Final Exam

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

Final Preparation

- Exam discussion on D2L
  - Post sample questions (and answers)
  - Some may appear on the exam
- Look to homework assignments and exams from last year (both the midterm and final) for the types of questions
  - Note that class coverage in previous years has been different

Pre-Midterm Material

- Number Representations (binary, hex)
  - Two's complement for signed numbers
- Arithmetic: incrementing, decrementing and shifting
- Bit-wise operators
- Analog to digital conversion (and vice versa)
- Microprocessor components
- Digital I/O on the Atmel Mega processors
- Basic circuits: LEDs, analog comparators, resistors

Key Microprocessor Components

- Data bus
- Data memory (RAM)
- Program memory (EEPROM in our case)
- General- versus special-purpose registers
  - Instruction register
  - Program counter
- Instruction decoder
- Arithmetic Logical Unit

Microcontroller I/O

- Special purpose registers in the Atmel Mega processors:
  - DDRx: data direction
  - PORTx: control pin state
  - PINx: read pin state
- Relationship to C code

New Material

- Pulse-width modulation (PWM)
- H-bridges
- Serial communication and the ASCII representation
- Proportional-derivative control
- Timer/counters
- Interrupts and interrupt service routines
- Finite state machines

Timer/Counters

- Prescalers
- Counters (hardware)
  - Timer0, 2: 8-bit
  - Timer1, 3, 4, 5: 16-bit
- Interrupts on timerX overflow

- Computing timerX count frequencies/periods
- Computing timerX interrupt frequencies/periods

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)

Finite State Machines

- Definition
  - States
  - Events
  - Transition function
  - Outputs
  - 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 few lines of code
- Look to lecture discussions of code and your projects as you prepare