circle(ind, ucb1, legend="ucb1", color="orange")
         p1.line(ind, ucb1, legend="ucb1", line_color="orange", line_width=2)
         p1.line(ind, Acc, legend="Accuracy", line_dash=(4, 4), line_color="orange", line_width=
         #p1.square(ind, Hedge, legend="3*sin(x)", fill_color=None, line_color="brown")
         p1.title.align = "center"


         show(p1)
         #show(gridplot(p1, p2, ncols=2, plot_width=400, plot_height=400))  # open a brow
```

2.3 Epsilon greedy and Softmax

```
In [21]: fig = plt.figure(figsize=(10, 6), dpi=80)
         ax = fig.add_subplot(111)
         N = len(EpsilonGreedy)
         Acc = [Accuracy for col in range(N)]
         ## necessary variables
         ind = np.arange(N)                # the x locations for the groups
         plt.plot(ind , EpsilonGreedy, color="red", linewidth=2.5, linestyle="-", label="Epsilon
         plt.plot(ind , AnnealingEpsilonGreedy, color="cyan", linewidth=2.5, linestyle="-", labe
         plt.plot(ind , Softmax, color="magenta", linewidth=2.5, linestyle="-", label="Softmax")
         plt.plot(ind , AnnealingSoftmax, color="yellow", linewidth=2.5, linestyle="-", label="A
```

```
plt.plot(ind , Acc, color="pink", linewidth=2.5, linestyle="-", label="Accuracy before
plt.legend(loc = 3)
plt.axis([0, 25, 0, 1])
plt.xlabel('Number of pruned Neurons')
plt.ylabel('The Accuracy')
plt.grid(True)
plt.show()
```

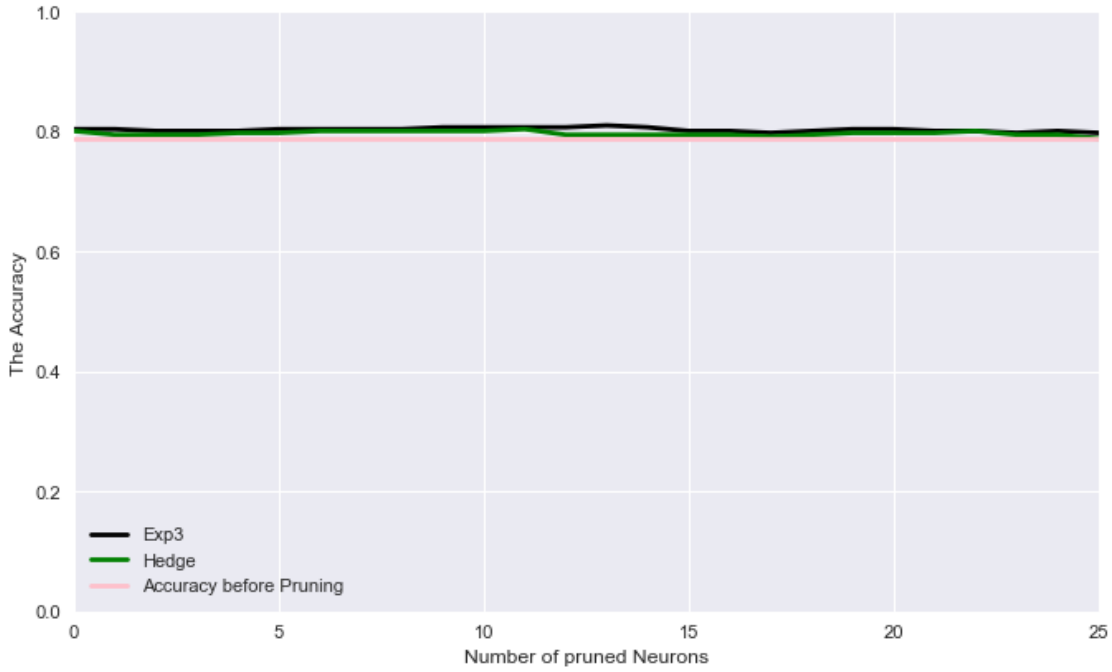


In [22]:
```
p1 = figure(title="The Performance over the number of neurons' pruned", tools=TOOLS)


#p1.square(ind, EpsilonGreedy, legend="Epsilon Greedy", fill_color=None, line_color="re
p1.line(ind, EpsilonGreedy, legend="Epsilon Greedy", line_color="red", line_width=2)

#p1.ellipse(ind, AnnealingEpsilonGreedy, legend="Annealing Epsilon Greedy", line_color=
p1.line(ind, AnnealingEpsilonGreedy, legend="Annealing Epsilon Greedy", line_color="blu

#p1.diamond(ind, Softmax, legend="Softmax", line_color="green")
p1.line(ind, Softmax, legend="Softmax", line_color="green", line_width=2)

#p1.arc(ind, AnnealingSoftmax, legend="Annealing Softmax", line_color="grey", end_angle
p1.line(ind, AnnealingSoftmax, legend="Annealing Softmax", line_color="grey", line_widt

p1.line(ind, Acc, legend="Accuracy", line_dash=(4, 4), line_color="orange", line_width=
#p1.square(ind, Hedge, legend="3*sin(x)", fill_color=None, line_color="brown")
```

```
p1.title.align = "center"


show(p1)
#show(gridplot(p1, p2, ncols=2, plot_width=400, plot_height=400))  # open a browser
```

2.4 Adversial Bandits Hedge and EXP3

In [23]:
```
fig = plt.figure(figsize=(10, 6), dpi=80)
ax = fig.add_subplot(111)
N = len(Exp3)
Acc = [Accuracy for col in range(N)]
## necessary variables
ind = np.arange(N)                # the x locations for the groups
plt.plot(ind , Exp3, color="black", linewidth=2.5, linestyle="-", label="Exp3")
plt.plot(ind , Hedge, color="green", linewidth=2.5, linestyle="-", label="Hedge")
plt.plot(ind , Acc, color="pink", linewidth=2.5, linestyle="-", label="Accuracy before
plt.legend(loc = 3)
plt.axis([0, 25, 0, 1])
plt.xlabel('Number of pruned Neurons')
plt.ylabel('The Accuracy')
plt.grid(True)
plt.show()
```

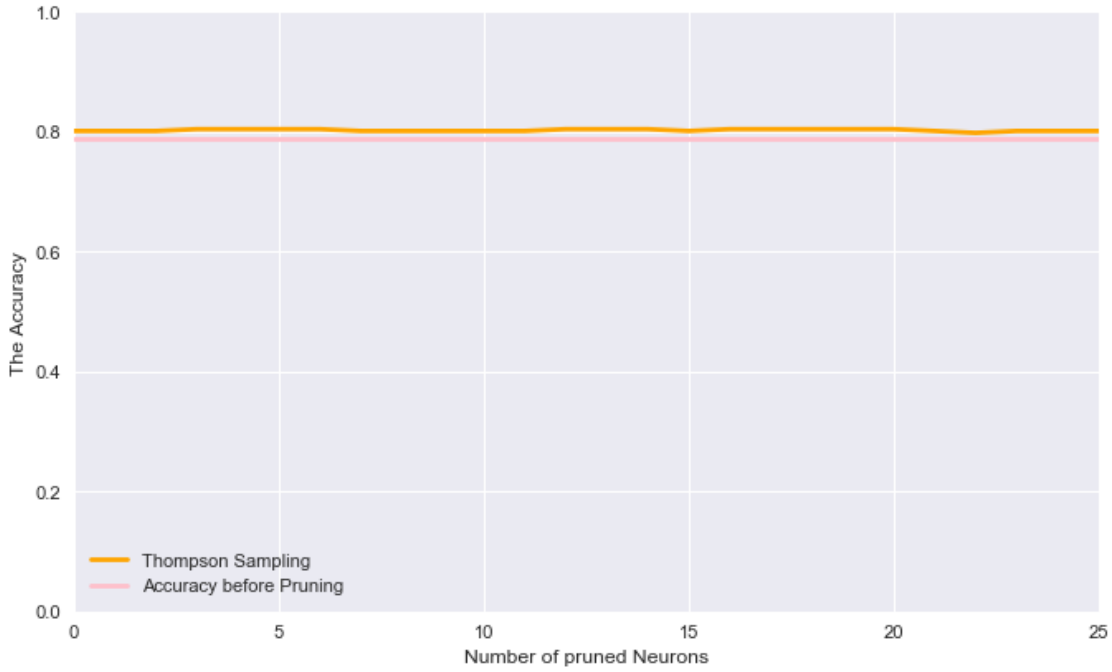


In [24]:
```
p1 = figure(title="The Performance over the number of neurons' pruned", tools=TOOLS)
```

```
#p1.oval(ind, Exp3, legend="Exp3", line_color="black", height=0.01, width=0.01)
p1.line(ind, Exp3, legend="Exp3", line_color="black", line_width=2)

#p1.arc(ind, Hedge, legend="Hedge", line_color="yellow")
#p1.triangle(ind, Hedge, legend="Hedge", line_color="yellow")
p1.line(ind, Hedge, legend="Hedge", line_color="yellow", line_width=2)

p1.line(ind, Acc, legend="Accuracy", line_dash=(4, 4), line_color="orange", line_width=
#p1.square(ind, Hedge, legend="3*sin(x)", fill_color=None, line_color="brown")
p1.title.align = "center"


show(p1)
#show(gridplot(p1, p2, ncols=2, plot_width=400, plot_height=400))  # open a browser
```

2.5 Thompson Sampling

In [25]:
```
fig = plt.figure(figsize=(10, 6), dpi=80)
ax = fig.add_subplot(111)
N = len(ThompsonSampling)
Acc = [Accuracy for col in range(N)]
## necessary variables
ind = np.arange(N)                # the x locations for the groups
plt.plot(ind , ThompsonSampling, color="orange", linewidth=2.5, linestyle="-", label="T
plt.plot(ind , Acc, color="pink", linewidth=2.5, linestyle="-", label="Accuracy before
plt.legend(loc = 3)
plt.axis([0, 25, 0, 1])
plt.xlabel('Number of pruned Neurons')
plt.ylabel('The Accuracy')
plt.grid(True)
plt.show()
```



In [26]:
```
p1 = figure(title="The Performance over the number of neurons' pruned", tools=TOOLS)

#p1.square_cross(ind, ThompsonSampling, legend="Thompson Sampling", line_color="pink")
p1.line(ind, ThompsonSampling, legend="Thompson Sampling", line_color="pink", line_widt


p1.line(ind, Acc, legend="Accuracy", line_dash=(4, 4), line_color="orange", line_width=
#p1.square(ind, Hedge, legend="3*sin(x)", fill_color=None, line_color="brown")
p1.title.align = "center"


show(p1)
#show(gridplot(p1, p2, ncols=2, plot_width=400, plot_height=400))  # open a browser
```

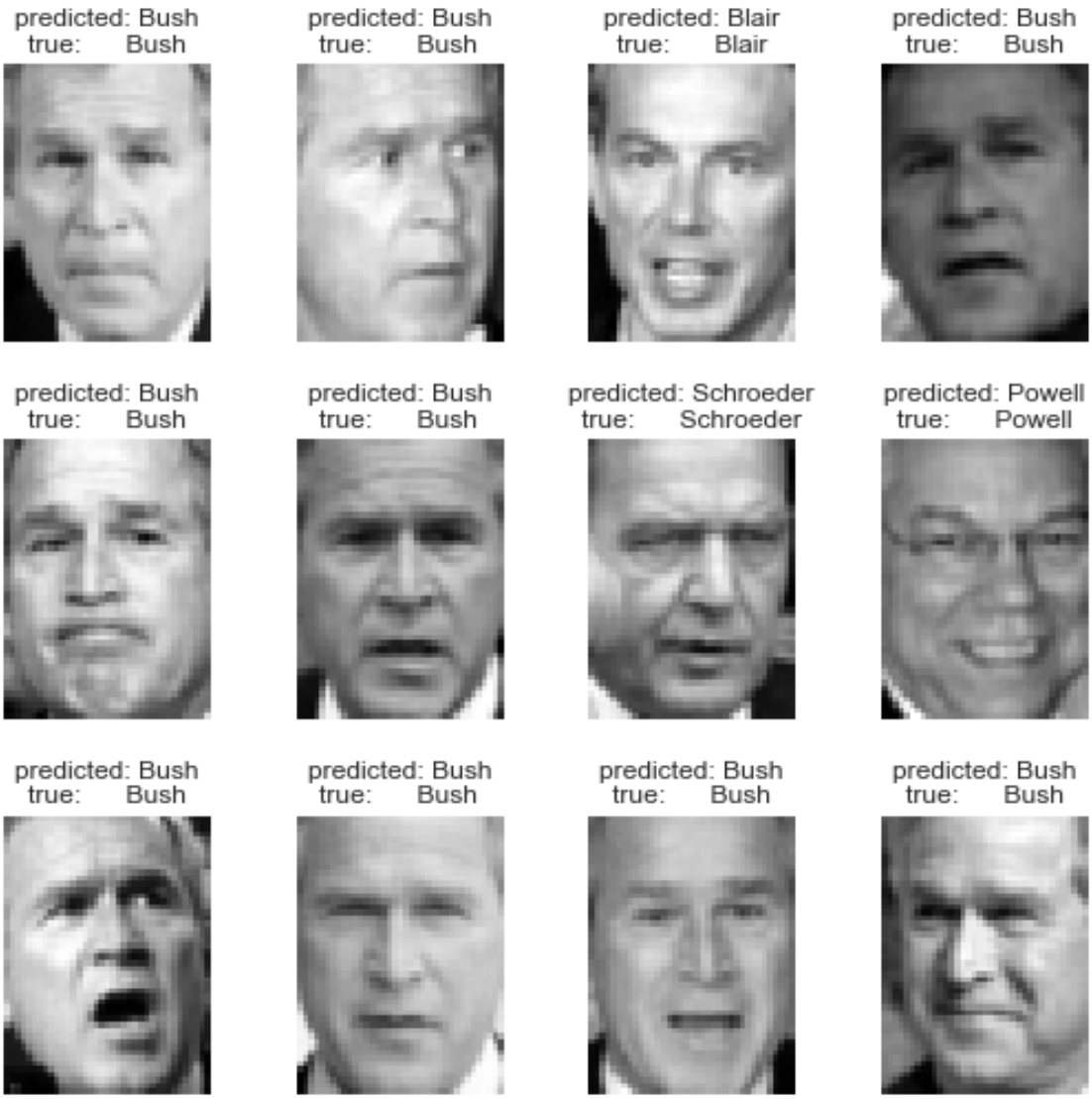
2.6 UCB1 NN after pruning

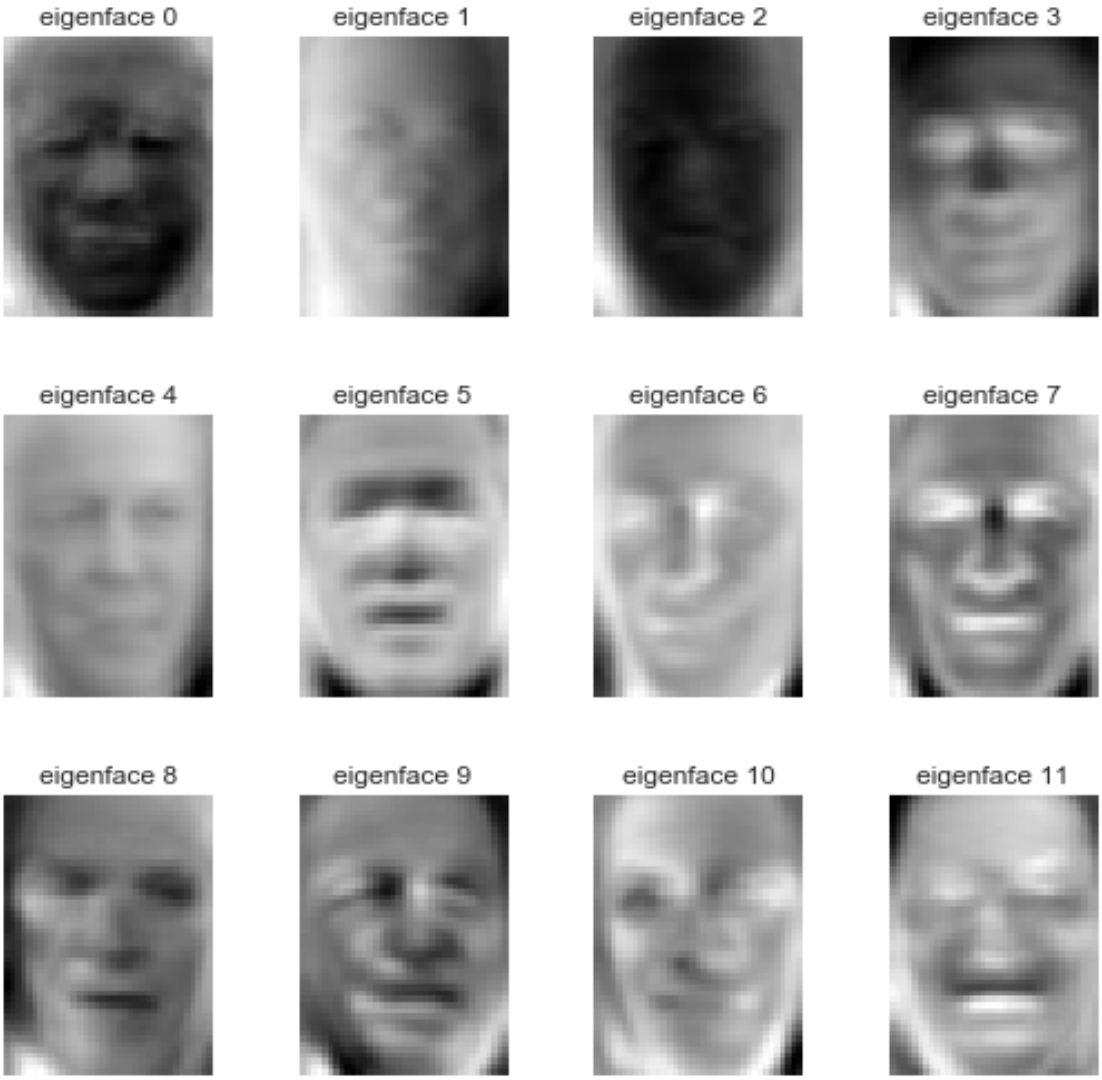
In [27]:
```
# MAB_NN(4%REMOVED) MODEL1 10
model1 = Sequential()
model1.add(Dense(300,
                 input_shape=(150,),
                 activation="relu"))
model1.add(Dropout(0.5))
model1.add(Dense(7, activation="softmax"))
model1.load_weights('./UCB1/spam5.hdf5')
model1.compile(loss='categorical_crossentropy',
```

