

# Game: Ten Point Half

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## Preliminary work

- **Frequency Divider**
- **FSM**
- **LUT(LUT will be provided beforehand)**
- **LED**
- **Seven-Segment Display**

## Game Introduction:

Ten-point-half is a kind of poker card game usually used for gambling. There are two characters in this game. One is the dealer and the other is the player. The players aim to get larger values of cards in total than the dealer to win the game. In contrast, the dealer gets higher values than the players to win. The only restriction is that both players and dealer can't have their cards greater than 10.5 in total.



In this Lab, there are only 1 dealer and 1 player participating in the game. In the beginning, both of the two get 1 card which is ranging from 1 to 13. The numbers larger than 10 represent a half-point in this game, **and two cards of half-point should be 1 point**. Both of player and dealer **can decide to hit cards or not**, but **the limit of cards in hand is five**. (Including the first card in the beginning.)

### Win or Lose:

Examples: In the beginning, the player gets 3 and the dealer gets 9.

<E.g.1>The player hit a card and the number is 7, which means he has 10 in total. At the same time, if the dealer chooses not to hit cards, the player wins.

<E.g.2>The player hit a card and the number is 5, which means he has 8 in total. At the same time, if the dealer chooses not to hit cards, the dealer wins.

<E.g.3>The player hit a card and the number is 6, which means he has 9 in total. At the same time, if the dealer chooses not to hit cards, the dealer wins.

<E.g.4>The player hit a card and the number is 6, which means he has 9 in total. At the same time, if the dealer chooses to hit cards and the number is 11, which means the dealer has 9.5 in total. The dealer wins.

<E.g.5>The player hit a card and the number is 6, which means he has 9 in total. At the same time, if the dealer chooses to hit a card and the number is 3, which means the dealer has 12 in total. The player wins.

<E.g.6>The player hit cards and the number is 3, then he hit a card again and the number is 6, which means he has 12 in total. At the same time, if the dealer chooses to hit a card and the number is 6, which means the dealer has 12 in total. The dealer wins. **(In this case, because the player is already busted, no matter whether the dealer is busted or not, the dealer wins.)**

Note: To simplify, **we don't need to consider the case of "Five-Dragon"**.

## Lab Introduction

In this Lab, you need to design a ten-point-half game using EGO1. And **"The deadline for the coding submission is before the start of the LAB7 class"**. Now we are going to talk about how to design a ten-point-half game and some constraints you have to know. First, **you have to press the btn\_m to enter the beginning state in each round**. The game will **last for four rounds**, then enter the DONE STATE. Let's keep going to see what to do at the beginning state.

### Beginning state:

The player will get 1 card first and then the dealer get another card from LUT.v. First, you need to instantiate the LUT.v into tenthirty.v. When you need to get a card, the "pip" signal rises, at the same time, **the "number" signal will delay one clock cycle and then send a number out to tenthirty.v**. (This number represents the cards you get.) After the Beginning states, the FSM should enter the Hit Cards state.

**NOTE:** No seven-segment display is needed in this state.

### Hit Cards state:

You are using LUT.v for hit cards, the principle of LUT.v is the same as before. In this state, pressing btn\_m means to hit cards and the btn\_r represents entering the next state. Start from the player, if pressing btn\_r, the turn goes to the dealer to hit cards. If the player hits a card, only one card will be sent at a time and the limit times of hitting cards are 4. (cause the total number of cards in hand is 5) If the player gets 5 cards in hand or he is busted, the turn **directly** goes to the dealer. Also, the dealer can only hit a card at a time and if he gets 5 cards in hand or he is busted, the turn **directly** goes to Compare state.

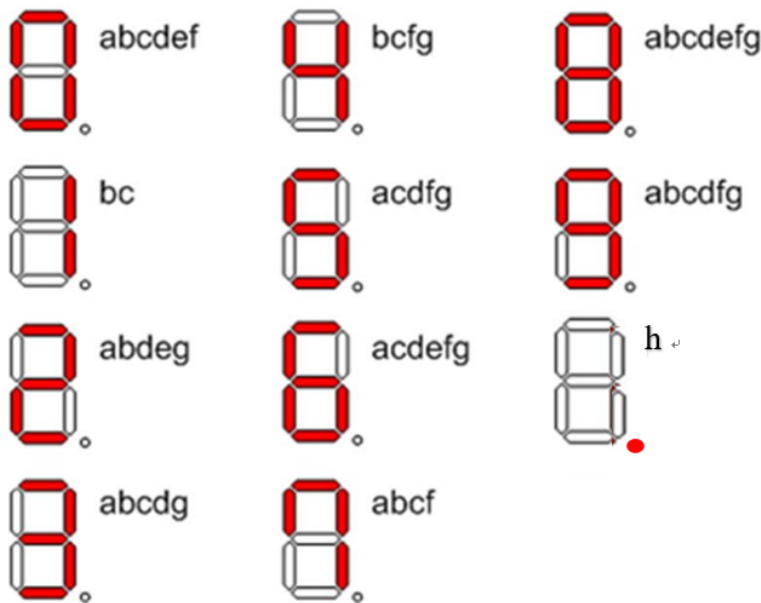
### Compare state:

- If none of the both is busted, the winner is the one who has bigger values of cards in hand.
- **If the values of the two are the same, the dealer wins.**
- **If the player is busted, the dealer wins. (No matter what the value of the dealer is.)**

