CLASSWORK of COMPUTER ARCHITECTURES -- UNIT 1
January 12th, 2021

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Exercise 1 (3 points): Prove, by using axioms and laws of the Boolean algebra (and by specifying which axiom/law has been used), the following equality:

$$a\,b + c(\bar{a} + \bar{b}) = a\,b + c$$

Exercise 2 (3+1 points): Design a Mealy automaton with input alphabeth {X, Y, Z} that accepts the sequences XXYZ, XYXY and XYZZ also with overlappings. How would the automaton change if no overlapping was allowed?

Exercise 3 (5 points): Design an interconnection net among registers R_0, R_1, R_2, R_3, R_4 and R_5 such that:

- If the value contained in R_0 is negative, then the arithmetic sum between R_0 and R_1 is moved into R_4; otherwise, R_4 receives the content of R_3;
- If R_2 is greater than R_3, then R_1 is copied into R_5; otherwise, R_5 receives R_3;
- R_4 is copied into register R_i where *i* is given by the two less signifying bits of R_5.

The transfers are enabled only when the content of R_0 is a negative integer.

Exercise 4 (4 points): Turn into base 8 the number 339_{10}. Then, sum 267_8 to the obtained number, turn the result in base 2 and calculate the opposite of this number in 2-complement format with 12 bits.

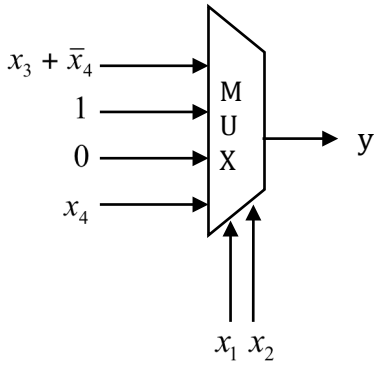
Exercise 5 (3 points): Let A = <0;01111;0011100000> and B = <1;10001;0011100000> be two numbers in the IEEE half-precision format. Sum them and represent the result in the same format.

Exercise 6 (3+2 points): Consider the following automaton with initial state S0:

	0	1
S0	S1/1	S0/0
S1	S2/0	S3/1
S2	S1/0	S4/1
S3	S1/0	S0/0
S4	S2/0	S0/0
S5	S2/0	S3/0

Minimize it and then provide (for the minimal automaton) the temporal diagram for the input 000101.

Exercise 7 (2+2+2 points): Consider the following combinatorial circuit:



a) Write the boolean expression associated to y and its truth table;
b) Find a minimal SOP for y;
c) Turn the resulting expression in ALL-NAND form.