EDA284 H18 Student Project Description

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Project Goal and Description

The goal of this assignment is to research and reason about trade-offs in the design of parallel computer systems (including functional, performance and cost requirements) when addressing a particular class of algorithms (called "scenario"). To this end, you are given a list of options under the umbrella of *High-performance Computing*, *Machine Learning*, *Data Mining*, *Computer Graphics* and *Sorting Networks*. You are allowed to choose your own nontrivial scenario provided that it is relevant to applications in science and technology.

You will form designer teams composed of two "architects" who will be evaluated based on fulfillment of the following points

1) bibliographic research on the available parallel computer architectures applicable to the selected scenario.
2) discussing potential architectural designs while understanding and classifying the selected scenario in terms of its performance and energy requirements.
3) assessing the programmability requirements for scenario (e.g., instruction sets, required programming schemes, portability of existing codes, existing parallel programming models/runtimes).

Given the time constraints of the project (< 2 months), the work is limited to bibliography research, and the researched solutions and ideas should only be discussed qualitatively. During the development of this project you will act as computer architects and as reviewers (managers) for another designer team.

Roles

Below we define the roles that each student has to play.

Role 1: Design team member

Your task is to write a survey describing parallel computer designs that address the selected algorithm (scenario). You are expected to perform bibliographic research and select and discuss a few relevant articles proposing solutions ranging from general purpose hardware to special purpose designs. The discussion should focus on the trade-offs between functional, performance and cost. Finally, you should also analyze the solutions considering technological trends, flexibility (i.e. how easily can it be adapted to changes in the application) and energy efficiency, and select which is -in your opinion- the most promising solution for the near future (0-5 years).

Role 2: Reviewer (Manager)

You are in charge of ensuring the quality of the written survey and discussion. You will obtain the survey written by one of the design teams and provide feedback on the discussion. The design team will then address the identified problems and submit an updated survey, that you will reevaluate according to a score sheet. The process of evaluation and scoring will be conducted under the supervision of the course examiner and the teaching assistant.

Project Scenario

A scenario is an application/algorithm that is of relevance and impact on science or technology. Instead of describing the scenario, we provide a paper or website that proposes a solution for the particular problem. Thus each scenario is implicitly identified by a paper. The set of scenarios is distributed such that no participant acts as a designer and reviewer for the same scenario.

Suggested Scenarios

Scenario	Suggested "Fundamental" Paper	Notes
The PageRank algorithm	https://www.dropbox.com/s/giu8z5x4n5hblqk/page_rank.pdf?dl=0	
A Cryptocurrency Mining Algorithm from the list	https://en.bitcoinwiki.org/wiki/Mining_algorithms	
Sparse Matrix-Vector Multiplication (SpMV) using Compressed Sparse Row (CSR) format.	https://www.dropbox.com/s/0fy7nyql3wjd4yz/spmv.pdf?dl=0	This paper gives an overview of the different matrix structures (Figure 3). Pick 2-3 structures for the study
Direct N-Body Methods	https://www.dropbox.com/s/54ygp7lo2euwil5/direct_nbody.pdf?dl=0	
Dense Linear Algebra	https://www.dropbox.com/s/60vektsfwsjdkkk/dense.pdf?dl=0	Pick from LU/QR or Cholesky Decomposition. The attached article has useful surveys
Classification algorithms	http://yann.lecun.com/exdb/mnist/	Such as Kmeans or Neural Networks. We recommend simple datasets such as MNIST similar to the attached link
Ray-tracing algorithm	https://www.dropbox.com/s/7ixnomxs6wyyrbh/ray_tracing.pdf?dl=0	

Sorting Networks	https://www.dropbox.com/s/aoi0lv3zdbzs5eq/sorting_network.pdf?dl=0	

Grading

The grading of the project will be: Fail, 3, 4, 5 (Chalmers) or F, G, VG (GU). The projects will be graded based on (i) the quality of the bibliographic research and survey, (ii) the discussion of performance and energy requirements and the proposed architecture, (iii) the discussion on programmability, (iv) the clarity of the written presentation, (v) the quality of the provided feedback, and (vi) how the feedback has been addressed in the document. The final grade will be set by the examiner.

Tentative Timeline:

- January 28th - Project discussed in class
- February 4th - Deadline for proposing a team and selecting three scenarios (otherwise random selection will be done)
- February 5th - Teams and Scenarios are finalized
- February 19th - Design teams submit first version to reviewers
- February 26th - Reviewers provide first round of detailed feedback
- March 4th - Design teams submit revised version to reviewers
- March 10th - Reviewers provide final comments and assessment
- March 13th - Design teams submit final revised version -- Note: only for surveys that have not achieved the minimum passing grade after 2nd round