Revise CS 552: Distributed Systems to CS552: Distributed Real-Time Systems

Course Description

As the advance of computer hardware, embedded devices, and network technology, real-time applications have become pervasive, ranging from smart automobile to automated traffic control. Different from general-purpose applications, correct executions of real-time applications depend on both functional correctness and temporal correctness. This course is to study the fundamentals of distributed real-time computing with the focus on its temporal aspects.

Course Objective

To study the basic concepts, requirements, principles and techniques in distributed real-time computing. The focus is on the differences between general-purpose computing and real-time computing, how the temporal requirements are realized through real-time scheduling and resource management, real-time communication, real-time programming languages and real-time operating systems, and how the real-time system's safety properties are verified. The course is also to stimulate research interest in this area.

Approximately two-thirds of the course will be devoted to basic concepts and techniques, and one-third will be devoted to the discussion of current research challenges in the related topics.

Course Syllabus

The topics to be covered in the course include the following:

- Overview of distributed real-time and embedded systems [1]

- Commonly used approaches to real-time scheduling

    - Clock-driven scheduling
    - Priority-driven scheduling
    - Scheduling aperiodic and sporadic jobs in priority-driven systems
    - Scheduling flexible computations and tasks with temporal distance constraints

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[1] Main material is from Jane Liu's book

- Resources and resource access control
- Multiprocessor scheduling, resource access control and synchronization

• Real-time communication

- Model of real-time communication
- Real-time protocol
- Communication in multicomputer systems

• Real-time operating systems

- Overview
- Capabilities of commercial real-time operating systems
- Predictability of general-purpose operating systems

• Real-time programming languages [2]

- Overview
- The notion of time
- Programming timeouts
- Specifying timing requirements
- Temporal scopes
- Language support for temporal scopes

• Real-time system specification and verification [3]

- Formal methods for real-time computing: an overview
- Formal verification of real-time systems using timed automata
- Constraint-oriented specification style for time-dependent behaviors
- End-to-end design of real-time systems

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[2]Main material is from Allen Burns' book
[3]From Formal methods for real-time computing, edited by Constance Heitmeyer and Dino Mandrioli, Wiley publisher

Course Material

Reference Text Book: Real-Time Systems by Jane W.S. Liu, Prentice Hall, 2000

Research papers: Research papers in the area will be provided.

Course Prerequisite

CS450