Adv. ML Sys: CS839 Spring '22 Project Check-in Ashwin Poduval, Rajesh Shashi Kumar

1. Goal: Demonstrate and characterize GPU power variations in ML parallel workloads. This could enable power-aware time/space-sharing and placement performance optimizations
    a. **Profiling**: Measurable metrics that affect variability at device level
        i. Jetson:
            a) SGEMM metrics with/without DVFS. Measurements with fine-grained frequency control is a good approximation to understand range of variations
            b) Fine-grained sensor measurements contrasted with nvprof reporting
        ii. V100:
            a) Testbench: Automated toolchain install, runs and reporting
            b) Concurrent SGEMM runs across 4xV100 (space locality), Multiple jobs on a single GPU (to represent time locality). Extend this to future measurements
        iii. Obtain power, frequency, temperature metrics across all GPUs using nvprof
    b. **Characterization**: Create stressmark suite to demonstrate variability by picking workloads that span applications/bottlenecks representing realistic usage in space-sharing systems
        i. SGEMM/DGEMM
        ii. RESNET (Language)
        iii. BERT (Vision)
        iv. DLRM (Recommender systems)
    c. **Mitigation**: Decided to defer to future work post project-proposal.
2. Challenges
    a. C4130 nodes require force reboot after 30m or so with CUDA installation. This seems to be a known issue, but the provided workaround isn't working yet. This limits long running simulations Mailing list link
    b. SGEMM kernel fails for matrix dimensions larger than 16k x 16k
    c. More than 4 GPU variation study likely not possible. Even if we get two nodes of c4130, the relative placement in cluster is unknown to have reproducible effects
3. Timeline

Week starting	**Goals**
April 10	• Co-locate cross combinations of the following from the Nvidia DL repository with SGEMM (base vs test) a) RESNET (Vision) b) BERT (Language) c) DLRM (Recommender) • Collect metrics for same scenarios with GPU-boost disabled • Collate database with metrics captured across all runs include 1-4 GPU combinations • Formalize variation using model properties and trends/anomalies from profiling
April 17	
April 24	Analysis, documentation, and presentation

4. Resource request from course staff
    a. We have c4130 node reserved until the 20th. It might be helpful if we can get an extension on this for a week or 2 nodes of c4130.
    b. Guidance on analysis plan since the data collection part feels open ended