

Conclusion:

- Green cells show the highest average accuracy for given step size and hyperparameter. Average accuracy is calculated by taking the accuracies of all other hyperparameters.
- BRNN (Bidirectional LSTM) learns faster and achieves better accuracy than RNN (LSTM).
- 1024 learns faster as well as achieve highest accuracy among other hidden unit sizes i.e 128,256,512,2048.
- After 10000 steps, no impact of embedding size so we can use the minimum size which is 256.
- Up to 10000 steps layer 1 is better. After 10000 steps 2 LSTM layers outperform 1 and 3.

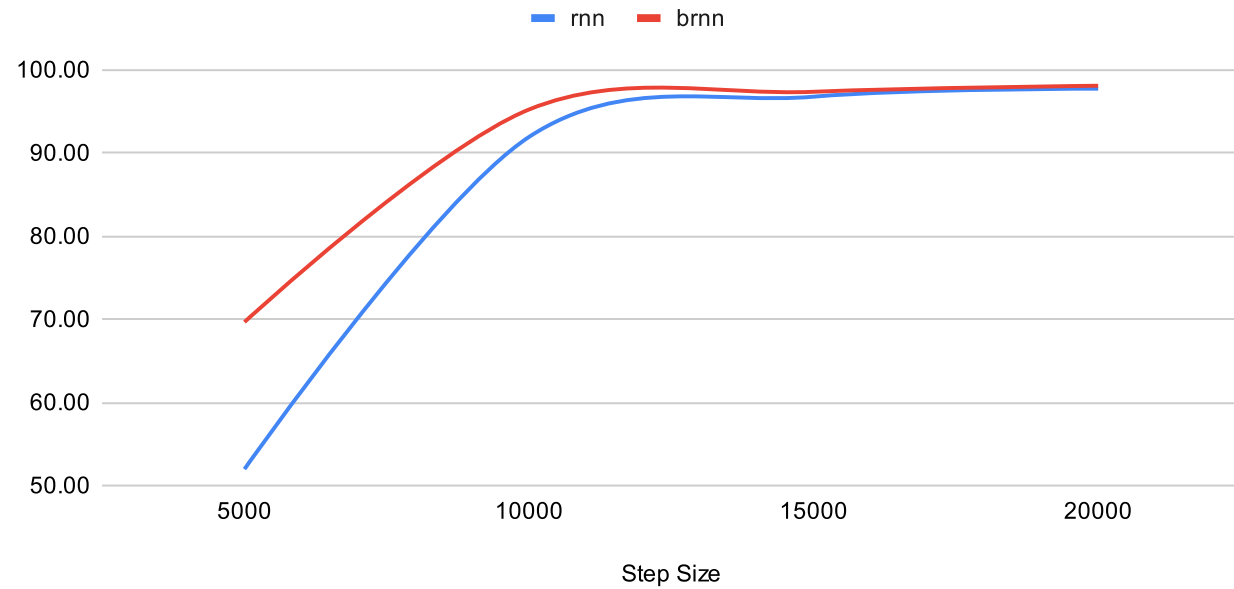
Max average accuracy	84.08	96.89	97.68	98.17	98.53	98.64	98.56	98.90	99.01	99.05	99.29	99.30	99.34	99.35	99.34	99.36	99.36	99.36	99.36	99.36
Step Size	5000	10000	15000	20000	25000	30000	35000	40000	45000	50000	55000	60000	65000	70000	75000	80000	85000	90000	95000	100000
rnn	51.96	91.92	96.76	97.72	98.23	98.44	98.41	98.76	98.88	98.92	99.22	99.23	99.28	99.29	99.29	99.30	99.30	99.30	99.30	99.30
brnn	69.65	95.22	97.35	98.08	98.43	98.63	98.33	98.87	98.95	99.02	99.27	99.27	99.32	99.33	99.32	99.34	99.34	99.35	99.34	99.34
rnn_size_128	46.49	85.76	95.71	97.43	98.00	98.31	98.08	98.65	98.78	98.83	99.15	99.16	99.23	99.23	99.24	99.25	99.25	99.26	99.25	99.25
rnn_size_256	66.13	94.91	97.10	97.91	98.34	98.53	98.20	98.84	98.92	98.99	99.24	99.26	99.30	99.31	99.30	99.32	99.32	99.32	99.32	99.32
rnn_size_512	79.17	96.51	97.65	98.14	98.50	98.64	98.55	98.89	98.95	99.03	99.28	99.27	99.32	99.33	99.32	99.33	99.34	99.34	99.34	99.34
rnn_size_1024	84.08	96.89	97.68	98.17	98.53	98.64	98.43	98.90	98.97	99.03	99.29	99.30	99.34	99.35	99.34	99.36	99.36	99.36	99.36	99.36
rnn_size_2048	30.41	93.91	97.16	97.86	98.29	98.56	98.56	98.81	98.95	98.97	99.26	99.27	99.30	99.32	99.32	99.33	99.34	99.34	99.34	99.34
embed_size_256	63.43	94.49	97.06	97.83	98.30	98.47	98.29	98.79	98.92	98.95	99.24	99.25	99.29	99.31	99.30	99.32	99.32	99.32	99.32	99.32
embed_size_512	55.58	94.56	97.07	97.93	98.29	98.57	98.32	98.83	98.91	98.98	99.24	99.25	99.30	99.30	99.30	99.32	99.32	99.32	99.32	99.31
embed_size_1024	62.58	92.40	97.06	97.92	98.39	98.55	98.37	98.84	98.92	99.00	99.26	99.26	99.31	99.32	99.32	99.33	99.33	99.33	99.34	99.33
embed_size_2048	60.64	92.64	97.02	97.94	98.37	98.56	98.51	98.81	98.93	98.97	99.26	99.25	99.29	99.31	99.31	99.32	99.33	99.32	99.33	99.32
Layers_1	80.25	96.62	97.58	97.89	98.36	98.54	98.40	98.80	98.90	98.90	99.24	99.24	99.28	99.29	99.28	99.30	99.30	99.30	99.30	99.29
Layers_2	62.67	96.05	97.44	98.12	98.50	98.64	98.46	98.90	99.01	99.05	99.29	99.29	99.34	99.35	99.34	99.36	99.36	99.36	99.36	99.36
Layers_3	39.50	88.05	96.15	97.69	98.14	98.43	98.24	98.75	98.84	98.96	99.21	99.22	99.28	99.29	99.29	99.30	99.31	99.31	99.31	99.31

