Welcome To 18-348!

18-348 Embedded System Engineering
Prof. Philip Koopman
Wednesday, 13-Jan-2016

Lectures: Mon & Wed 10:30-12:20 AM, BH A53
Labs: Mon-Thu 6:30-9:20 PM; Fri 1:30-4:20 PM, HH 1303
Recitations: Fri 10:30-11:20 AM, BH A53
Preview

- **A Little Embedded Background/Motivation**
  - “Embedded” is almost 100% of the market
  - Big CPUs don’t necessarily Rule

- **Course Administrative Information**
  - Grading
  - Course policies
  - This course has a lot of moving parts, so it takes a while to cover them all
    - In industry there are lots of moving parts to making a project work; the experience is really not all that different

- **Lab Equipment**
  - Hardware, Software
  - How the labs are going to work
  - Key idea: hands-on experience with lecture topics, *NOT* killer design projects!
    - There will be a larger last project, but complexity is mostly up to you
Instructor Background

◆ Prof. Phil Koopman
  • HH A-308
  • ece348-staff@ece.cmu.edu

◆ Research:
  • Dependable & secure embedded systems
  • Embedded real-time networking

◆ Engineering experiences outside Carnegie Mellon
  • US Navy submarine officer
  • Startup company that created an embedded CPU design
  • Embedded CPU designer for Harris Semiconductor
  • Embedded system architect for United Technologies (Otis, UT Automotive, Pratt & Whitney, Carrier, Norden, Sikorsky, …)
  • Numerous design reviews (~140 and counting) of industry embedded systems
  • Software safety expert for Toyota Unintended Acceleration lawsuits
Embedded System =

Computers Inside a Product
A Common View of Computing

- Measured by: Performance, Cost
  - Compilers & OS matter

- The Chevy Volt has 10,000,000 lines of source code
  - That could easily be $250M worth of code
  - Where’s that part on this picture?
An Embedded System Designer’s View

- Measured by: Cost, Time-to-market, Cost, Functionality, Cost & Cost.
Small Computers Rule The Marketplace

- Everything here has a computer – but where are the Pentiums?
15 Million PCs per month in 2004 (15,000 on this graph) (We’ll update this information in the economics lecture)
More Recent Data from 2007

- **About 10 billion Microcontrollers per year shipped**
  - Perhaps 250 million PCs shipped per year until recently
    - (tablets disrupting that market; maybe tablets are the new PC)

- **8-bit:** $4.9 billion/yr
- **16-bit:** $3.9 billion/yr
- **32-bit:** $3.8 billion/yr (ARM is growing fastest here)
- **Automotive market:** $6 billion/yr


- **Course processor is Freescale:** Their “68” family is 15% of market
  - Freescale ships 100M of the class lab S12 microcontroller family per year
    (source: http://blogs.freescale.com/2010/11/03/16-bit-microcontrollers-automotive/)

**Guesses as to units shipped:**

- **8-bit MCUs often below $1** ~ 750 million/month
- **16-bit MCUs perhaps $1-$10** ~ 75 million/month
- **32-bit MCUs $10 or more** ~ 25 million/month

  - Many systems-on-chip are embedding ARM, making analysis more complicated
  - (Yes, you can get a 32-bit CPU for $1. But that’s not the mainstream market … yet)
Breaking News – 2015 Survey

- **MCU Market Size $27B by 2020**
  - Potentially driven by “Internet of Things”
  - 16-bit CPUs are highest # units, and 31% of dollar value in 2014

North America microcontroller market, by Product, 2012-2020 (Million units)

http://www.radiantinsights.com/research/microcontroller-market
Small CPUs Rule

- Until 2011, 8-bit CPUs had the most volume
  - In 2011, most CPUs sold are 16 bit CPUs (like the course CPU we use)
  - 16-bit CPUs gained traction as they approached $1 cost

- ARM is growing as a 32-bit platform…
  - But it hasn’t taken over the world yet!

