

//submit one email with attached file(s) to jpark@csufresno.edu. //Email title as **CS113-Exam1-yourName**

- (25pts) **1.** (a) Write the distributive laws for logic equations.
(b) Draw a schematic diagram of the 2-input XOR component using only basic gates (2 input AND/OR and negator).
(b) What is the input width of the decoder used in a 16x1 multiplexer?
(c) Draw a schematic diagram of 1bit-ALU for {and, or, add, sub, nor} and show control signal names/values for each.
- (20pts) **2.** Consider the following instruction mix and CPI values for computers M1 (rate=400 MHz) and M2 (rate=500 MHz):
Type1 (30%): CPI_M1=1, CPI_M2 =2; Type2 (40%): CPI_M1=2, CPI_M2 =1; Type3 (30%): CPI_M1=2, CPI_M2 =4;
(a) Compute CPU execution times of M1 and M2, and answer which computer is how much times faster than the other.
(b) Compute MIPS rates of M1 and M2.
- (10pts) **3.** Consider a computer C1(rate=500 MHz) on which a benchmark program execution takes 30 sec.
A design team is developing a new computer C2 aiming the triple performance (i.e., 3 times faster) by increasing the clock rate with the cost of increased clock cycles with the factor of 2. What would be the clock rate of computer C2?
- (10pts) **4.** MIPS ISA: Assume that data (A1B2C3D4)hex and (B1C2D3E4)hex are stored in memory at address 0 and 4, respectively.
Consider the following 3 consecutive instruction executions: lw \$t1, 2(\$zero); sw \$t1, 3(\$zero); lw \$t2, 4(\$zero);
(a) Show the final contents of \$t1 and \$t2 in hex number.
(b) How many memory accesses are made?
- (20pts) **5.** Consider the following MIPS assembly code segment for implementing a loop:
- | |
|--------------------------|
| Start: lw \$t1, 8(\$s1); |
| bne \$s2, \$t1, LabelA; |
| addi \$s1, \$s1, 4; |
| j Start; |
| j LabelA; |
| LabelA: |
- (a) What are addressing modes of the 1st, 2nd, 3rd and 4th instructions?
(b) Write the MIPS machine code in hex number for the 1st instruction (lw...).
 //use: opcode=35, \$s1(17), \$t1(9)
(c) Write the MIPS machine code in hex number for the 2nd instruction (bne...).
 //use: opcode=5, \$t1(9), \$s2(18)
- (15pts) **6.** Consider the global pointer (\$gp) value 10008000(hex).
(a) Write a MIPS assembly code for loading a word size data stored at memory address 10000180(hex) to register \$s1.
(b) Compute and show the data address (in hex number) from the following sw instruction: sw \$t1, 8014h (\$gp);