

ECE 471 – Embedded Systems

Lecture 17

Vince Weaver

`http://web.eece.maine.edu/~vweaver`

`vincent.weaver@maine.edu`

11 October 2017

Announcements

- How is HW#5 going?
- Courses next semester: ECE598 and ECE571



Last HW#4 Review

- Grades posted
- Error handling — don't just print error, also should exit.
Just charging on with -1 file descriptor?



Midterm Review

1. Embedded Systems
Supercomputer

2. Operating Systems

(a) Benefit of OS: abstraction, portability

user friendly? easier to program? libraries?

(b) Drawback of OS: overhead, not all features available,
timing

(c) Themoostat: can you write an OS in 8kb?



3. ARM Assembly

High-level. Save file descriptor, not just “push r0 on stack”

Why do we need to save r0 anyway?

Why compare against 100? Arbitrary or not?

Convert ASCII 0 to ASCII 1

Note the direction of store instruction, source to dest

So writing 0 or 1 to buffer

Calls syscall

What does this code do?

4. Code Density



regs, conditional, shifts, 8-bit constants, two-args less space. Faster? Why?

5. GPIO: no not that fast. Can Pi do 1GHz of anything?
i2c can do 5 stories?

6. C-coding.

fd should be int

error check should be less than 0 (is it ever 0,1,2?)

"out" count should be 3 on write

If writing to file can't open O_RDONLY



cannot write '1', needs to be char pointer (string)

7. Extra Credit



Real Time Constraints

What are real time constraints?

- Time deadlines that hardware needs to respond in.
- Goal not performance, but response time



Types of Real Time Constraints

- Hard – miss deadline, total failure (people die?)
Antilock brakes?
- Firm – result no longer useful after deadline missed
lost frames in video, missed frames in video game
- Soft – results gradually less useful as deadline passes.
Caps lock LED coming on?



Constraints depend on the Application

Can almost always come up with a scenario where a soft constraint could become hard.

For example: Unlocking a car door taking an extra second? Not hard real-time, except maybe if your car is about to crash and you need to escape quickly.



What can cause problems with real-time?

Sources of “Jitter”

- Interrupts. Taking too long to run; being disabled (cli)
- Unpredictable nature of modern CPUs. Caches, branch-predictors, etc.
- Operating system. Scheduler. Context-switching.
- Dynamic memory allocation, garbage collection.
- Slow/unpredictable hardware (hard disks, network access)

