```
Python 3 O
                                            Widgets
                                                      Help
                     Insert Cell
                                   Kernel
              View
                                                                                                                           Trusted
~
       In [1]: # a)
               import numpy as np
               from scipy.io import loadmat
               import matplotlib.pyplot as plt
               in data = loadmat('face emotion data.mat')
               y = in_data['y']
               X = in_data['X']
      In [2]: w= np.linalg.inv(X.T@X)@X.T@y
               print(w)
               [[ 0.94366942]
                 0.21373778]
                 0.26641775
                 [-0.39221373]
                 [-0.00538552]
                 [-0.01764687]
                 [-0.16632809]
                 [-0.0822838
                [-0.16644364]]
       In [3]: # b) If the new image has a input vector of x, the predicted label for
               # this image is sign(x@w). If the result is +1 then the image is a happy face, otherwise
               # an angry faces.
      In [4]: # c) the first feature vector is more important: since it is 0.94, which is the largest value among all vectors
       In [5]: # d)
               # easy to find that vectors with greatest values should be used to build classifier
               X3 = X[:,[0,2,3]]
               w3 = np.linalg.inv(X3.T@X3)@X3.T@y
               print(w3)
               [[ 0.70546316]
                 0.8737872
                [-0.78805643]]
       In [6]: # e)
               error = len([1 for i in np.hstack((np.sign(X@w), y)) if i[0]!=i[1]])
               print("error rate 9 features: ",error/len(np.sign(X@w))*100,"%")
               error_vec_3 = len([1 for i in np.hstack((np.sign(X3@w3), y)) if i[0]!=i[1]])
               print("error rate 3 features: ",error_vec_3/len(np.sign(X3@w3))*100,"%")
               error rate 9 features: 2.34375 %
               error rate 3 features: 6.25 %
     In [10]: # f)
               from IPython.core.interactiveshell import InteractiveShell
               InteractiveShell.ast_node_interactivity = "all"
               # %%javascript
               # IPython.OutputArea.auto_scroll_threshold = 9999
               for i in range(8):
                hold = [j for j in range(i*16,i*16+16)]
                error = len([1 for i in np.hstack((np.sign(X[hold,:]@w), y[hold])) if i[0]!=i[1]])
                learn = [j for j in range(len(X)) if j not in hold]
                w = np.linalg.inv(X[learn,:].T@X[learn,:])@X[learn,:].T@y[learn]
                error=error/len(y[hold])*100
                print(i," Holdout set: ",hold)
                print(i," Training set: ",learn)
                print(i," iteration: error rate ",error,"%")
                print(i," iteration: weight: \n",w)
                print("-----")
               0 Holdout set: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15]
               0 Training set: [16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42,
               43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74,
               75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 10
               5, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127]
               0 iteration: error rate 0.0 %
               0 iteration: weight:
                [[ 0.91041778]
                 [ 0.00918976]
                 0.40141401]
                 [-0.32425274]
                 [-0.05200825]
                 0.01241881]
                 [-0.11750884]
                [-0.03420966]
                [-0.10223542]]
               1 Holdout set: [16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]
               1 Training set: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 4
               5, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76,
               77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106,
               107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127]
               1 iteration: error rate 6.25 %
               1 iteration: weight:
                [[ 0.96509442]
                 [ 0.14376855]
                 0.2815907
                 [-0.36587949]
                [-0.01368285]
                 0.00729999]
                 [-0.19015301]
                 [-0.09899926]
                [-0.14497313]]
               2 Holdout set: [32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47]
               2 Training set: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 2
               9, 30, 31, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76,
               77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106,
               107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127]
               2 iteration: error rate 12.5 %
               2 iteration: weight:
                [[ 0.94323221]
                 0.34632076]
                 0.21576937
                 [-0.47637296]
                 0.05743401]
                 [-0.04440264]
                 [-0.22623441]
                 [-0.08717742]
                [-0.14326328]
               3 Holdout set: [48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63]
               3 Training set: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 2
               9, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76,
               77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106,
               107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127]
               3 iteration: error rate 0.0 %
               3 iteration: weight:
                [[ 0.95057284]
                 0.36010262]
                 0.17170438]
                 [-0.39965363]
                 [-0.03698837]
                 0.00352684
                 [-0.22439815]
                 [-0.02562857]
                [-0.18695421]]
               4 Holdout set: [64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79]
               4 Training set: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 2
               9, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60,
               61, 62, 63, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106,
               107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127]
               4 iteration: error rate 0.0 %
               4 iteration: weight:
                [[ 0.98904732]
                 [ 0.23635813]
                 0.15092244]
                 [-0.31409029]
                 0.00750529
                 [-0.03473085]
                 [-0.15501731]
                [-0.11683411]
                [-0.18145734]]
               5 Holdout set: [80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95]
               5 Training set: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 2
               9, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60,
               61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106,
               107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127]
               5 iteration: error rate 6.25 %
               5 iteration: weight:
                [[ 0.95162553]
                 [ 0.20380173]
                 0.28824369]
                 [-0.41078527]
                 [-0.02677623]
                 [-0.01373647]
                 [-0.1240282
                 [-0.11141277]
                [-0.18399559]]
               6 Holdout set: [96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111]
               6 Training set: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 2
               9, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60,
               61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92,
               93, 94, 95, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127]
               6 iteration: error rate 0.0 %
               6 iteration: weight:
                [[ 0.94104084]
                [ 0.13361189]
                 0.32923606]
                 [-0.38697515]
                 [-0.00930223]
                 [-0.02867065]
                 [-0.13882858]
                 [-0.10526937]
                [-0.15762386]]
               7 Holdout set: [112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127]
               7 Training set: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 2
               9, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60,
               61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92,
               93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111]
               7 iteration: error rate 0.0 %
               7 iteration: weight:
                [[ 0.9038598
                 0.23993966]
                 0.3204506
                 [-0.44786928]
                 0.02857411]
                 [-0.04489301]
                 [-0.14655297]
                 [-0.06252364]
                [-0.19587465]]
      In [ ]:
      In [ ]:
```

Jupyter Untitled Last Checkpoint: a few seconds ago (unsaved changes)

Logout