Conclusion:

- BRNN (Bidirectional LSTM) learns faster and achieves better accuracy than RNN (LSTM).

Step Size	rnn	brnn
5000	51.96	69.65
10000	91.92	95.22
15000	96.76	97.35
20000	97.72	98.08
25000	98.23	98.43
30000	98.44	98.63
35000	98.41	98.33
40000	98.76	98.87
45000	98.88	98.95
50000	98.92	99.02
55000	99.22	99.27
60000	99.23	99.27
65000	99.28	99.32
70000	99.29	99.33
75000	99.29	99.32
80000	99.30	99.34
85000	99.30	99.34
90000	99.30	99.35
95000	99.30	99.34
100000	99.30	99.34

LSTM direction experiments

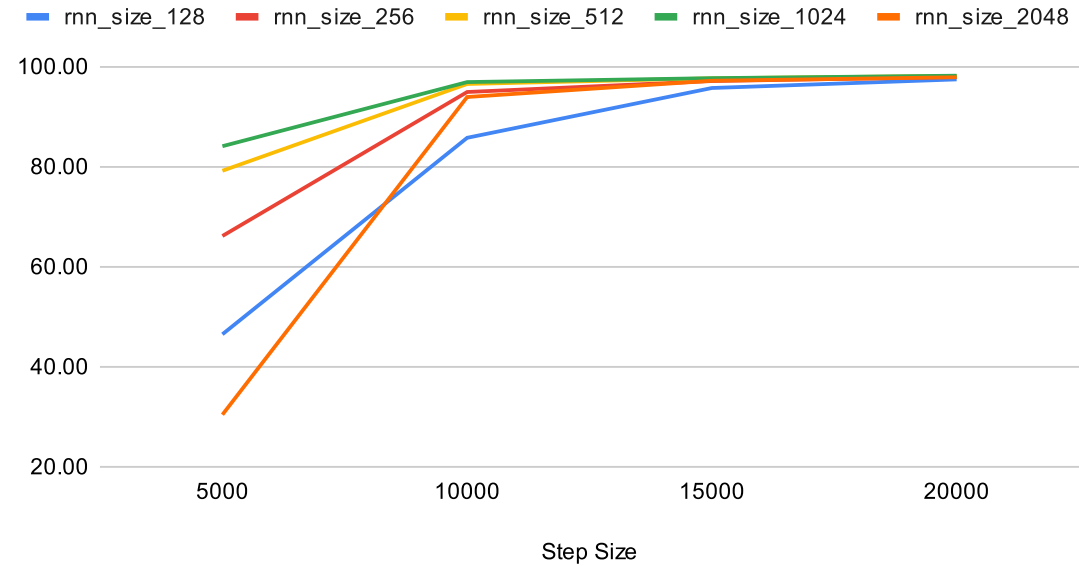


Conclusion :

- 1024 learns faster as well as achieve highest accuracy among other hidden unit sizes i.e 128,256,512,2048.

Step Size	rnn_size_ 128	rnn_size_ 256	rnn_size_ 512	rnn_size_ 1024	rnn_size_ 2048
5000	46.49	66.13	79.17	84.08	30.41
10000	85.76	94.91	96.51	96.89	93.91
15000	95.71	97.10	97.65	97.68	97.16
20000	97.43	97.91	98.14	98.17	97.86
25000	98.00	98.34	98.50	98.53	98.29
30000	98.31	98.53	98.64	98.64	98.56
35000	98.08	98.20	98.55	98.43	98.56
40000	98.65	98.84	98.89	98.90	98.81
45000	98.78	98.92	98.95	98.97	98.95
50000	98.83	98.99	99.03	99.03	98.97
55000	99.15	99.24	99.28	99.29	99.26
60000	99.16	99.26	99.27	99.30	99.27
65000	99.23	99.30	99.32	99.34	99.30
70000	99.23	99.31	99.33	99.35	99.32
75000	99.24	99.30	99.32	99.34	99.32
80000	99.25	99.32	99.33	99.36	99.33
85000	99.25	99.32	99.34	99.36	99.34
90000	99.26	99.32	99.34	99.36	99.34
95000	99.25	99.32	99.34	99.36	99.34
100000	99.25	99.32	99.34	99.36	99.34

LSTM hidden unit size experiment

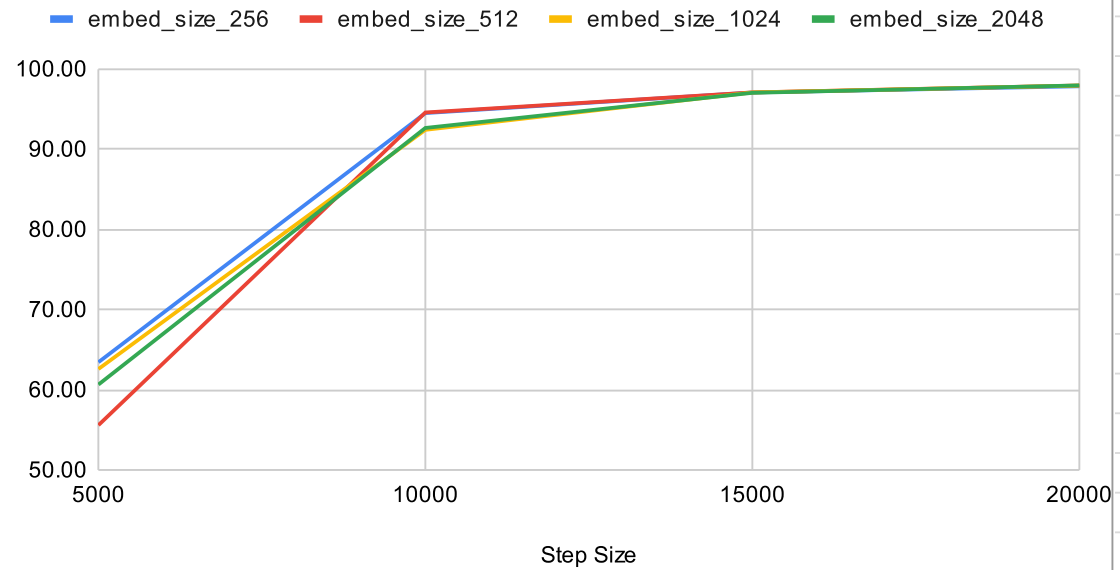


Conclusion :

