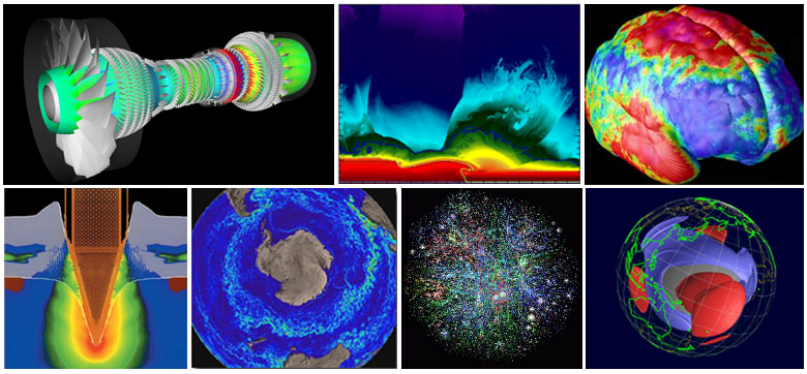

CENG478 - Introduction to Parallel Computing - Spring 2021

Online meeting: Wednesdays 9:40 Zoom Link (Password will be shared later)

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Motivation: Today parallel computing is everywhere, it is not only the fastest computers, but also from laptops to cellphones, most devices contain parallel processors. While the fastest computers are large parallel clusters today, programming them remains a challenge. Programmer needs to consider multiple issues like how to load balance and how to effectively use multiple levels of caches and the communication network which are not independent from the architecture being used. This course will start with high performance aspects of sequential computing, and continue with parallel computing platforms, parallel algorithms and their applications. Finishing with a brief introduction to quantum computing.

Image source: `https://computing.llnl.gov/tutorials/parallel_comp/`

Outline:

- Introduction and an overview of architectural features of parallel processors and their memory hierarchy
- Performance of sequential algorithms and efficient implementations
- Parallel platforms and programming models
- Principles of parallel algorithm design and performance analysis
- Basic communication operations and their implementation on various network topologies
- Parallel algorithms and applications (including parallel algorithms involving matrices, graphs, and large amounts of data)
- Ultimate form of parallelism: An introduction to quantum computing for computer scientists

Prerequisites:

Mathematical skills to understand the algorithms and their analysis, and conventional (sequential) programming skills in at least one language (C, C++, etc.).

Lectures:

Based on the feedback provided last semester, approximately 2 hours of video lectures will be posted weekly and during the regular class hours we will have live discussion (approximately 1 hour long but could be longer if needed) about the current week's topics using Zoom which will not be recorded. In these discussion hours we will talk about important details that are not discussed in the videos and you will have the opportunity to ask any question you might have.

Midterm and Final:

Midterm and final will be oral exams and they will be conducted via Zoom each will be no longer than 20 minutes long. They will be recorded.

Project:

The project can be done individually or with a team of at most 3 people. It will consist of 3-phases: pre-proposal, proposal and final report. The project topics should be chosen so that they require approximately 4-homework equivalent amount of work and they should not have been submitted anywhere else before (as a paper or as work on another course). In the pre-proposal phase, the topic and the challenging problems should be determined. If there is a team, it should be formed at this point. The pre-proposals will be due on April 11^{th}. The proposal should give the existing methods for solving the problem and your brief plan on how to solve the problem. The proposals are due on April 25^{th}. The final reports are due on June 26^{th}, and demos are going to be during the final's week.

Discussions and communication:

We will use odtuclass.

Attendance and Participation:

Attendance and participation to online discussions are encouraged. I may use it in your favor when assigning letter grades.

Grading:

Project	65% (including preproposal-10%, proposal-15% and the final report & demo -40%)
Oral Midterm	15% (week of April 26^{th})
Oral Final	20% (during the finals)
Total	100%

Course Policy and academic honesty:

All phase-reports of the project should be your work. If you use a source you are expected to cite it.

Makeup policy:

In case of an official medical or family emergency that prevented you from attending the midterm or the final, or submitting any of the project reports on time, you should contact the instructor as soon as possible and provide documentation.

Textbook

Introduction to Parallel Computing, by Grama, Gupta, Kumar, and Karypis, Addison Wesley. 2003

Some other references:

Introduction to Hight Performance Computing for Scientists and Engineers, by Hager and Wellein, Chapman & Hall/CRC Computational Science. 2010
The Sourcebook of Parallel Computing, Dongarra, Foster, Fox, and Gropp, Kaufmann. 2002
Parallel Programming for Multicore and Cluster Systems, Rauber and Runger, Springer Verlag, 2010.
Introduction to Parallel Computing: A Practical Guide with Examples in C , Petersen and Arbenz, Oxford University Press, 2004.