```
                    metrics=['accuracy'],
                    optimizer='adam')
```

```
In [28]: ###############################################################################
         # Quantitative evaluation of the model quality on the test set
         from time import time
         print("Predicting people's names on the test set")
         t0 = time()
         y_pred = model1.predict_classes(X_test_pca)
         y_pred_NN1 = y_pred
         print("done in %0.3fs" % (time() - t0))
         print(classification_report(y_test, y_pred, target_names=target_names))
         print(confusion_matrix(y_test, y_pred, labels=range(n_classes)))
         prediction_titles = [title(y_pred, y_test, target_names, i)
                              for i in range(y_pred.shape[0])]
         plot_gallery(X_test, prediction_titles, h, w)
         # plot the gallery of the most significative eigenfaces
         eigenface_titles = ["eigenface %d" % i for i in range(eigenfaces.shape[0])]
         plot_gallery(eigenfaces, eigenface_titles, h, w)
         plt.show()
```

```
Predicting people's names on the test set
 32/322 [=>...] - ETA: 0sdone in 0.065s
                   precision    recall  f1-score   support

     Ariel Sharon       0.46      0.46      0.46        13
     Colin Powell       0.80      0.87      0.83        60
  Donald Rumsfeld       0.75      0.56      0.64        27
    George W Bush       0.85      0.92      0.89       146
Gerhard Schroeder       0.85      0.68      0.76        25
      Hugo Chavez       0.88      0.47      0.61        15
       Tony Blair       0.73      0.75      0.74        36

      avg / total       0.80      0.80      0.80       322

[[  6   2   1   3   0   0   1]
 [  1  52   0   4   1   1   1]
 [  4   3  15   3   1   0   1]
 [  1   4   3 135   0   0   3]
 [  1   0   0   3  17   0   4]
 [  0   2   1   4   1   7   0]
 [  0   2   0   7   0   0  27]]
```

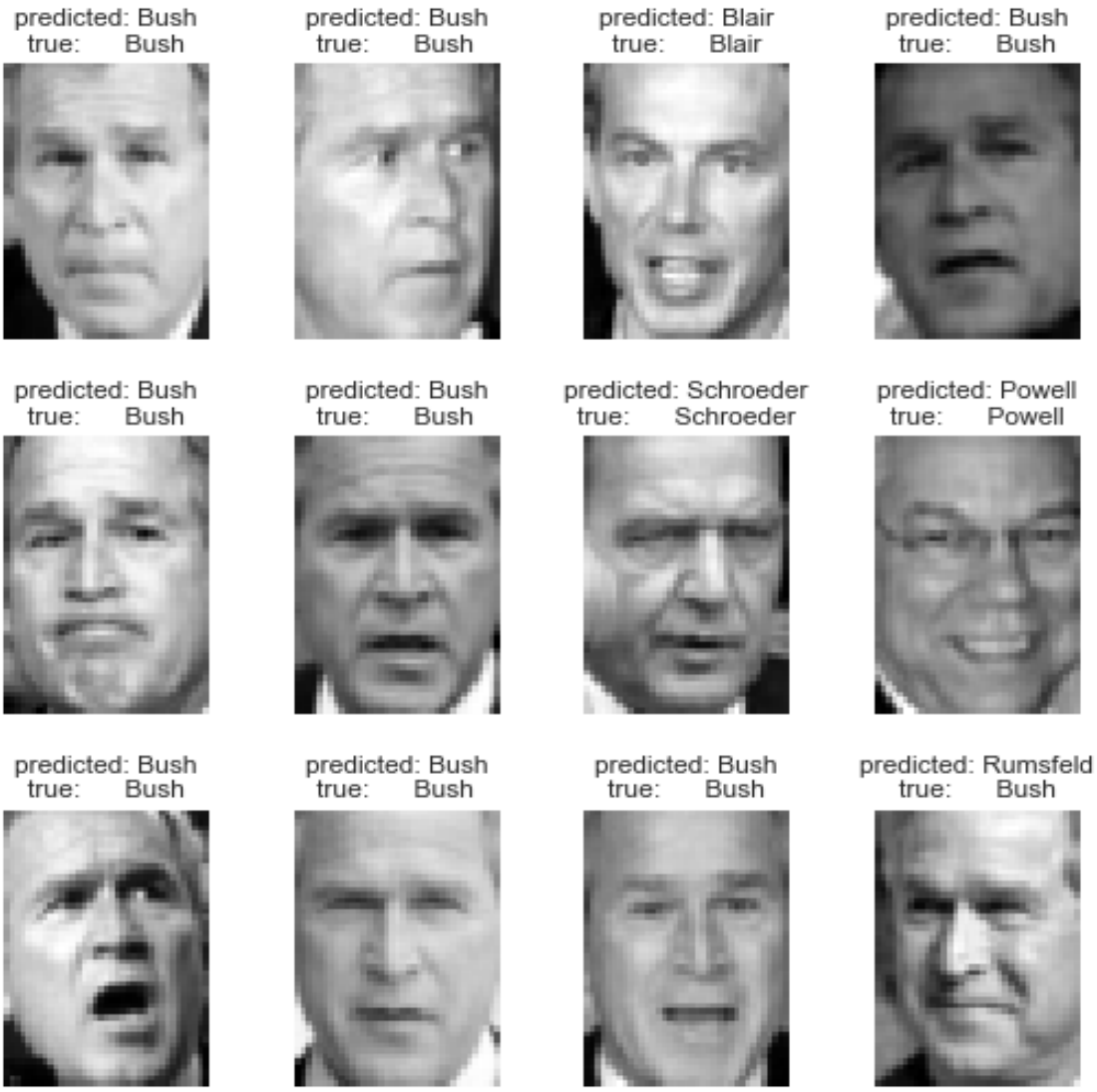

predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Blair
true: Blair
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Schroeder
true: Schroeder
predicted: Powell
true: Powell
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush

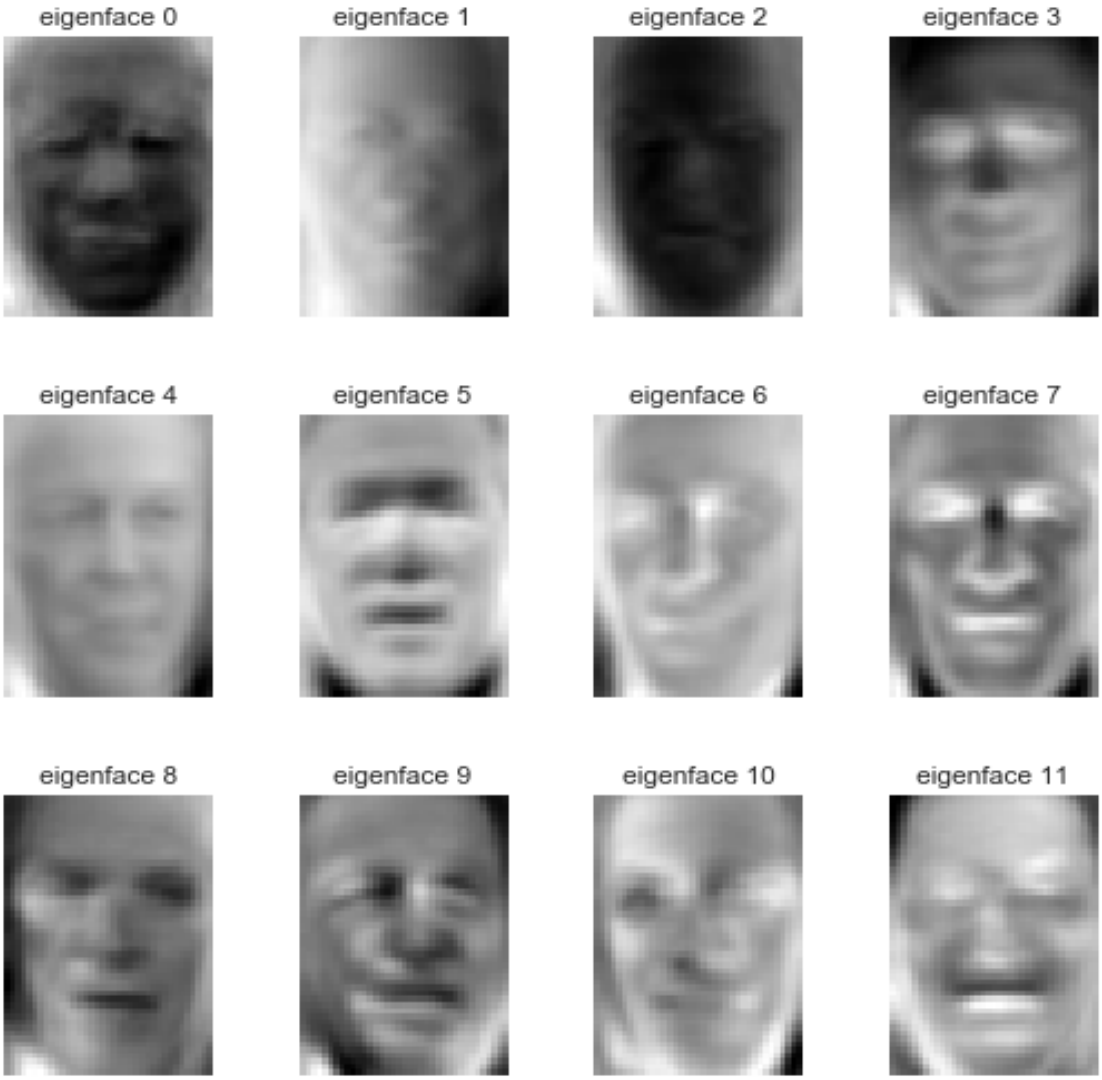


2.7 NN after pruning 8.8%

```
In [29]: # MAB_NN(8.8%REMOVED) MODEL1 22
         model2 = Sequential()
         model2.add(Dense(300,
                          input_shape=(150,),
                          activation="relu"))
         model2.add(Dropout(0.5))
         model2.add(Dense(7, activation="softmax"))
         model2.load_weights('/Users/salemameen/Desktop/banditsbook/python_face/UCB1/spam20.hdf5
         model2.compile(loss='categorical_crossentropy',
                        metrics=['accuracy'],
                        optimizer='adam')
```

```
In [30]: ##############################################################################
         # Quantitative evaluation of the model quality on the test set
         from time import time
         print("Predicting people's names on the test set")
         t0 = time()
         y_pred = model2.predict_classes(X_test_pca)
         y_pred_NN2 = y_pred
         print("done in %0.3fs" % (time() - t0))
         print(classification_report(y_test, y_pred, target_names=target_names))
         print(confusion_matrix(y_test, y_pred, labels=range(n_classes)))
         prediction_titles = [title(y_pred, y_test, target_names, i)
                              for i in range(y_pred.shape[0])]
         plot_gallery(X_test, prediction_titles, h, w)
         # plot the gallery of the most significative eigenfaces
         eigenface_titles = ["eigenface %d" % i for i in range(eigenfaces.shape[0])]
         plot_gallery(eigenfaces, eigenface_titles, h, w)
         plt.show()

Predicting people's names on the test set
 32/322 [=>...] - ETA: 0sdone in 0.062s
                    precision    recall  f1-score   support