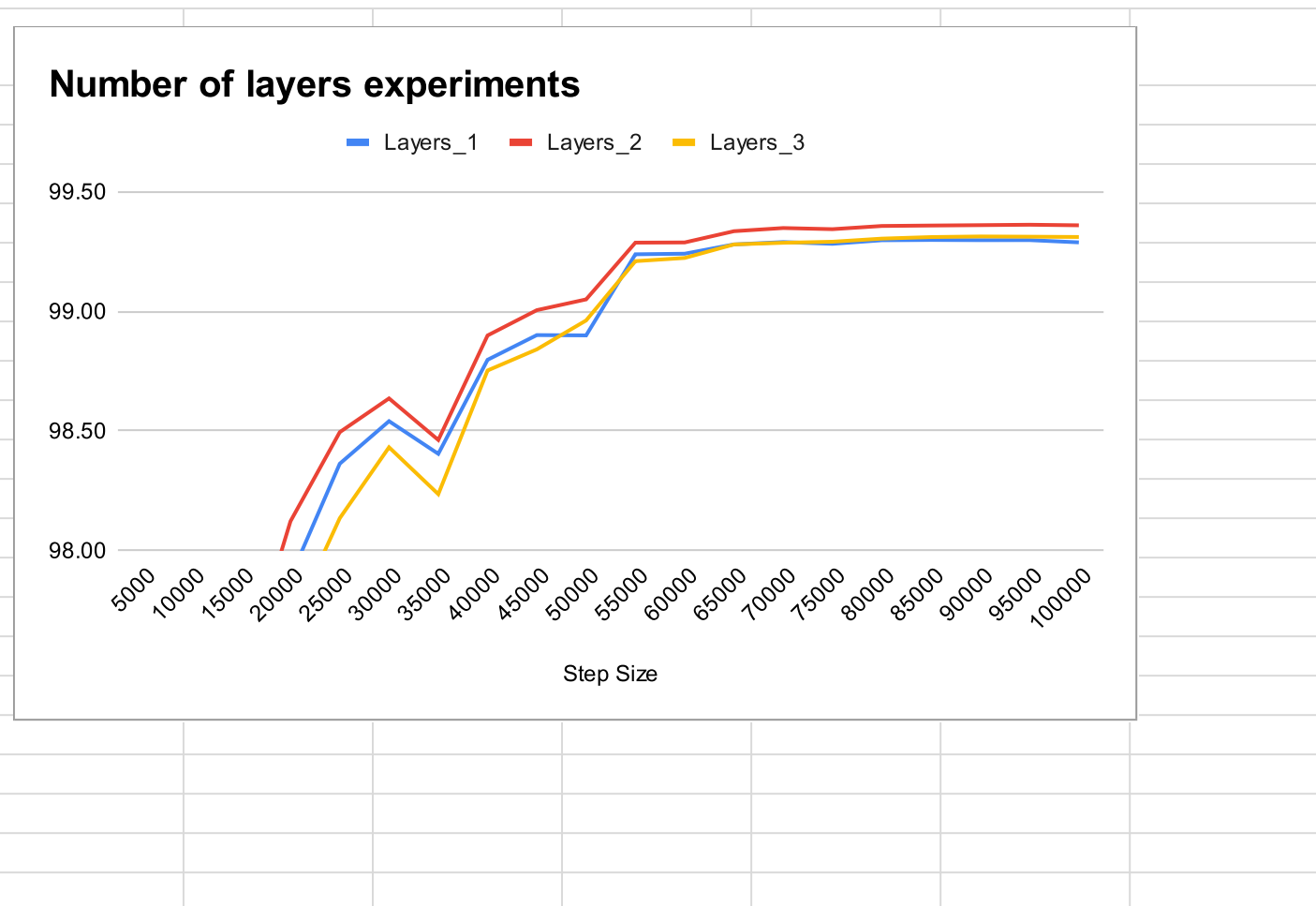
- After 10000 steps, no impact of embedding size so we can use the minimum size which is 256.

