Rough Outcomes List

Dr. Yoder
Lecture 1-2 • Define soft, firm, hard real-time systems • Define real-time system • Define embedded system • Define event, synchronous, asynchronous, aperiodic, sporadic, punctual, deterministic, stochastic • Don't exhibit the 5 misconceptions commonly made about real-time systems Not covered: • Explain why deterministic algorithms may be superior for real-time systems Lecture 1-3: • Compute the theoretical response-time of a person grabbing a stick • Measure above experimentally • etc.
Lecture 2-1: • Read distances in time and voltage on an oscilloscope • etc. Lecture 2-2: • Describe distances on a waveform • Compute period from frequency, and vice-versa • etc. Lecture 2-3: • Analyze simple circuits involving resistors and switches in series • (optional) Describe how different signals sound. • (introduced later) Given information about standard encodings, describe maximum frequency that can be heard.
Lecture 3-1: • Describe how to not burn up your beaglebone • etc. Lecture 3-2, 3-3 • Do simple programming exercises in C • (optional) compute the power of a signal • etc.
Lecture 4-1: • Resistor color codes • pthreads (see also: qt threads) • POSIX sockets (see also: qt sockets) TODO: when? Covered (Lecture 4-3?) • Explain the concept of a Beaglebone cape • Understand how to read a basic schematic   ○ Explain the concept of a pull up ~~and a pull down~~ resistor • Explain the difference between polling and interrupts • Explain how an interrupt service routine is handled

- JLDefinitions, Flowchart, Timing diagram
- Cartoons
- Detailed steps

- Explain the purpose for a watchdog timer

Not yet covered:

- Explain the concept of a system on a chip
- Explain the concept of a dropping resistor
- Limiting current through an LED
- Explain the process of **setting the time out** on the Watchdog Timer

TODO: When? Covered.

- Watchdog Timer (wrap-up)
  - "Video" of rotating timer
- Conditional compilation
  - ***Code demo***

Covered in lab only:

- multithreading
  - ***Code demo***

Lecture 4-2

- Quiz: Define real-time and embedded systems
  - Slides have notes for discussions
- CPU Utilization
  - **In-class exercise**
- Interrupts

TODO: When? Covered earlier

- Operating System Roles
  - Essential (Scheduling, Dispatch, Intertask comm and sync)
  - Important (Privatized memory, I/O services, "Supporing features")
  - Handy (UI, Security, File management)

TODO: when? Covered by Schilling

- Resistor Color Codes

TODO: When? Covered earlier

- Sockets on an embedded platform

Not yet covered:

- TODO: **demo**

Lecture 5-3

- RTOS Scheduling
  - Task State Diagram
  - Pre-runtime vs runtime scheduling
  - Round Robin Scheduling
    - Impact on latency
  - Cyclic Code Scheduling
  - Rate-Monatonic Scheduling
    - **In-class Exercise**

Lecture 6-1

- ***Review only***

Lecture 6-2

- ***Exam***

Lecture 6-3

- ***Good Friday***

Not covered

- Selecting frame size in cyclic code scheduling

Lecture 7-1

- Gstreamer application

Lecture 7-2

- QT Application

N/A

Not covered

Lecture 7-3

- Data-rate
  - Explain the relationship between bandwidth and image quality for a video stream.
  - Calculate the bandwidth needed to deliver a given quality video
  - Calculate bandwidth required to achieve a particular compression ratio, etc.
  - Explain the differences between MB, Mb, MiB, and Mib, and similarly for KB, GB, TB.
  - Write out MB, etc. in full form (e.g. Mebibits for Mib).
  - Convert between orders of magnitude using MiB and MB, etc.
  - Explain the advantage of MiB over the modern MB.
  - Explain actions you should take if you see a unit like MB in documentation. Explain why you should take action.
  - Give two reasons why a higher frame-rate might be good
  - Explain the stroboscopic effect
  - Describe two approaches to correct the stroboscopic effect
  - Calculate the maximum data rate of a channel under noisy signal conditions
  - Explain the Nyquist sampling theorem

In Lecture 8-1 slides, covered 8-2:

- Rate Calculation
  - Explain the Nyquist sampling theorem (cont.)
  - Calculate the minimum sampling rate necessary to transmit a signal using the Nyquist Theorem
  - Explain the relationship between the number of bits and quality when quantizing a signal

Not covered:

- Rate Calculation
  - Calculate the maximum data rate of a channel under noiseless signal conditions
- Critique the Java language for usage in Real Time Systems
  -

Not covered

- Optimize source code using well known optimization techniques, such as
  - Repeated calculations
  - Constant folding
  - Loop invariance removal
  - Induction variance
  - Loop unrolling
  - Loop jamming

Lecture 8-3

This lecture may need to be greatly reduced next time around to avoid redundancy with previous classes.

Needs to focus on how this impacts real-time systems.

- Static Analysis
  - Understand the difference between static analysis and testing
  - Define the halting problem
  - Explain the difference between a false positive and a false negative
  - Construct a primitive static analysis tool using grep
  - Describe the impact of using static analysis tools over time
  - Compare and contrast style guides and programming standards
  - Explain the steps necessary to integrate static analysis into a development process
  - Explain the steps necessary for new code
  - Explain the steps necessary for legacy code

Lecture 9-1

- (optional) Derive the statistics necessary to determine if two processes have the same mean

Lecture 9-2

- Determine p-value for the difference of two means when the std. is known
- Determine p-value for the difference of two means when the std. is unknown
- Determine confidence intervals for two processes having the same mean
- Determine whether two processes have a significantly different means
- Describe how “significant” can be quantified
- Determine the probability of success if failure during each hour is independent
- Determine the probability of success if prob. of failure is linearly increasing per hour
- List the three or four key steps you would use to quantify whether a failure rate similar to 10^{-10}/hr is a reasonable failure rate for a given software system

Lecture 9-3

- Describe the advantages and disadvantages of Structured Analysis and Design (SA/SD) compared to Object-Oriented Analysis and Design (OOAD)
- Give an example of a hierarchical SD.
- Explain the importance of data dictionaries to any kind of design (e.g. both SD and OOD)
- Explain how SD & data dictionaries can aid in discovering incompatible data representations

Covered previously, optional for this class

- Explain the difference between internal and external qualities of software
- List the 8 qualities of real-time software
- Explain how one might assess the qualities of real time software
- Explain the concept of software reliability
- Explain the exponential model of software reliability
- Explain the reliability curves typically exhibited by software
- Calculate the reliability of a software system at a given time
- Explain how one might measure the 8 qualities of real time software