     Ariel Sharon       0.47      0.54      0.50        13
     Colin Powell       0.78      0.83      0.81        60
  Donald Rumsfeld       0.62      0.56      0.59        27
    George W Bush       0.85      0.90      0.88       146
Gerhard Schroeder       0.85      0.68      0.76        25
      Hugo Chavez       0.78      0.47      0.58        15
       Tony Blair       0.71      0.69      0.70        36

      avg / total       0.79      0.79      0.78       322

[[  7   1   2   2   0   0   1]
 [  1  50   1   6   0   1   1]
 [  5   3  15   3   0   0   1]
 [  1   4   5 132   0   1   3]
 [  1   1   0   2  17   0   4]
 [  0   2   1   4   1   7   0]
 [  0   3   0   6   2   0  25]]
```

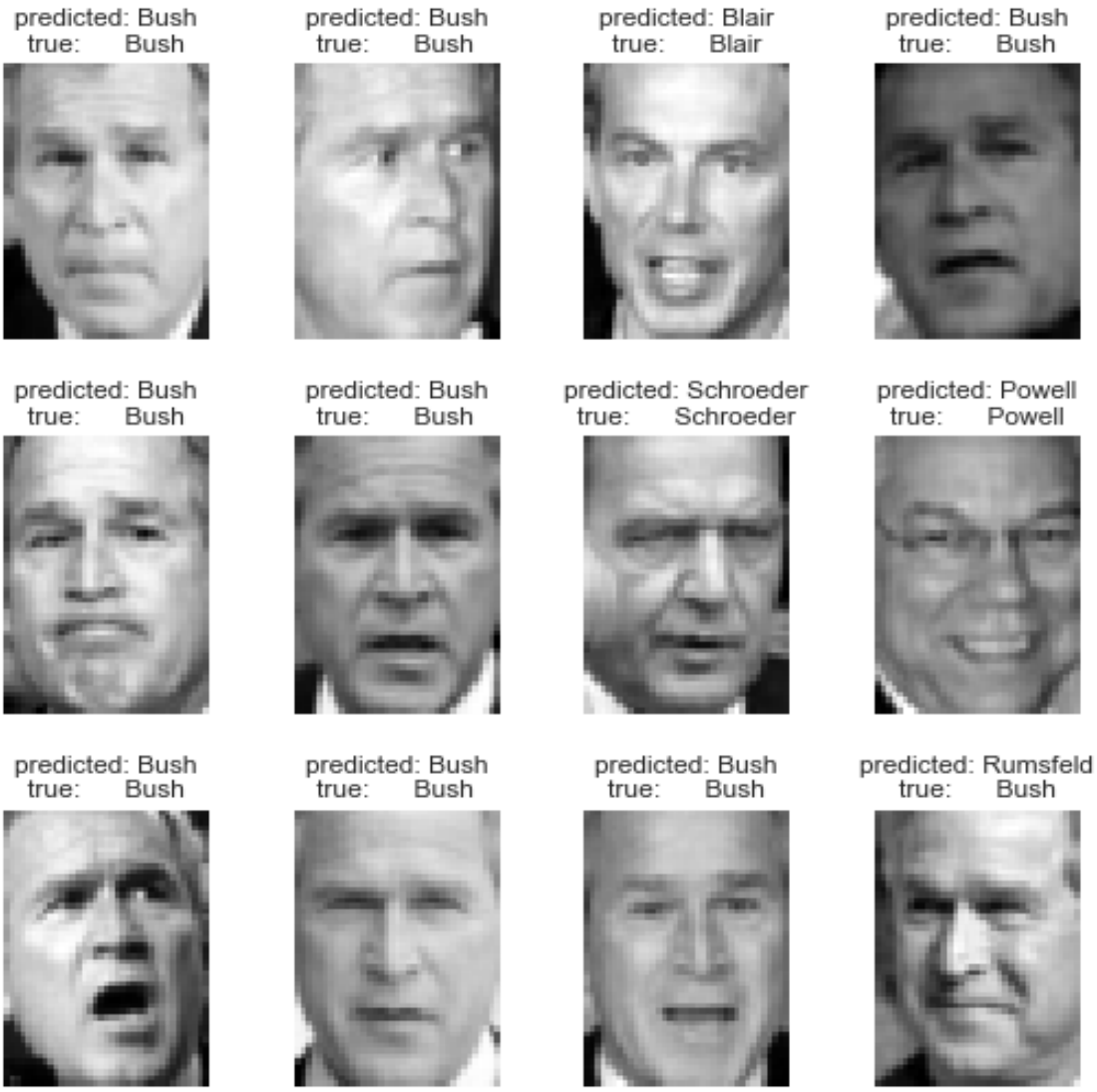

predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Blair
true: Blair
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Schroeder
true: Schroeder
predicted: Powell
true: Powell
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Rumsfeld
true: Bush

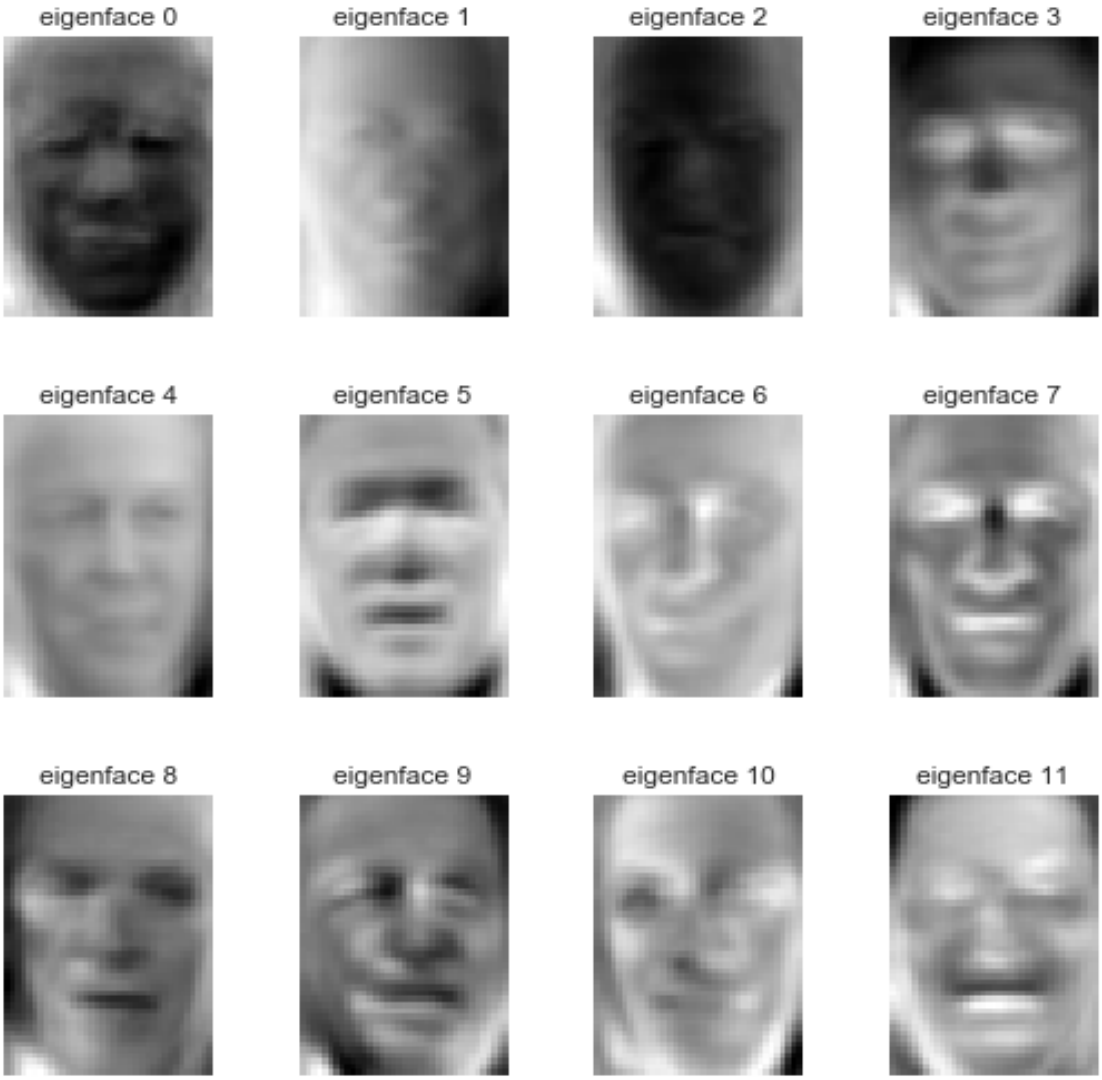


2.8 NN after pruning 50%

```
In [31]: # MAB_NN(50%REMOVED) MODEL1 125
         model3 = Sequential()
         model3.add(Dense(300,
                          input_shape=(150,),
                          activation="relu"))
         model3.add(Dropout(0.5))
         model3.add(Dense(7, activation="softmax"))
         model3.load_weights('/Users/salemameen/Desktop/banditsbook/python_face/UCB1/spam124.hdf
         model3.compile(loss='categorical_crossentropy',
                        metrics=['accuracy'],
                        optimizer='adam')
```

```
In [32]: ##############################################################################
         # Quantitative evaluation of the model quality on the test set
         from time import time
         print("Predicting people's names on the test set")
         t0 = time()
         y_pred = model2.predict_classes(X_test_pca)
         y_pred_NN3 = y_pred
         print("done in %0.3fs" % (time() - t0))
         print(classification_report(y_test, y_pred, target_names=target_names))
         print(confusion_matrix(y_test, y_pred, labels=range(n_classes)))
         prediction_titles = [title(y_pred, y_test, target_names, i)
                              for i in range(y_pred.shape[0])]
         plot_gallery(X_test, prediction_titles, h, w)
         # plot the gallery of the most significative eigenfaces
         eigenface_titles = ["eigenface %d" % i for i in range(eigenfaces.shape[0])]
         plot_gallery(eigenfaces, eigenface_titles, h, w)
         plt.show()

Predicting people's names on the test set
 32/322 [=>...] - ETA: 0sdone in 0.007s
                    precision    recall  f1-score   support

     Ariel Sharon       0.47      0.54      0.50        13
     Colin Powell       0.78      0.83      0.81        60
  Donald Rumsfeld       0.62      0.56      0.59        27
    George W Bush       0.85      0.90      0.88       146
Gerhard Schroeder       0.85      0.68      0.76        25
      Hugo Chavez       0.78      0.47      0.58        15
       Tony Blair       0.71      0.69      0.70        36

      avg / total       0.79      0.79      0.78       322

[[  7   1   2   2   0   0   1]
 [  1  50   1   6   0   1   1]
 [  5   3  15   3   0   0   1]
 [  1   4   5 132   0   1   3]
 [  1   1   0   2  17   0   4]
 [  0   2   1   4   1   7   0]
 [  0   3   0   6   2   0  25]]
```


predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Blair
true: Blair
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Schroeder
true: Schroeder
predicted: Powell
true: Powell
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Rumsfeld
true: Bush

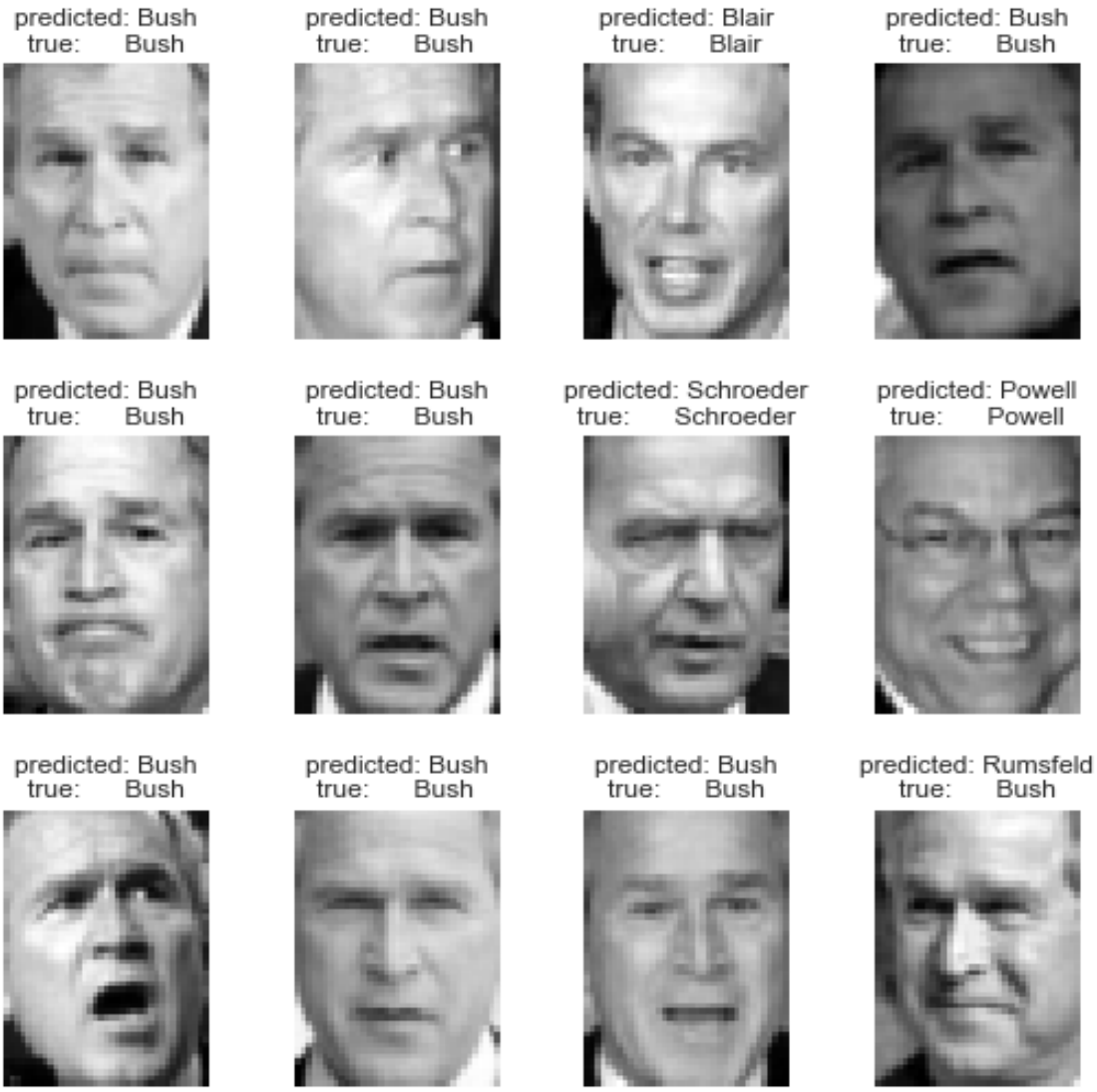


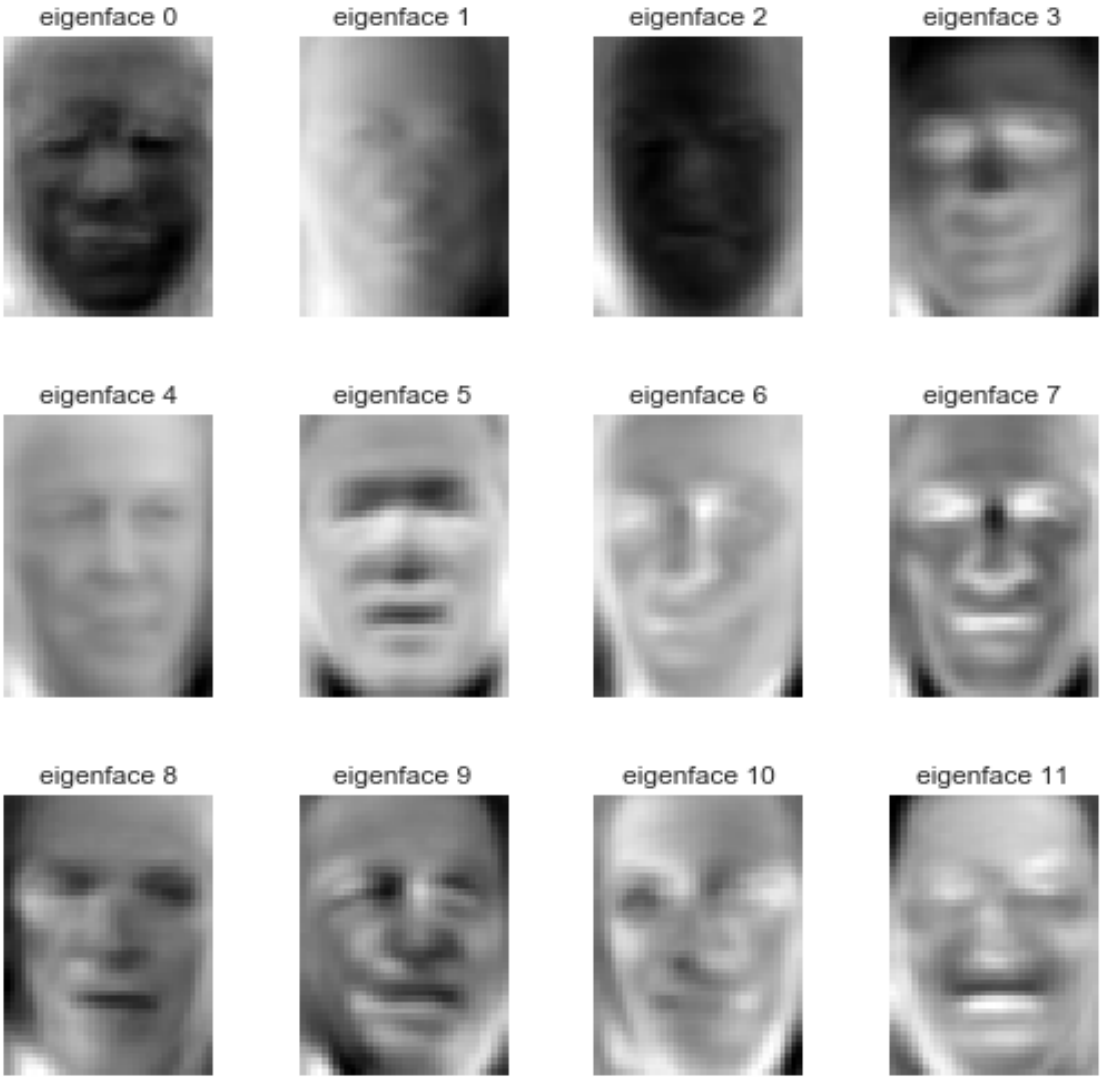
2.9 UCB1 prune over 80%

