



Computer Aided Digital System Design
(99-00-1)
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Homework 1: Logic Design and Analysis Deadline: 1399/ 08/20 23:59			
Problem	Definition	Credit	Your Mark
P0	Team Specification	3	
P1	Logic Analysis and Design: K-map	12	
P2	Logic Analysis	10	
P3	Logic Design	22	
P4	Vending Machine	22	
P5	Intelligent House	35	
Total		104	

Required File:

Upload a zip file titled as “CAD-HW1- *Student number1- Student number2- Student number3*”.

Contact Information:

Ask your questions via the course website or send an email to:

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0- Team [3 points]

Please your teammate specifications:

- i.
- ii.
- iii.

1- Logic Analysis and Design: K-map [12 points]

Consider the following functions and answer the questions.

Hint: To analyze these functions, use K-map.

$$f_1(w, x, y, z) = wx\bar{y} + \bar{y}z + \bar{w}y\bar{z} + \bar{x}y\bar{z}$$

$$f_2(w, x, y, z) = (w + x + \bar{y} + \bar{z})(\bar{x} + \bar{y} + z)(\bar{w} + y + \bar{z})$$

- i. Simplify the $F = f_1.f_2$ in SOP form.
- ii. Implement F by only using 2-input NAND gates.

2- Logic Analysis [10 points]

Analysis these logics and find out their functionality.

- i. Each box is a multiplexer where green links are input data, light blue links are output data, red links are control inputs, and dark blue links are intermediate links.

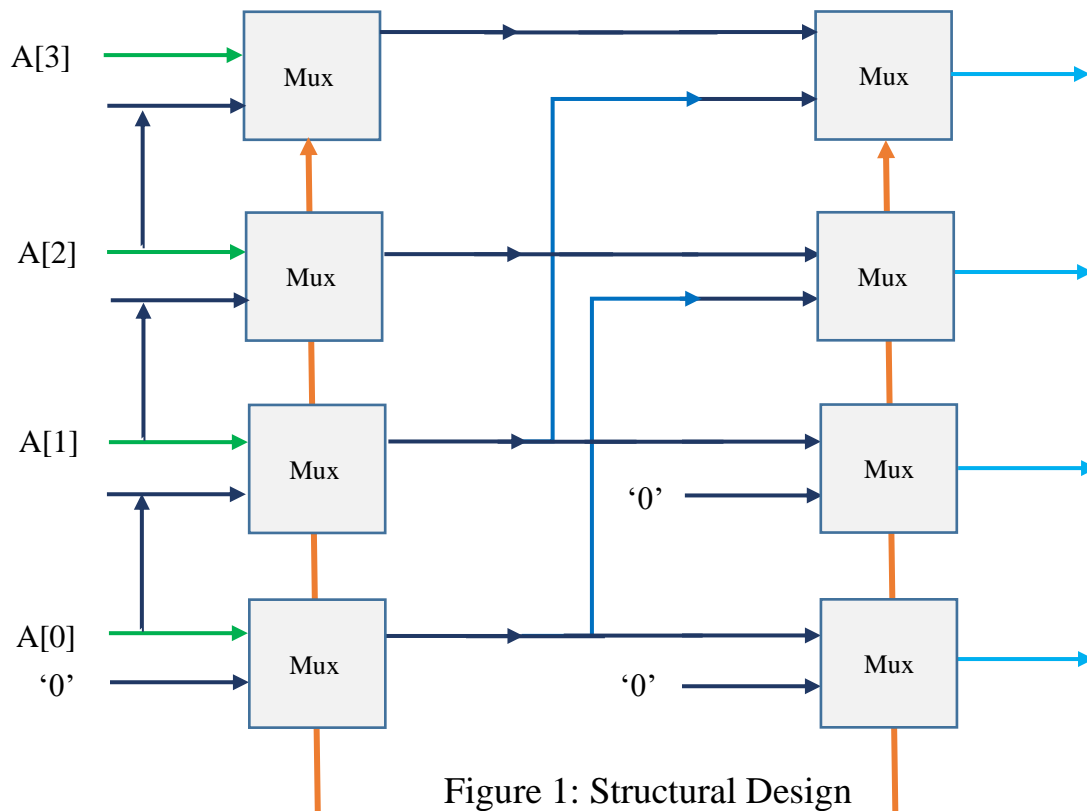


Figure 1: Structural Design

- ii. Figure 2 shows the dataflow model of a system, where:
- The **fork** actor reads one token and produces two copies of the input token, one on each output.
 - The **add** actor adds up two tokens, producing a single token that holds the sum of the input tokens
 - The **snk** actor is a token-sink which records the sequence of tokens appearing at its input

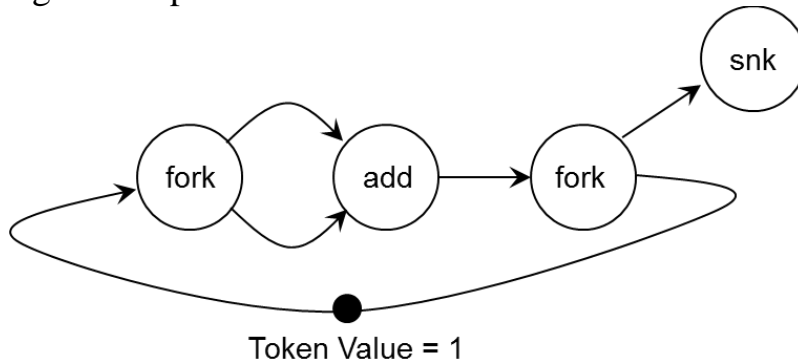


Figure 1: DataFlow Model

3- Logic Design [22 points]

Design a logic which calculates $|A-B|$.

- A, B are 5-bit binary numbers
- You have only one-bit full adders and 2-input XOR gates

4- Vending Machine [22 points]

Considered the designed vending machine in the class and answer the questions. [35 points]

- Improve the vending machine to return the money by enough *five coins*.
Draw the FSM
- Implement the improved vending machine with the following assumptions and compare them.
 - One hot coding (assign a binary code to each state where at most one bit is 1, e.g., 100, 010, 001)
 - One cold coding (assign a binary code to each state where at most one bit is 0, e.g., 011, 101, 110)
 - Binary coding (assign a binary code to each state, e.g., 000, 001, 010, 011,.....)
- Which design has a minimum number of flipflops?
- Which design has a simpler logic?

5- Intelligent House [35 points]

Design an intelligent house with these features:

- a) Every day with sunrise, the window curtains are opened and a light music is played for waking the residents up.
- b) When the temperature goes upper than 30 °C, the Air conditioner is started and wouldn't turned off until the degree reached to 24 °C.
- c) With the sunset, the lights of the house are turned on.
- d) When one of the residents says 'open window', all of the windows of the house are opened immediately.
- e) ...
- f) ...

You are a computer engineer who is expert in digital system design. Please design the intelligent house while considering the following requirements:

- i. Add 2 more features to the above list.
- ii. Draw ASM (including the two above features)
- iii. Draw FSM

Note: Consider that we have one sensor for each feature except feature d. In feature d, we have a letter recognition sensor. You need to design a phrase recognition to receive these letters and detect the phrase.