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
- 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

1Main 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
  – Overview
  – The notion of time
  – Programming timeouts
  – Specifying timing requirements
  – Temporal scopes
  – Language support for temporal scopes

• Real-time system specification and verification
  – 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

\(^2\)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


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

Course Prerequisite

CS450