Parallel Neural Network Framework

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Neural Network, why fast?

Learn from DATA

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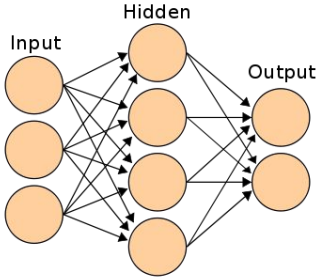
Learn from DATA

Network (trainable)



Probability for each digit

Neural Network, why fast?

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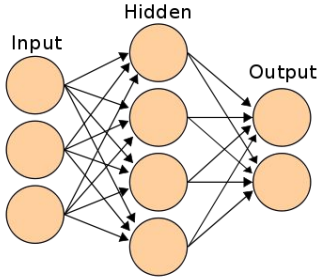

Probability for each digit

Predict: Forward pass

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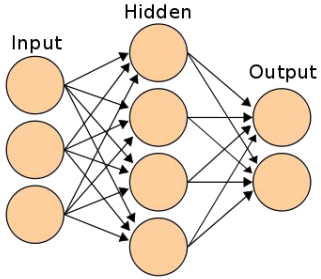

Probability for each digit

Predict: Forward pass

Learn: Backward pass

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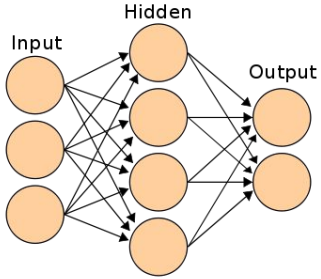

Probability for each digit

Predict: Forward pass

Learn: Backward pass

REPEAT (a lot!)

Neural Network Framework

- Layers
  - Input
  - Dense
  - Convolution (Forward Pass)
  - Activation
    - Sigmoid
    - Leaky ReLU
- Error Criteria
  - Mean Squared Error
  - Cross Entropy

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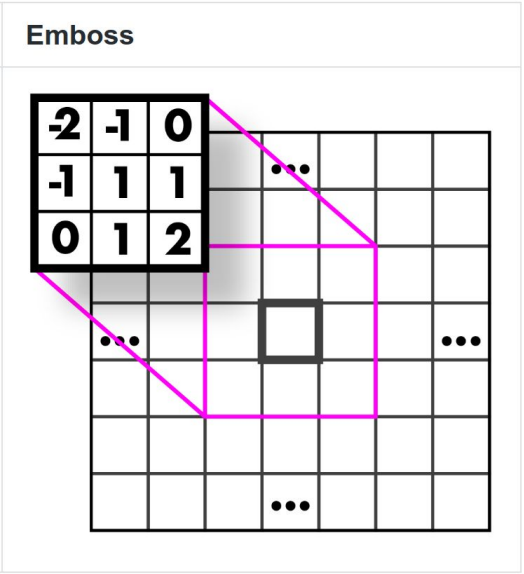
Can be used to create **ANY** dense neural network architecture!

Parallelization

- OpenMP (CPU)
- CUDA (GPU)
  - Matrix Multiplication
  - Convolution
  - Tensor Operations : addition, multiplication etc
- Ensured that data is copied to GPU only once, further calls **reuse the data copy present on GPU**
  - Significant overhead time saved

Convolution Forward Pass on Image



- Evaluated using specific kernel on real images for
  - Blur: Gaussian and Box
  - Edge Detection (Sobel Filters)
  - Emboss
  - High Pass Filter

