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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:  11.313333333333334
4 Test Accuracy:  11.4
5 Epoch Number: 1
6 Training Accuracy:  88.93833333333333
7 Test Accuracy:  93.5
8 Epoch Number: 2
9 Training Accuracy:  95.12
10 Test Accuracy:  95.53
11 Epoch Number: 3
12 Training Accuracy:  96.45833333333333
13 Test Accuracy:  96.12
14 Epoch Number: 4
15 Training Accuracy:  97.05666666666667
16 Test Accuracy:  96.52
17 Epoch Number: 5
18 Training Accuracy:  97.43333333333334
19 Test Accuracy:  96.69
20 Epoch Number: 6
21 Training Accuracy:  97.72333333333333
22 Test Accuracy:  96.92
23 Epoch Number: 7
24 Training Accuracy:  97.895
25 Test Accuracy:  96.98
26 Epoch Number: 8
27 Training Accuracy:  98.10166666666666
28 Test Accuracy:  97.06
29 Epoch Number: 9
30 Training Accuracy:  98.25
31 Test Accuracy:  97.11
32 Epoch Number: 10
33 Training Accuracy:  98.36500000000001
34 Test Accuracy:  97.22
35 Epoch Number: 11
36 Training Accuracy:  98.465
37 Test Accuracy:  97.25
38 Epoch Number: 12
39 Training Accuracy:  98.555
40 Test Accuracy:  97.35000000000001
41 Epoch Number: 13
42 Training Accuracy:  98.63
43 Test Accuracy:  97.39999999999999
44 Epoch Number: 14
45 Training Accuracy:  98.69333333333333
46 Test Accuracy:  97.47
47 Epoch Number: 15
48 Training Accuracy:  98.745
49 Test Accuracy:  97.5
50 Epoch Number: 16
51 Training Accuracy:  98.80166666666666
52 Test Accuracy:  97.53
53 Epoch Number: 17
54 Training Accuracy:  98.85666666666667
55 Test Accuracy:  97.53
56 Epoch Number: 18
57 Training Accuracy:  98.90666666666667
58 Test Accuracy:  97.55
59 Epoch Number: 19
60 Training Accuracy:  98.95166666666667
61 Test Accuracy:  97.56
62 Epoch Number: 20
```

63 Training Accuracy: 98.99333333333334
64 Test Accuracy: 97.58
65 Epoch Number: 21
66 Training Accuracy: 99.02333333333333
67 Test Accuracy: 97.59
68 Epoch Number: 22
69 Training Accuracy: 99.05333333333334
70 Test Accuracy: 97.59
71 Epoch Number: 23
72 Training Accuracy: 99.08833333333334
73 Test Accuracy: 97.6
74 Epoch Number: 24
75 Training Accuracy: 99.13166666666666
76 Test Accuracy: 97.61
77 Epoch Number: 25
78 Training Accuracy: 99.15
79 Test Accuracy: 97.6
80 Epoch Number: 26
81 Training Accuracy: 99.18333333333334
82 Test Accuracy: 97.61
83 Epoch Number: 27
84 Training Accuracy: 99.21833333333333
85 Test Accuracy: 97.61
86 Epoch Number: 28
87 Training Accuracy: 99.23666666666666
88 Test Accuracy: 97.61
89 Epoch Number: 29
90 Training Accuracy: 99.26333333333334
91 Test Accuracy: 97.61
92 Epoch Number: 30
93 Training Accuracy: 99.28
94 Test Accuracy: 97.6
95 Epoch Number: 31
96 Training Accuracy: 99.29833333333333
97 Test Accuracy: 97.61
98 Epoch Number: 32
99 Training Accuracy: 99.30666666666667
100 Test Accuracy: 97.64
101 Epoch Number: 33
102 Training Accuracy: 99.33
103 Test Accuracy: 97.69
104 Epoch Number: 34
105 Training Accuracy: 99.35666666666667
106 Test Accuracy: 97.68