- Desktop CPUs (Pentiums) are essentially 0% of the market by # units

The Big Market is the Sub-$1 CPU

- How much CPU can you put in a $20 thermostat?  A $4 greeting card?
  - CPUs can become more pervasive as cost goes down
  - 32-bit CPUs will dominate when a complete 32-bit microcontroller costs $0.50
    – *Almost* there .. but not quite yet…  see economics lecture for more

![MCU Market History and Forecast](http://eetimes.com/design/microcontroller-mcu/4413015/MCU-market-turns-to-32-bits-and-ARM)
There Are Many Application Areas

Primary End Product of *Embedded Systems Programming* Subscribers (Dec. 1998)

- Industrial Control: 15%
- Communications/Telecommunications/Networking: 21%
- Computers/Peripherals: 13%
- Office Automation: 13%
- Government/Military: 11%
- Electronics: 10%
- Other: 11%
- Aerospace/Space Electronics: 6%
- Medical Electronic Equipment: 6%
- Automotive/Transportation Systems & Equipment: 5%
- Consumer Electronics/Entertainment/Multimedia: 6%
- Automotive/Transportation Systems & Equipment: 5%
- Communications/Telecommunications/Networking: 21%
- Industrial Control: 15%
- Computers/Peripherals: 13%
- Office Automation: 13%
- Government/Military: 11%
- Electronics: 10%
- Other: 11%
- Aerospace/Space Electronics: 6%
- Medical Electronic Equipment: 6%
- Automotive/Transportation Systems & Equipment: 5%
- Consumer Electronics/Entertainment/Multimedia: 6%
What’s the difference between 18-348 & 18-349?
- Taught alternating semesters

18-348 has more coverage of:
- Hardware design
- Analog I/O
- 8-/16-bit CPUs
  - Makes it easier to access raw HW
  - Different tradeoffs than big CPUs
- But still touches on essentially all 18-349 topics, including real time
- Either course is sufficient preparation for later courses

Embedded System Engineers are Generalists
- Often they write specifications, lay out printed circuit boards, write software, create tests, and give marketing presentations to customers too!
Course Contents

◆ Core skills that apply to essentially all embedded systems
  • Using a simpler CPU makes it easier to get at the “bare metal”

◆ Part 1 – Hardware and Software; Intro to I/O
  • Embedded HW; assembly language; embedded C
  • Bit manipulation; multiprecision math; optimization
  • Memory bus; serial ports; debug/test
  • **Mid-Term Exam is Wed., Feb 24, 2016 – be there!**

◆ Part 2 – Control, Interrupts, Concurrency, Scheduling
  • Counters/timers; watchdog timers; robust systems
  • Interrupts; concurrency; real time scheduling
  • Analog inputs; analog outputs; Filtering; feedback control
  • Advanced networking (Bluetooth; CAN)
  • Safety critical systems and other “kids don’t try this at home” topics
  • **Second Exam is Wed., Apr 20, 2016 – be there!**

◆ Weekly lab/project content
  • Weekly labs to give hands-on exposure to most lecture topics
  • Two-week project at end of course to demonstrate putting pieces together
    – Last week of classes leaves time to work on this; due finals week; no final exam
    – You pick the project; most of you will want to keep it simple

http://www.ece.cmu.edu/~ece348 always has the most up-to-date lecture schedule
Guide for Navigationally Impaired

18-348 Lab HH 1303

Tech Electronics
1st floor

Prof. Koopman HH A-308

TA office hours held here

Up steps into HH front door

A-level Basement

A-300 Security Door

Administrative matters:
ECE Course Hub
HH 1112
Course Structure – 1

◆ Lectures – Mondays & Wednesdays 10:30-12:20
  • Anything presented in lecture is fair game, even if not in handouts
    – Textbook is meant to supplement and explain lecture material
  • Hard-copy handouts only (no electronic copies)
    – Ask someone to pick one up for you if you are missing class
    – TA will bring spare copies to following recitation; after that they are recycled.