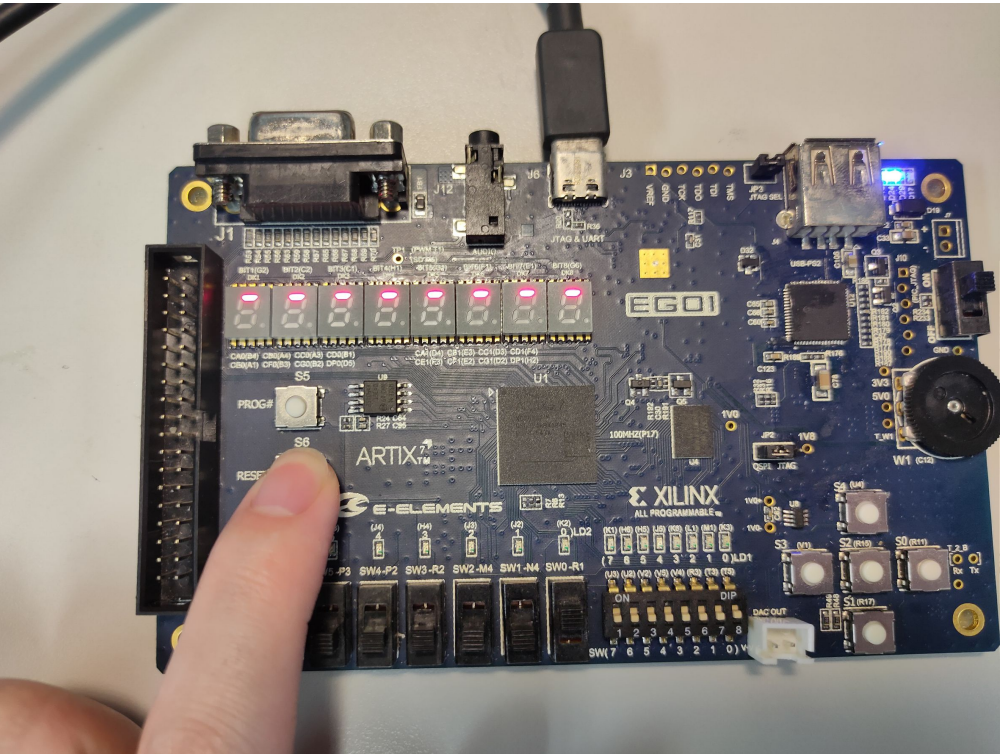
After the compare state is finished, 1 round is done. Press btn\_r to enter the next round. **Also, press the btn\_m to start the game.**

# Seven-Segment Display:

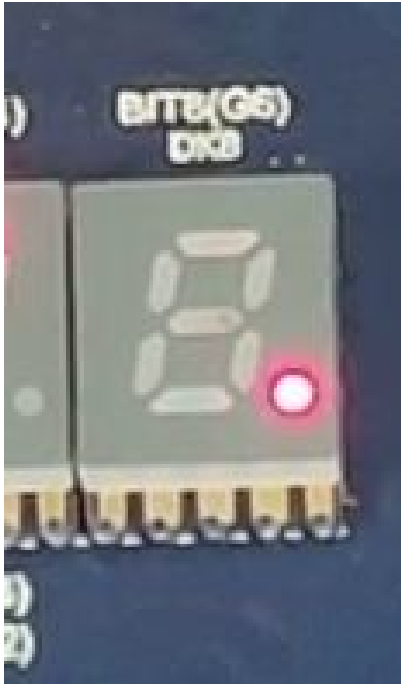
The values of the seven-segment display coding are listed below :



The Reset-display of the seven-segment display:



If the number greater than 10(i.e. number is 11, 12 or 13) should display half-point:



### Beginning state

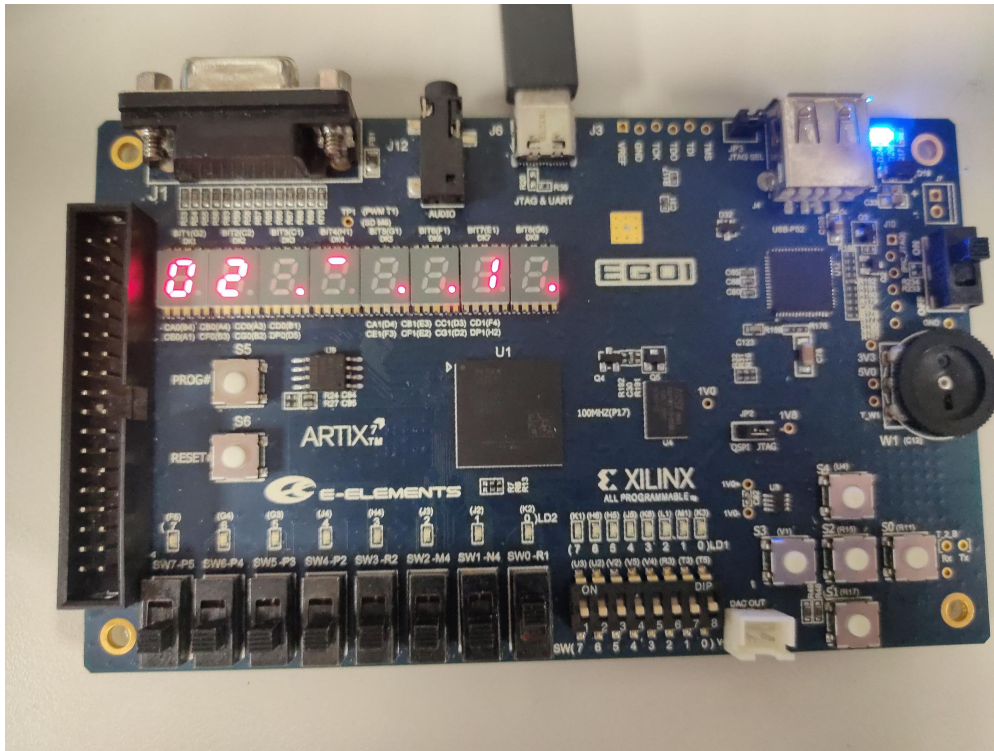
In the Beginning state, **you don't have to show the seven-segment values.**