107 Epoch Number: 35
108 Training Accuracy: 99.36666666666667
109 Test Accuracy: 97.65
110 Epoch Number: 36
111 Training Accuracy: 99.38333333333334
112 Test Accuracy: 97.66
113 Epoch Number: 37
114 Training Accuracy: 99.39166666666667
115 Test Accuracy: 97.65
116 Epoch Number: 38
117 Training Accuracy: 99.405
118 Test Accuracy: 97.65
119 Epoch Number: 39
120 Training Accuracy: 99.41666666666666
121 Test Accuracy: 97.65
122 Epoch Number: 40
123 Training Accuracy: 99.425
124 Test Accuracy: 97.65
125 Epoch Number: 41

```
126 Training Accuracy: 99.44166666666666
127 Test Accuracy: 97.64
128 Epoch Number: 42
129 Training Accuracy: 99.45666666666668
130 Test Accuracy: 97.65
131 Epoch Number: 43
132 Training Accuracy: 99.47
133 Test Accuracy: 97.65
134 Epoch Number: 44
135 Training Accuracy: 99.485
136 Test Accuracy: 97.66
137 Epoch Number: 45
138 Training Accuracy: 99.49666666666667
139 Test Accuracy: 97.66
140 Epoch Number: 46
141 Training Accuracy: 99.50333333333333
142 Test Accuracy: 97.66
143 Epoch Number: 47
144 Training Accuracy: 99.51333333333334
145 Test Accuracy: 97.68
146 Epoch Number: 48
147 Training Accuracy: 99.51666666666667
148 Test Accuracy: 97.66
149 Epoch Number: 49
150 Training Accuracy: 99.53
151 Test Accuracy: 97.65
152 Confusion Matrix for the test data for momentum: 0
153 [[ 972      1      0      0      0      0      3      1      3      0]
154 [    0 1124      1      2      0      1      4      1      2      0]
155 [    2      1 1005      5      2      1      3      6      5      2]
156 [    1      0      3 991      2      2      0      3      3      5]
157 [    1      0      2      1 965      0      5      0      0      8]
158 [    3      1      0      7      0 864      4      1      9      3]
159 [    5      3      1      0      2      9 931      0      6      1]
160 [    1      5      9      1      4      0      0 997      2      9]
161 [    5      2      2      2      6      3      3      3 946      2]
162 [    5      7      0      7     10      1      0      5      4 970]]
163 Epoch Number: 0
164 Training Accuracy: 13.145000000000001
165 Test Accuracy: 13.84
166 Epoch Number: 1
167 Training Accuracy: 90.17666666666668
168 Test Accuracy: 94.13
169 Epoch Number: 2
170 Training Accuracy: 95.73333333333333
171 Test Accuracy: 95.87
172 Epoch Number: 3
173 Training Accuracy: 96.87666666666667
174 Test Accuracy: 96.41999999999999
175 Epoch Number: 4
176 Training Accuracy: 97.44
177 Test Accuracy: 96.78999999999999
178 Epoch Number: 5
179 Training Accuracy: 97.78
180 Test Accuracy: 97.09
181 Epoch Number: 6
182 Training Accuracy: 98.00166666666667
183 Test Accuracy: 97.28
184 Epoch Number: 7
185 Training Accuracy: 98.13666666666667
186 Test Accuracy: 97.38
187 Epoch Number: 8
188 Training Accuracy: 98.29
```

189 Test Accuracy: 97.46000000000001
190 Epoch Number: 9
191 Training Accuracy: 98.38833333333334
192 Test Accuracy: 97.5
193 Epoch Number: 10