◆ Recitations – Fridays 10:30-11:20
  • Q&A about lectures, pre-labs, lab skills, etc.
  • Walk-through of lab exercises – read lab assignment before recitation!
  • Generally an open book quiz to make sure you’re “getting it”

◆ Pre-Labs==Homework – Due each Friday at 9:00 PM
  • Bonus points for hand-in by 1:30 PM
    – Encourages you to find out if there are problems in time to ask at recitation
  • Individual work – individual grade – do NOT get help from lab partner!
  • Some traditional homework questions
  • Some preparation for the lab
Course Structure – 2

◆ Lab skills – evenings, topics follow lectures by ~1-2 weeks
  • Apply concepts from lecture in the lab after you see them in lecture
  • Teams of 2 (think about who you want as a lab partner) (not 3; not 1 – only 2)
    – A couple singles may need to switch lab sections to get balanced pairs
    – We can work out flexible lab demo arrangements to make this work
  • **Joint effort for your team of 2; joint grade**
  • Lab rooms are open as much as possible (normally 24x7), but are shared spaces
  • Demos must be done by YOUR ASSIGNED scheduled lab demo time
  • Lab writeups due on Wednesday following lab (9:00 PM)

◆ Tests
  • 1st Exam during class hours
  • 2nd Exam during class hours
  • You’re allowed one 8.5”x11” 2-sided “crib sheet” for exams only
    – Must be *Hand Written in your own hand writing*
    – Must have your name on it
    – Must be turned in with exam
    – Printouts of slides, non-hand-written, or someone else’s writing is prohibited
Course Materials

◆ Free required reading materials via course web site
  • Some lectures have reading beyond book – see the web site
  • Processor Data Sheet
  • Some articles on embedded systems
  • Lab assignments
  • Get printed handouts at class or at following Friday recitation
    – If you miss those two opportunities get them from a friend; we don’t stockpile back issues

◆ Required microcontroller module
  • Get a kit at lab hours: 1 CPU module per student
    – 1 proto-board + 1 parts pack per team of 2 students
  • You can do much of the lab work at home with a Windows PC and USB port without the prototype board
    – You can do pre-lab 1 just with the simulator downloaded from course web page
  • A Mac might work, but we can only officially support the lab machine version of the windows build. (Development software is free download for student use)

◆ Required text
  • Can get new/used on-line (hint: try bookfinder.com or addall.com used book search)
  • Be sure to get 2nd Edition!
    – We can NOT use the newer 3rd edition due to deleted material
Registration & Grading

◆ **Grading**
  - A is 90% or above; B at 80%; C at 70%; D at 65% using following weights:
    - Pre-Labs: 15% (lowest 1 dropped, except double weight final lab)
    - Lab Demos: 14% (final demo counts double weight)
    - Lab Writeups: 14% (lowest 1 dropped, except double weight final lab)
    - First Exam: 25%
    - Second Exam: 25%
    - Participation: 7% (lowest 2 dropped)
  - All assignments within a category are normalized (equally weighted)
  - All grading issues/appeals must be made in writing within **ONE WEEK** of hand-back!

◆ **No make-up events** (labs, exams, recitations)
  - If you have special needs (e.g., extra test time) give >30 days advance notice

◆ **Late penalty for Labs & Pre-Labs** = 10% for first hour + 10% per day “N”
  - Up to 1 hour: 90% of grade; 1 hour to 24 hours late: 81% of grade

\[
\text{LateGrade} = \text{RawGrade} \times 0.9^{N+1}
\]
“Extra Credit” and Bonus Points

◆ Pre-labs early hand-in
  • Bonus: hand in pre-lab before (1:30 PM) on Friday it is due
  • You can get 5% extra credit (grade multiplied by 1.05)
  • *Go to recitation* – the point is to make sure you know what questions to ask

