Hardware Design and Lab: Lab5

Team 28

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Catalog

1. Advanced Question: Sliding Window Sequence Detector

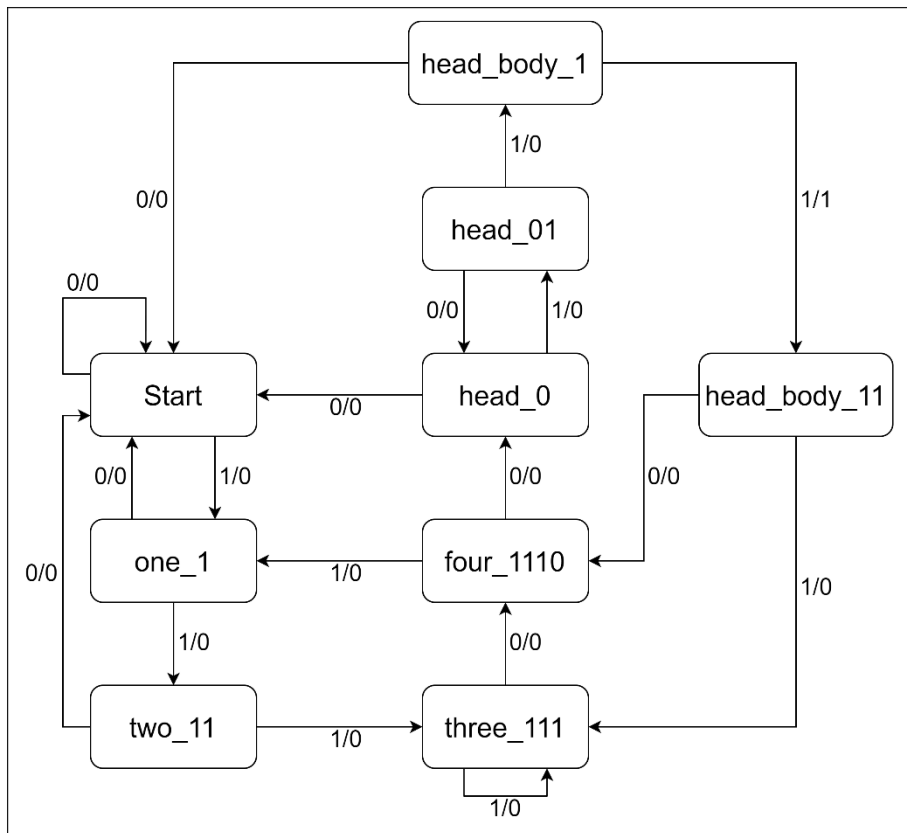## A. Finite State Diagram

Figure 1.1

B. Explanation

Start: Detect 0 bit that match the pattern.

one_1: Detect the first bit **1** of the pattern.

two_11: Detect the second bit **1** of the pattern.

three_111: Detect the third bit **1** of the pattern.

four_1110: Detect the fourth bit **0** of the pattern.

head: It means 1110.

head_0: Detect **0** of the "several **01**".

head_01: Detect **1** of the "several **01**".

body: It means "several **01**".

head_body_1: Detect the second-to-last bit **1** of the pattern.