194 Training Accuracy: 98.50166666666667
195 Test Accuracy: 97.53
196 Epoch Number: 11
197 Training Accuracy: 98.58166666666666
198 Test Accuracy: 97.58
199 Epoch Number: 12
200 Training Accuracy: 98.68
201 Test Accuracy: 97.58
202 Epoch Number: 13
203 Training Accuracy: 98.75666666666667
204 Test Accuracy: 97.59
205 Epoch Number: 14
206 Training Accuracy: 98.83666666666666
207 Test Accuracy: 97.58
208 Epoch Number: 15
209 Training Accuracy: 98.90333333333334
210 Test Accuracy: 97.64
211 Epoch Number: 16
212 Training Accuracy: 98.95333333333333
213 Test Accuracy: 97.61
214 Epoch Number: 17
215 Training Accuracy: 99.015
216 Test Accuracy: 97.63
217 Epoch Number: 18
218 Training Accuracy: 99.065
219 Test Accuracy: 97.66
220 Epoch Number: 19
221 Training Accuracy: 99.11833333333333
222 Test Accuracy: 97.66
223 Epoch Number: 20
224 Training Accuracy: 99.15166666666667
225 Test Accuracy: 97.67
226 Epoch Number: 21
227 Training Accuracy: 99.195
228 Test Accuracy: 97.67
229 Epoch Number: 22
230 Training Accuracy: 99.235
231 Test Accuracy: 97.64
232 Epoch Number: 23
233 Training Accuracy: 99.26333333333334
234 Test Accuracy: 97.65
235 Epoch Number: 24
236 Training Accuracy: 99.28333333333333
237 Test Accuracy: 97.65
238 Epoch Number: 25
239 Training Accuracy: 99.30499999999999
240 Test Accuracy: 97.61999999999999
241 Epoch Number: 26
242 Training Accuracy: 99.33333333333333
243 Test Accuracy: 97.66
244 Epoch Number: 27
245 Training Accuracy: 99.35000000000001
246 Test Accuracy: 97.65
247 Epoch Number: 28
248 Training Accuracy: 99.36833333333334
249 Test Accuracy: 97.65
250 Epoch Number: 29
251 Training Accuracy: 99.39833333333333

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252 Test Accuracy: 97.65
253 Epoch Number: 30
254 Training Accuracy: 99.41
255 Test Accuracy: 97.67
256 Epoch Number: 31
257 Training Accuracy: 99.42
258 Test Accuracy: 97.69
259 Epoch Number: 32
260 Training Accuracy: 99.43166666666666
261 Test Accuracy: 97.67
262 Epoch Number: 33
263 Training Accuracy: 99.45166666666667
264 Test Accuracy: 97.67
265 Epoch Number: 34
266 Training Accuracy: 99.465
267 Test Accuracy: 97.67
268 Epoch Number: 35
269 Training Accuracy: 99.47833333333334
270 Test Accuracy: 97.65
271 Epoch Number: 36
272 Training Accuracy: 99.485
273 Test Accuracy: 97.66
274 Epoch Number: 37
275 Training Accuracy: 99.49333333333334
276 Test Accuracy: 97.67
277 Epoch Number: 38
278 Training Accuracy: 99.50166666666667
279 Test Accuracy: 97.66
280 Epoch Number: 39
281 Training Accuracy: 99.51166666666667
282 Test Accuracy: 97.66
283 Epoch Number: 40
284 Training Accuracy: 99.52666666666666
285 Test Accuracy: 97.66
286 Epoch Number: 41
287 Training Accuracy: 99.535
288 Test Accuracy: 97.66
289 Epoch Number: 42
290 Training Accuracy: 99.54666666666667
291 Test Accuracy: 97.67
292 Epoch Number: 43
293 Training Accuracy: 99.555
294 Test Accuracy: 97.69
295 Epoch Number: 44
296 Training Accuracy: 99.56833333333334