```
In [33]: model4 = Sequential()
         model4.add(Dense(300,
                          input_shape=(150,),
                          activation="relu"))
         model4.add(Dropout(0.5))
         model4.add(Dense(7, activation="softmax"))
         model4.load_weights('/Users/salemameen/Desktop/banditsbook/python_face/UCB1/spam150.hdf
         model4.compile(loss='categorical_crossentropy',
                        metrics=['accuracy'],
                        optimizer='adam')

In [34]: ################################################################################
```

```
        # Quantitative evaluation of the model quality on the test set
        from time import time
        print("Predicting people's names on the test set")
        t0 = time()
        y_pred = model4.predict_classes(X_test_pca)
        y_pred_NN4 = y_pred
        print("done in %0.3fs" % (time() - t0))
        print(classification_report(y_test, y_pred, target_names=target_names))
        print(confusion_matrix(y_test, y_pred, labels=range(n_classes)))
        prediction_titles = [title(y_pred, y_test, target_names, i)
                             for i in range(y_pred.shape[0])]
        plot_gallery(X_test, prediction_titles, h, w)
        # plot the gallery of the most significative eigenfaces
        eigenface_titles = ["eigenface %d" % i for i in range(eigenfaces.shape[0])]
        plot_gallery(eigenfaces, eigenface_titles, h, w)
        plt.show()
```

```
Predicting people's names on the test set
 32/322 [=>...] - ETA: 0sdone in 0.058s
                   precision    recall  f1-score   support

     Ariel Sharon       0.57      0.31      0.40        13
     Colin Powell       0.79      0.75      0.77        60
  Donald Rumsfeld       0.44      0.70      0.54        27
    George W Bush       0.77      0.91      0.83       146
Gerhard Schroeder       0.76      0.64      0.70        25
      Hugo Chavez       1.00      0.27      0.42        15
       Tony Blair       0.94      0.44      0.60        36

      avg / total       0.77      0.74      0.72       322

[[  4   2   3   4   0   0   0]
 [  1  45   4   8   2   0   0]
 [  1   2  19   5   0   0   0]
 [  0   3   9 133   0   0   1]
 [  1   0   5   3  16   0   0]
 [  0   2   1   7   1   4   0]
 [  0   3   2  13   2   0  16]]
```


predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Blair
true: Blair
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Schroeder
true: Schroeder
predicted: Powell
true: Powell
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Rumsfeld
true: Bush

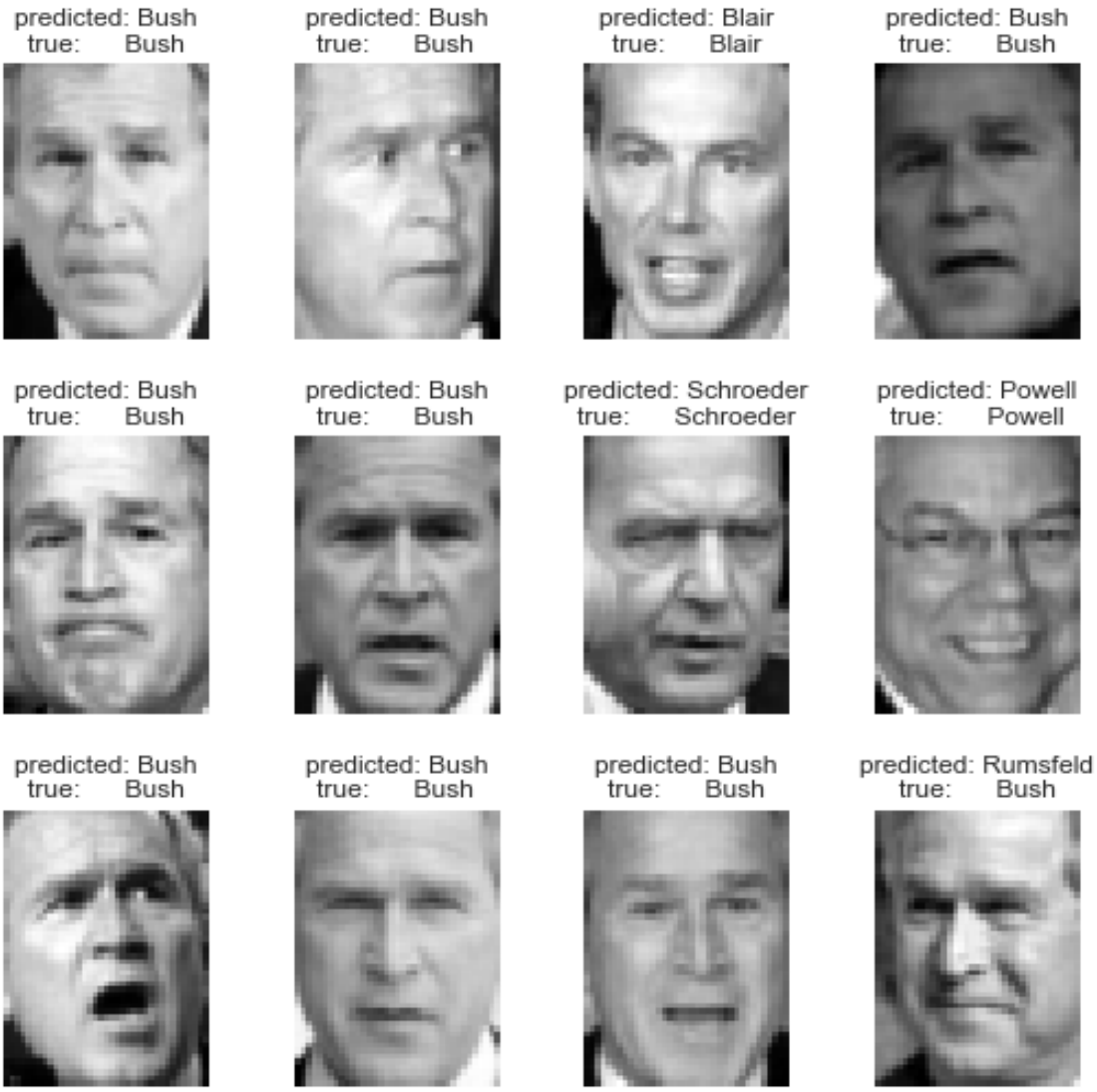


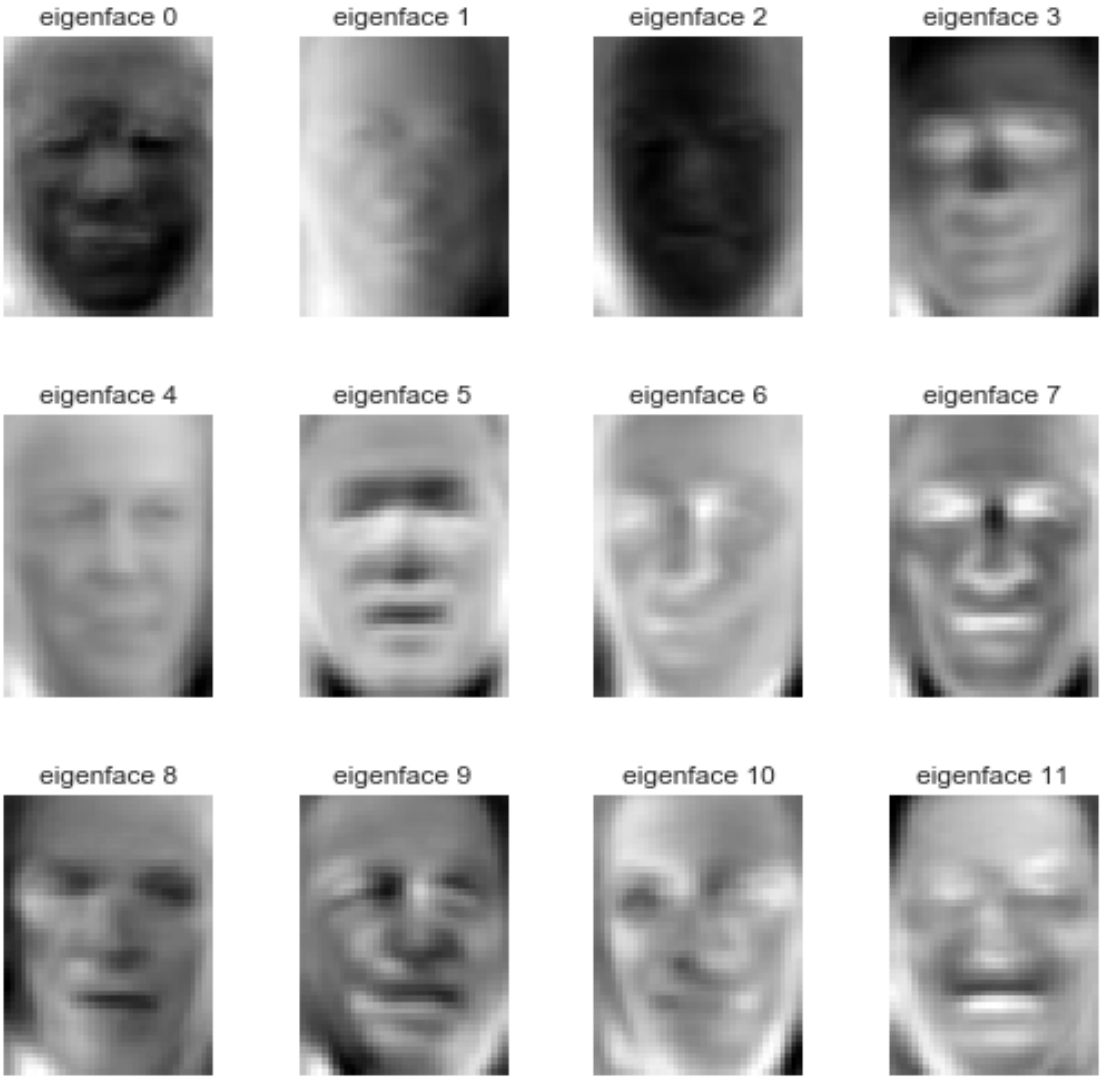
2.10 Epsilon Greedy

```
In [35]: # MAB_NN(50%REMOVED) MODEL1 125
         model_EG = Sequential()
         model_EG.add(Dense(300,
                            input_shape=(150,),
                            activation="relu"))
         model_EG.add(Dropout(0.5))
         model_EG.add(Dense(7, activation="softmax"))
         model_EG.load_weights('/Users/salemameen/Desktop/banditsbook/python_face/EpsilonGreedy/
         model_EG.compile(loss='categorical_crossentropy',
                          metrics=['accuracy'],
                          optimizer='adam')
```

In [36]:
```
###############################################################################
# Quantitative evaluation of the model quality on the test set
from time import time
print("Predicting people's names on the test set")
t0 = time()
y_pred = model_EG.predict_classes(X_test_pca)
y_pred_EG = y_pred
print("done in %0.3fs" % (time() - t0))
print(classification_report(y_test, y_pred, target_names=target_names))
print(confusion_matrix(y_test, y_pred, labels=range(n_classes)))
prediction_titles = [title(y_pred, y_test, target_names, i)
                     for i in range(y_pred.shape[0])]
plot_gallery(X_test, prediction_titles, h, w)
# plot the gallery of the most significative eigenfaces
eigenface_titles = ["eigenface %d" % i for i in range(eigenfaces.shape[0])]
plot_gallery(eigenfaces, eigenface_titles, h, w)
plt.show()
```

```
Predicting people's names on the test set
 32/322 [=>...] - ETA: 0sdone in 0.065s
                   precision    recall  f1-score   support

