Final Preparation

Questions?

Final Exam

- When: 8:00-10:00 am Tuesday, 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

Exam Parameters

- Most questions: multiple choice
  - Can grade your exam as you leave
- Assigned seating

Sources of Material

- Exam discussion on D2L
  - Post sample questions (and answers)
  - Some may appear on the exam
- In-class and Zyante exercises
- Pencasts; linked web pages
- Lecture notes
- Homework assignments and exams from prior years (both midterms and finals)

Pre-Midterm Material

- Number Representations (binary, hex)
  - Two's complement for signed numbers
- Arithmetic: incrementing, decrementing and shifting; computing the negative of a number
- Bit-wise operators
- Analog to digital conversion (and vice versa)
- Digital I/O on the Atmel Mega processors
- Basic circuits: LEDs, analog comparators, resistors
- Motor control: H-bridges; PWM

New Material

- Proportional-derivative control
- Timer/counters
- Interrupts and interrupt service routines
- Finite state machines
- Serial communication and the ASCII representation
- Fixed point math

Proportional-Derivative Control

- Key PD control equation
- Meaning of the gains

Timer/Counters

- Prescalers
- Counters (hardware)
  - Timer 0, 2: 8-bit
  - Timer 1, 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
  - 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 few lines of code
- Look to lecture discussions of code and your projects as you prepare

Serial Communication

- Synchronous vs asynchronous communication
- Asynchronous:
  - Start bit for clock synchronization
- ASCII representation of characters

Character Representation: ASCII

Binary	Dec	Hex	Glyph
010 0000	32	20	SP
010 0001	33	21	!
010 0010	34	22	"
010 0011	35	23	#
010 0100	36	24	$
010 0101	37	25	%
010 0110	38	26	&
010 0111	39	27	'
010 1000	40	28	(
010 1001	41	29	)
010 1010	42	2A	*
010 1011	43	2B	+
010 1100	44	2C	,
010 1101	45	2D	-
010 1110	46	2E	.
010 1111	47	2F	/
011 0000	48	30	0
011 0001	49	31	1
011 0010	50	32	2
011 0011	51	33	3
011 0100	52	34	4
011 0101	53	35	5
011 0110	54	36	6
011 0111	55	37	7
011 1000	56	38	8
011 1001	57	39	9
011 1010	58	3A	:
011 1011	59	3B	;
011 1100	60	3C	<
011 1101	61	3D	=
011 1110	62	3E	>
011 1111	63	3F	?

Binary	Dec	Hex	Glyph
100 0000	64	40	@
100 0001	65	41	A
100 0010	66	42	B
100 0011	67	43	C
100 0100	68	44	D
100 0101	69	45	E
100 0110	70	46	F
100 0111	71	47	G
100 1000	72	48	H
100 1001	73	49	I
100 1010	74	4A	J
100 1011	75	4B	K
100 1100	76	4C	L
100 1101	77	4D	M
100 1110	78	4E	N
100 1111	79	4F	O
101 0000	80	50	P
101 0001	81	51	Q
101 0010	82	52	R
101 0011	83	53	S
101 0100	84	54	T
101 0101	85	55	U
101 0110	86	56	V
101 0111	87	57	W
101 1000	88	58	X
101 1001	89	59	Y
101 1010	90	5A	Z
101 1011	91	5B	[
101 1100	92	5C	\
101 1101	93	5D	]
101 1110	94	5E	^
101 1111	95	5F	_

Binary	Dec	Hex	Glyph
110 0000	96	60	`
110 0001	97	61	a
110 0010	98	62	b
110 0011	99	63	c
110 0100	100	64	d
110 0101	101	65	e
110 0110	102	66	f
110 0111	103	67	g
110 1000	104	68	h
110 1001	105	69	i
110 1010	106	6A	j
110 1011	107	6B	k
110 1100	108	6C	l
110 1101	109	6D	m
110 1110	110	6E	n
110 1111	111	6F	o
111 0000	112	70	p
111 0001	113	71	q
111 0010	114	72	r
111 0011	115	73	s
111 0100	116	74	t
111 0101	117	75	u
111 0110	118	76	v
111 0111	119	77	w
111 1000	120	78	x
111 1001	121	79	y
111 1010	122	7A	z
111 1011	123	7B	{
111 1100	124	7C	|
111 1101	125	7D	}
111 1110	126	7E	~

Andrew H. Fag
Time Systen

Fixed Point Math

- Converting between floating point and fixed point representations
- Addition, subtraction, multiplication and division of fixed point numbers