High Performance Computing

Lecture 2 & 3: Introduction

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Last Lecture

- Logistics of the course
  - Homeworks
    - Problems, software, reading, analysis
  - Project
    - Related to your research

      Or

    - If you do not have a topic, I will give you a topic

Last Lecture

- Nayda Santiago
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  - Office Hours: 2:00pm to 4:00pm
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- NO TA!!!!!!!!!!

Project

- Related to High Performance Computing
- Significant
- Write a proposal
  - Defend the proposal

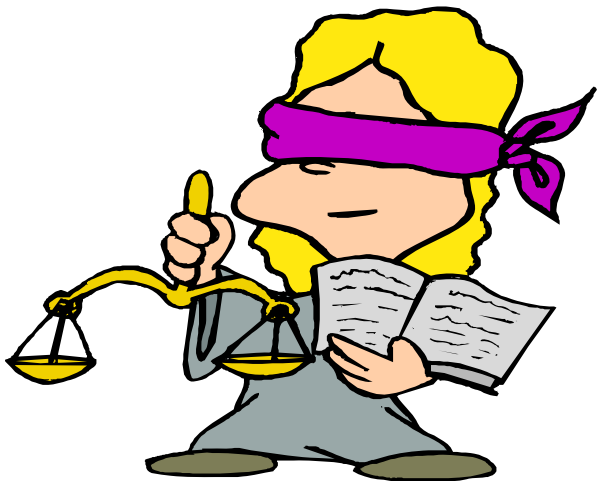
Project Topic

- Subject
  - Your research area!!!!!!
    - Link it to your expertise area
  - Computational Electromagnetics
  - Simulated Annealing
    - Circuit placement and routing
  - Genetic Algorithms
    - Circuit placement and routing

Proposal and Project Information

The rationale and significance

Convince the reviewer that the problem is IMPORTANT!



Proposal Content

- *WHAT* you are proposing
- *HOW* you plan to do it
- *WHEN* you plan to do it

Format

- **Front Matter**
  - **Title Page**
  - **Project Summary (approx. 200 word abstract)**
- **THE PROPOSAL**
  - **Introduction**
    - **Body**
      Project Proposal: (Includes Problem Statement, Proposed Solution, Program of Implementation)
  - **Conclusion/Recommendations**
- **Back Matter**
  - **Bibliography and/or Works Cited**
  - **Appendices**

Dates

- Proposal Presentation
  - Aug 29, 2008 - Sept 3, 2008
- Literature Search
  - Sept 29, 2008
- Project Due
  - End of November
  - Nov 17

New Material

Introduction to HPC

Introduction

- High Performance Computing
  - High performance parallel computing is accomplished by splitting up large and complex tasks across multiple processors.
    - Associated to supercomputers
    - Data warehouse
      - data storage
      - retrieve and analyze data
      - extract, transform and load data
      - manage the dictionary data
    - Transaction processing
      - Databases
      - Filesystems

Evolution of the term

Why?

- Traditional Scientific or Engineering paradigm
  - Do theory or paper design
  - Perform experiment or build a system
- Limitations
  - Too difficult
    - Build a large wind tunnel
    - Construct a high power electric system

Why?

- Limitations
  - Too expensive
    - Construct a jet
  - Too slow
    - Wait for climate change
  - Too dangerous
    - Weapon design
    - Drug design

Why?

- Computational science paradigm
  - Use high performance computing to SIMULATE the phenomenon
    - Based on
      - Known physical laws
      - Efficient numerical

Computational Science

- Use of advanced computing capabilities to understand and solve complex problems.
- Three key elements
  - Algorithms
  - Components
  - Infrastructure

Computational Science

- Computational Science enables us to investigate phenomena where economics or constraints preclude experimentation
- Evaluate complex models and manage massive data volumes
- Transform business and engineering practices

Computing Capabilities

- Algorithms
  - Simulation software to solve problems
    - Science
    - Social
    - Biological
    - Physical
    - Engineering
    - Humanities

Computing Components

- Advanced system hardware
- Advanced system software
- Networking
- Data management components

Computing Infrastructure

- Interconnect
- Power
- System Admin
- Development Software
- I/O

References

- Jack Dongarra, Geoffrey Fox, William Gropp, Andy White, Linda Torczon, Ken Kennedy, Ian Foster. Sourcebook of Parallel Computing, Morgan Kauffman, 2002.