Real-Time Systems

Chan-Gun Lee

What are real-time embedded systems?

- Embedded Systems
  - Cell phones, PDAs
  - Digital cameras
  - Microwave ovens
  - Multimedia systems such as DVR, VOD server, etc
  - Factory process control
  - Radar systems
  - Avionics
- Most of embedded systems have a certain level (hard or soft) of timing constraints in addition to logical correctness requirements
- “Real-Time Embedded Systems”

Course Philosophy

- Purposes
  - Familiarize students with fundamental theory and design practice of real-time and embedded systems
    - Theory
      - real-time task models, real-time scheduling, schedulability analysis, inter-task synchronization, end-to-end scheduling, etc.
      - students get ready for “active research” in real-time area
    - Practice
      - Confirm real-time theory with real examples
      - Low-level programming, inline ASM, Interrupts & Timers
      - System development with RTOS (RT-Linux)

Topics

- **Real-Time Embedded Systems**
  - Definitions
  - Examples
- **Theory**
  - Real-time Task Modeling – Formalize the problem
  - Real-Time Scheduling and Analysis
    - Cyclic executive, Rate monotonic, Earliest deadline first
    - Schedulability analysis
    - Timing analysis
  - Task synchronization
  - Sporadic and Aperiodic Task Scheduling
  - Other advanced topics (OORT, QoS, Power-aware, RT-communication)
- **Practical Skills**
  - Timers and Interrupts
  - Real-Time Operating Systems – RT-Linux
  - Device Drivers

Prerequisite

- Assume pre-built knowledge on basic ideas of computer programming and computer architecture
  - C-programming skills
  - Basic concepts on computer architecture
  - Basic concepts on operating systems

Course Information

- Instructor: Chang-Gun Lee (cglee@snu.ac.kr)
- TA: None
- Class meeting time: Mon, Wed 5 pm ~ 6:15 pm
- Classroom: 301-203
- Office Hours: Wed 12-1pm (Pizza or Gim-Bob will be served by appointment)
- Textbook:
  - Jane W. S. Liu, Real-Time Systems, Prentice-Hall
- Grading
  - Attendance: 0%, Midterm 30%, Final 40%, HW, Prjs, Term-Paper 30%
- NOTE1: Four computer projects will be assigned. The ones who complete the projects and turn in reports will get extra credits.
- NOTE2: Each student should turn in a term-paper. A couple of good papers will be selected and submitted to prestigious international conference.

Passive vs. Active Learning

- After 2 weeks, we tend to remember

- Passive learning
  - 10% of what we read
  - 20% of what we hear
  - 30% of what we see (picture)
  - 50% of what we hear and see

- Active learning
  - 70% of what we say
  - 90% of what we say and do

Everybody! be an Active Learner

- recall prior material
- answer a question (say a lot!)
- guess the solution first (even guessing wrong will help you to remember the right approach)
- raise questions
- think of application
- imagine that you were the professor and think about how you would give a test on the subject material so that key concepts and results will be checked
- summarize a lecture, a set of homework or a lab in your own words concisely

An Active Learner will become an Independent Researcher and Engineer

First Assignment

- **Install RT-Linux (by March 15 Monday)**
  - Installation instruction available on the website
  - You will encounter huge number of unexpected problems, just be patient, invest more time (searching Internet for helps or consult RT-Linux mailing list archive)
  - Run the examples and turn in a report
    - The report should explain the whole process we should take
    - The report should include problems found and solutions for them
    - The report should look like an in-depth installation guide – the best one will be used for next offerings