Power and Performance Analysis of AI Models on NVIDIA Grace Hopper Superchips

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Introduction

- **Large Language Models (LLM) -** powerful tools in natural language processing, leveraging vast amounts of internet text for inference tasks
- **High performance computing (HPC)** - Also known as supercomputers use of powerful of computers and specialized techniques to tackle complex tasks.
- **Nvidia Grace Hopper Superchip 200 (GH2) -** Referring the new Grace Hopper Superchip 200. (Specs: 900W Power consumption, 96GB of memory, $40K)
- **Motivation** - With ever growing powerful chips there is a need to Improve the AI model power consumption on HPC such as the GH2.

Objectives

- Identify power and memory consumption with model training on GH2.
- Analysis correlation between a LLM size and power consumption.
- Explore solutions to improve LLM models on GH2.
- Collect benchmarks of the CPU and GPU during model training of LLM.

Research Question:

Q1. Will model size affect the overall power consumptions on GH2?

Q2. How can we effectively train an LLM with lower power consumption on GH2?

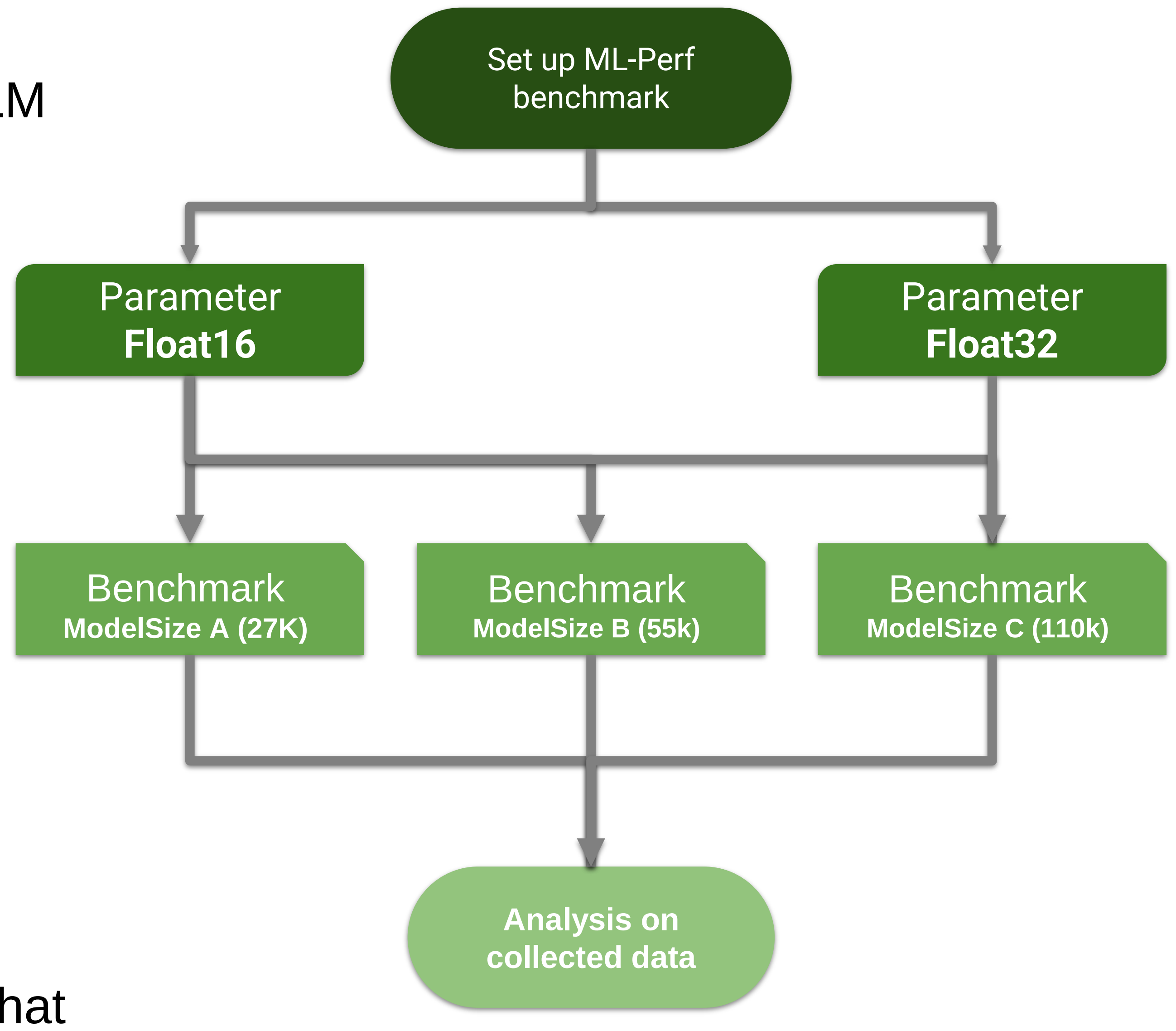
Methodology

Utilized Nvidia ML-Perf, configured the training benchmarks for each selected LLM to run GH2.