◆ Pre-lab & lab bonus points
  • Intended *only* for students who are finding the course “easy” for *some* labs
    – A few points (10-20%) for doing extra work to make things more challenging
    – Gives you bragging rights, especially if you want a recommendation letter
  • If you are spending fewer than 12 hours per week, you should do the bonus assignments to get more out of the course
  • If you are spending more than 12 hours per week, you should *not* do these
    – Instead, spend your time getting pre-labs handed in early
    – Instead, spend your time studying for the tests before the last minute
    – *Do not* spend insane hours in the lab chasing these few points; that’s the wrong priority to have!
Multiple Choice Grading

◆ Most test questions are multiple choice
  • Requires more work for me to compose good questions
  • Less ambiguity and variation in grading
  • You have plenty of “essay” problems in homework and lab already
  • But, traditionally, has problems with quantization noise in grading

◆ Our approach – partial credit for multiple choice
  • One or more answers are correct (usually one, but sometimes more than one)
  • We will provide example questions for study/practice
  • You get credit in proportion to the number of correct answers you choose
    – 1 answer correct; you pick it = full credit
    – 1 answer correct; you pick two (one correct; one incorrect) = ½ credit
    – 2 answers correct; you pick one correct = full credit
    – Credit = (# correct answers you pick) / (Total # answers you pick)

  – If unsure, you can guess two, and get half credit if one is true
  – If unsure, you can mark all answers and get ~20% credit (depending on question)
WAIT LIST INFORMATION

- Class has hard limit of 72 students, 5 lab sections
  - Attendance sheets show current status

- Lab sections
  - Need to have roughly even lab sections
  - It is always OK to demo early if you have an occasional conflict
  - Partial lab conflicts are OK
    - Just need to hit a ~30-minute demo window
    - AND, you can request a demo window that doesn’t conflict for you

- Let us know if you want to move to empty sections
  - Need to get sections reasonably balanced
  - If you want to partner with someone in a different section, let us know
    - Give us ALL available possibilities so we can figure out a workable schedule

- If waitlist/switch request, use Doodle Poll to let us know your possible sections
LAB PARTNER ANNOUNCEMENT

◆ WEDNESDAY by about 5 PM:
send e-mail to ece348-staff@ece.cmu.edu with your lab partner choice; no mail means we will randomly assign you

  • INCLUDE:
    – BOTH student names
    – BOTH student andrew IDs
    – Don’t use your Gmail account and just say “Me and Joe want to be partners”

  • If you want to partner with someone in a different section, make sure you tell us all sections (Mon-Fri) you can both make. Please be flexible. Use the Doodle Poll to do this.
  • If you don’t have a partner, send us mail saying so and we’ll assign you one

◆ If you are wait-listed, still pick a partner
  • Hard limit of 72 students (room capacity is listed as 73)
  • Usually all or almost all ECE students get in
Workload: 12 Unit Course = Target 12 hrs/week

- Goal for this year: MEDIAN student works about 12 hrs/week

Spring 2015 18-348 Student Hours

Accumulated Median = 10.98 hrs
Web, Blackboard, E-mail

- **Course home page is definitive source for information:**
  - http://www.ece.cmu.edu/~ece348

- **Blackboard used for**
  - Posting grades
  - Course announcements (we expect you will check blackboard daily)

- **E-mail use:**
  - Asking questions about course content, labs, etc. should be done in person at office hours and the lab, not via e-mail!
  - Reasonable e-mail use includes:
    - Asking to schedule a special meeting of some sort outside office hours
    - Notifying staff of a technical problem ("lab equipment X is broken")
    - Notifying staff of defects in assignments ("looks like a typo on assignment Y")

- Send **all course e-mails** to: ece348-staff@lists.andrew.cmu.edu
  (if you send it elsewhere and it doesn’t get read, don’t be surprised)
Lab Partners

◆ Get a partner. We have limited lab facilities and staff
  • Perhaps pick somebody with complementary skills
  • (Like somebody who actually knows something about, say, hardware, or software if one of those is a weak spot for you.)