     Ariel Sharon       0.40      0.46      0.43        13
     Colin Powell       0.75      0.83      0.79        60
  Donald Rumsfeld       0.62      0.56      0.59        27
    George W Bush       0.89      0.90      0.89       146
Gerhard Schroeder       0.85      0.68      0.76        25
      Hugo Chavez       0.73      0.53      0.62        15
       Tony Blair       0.70      0.72      0.71        36

      avg / total       0.79      0.79      0.78       322

[[  6   3   2   1   0   0   1]
 [  1  50   1   4   1   1   2]
 [  5   3  15   3   0   0   1]
 [  2   4   5 131   0   1   3]
 [  1   1   0   1  17   1   4]
 [  0   2   1   3   1   8   0]
 [  0   4   0   5   1   0  26]]
```


predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Blair
true: Blair
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Schroeder
true: Schroeder
predicted: Powell
true: Powell
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Rumsfeld
true: Bush

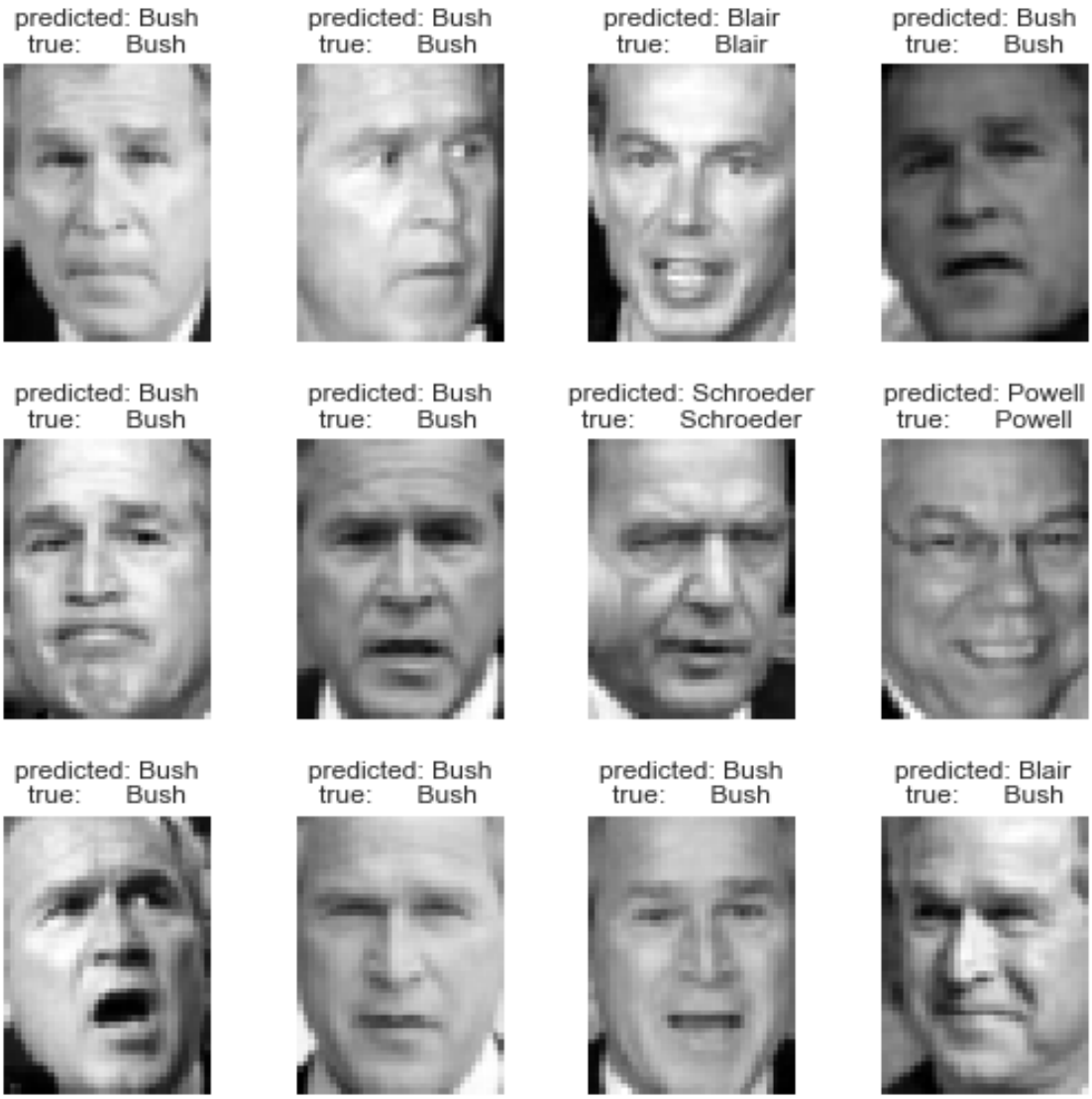


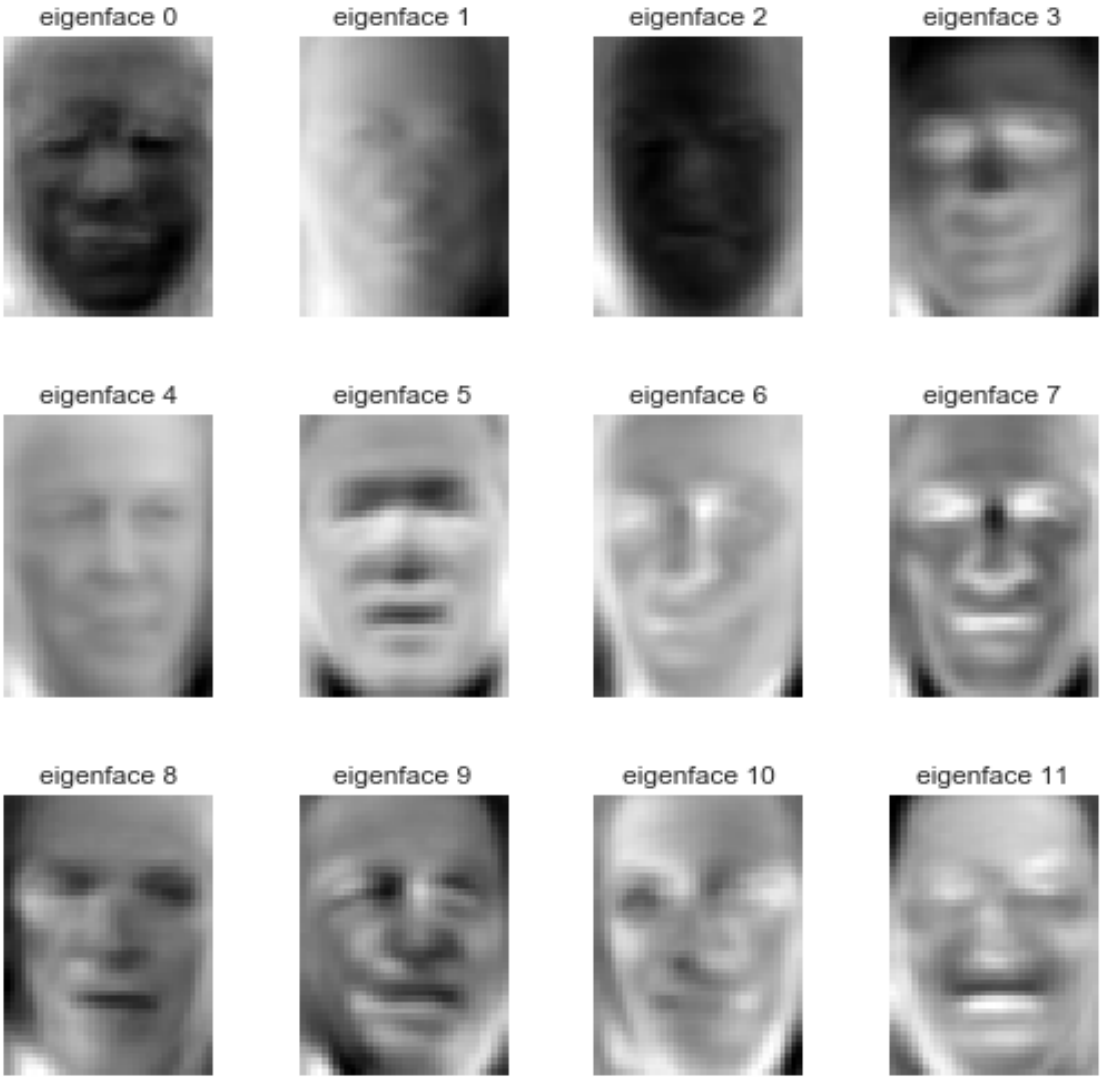
2.11 Decay Epsilon Greedy

```
In [37]: model_AEG = Sequential()
         model_AEG.add(Dense(300,
                             input_shape=(150,),
                             activation="relu"))
         model_AEG.add(Dropout(0.5))
         model_AEG.add(Dense(7, activation="softmax"))
         model_AEG.load_weights('/Users/salemameen/Desktop/banditsbook/python_face/AnnealingEpsi
         model_AEG.compile(loss='categorical_crossentropy',
                           metrics=['accuracy'],
                           optimizer='adam')
         ################################################################################
         ################################################################################
```

```
        # Quantitative evaluation of the model quality on the test set
        from time import time
        print("Predicting people's names on the test set")
        t0 = time()
        y_pred = model_AEG.predict_classes(X_test_pca)
        y_pred_AEG = y_pred
        print("done in %0.3fs" % (time() - t0))
        print(classification_report(y_test, y_pred, target_names=target_names))
        print(confusion_matrix(y_test, y_pred, labels=range(n_classes)))
        prediction_titles = [title(y_pred, y_test, target_names, i)
                             for i in range(y_pred.shape[0])]
        plot_gallery(X_test, prediction_titles, h, w)
        # plot the gallery of the most significative eigenfaces
        eigenface_titles = ["eigenface %d" % i for i in range(eigenfaces.shape[0])]
        plot_gallery(eigenfaces, eigenface_titles, h, w)
        plt.show()
```

```
Predicting people's names on the test set
 32/322 [=>...] - ETA: 0sdone in 0.063s
                   precision    recall  f1-score   support

     Ariel Sharon       0.46      0.46      0.46        13
     Colin Powell       0.78      0.82      0.80        60
  Donald Rumsfeld       0.67      0.52      0.58        27
    George W Bush       0.86      0.91      0.88       146
Gerhard Schroeder       0.71      0.68      0.69        25
      Hugo Chavez       0.88      0.47      0.61        15
       Tony Blair       0.68      0.72      0.70        36

      avg / total       0.78      0.78      0.78       322

[[  6   3   2   1   0   0   1]
 [  1  49   1   4   2   1   2]
 [  4   3  14   4   1   0   1]
 [  1   4   3 133   1   0   4]
 [  1   0   0   3  17   0   4]
 [  0   2   1   4   1   7   0]
 [  0   2   0   6   2   0  26]]
```


predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Blair
true: Blair
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Schroeder
true: Schroeder
predicted: Powell
true: Powell
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Blair
true: Bush

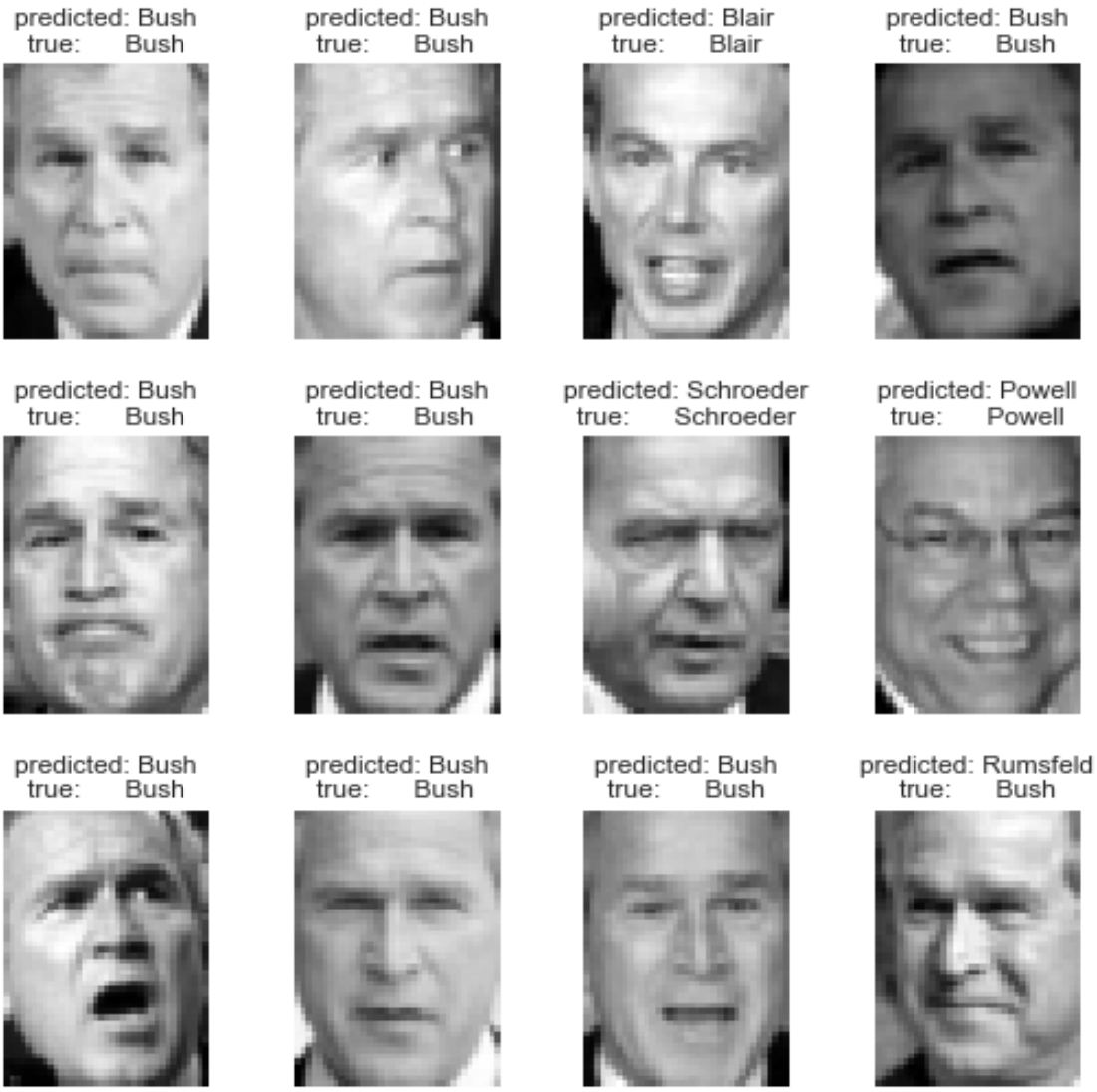


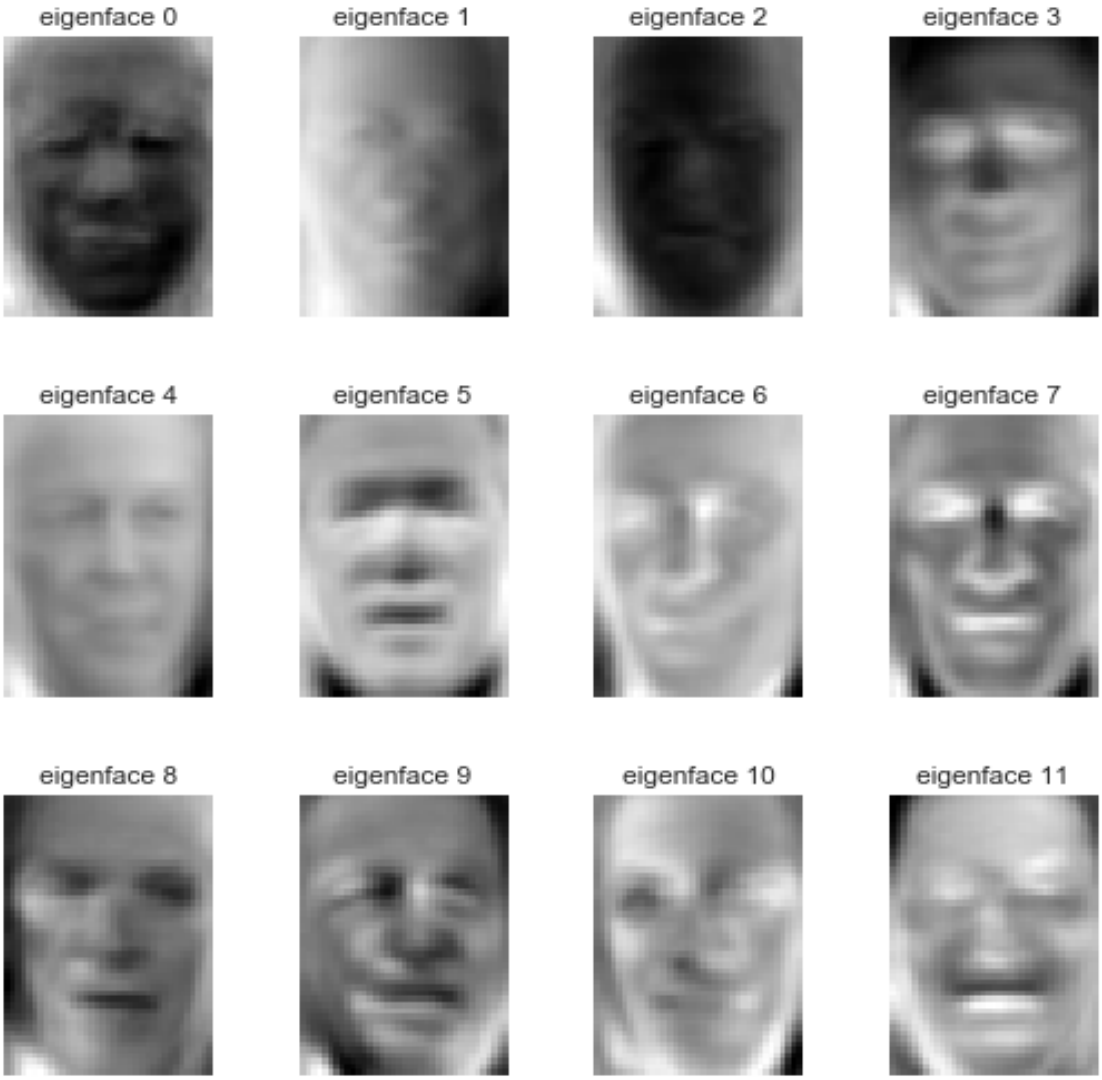
2.12 Softmax