Step Size	embed_size_256	embed_size_512	embed_size_1024	embed_size_2048
5000	63.43	55.58	62.58	60.64
10000	94.49	94.56	92.40	92.64
15000	97.06	97.07	97.06	97.02
20000	97.83	97.93	97.92	97.94
25000	98.30	98.29	98.39	98.37
30000	98.47	98.57	98.55	98.56
35000	98.29	98.32	98.37	98.51
40000	98.79	98.83	98.84	98.81
45000	98.92	98.91	98.92	98.93
50000	98.95	98.98	99.00	98.97
55000	99.24	99.24	99.26	99.26
60000	99.25	99.25	99.26	99.25
65000	99.29	99.30	99.31	99.29
70000	99.31	99.30	99.32	99.31
75000	99.30	99.30	99.32	99.31
80000	99.32	99.32	99.33	99.32
85000	99.32	99.32	99.33	99.33
90000	99.32	99.32	99.33	99.32
95000	99.32	99.32	99.34	99.33
100000	99.32	99.31	99.33	99.32

Embedding vector size experiment



Conclusion : - Up to 10000 steps layer 1 is better. - After 10000 steps 2 LSTM layers outperform 1 and 3.			
Step Size	Layers_1	Layers_2	Layers_3
5000	80.25	62.67	39.50
10000	96.62	96.05	88.05
15000	97.58	97.44	96.15
20000	97.89	98.12	97.69
25000	98.36	98.50	98.14
30000	98.54	98.64	98.43
35000	98.40	98.46	98.24
40000	98.80	98.90	98.75
45000	98.90	99.01	98.84
50000	98.90	99.05	98.96
55000	99.24	99.29	99.21
60000	99.24	99.29	99.22
65000	99.28	99.34	99.28
70000	99.29	99.35	99.29
75000	99.28	99.34	99.29
80000	99.30	99.36	99.30
85000	99.30	99.36	99.31
90000	99.30	99.36	99.31
95000	99.30	99.36	99.31
100000	99.29	99.36	99.31



