```
2)
b)
1 hidden layer size
Training
        precision
                   recall f1-score support
      0
                   0.76
            1.00
                           0.86
                                   2589
                           0.74
      1
            0.63
                   0.89
                                   1410
      2
            0.78
                   0.85
                           0.81
                                   1782
      3
           0.40
                   0.73
                           0.52
                                   1114
      4
           0.98
                   0.66
                           0.79
                                   3105
  accuracy
                           0.76
                                  10000
                0.76
                       0.78
                               0.74
 macro avg
                                       10000
weighted avg
                0.84
                        0.76
                                0.78
                                       10000
Test
        precision
                   recall f1-score support
                   0.89
      0
            1.00
                           0.94
                                   258
            0.73
                           0.81
                                   158
      1
                   0.91
      2
            0.67
                   0.78
                           0.72
                                   170
      3
            0.32
                   0.55
                           0.40
                                   107
      4
            0.98
                   0.60
                           0.74
                                   307
                           0.75
                                   1000
  accuracy
 macro avg
                0.74
                       0.75
                               0.72
                                       1000
                0.82
                                0.76
weighted avg
                        0.75
                                        1000
5 hidden layer size
Training
        precision
                   recall f1-score support
      0
                   0.99
                           1.00
                                   1980
            1.00
      1
            0.97
                           0.97
                   0.97
                                   1967
      2
            0.90
                           0.91
                   0.92
                                   1902
      3
            0.85
                   0.88
                           0.87
                                   1940
      4
            0.96
                   0.91
                           0.94
                                   2211
                           0.94
                                  10000
  accuracy
                0.94
                       0.94
                               0.94
                                      10000
 macro avg
weighted avg
                0.94
                        0.94
                                0.94
                                       10000
Test
                   recall f1-score support
        precision
      0
            0.99
                   0.97
                           0.98
                                   233
      1
            0.84
                   0.93
                           0.89
                                   179
      2
            0.73
                   0.78
                           0.76
                                   185
      3
            0.58
                                    167
                   0.65
                           0.61
      4
            0.90
                   0.72
                           0.80
                                   236
  accuracy
                           0.82
                                   1000
                0.81
                       0.81
                                       1000
 macro avg
                               0.81
weighted avg
                0.83
                        0.82
                                0.82
                                        1000
10 hidden layer size
Training
        precision recall f1-score support
```

	0 1 2 3 4	1.00 0.98 0.91 0.90 0.95	1.00 0.98 0.94 0.88 0.94	0.9 0.9 0.8	8 19 <sup>3</sup> 3 188 9 208	77 32 53
	uracy ro avo ted av	g 0.9	95 .95	0.99 0.95 0.95	5 100 0.95 0.95	00 10000 10000
Test	pre	cision	reca	ll f1-sc	ore su	pport
	0 1 2 3 4	0.99 0.87 0.73 0.67 0.89	0.99 0.93 0.80 0.66 0.77	0.9 0.7 0.6	0 18 6 18 6 19	55 51 00
	uracy ro avo ted av	g 0.	83 .84	0.83 0.83 0.83	3 100 0.83 0.83	00 1000 1000
50 hid Trainir	ng	ayer size		ll f1-sc	ore su	pport
	0 1 2 3 4	1.00 0.98 0.97 0.98 1.00	1.00 0.99 0.98 0.98 1.00	0.9 0.9 0.9	8 19 <sup>-</sup> 7 19 <sup>-</sup> 8 20 <sup>-</sup>	76 40 13
	uracy ro avo ted av	g 0.9	99 .99	0.99 0.99 0.99	9 100 0.99 0.99	00 10000 10000
Test	pre	cision	reca	ll f1-sc	ore su	pport
	0 1 2 3 4	0.99 0.89 0.76 0.74 0.90	1.00 0.94 0.84 0.71 0.82	0.9 0.8 0.7	2 18 0 18 3 19	88 82 85
	uracy ro avo ted av	g 0.8	86 .87	0.86 0.86 0.86	6 100 0.86 0.86	00 1000 1000
100 hi Trainir	ng	layer si ecision		ll f1-sc	ore su	pport
	0 1 2 3 4	1.00 0.98 0.97 0.99 1.00	1.00 0.98 0.98 0.98 1.00	0.9 0.9 0.9	0 19 8 19 8 19 9 20	77 79 40 17

accu macr weighte		9	0.9	99 99	0.9	0.99 99 .99	9 0.9 0.9	-	00 10000 10000
Test									
	pre	cisic	n	reca	all 1	f1-sc	ore	sup	port
	0	0.98	3	1.0	0	0.9	9	22	5
	1	0.88	3	0.9	3	0.9	0	188	3
	2	0.78	3	0.8	1	0.7	9	192	2
	3	0.72	2	0.7	2	0.7	2	186	3
,	4	0.9	1	8.0	1	0.8	6	209	9
accu macr	ıracy		0.8	25	0.8	0.8	6 0.8	100 5	0 1000
weight				86		.86	0.8	-	1000