```
In [38]: model_SM = Sequential()
         model_SM.add(Dense(300,
                            input_shape=(150,),
                            activation="relu"))
         model_SM.add(Dropout(0.5))
         model_SM.add(Dense(7, activation="softmax"))
         model_SM.load_weights('/Users/salemameen/Desktop/banditsbook/python_face/Softmax/spam20
         model_SM.compile(loss='categorical_crossentropy',
                          metrics=['accuracy'],
                          optimizer='adam')
         ################################################################################
         ################################################################################
```

```
        # Quantitative evaluation of the model quality on the test set
        from time import time
        print("Predicting people's names on the test set")
        t0 = time()
        y_pred = model_SM.predict_classes(X_test_pca)
        y_pred_SM = y_pred
        print("done in %0.3fs" % (time() - t0))
        print(classification_report(y_test, y_pred, target_names=target_names))
        print(confusion_matrix(y_test, y_pred, labels=range(n_classes)))
        prediction_titles = [title(y_pred, y_test, target_names, i)
                             for i in range(y_pred.shape[0])]
        plot_gallery(X_test, prediction_titles, h, w)
        # plot the gallery of the most significative eigenfaces
        eigenface_titles = ["eigenface %d" % i for i in range(eigenfaces.shape[0])]
        plot_gallery(eigenfaces, eigenface_titles, h, w)
        plt.show()
```

```
Predicting people's names on the test set
 32/322 [=>...] - ETA: 0sdone in 0.059s
                   precision    recall  f1-score   support

     Ariel Sharon       0.46      0.46      0.46        13
     Colin Powell       0.75      0.83      0.79        60
  Donald Rumsfeld       0.65      0.56      0.60        27
    George W Bush       0.85      0.92      0.88       146
Gerhard Schroeder       0.77      0.68      0.72        25
      Hugo Chavez       0.88      0.47      0.61        15
       Tony Blair       0.69      0.61      0.65        36

      avg / total       0.78      0.78      0.77       322

[[  6   4   1   2   0   0   0]
 [  1  50   1   5   1   1   1]
 [  5   3  15   3   0   0   1]
 [  0   4   4 134   0   0   4]
 [  1   0   0   3  17   0   4]
 [  0   2   1   4   1   7   0]
 [  0   4   1   6   3   0  22]]
```


predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Blair
true: Blair
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Schroeder
true: Schroeder
predicted: Powell
true: Powell
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Rumsfeld
true: Bush

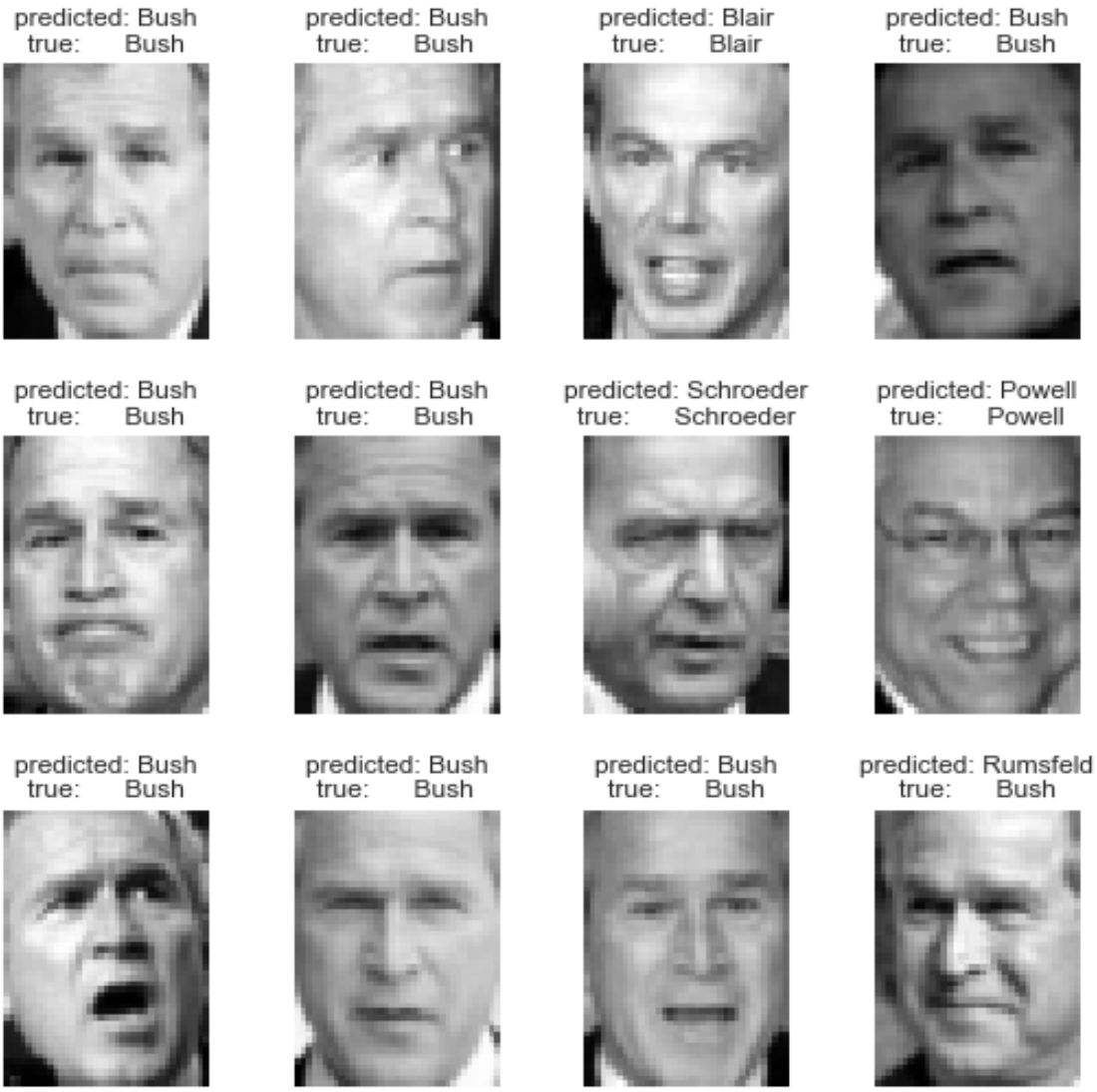


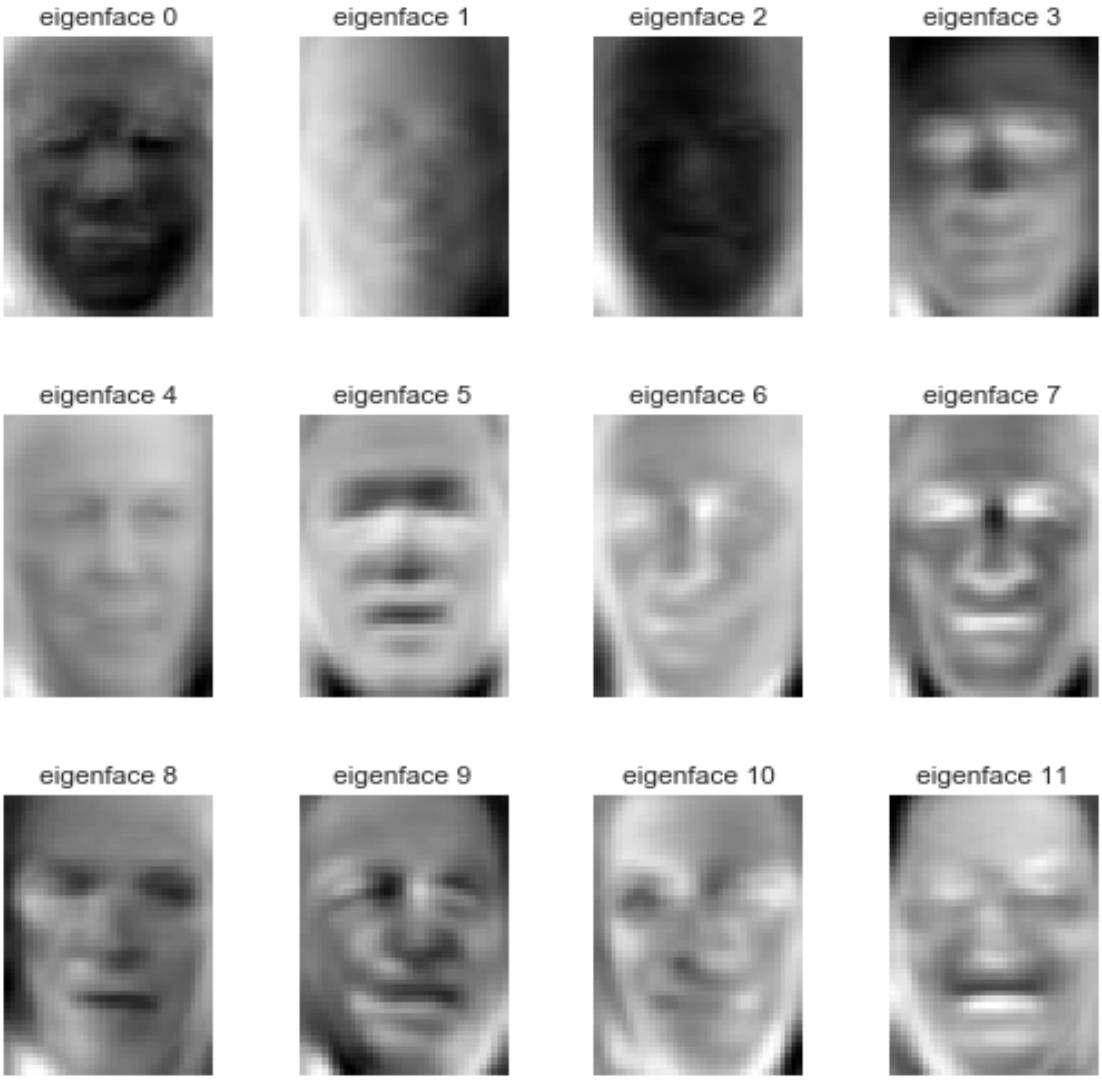
2.13 Decaying Softmax

```
In [39]: model_ASM = Sequential()
         model_ASM.add(Dense(300,
                             input_shape=(150,),
                             activation="relu"))
         model_ASM.add(Dropout(0.5))
         model_ASM.add(Dense(7, activation="softmax"))
         model_ASM.load_weights('/Users/salemameen/Desktop/banditsbook/python_face/AnnealingSoft
         model_ASM.compile(loss='categorical_crossentropy',
                           metrics=['accuracy'],
                           optimizer='adam')
         ################################################################################
         ################################################################################
```

```
        # Quantitative evaluation of the model quality on the test set
        from time import time
        print("Predicting people's names on the test set")
        t0 = time()
        y_pred = model_SM.predict_classes(X_test_pca)
        y_pred_ASM = y_pred
        print("done in %0.3fs" % (time() - t0))
        print(classification_report(y_test, y_pred, target_names=target_names))
        print(confusion_matrix(y_test, y_pred, labels=range(n_classes)))
        prediction_titles = [title(y_pred, y_test, target_names, i)
                             for i in range(y_pred.shape[0])]
        plot_gallery(X_test, prediction_titles, h, w)
        # plot the gallery of the most significative eigenfaces
        eigenface_titles = ["eigenface %d" % i for i in range(eigenfaces.shape[0])]
        plot_gallery(eigenfaces, eigenface_titles, h, w)
        plt.show()
```

```
Predicting people's names on the test set
 32/322 [=>...] - ETA: 0sdone in 0.006s
                   precision    recall  f1-score   support

