Parallel Programming Principle and Practice

Lab Syllabus

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Objective and Requirement

- Understand the purpose, ideas and methods of parallel programming, familiar with parallel computing analysis and problem solving skills
  - use the basic principles and methods of using the common tools and program models, such as pthread, OpenMP, MPI, MapReduce and CUDA, to parallel existing algorithms and develop new parallel algorithms
  - analysis of parallel processes and results, let the students understand the purpose of the parallelization and reasons of performance improvement on a deeper level of the theories of parallelization, fundamentals of compiling and operating system
Syllabus

Lab

- Lab1 Be Familiar with the parallel programming environment (Required)
- Lab2 Parallel implementation of matrix multiplication (pthread, OpenMP, MPI, CUDA are ok)(Required)
- Lab3 PageRank algorithm implementation based on MapReduce (Elective)

Project

- Project1 Solve Akari problem using parallelizing backtracking (Elective)
- Project2 parallel optimization of Breadth First Search (Elective)
- Project3 parallel optimization of K-means algorithm (Elective)
Labs

- Lab1 Be Familiar with the parallel programming environment (Required)

  - become familiar with the parallel development environments, and the basic principles and methods of parallel programming and performance optimization by using tools and frameworks like pthread, OpenMP, MPI under Linux system
Labs

Lab2 Parallel implementation of matrix multiplication using pthread (Required)

- master the basic principles and methods of parallel programming design and performance optimization using pthread
- understand the basic method for data partition and task decomposition in parallel programming
- implement the parallel algorithm of matrix multiplication using pthread
- then carries on the simple analysis and summary of the program execution results
Labs

- Lab2 Parallel implementation of matrix multiplication using OpenMP (Required)
  - master the basic principles and methods of parallel programming design and performance optimization using OpenMP
  - implement the parallel algorithm of matrix multiplication using OpenMP
  - carries on the simple analysis and summary of the program execution results
Lab2 Parallel implementation of matrix multiplication using MPI (Required)

- master the basic principles and methods of parallel programming design and performance optimization using MPI
- implement the parallel algorithm of matrix multiplication using MPI
- carries on the simple analysis and summary of the program execution results
Labs

- Lab2 Parallel implementation of matrix multiplication using CUDA (Required)
  - understand deeply the architecture of GPGPU and master the CUDA programming model
  - implement the parallel algorithm of matrix multiplication using CUDA
  - carries on the simple analysis and summary of the program execution results
  - propose optimization solution based on the execution results and hardware environment
Labs

- Lab3 PageRank algorithm implementation based on MapReduce (Elective)
  - realize of the PageRank algorithm based on MapReduce
  - master the MapReduce programming model
  - understand the distributed programming methods in cloud computing environments
Project

- Project 1: Solve Akari problem using parallelizing backtracking (Elective)
  - master the methods to parallelize and improve a program
  - understand the relationship between parallel granularity and performance
  - master how to partition data and decompose tasks of a complex algorithm
Project2 Parallel optimization of Breadth First Search (Elective)

- master the methods to parallelize and improve BFS algorithm
- adjust and analyze the parallel granularity of the generated parallel algorithms because of optimization
- further understand the principles of parallel programming and what should pay attention to
Project

- Project3 Parallel optimization of K-means algorithm（Elective）
  - master the methods to parallelize and improve K-means algorithm
  - master the synchronization and communication methods of parallelize program
实验时间和方式

- ?月?日在东五楼210教室讲授实验操作过程
- 通过账号使用服务器进行实验
- 随时答疑
实验报告

- 实验一
  - 实验目的与要求
  - 实验内容
  - 实验结果

- 实验二/三
  - 实验目的与要求
  - 算法描述
  - 实验方案（含开发与运行环境描述）
  - 实验结果与分析

- 实验小结
**Project Name**
(Your Name, Class, & ID)

**AIM**
What are the purposes of this project?

**HYPOTHESIS**
Do you have any hypothesis you are going to test in this project?

**METHODS**
Detailed description of models, algorithms, experimental scheme, and program design et al.

**RESULTS**
Results and necessary explanation

**DISCUSSION & CONCLUSION**
The content expressed in this chapter comes from

- Michael Wrinn, Intel Manager, Innovative Software Education