2) c) [1024, 512, 5] hidden layer size Training	
precision recall f1-score support	
0       1.00       0.99       1.00       1978         1       0.97       0.96       0.97       1989         2       0.93       0.94       0.94       1941         3       0.94       0.94       0.94       2013         4       0.97       0.98       0.97       2079	
accuracy 0.96 10000 macro avg 0.96 0.96 0.96 1000 weighted avg 0.96 0.96 0.96 100	
Test precision recall f1-score support	
0       0.97       1.00       0.98       224         1       0.89       0.92       0.90       191         2       0.78       0.80       0.79       194         3       0.70       0.72       0.71       181         4       0.91       0.81       0.86       210	
accuracy 0.85 1000 macro avg 0.85 0.85 0.85 1000 weighted avg 0.86 0.85 0.86 100	
[1024, 512, 256, 5] hidden layer size Training	
precision recall f1-score support	
0       0.99       0.99       0.99       1982         1       0.96       0.96       0.96       1969         2       0.91       0.90       0.90       1969         3       0.83       0.90       0.86       1855         4       0.96       0.91       0.93       2225	
accuracy 0.93 10000 macro avg 0.93 0.93 0.93 1000 weighted avg 0.93 0.93 0.93 100	
Test precision recall f1-score support	
0       0.98       1.00       0.99       225         1       0.88       0.94       0.91       185         2       0.79       0.82       0.81       191         3       0.71       0.76       0.73       175         4       0.96       0.80       0.88       224	
accuracy 0.87 1000 macro avg 0.86 0.87 0.86 1000 weighted avg 0.87 0.87 0.87 100	
[1024, 512, 256, 128, 5] hidden layer size Training precision recall f1-score support	

0 1 2 3 4	1.00 0.99 0.97 0.95 0.97	1.00 0.98 0.96 0.96 0.99	0.99 0.97 0.96	9 200 7 198 6 199	)1 86 )1
accurac macro av weighted a	g 0.9	98 .98	0.98 0.98 0.98	0.98 0.98 0.98	00 10000 10000
Test pr	ecision	recal	ll f1-sco	ore sup	port
0 1 2 3 4	1.00 0.90 0.84 0.77 0.87	1.00 0.94 0.84 0.75 0.84	0.92 0.84 0.76	2 189 4 199 6 19	9 9 1
accuracy macro av weighted a	g 0.8	87 .88	0.88 0.87 0.88	3 100 0.87 0.88	0 1000 1000
[1024, 512 Training pr	, 256, 12 ecision		5] hidd I f1-sco	-	size oport
0 1 2 3 4	0.99 0.99 0.98 0.96 1.00	1.00 0.98 0.98 0.99 0.97	0.99 0.98 0.98	9 198 3 196 3 195	66 62 63
accuracy macro av weighted a	g 0.9	98 .99	0.99 0.99 0.99	0.99 0.99 0.99	00 10000 10000
Test pr	ecision	recal	ll f1-sco	ore sup	port
0 1 2 3 4	0.97 0.89 0.83 0.64 0.95	1.00 0.93 0.84 0.76 0.76	0.91 0.84 0.70	19 19 15 15	1 6 7
accurac macro av weighted a	g 0.8	86 .87	0.86 0.86 0.86	0.85 0.86	0 1000 1000

2)d)

