```
C:\Users\Sapan\Downloads\4p76Assign1\assign1\venv\Scripts\python.exe C:/Users/Sapan/Downloads/4p76Assign1/assign1/main.py
Enter 1 for Digits classification, Enter 2 for Cancer classification: 1
Enter number of tests to compare (only works on 3), if don't want to run tests just single run enter 1: 3
Give name to your Test for files: hidden_digits

Test no.: 0
Enter number of neurons for hidden layer: 15
Enter number of epochs: 25
Enter 1 for sigmoid or 2 for tanh activation function: 1
Enter learning rate: 01.7
Enter Momentum: 0.15
Running---------
Fold no.:  0
Accumulated sum error over epochs:  [5747.225052936327, 4706.309838586914, 3924.6408169211545, 2941.624607897399, 2285.9242425472767, 1816.4503040151358, 1668.6828247430685, 1590.5863887196435, 1565.610922782905, 1510.4185176402698, 1554.5409983624882, 1574.375119654311, 1518.217320090183, 1607.973469736181, 1494.1646035700535, 1492.1306947969317, 1382.8970000267122, 881.9828120176779, 765.7025352713028, 762.5496586537821, 761.0247774308963, 700.5444532215733, 717.4933892734152, 697.5078038388153, 710.0924109749625]

Correct classification validation set:  1610

Correct classification test set:  3651
end of fold

Running---------
Fold no.:  1
Accumulated sum error over epochs:  [6289.31201775337, 4616.786740386116, 2703.952395612488, 1703.9915133556, 1479.3730820698167, 1413.9949991743758, 1307.8319085385447, 1307.6457043607668, 1304.6292506877605, 1253.7750660368326, 1194.4899660683707, 1214.3981434428754, 1143.2315156361162, 1068.252185997021, 1079.5077065392172, 1076.6319855762497, 959.8128658100353, 884.1527103268451, 919.1704183697942, 813.9251608411047, 814.265502768826, 864.5081620461425, 822.0851724384149, 812.5302451116958, 750.9368761526897]

Correct classification validation set:  1553

Correct classification test set:  3609
end of fold

Running---------
Fold no.:  2
Accumulated sum error over epochs:  [6565.224398326837, 3685.5291731764596, 1692.1449735603057, 1244.5055562690786, 1137.54569630369, 1099.0491893474677, 982.3544878962272, 993.2401315272322, 954.7709537823039, 887.6955991462966, 856.4670115777682, 811.1452852231636, 809.5655990389763, 756.281540429361, 733.6725031681646, 698.7775987234608, 708.0300077455333, 695.7792629316036, 687.7791451419503, 646.8073558718849, 632.0470734052186, 618.3380944602051, 619.0887089056226, 590.2375714485622, 594.4365548396686]

Correct classification validation set:  1609

Correct classification test set:  3687
end of fold

Running---------
Fold no.:  3
Accumulated sum error over epochs:  [6223.226336141074, 4910.2028664488225, 4581.136203739568, 2162.805696091101, 1499.332669590906, 1353.9205651857812, 1313.7157291100018, 1206.1678576944869, 1061.3749699717853, 997.6043717476632, 906.
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0204131868518, 889.3726635610402, 833.680472435766, 792.5781591593885, 772.6812804515835
, 774.553603370006, 746.5774353362053, 737.9906919408947, 707.2158631614113, 681.
7316943042632, 725.0887718580498, 696.505437714984, 670.2144609420419, 677.2267187872354
, 699.6391730345157]

Correct classification validation set:  1593

Correct classification test set:  3651
end of fold

Fold test accuracies%:  [91.27499999999999, 90.225, 92.175, 91.27499999999999]
Fold validation accuracies%:  [92.05260148656374, 88.79359634076616, 91.99542595769012,
91.08061749571183]
Mean fold validation accuracies%:  90.98056032018297

Test no.: 1
Enter number of neurons for hidden layer: 30
Enter number of epochs: 25
Enter 1 for sigmoid or 2 for tanh activation function: 1
Enter learning rate: 1.7
Enter Momentum: 0.15
Running---------
Fold no.:  0
Accumulated sum error over epochs:  [46860.87379694094, 43049.98156201051, 39184.
53590278934, 35464.94471178163, 30855.871533676393, 23135.959726366054, 22375.
201131654452, 21893.970299229477, 21386.787906928654, 21264.947794933807, 21117.
646906837574, 20567.88062007712, 15033.692867237625, 11161.185812684404, 10371.
4875957928, 5893.113475907073, 5678.57131853833, 5588.760839284703, 5594.465260287326,
5530.3161237782215, 5566.9354062962175, 5529.490959785132, 5478.365360111064, 5450.