◆ Manage group dynamics.
  • It’s your problem …
    … unless you tell us early enough.
  • If you are awake all night worrying about your lab partner, you should be talking to us sooner rather than later
  • If you cover for your lab partner and it bites you later, don’t come crying to us

◆ Course lab philosophy
  • Lab is a place to demonstrate you “got” what the lectures were about
  • The lab is not a place for fancy design projects – take 18-549 for that!
Cheating

◆ **No tolerance for cheating at all**
  
  • *READ the course policy on cheating on the course web page.*
  • Penalty for being convicted of cheating is failing the course. *No kidding.*
  • If you think you are too smart for us to figure out you are cheating, think again
    – We will use MOSS and other techniques to find code copying
  • If you honestly aren’t cheating, don’t worry about this. Being “perfect” isn’t cheating.

◆ **Examples of cheating behavior (non-comprehensive list):**

  • Did someone else tell you how to do *any aspect* of your homework?
    – General discussions of lecture material are fine if not specific to homework
    – Lab partners collaborate on joint assignments only *(not pre-labs)*
    – Did you help someone else with their homework? (that’s cheating too)
  • Did you look at a previous semester solution or someone else’s solution?
    – Did you look up stuff on the web and use it in your solution?
    – Did you look at quizzes, or other stuff from a previous year not on blackboard?
  • Did you access anything other than the permitted “crib sheet” during an exam?
    – Did you let your eyes roam on to others’ papers during an exam?
  • Did you do homework sitting next to each other and ask leading TA questions?
    – “Dear TA, I think I should do it this way. Is that right?” (Is my friend taking notes of this?)
  • Are you involved in faking attendance or results at a class, lab, recitation, or exam?
Actual Examples of Cheating

◆ Doing prelabs (which are homeworks) as a group
  • Discussing lecture slides as a group is encouraged and fine
  • Discussing prelabs as a group is NOT ok – we want you to make your own mistakes and learn from them; don’t do your prelab next to your partner
  • Discussing labs with anyone other than your partner (and staff) is NOT ok

◆ Looking at or copying a prelab program you “found” in the lab
  • Erase your files when you leave the lab, or you risk being the same as someone else who copies you!
  • It is OK to look at your partner’s relevant prelab code after both of you have handed in your prelabs for grading

◆ Sharing a calculator
  • “I didn’t have a calculator with me, and it makes no sense for me to punch in numbers that my lab partner just punched in, so I just used his numbers”

◆ Looking at a previous year pre-lab or lab you find on the web
  • Showing someone else your prelab to help them, even if it is simply a cosmetic issue or otherwise just a general look rather than detailed copying

◆ We are really serious about this – no exceptions!
  • We have found you don’t really learn the stuff if you don’t do it on your own
Course Lab Microcontroller: MC9S12C128

**MC9S12C128:**
- “M” = “Motorola” … but spun off as new company “Freescale”
- C9S = “C” for CMOS technology; “9S” is general model number
- “12” = mostly code compatible with older 68HC12 chip and 68HC11
- C = Has a CAN network controller (might be useful for 18-549 projects!)
- 128 = 128KB of on-chip flash memory (and 12KB of RAM)

**General specs**
- 16-bit CPU
- 4-25 MHz bus; 3.3V to 5V operation
- Timers, A-to-D converters, pulse generator … lots of cool stuff on chip
- Very popular mid-range microcontroller sold for use in automotive applications

**Web site has Data “Sheet” (684 pages)**
- Industrial automation and automotive
MC9S12 Block Diagram & Pinout

Figure 1-9. Pin Assignments in 48-Pin LQFP

[Freescale]
Lab Module – Axiom CSM12C32 / Freescale

◆ This is the module you’re using

- Includes development tools – 1 per student
- You can use it at home with your own Windows PC