### Hit Cards state

From the rightmost to the left are the values of cards that the dealer/player gets in this state. (The rightmost seven-segment display is the first card he gets in the beginning state and the second seven-segment display is the first card he gets in the Hit Cards state, and so on...

Note: He can only have 5 cards in hand, so only 5 seven-segment display(from right to left) are used for showing each point of a card he got.)

The leftmost three seven-segment display show total values, as the following figure shows:

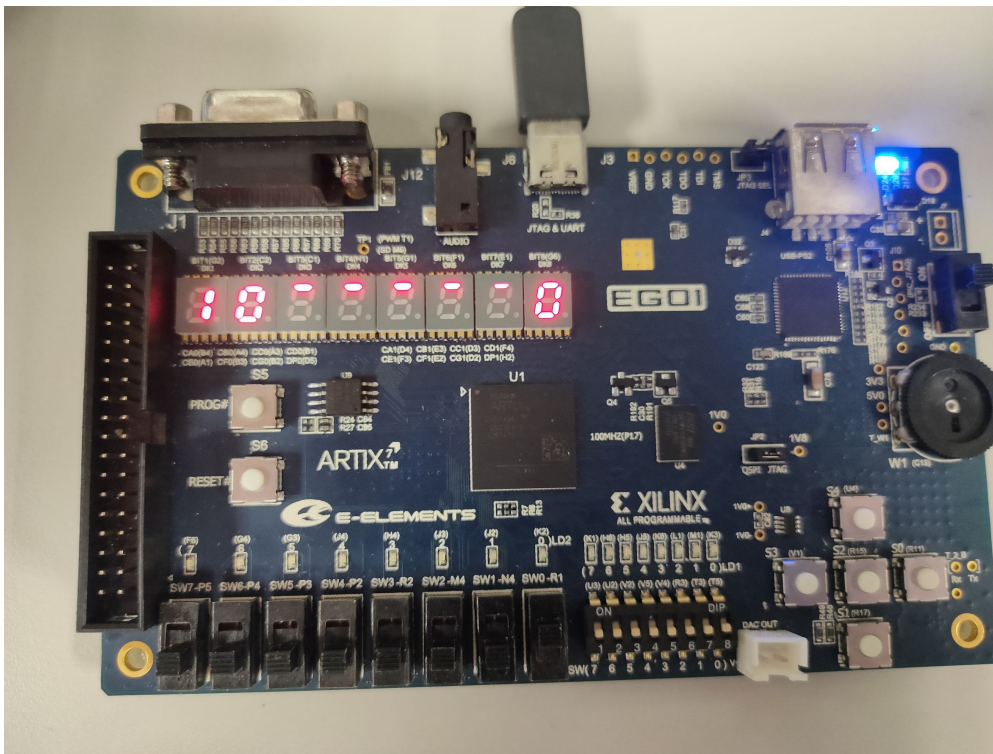


He gets a half-point in the beginning state and then in the Hit Cards state, he gets 1, half, half in sequence. The total value of the cards in hand is 2.5 and the number of cards in hand is 4.

In the Hit Cards state, **no matter is the player's turn or the dealer's turn**, 3 of the seven-segment display on the leftmost are used for the total values of cards in hand. The leftmost of the 3 seven-segment display are represent the tens digit(十位數), unit digits(個位數), and half-point respectively(from left to right). If there is no half point in total, the seven-segment display should show the default state.