head_body_11: Detect the last bit **1** of the pattern
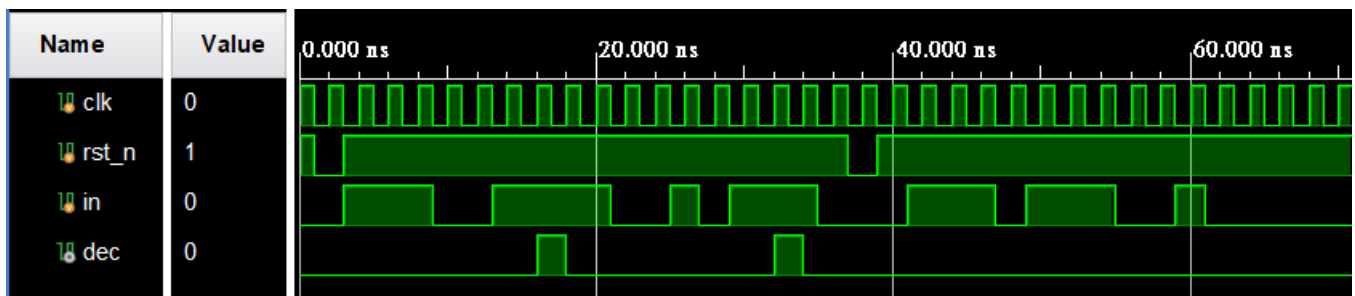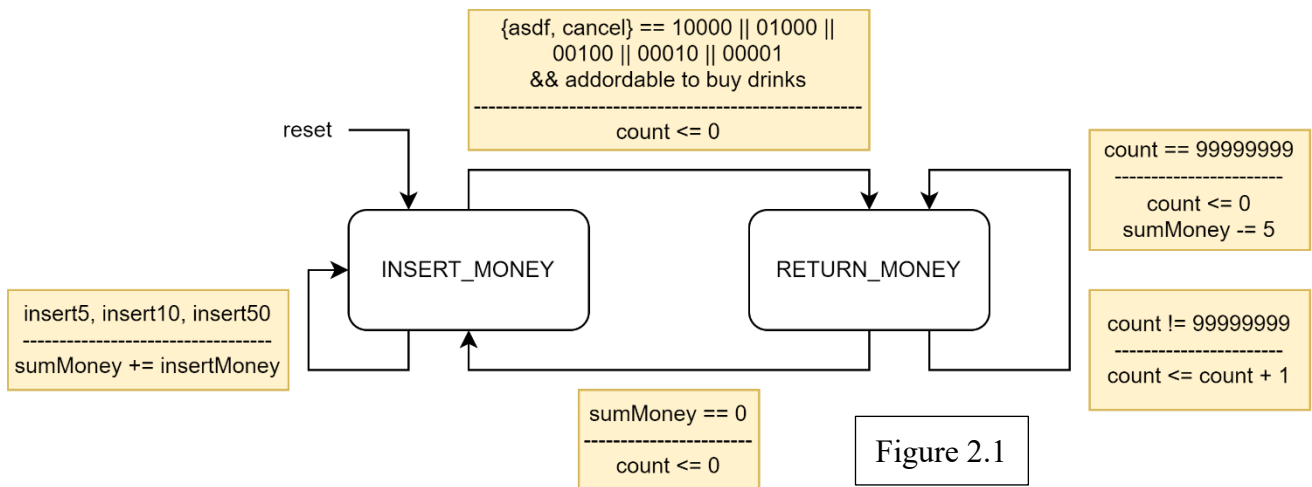