     Ariel Sharon       0.46      0.46      0.46        13
     Colin Powell       0.75      0.83      0.79        60
  Donald Rumsfeld       0.65      0.56      0.60        27
    George W Bush       0.85      0.92      0.88       146
Gerhard Schroeder       0.77      0.68      0.72        25
      Hugo Chavez       0.88      0.47      0.61        15
       Tony Blair       0.69      0.61      0.65        36

      avg / total       0.78      0.78      0.77       322

[[  6   4   1   2   0   0   0]
 [  1  50   1   5   1   1   1]
 [  5   3  15   3   0   0   1]
 [  0   4   4 134   0   0   4]
 [  1   0   0   3  17   0   4]
 [  0   2   1   4   1   7   0]
 [  0   4   1   6   3   0  22]]
```


predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Blair
true: Blair
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Schroeder
true: Schroeder
predicted: Powell
true: Powell
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Rumsfeld
true: Bush

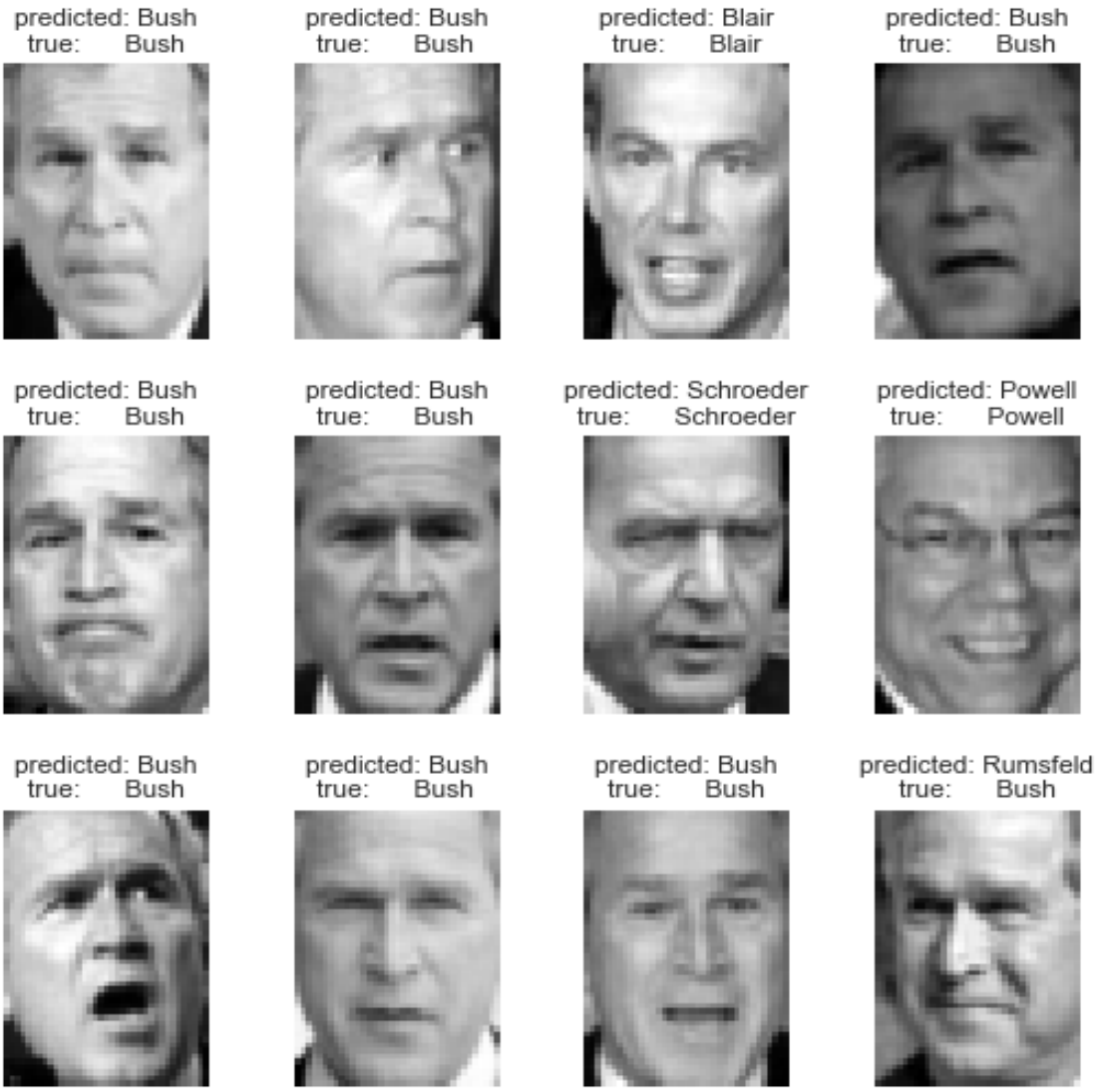


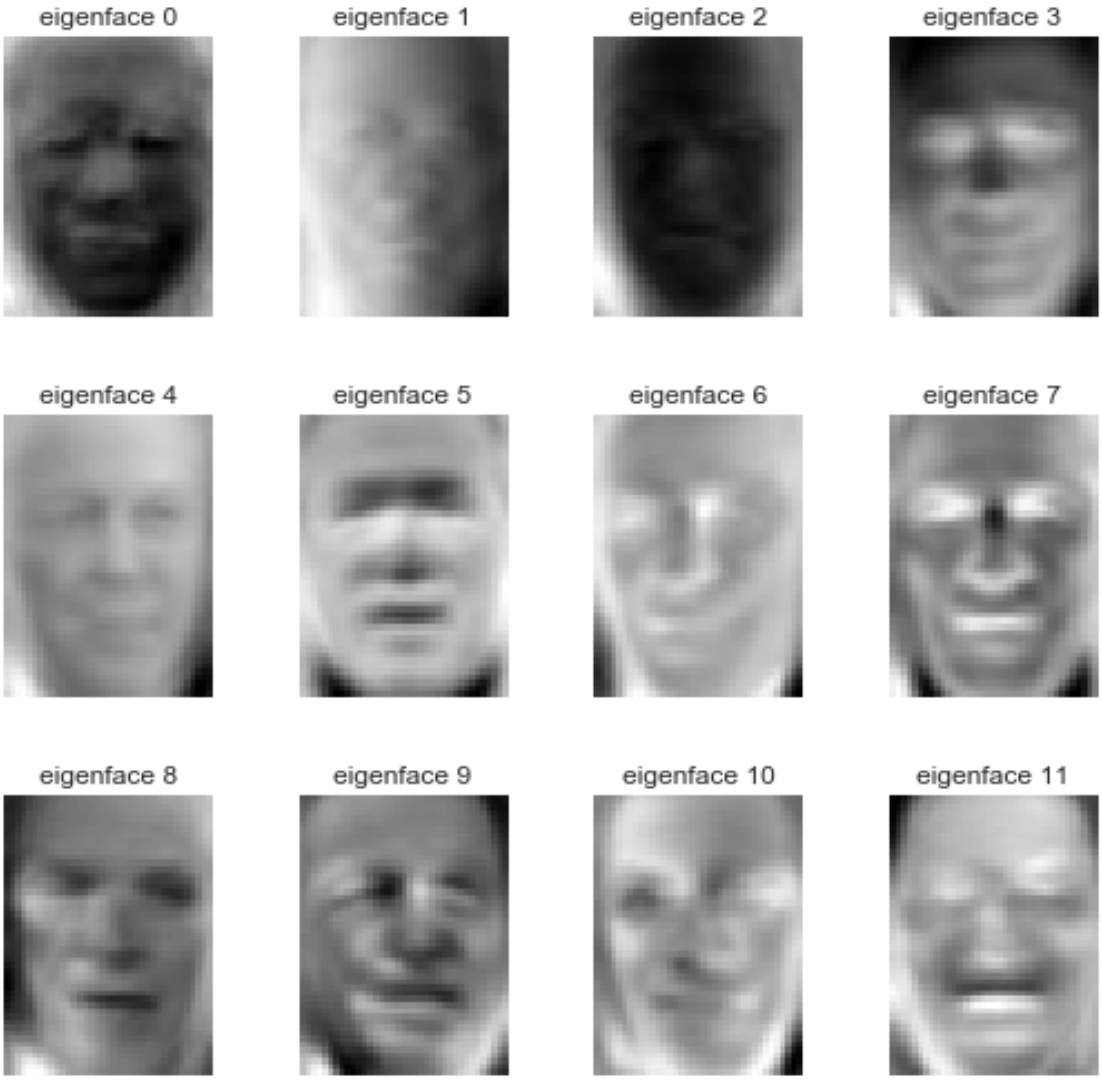
2.14 THOMPSON SAMBLING

```
In [40]: model_TS = Sequential()
         model_TS.add(Dense(300,
                            input_shape=(150,),
                            activation="relu"))
         model_TS.add(Dropout(0.5))
         model_TS.add(Dense(7, activation="softmax"))
         model_TS.load_weights('/Users/salemameen/Desktop/banditsbook/python_face/thompson_sampl
         model_TS.compile(loss='categorical_crossentropy',
                          metrics=['accuracy'],
                          optimizer='adam')
         ################################################################################
         ################################################################################
```

```
        # Quantitative evaluation of the model quality on the test set
        from time import time
        print("Predicting people's names on the test set")
        t0 = time()
        y_pred = model_SM.predict_classes(X_test_pca)
        y_pred_TS = y_pred
        print("done in %0.3fs" % (time() - t0))
        print(classification_report(y_test, y_pred, target_names=target_names))
        print(confusion_matrix(y_test, y_pred, labels=range(n_classes)))
        prediction_titles = [title(y_pred, y_test, target_names, i)
                             for i in range(y_pred.shape[0])]
        plot_gallery(X_test, prediction_titles, h, w)
        # plot the gallery of the most significative eigenfaces
        eigenface_titles = ["eigenface %d" % i for i in range(eigenfaces.shape[0])]
        plot_gallery(eigenfaces, eigenface_titles, h, w)
        plt.show()
```

```
Predicting people's names on the test set
 32/322 [=>...] - ETA: 0sdone in 0.006s
                   precision    recall  f1-score   support

     Ariel Sharon       0.46      0.46      0.46        13
     Colin Powell       0.75      0.83      0.79        60
  Donald Rumsfeld       0.65      0.56      0.60        27
    George W Bush       0.85      0.92      0.88       146
Gerhard Schroeder       0.77      0.68      0.72        25
      Hugo Chavez       0.88      0.47      0.61        15
       Tony Blair       0.69      0.61      0.65        36

      avg / total       0.78      0.78      0.77       322

[[  6   4   1   2   0   0   0]
 [  1  50   1   5   1   1   1]
 [  5   3  15   3   0   0   1]
 [  0   4   4 134   0   0   4]
 [  1   0   0   3  17   0   4]
 [  0   2   1   4   1   7   0]
 [  0   4   1   6   3   0  22]]
```


predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Blair
true: Blair
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Schroeder
true: Schroeder
predicted: Powell
true: Powell
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Rumsfeld
true: Bush

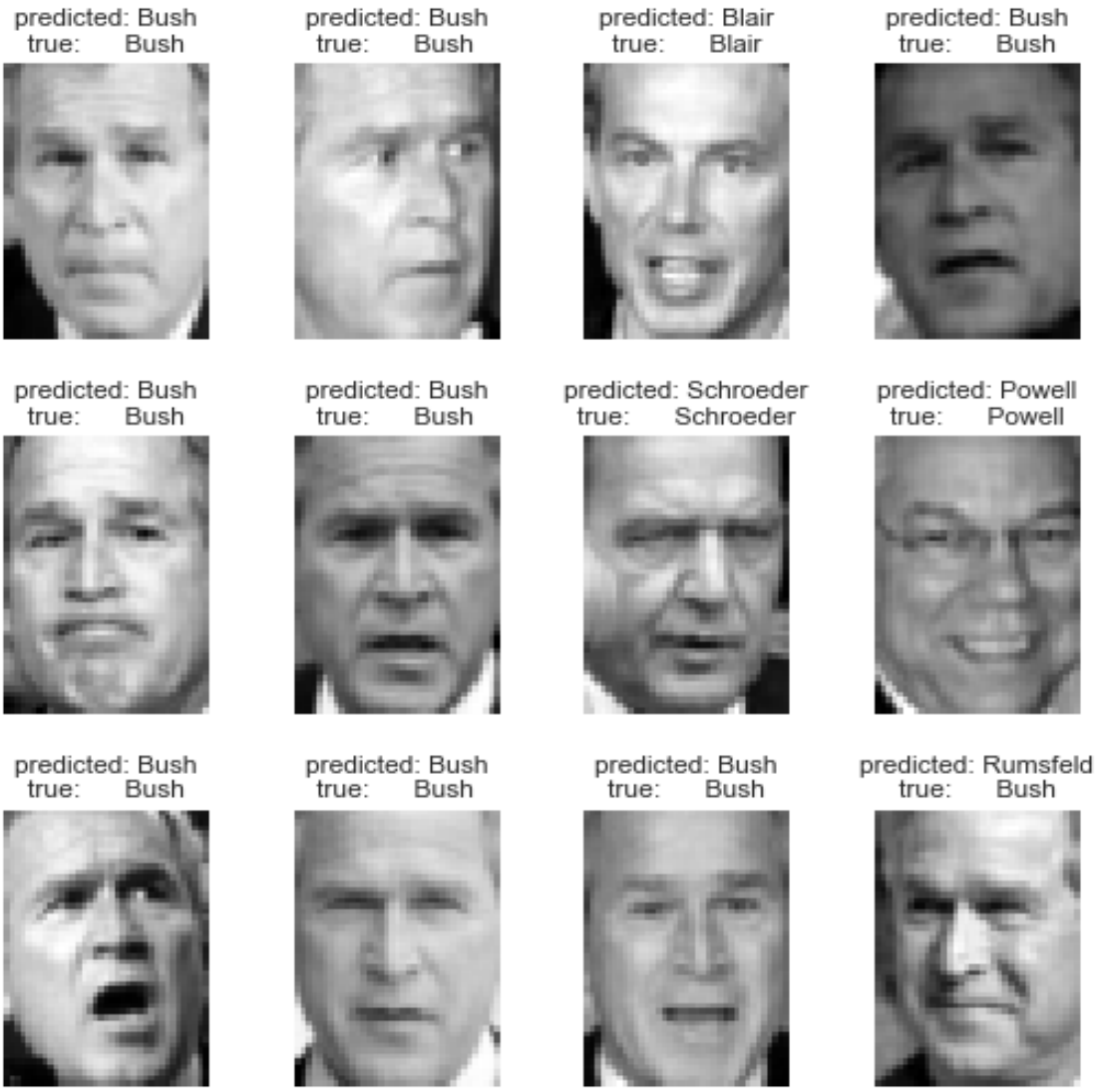


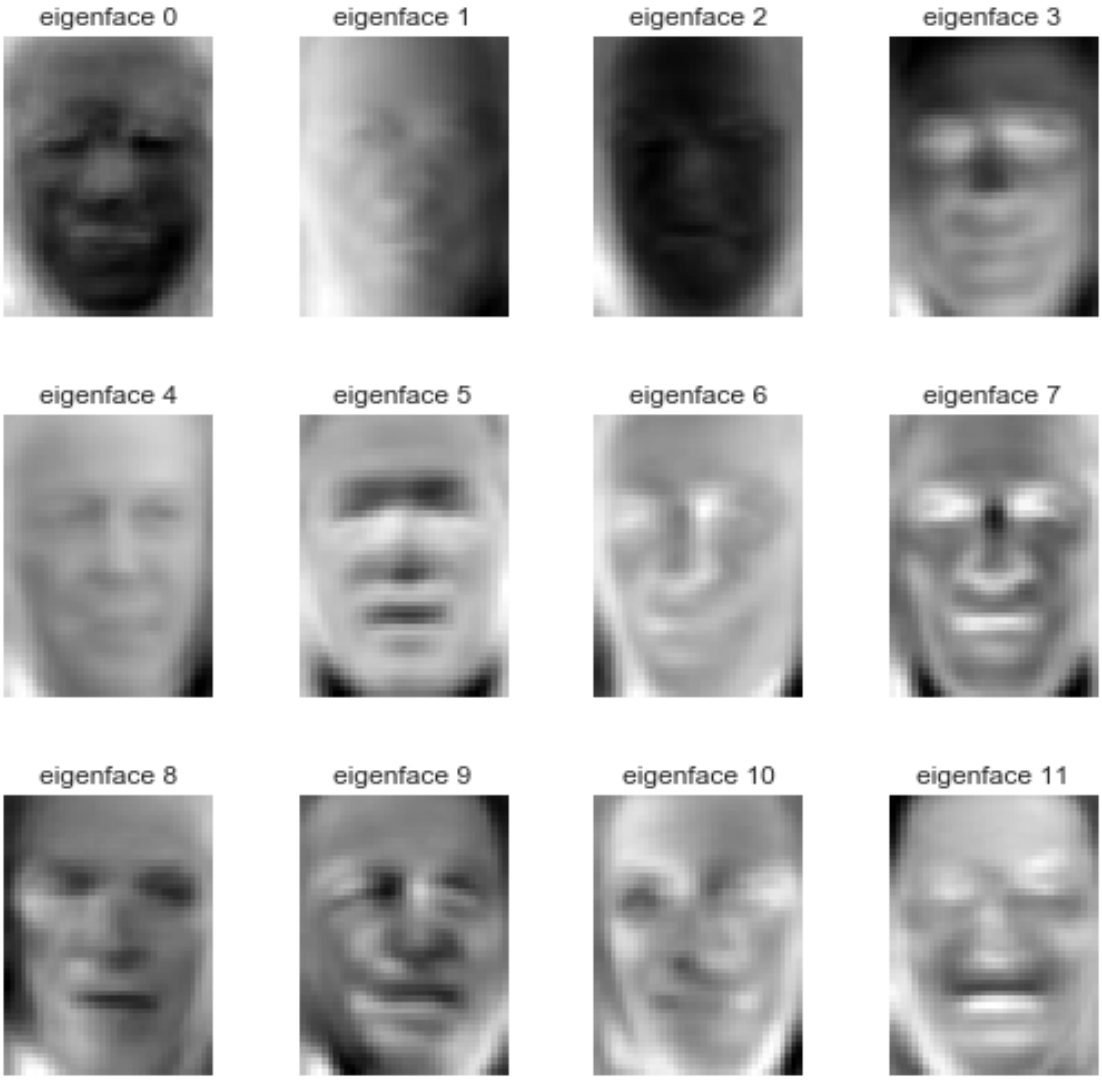
2.15 HEDGE