297 Test Accuracy: 97.68
298 Epoch Number: 45
299 Training Accuracy: 99.58
300 Test Accuracy: 97.7
301 Epoch Number: 46
302 Training Accuracy: 99.58833333333334
303 Test Accuracy: 97.68
304 Epoch Number: 47
305 Training Accuracy: 99.60166666666666
306 Test Accuracy: 97.7
307 Epoch Number: 48
308 Training Accuracy: 99.61666666666666
309 Test Accuracy: 97.72
310 Epoch Number: 49
311 Training Accuracy: 99.62166666666667
312 Test Accuracy: 97.72999999999999
313 Confusion Matrix for the test data for momentum: 0.25
314 [[ 972    1    0    0    0    1    2    1    2    1]
```

```
315 [ 0 1123 1 3 0 3 3 0 2 0]
316 [ 5 2 1002 5 3 0 3 4 7 1]
317 [ 0 0 4 992 0 5 0 4 2 3]
318 [ 3 0 1 0 957 0 4 1 2 14]
319 [ 4 0 0 4 2 865 6 1 6 4]
320 [ 5 3 0 0 2 3 944 0 1 0]
321 [ 2 2 9 3 1 0 0 995 3 13]
322 [ 5 2 4 3 5 2 1 4 945 3]
323 [ 3 7 0 6 7 2 1 3 2 978]]
```

```
324 Epoch Number: 0
325 Training Accuracy: 9.871666666666666
326 Test Accuracy: 9.8
327 Epoch Number: 1
328 Training Accuracy: 91.52
329 Test Accuracy: 94.73
330 Epoch Number: 2
331 Training Accuracy: 96.28166666666667
332 Test Accuracy: 96.34
333 Epoch Number: 3
334 Training Accuracy: 97.20833333333333
335 Test Accuracy: 96.78
336 Epoch Number: 4
337 Training Accuracy: 97.68333333333334
338 Test Accuracy: 96.98
339 Epoch Number: 5
340 Training Accuracy: 97.965
341 Test Accuracy: 97.09
342 Epoch Number: 6
343 Training Accuracy: 98.20333333333333
344 Test Accuracy: 97.28999999999999
345 Epoch Number: 7
346 Training Accuracy: 98.37833333333333
347 Test Accuracy: 97.33000000000001
348 Epoch Number: 8
349 Training Accuracy: 98.52
350 Test Accuracy: 97.42
351 Epoch Number: 9
352 Training Accuracy: 98.62166666666667
353 Test Accuracy: 97.48
354 Epoch Number: 10
355 Training Accuracy: 98.73833333333333
356 Test Accuracy: 97.49
357 Epoch Number: 11
358 Training Accuracy: 98.81166666666667
359 Test Accuracy: 97.46000000000001
360 Epoch Number: 12
361 Training Accuracy: 98.89
362 Test Accuracy: 97.49
363 Epoch Number: 13
364 Training Accuracy: 98.96000000000001
365 Test Accuracy: 97.49
366 Epoch Number: 14
367 Training Accuracy: 99.01833333333333
368 Test Accuracy: 97.46000000000001
369 Epoch Number: 15
370 Training Accuracy: 99.07833333333333
371 Test Accuracy: 97.46000000000001
372 Epoch Number: 16
373 Training Accuracy: 99.14833333333334
374 Test Accuracy: 97.47
375 Epoch Number: 17
376 Training Accuracy: 99.16666666666667
377 Test Accuracy: 97.45
```

378 Epoch Number: 18
379 Training Accuracy: 99.20333333333333
380 Test Accuracy: 97.46000000000001
381 Epoch Number: 19
382 Training Accuracy: 99.25333333333334
383 Test Accuracy: 97.47
384 Epoch Number: 20
385 Training Accuracy: 99.27
386 Test Accuracy: 97.49
387 Epoch Number: 21
388 Training Accuracy: 99.28333333333333
389 Test Accuracy: 97.53
390 Epoch Number: 22
391 Training Accuracy: 99.30833333333334
392 Test Accuracy: 97.54
393 Epoch Number: 23
394 Training Accuracy: 99.33833333333332
395 Test Accuracy: 97.54