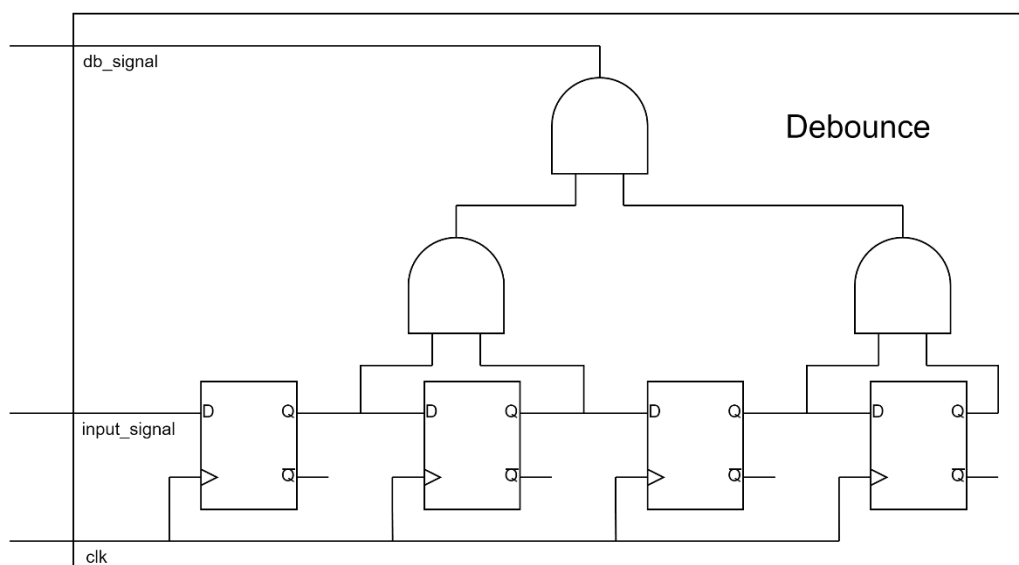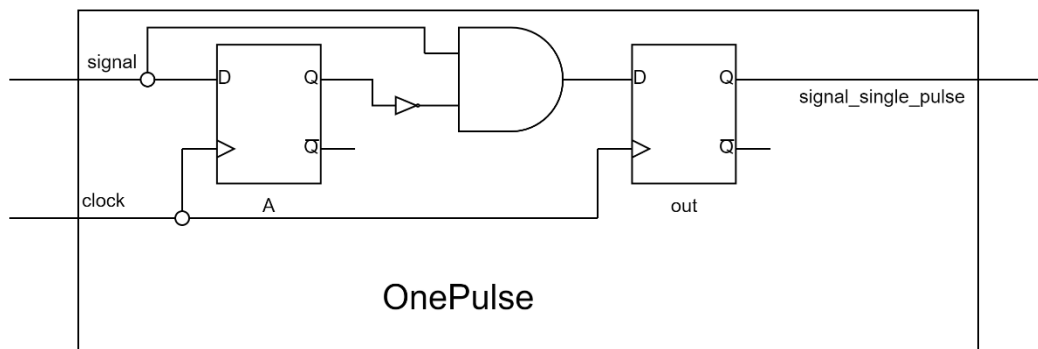## C. Testbench