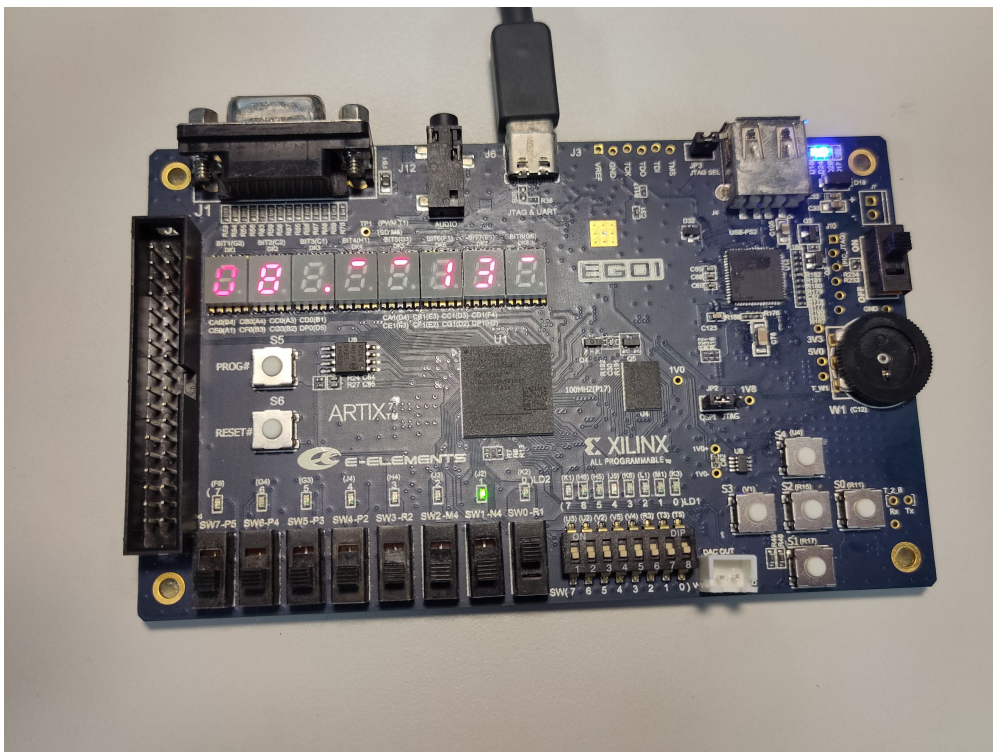


If the point is 10, the seven-segment display uses "0" to represent the card. As the following figure is shown on the right-hand side :



### Compare state

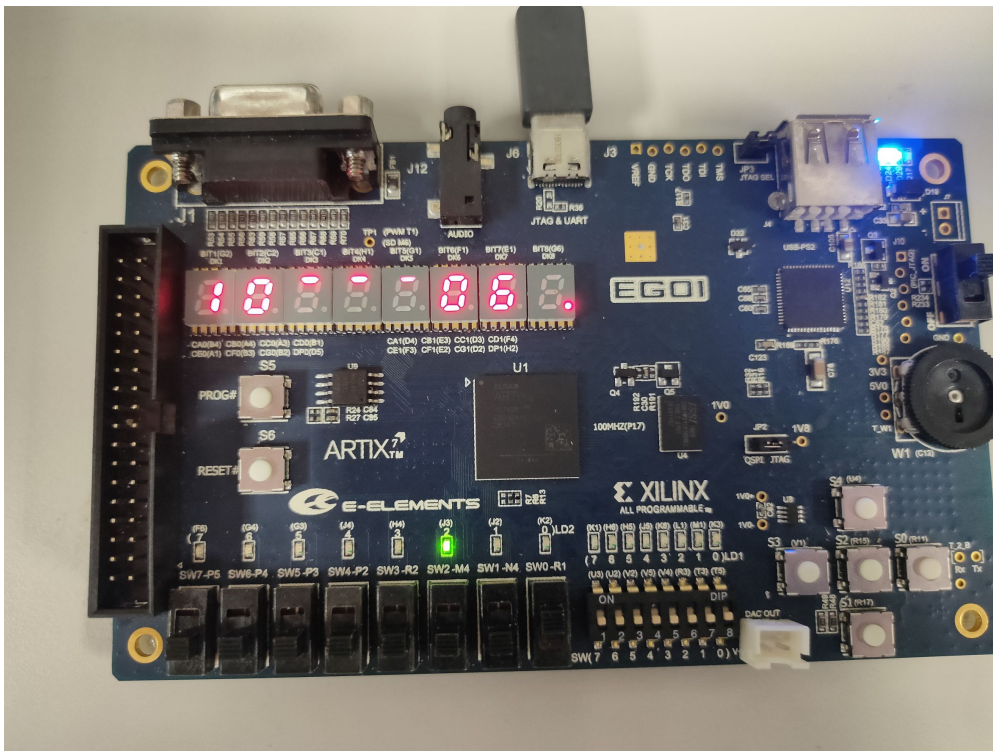
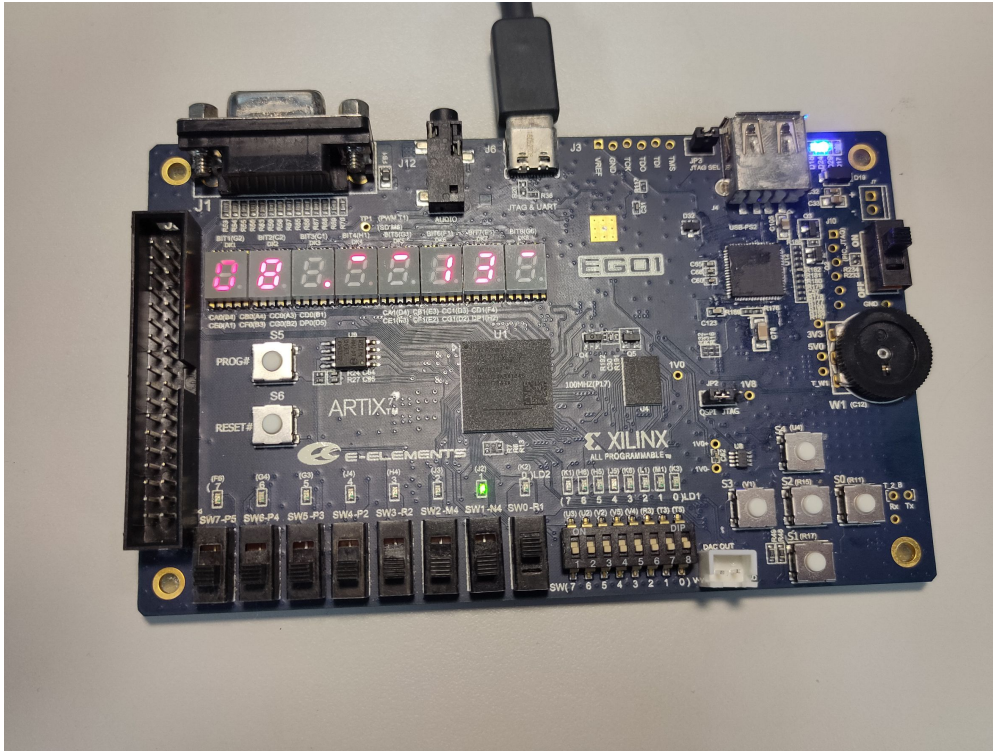
In the Compare state, 3 of the seven-segment display on the leftmost are used for the display of the total values of the dealer's cards in hand, and 3 of the seven-segment display on the rightmost are used for displaying the total value of the player's cards in hand.