899619120216, 5413.022636866059]

Correct classification validation set:  417

Correct classification test set:  996
end of fold

Running---------
Fold no.:  1
Accumulated sum error over epochs:  [47222.92342595724, 44051.29263091111, 43045.
58962371288, 43077.975933578986, 36195.58560177424, 34791.5130894793, 34852.46316512675
, 34841.707352749734, 34816.210889360045, 34919.86542983258, 34523.95159204646, 34125.
31026457701, 33379.212898256395, 29654.286522464405, 29615.61617938607, 23191.
92378683797, 13558.891243264869, 5761.141914037499, 2671.78849205714, 2137.866252355808
, 1834.3378571870494, 1543.7720654772288, 1411.0364728570062, 1402.0901047930195, 1260.
611088016176]

Correct classification validation set:  1429

Correct classification test set:  3267
end of fold

Running---------
Fold no.:  2
Accumulated sum error over epochs:  [47222.97412273861, 47222.969782583714, 47222.
962813542086, 47222.94863844927, 47222.86449793083, 39719.42826546691, 31611.17482031803
, 25404.211714767396, 20339.897239929025, 18200.892044148855, 17760.031284452878, 17130.
242422947904, 12186.460704310208, 7927.807021643324, 6781.686317317145, 1758.
8703111899408, 1509.2633176720756, 1397.4629036521505, 1311.3426057569784, 1287.
6370943429574, 1169.8149807154537, 1131.2422287340137, 1070.9142080957588, 1060.
190607447023, 1065.4176660004193]

Correct classification validation set:  1460
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Correct classification test set:  3381
end of fold

Running---------
Fold no.:  3
Accumulated sum error over epochs:  [47222.9521422813, 47222.93283298862, 47222.85679296908, 40374.34831394763, 30198.54321183878, 22281.802274186688, 22429.32079084107, 22018.564870561797, 21870.624040313327, 21902.81056940856, 21363.610483026765, 20937.37866303392, 20910.774208945837, 20356.96394961766, 11878.437015665157, 2635.758582665454, 2094.925424462423, 1959.9957569589455, 1731.9538121829155, 1327.5558168525006, 1269.5993453880592, 1225.2528598729948, 1184.422820668959, 1172.5070131076866, 1175.2048470025406]

Correct classification validation set:  1433

Correct classification test set:  3292
end of fold

Fold test accuracies%:  [24.9, 81.675, 84.52499999999999, 82.3]
Fold validation accuracies%:  [23.842195540308747, 81.70383076043454, 83.47627215551744, 81.9325328759291]
Mean fold validation accuracies%:  67.73870783304746

Test no.: 2
Enter number of neurons for hidden layer: 45
Enter number of epochs: 25
Enter 1 for sigmoid or 2 for tanh activation function: 1
Enter learning rate: 1.7
Enter Momentum: 0.15
Running---------
Fold no.:  0
Accumulated sum error over epochs:  [47222.99992139518, 47222.999921204304, 47222.999921012146, 47222.99992081924, 47222.999920625036, 47222.999920429764, 47222.9999202336, 47222.9999200364, 47222.99991983782, 47222.99991963826, 47222.9999194376, 47222.99991923583, 47222.99991903318, 47222.99991882909, 47222.999918623864, 47222.99991841748, 47222.999918210066, 47222.99991800139, 47222.999917791494, 47222.9999175803, 47222.99991736808, 47222.99991715453, 47222.99991693972, 47222.999916724075, 47222.99991650673]

Correct classification validation set:  188

Correct classification test set:  400
end of fold

Running---------
Fold no.:  1
Accumulated sum error over epochs:  [47222.999958958935, 47222.999958926775, 47222.999958894296, 47222.99995886204, 47222.999958829634, 47222.99995879708, 47222.999958764645, 47222.99995873209, 47222.99995869957, 47222.99995866697, 47222.99995863404, 47222.99995860131, 47222.99995856861, 47222.99995853569, 47222.999958502696, 47222.99995846951, 47222.99995843634, 47222.99995840309, 47222.999958369895, 47222.99995833655, 47222.9999583031, 47222.9999582696, 47222.99995823599, 47222.99995820236, 47222.99995816878]

Correct classification validation set:  169

Correct classification test set:  400
end of fold

Running---------
Fold no.:  2
Accumulated sum error over epochs:  [47222.99998154202, 47222.99998153832, 47222.99998153437, 47222.9999815304, 47222.999981526395, 47222.99998152263, 47222.99998151902
```