Figure 1.2

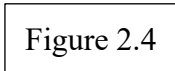I use the testcase of the lab slide to check if there is something wrong and it seems that the design works properly.
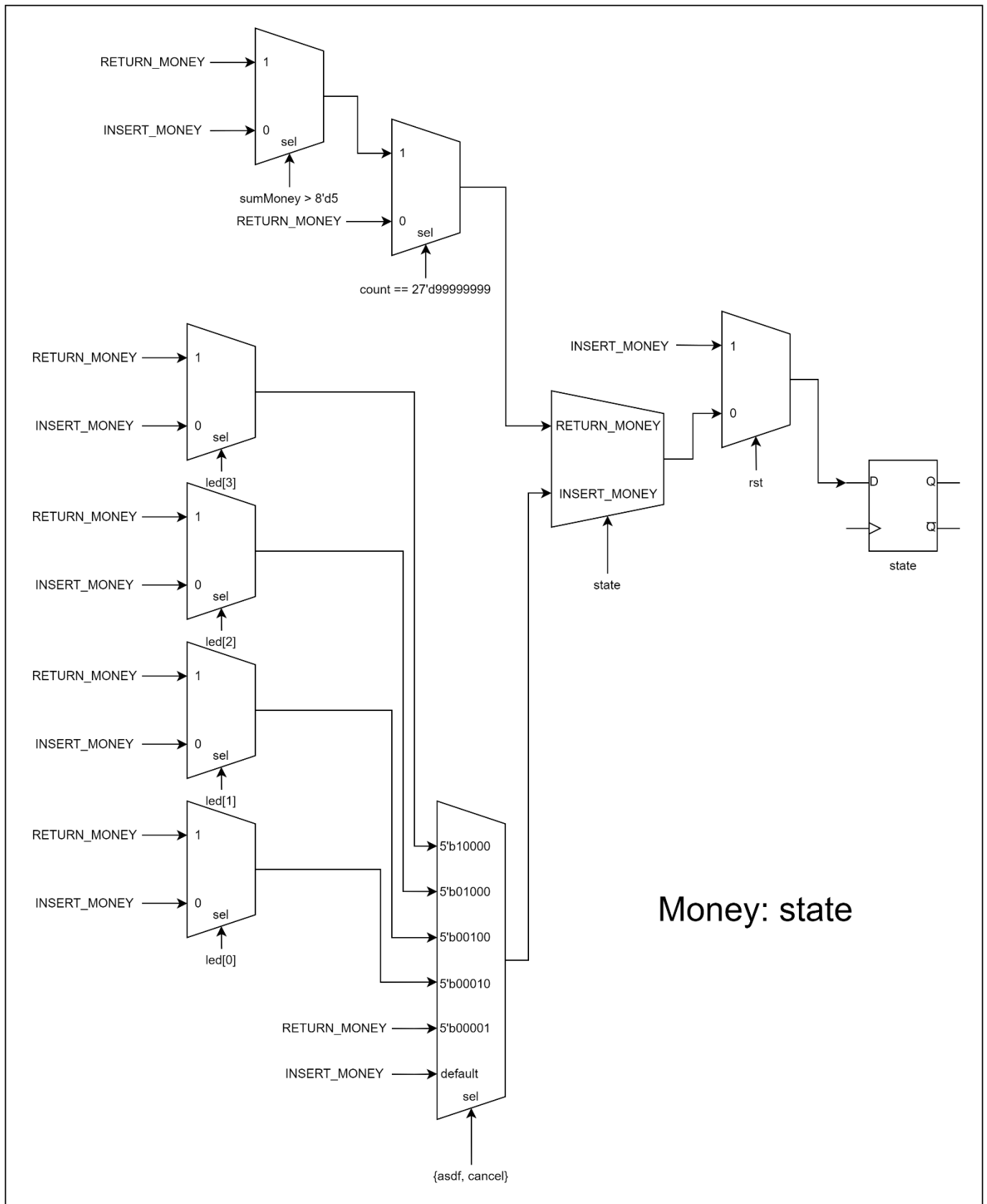
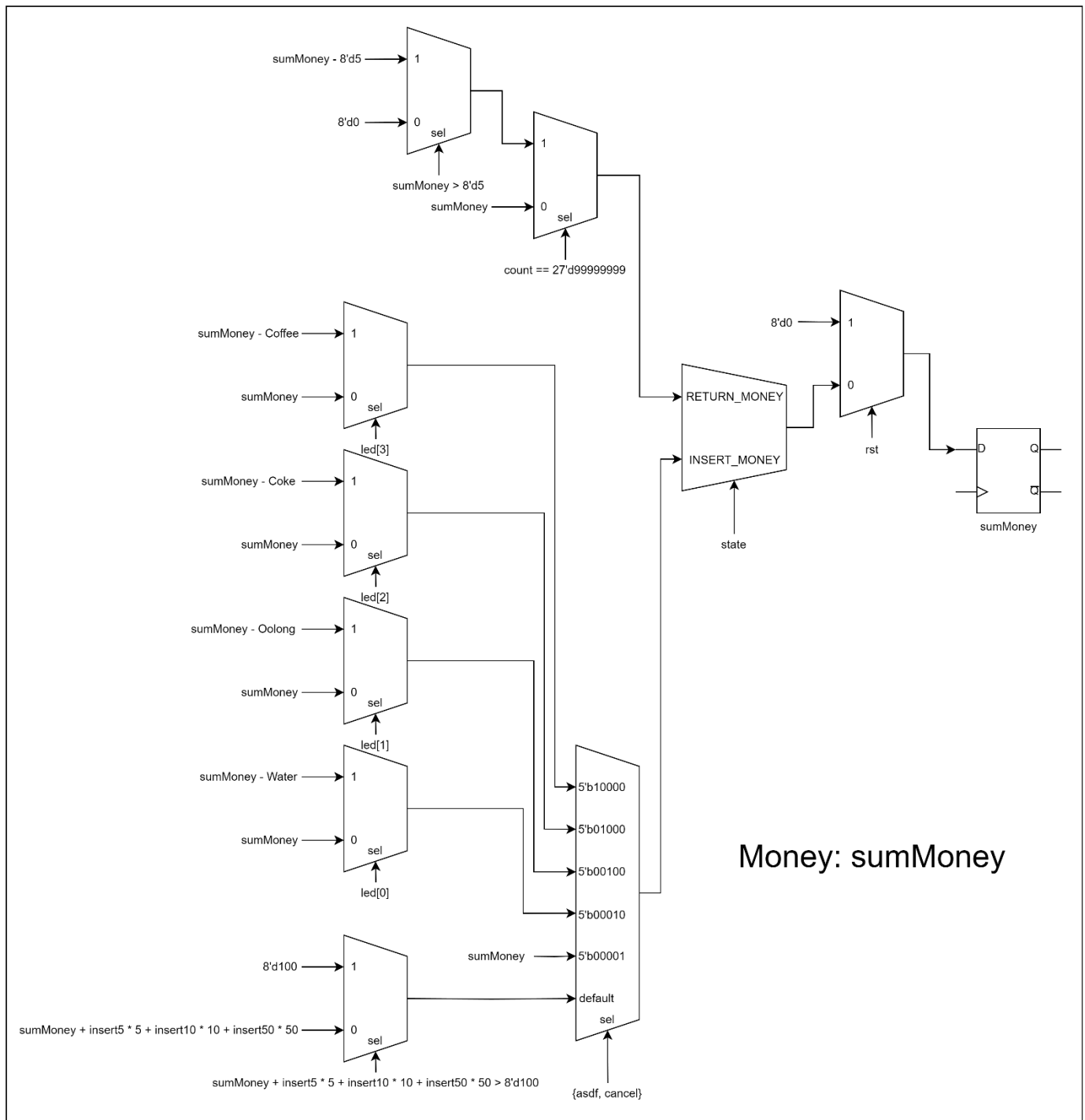# 2. Vending Machine

