Load Data

```
clear
clf
clc

orl_data = load('orl_data.mat');
orl_data = orl_data.data;
orl_lbls = load('orl_lbls.mat');
orl_lbls = orl_lbls.lbls;

%One sample of the data.
img1 = orl_data(:,80)
```

```
img1 = 1200×1
    0.4506
    0.4493
    0.4415
    0.4309
    0.3835
    0.3687
    0.3362
    0.2535
    0.2315
    0.2200
      ⋮
```

```
imshow(reshape(img1, [40, 30]))
```

```
%Pre allock
train_images = zeros(1200, 280);
test_images = zeros(1200, 120);

train_labels = zeros(280,1);
test_labels = zeros(120,1);

for i = 0:39
    p = randperm(10); %Random slice
    train_images(:,(i*7+1):((i+1)*7)) = orl_data(:,p(1:7)+i*10); %Take from 1 to 7.
    train_labels((i*7+1):((i+1)*7)) = orl_lbls(p(1:7)+i*10);
    test_images(:,(i*3+1):((i+1)*3)) = orl_data(:,p(8:10)+i*10); % Use the rest for test.
    test_labels((i*3+1):((i+1)*3)) = orl_lbls(p(8:10)+i*10);
end
```

```
%One sample of the data.
img1 = train_images(:,1)
```

```
img1 = 1200×1
    0.1874
    0.1695
    0.1576
    0.2450
    0.2266
    0.3070
    0.3784
    0.4194
    0.4776
    0.5339
      ⋮
```

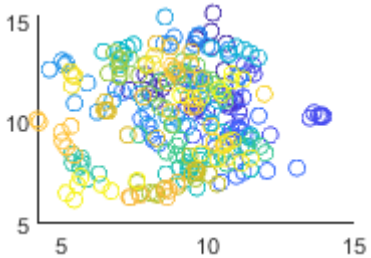
```
imshow(reshape(img1, [40, 30]))
```

PCA

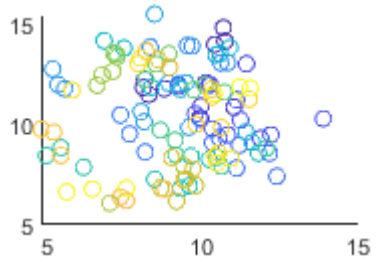
```
all_images = [train_images test_images];

[train_pca,test_pca] = pcaManual(all_images,train_images,test_images)
```

```
train_pca = 2×280
   10.6447    9.6305   10.1287    9.6972   10.2010   10.5618   10.1333    8.2576 ···
   13.8932   14.1129   13.6999   14.2603   15.3841   12.5576   14.4910   11.0884
test_pca = 2×120
   10.6806   10.7291   10.3949    8.1077    8.1543    8.2894   11.0189    9.9529 ···
   14.8459   14.1733   14.0191   11.8616   12.2710   11.5160   10.8768   10.9294
```

```
% Plot the data
scatter(train_pca(1,:),train_pca(2,:),[],train_labels)
```

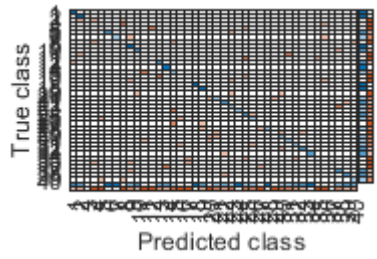


```
scatter(test_pca(1,:),test_pca(2,:)  ,[],test_labels)
```



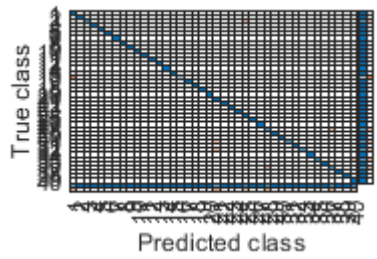
Nearest Class Centroid Classifier

```
%Pca data
class_labels = nearestClassCentroidClassifierORL(train_labels, train_pca, test_pca);
plotconfusionMatrixManual(test_pca, test_labels, class_labels)
```




```
Overall accuracy: 39.1667%
```

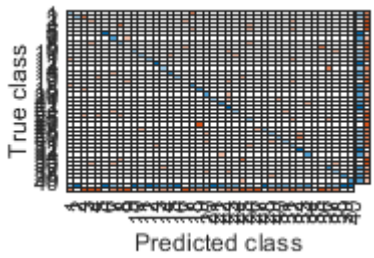
```
%Real data
class_labels = nearestClassCentroidClassifierORL(train_labels, train_images, test_images);
plotconfusionMatrixManual(test_images, test_labels, class_labels)
```




```
Overall accuracy: 93.3333%
```