The representation formats of total values are the same as the display in the Hit Cards state. (**Even if the dealer/player is busted, the seven-segment display should show the value**)

## LED

In the Compare state, LEDs are used for displaying the winner. Led[0], led[1], and led[2] are represented as the winner is the player, the winner is the dealer, and the DONE STATE respectively. **For other states (excludes Compare state and DONE state) Led should be turned off.**





## Data Config

- LUT(look up table)

Signal Name	I/O	Width	Simple Description
clk	I	1	Posedge triggered Clock
rst_n	I	1	Asynchronous negedge Reset
pip	I	1	Pip 訊號拉起時，會將 number 訊號延遲一個 cycle 後送出
number	O	4	表示撲克牌數值，數值從 1~13

- TenThirty

Signal Name	I/O	Width	Simple Description
clk	I	1	Posedge triggered Clock
rst_n	I	1	Asynchronous negedge Reset
btn_m	I	1	表示 S2 按鍵
btn_r	I	1	表示 S0 按鍵
seg7_sel	O	8	七段顯示器選擇器，控制八顆七段顯示器何時亮
Seg7	O	8	右邊四顆七段顯示器(DK5~DK8)
Seg7_l	O	8	左邊四顆七段顯示器(DK1~DK4)
led	O	3	LD2(0、1、2)

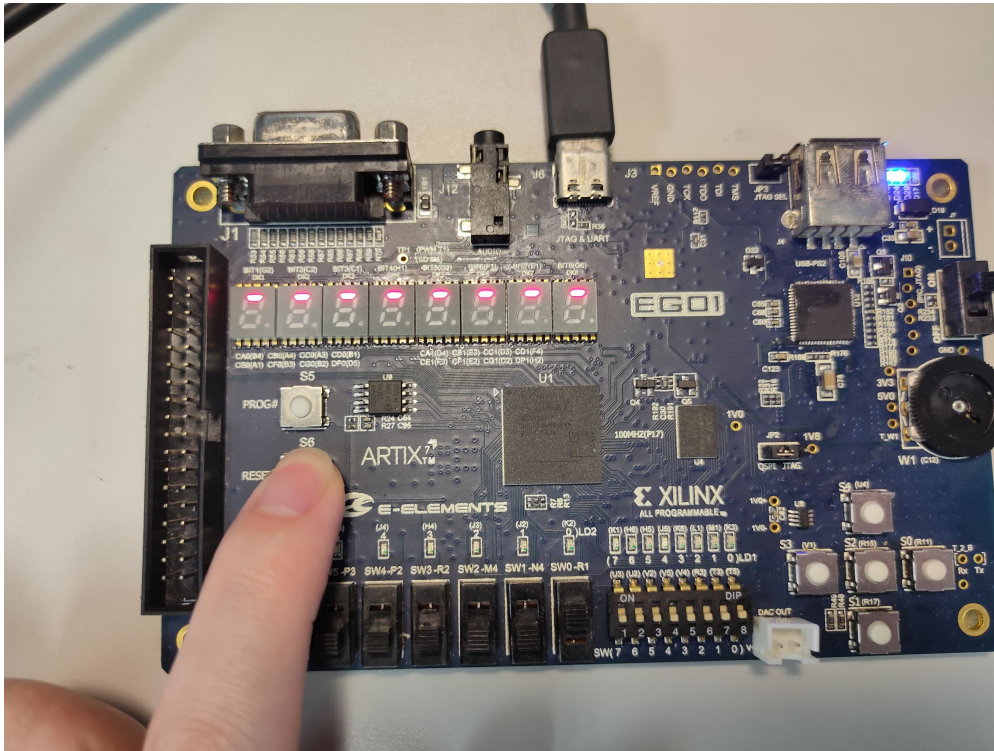
**The URL of the Demo videos is below:**

<https://www.youtube.com/watch?v=MHQ68WXCOEY&list=PLn0-Y9IYJqqvGrmoE9heed0lfZplog0h0&index=1>