[1024, 512, 5] hidden layer size
Training
precision recall f1-score support

0 0.98 0.97 0.97 2006

2		74 67	0.88 0.77 0.71 0.82	0.88 0.76 0.69 0.85	188 189	37 91
accu macro weighte	o avg	0.83		0.83 ).83 0.83	1000 0.83 0.83	00 10000 10000
Test	precis	ion	recall	f1-sco	re sup	pport
4	0 0.9 1 0.9 2 0.9 3 0.9 4 0.9	84 69 64	0.99 0.90 0.76 0.66 0.75	0.98 0.87 0.73 0.65 0.82	18 18 18	4 1 1
accu macro weighte	o avg	0.8 <sup>-</sup> 0.8		0.82 ).81 0.82	100 0.81 0.82	0 1000 1000
[1024, 5 Training		6, 5] h	idder	ı layer s	size	
Training	precis	ion	recall	f1-sco	re sup	port
2	0 0.9 1 0.9 2 0.9 3 0.9 4 0.9	86 71 64	0.95 0.86 0.76 0.68 0.79	0.96 0.86 0.74 0.66 0.83	196 182 187	65 21 79
accu macro weighte	o avg	0.8		0.81 ).81 0.81	1000 0.81 0.81	00 10000 10000
Test	precis	ion	recall	f1-sco	re sup	port
2	1 0.0 2 0.0	82 67 60	0.98 0.89 0.75 0.64 0.72	0.97 0.85 0.71 0.62 0.81	18: 17	2 7 5
accu macro weighte	o avg	0.80		0.80 ).80 0.80	100 0.79 0.80	0 1000 1000
[1024, 5 Training		6, 128	, 5] h	idden la	ıyer siz	е
	precis	ion	recall	f1-sco	re sup	port
2	1 1.1 2 1.1 3 1.1	00 00 00	1.00 1.00 1.00 1.00 1.00	1.00 1.00 1.00 1.00 1.00	197 195 200	78 52 08
accu	racy			1.00	1000	00

macr weight	o avg ed av		00 .00	1.0 1.	00 00	1.0 1.0	0 00	10000 10000
Test	pre	cision	reca	all f	1-sc	ore	sup	port
	0 1 2 3 4	0.99 0.89 0.85 0.72 0.94	1.0 0.9 0.8 0.8	6 5 0	1.00 0.92 0.85 0.76 0.87	2 5 6	22 18 20 16 21	5 0 9
	uracy o avg ed av		88 ).89	0.8	0.89 88 89	9 0.8 0.8	_	0 1000 1000
[1024, Training		256, 12	28, 64	1, 5]	hidd	en la	ayer	size
	pre	cision	reca	all f	1-sc	ore	sup	port
	0 1 2 3 4	1.00 0.99 0.98 0.98 0.98	0.9 0.9 0.9 0.9 1.0	9 8 7	1.00 0.99 0.98 0.98	9 3 3	198 197 196 202 205	79 83 20
	uracy o avg ed av		99 ).99	0.9	0.99 9 99	0.9 0.9		00 10000 10000
Test	pre	cision	reca	all f	1-sc	ore	sup	port
	0 1 2 3 4	1.00 0.90 0.84 0.72 0.90	1.0 0.9 0.8 0.7 0.8	6 2 6	1.00 0.93 0.83 0.74 0.87	3 3 4	229 18 209 17 209	7 5 7
	uracy o avg ed av		87 ).88	0.8	0.88 7 88	3 0.8 0.8	-	0 1000 1000

2) d) [1024, Trainin	g	5] hidd			size f1-sc	oro	cur	uport.
	ριθ	CISION	reca	a11 1	11-50	ore	Sup	port
	0 1 2 3 4	0.98 0.88 0.74 0.67 0.88	0.9 0.8 0.7 0.7 0.8	8 7 1	0.9° 0.8° 0.7° 0.6° 0.8°	8 6 9	200 197 188 189 224	6 7 1
	uracy ro av ed a	g 0.	83 ).83		0.83 .83	0.8	1000 3 83	00 10000 10000
Test	pre	ecision	reca	all 1	f1-sc	ore	sup	port
	0 1 2 3 4	0.97 0.84 0.69 0.64 0.91	0.9 0.9 0.7 0.6 0.7	0 6 6	0.98 0.8 0.73 0.68 0.88	7 3 5	226 18 <sup>2</sup> 18 <sup>2</sup> 18 <sup>2</sup> 228	<del>1</del> 1 1
	uracy ro av ed a	g 0.	81 ).82	0.8	0.82 31 .82	0.8	100 1 82	0 1000 1000
[1024, Trainin	g	256, 5]			•			
	pre	ecision	reca	ali 1	f1-sc	ore	sup	port
	0 1 2 3 4	0.97 0.86 0.71 0.64 0.87	0.9 0.8 0.7 0.6 0.7	6 6 8	0.90 0.80 0.74 0.60 0.83	6 4 6	202 196 182 187 230	5 1 9
	uracy ro av ed a	g 0.	81 ).82		0.8 <sup>-</sup> 31 .81			00 10000 10000
Test	pre	ecision	reca	all 1	f1-sc	ore	sup	port
	0 1 2 3 4	0.97 0.82 0.67 0.60 0.93	0.9 0.8 0.7 0.6 0.7	9 5 4	0.9 0.8 0.7 0.6 0.8	5 1 2	225 182 177 175 24	2 7 5
	uracy ro av ed av	g 0.	80 ).81		0.80 .80	0.7	100 9 80	0 1000 1000
[1024, Trainin	512,	256, 12	28, 5]	hid	den l	aye	r size	e
IIailiili		ecision	reca	all 1	f1-sc	ore	sup	port