Nearest Sub-Class Centroid Classifier 2

```
%Pca data
tic
class_labels = NearestSubClassCentroidClassifierORL(train_labels, train_pca, test_pca,2);
plotconfusionMatrixManual(test_pca, test_labels, class_labels')
```

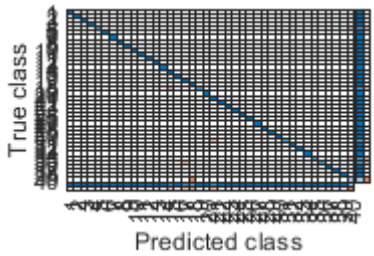



```
Overall accuracy: 40.8333%
```

```
toc
```

```
Elapsed time is 0.802422 seconds.
```

```
%Real data
tic
class_labels = NearestSubClassCentroidClassifierORL(train_labels, train_images, test_images,2)
plotconfusionMatrixManual(test_images, test_labels, class_labels')
```



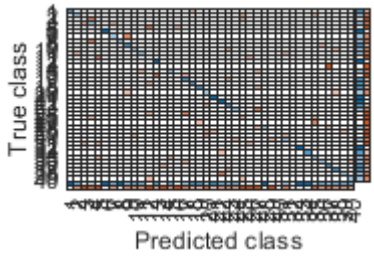

```
Overall accuracy: 94.1667%
```

```
toc
```

```
Elapsed time is 1.109211 seconds.
```

Nearest Sub-Class Centroid Classifier 3

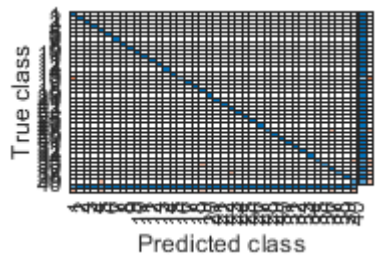
```
%Pca data
class_labels = NearestSubClassCentroidClassifierORL(train_labels, train_pca, test_pca,3);
plotconfusionMatrixManual(test_pca, test_labels, class_labels')
```




```
Overall accuracy: 40%
```

```

```

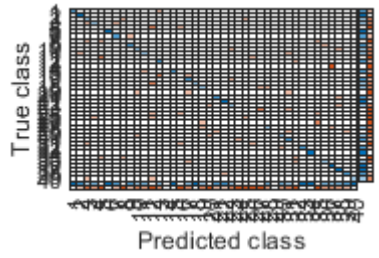
```
%Real data
class_labels = NearestSubClassCentroidClassifierORL(train_labels, train_images, test_images,3)
plotconfusionMatrixManual(test_images, test_labels, class_labels')
```




```
Overall accuracy: 94.1667%
```

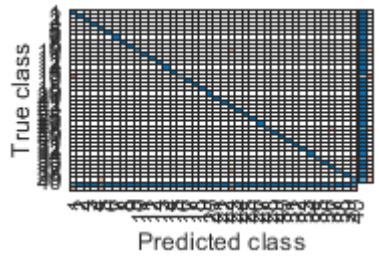
Nearest Sub-Class Centroid Classifier 5

```
%Pca data
class_labels = NearestSubClassCentroidClassifierORL(train_labels, train_pca, test_pca,5);
plotconfusionMatrixManual(test_pca, test_labels, class_labels')
```




```
Overall accuracy: 40.8333%
```

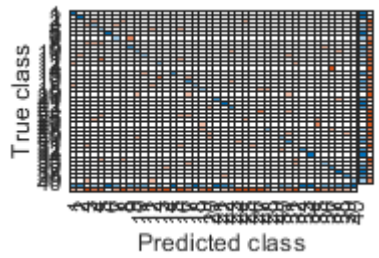
```
%Real data
class_labels = NearestSubClassCentroidClassifierORL(train_labels, train_images, test_images,5)
plotconfusionMatrixManual(test_images, test_labels, class_labels')
```




```
Overall accuracy: 94.1667%
```

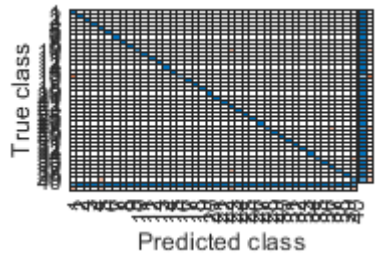
Nearest Neighbor classifier

```
%Pca
class_labels = NearestNeighborClassifier(train_labels, train_pca, test_pca);
plotconfusionMatrixManual(test_pca, test_labels, class_labels)
```




```
Overall accuracy: 40%
```

```
%Real data
class_labels = NearestNeighborClassifier(train_labels, train_images, test_images);
plotconfusionMatrixManual(test_pca, test_labels, class_labels)
```




```
Overall accuracy: 94.1667%
```