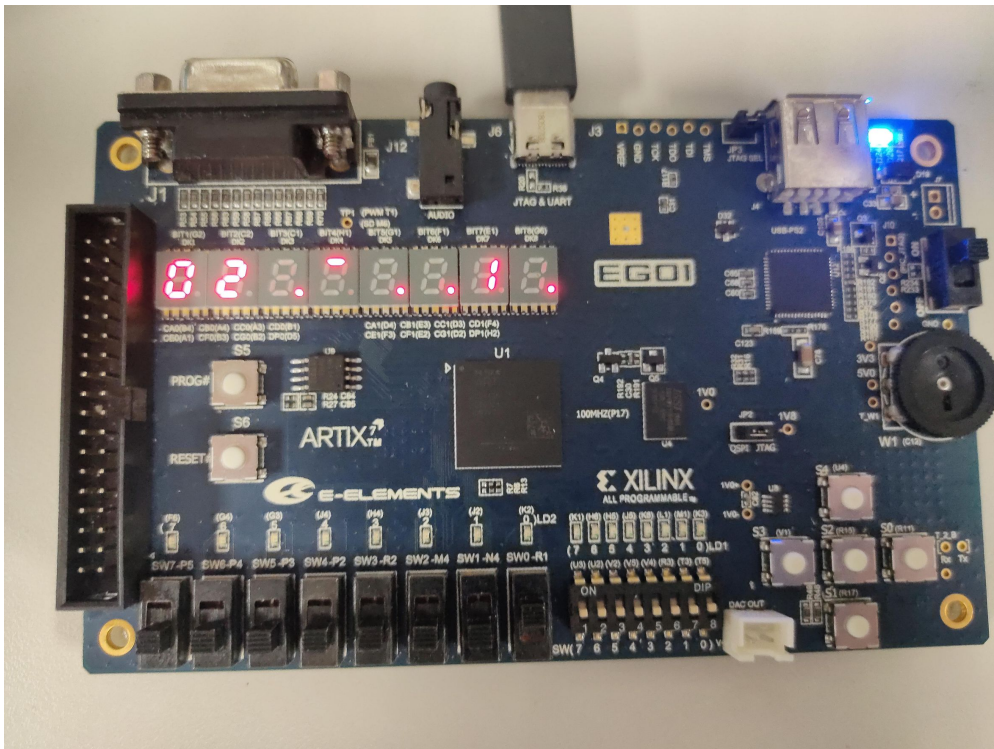


## Cases for checking

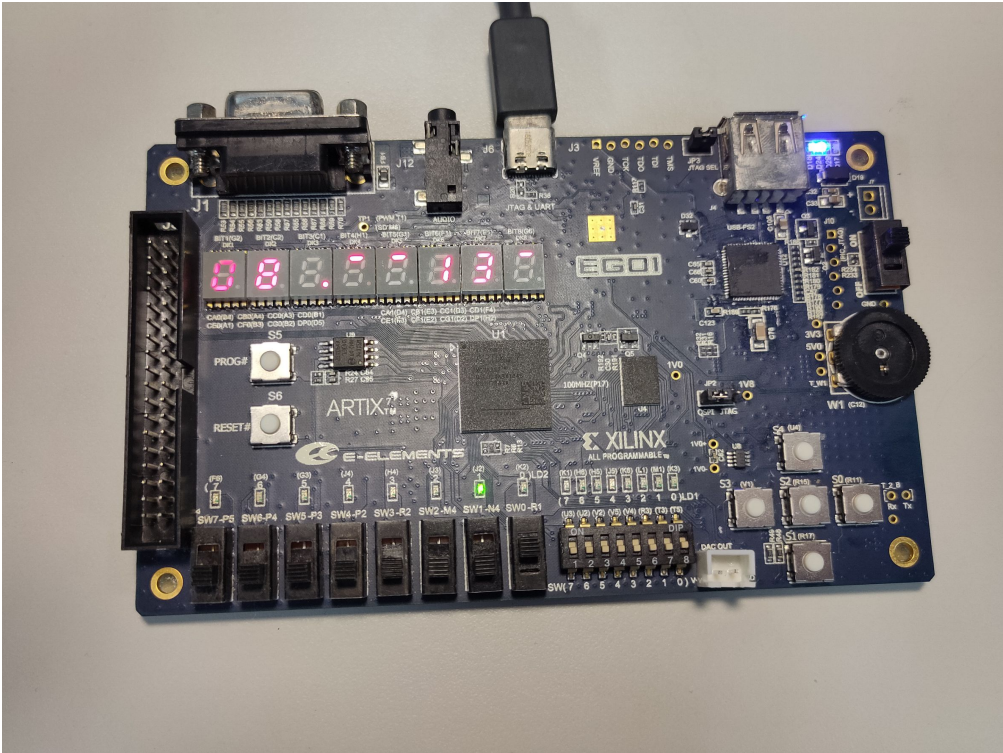
- Case 1 : Reset



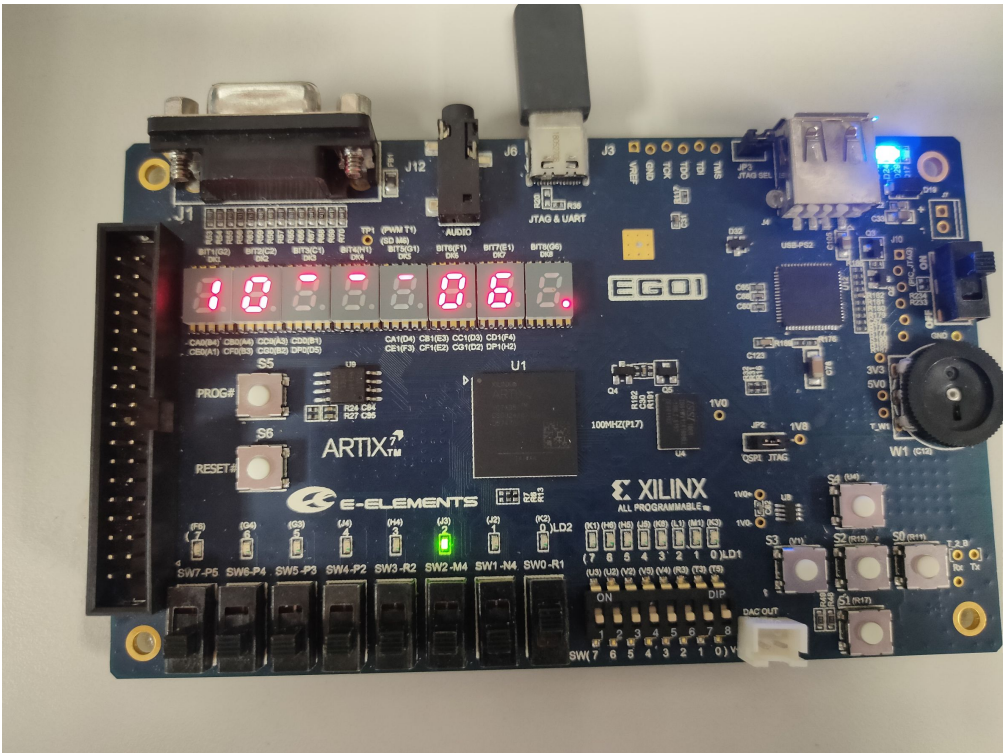
- Case 2 : Showing the points of cards that the dealer/player got and the total points of the cards.  
E.g: The player/dealer gets Half-point in the Beginning state, and then gets 1, half, half in sequence during the Hit Cards state.



- Case 3 : The Compare state, includes the LEDs and the total points of the dealer and player.



- Case 4 : After 4 rounds, Led[2](DONE state) should be turned on.





## Grading Policy

All the grading policy below is 10% for each.

1. Reset mode works functional correct.
2. When btn\_m is pressed to start the game, your design could finish the beginning state and turns to the Hit Cards state and show the first card that the player/dealer got from LUT.v in the beginning state.
3. At the first round, the player has the correct point of the cards (also the total points of cards in hand should be correct!) showing on the seven-segment display and by pressing the btn\_r bottom, it could turn to the dealer to Hit the Cards.
4. At the first round, the dealer has the correct point of the cards (also the total points of cards in hand should be correct!) showing on the seven-segment display and by pressing the btn\_r bottom, it could turn to Compare state.
5. In the compare state of the first round, the seven-segment display correctly shows the total points of the dealer and the player, and the LEDs are correctly turned on to show who is the winner.
6. The player/dealer could successfully hit cards at least one time, and the seven-segment display shows the correct points of cards in their hands.
7. The player/dealer could successfully hit cards 4 times (total 5 cards in hand).
8. When the player/dealer is busted, your design could turn to the next state successfully. (The player turns to the dealer for Hit cards, while the dealer turns to Compare state.)
9. If there is anyone is busted, the compare state works properly in this case.
10. Your design could go through the entire 4 rounds and turn into the DONE state.
11. **If using "one\_shot\_pulse" design in your work, you'll get another bonus point.**

Total: 100 points

### Important Rules:

Rule 1: In this lab, **you CAN'T revise the codes of LUT.v and I/O in tenthirty.v**, violators will get 0 points in this lab.

Rule 2: You **MUST use FSM in your design**, violators only get 80% of the original scores in this lab.

Rule 3: You **CAN'T revise the part of "DON'T TOUCH" in tenthirty.v**, violators only get 80% of the original scores in this lab.

Rule 4: **Plagiarizing(抄襲) is NOT allowed, violators get "0" points in this lab.**