A. Finite State Diagram

Figure 2.1

B. Block Diagram

Figure 2.2

Figure 2.3

Figure 2.4

Figure 2.5

Figure 2.6

Figure 2.7

Figure 2.8

Figure 2.9

Figure 2.10

Figure 2.11

Figure 2.12

Figure 2.13

Figure 2.14

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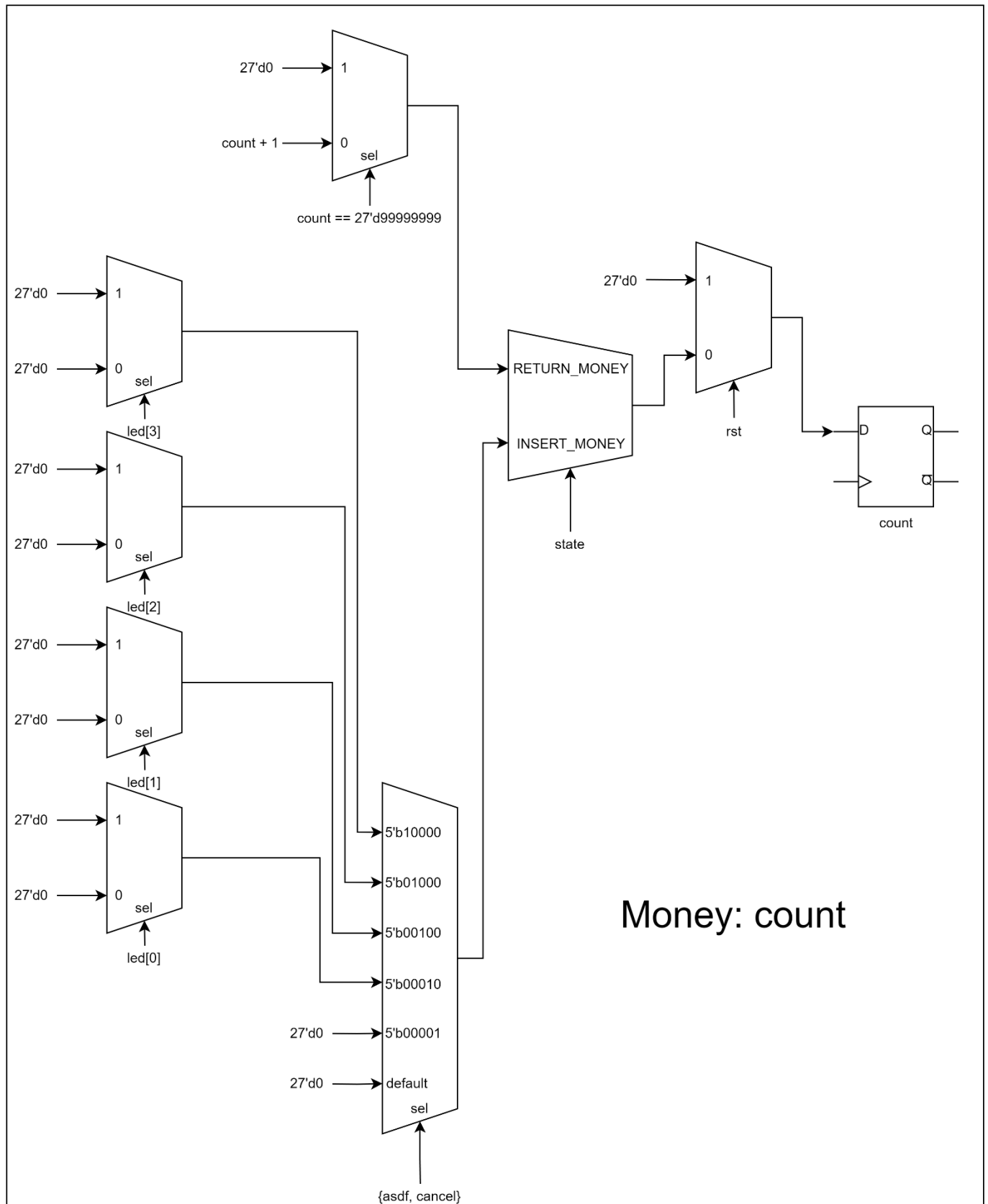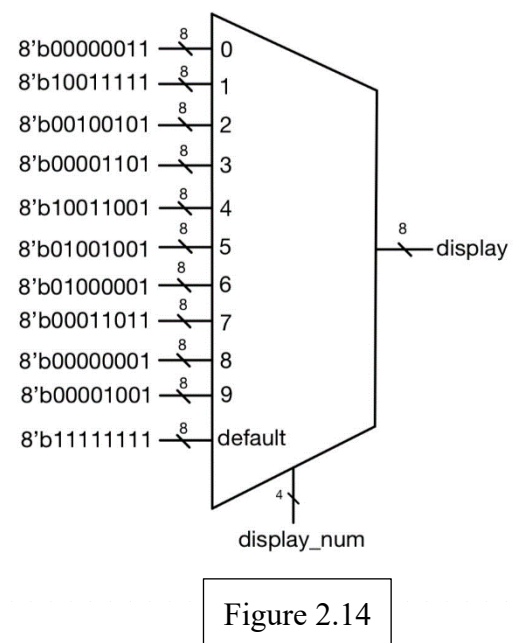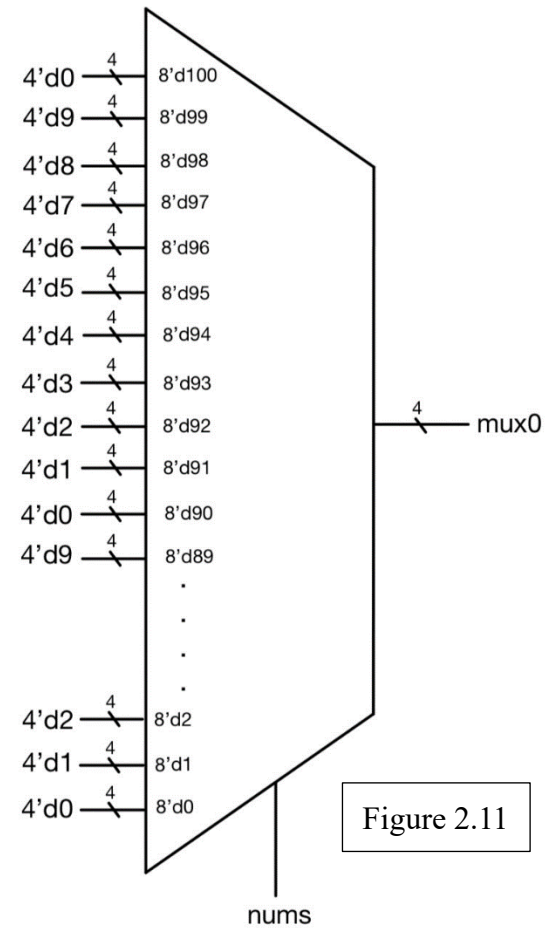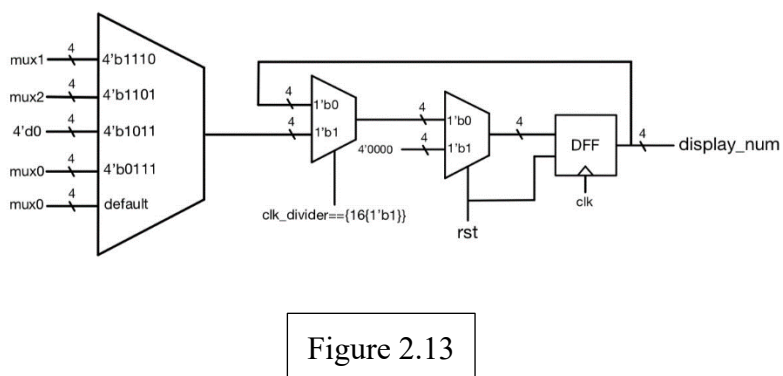
C. Explanation

