Parallel Real-Time Systems
An Online Computer Science Graduate Course
KSU Course Number: CS 6/79995
Spring 2009

Instructors: Dr. Johnnie Baker at CS Dept at Kent State University and Dr. Frank Drews at EECS Dept at Ohio University

Prerequisites: Admission to the computer science graduate program or permission.

Credit: This course is designed to be a 3 hour semester system course for the spring semester or a 4 hour quarter system course for the winter quarter in 2009.

Description: Real-time system professionals build our modern space, avionics, defense, telecommunication, transportation, e-commerce, automated manufacturing, and process control and robotics systems. However, many real-time systems require far more computational power and memory than can be provided by conventional CPU architectures and typically utilize parallel architectures. This course will focus on providing the background knowledge and skills needed for the design and construction of large real-time systems and applications. This will be a project-oriented course, and will involve a series of problems for the students to solve. In the course of their projects, students will obtain hands-on experience with the design, implementation and analysis of real-world applications. The air traffic control (ATC) system is a classic large scale real-time application and will be used to provide examples and some projects for this class.

Class Presentation Mode and Schedule: This class will meet in Room 243 (Graphics/Media Room) in MSB. It will be an online course, with students at both KSU and OU. The two classrooms at KSU and OU will be connected using the polycom equipment in Rm 243 so that participants at both KSU and OU will be able to listen to lectures, ask questions, and in general, to communicate with each other. Since OU is on a quarter system and KSU is on a semester system, the entire class will be taught during the time that both OU is in their 2009 Winter quarter and KSU is in the Spring 2009 semester. In particular, classes will start on January 20, 2009 (the start of the KSU 2009 semester) and will stop on March 20 (the end of the OU 2009 winter quarter). The final exam period will occur the following week, probably during the standard class meeting time. Classes will meet on MWF from 10:25-12:15, with a 15 minute break around the middle of the class period.

Major Units and Approximate Descriptions:
1) Brief coverage of basic parallel computation knowledge needed for this course, such as
   • Basic types of parallel architectures
   • Basic metrics for evaluating efficiency of parallel programs (e.g., cost, speedup)
   • General principles for designing efficient parallel programs
2) Basics of parallel programming
   • Introduction to programming on the ClearSpeed system using the parallel C\textsuperscript{a} extension of the C language.
   • Short overview of MPI programming to provide background information.

3) Introduction to real-time processing, including
   • Dealing with a mix of periodic, aperiodic, and sporadic tasks
   • Dealing with a mix of non-real-time, soft real-time, and hard real-time activities

4) Overview of conventional real-time design principles

5) Introduction to the ATC problem. Information about this problem will be introduced as needed during the course to provide needed examples and projects. Activities include
   • Discussion aspects of providing a multi-computer solution to the ATC
   • Discussion and projects involving providing a solution to ATC using the ClearSpeed system.

**Textbook and References:** There is currently no appropriate text or reference book for this course. While there are a number of textbooks on (sequential) real-time systems, these generally contain little or no material concerning parallel real-time systems. Our PowerPoint Slides will contain considerable information and will be a primary reference for this course. Additionally, students will be provided with some online papers and other reference material.

**Grading Policy:** Since this is the first time this course has been offered, some flexibility will be needed so that some fine-tuning can occur during the course. As this course will be project-oriented, a major portion (i.e., 60\%-70\%) of the grade will be based on work related to your performance on these projects. There will be some homework and/or graded in-class exercises, and this will constitute at most 20\% of your grade. One or two exams will be given during the course and these will constitute 20\%-40\% of your grade.

**Attendance & Makeup Policies:** Since this is a project-oriented course, students are expected to attend and participate in all classes. Class sessions may frequently involve activities in which students learn the course material. Some in-class activities are expected to be evaluated. Makeup activities and project deadline extensions will not be granted, except for legitimate reasons (based on standard policies at the respective universities).