```
In [41]: model_HG = Sequential()
         model_HG.add(Dense(300,
                            input_shape=(150,),
                            activation="relu"))
         model_HG.add(Dropout(0.5))
         model_HG.add(Dense(7, activation="softmax"))
         model_HG.load_weights('/Users/salemameen/Desktop/banditsbook/python_face/Hedge/spam20.h
         model_HG.compile(loss='categorical_crossentropy',
                          metrics=['accuracy'],
                          optimizer='adam')
         ################################################################################
         ################################################################################
```

```
        # Quantitative evaluation of the model quality on the test set
        from time import time
        print("Predicting people's names on the test set")
        t0 = time()
        y_pred = model_SM.predict_classes(X_test_pca)
        y_pred_HG = y_pred
        print("done in %0.3fs" % (time() - t0))
        print(classification_report(y_test, y_pred, target_names=target_names))
        print(confusion_matrix(y_test, y_pred, labels=range(n_classes)))
        prediction_titles = [title(y_pred, y_test, target_names, i)
                             for i in range(y_pred.shape[0])]
        plot_gallery(X_test, prediction_titles, h, w)
        # plot the gallery of the most significative eigenfaces
        eigenface_titles = ["eigenface %d" % i for i in range(eigenfaces.shape[0])]
        plot_gallery(eigenfaces, eigenface_titles, h, w)
        plt.show()
```

```
Predicting people's names on the test set
 32/322 [=>...] - ETA: 0sdone in 0.006s
                   precision    recall  f1-score   support

     Ariel Sharon       0.46      0.46      0.46        13
     Colin Powell       0.75      0.83      0.79        60
  Donald Rumsfeld       0.65      0.56      0.60        27
    George W Bush       0.85      0.92      0.88       146
Gerhard Schroeder       0.77      0.68      0.72        25
      Hugo Chavez       0.88      0.47      0.61        15
       Tony Blair       0.69      0.61      0.65        36

      avg / total       0.78      0.78      0.77       322

[[  6   4   1   2   0   0   0]
 [  1  50   1   5   1   1   1]
 [  5   3  15   3   0   0   1]
 [  0   4   4 134   0   0   4]
 [  1   0   0   3  17   0   4]
 [  0   2   1   4   1   7   0]
 [  0   4   1   6   3   0  22]]
```


predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Blair
true: Blair
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Schroeder
true: Schroeder
predicted: Powell
true: Powell
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Rumsfeld
true: Bush

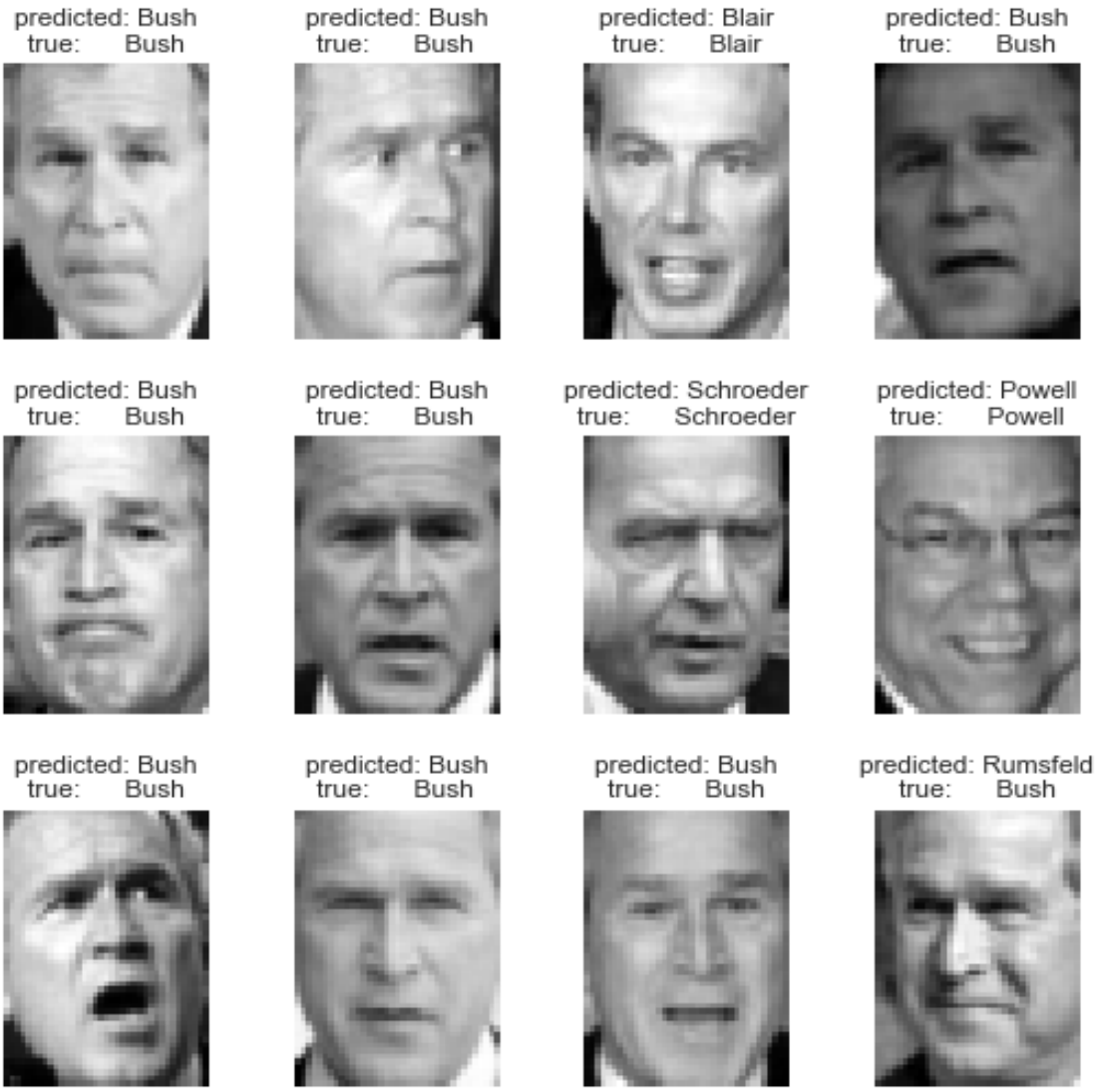


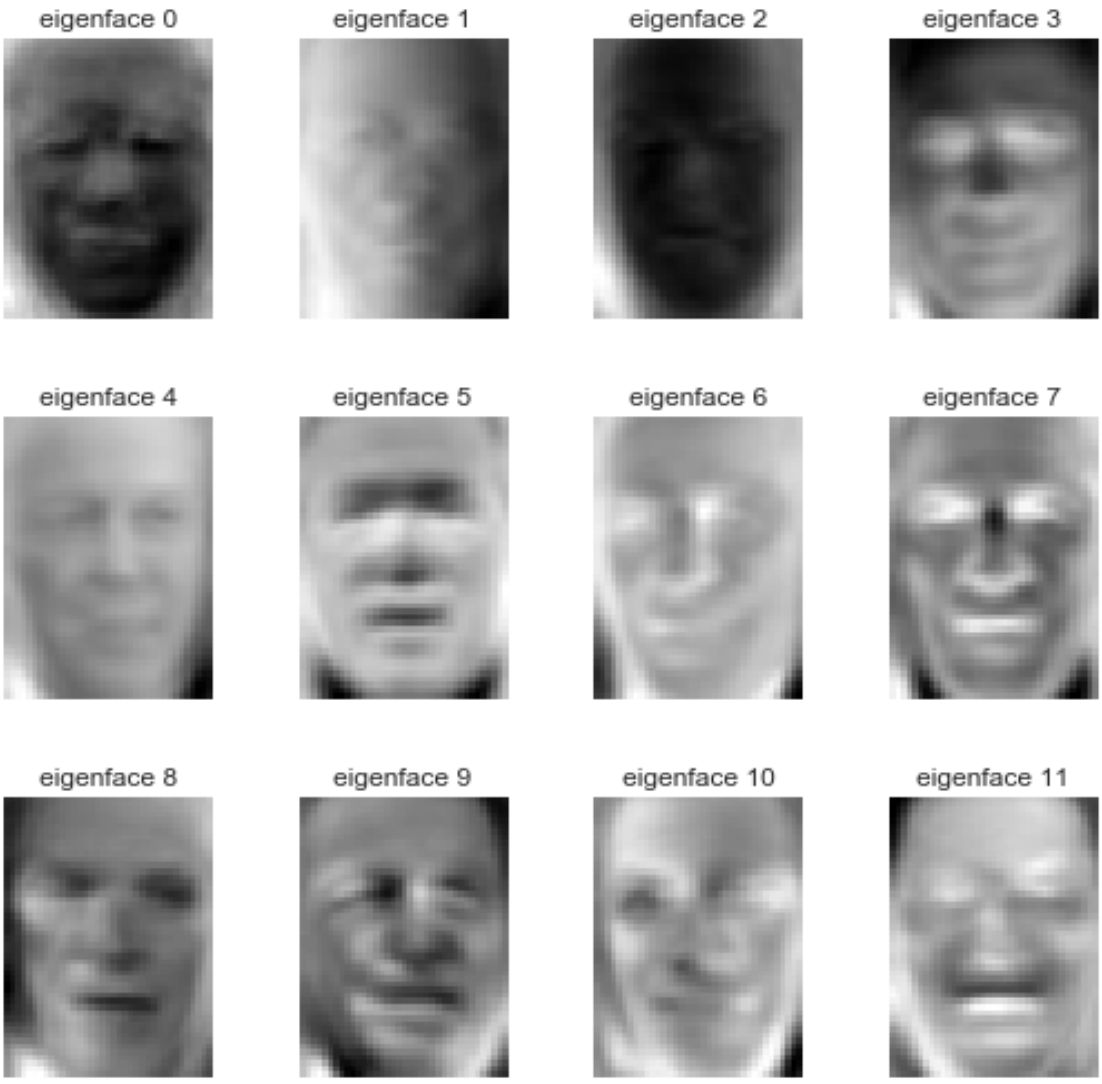
2.16 EXP3

```
In [42]: model_EXP = Sequential()
         model_EXP.add(Dense(300,
                             input_shape=(150,),
                             activation="relu"))
         model_EXP.add(Dropout(0.5))
         model_EXP.add(Dense(7, activation="softmax"))
         model_EXP.load_weights('/Users/salemameen/Desktop/banditsbook/python_face/Exp3/spam20.h
         model_EXP.compile(loss='categorical_crossentropy',
                           metrics=['accuracy'],
                           optimizer='adam')
         ################################################################################
         ################################################################################
```

```
        # Quantitative evaluation of the model quality on the test set
        from time import time
        print("Predicting people's names on the test set")
        t0 = time()
        y_pred = model_SM.predict_classes(X_test_pca)
        y_pred_EXP = y_pred
        print("done in %0.3fs" % (time() - t0))
        print(classification_report(y_test, y_pred, target_names=target_names))
        print(confusion_matrix(y_test, y_pred, labels=range(n_classes)))
        prediction_titles = [title(y_pred, y_test, target_names, i)
                             for i in range(y_pred.shape[0])]
        plot_gallery(X_test, prediction_titles, h, w)
        # plot the gallery of the most significative eigenfaces
        eigenface_titles = ["eigenface %d" % i for i in range(eigenfaces.shape[0])]
        plot_gallery(eigenfaces, eigenface_titles, h, w)
        plt.show()
```

```
Predicting people's names on the test set
 32/322 [=>...] - ETA: 0sdone in 0.006s
                   precision    recall  f1-score   support

     Ariel Sharon       0.46      0.46      0.46        13
     Colin Powell       0.75      0.83      0.79        60
  Donald Rumsfeld       0.65      0.56      0.60        27
    George W Bush       0.85      0.92      0.88       146
Gerhard Schroeder       0.77      0.68      0.72        25
      Hugo Chavez       0.88      0.47      0.61        15
       Tony Blair       0.69      0.61      0.65        36

      avg / total       0.78      0.78      0.77       322

[[  6   4   1   2   0   0   0]
 [  1  50   1   5   1   1   1]
 [  5   3  15   3   0   0   1]
 [  0   4   4 134   0   0   4]
 [  1   0   0   3  17   0   4]
 [  0   2   1   4   1   7   0]
 [  0   4   1   6   3   0  22]]
```


predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Blair
true: Blair
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Schroeder
true: Schroeder
predicted: Powell
true: Powell
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Bush
true: Bush
predicted: Rumsfeld
true: Bush


eigenface 0
eigenface 1
eigenface 2
eigenface 3
eigenface 4
eigenface 5
eigenface 6
eigenface 7
eigenface 8
eigenface 9
eigenface 10
eigenface 11

In [ ]: