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1 "C:\Program Files\Anaconda3\python.exe" C:/Users/anant/OneDrive/Documents/Niveditha/PSU/
  Spring2018/ML/ProgrammingAssignments/neuralNet/neuralNetworkExp2.py
2 Epoch Number: 0
3 Training Accuracy:  10.941666666666666
4 Test Accuracy:  10.620000000000001
5 Epoch Number: 1
6 Training Accuracy:  88.97
7 Test Accuracy:  93.38
8 Epoch Number: 2
9 Training Accuracy:  95.29333333333334
10 Test Accuracy:  95.52000000000001
11 Epoch Number: 3
12 Training Accuracy:  96.52833333333334
13 Test Accuracy:  96.28999999999999
14 Epoch Number: 4
15 Training Accuracy:  97.19
16 Test Accuracy:  96.64
17 Epoch Number: 5
18 Training Accuracy:  97.54166666666667
19 Test Accuracy:  96.91
20 Epoch Number: 6
21 Training Accuracy:  97.795
22 Test Accuracy:  97.08
23 Epoch Number: 7
24 Training Accuracy:  98.01166666666667
25 Test Accuracy:  97.18
26 Epoch Number: 8
27 Training Accuracy:  98.17833333333333
28 Test Accuracy:  97.26
29 Epoch Number: 9
30 Training Accuracy:  98.295
31 Test Accuracy:  97.36
32 Epoch Number: 10
33 Training Accuracy:  98.43499999999999
34 Test Accuracy:  97.35000000000001
35 Epoch Number: 11
36 Training Accuracy:  98.52
37 Test Accuracy:  97.39999999999999
38 Epoch Number: 12
39 Training Accuracy:  98.57000000000001
40 Test Accuracy:  97.41
41 Epoch Number: 13
42 Training Accuracy:  98.63333333333333
43 Test Accuracy:  97.44
44 Epoch Number: 14
45 Training Accuracy:  98.695
46 Test Accuracy:  97.5
47 Epoch Number: 15
48 Training Accuracy:  98.73833333333333
49 Test Accuracy:  97.5
50 Epoch Number: 16
51 Training Accuracy:  98.78833333333333
52 Test Accuracy:  97.53
53 Epoch Number: 17
54 Training Accuracy:  98.83833333333332
55 Test Accuracy:  97.55
56 Epoch Number: 18
57 Training Accuracy:  98.875
58 Test Accuracy:  97.57000000000001
59 Epoch Number: 19
60 Training Accuracy:  98.91333333333333
61 Test Accuracy:  97.59
62 Epoch Number: 20
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63 Training Accuracy:  98.95666666666668
64 Test Accuracy:    97.6
65 Epoch Number: 21
66 Training Accuracy:  99.0
67 Test Accuracy:    97.61999999999999
68 Epoch Number: 22
69 Training Accuracy:  99.02666666666666
70 Test Accuracy:    97.63
71 Epoch Number: 23
72 Training Accuracy:  99.05166666666668
73 Test Accuracy:    97.65
74 Epoch Number: 24
75 Training Accuracy:  99.08333333333333
76 Test Accuracy:    97.71
77 Epoch Number: 25
78 Training Accuracy:  99.1
79 Test Accuracy:    97.74000000000001
80 Epoch Number: 26
81 Training Accuracy:  99.125
82 Test Accuracy:    97.76
83 Epoch Number: 27
84 Training Accuracy:  99.14833333333334
85 Test Accuracy:    97.75
86 Epoch Number: 28
87 Training Accuracy:  99.17166666666667
88 Test Accuracy:    97.75
89 Epoch Number: 29
90 Training Accuracy:  99.195
91 Test Accuracy:    97.74000000000001
92 Epoch Number: 30
93 Training Accuracy:  99.21833333333333
94 Test Accuracy:    97.72
95 Epoch Number: 31
96 Training Accuracy:  99.24
97 Test Accuracy:    97.74000000000001
98 Epoch Number: 32
99 Training Accuracy:  99.25666666666667
100 Test Accuracy:    97.76
101 Epoch Number: 33
102 Training Accuracy:  99.265
103 Test Accuracy:    97.78
104 Epoch Number: 34
105 Training Accuracy:  99.27333333333334
106 Test Accuracy:    97.78
107 Epoch Number: 35
108 Training Accuracy:  99.29333333333334
109 Test Accuracy:    97.8
110 Epoch Number: 36
111 Training Accuracy:  99.30833333333334
112 Test Accuracy:    97.77
113 Epoch Number: 37
114 Training Accuracy:  99.32333333333332
115 Test Accuracy:    97.77
116 Epoch Number: 38
117 Training Accuracy:  99.34166666666667
118 Test Accuracy:    97.76
119 Epoch Number: 39
120 Training Accuracy:  99.35833333333333
121 Test Accuracy:    97.77
122 Epoch Number: 40
123 Training Accuracy:  99.37166666666667
124 Test Accuracy:    97.77
125 Epoch Number: 41

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126 Training Accuracy:  99.38166666666667
127 Test Accuracy:    97.77
128 Epoch Number: 42
129 Training Accuracy:  99.395
130 Test Accuracy:    97.78
131 Epoch Number: 43
132 Training Accuracy:  99.41666666666666
133 Test Accuracy:    97.78
134 Epoch Number: 44
135 Training Accuracy:  99.42666666666666
136 Test Accuracy:    97.81
137 Epoch Number: 45
138 Training Accuracy:  99.43666666666667
139 Test Accuracy:    97.78
140 Epoch Number: 46
141 Training Accuracy:  99.44833333333334
142 Test Accuracy:    97.76
143 Epoch Number: 47
144 Training Accuracy:  99.45833333333334
145 Test Accuracy:    97.74000000000001
146 Epoch Number: 48
147 Training Accuracy:  99.46166666666667
148 Test Accuracy:    97.74000000000001
149 Epoch Number: 49
150 Training Accuracy:  99.47333333333333
151 Test Accuracy:    97.72
152 Confusion Matrix for the test data for momentum:  0
153 [[ 973      0      0      1      0      1      1      1      3      0]
154 [    0 1121      2      5      0      1      2      2      2      0]
155 [    4      2 1007      1      0      1      3      5      4      5]
156 [    1      0      0 991      0      5      1      5      5      2]
157 [    2      1      1      1 958      0      5      1      2     11]
158 [    5      0      0      6      0 867      3      2      5      4]
159 [    8      3      0      1      2      5 936      0      3      0]
160 [    2      3      9      3      1      0      0 997      4      9]
161 [    4      1      2      5      4      5      1      3 947      2]
162 [    1      7      0      5      8      3      1      4      5 975]]
163 Epoch Number: 0
164 Training Accuracy:  9.62
165 Test Accuracy:    9.39
166 Epoch Number: 1
167 Training Accuracy:  90.23333333333333
168 Test Accuracy:    94.04
169 Epoch Number: 2
170 Training Accuracy:  95.86166666666666
171 Test Accuracy:    95.66
172 Epoch Number: 3
173 Training Accuracy:  96.85166666666667
174 Test Accuracy:    96.34
175 Epoch Number: 4
176 Training Accuracy:  97.37333333333333
177 Test Accuracy:    96.78999999999999
178 Epoch Number: 5
179 Training Accuracy:  97.73333333333333
180 Test Accuracy:    97.03
181 Epoch Number: 6
182 Training Accuracy:  97.96666666666667
183 Test Accuracy:    97.11999999999999
184 Epoch Number: 7
185 Training Accuracy:  98.13833333333334