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, 47222.99998151499, 47222.999981511006, 47222.999981507164, 47222.99998150333, 47222.
999981499524, 47222.999981495384, 47222.99998149144, 47222.99998148754, 47222.
99998148392, 47222.999981479974, 47222.99998147603, 47222.99998147206, 47222.99998146815
, 47222.9999814644, 47222.999981460394, 47222.99998145634, 47222.99998145256, 47222.
99998144885]

Correct classification validation set:  176

Correct classification test set:  400
end of fold

Running---------
Fold no.:  3
Accumulated sum error over epochs:  [47222.99994897663, 47222.99994895112, 47222.
99994892574, 47222.99994889997, 47222.99994887433, 47222.99994884861, 47222.999948822944
, 47222.99994879707, 47222.99994877122, 47222.99994874535, 47222.9999487196, 47222.
999948693534, 47222.999948667915, 47222.99994864176, 47222.99994861578, 47222.
999948589626, 47222.9999485639, 47222.99994853802, 47222.9999485115, 47222.99994848546,
47222.999948459474, 47222.99994843335, 47222.99994840664, 47222.99994838052, 47222.
99994835458]

Correct classification validation set:  180

Correct classification test set:  400
end of fold

Fold test accuracies%:  [10.0, 10.0, 10.0, 10.0]
Fold validation accuracies%:  [10.748999428244712, 9.662664379645513, 10.062893081761008
, 10.291595197255575]
Mean fold validation accuracies%:  10.191538021726702

Test results:
    test0   test1  test2
0  91.275  24.900   10.0
1  90.225  81.675   10.0
2  92.175  84.525   10.0
3  91.275  82.300   10.0
Test stats:
           test0      test1  test2
count   4.000000   4.000000    4.0
mean   91.237500  68.350000   10.0
std     0.797261  28.992477    0.0
min    90.225000  24.900000   10.0
25%    91.012500  67.481250   10.0
50%    91.275000  81.987500   10.0
75%    91.500000  82.856250   10.0
max    92.175000  84.525000   10.0

Validation results:
       test0      test1      test2
0  92.052601  23.842196  10.748999
1  88.793596  81.703831   9.662664
2  91.995426  83.476272  10.062893
3  91.080617  81.932533  10.291595
Valid stats:
           test0      test1      test2
count   4.000000   4.000000   4.000000
mean   90.980560  67.738708  10.191538
std     1.524472  29.274927   0.453516
min    88.793596  23.842196   9.662664
25%    90.508862  67.238422   9.962836
50%    91.538022  81.818182  10.177244
75%    92.009720  82.318468  10.405946
```

```
176 max    92.052601  83.476272  10.748999
177
178 shapiro test for testing accuracies
179 test0 stats=0.9419, p=0.6658
180 test1 stats=0.6693, p=0.0048
181 test2 stats=1.0000, p=1.0000
182
183 shapiro test for validation accuracies
184 test0 stats=0.8206, p=0.1447
185 test1 stats=0.6545, p=0.0030
186 test2 stats=0.9978, p=0.9928
187
188 ANOVA test
189                           sum_sq   df            F    PR(>F)
190 df_test.iloc[:, 1]     0.000127  1.0     0.000133  0.991834
191 df_test.iloc[:, 2]  3957.682141  1.0  4151.238085  0.000241
192 Residual               1.906748  2.0          NaN       NaN
193
194 t-tests:
195 Ttest_indResult(statistic=1.5782612085723584, pvalue=0.2124804312077791)
196 Ttest_indResult(statistic=4.025182053180372, pvalue=0.027551803521254484)
197 Ttest_indResult(statistic=203.79149745416635, pvalue=2.605403067423465e-07)
198
199 Statistically better mean available, the one with highest average accuracy
200 C:\Users\Sapan\Downloads\4p76Assign1\assign1\venv\lib\site-packages\scipy\stats\
    morestats.py:1678: UserWarning: Input data for shapiro has range zero. The results may
    not be accurate.
201   warnings.warn("Input data for shapiro has range zero. The results "
202
203 Process finished with exit code 0
204
```