0 1 2 3 4	1.00 1.00 1.00 1.00 1.00	1.00 1.00 1.00 1.00 1.00	1.00 1.00 1.00 1.00 1.00	197 197 195 200 209	8 2 8
accura macro weighted	avg 1.			1000 00 .00	00 10000 10000
Test	precision	recall	f1-score	e sup	port
0 1 2 3 4	0.99 0.89 0.85 0.72 0.94	1.00 0.96 0.85 0.80 0.80	1.00 0.92 0.85 0.76 0.87	227 185 200 169 219	5 ) )
accura macro weighted	avg 0.			1000 88 ).89	0 1000 1000
Training	12, 256, 12 precision		] hidden f1-score	•	size port
0 1 2 3 4	1.00 0.99 0.98 0.98 0.98	0.99 0.99 0.98 0.97 1.00	1.00 0.99 0.98 0.98 0.99	198 197 196 202 205	9 3 0
accura macro weighted	avg 0.			1000 99 ).99	00 10000 10000
Test	precision	recall	f1-score	sup	port
0 1 2 3 4	1.00 0.90 0.84 0.72 0.90	1.00 0.96 0.82 0.76 0.84	1.00 0.93 0.83 0.74 0.87	229 187 205 177 202	7 5 7
accura macro weighted	avg 0.		_	1000 87 ).88	0 1000 1000

2) e) [1024, 51: Training	2, 5] hidd	en laye	r size		
	recision	recall	f1-score	sup	port
0 1 2 3 4	1.00 0.97 0.94 0.94 0.97	0.99 0.97 0.95 0.94 0.97	0.99 0.97 0.95 0.94 0.97	198 198 192 202 208	4 4 5
accura macro a weighted	vg 0.				00 10000 10000
Test p	recision	recall	f1-score	sup	port
0 1 2 3 4	0.97 0.87 0.79 0.73 0.90	0.99 0.93 0.83 0.72 0.80	0.98 0.90 0.81 0.72 0.85	224 187 190 189 210	, ) )
accura macro a weighted	vg 0.			1000 35 .86	0 1000 1000
[1024, 512 Training	2, 256, 5] recision		layer size		port
0 1 2 3 4	1.00 0.99 0.98 0.99 1.00	1.00 0.99 0.99 0.98 1.00	1.00 0.99 0.98 0.98 1.00	197 198 193 201 209	7 5 4 3
accura macro a weighted	vg 0.				00 10000 10000
Test p	recision	recall	f1-score	sup	port
0 1 2 3 4	0.97 0.88 0.84 0.80 0.90	0.99 0.94 0.86 0.77 0.84	0.91 0.85 0.79	224 186 195 194 201	S 5 4
accurae macro a weighted	vg 0.		0.88 0.88 0.8 0.88 0		0 1000 1000
[1024, 51; Training F		_	idden laye		