186 Test Accuracy:    97.27
187 Epoch Number: 8
188 Training Accuracy:  98.30666666666666
```

189 Test Accuracy: 97.37
190 Epoch Number: 9
191 Training Accuracy: 98.42999999999999
192 Test Accuracy: 97.44
193 Epoch Number: 10
194 Training Accuracy: 98.56833333333334
195 Test Accuracy: 97.5
196 Epoch Number: 11
197 Training Accuracy: 98.65666666666667
198 Test Accuracy: 97.52
199 Epoch Number: 12
200 Training Accuracy: 98.72166666666666
201 Test Accuracy: 97.57000000000001
202 Epoch Number: 13
203 Training Accuracy: 98.78166666666667
204 Test Accuracy: 97.56
205 Epoch Number: 14
206 Training Accuracy: 98.85166666666667
207 Test Accuracy: 97.6
208 Epoch Number: 15
209 Training Accuracy: 98.91
210 Test Accuracy: 97.61
211 Epoch Number: 16
212 Training Accuracy: 98.955
213 Test Accuracy: 97.61999999999999
214 Epoch Number: 17
215 Training Accuracy: 99.00166666666667
216 Test Accuracy: 97.61
217 Epoch Number: 18
218 Training Accuracy: 99.05000000000001
219 Test Accuracy: 97.59
220 Epoch Number: 19
221 Training Accuracy: 99.07333333333334
222 Test Accuracy: 97.61
223 Epoch Number: 20
224 Training Accuracy: 99.115
225 Test Accuracy: 97.58
226 Epoch Number: 21
227 Training Accuracy: 99.14833333333334
228 Test Accuracy: 97.58
229 Epoch Number: 22
230 Training Accuracy: 99.18333333333334
231 Test Accuracy: 97.6
232 Epoch Number: 23
233 Training Accuracy: 99.21
234 Test Accuracy: 97.58
235 Epoch Number: 24
236 Training Accuracy: 99.24166666666666
237 Test Accuracy: 97.61
238 Epoch Number: 25
239 Training Accuracy: 99.26166666666667
240 Test Accuracy: 97.61
241 Epoch Number: 26
242 Training Accuracy: 99.29333333333334
243 Test Accuracy: 97.64
244 Epoch Number: 27
245 Training Accuracy: 99.32
246 Test Accuracy: 97.6
247 Epoch Number: 28
248 Training Accuracy: 99.33666666666666
249 Test Accuracy: 97.58
250 Epoch Number: 29
251 Training Accuracy: 99.35666666666667

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252 Test Accuracy: 97.6
253 Epoch Number: 30
254 Training Accuracy: 99.37666666666667
255 Test Accuracy: 97.58
256 Epoch Number: 31
257 Training Accuracy: 99.38833333333334
258 Test Accuracy: 97.58
259 Epoch Number: 32
260 Training Accuracy: 99.40666666666667
261 Test Accuracy: 97.59
262 Epoch Number: 33
263 Training Accuracy: 99.42166666666667
264 Test Accuracy: 97.6
265 Epoch Number: 34
266 Training Accuracy: 99.43666666666667
267 Test Accuracy: 97.61
268 Epoch Number: 35
269 Training Accuracy: 99.44666666666667
270 Test Accuracy: 97.61999999999999
271 Epoch Number: 36
272 Training Accuracy: 99.46166666666667
273 Test Accuracy: 97.63
274 Epoch Number: 37
275 Training Accuracy: 99.47500000000001
276 Test Accuracy: 97.64
277 Epoch Number: 38
278 Training Accuracy: 99.495
279 Test Accuracy: 97.63
280 Epoch Number: 39
281 Training Accuracy: 99.50666666666666
282 Test Accuracy: 97.63
283 Epoch Number: 40
284 Training Accuracy: 99.51666666666667
285 Test Accuracy: 97.64
286 Epoch Number: 41
287 Training Accuracy: 99.52833333333334
288 Test Accuracy: 97.6
289 Epoch Number: 42
290 Training Accuracy: 99.54166666666666