Variation in Model Testing

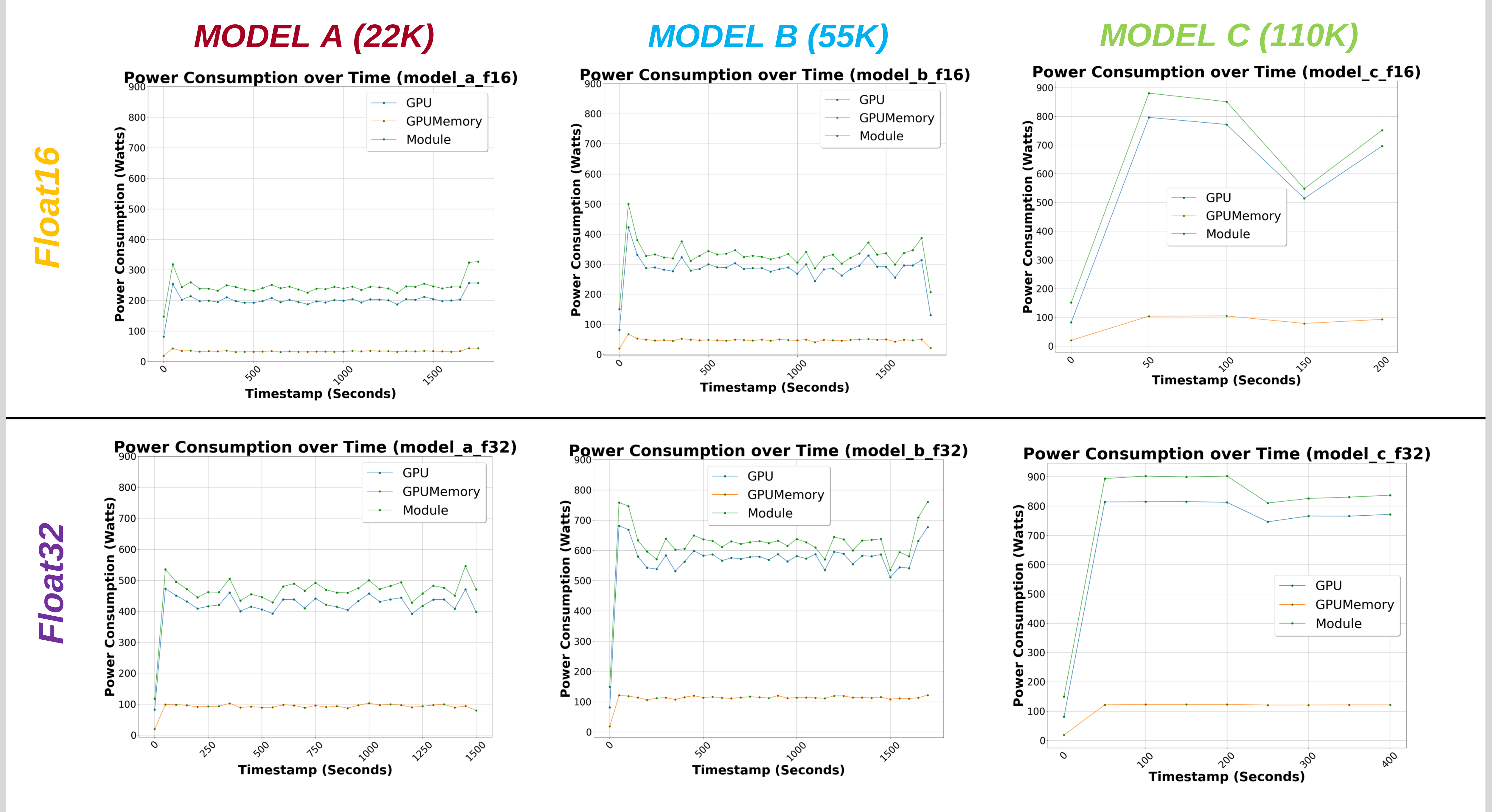
- Tested 3 different model sizes restricted to memory utilization
  - Model memory from 50% - 70%
- Used floating-point precision for the model weights
  - Float16 (F16) vs. Float32 (F32)
- Collected CPU utilization and GPU utilization