	0 1 2 3 4	1.00 1.00 1.00 1.00 1.00	1.00 1.00 1.00 1.00	0 1. 0 1. 0 1.	00 00 00 00 00	197 198 195 200 209	0 0 2
	uracy ro avo ted av	g 1.	00 1.00	1.00 1.00	1.0	1000 0 00	0 10000 10000
Test	pre	cision	reca	all f1-s	score	sup	port
	0 1 2 3 4	1.00 0.90 0.86 0.80 0.92	1.00 0.98 0.8 0.79 0.84	3 0. 7 0. 9 0.	00 94 87 79 88	229 183 196 188 204	3 5 3
	uracy ro avo ted av	g 0.	90 ).90	0.90 0.90	90 0.9 0.	1000 0 90	0 1000 1000
[1024, Trainin		256, 12	28, 64	, 5] hic	dden I	ayer	size
	pre	cision	reca	all f1-s	score	sup	port
	0 1 2 3 4	1.00 1.00 1.00 0.99 1.00	1.00 1.00 1.00 1.00 0.99	0 1. 0 1. 0 0.	00 00 00 99 99	197 197 195 198 211	6 1 7
	uracy ro avo ted av	g 1.	00 1.00	1.00 1.00	1.0	1000 0 00	0 10000 10000
Test	pre	ecision	reca	all f1-s	score	sup	port
	0 1 2 3 4	0.99 0.95 0.84 0.74 0.94	1.00 0.90 0.9 0.79 0.80	6 0. 1 0. 9 0.	00 95 87 76 86	227 196 183 174 220	S B I
	uracy ro avo ted av	g 0.	89 ).90	0.89 0.90	90 0.8 0.	1000 9 90	0 1000 1000

```
2)
f)
[512] hidden layer size
Training
        precision recall f1-score support
      0
           0.97
                   0.93
                           0.95
                                   2042
      1
           0.82
                   0.82
                           0.82
                                   1976
      2
           0.69
                   0.71
                           0.70
                                   1906
      3
           0.66
                   0.69
                           0.68
                                   1913
      4
           0.86
                   0.83
                           0.84
                                   2163
  accuracy
                           0.80
                                  10000
 macro avg
                0.80
                       0.80
                               0.80
                                      10000
weighted avg
                0.80
                        0.80
                                0.80
                                       10000
Test
        precision
                   recall f1-score support
      0
           0.91
                   0.98
                           0.94
                                   214
                           0.78
                                   206
      1
           0.80
                   0.77
      2
           0.61
                   0.66
                           0.63
                                   183
      3
           0.59
                   0.62
                           0.61
                                   179
      4
           0.87
                   0.74
                           0.80
                                   218
                           0.76
                                  1000
  accuracy
 macro avg
               0.76
                       0.75
                               0.75
                                       1000
                                0.76
weighted avg
                0.77
                       0.76
                                        1000
[512, 256] hidden layer size
Training
        precision
                   recall f1-score support
      0
           0.97
                   0.94
                           0.95
                                   2025
           0.84
                   0.84
                           0.84
                                   1974
      1
      2
           0.71
                   0.73
                           0.72
                                   1911
      3
           0.65
                   0.69
                           0.67
                                   1889
      4
           0.86
                   0.82
                           0.84
                                   2201
                           0.81
                                  10000
  accuracy
 macro avg
                0.81
                       0.80
                               0.81
                                      10000
weighted avg
                0.81
                        0.81
                                0.81
                                       10000
Test
        precision
                   recall f1-score support
      0
           0.93
                   0.98
                           0.95
                                   216
      1
           0.79
                   0.80
                           0.79
                                   196
      2
           0.64
                   0.67
                           0.65
                                   189
      3
           0.57
                   0.60
                           0.58
                                   179
      4
           0.84
                   0.72
                           0.78
                                   220
                                  1000
                           0.76
  accuracy
                0.75
                       0.75
                               0.75
                                       1000
 macro avg
                0.76
                                0.76
                                        1000
weighted ava
                        0.76
[512, 256, 128] hidden layer size
Training
        precision
                   recall f1-score support
      0
           0.97
                   0.95
                           0.96
                                   2010
      1
           0.85
                   0.86
                           0.85
                                   1975
```

	2 3 4	0.74 0.68 0.86	0.76 0.71 0.82		192	29
	uracy ro avo ted av	g 0.8	32 ( .82	0.82 0.82 0.82	100 0.82 0.82	00 10000 10000
Test	pre	ecision	recal	l f1-sco	ore su	oport
	0 1 2 3 4	0.95 0.76 0.66 0.57 0.86	0.98 0.83 0.67 0.59 0.72	0.80 0.67	) 18 7 19 3 17	1 6 9
	uracy ro avo ted av	g 0.1	76 ( .77	0.77 0.76 0.77	0.76 0.77	00 1000 1000
[512, 2 Trainin	ıg	28, 64] ecision		n layer s		oport
	0 1 2 3 4	0.98 0.87 0.72 0.66 0.85	0.96 0.86 0.75 0.68 0.82	0.86 0.73	3 199 3 187 7 198	99 71 56
	uracy ro avo ted av	g 0.8	82 .82	0.82 0.81 0.82	100 0.81 0.82	00 10000 10000
Test	pre	ecision	recal	l f1-sco	ore su	pport
	0 1 2 3 4	0.97 0.82 0.66 0.61 0.90	0.99 0.87 0.72 0.64 0.75	0.84 0.69 0.62	18 18 2 17	8 3 9
	uracy ro ave ted av	g 0.7	79 ( .80	0.80 0.79 0.80	0.79 0.80	00 1000 1000