396 Epoch Number: 24
397 Training Accuracy: 99.35333333333334
398 Test Accuracy: 97.5
399 Epoch Number: 25
400 Training Accuracy: 99.36833333333334
401 Test Accuracy: 97.47
402 Epoch Number: 26
403 Training Accuracy: 99.38833333333334
404 Test Accuracy: 97.5
405 Epoch Number: 27
406 Training Accuracy: 99.425
407 Test Accuracy: 97.49
408 Epoch Number: 28
409 Training Accuracy: 99.43166666666666
410 Test Accuracy: 97.48
411 Epoch Number: 29
412 Training Accuracy: 99.45166666666667
413 Test Accuracy: 97.5
414 Epoch Number: 30
415 Training Accuracy: 99.46333333333334
416 Test Accuracy: 97.52
417 Epoch Number: 31
418 Training Accuracy: 99.47833333333334
419 Test Accuracy: 97.50999999999999
420 Epoch Number: 32
421 Training Accuracy: 99.48666666666666
422 Test Accuracy: 97.52
423 Epoch Number: 33
424 Training Accuracy: 99.49666666666667
425 Test Accuracy: 97.52
426 Epoch Number: 34
427 Training Accuracy: 99.51666666666667
428 Test Accuracy: 97.5
429 Epoch Number: 35
430 Training Accuracy: 99.52833333333334
431 Test Accuracy: 97.43
432 Epoch Number: 36
433 Training Accuracy: 99.54666666666667
434 Test Accuracy: 97.43
435 Epoch Number: 37
436 Training Accuracy: 99.55666666666667
437 Test Accuracy: 97.44
438 Epoch Number: 38
439 Training Accuracy: 99.56833333333334
440 Test Accuracy: 97.46000000000001

```
441 Epoch Number: 39
442 Training Accuracy: 99.58166666666666
443 Test Accuracy: 97.49
444 Epoch Number: 40
445 Training Accuracy: 99.59333333333333
446 Test Accuracy: 97.48
447 Epoch Number: 41
448 Training Accuracy: 99.60166666666666
449 Test Accuracy: 97.48
450 Epoch Number: 42
451 Training Accuracy: 99.615
452 Test Accuracy: 97.47
453 Epoch Number: 43
454 Training Accuracy: 99.625
455 Test Accuracy: 97.47
456 Epoch Number: 44
457 Training Accuracy: 99.62833333333333
458 Test Accuracy: 97.45
459 Epoch Number: 45
460 Training Accuracy: 99.64
461 Test Accuracy: 97.43
462 Epoch Number: 46
463 Training Accuracy: 99.645
464 Test Accuracy: 97.43
465 Epoch Number: 47
466 Training Accuracy: 99.65
467 Test Accuracy: 97.42
468 Epoch Number: 48
469 Training Accuracy: 99.65833333333333
470 Test Accuracy: 97.42
471 Epoch Number: 49
472 Training Accuracy: 99.66666666666667
473 Test Accuracy: 97.39
474 Confusion Matrix for the test data for momentum: 0.5
475 [[ 972    1    2    0    0    0    2    1    2    0]
476 [   0 1119    4    4    0    1    2    2    3    0]
477 [   4    1 1002    5    2    0    4    7    6    1]
478 [   2    0    4 988    0    6    0    3    4    3]
479 [   1    0    1    0 957    0    6    0    2 15]
480 [   3    0    0    9    0 858    7    1    9    5]
481 [   8    3    1    1    1    7 934    0    3    0]
482 [   2    5   10    3    2    0    0 987    4 15]
483 [   4    1    3    4    5    3    4    3 941    6]
484 [   4    6    0    3    8    1    0    5    1 981]]
485 Total Time taken for the experiment: 1:44:50.735696
486
487 Process finished with exit code 0
488
```