309	rnn	512	1024	1	86.47	96.84	97.55	98.02	98.54	98.61	98.60	98.74	98.83	99.07	99.26	99.29	99.33	99.31	99.30	99.28	99.30	99.29	99.28	99.28	65000	99.33	12287481	6	179	123	22546.971
310	rnn	256	1024	3	36.20	93.80	96.17	97.84	98.07	98.34	97.83	98.68	98.90	98.92	99.16	99.14	99.24	99.24	99.22	99.26	99.26	99.27	99.27	99.26	90000	99.27	9835769	7	179	123	28355.8428
311	rnn	256	1024	2	20.97	93.84	97.31	98.18	98.47	98.58	98.86	98.91	98.75	98.97	99.32	99.30	99.32	99.33	99.32	99.33	99.35	99.34	99.36	99.36	95000	99.36	8783097	6	177	124	23312.6503
312	rnn	256	1024	1	87.87	97.06	97.62	97.82	98.47	98.23	98.48	98.81	98.90	98.96	99.29	99.24	99.29	99.28	99.29	99.32	99.32	99.30	99.31	99.31	95000	99.31	7730425	5	174	126	20179.4058
313	rnn	128	1024	3	16.80	25.40	95.96	97.47	97.75	98.18	98.55	98.56	98.81	98.98	99.03	99.14	99.12	99.15	99.17	99.18	99.19	99.18	99.17	90000	99.17	6717561	7	179	123	25807.5439	
314	rnn	128	1024	2	22.67	92.32	96.53	97.69	98.09	98.31	98.66	98.53	98.96	98.82	99.16	99.18	99.23	99.29	99.27	99.30	99.28	99.27	99.28	99.27	95000	99.28	6453369	6	170	129	22046.21437
315	rnn	128	1024	1	85.29	96.93	97.63	97.40	97.95	98.45	97.88	98.67	98.61	98.61	99.09	99.17	99.24	99.21	99.22	99.24	99.21	99.22	99.22	99.21	90000	99.22	6189177	5	183	120	18826.4057
401	brnn	2048	512	3	0.00	93.94	96.58	98.00	98.42	98.76	98.58	98.98	98.90	99.14	99.29	99.31	99.36	99.37	99.40	99.40	99.40	99.40	99.40	99.39	80000	99.4	185778681	41	543	41	150409.6986
402	brnn	2048	512	2	28.31	96.23	97.76	98.47	98.47	98.69	98.84	98.99	99.10	99.09	99.34	99.35	99.39	99.40	99.40	99.41	99.42	99.42	99.42	99.41	90000	99.42	127025657	29	422	52	107677.1856
403	brnn	2048	512	1	34.31	95.54	97.21	97.76	98.06	98.61	98.78	98.84	98.95	98.83	99.20	99.20	99.25	99.31	99.29	99.32	99.32	99.32	99.31	99.29	80000	99.32	68272633	17	325	68	64042
404	brnn	1024	512	3	87.47	96.32	97.51	97.92	98.37	98.50	98.55	98.77	98.92	99.03	99.23	99.26	99.26	99.25	99.26	99.27	99.28	99.25	99.28	100000	99.27	52436473	18	282	78	66939	
405	brnn	1024	512	2	91.78	97.43	97.75	98.51	98.79	98.74	98.90	98.96	99.06	99.16	99.31	99.35	99.39	99.38	99.37	99.39	99.39	99.40	99.39	99.39	85000	99.35	37740025	14	248	89	50655.2431
406	brnn	1024	512	1	90.27	97.29	97.93	98.24	98.57	98.77	97.92	98.90	99.04	99.12	99.35	99.37	99.40	99.39	99.38	99.40	99.40	99.40	99.40	99.40	90000	99.4	23043577	9	209	105	33717.4345
