Final Preparation
Final Exam

- Our final period is scheduled for 8:00-10:00 am Friday, May 14th
- Plan: to have an on-line version of the exam
  - 1/3: midterm material
    – See lecture notes for midterm preparation
  - 2/3: material since midterm
Exam Parameters

• May use personal notes, the book and anything that I have released (web site or Canvas)
• Other resources are off limits (including human resources)
Exam Parameters

• Old exams are available, and are split into sections
  – See the ‘prior courses section of my web site
• Expect similar sections:
  – Each section will either appear either as a Canvas Quiz or as a hand-written set of answers that will be submitted to Gradescope
  – The Canvas sections will be independent of one-another, but you will have one attempt at them
Sources of Material

• Zyante book and other assigned readings
• In-class and Zyante exercises
• Lecture notes
• Exams from prior years (both midterms and finals are available)
  – Exception: Final from 2020 is not available
Pre-Midterm Material

- Number Representations (binary, hex, decimal)
- Arithmetic: adding, multiplying, incrementing, decrementing and shifting (<< and >>)
- Bit-wise operators: &, |, ~, ^
- Digital to analog conversion
- Analog to digital conversion
- Analog comparators
- Digital I/O on the Teensy processors
- Basic circuits: LEDs, resistors, switches
- Motor control: H-bridges; PWM
- FSM basics
New Material

• Finite State Machines for control
• Signed numbers
• Fixed point math
• Proportional-derivative control
• Serial communication
• Performing multiple tasks and scheduling
Finite State Machines for Control

- FSMs for mission-level control
- Events:
  - Sensor-driven
  - Internally-driven (e.g., a counter)
- Actions
  - External effects
  - Setting commands for lower-level controllers (e.g., position or velocity goals)
  - Resetting counters
  - Printing
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
Serial Communication

- Synchronous vs asynchronous communication
- For asynchronous:
  - Start bit for synchronization
- Communication buffers
- ASCII representation: translation of bits to glyphs
Performing Multiple Tasks

With PeriodicAction, we can define multiple, semi-independent code blocks (tasks)

- Naturally partition for the code
- Different tasks can be executed at different frequencies
- Some communication between tasks through global variables
Task States

- Waiting
- Ready
- Running
Scheduling

We focused on non-preemptive scheduling

• Priority-based scheduling
  – Fixed priority
  – Shortest WCET first
  – Highest frequency first

• Round-robin scheduling
C Code

- Be prepared to read (and possibly fix) simple C code
- Look to lecture discussions of code and your projects as you prepare