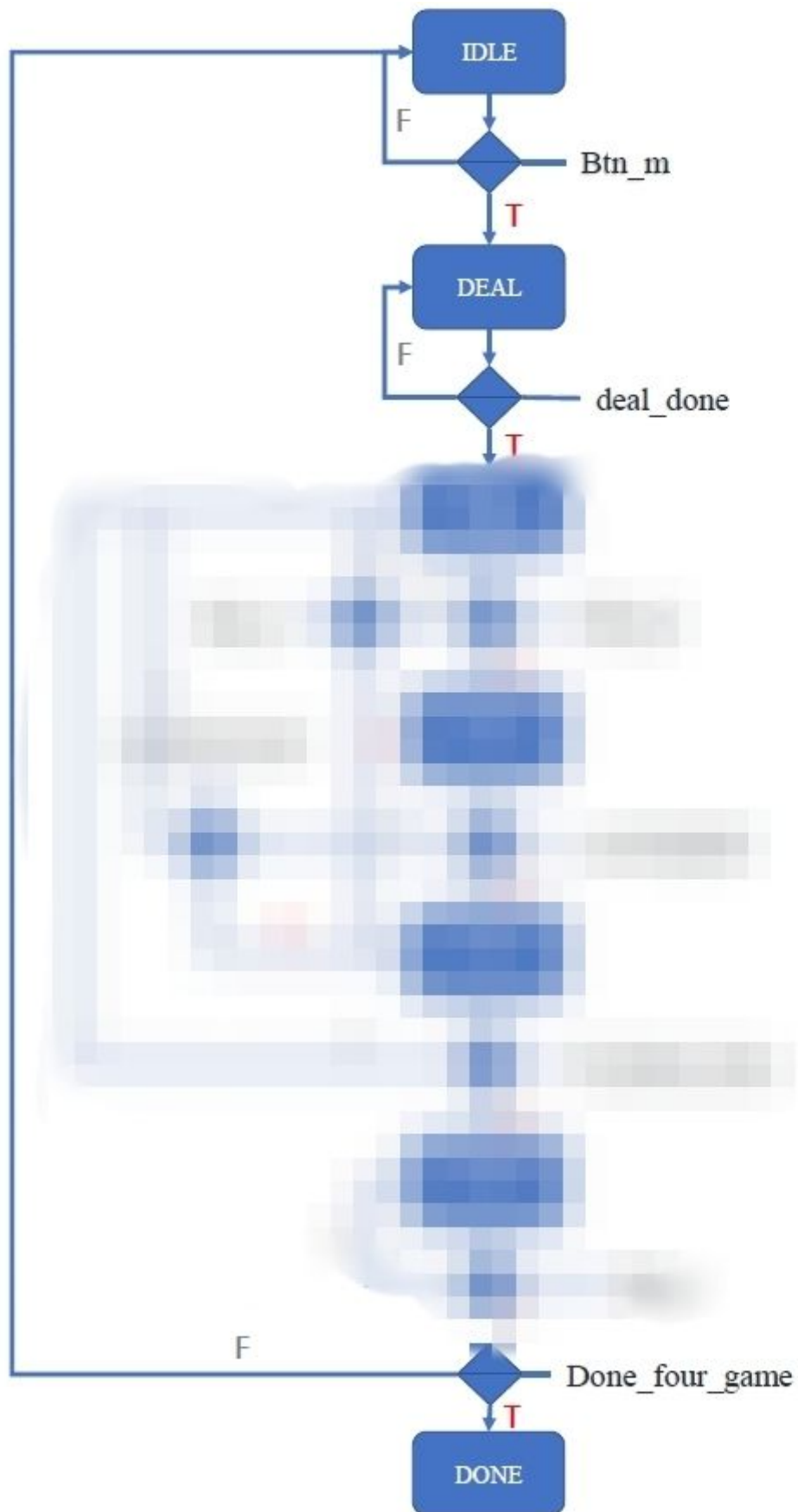
Rule 5: Please upload the file to iLearning 3.0 with the following format: " **tenthirty\_studentID.v**". If the file is not submitted in this format, the score will be discounted by 30%.

Rule 6: If only a few students make this midterm project, TA will give the scores depending on the degree of completion of your design, please **DON'T give up!**

## HINT

1. The clock rate of **dis\_clk needs to work faster than d\_clk**.
2. The seg7\_temp register is **only used for the display format for 8 seven-segment display**. (i.e. seg7\_temp0 controls the display format of the rightmost seven-segment display.)
3. You may need other registers for storing the number of cards in hand(for dealer/player), **DON'T use seg7\_temp for this purpose**.
4. **You may need 1 more bit for registers to store the half-point information**, and remember, if there are two half-point cards in hand, the total points should be 1.

## FSM Demonstration





## TB example

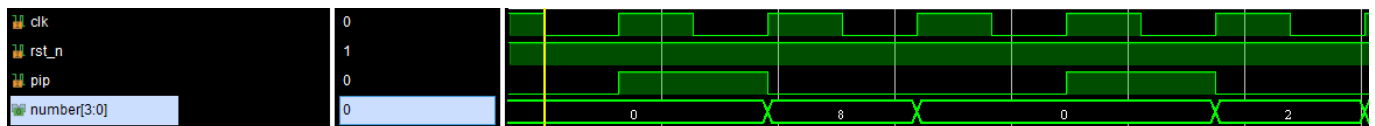
```
initial begin
    rst_n = 1;
    set_initiaial;
    gap = $urandom_range(1,5);
    repeat(gap)@(negedge clk);
    rst_n = 0;
    repeat(gap)@(negedge clk);
    rst_n = 1;
    repeat(gap)@(negedge d_clk);
    btn_m = 1;
    repeat(2)@(negedge d_clk);
    btn_m = 0;
    repeat(2)@(negedge d_clk);
    btn_r = 1;
    repeat(2)@(negedge d_clk);
    btn_r = 0;
    btn_m = 1;
    repeat(1)@(negedge d_clk);
    btn_m = 0;
    repeat(2)@(negedge d_clk);
    btn_m = 1;
    repeat(6)@(negedge d_clk);
    $finish;
end
```

### TA's Remind♥♥♥:

1. When using TB, remember to modify the d\_clk signal into the format as d\_clk=counter[5]
2. You need to self-define your own TB.
3. TB can only check your FSM design flow.

## LUT Demonstration

As the following figure shows, the number signal will delay one clock cycle after the pip signal rises.



## Reference

- [1] 十點半 維基百科  
<https://zh.wikipedia.org/wiki/%E5%8D%81%E9%BB%9E%E5%8D%8A>
- [2] Markdown 語法大全  
<https://ed521.github.io/2019/08/hexo-markdown/>