High Performance Computing
EECE5640
Prof. Kaeli

Final Project description:

For your project, you can select one of the following project options, or you can propose your own (to be approved by Prof. Kaeli).

OPTION A: The assignment is to evaluate the performance of two machine learning workloads on a parallel hardware/software platform. The applications studied should present significant computing challenges and should require high performance to achieve good throughput. Some examples of potential machine learning tasks include: classification, clustering, regression, association and dimensionality reduction.

Before starting the project, you should submit a project proposal, which includes the following information:

1. The workloads you will evaluate (e.g., I will study logistic regression and k-means clustering).
2. The input datasets you will use (e.g., I will use the XYZ data set from the UCI ML repository).
3. The platform you will use in the study (e.g., I use MPI and evaluate a multi-GPU implementation on Discovery using multiple nodes).
4. Experiments you will run (e.g., I will generate timing data on the platform, as well as consider model accuracy. I will use 3 different input data sets).
5. The results you will generate, and the associated grade you would expect to receive. For example:
   A = two workloads evaluated, 3 different inputs used on the platform, all results reported and analyzed thoroughly in the project writeup.
   A- = two workloads evaluated, 3 different inputs used on the platform, all results reported, but little analysis of the data included in the project writeup.
   B+ = one workload evaluated, 3 different inputs used on the platform all results reported and analyzed thoroughly in the project writeup.
   etc…..

OPTION B: Review the state of the art in GPU microarchitectural enhancements. You can find these described in many conferences and workshops proceedings, including GPGPU. Based on the selected paper, your goal is to reproduce the results in the paper. You can use GPGPUsim, Multi2sim or another GPU simulation infrastructure for your assignment. The range of GPU architectural features include the L2 cache, shared memory, streaming multiprocessors, and many others. You should evaluate the proposed design using the simulation framework. Then you will run programs (e.g., benchmarks) to evaluate the effectiveness of the studied feature.

Before starting the project, you should submit a project proposal, which includes the following information:

1. Problem you will study (e.g., cite the paper your work will be based on, and include a describe of the microarchitectural feature you plan to study).
2. Tools you will use in the study (GPGPUsim, Multi2sim or another simulator).
3. Experiments you will run (e.g., 3 benchmarks, 12 different configurations)
4. The results you will generate, and the associated grade you would expect to receive. For example:

> *A = 3 benchmarks studied, 12 different configurations modeled, all results reported in project writeup.*
> *A- = only 1 benchmark studied, 12 different configurations modeled, all results reported in project writeup.*
> *B+ = only 1 benchmark studied, 6 different configurations modeled, all results reported in project writeup.*
> *Etc…..*

OPTION C: Select a research topic in the field of high performance computing. The topic could focus on hardware, software or middleware. Complete a literature review on that topic, carefully characterizing and comparing a minimum of 10 different papers related to the topic. The project write-up should include 1-page summaries of each paper, following by a 7-10 page discussion comparing the various approaches and suggesting what future directions should be considered on this research problem. It is expected that the paper will include more than 20 cited papers in the citation list. The write-up should be single-spaced and use 12pt font.

GENERAL:
You can work in teams of 1, 2 or 3, but of course, a team of 2 should produce 2.25X as much output, and a team of 3 should produce 3.5X as much output. All team members will receive the same project grade. You will have the option of submitting your project to be presented in class. I reserve the right to ask any team member to present the presentation.

When you are done with your project, you should submit your completed project in a report. Your report should include the original proposal, as well as a well-written description of the work completed and analysis of the results obtained. We will try to leave time during the last class of the semester for students to give a 10-minute presentation on their project. This is not a required component of the project, but can add up to 10 points of extra credit.

Please pay close attention to citing your sources, documenting any tools or work that you use in your project, and produce a document that could be shared with a future employer.