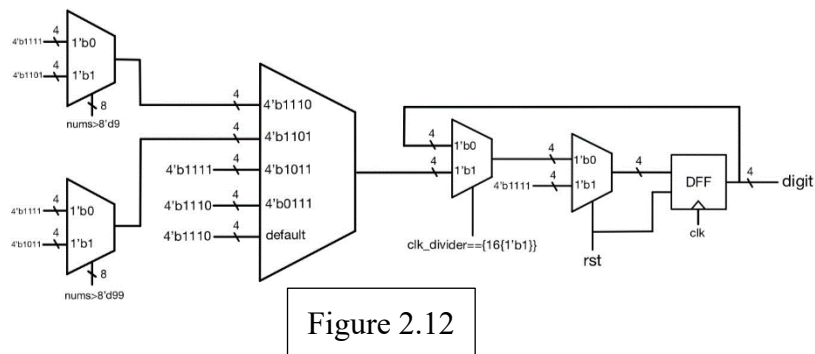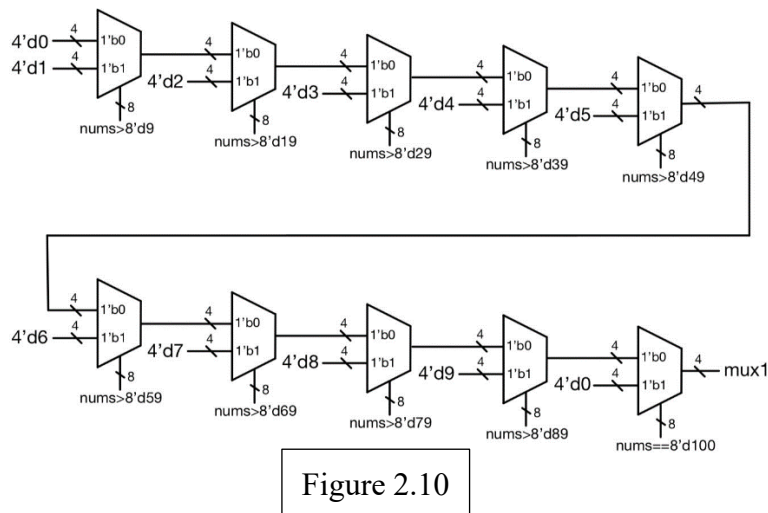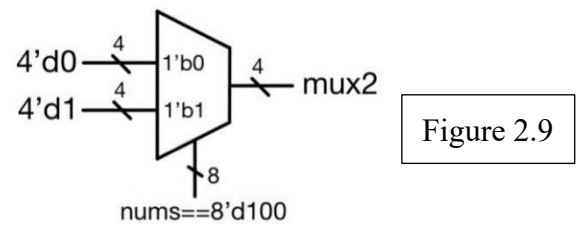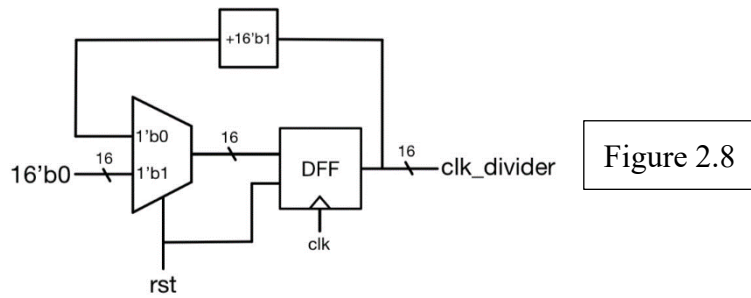如 **Figure 2.1** 所示我將使用狀態分成兩種,第一種是 **INSERT_MONEY**,一開始 reset 會進到這個狀態,等待使用者投錢,並用七段顯示器顯示使用者投入了多少錢,一旦使用者選擇了飲料而且投進去的錢足夠多,或是使用者按了 **cancel** 按鈕,則會進入第二種狀態 **RETURN_MONEY**,在這個狀態之下,販賣機對於投錢、選擇飲料和 **cancel** 按鈕不會做出反應,七段顯示器會以每秒減少 5 元的速度改變數值,直到 **sumMoney** 變為 0,接者會回到 **INSERT_MONEY** 等待後續的操作。整體的電路圖如 **Figure 2.4** 所示,其中 **OnePulse** 與 **Debounce** 是沿用上一個 Lab 使用的 module (**Figure 2.2, Figure 2.3**)。Money 這個 module 的電路圖為 **Figure 2.5 ~ Figure 2.7**,大致分為三塊電路:**state, sumMoney, count**。其中 **state** 用來記錄狀態變化,**sumMoney** 用來記錄販賣機內有多少錢,**count** 則是計數器,用來 devide clock。**SevenSegment** 這個 module 的電路圖為 **Figure 2.8 ~ Figure 2.14**,**mux2, mux1, mux0** 分別代表百位數、十位數與個位數。