

Boot Camp

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This Is a Hard Class

- Traditional hazards
 - 410 letter grade one lower than other classes
 - All *other* classes this semester: one grade lower
- Aim
 - If you aim for a B you might not get one
 - If you aim for a C you might not get one
 - “I’ll drop if I can’t get an A”
 - You *must* discuss this with your partner *early*

Good News

- Good news...it can be done!
 - Fall 2004: *all groups* turned in working kernels
- Remainder of this lecture
 - How to get from here to there

This is a *Transformative* Class

- Genuine achievement, available to you
 - What is an OS, *really*?
 - Mutual exclusion, synchronization, concurrency
 - Deadlock
- Design, planning
- Serious competence in debugging!

Work Flow – You may be used to...

- Assignment handout \Rightarrow code outline
- Compilation implies correctness
- Graded by a script
- All done!
 - Never use it again
 - Delete it at end of semester
- *Total opposite of real life*

Work Flow – 410 Additions

- Design
- Divide into parts
- Manage your partner
- Merge

Surprises

- “Code complete” means *nothing*
 - Merge can take *three days*
 - *Then* you find bugs.
- Code with “the right idea” will *immediately* crash
 - If you're lucky!

On Debugging

As soon as we started programming, we found to our surprise that it wasn't as easy to get programs right as we had thought. Debugging had to be discovered. I can remember the exact instant when I realized that a large part of my life from then on was going to be spent in finding mistakes in my own programs.

– Maurice Wilkes (1949)

Debugging

- Bugs aren't just last-minute glitches
- They are crucial learning experiences
 - Learning a lot can take a while

What Does A Bug Mean?

- “It tells me 'triple fault' – why??”
 - Research: 20 minutes
 - Think: 20 minutes
 - Debug: 2 hours.
 - ...three times.
- May need to *write code* to trap a bad bug
 - Asserts or more-targeted debug module
- Then you will find your design was wrong!
 - Don't be shocked – this is part of 410 / life

“All Done”?

- Finally, when you're done...
 - You will use your code for next assignment
 - We will read it (goal: every line)

Interlude

- What is source code “for”?
 - What do we do with it?

Interlude

- The purpose of code is for *people to read*
 - By a reviewer / security auditor
 - By your group
 - By your manager
 - By your successor
 - By you six months later (6 hours later if no sleep)
- Oh, yeah, the compiler reads it too

Confront the Material

- We are doing printf() *all the way down*
 - Subroutine linkage, how & why
 - Stub routine, IDT entry, trap handler wrapper
 - Output/input-echo interlock
 - Logical cursor vs. physical cursor
 - Video memory (what does scrolling mean?)
- Can't really gloss over *anything*

On Investing

A week of coding can sometimes save
an hour of thought.

– Josh Bloch

Confront Debugging

- Real life: you will debug other people's code
 - Any bug could be yours, partner's, ours, or simics; you need to *find* it.
- *Can't* debug with only printf()
 - printf() *changes your code*
 - printf() may be broken by whatever breaks your code
 - Learn the Simics debugger
 - Assertions, consistency checks
 - Debugging code

Confront Debugging

- 1/2 hour of studying the debugger
 - vs. 2 days of thrashing
- Papering over a problem
 - Re-ordering object files to avoid crash

How to Have Trouble

- How to get an R
 - Arrive unprepared (barely escape 113, 213)
 - Do everything at the last minute
 - Don't read the book or come to class
 - Hide from course staff no matter what
- How to get a D
 - Don't get the core of the kernel project working
 - (There are other ways, but this one is popular)

Warning About 15-213

- It's an important class
- We expect you to *know*
 - Byte, word, register, $1 \ll 2$
 - Thread, stack
 - malloc(), free() (when & why)
- Trouble with 213?
 - Was the malloc() lab a struggle?
 - Expect to spend extra effort on 410

Warning to Graduate Students

- This is an undergraduate class
 - There is typically a diversity of grades
- Getting “average grades on every assignment” *may* mean a C, not a B
- Working really hard and doing everything somewhere between “ok” and “well” may mean a B, not an A.

Doing Well – Invest in Good Code

- Mentally commit to writing *good* code
 - Not just something kinda-ok
 - You will *depend* on your code
- Anand Thakker
 - Remind yourself that you love yourself
 - So you should wrote good code for yourself

Doing Well – Start Early

- Starting a week late on a 2-week project will be bad
- Not making “just one” checkpoint can be bad
 - Missing two kernel-project checkpoints...
 - ...may make passing impossible.

Doing Well – Read Partner's Code

- You will *need* to read everything your partner wrote
 - (and answer test questions about it)
- Set up a mechanism
 - Daily meeting? Careful reading of merge logs?
- Do “one of each”
 - Partner does N-1 stub routines, you do hardest

Doing Well – Time for Design

- “Design” means you may need to think overnight

How to get an A

- Understand *everything*
 - (consider 2-3 ways to do each thing, pick the best)
- Read *all of* your partner's code
- Work *with* your partner
 - (not: work alone for 4-5 weeks out of 6, then (fail to) merge)

How to get an A

- Write *good code*
- Do things which *help you*
 - asserts, good variable names, source control
- Document *before* coding
- Be “done” *days* early