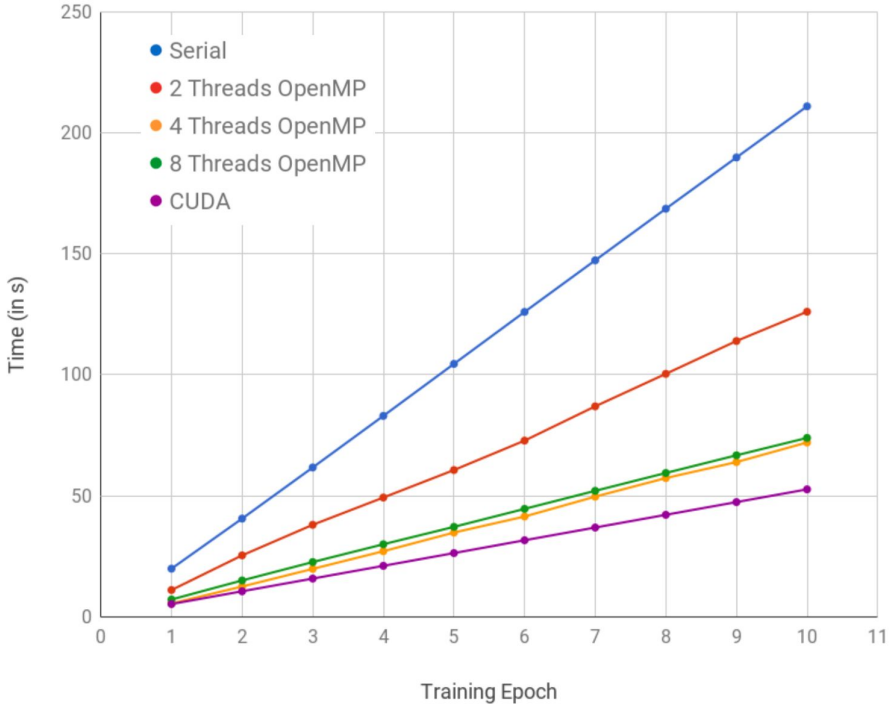

Original

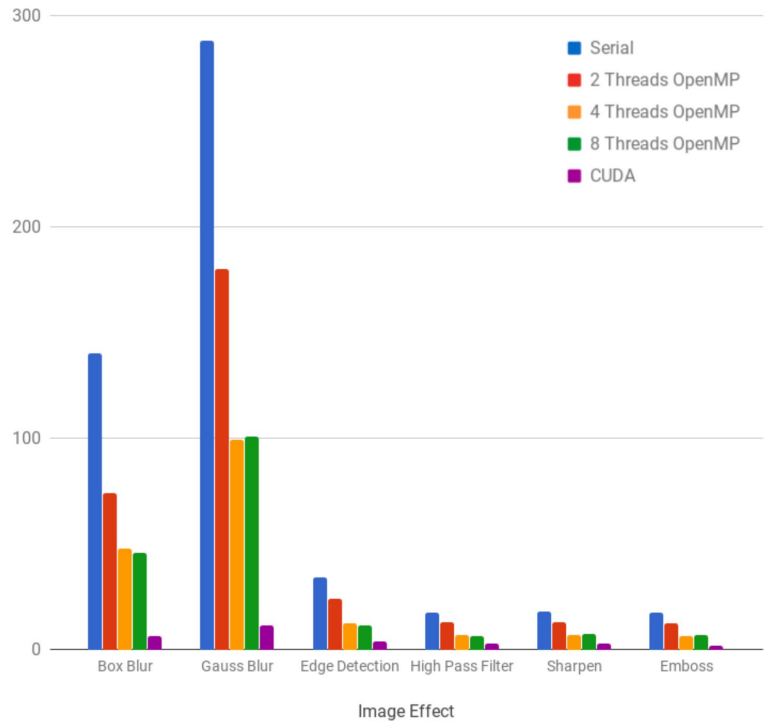

1× 1× 1×
1× 1× 1×
1× 1× 1×


-1 -2 -1
0 0 0
1 2 1
-1 0 1
-2 0 2
-1 0 1


-2 -1 0
-1 1 1
0 1 2

Results


Serial
2 Threads OpenMP
4 Threads OpenMP
8 Threads OpenMP
CUDA
Time (in s)
Training Epoch
0
50
100
150
200
250
0
1
2
3
4
5
6
7
8
9
10
11


Serial
2 Threads OpenMP
4 Threads OpenMP
8 Threads OpenMP
CUDA
0
100
200
300
Box Blur
Gauss Blur
Edge Detection
High Pass Filter
Sharpen
Emboss
Image Effect

Results - Speedup

Epoch	Serial	2 Threads	4 Threads	8 Threads	CUDA
1	1	1.80	3.61	2.78	3.77
5	1	1.72	3.00	2.81	3.97
10	1	1.67	2.93	2.85	4.01