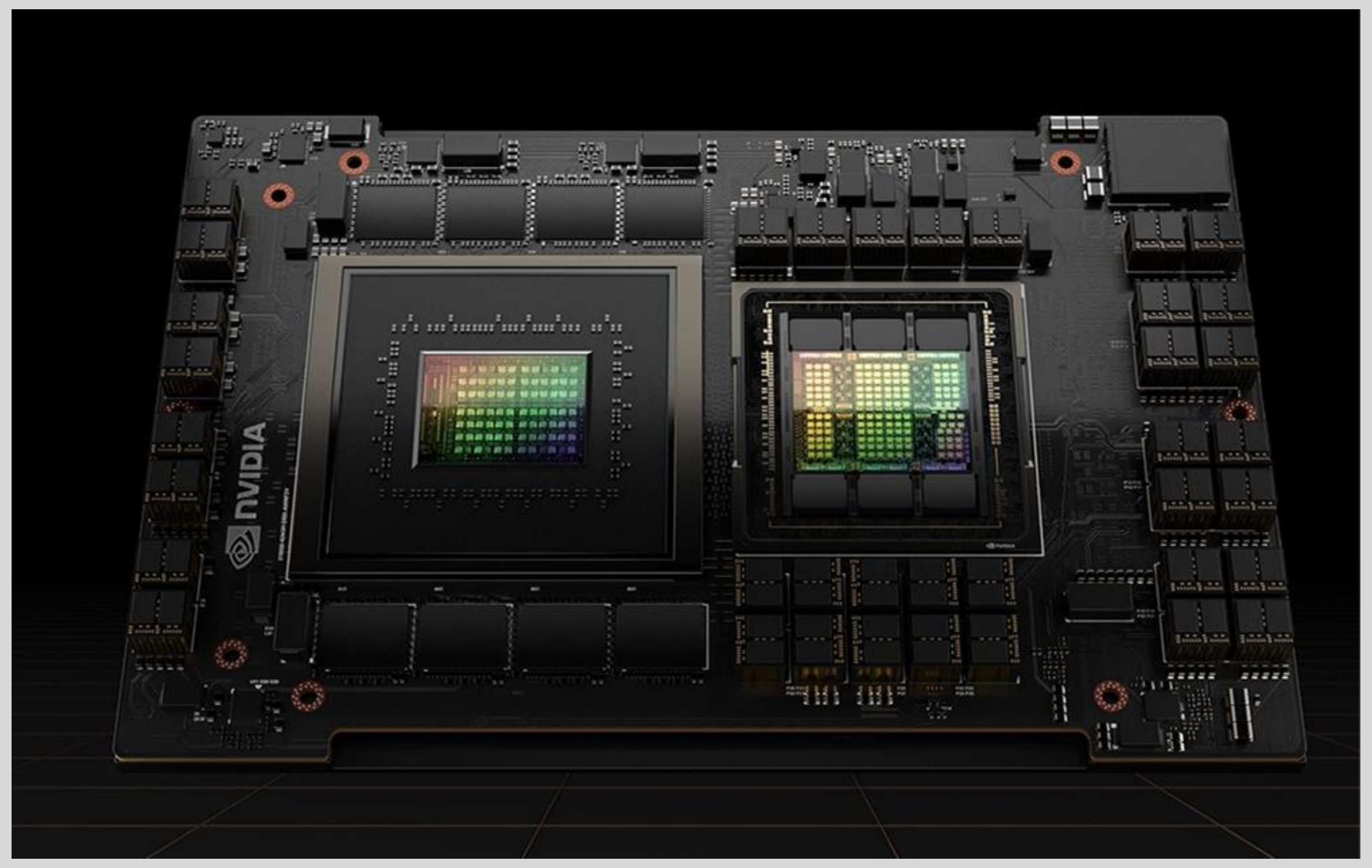
Test was repeated many time to ensure that the model runs smoothly.


Set up ML-Perf benchmark
Parameter Float16
Parameter Float32
Benchmark ModelSize A (27K)
Benchmark ModelSize B (55k)
Benchmark ModelSize C (110k)
Analysis on collected data

Power and Training process for Benchmark and Analysis

Results





Nvidia Grace Hopper superchip (H200)

Conclusions

- Correlation observed between model size and power consumption on GH2.
- Optimizing model architectures and deployment strategies is vital for desired performance with minimal power usage.
- Memory power consumption for Foalt16 is signifyingly lower than Float32.

Future Plans

- Improve energy efficiency in LLM computations on platforms like GH2.
- Explore and test alternative models beyond LLM.

References