High Performance Computing with GPUs
Neural Network Acceleration
Deliverable 1

Team Members

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Execution Time of Baseline Application

```
(venv) ayesha@DESKTOP-T2SU9L6:/mnt/d/work_stuff/hpc/project/src/v1$ make run
./nn.exe
MNIST Neural Network

Epoch 1 - Loss: 0.2681 - Train Accuracy: 91.85% - Time: 3.650s
Epoch 2 - Loss: 0.1051 - Train Accuracy: 96.86% - Time: 3.679s
Epoch 3 - Loss: 0.0722 - Train Accuracy: 97.83% - Time: 3.662s
Total training time: 10.990s
Test Accuracy: 97.10%
gprof -b nn.exe gmon.out > profile_results.txt
```

Gprof Profile

```
Flat profile:

Each sample counts as 0.01 seconds.
  %   cumulative   self              self     total
 time   seconds   seconds    calls   s/call   s/call  name
61.45      7.65      7.65   190000     0.00     0.00  forward
36.06     12.14      4.49   180000     0.00     0.00  backward
 2.01     12.39      0.25        2     0.12     0.12  loadMNISTImages
 0.32     12.43      0.04                               _init
 0.16     12.45      0.02        1     0.02    11.76  train
 0.00     12.45      0.00        2     0.00     0.00  loadMNISTLabels
 0.00     12.45      0.00        1     0.00     0.00  createNetwork
 0.00     12.45      0.00        1     0.00     0.40  evaluate
 0.00     12.45      0.00        1     0.00     0.00  freeNetwork
```

```
Call graph

granularity: each sample hit covers 4 byte(s) for 0.08% of 12.45 seconds

index % time    self  children    called     name
                                              <spontaneous>
[1]      99.7    0.00    12.41                 main [1]
                 0.02    11.74       1/1           train [2]
                 0.00     0.40       1/1           evaluate [5]
                 0.25     0.00       2/2           loadMNISTImages [6]
                 0.00     0.00       2/2           loadMNISTLabels [8]
                 0.00     0.00       1/1           createNetwork [9]
                 0.00     0.00       1/1           freeNetwork [10]
-----------------------------------------------
                 0.02    11.74       1/1           main [1]
[2]      94.4    0.02    11.74       1        train [2]
                 7.25     0.00  180000/190000       forward [3]
                 4.49     0.00  180000/180000       backward [4]
-----------------------------------------------
                 0.40     0.00   10000/190000       evaluate [5]
                 7.25     0.00  180000/190000       train [2]
[3]      61.4    7.65     0.00  190000         forward [3]
-----------------------------------------------
                 4.49     0.00  180000/180000       train [2]
[4]      36.1    4.49     0.00  180000         backward [4]
-----------------------------------------------
                 0.00     0.40       1/1           main [1]
[5]       3.2    0.00     0.40       1        evaluate [5]
                 0.40     0.00   10000/190000       forward [3]
-----------------------------------------------
                 0.25     0.00       2/2           main [1]
[6]       2.0    0.25     0.00       2        loadMNISTImages [6]
-----------------------------------------------
                                              <spontaneous>
[7]       0.3    0.04     0.00                 _init [7]
-----------------------------------------------
                 0.00     0.00       2/2           main [1]
[8]       0.0    0.00     0.00       2        loadMNISTLabels [8]
-----------------------------------------------
                 0.00     0.00       1/1           main [1]
[9]       0.0    0.00     0.00       1        createNetwork [9]
-----------------------------------------------
                 0.00     0.00       1/1           main [1]
[10]      0.0    0.00     0.00       1        freeNetwork [10]
-----------------------------------------------
```

[Github Repo](#)