Exposing Undergraduates to Parallel Performance Concepts with a Three-Module Sequence

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- Current enrollment ~35000
- Student body reflects area demographic
  - 28% of students are of Hispanic origin
- Student body includes
  - commuters, veterans, non-traditional
- Departmental faculty
  - 28 TTF and Lecturer
  - 8-10 “rotating” adjuncts
- Class sizes relatively
  - CS I class has 16 sections + labs
The Three-Module Sequence

Module 1: Elementary Concepts

Module 2: Task Orchestration

Module 3: Analysis and Evaluation
Module Features

- Modules meant to complement an existing parallel programming course in the curriculum
- Little or no parallel programming involved
- Self-contained
  - Example codes
  - Tools for running experiments
Elementary Concepts

- **Topics**
  - Concurrency, parallelism, scalability
  - Efficiency, Speedup
  - Amdahl’s Law
  - Differences in sequential and parallel architectures (very high-level)

- **Course**
  - CS I (CS1428 at Texas State, Honors-only section)

- **In-class time**: 1 lecture,
- **Out-of class time**: ~3-4 hours
- **Context**: follows lecture on sorting algorithms (week 11)
- **Evaluation**:
  - Exam question
Task Orchestration

- **Topics**
  - Tasks, threads, concurrency, parallelism
  - Data dependence, race condition, process synchronization
  - Load balancing
  - Scheduling and mapping
  - Communication vs. computation trade-off

- **Course**:
  - Operating Systems (CS4328 at Texas State)

- **Context**:
  - OS scheduling algorithms

- **In-class time**: 1.5 lectures

- **Evaluation**:
  - Exam question
Evaluation and Analysis

- **Topics**
  - Efficiency, Speedup, super-linear speedup
  - Data locality
  - Latency, bandwidth
  - Parallel benchmarks and performance tools

- **Course:**
  - Computer Architecture (CS3339 at Texas State)

- **In-class time:** 1.5 lectures
- **Out-of class time:**

- **Context:**
  - split into two parts: week 2 (intro) and week 12 (after parallel architecture)

- **Evaluation:**
  - project involving performance evaluation on a parallel system
Learning Outcome Evaluation

CS I

Operating Systems

Computer Architecture

Overall passing rate 72%

About 7% higher than average passing rate in these courses

Some concerns with specific implementations
Challenges

• **Which course is the best fit for a module?**
  • Identify context
    • thread scheduling and task orchestration in OS
    • emphasis of P&H text on performance evaluation

• **How much time to devote to a module?**
  • Keep it short
    • Strip away content to get it down to one lecture

• **When in the semester should the module be introduced?**
  • Later is better
    • in-course pre-requisites
Tackling the Challenges

• **What content should be removed or condensed?**
  • Use ACM 2013 to de-emphasize content
    • reduced focus on AR topics
  • Look for redundancy
    • number representation and conversion

• **How to engage in-experienced/disinterested instructors?**
  • In-experience addressed with training
Thank you!