Motivation

- Early experience institutionalizing MS and PhD program in Computational Science at NCAT – after PI departure, program faltered – want to do the same at HU and remain
- Cps entails parallel computing and HPC on clusters to supercomputers • HU Cps research begins • Intel™ has donated Parallel Studio software suite • Al, SE have established curricula • Cps does not have an established curriculum
- We are proposing to NSF HBCU RISE to increase PhD production in SMET areas
- Hardware and Software are in place at HU
- Parallel computing abilities are now required of UG and Grad students
- Parallel systems are now widely available – Many applications in simulation & modeling, data analysis, video and signal analysis, data mining – Many sectors: medical, scientific, academic, industrial, commercial, governmental
- % wise:
  - small scale departmental (< 12 nodes)
  - large scale governmental (> 10,000 nodes)
- New tools are widely available: OpenMP®, MPI, CUDA, OpenCL

Overview

We infuse 1) parallel programming into CSC 151, 152, 2) parallel architecture into CSC 204, 205 and 3) parallel algorithms into CSC 251, 252

All CS UG Programs

- Master of Science Concentration in Computational Science

CSC 120* CSC 151* CSC 152* CSC 204* CSC 215* CSC 251* CSC 252* CSC 529

CSC 510** CSC 620* CSC 620** CSC 621* CSC 622* CSC 650** CSC 651

Master's Thesis Comprehensive Exam

Early Adopter - Parallel Computing: Keys to a Future in Computing

First NSF/ITCP Workshop on Parallel and Distributed Computing Education, 2011

An Undergraduate to Graduate Student Curriculum / Concentration

MS Program in Computer Science

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Overview

- CSC 204* – Computer Architecture, Systems and Organization I
  - Binary number representation and arithmetic
  - Computer structure: Addressing
  - Storage allocation
  - Subroutine linkage
  - Reusability and program segmentation, I/O manipulation
  - Operating system supplied I/O routines and interfaces using system programming language and system call libraries

- CSC205* – Computer Architecture, Systems and Organization II
  - Intermediate logic design including truth tables, logic diagrams, Boolean functions and K-map
  - Computer architecture including CPU design, memory organization, I/O processing including programmable I/O, interrupt I/O, and direct memory access (DMA)
  - Computer systems: Windows technology, MSISD, mainframe computers, UMA & NUMA multiprocessors
  - Spring 2010 Coding: C, Assembly, ESC 204

- CSC 529 – Topics in Parallel Programming
  - A treatment of topics not routinely covered by other courses (foundations parallel programming in MPI & OpenMP®)

- Prerequisite: Permission of the instructor

- CSC 215* – Discrete Structures
  - Set theory, logic and combinatorics
  - Relations and functions
  - Proof techniques, including mathematical induction
  - Introduction to graph theory

- Prerequisites: CSC 152, MAT 117 (pre-calculus)

- CSC 251* – Data Structures and Algorithm Analysis I
  - Representation of computer related data structures
  - Continuous linked hash tables
  - Simple and complex analysis of time and space of computing representation
  - Space optimization
  - Specification, design, implementation, and verification of linear and hierarchical data structures and data types, including stacks, lists, queues and trees

- Basic techniques to algorithms design and analysis; ethical principles in computing

- Prerequisite: CSC 152, Corequisite: CSC 215

- CSC 252* – Data Structures and Algorithm Analysis II
  - An in-depth survey of data structures and algorithms, exploring their design, running efficiency, and applications
  - Advanced methods for internal and external sorting and searching
  - Advanced methods for graph algorithms
  - Advanced algorithms, which may include parsing, breadth-first and depth-first graph traversals, minimum weighted paths and information flow analysis

- Prerequisites: CSC 204, 215, 251

Student Parallel Computing Research

- Benchmarking:
- Execution Time
- Number of Processors

CS 205 Interest Results

All CS UG Program Courses

- CSC 120* – Introduction to Computers
  - This course helps the student understand how computers can be used to enhance his or her personal, academic or professional life. A hands-on approach is used to introduce students to various software packages for word processing, spreadsheet applications, and database management.

- CSC 151* – Computer Programming I
  - Computer basics; goal of quality software concepts of input/output, constants, variables, expressions, program control structures including iterations, sequence, selection; overview of object-oriented programming; use of a high level language;

- CSC 152* – Computer Programming II
  - Exception handling files and streams. Ethical issues in computing

Prerequisite: CSC 151

Master’s of Science in Computational Science

- CSC 510** – Mathematical Foundations
  - Propositional and Predicate Calculus
  - Proof techniques
  - Queuing theory
  - Mathematical formulations of data structures
  - Basic models of computation expressions and grammars

Prerequisite: CSC 215, 252

- CSC 612 – Numerical Computation
  - Numerical and optimization methods useful for simulation, graphics, and image processing
  - Computation statistics and Monte Carlo methods
  - Signal analysis foundations

Prerequisite: CSC 510 or permission of the instructor

- CSC 620** – Operating Systems
  - Relation between architectures and operating systems
  - Multiprogramming
  - Multithreading
  - Distributed processing and real time processing
  - Interprocess communication and synchronization
  - Resource allocation and related problems

Prerequisite: CSC 620 or permission of the instructor

- CSC 622 – Parallel Processing
  - Parallel programming models and architectures
  - Concurrent processes and controls
  - Parallel algorithms and their analysis

Prerequisite: CSC 620 or permission of the instructor

- CSC 529 – Topics in Parallel Programming
  - A treatment of topics not routinely covered by other courses
  - Foundations parallel programming in MPI & OpenMP®

Prerequisite: Permission of the instructor