- MC9S12 C128/DT256/XDT512 MCU, 80 LQFP
- 128/256/512 KB Flash EEPROM
- 4KB EEPROM
- 12 KB RAM
- SAE J1850 Byte Data Link Controller
- 8-ch, 10-bit, ATD w/ external trigger
- 8-bit Enhanced Capture Timer with IC, OC, and Pulse Accumulate capabilities
- 7-ch, 8-bit PWM
- 9 KBI inputs
- 58 GPIO
- 3 CAN Channels
- CAN 2.0 A/B PHY w/ 3-pos header
- 2 SCI & 2 SPI Channels
- 1 IIC Channel
- RS-232 transceiver w/ DB9 connector
- 4 MHz Clock Oscillator
- Low Voltage Reset Supervisor
- Power Input Selection Header
- On-board 5V regulator
- Optional power Input/Output from Connector J1

User Components Provided
- 1 DIP Switch, 4-pos
- 3 Push Button Switches: 2 User, RESET
- 5 LED Indicators: 4 User, +5V

- Jumpers
  - USER_EN
  - PWR_SEL
  - COM_EN

- Connectors
  - 60-pos pin-header providing access to MCU I/O signals
  - 2.0mm barrel connector power input
  - 6-pin BDM interface connector
  - 3-pos CAN interface connector
  - DB9 connector

- Supplied with DB9 Serial Cable, Power Supply, Documentation (CD), and Manual

Specifications:
Module Size 3.8" x 2.0"
Power Input: +9V typical, +6V to +20
Lab Hardware – project board

- CPU module plugs into this board
  - Prototype area; LEDs; Switches; etc.
  - 1 per team of 2 students
Lab Software

◆ CodeWarrior IDE
  • Integrated editor, C compiler, debugger
  • Also supports assembly language
  • Official support for windows
    – Might work on Mac with emulation software, but we don’t support that
    – Linux probably does not work

◆ Can develop with lab module
  • Cross-compiled from PC onto lab module via serial cable

◆ Can develop with project board + lab module
  • Cross-compiled from PC through project board via USB or serial cable

◆ Go to lab this week and pick up your equipment
  • We’ll announce when it is available
  • Recitation Friday will explain how to use the equipment and prepare you for next week’s lab
  • You only need the simulator for the pre-lab, which is on the course web site
Look For The Schedule Grid On Web Page

Below might change – web site has up to date version

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<th>Tue (Sec A)</th>
<th>Wed (Sec B)</th>
<th>Thu (Sec C)</th>
<th>Fri (Sec D)</th>
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<td>25-Apr</td>
<td>Open Lab</td>
<td>Open Lab</td>
<td>Open Lab</td>
<td>Open Lab</td>
<td>Open Lab</td>
<td>None</td>
<td>None</td>
<td>Optional/In-Lab</td>
</tr>
<tr>
<td>16</td>
<td>2-May Finals</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>11 Due <strong>(Thursday)</strong></td>
<td>None</td>
<td>No Recitation</td>
</tr>
</tbody>
</table>

(*See blackboard for Lab 11 prelab, demo & writeup information)
How Lab Sessions Will Work

◆ Homework/Pre-Lab
  • Start early! – Be done enough to ask intelligent questions at recitation Friday
    – (If you haven’t read the assignment, don’t expect TAs to spoon-feed you!)
  • Hand in pre-labs Friday evening at 9 PM via afs
    – 5% bonus points for early hand-in by 1:30 PM

◆ After Pre-lab Hand-In (we urge you to hand in even earlier!!)
  • Work with your partner on a solution strategy for the lab demo
  • Spend some time in the lab to make sure your stuff will work

◆ During scheduled lab time
  • Arrive prepared
  • Do your demo at assigned demo slot
    – Early demos are fine, but students with assigned time slot have priority
  • Lab writeups are due at 9 PM Wednesday a week or so later via afs
  • TA may leave 1 hour before end of lab if nobody is there at 8:20 PM
    – If you are going to arrive after 8:20PM send e-mail to course staff
Lab Writeups

