Computer Architecture – June 7th, 2022

Exercise 1 (8 points) Design a sequential circuit with two inputs x1 and x0 that codify the characters A, B, C. The circuit has two outputs z1 and z0 such that z1z0=10 whenever it receives ABA, z1z0=01 whenever it receives ABC and z1z0=00 otherwise. Overlappings are admitted. Use a PLA for the combinatorial part; use a SR FF for the most signifying bit and T FFs for the remaining bits.

Exercise 2 (5 points) Design an interconnection among registers S0, …, S3 and D0,D1 such that:

- in D0 is moved Ri, where index i is given by the most signifying bits of D0 and D1
- the sum of D0 and D1 is moved into
    - S0, if both D0 and D1 are even,
    - S1, if both D0 and D1 are odd**,**
    - S2, if D0 and D1 are one even and one odd.

All movements are enabled if S3 is not a multiple of 4.

Exercise 3 (4 points) Consider the hexadecimal number 51BB; subtract to it in base 16 the hexadecimal number A3B. Then, turn the result in a 16-bits binary number, and consider it as a rational IEEE half-precision number. Then, take <1 ; 10001 ; 1000000000> and multiply these two numbers in IEEE half-precision.

Exercise 4 (4 points) Given the decimal numbers X = 94 and Y = 85:

- turn them in 2-complement;
- compute X+Y and X-Y;
- turn the results in base 10 and check their correctness.

For the 2-complement, use the minimum number of bits that make all the involved numbers representable.

Exercise 5 (3 points) Given $f = \left(\overline{a(a + \overline{cde})}\right) \oplus \left(\bar{b}\right)$, turn it in POS normal form by using axioms and rules of Boolean algebra. Then, give the equivalent ALL-NOR expression.

Exercise 6 (2+1+1+2 points)

- Consider the circuit below and write the boolean expression for f
- Turn such expression in SOP normal form, by using axioms and e rules of the Boolean algebra
- Give the truth table for f
- Derive the minimal POS form of f