Perceptron with backpropagation

```
nDOT     = 10^(-3);
max_runs = 600;
%Pca
result = perceptron_with_back(train_pca,train_labels,nDOT,max_runs)
```

```
bincounts = 1×40
     7     7     7     7     7     7     7     7     7     7     7     7     7 ···
result = 3×40
    0.0900   -0.7633    0.7861   -0.2329   -0.1001    2.0266   -1.0630    0.2331 ···
    0.3300    0.5343   -0.6714   -0.4484   -0.1695   -1.5958   -1.4939   -0.0541
   -4.5790   -0.2640   -1.1100   -0.3860   -0.2580   -1.5940   -2.8590   -1.0760
```

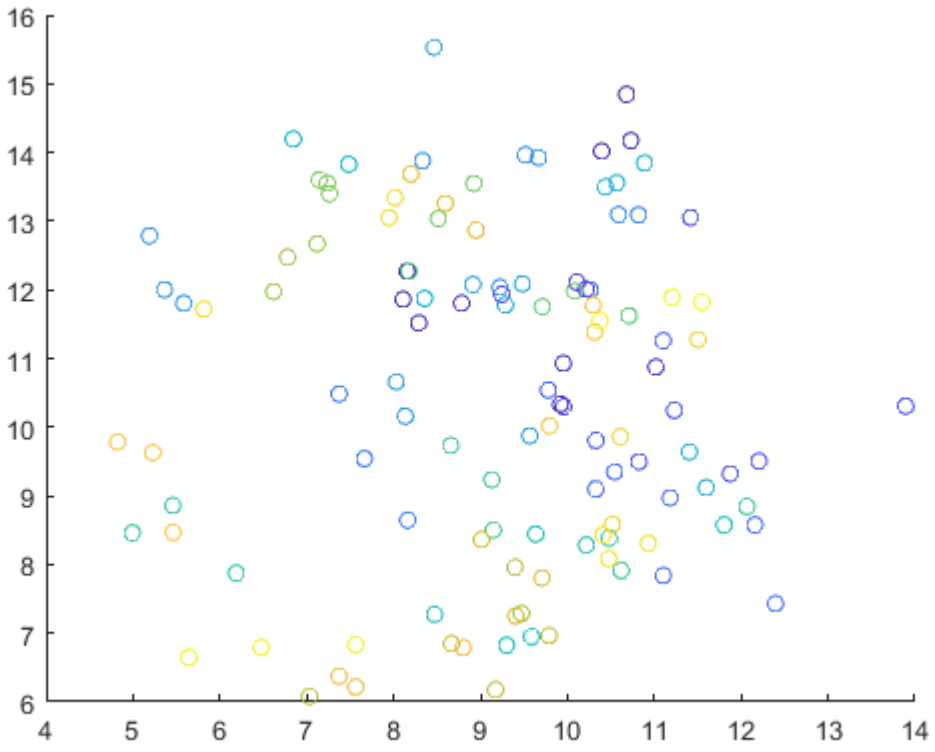
```
%Real data
result = perceptron_with_back(train_images,train_labels,nDOT,max_runs)
```

```
bincounts = 1×40
     7     7     7     7     7     7     7     7     7     7     7     7     7 ···
result = 1201×40
    0.3356    0.2422    0.9738    1.1100    1.1276    0.9866    0.1740    0.8609 ···
    0.3335    0.2906    1.0173    1.1520    1.1684    1.0161    0.2147    0.8699
    0.3326    0.3371    1.0666    1.1915    1.2194    1.0460    0.2688    0.8794
    0.3372    0.2794    1.0035    1.1126    1.1483    0.9954    0.2411    0.8271
    0.3466    0.3165    1.0236    1.1222    1.1486    1.0018    0.2800    0.7787
    0.3662    0.2716    0.9015    1.0438    1.0595    0.9431    0.2614    0.6348
    0.3882    0.2445    0.7689    0.9198    0.9799    0.8846    0.2621    0.5415
    0.4170    0.1978    0.6664    0.7905    0.8715    0.8175    0.2819    0.4129
```

```
    0.4629    0.2380    0.4715    0.7056    0.8707    0.7542    0.3755    0.3184
    0.5131    0.2986    0.3148    0.4779    0.8872    0.6598    0.5135    0.3491
      ⋮
```

Perceptron LMS

```
%Pca data
w = Perceptron_LMS_ORL(train_labels, train_pca);

figure
scatter(test_pca(1,:),test_pca(2,:),[],test_labels)
hold on
for i = 1:size(w,2)
    plotpc(w(2:end,i)',w(1,i));
end
hold off
```




```
plots_perceptronForORL(train_pca,train_labels,w)
```

```
Overall accuracy: 97.5%
```

```
%Real data
w = Perceptron_LMS_ORL(train_labels, train_images);
```

```
plots_perceptronForORL(test_images,test_labels,w)
```

```
Overall accuracy: 99.5%
```