407	brnn	512	1024	3	79.77	96.48	97.58	97.70	98.43	98.59	98.85	98.96	98.88	99.13	99.29	99.32	99.34	99.35	99.34	99.36	99.40	99.37	99.37	99.37	90000	99.37	18009081	10	206	107	38559.712
408	brnn	512	512	2	91.46	97.20	97.82	98.10	98.61	98.83	98.52	98.96	99.09	99.13	99.32	99.31	99.35	99.36	99.36	99.40	99.39	99.39	99.40	99.37	80000	99.4	14330873	8	195	113	31003.7721
409	brnn	512	512	1	91.33	97.49	97.98	98.29	98.59	98.62	98.54	98.81	98.81	98.99	99.22	99.20	99.24	99.28	99.27	99.29	99.31	99.30	99.31	99.30	95000	99.3	10652665	6	187	118	23949.7119
410	brnn	256	512	3	48.03	94.41	96.47	97.73	98.19	98.40	98.22	98.77	98.78	98.91	99.17	99.21	99.26	99.28	99.27	99.30	99.29	99.29	99.29	99.28	95000	99.29	8856313	8	199	111	29758.62
411	brnn	256	512	2	85.03	96.24	97.13	98.09	98.31	98.77	98.62	99.04	99.09	99.15	99.32	99.33	99.36	99.36	99.37	99.38	99.37	99.37	99.37	99.36	85000	99.39	7934713	6	192	115	24933.4759
412	brnn	256	512	1	90.59	96.83	97.24	97.94	98.58	98.70	98.76	98.77	98.97	99.00	99.26	99.28	99.32	99.27	99.29	99.29	99.27	99.30	99.28	99.24	90000	99.29	6295161	5	188	117	20397.9079
413	brnn	128	512	3	17.09	88.11	95.67	97.17	98.02	98.49	98.41	98.62	98.82	98.94	99.17	99.18	99.26	99.25	99.27	99.27	99.27	99.29	99.27	99.29	75000	99.26	6295161	7	190	116	27922.681
414	brnn	128	512	2	52.45	94.87	97.07	97.74	97.92	98.26	94.56	98.66	98.96	98.80	99.23	99.18	99.30	99.27	99.31	99.32	99.32	99.32	99.32	99.32	90000	99.32	6063737	6	175	126	23791.79
415	brnn	128	512	1	78.43	96.85	97.67	97.92	98.45	98.37	98.55	98.82	98.91	98.87	99.12	99.15	99.17	99.17	99.17	99.16	99.18	99.18	99.18	99.16	85000	99.18	5832313	5	164	134	19606.81
501	rnn	2048	512	3	0.00	88.89	96.70	97.64	98.14	98.62	98.60	98.81	98.90	99.00	99.23	99.22	99.29	99.29	99.29	99.30	99.31	99.31	99.32	99.29	95000	99.32	210944505	45	542	41	163188.5118
502	rnn	2048	512	2	0.00	93.72	96.93	97.83	98.50	98.83	98.74	98.99	98.89	99.08	99.31	99.25	99.28	99.30	99.30	99.28	99.32	99.32	99.31	99.32	100000	99.32	143802873	31	445	49	114506.8165
503	rnn	2048	512	1	33.70	94.61	97.62	97.68	97.99	98.62	98.39	98.73	98.87	98.97	99.17	99.20	99.27	99.31	99.31	99.31	99.32	99.32	99.32	99.31	95000	99.32	76661241	19	329	67	68672.48521
504	rnn	1024	512	3	32.58	95.27	97.24	98.32	97.67	98.44	98.00	98.83	98.85	99.12	99.32	99.32	99.39	99.36	99.36	99.40	99.41	99.39	99.39	99.38	95000	99.41	58727929	16	272	81	60582.1913
505	rnn	1024	512	2	89.97	97.18	97.96	98.37	98.55	98.70	97.83	98.97	99.06	99.01	99.26	99.26	99.33	99.34	99.31	99.30	99.32	99.32	99.32	99.32	70000	99.34	41934329	12	244	90	45762.14251