- **Lab writeup content**
  - Lab assignment will specify writeup
  - You must actually follow directions – points off even for “minor” things like forgetting to put your name in comments within the code
    - *You MUST follow file name conventions!*
      This is a huge problem for us if you don’t
    
    ➜ 1 minute/student * class size = > 1 hour of wasted time for us
  - Usually has three elements:
    - Code listings, circuit diagrams
    - Answers to questions (sketch a curve of this measurement, etc.)
    - How can we make the lab better for next time?

- **Electronic hand-in via afs**
  - Writeup
  - We will spot-check to make sure code really works
  - Do your writeup right after the lab; don’t wait

- **IMPORTANT: save your lab code!**
  - Some labs require code from previous labs
  - Try out version management software (Git may work, but hates .xlsx files)
  - *Do NOT* use software that makes your code publicly available (e.g., Google)
Lab Hours & Expectations

◆ Scheduled lab times
  • We will schedule demo slots – be there when it is your slot!
  • This means partial conflicts with lab session are OK, but tell us the situation

◆ During schedule lab times
  • Be there when it is your section (e.g., Section A is Tuesday night)
  • Don’t get in the way when it isn’t your section
  • Our class has priority during our lab times (other class has priority in theirs)

◆ At other times
  • TAs have office hours in the lab
  • Use the lab as much as possible
  • But, you can do a lot of the course work on the MCU module with your laptop or home PC!

◆ If you see a problem in the lab, let us know right away via e-mail
  • Missing equipment, supplies have run out, safety issues
  • Too hot/too cold, anything that doesn’t seem right
  • Also can notify Tech Electronics (but tell us too)
“Its a course that teaches a lot about real world cases and hence is very useful for job interviews.”

“The Embedded Systems programming was useful, but what was more so was the mindset behind the course: learning how to set up and create an engineering project from ground-up.”
Should You Go To Recitation?

- Low recitation attendance predicts a low course score

![Graph showing the relationship between recitation attendance and course grade for 18-348 Spring 2014. The graph indicates a positive correlation, with students who attend recitations more frequently achieving higher course grades.]
Should You Attend Lecture?

Unedited 18-348 Spring 2014 FCE comment:

“Very great course. I didn't go to too many lectures because I had a full schedule, and I did not want to have to wake up at 10:30 after staying up late into the night, but I wish I had gone to class. Also, I applied to a Tesla embedded systems internship, and didn't get the job. But I'm pretty sure that, had I shown up to class, I would have been able to answer the technical questions much better (they were on CRC checking and communications between MCU and pc).”
Is It All About Putting In Hours?

- Hours does not necessarily correlate with course grade
  - This doesn’t mean hours don’t matter! It means that material is easier for some than for others.
Review (This Is Where You Get Exam Hints)

- **Course overview**
  - Course organization
  - Assignments: Pre-labs, labs, weekly quizzes, mid-term exam, final exam
  - Cheating policy

- **WEDNESDAY (before 4 PM):**
  send e-mail to 348 TAs <ece348-staff@lists.andrew.cmu.edu> with your lab partner choice; no mail means we can randomly assign you

- **Lab orientation**
  - Lab #1 is just to make sure you can use all the lab hardware and software
    - Pre-lab due on Friday
Lab Skills For This Lecture

◆ Board hook up
  • Be able to correctly hook up cables and power without board damage

◆ Download and execute program
  • Be able to down-load a pre-prepared program and run it:
    – On simulator
    – On microcontroller module
    – On module + proto-board
    – Assembly language program
    – C program

  • General idea of Lab #1 – make sure you can get everything to work so that in Lab #2 we can get on to doing real stuff.

(Don’t worry, lab skills will get a more challenging after this!!)