US Patent 12,242,946-B1 - MLiglon Corporation

26 June 2025. Integer Gate Logic (IGL) Benchmark Comparison Study.

IGL produces networks that are smaller and more accurate than those produced by back propagation using the same parameter memory sizes. Also, IGL uses no floating point math and uses integer values only. This means deployed models produce results quicker and with less power, and fit in smaller memory spaces. Lookup tables can be used as well for all necessary multiplications and additions, greatly enhancing computation speeds for inference as well as training.

This is useful for large language models, AI datacenters, robotics, remote sensing, drones, microcontrollers, image and speech recognition.

The benchmarks below show results from the EMNIST dataset and comparative parameter memory size and accuracy on training, verification, and final test data. Sample EMNIST handwritten digits (70,000 images are included in the dataset, 60,000 for training, 10,000 for verification, and 10,000 for final testing):

Backpropagation with **38.177** kilobytes of parameters and 4 byte (32-bit) floating point values for parameters being trained. Final test average over all 10 digits: **99.12%.**

EMNIST	Digit	Train	Validate	Final Test
9547p	0	99.85	99.60	99.56
BackProp	1	99.97	99.73	99.75
4 Byte	2	99.71	99.24	99.18
38.188	3	99.51	98.89	99.23
kb	4	98.78	98.78	98.63
	5	99.99	99.15	99.26
	6	99.99	99.62	99.48
	7	99.17	99.00	98.82
	8	99.12	98.43	98.50
	9	99.55	98.87	98.77
	Average	99.56	99.13	99.12%

Backpropagation with **19.052** kilobytes of parameters and 4 byte (32-bit) floating point values for parameters being trained. Final test average over all 10 digits: **98.77%.**

EMNIST	Digit	Train	Validate	Final Test
4763p	0	99.88	99.56	99.48
BackProp	1	99.74	99.39	99.46
4 Byte	2	99.74	99.17	99.09
19.052	3	98.69	98.47	98.61
kb	4	99.72	99.34	99.21
	5	99.63	98.83	98.76
	6	100.00	99.53	99.28
	7	99.73	99.15	99.11
	8	95.69	96.06	95.97
	9	99.56	98.92	98.68
	Average	99.24	98.84	98.77%

Backpropagation with **9.512** kilobytes of parameters and 4 byte (32-bit) floating point values for parameters being trained. Final test average over all 10 digits: **98.35%.**

EMNIST	Digit	Train	Validate	Final Test
2378p	0	99.21	99.17	99.13
BackProp	1	98.13	98.41	98.33
4 Byte	2	98.52	98.85	98.55
9.512	3	98.79	98.13	98.19
kb	4	99.59	99.18	98.98
	5	99.03	98.35	98.37
	6	99.00	98.85	98.76
	7	99.63	98.80	98.72
	8	95.79	96.27	96.23
	9	98.25	97.97	98.20
	Average	98.59	98.40	98.35%

IGL with **9.537** kilobytes of parameters and 1 byte (8-bit) integer values for parameters being trained. Final test average over all 10 digits: **99.26%.**

EMNIST	Digit	Train	Validate	Final Test
9537p	0	99.91	99.97	99.69
IGL	1	99.84	99.92	99.73
1 Byte	2	99.72	99.93	99.19
9.537	3	99.61	99.84	99.13
kb	4	99.72	99.84	99.29
	5	99.70	99.83	99.23
	6	99.84	99.97	99.47
	7	99.66	99.87	99.06
	8	99.59	99.78	99.11
	9	99.44	99.60	98.74
	Average	99.70	99.86	99.26%

Conclusion: Integer Gate Logic (IGL) using 9.537 kilobytes of parameters produces 99.26% accuracy across all 10 EMNIST digits as compared to 38.177 kilobytes (4x) of parameters using backpropagation which produces 99.12% accuracy across the 10 EMNIST digits. IGL produces significantly smaller and more accurate models than backpropagation when compared on a parameter-size basis.

This in consequence produces models which train and infer much more efficiently than backpropagation as well for several reasons. One of these reasons is integer math only is used, another reason is the possibility to use extremely small memory lookup tables instead of math altogether.