291 Test Accuracy: 97.61
292 Epoch Number: 43
293 Training Accuracy: 99.54666666666667
294 Test Accuracy: 97.59
295 Epoch Number: 44
296 Training Accuracy: 99.56
297 Test Accuracy: 97.55
298 Epoch Number: 45
299 Training Accuracy: 99.575
300 Test Accuracy: 97.54
301 Epoch Number: 46
302 Training Accuracy: 99.58166666666666
303 Test Accuracy: 97.53
304 Epoch Number: 47
305 Training Accuracy: 99.59333333333333
306 Test Accuracy: 97.52
307 Epoch Number: 48
308 Training Accuracy: 99.60666666666667
309 Test Accuracy: 97.5
310 Epoch Number: 49
311 Training Accuracy: 99.61833333333333
312 Test Accuracy: 97.49
313 Confusion Matrix for the test data for momentum: 0.25
314 [[ 971    1    1    0    0    1    3    1    1    1]
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315 [ 0 1122 1 4 0 1 4 1 2 0]
316 [ 7 2 995 6 1 0 6 5 7 3]
317 [ 1 1 3 987 2 6 0 1 4 5]
318 [ 3 2 0 0 953 0 6 0 2 16]
319 [ 4 1 0 8 1 859 7 2 5 5]
320 [ 7 3 0 1 1 5 940 0 1 0]
321 [ 1 1 12 3 2 0 0 996 4 9]
322 [ 5 2 2 5 3 2 2 3 946 4]
323 [ 4 6 0 5 7 1 2 4 0 980]]
```

```
324 Epoch Number: 0
325 Training Accuracy: 8.981666666666667
326 Test Accuracy: 9.36
327 Epoch Number: 1
328 Training Accuracy: 91.455
329 Test Accuracy: 94.66
330 Epoch Number: 2
331 Training Accuracy: 96.22333333333334
332 Test Accuracy: 96.25
333 Epoch Number: 3
334 Training Accuracy: 97.17333333333333
335 Test Accuracy: 96.83
336 Epoch Number: 4
337 Training Accuracy: 97.635
338 Test Accuracy: 96.95
339 Epoch Number: 5
340 Training Accuracy: 97.93833333333333
341 Test Accuracy: 97.11999999999999
342 Epoch Number: 6
343 Training Accuracy: 98.15
344 Test Accuracy: 97.22
345 Epoch Number: 7
346 Training Accuracy: 98.36500000000001
347 Test Accuracy: 97.2
348 Epoch Number: 8
349 Training Accuracy: 98.50333333333333
350 Test Accuracy: 97.28999999999999
351 Epoch Number: 9
352 Training Accuracy: 98.595
353 Test Accuracy: 97.38
354 Epoch Number: 10
355 Training Accuracy: 98.69333333333333
356 Test Accuracy: 97.46000000000001
357 Epoch Number: 11
358 Training Accuracy: 98.77833333333334
359 Test Accuracy: 97.5
360 Epoch Number: 12
361 Training Accuracy: 98.835
362 Test Accuracy: 97.50999999999999
363 Epoch Number: 13
364 Training Accuracy: 98.90166666666667
365 Test Accuracy: 97.54
366 Epoch Number: 14
367 Training Accuracy: 98.95833333333334
368 Test Accuracy: 97.54
369 Epoch Number: 15
370 Training Accuracy: 99.005
371 Test Accuracy: 97.47
372 Epoch Number: 16
373 Training Accuracy: 99.05666666666667
374 Test Accuracy: 97.49
375 Epoch Number: 17
376 Training Accuracy: 99.11666666666666
377 Test Accuracy: 97.46000000000001
```

378 Epoch Number: 18
379 Training Accuracy: 99.17166666666667
380 Test Accuracy: 97.42
381 Epoch Number: 19
382 Training Accuracy: 99.21
383 Test Accuracy: 97.44
384 Epoch Number: 20
385 Training Accuracy: 99.24833333333333
386 Test Accuracy: 97.41
387 Epoch Number: 21
388 Training Accuracy: 99.27333333333334
389 Test Accuracy: 97.42
390 Epoch Number: 22
391 Training Accuracy: 99.28833333333333
392 Test Accuracy: 97.41
393 Epoch Number: 23
394 Training Accuracy: 99.32833333333333