506	rnn	1024	512	1	89.84	96.93	97.92	98.18	98.60	98.65	98.70	98.84	98.82	98.92	99.26	99.23	99.32	99.32	99.30	99.32	99.32	99.26	99.26	99.30	65000	99.31	25140729	9	214	103	33068.4345
507	rnn	512	512	3	13.32	94.64	97.23	97.89	98.04	98.58	98.60	98.84	99.00	99.07	99.21	99.27	99.34	99.34	99.33	99.33	99.35	99.35	99.35	99.34	95000	99.35	19581945	9	202	109	33506.3611
508	rnn	512	512	2	81.42	97.02	98.11	98.25	98.52	98.86	98.51	99.03	99.02	99.09	99.32	99.34	99.40	99.39	99.38	99.40	99.40	99.38	99.39	99.41	100000	99.41	15379449	7	189	116	26881.90755
509	rnn	512	512	1	86.74	94.87	97.44	97.65	98.41	98.27	98.62	98.85	98.71	98.99	99.25	99.22	98.28	99.27	99.31	99.30	99.30	99.30	99.30	99.29	80000	99.3	11176953	6	182	121	22081.43249
510	rnn	256	512	3	17.27	90.30	96.43	97.70	97.72	98.21	98.40	98.69	98.80	98.90	99.18	99.18	99.23	99.27	99.27	99.27	99.29	99.28	99.28	99.28	85000	99.28	9249529	7	180	122	27222.94841
511	rnn	256	512	2	74.81	96.12	96.71	98.07	98.48	98.62	98.37	98.88	98.92	99.02	99.23	99.24	99.32	99.30	99.30	99.32	99.31	99.32	99.35	99.34	95000	99.34	8196857	6	172	128	22343.4074
512	rnn	256	512	1	88.71	96.96	97.55	98.02	98.58	98.54	98.28	98.91	98.82	98.94	99.16	99.25	99.29	99.29	99.30	99.29	99.31	99.31	99.30	99.30	90000	99.3	7144185	5	168	131	19735.4032
513	rnn	128	512	3	8.31	77.13	91.75	97.03	97.57	98.02	98.40	98.57	98.57	98.81	99.01	99.12	99.19	99.18	99.21	99.22	99.20	99.20	99.20	99.21	80000	99.22	6393456	7	174	126	25401.9626
514	rnn	128	512	2	23.64	93.79	96.20	97.63	98.32	98.65	97.80	98.80	98.88	98.88	99.24	99.22	99.31	99.29	99.29	99.31	99.32	99.32	99.32	99.32	90000	99.32	6129273	5	163	135	21425.16143
515	rnn	128	512	1	84.85	96.18	97.40	97.82	97.89	98.34	98.16	98.47	98.86	98.39	99.17	99.20	99.21	99.24	99.22	99.25	99.23	99.21	99.21	99.21	70000	99.24	5865081	5	166	133	18940.3761
601	brnn	2048	256	3	21.63	93.86	96.94	97.92	98.41	98.48	98.77	98.92	98.87	99.08	99.31	99.33	99.35	99.37	99.35	99.37	99.38	99.38	99.38	99.37	85000	99.38	183650533	41	537	41	150838.4499
602	brnn	2048	256	2	56.33	95.56	97.50	98.38	98.57	98.62	98.45	98.35	99.04	99.14	99.32	99.33	99.36	99.38	99.37	99.40	99.40	99.41	99.41	99.39	95000	99.41	124897529	29	421	52	107737.2759
603	brnn	2048	256	1	80.37	96.82	97.94	98.03	98.46	98.55	98.31	98.99	98.90	98.78	99.23	99.32	99.32	99.30	99.28	99.34	99.34	99.35	99.34	99.34	90000	99.35	66144505				

