Parallel Programming and Architectures (25537)

Sharif University of Technology
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Overview:

Parallel processors exist not only in supercomputers but recently also in many portable systems such as communication appliances, modern cars and even mobile phones and wearable devices. They provide high performance at relatively low power without the need to design custom hardware blocks.

This course serves as an introduction to the world of parallel processing and covers internal architecture, programming techniques and algorithm development for parallel platforms especially GPGPU.

Parallella Epiphany SoC:
16-core ARM

Nvidia Tegra SoC:
192-core GPU + 4-core ARM

Tilera Tile-Gx SoC:
100-core ARM

AMD Radeon SoC:
640-core GPU

Prerequisite:

- C Programming, Computer Architecture

Syllabus:

1. Introduction
   a. Motivation and demanding applications
   b. Types of parallelism: ILP, DLP, TLP
   c. Components of parallel architecture
2. Data parallelism
   a. Processor's SIMD unit
   b. Programming the SIMD unit
   c. GPGPU architecture
   d. CUDA programming model
   e. Basic data-parallel algorithms
   f. CUDA optimization techniques
3. Task parallelism
   a. Overview of OS concepts
   b. Mainstream cluster & multicore architecture
   c. Shared-memory multi-threading
   d. Distributed-memory message-passing
   e. NoC-based many-core architecture
4. High-level models
   a. Overview of available parallel hardware
   b. Overview of high-level programming models

Written exams:

- Preliminary: C/C++ programming
- Midterm: the first two sections
- Final: all sections

Take-home exams

(application design and programming):

- Data parallelism
- Task parallelism

Optional Presentation:

If you do well in other parts of the course, and if you are interested, you may hold a short lecture/workshop in the last day of class on selected topics.

Resources:

- Pacheco, "An Introduction to Parallel Programming", 2011.
- Nicholas Wilt, "The CUDA Handbook", 2013.
- David Yuen, "GPU Solutions to Multi-scale Problems in Science and Engineering", 2013