Fall 2017 **CECS 341**
Homework 7
Total: 45 Points **Due: 11/2/2017 11:59PM**

General Instruction

- Allowed submission file type: PDF only
- I recommend that you type your answers to questions by using a word processor (Microsoft word, LibreOffice writer, LaTeX, etc.).
- If you would write your answers to questions on papers, then you can scan them by using a scanner (Not phone/tablet/laptop camera) and convert to a single PDF file (Not separate image files). Please use a pen and make it legible.
- Submit your work in the Dropbox folder via BeachBoard (Not email or in class).

1. (25 points) Consider a datapath in Figure 1. Problems in this exercise assume that logic blocks needed to implement a processor's datapath have the following latencies:

I-Mem	Add	Mux	Alu	Regs	D-Mem	Sign-Extend	Shift-Left-2
200ps	70ps	20ps	90ps	90ps	250ps	15ps	10ps

   What would the cycle time be for the following instructions?

   (a) (5 points) `add $t0, $t1, $t2`

   (b) (5 points) `lw $t0, 32($t1)`

   (c) (5 points) `sw $t0, 32($t1)`

   (d) (5 points) `beq $t0, $t1, 0xffff`

   (e) (5 points) `j 0x0400008`

2. (20 points) Consider a datapath in Figure 1. In this exercise we examine in detail how an instruction is executed in a single-cycle datapath. Problems in this exercise refer to a clock cycle in which the processor fetches the following instruction word:

   `10101100011000100000000000010100`

   Assume that data memory is all zeros and that the processor's registers have the following values at the beginning of the cycle in which the above instruction word is fetched:

r0	r1	r2	r3	r4	r5	r6	r8	r12	r31
0	1	3	5	7	10	6	8	2	16

   (a) (5 points) What are the output of the sign-extend?

   (b) (5 points) What are the values of the ALU control unit's inputs (ALUOp[1-0] and instruction[5-0])?

   (c) (5 points) What are the data input values of ALU unit?

   (d) (5 points) What are the data input value of Write data in D-memory?

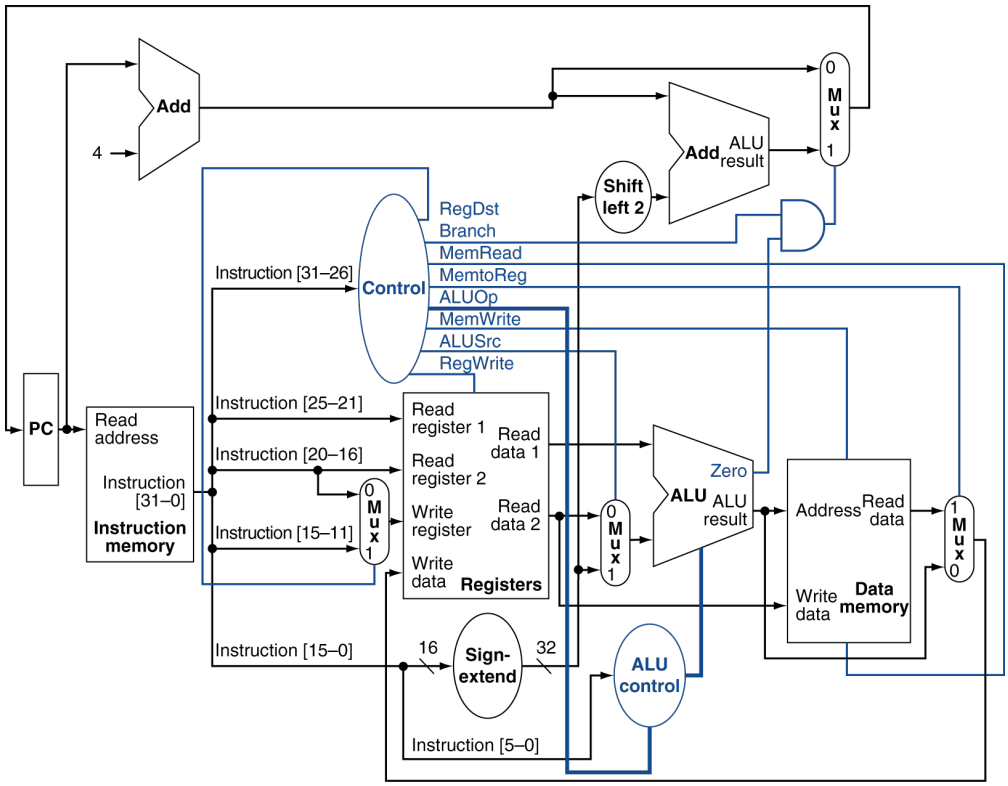

Figure 1: The simple datapath with control unit