Final Preparation

Questions?

Final Exam

- When: 8:00-10:00 am Thursday, May 11th

- Location: here

- 1/3: midterm material
  - See lecture notes for midterm preparation
- 2/3: material since midterm

- 1 page of personal notes
- No electronic devices/books/other notes

Exam Parameters

- Most questions: multiple choice
  - Can grade your exam as you leave
- Some hand-written FSM questions
- Assigned seating

Sources of Material

- Zyante book and other assigned readings
- In-class and Zyante exercises
- Lecture notes
- Exams from prior years (both midterms and finals)

Pre-Midterm Material

- Number Representations (binary, hex, decimal)
- Arithmetic: adding, multiplying, incrementing, decrementing and shifting
- Bit-wise operators: &, |, ~, ^
- Analog to digital conversion (and vice versa)
- Digital I/O on the Teensy processors
- Basic circuits: LEDs, analog comparators, resistors, switches
- Motor control: H-bridges; PWM
- Serial communication: synchronous vs asynchronous serial

New Material

- Signed numbers
- Fixed point math
- Proportional-derivative control
- Microprocessor components
- Interrupts and interrupt service routines
- System safety & watchdog timers
- Finite state machines for control

Representing Negative Integers

- Two's complement representation
- Taking the negative of an integer

Fixed Point Math

- Converting between floating point and fixed point representations

- Addition, subtraction, multiplication and division of fixed point numbers

- Why do we do fixed point math?

Proportional-Derivative Control

- Key PD control equation
- Meaning of the gains
- Phase plots

Key Microprocessor Components

- Data bus

- Data memory (RAM)

- Program memory (EEPROM in our case)

- General-purpose registers

- Special-purpose registers

  – Instruction register

  – Program counter

- Instruction decoder

- Arithmetic Logical Unit and Floating Point Unit

Interrupts

- What are they?

- Interrupt service routines. Examples:
  - Pulse Width Modulation (PWM) generation (see slides)
  - Producing digital signals of various frequencies (e.g., can introduce software counters, too)
  - Shared data problem

Safety and Watchdog Timers

Watchdog:

- Hardware counter that causes the processor to reset once it reaches a critical value

- The code's job is to reset the counter fast enough to prevent this from happening ("feeding the dog")

- If the code does become stuck due to a bug or hardware problem, it is guaranteed to reset

Finite State Machines

- Definition
  - States
  - Inputs / Events
  - Transition function
  - Outputs / Actions
  - State transition diagrams
- FSMs for control

C Code

- Be prepared to read (and possibly fix) simple C code

- If any, you will not write more than a function of new code

- Look to lecture discussions of code and your projects as you prepare