707	rnn	512	256	3	28.51	94.98	96.39	98.16	98.46	98.38	98.65	98.60	98.93	98.94	99.27	99.21	99.29	99.31	99.30	99.32	99.34	99.31	99.32	99.31	80000	99.31	19026681	9	201	109	33590.6791
708	rnn	512	256	2	80.87	96.09	97.58	98.40	98.60	98.58	98.77	98.94	99.09	98.98	99.30	99.33	99.33	99.37	99.37	99.38	99.38	99.38	99.38	99.38	100000	99.38	14824185	7	184	120	26844.1401
709	rnn	512	256	1	87.13	96.96	97.72	98.04	98.49	98.44	98.32	98.89	98.93	98.82	99.21	99.20	99.28	99.27	99.27	99.28	99.27	99.28	99.28	99.28	90000	99.28	10621689	6	184	120	22511.502
710	rnn	256	256	3	18.38	82.32	95.05	96.84	97.67	98.11	98.50	98.53	98.66	98.88	99.03	99.04	99.23	99.23	99.22	99.25	99.25	99.24	99.27	99.26	95000	99.26	8956409	7	177	124	27977.9486
711	rnn	256	256	2	79.74	96.42	97.30	97.66	98.54	98.34	98.76	98.93	98.96	99.07	99.27	99.30	99.32	99.34	99.31	99.35	99.34	99.34	99.34	99.34	80000	99.34	7903737	6	176	125	23507.2753
712	rnn	256	256	1	89.06	97.33	97.63	97.84	98.49	98.61	98.18	98.70	98.92	99.04	99.28	99.29	99.31	99.33	99.30	99.31	99.33	99.30	99.31	99.29	95000	99.31	6851065	5	171	129	20122.6243
713	rnn	128	256	3	20.36	76.85	92.69	95.80	97.34	97.94	97.10	98.36	98.70	98.69	99.08	99.04	99.12	99.11	99.15	99.16	99.17	99.18	99.18	99.18	95000	99.17	6231417	7	155	142	25677.05008
714	rnn	128	256	2	16.03	94.38	95.89	97.67	98.37	98.54	98.39	98.79	99.00	98.87	99.25	99.25	99.29	99.31	99.31	99.32	99.33	99.33	99.33	99.33	95000	99.32	5967225	6	171	129	22228.0631
715	rnn	128	256	1	84.47	96.62	97.28	96.64	97.54	98.05	98.12	98.62	98.68	98.80	99.16	99.17	99.18	99.24	99.23	99.22	99.22	99.21	99.21	99.22	85000	99.21	5703033	5	179	123	18641.4392