395 Test Accuracy: 97.43
396 Epoch Number: 24
397 Training Accuracy: 99.35833333333333
398 Test Accuracy: 97.44
399 Epoch Number: 25
400 Training Accuracy: 99.38166666666667
401 Test Accuracy: 97.41
402 Epoch Number: 26
403 Training Accuracy: 99.395
404 Test Accuracy: 97.42
405 Epoch Number: 27
406 Training Accuracy: 99.42
407 Test Accuracy: 97.39999999999999
408 Epoch Number: 28
409 Training Accuracy: 99.44333333333333
410 Test Accuracy: 97.41
411 Epoch Number: 29
412 Training Accuracy: 99.46833333333333
413 Test Accuracy: 97.43
414 Epoch Number: 30
415 Training Accuracy: 99.48166666666667
416 Test Accuracy: 97.43
417 Epoch Number: 31
418 Training Accuracy: 99.49166666666667
419 Test Accuracy: 97.45
420 Epoch Number: 32
421 Training Accuracy: 99.505
422 Test Accuracy: 97.46000000000001
423 Epoch Number: 33
424 Training Accuracy: 99.51666666666667
425 Test Accuracy: 97.44
426 Epoch Number: 34
427 Training Accuracy: 99.53166666666667
428 Test Accuracy: 97.45
429 Epoch Number: 35
430 Training Accuracy: 99.54166666666666
431 Test Accuracy: 97.47
432 Epoch Number: 36
433 Training Accuracy: 99.55333333333334
434 Test Accuracy: 97.47
435 Epoch Number: 37
436 Training Accuracy: 99.56666666666666
437 Test Accuracy: 97.47
438 Epoch Number: 38
439 Training Accuracy: 99.57666666666667
440 Test Accuracy: 97.48

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441 Epoch Number: 39
442 Training Accuracy:  99.58833333333334
443 Test Accuracy:  97.46000000000001
444 Epoch Number: 40
445 Training Accuracy:  99.60666666666667
446 Test Accuracy:  97.45
447 Epoch Number: 41
448 Training Accuracy:  99.61666666666666
449 Test Accuracy:  97.42
450 Epoch Number: 42
451 Training Accuracy:  99.625
452 Test Accuracy:  97.44
453 Epoch Number: 43
454 Training Accuracy:  99.63166666666666
455 Test Accuracy:  97.42
456 Epoch Number: 44
457 Training Accuracy:  99.63166666666666
458 Test Accuracy:  97.46000000000001
459 Epoch Number: 45
460 Training Accuracy:  99.64166666666667
461 Test Accuracy:  97.46000000000001
462 Epoch Number: 46
463 Training Accuracy:  99.65
464 Test Accuracy:  97.45
465 Epoch Number: 47
466 Training Accuracy:  99.65833333333333
467 Test Accuracy:  97.44
468 Epoch Number: 48
469 Training Accuracy:  99.665
470 Test Accuracy:  97.45
471 Epoch Number: 49
472 Training Accuracy:  99.66833333333334
473 Test Accuracy:  97.42
474 Confusion Matrix for the test data for momentum:  0.5
475 [[ 972    0    0    1    0    1    2    1    3    0]
476 [    0 1122    4    2    0    3    1    1    2    0]
477 [    4    4 1005    5    1    1    2    4    5    1]
478 [    0    0    4 984    1   10    1    3    4    3]
479 [    1    1    1    0 957    0    5    0    1   16]
480 [    3    0    0   11    1 857    8    1    6    5]
481 [    9    3    1    1    1    5 933    0    5    0]
482 [    2    4    7    4    2    0    0 993    3   13]
483 [    4    2    2    4    4    6    3    3 943    3]
484 [    4    5    0    4    9    1    1    3    6 976]]
485 Total Time taken for the experiment:  1:33:31.026289
486
487 Process finished with exit code 0
488
```