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Execution Time

The baseline application executed with a total training time of **21.755 seconds**. Each training epoch completed in approximately:

- **Epoch 1:** 7.221 seconds
- **Epoch 2:** 7.237 seconds
- **Epoch 3:** 7.297 seconds

Gprof Profile Analysis

Flat Profile Summary

- **forward:** Dominated the execution with 72.23% of total runtime (16.57 seconds over 190,000 calls), indicating heavy computational demand during forward propagation.
- **backward:** Accounted for 27.42% of the runtime (6.29 seconds over 180,000 calls), highlighting its critical role in the training process.
- Other functions (e.g., `loadMNISTImages`, `evaluate`, `loadMNISTLabels`, `createNetwork`, `freeNetwork`) contributed minimally, focusing most of the processing time on the core neural network operations.

Call Graph Overview

The call graph provides a hierarchical view of function calls:

- The `main` function initiates the execution and calls the `train` function.
- The `train` function internally calls `forward` and `backward`, which are responsible for most of the runtime.
- The `evaluate` function is invoked for accuracy assessment, with minimal impact on performance.
- Data loading functions (`loadMNISTImages` and `loadMNISTLabels`) and network setup/teardown functions (`createNetwork` and `freeNetwork`) occur once and do not significantly influence the overall execution time.

Conclusion

The profiling results suggest that the primary computational expense lies within the forward and backward propagation functions. For further performance improvements, optimization efforts should target these core functions.