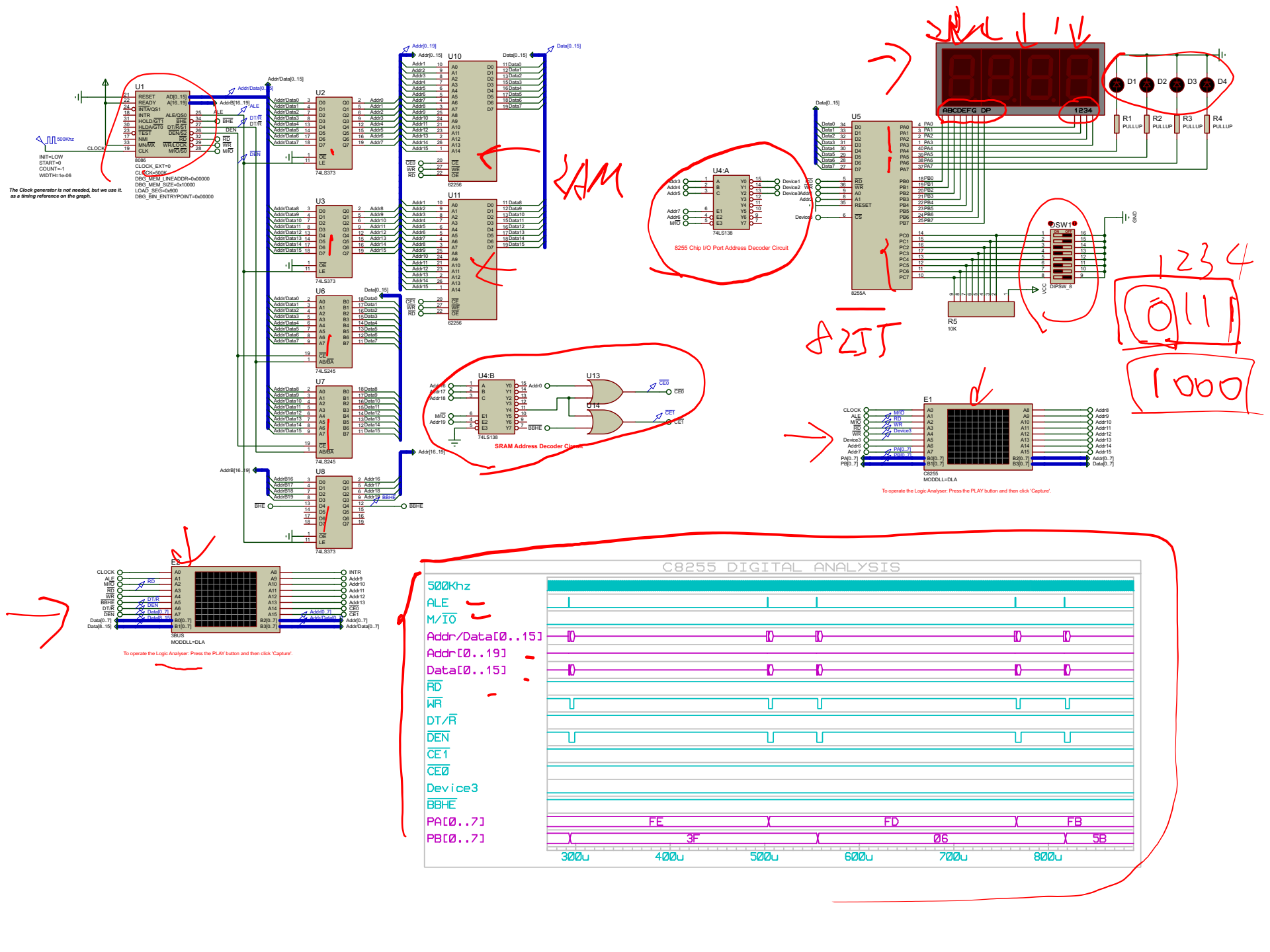
Lab 2 Content

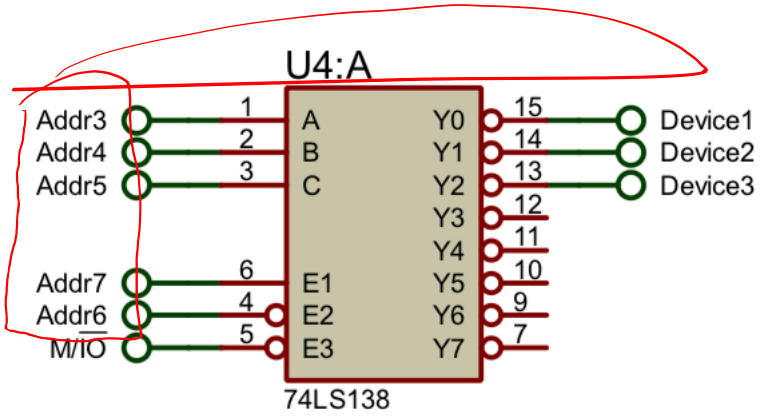
- Master the connection between 8086 and 8255
  - I/O Address decoding
- Master the control word of 8255
- Use the 8255 in mode 0
  - As the input to read from 8 switches
  - As the output to turn on/off 7-segment LEDs
- Master the memory address mapping
  - How to assign addresses to a memory chip
- Understand the concept of even/odd address, high/low byte of data bus, and even/odd banks


U1
8086
CLOCK_EXT=0
CLOCK=500K
DBG_MEM_LINEADDR=0x00000
DBG_MEM_SIZE=0x10000
LOAD_SEG=0x900
DBG_BIN_ENTRYPOINT=0x00000
500Khz
INIT=LOW
START=0
COUNT=-1
WIDTH=1e-06
The Clock generator is not needed, but we use it. as a timing reference on the graph.
U2
U3
U6
U7
U8
74LS373
74LS245
U10
U11
62256
RAM
U4:A
74LS138
8255 Chip I/O Port Address Decoder Circuit
U5
8255A
U4:B
U13
U14
SRAM Address Decoder Circuit
E1
C8255
MODDLL=DLA
To operate the Logic Analyser: Press the PLAY button and then click 'Capture'.
E3
3BUS
R1
R2
R3
R4
PULLUP
R5
10K
SW1
DIPSW_8
ADJT
1234
0111
1000
C8255 DIGITAL ANALYSIS
500Khz
ALE
M/IO
Addr/Data[0..15]
Addr[0..19]
Data[0..15]
RD
WR
DT/R
DEN
CE1
CE0
Device3
BBHE
PA[0..7]
PB[0..7]
FE
FD
FB
3F
06
5B
300u
400u
500u
600u
700u
800u

For the 8255

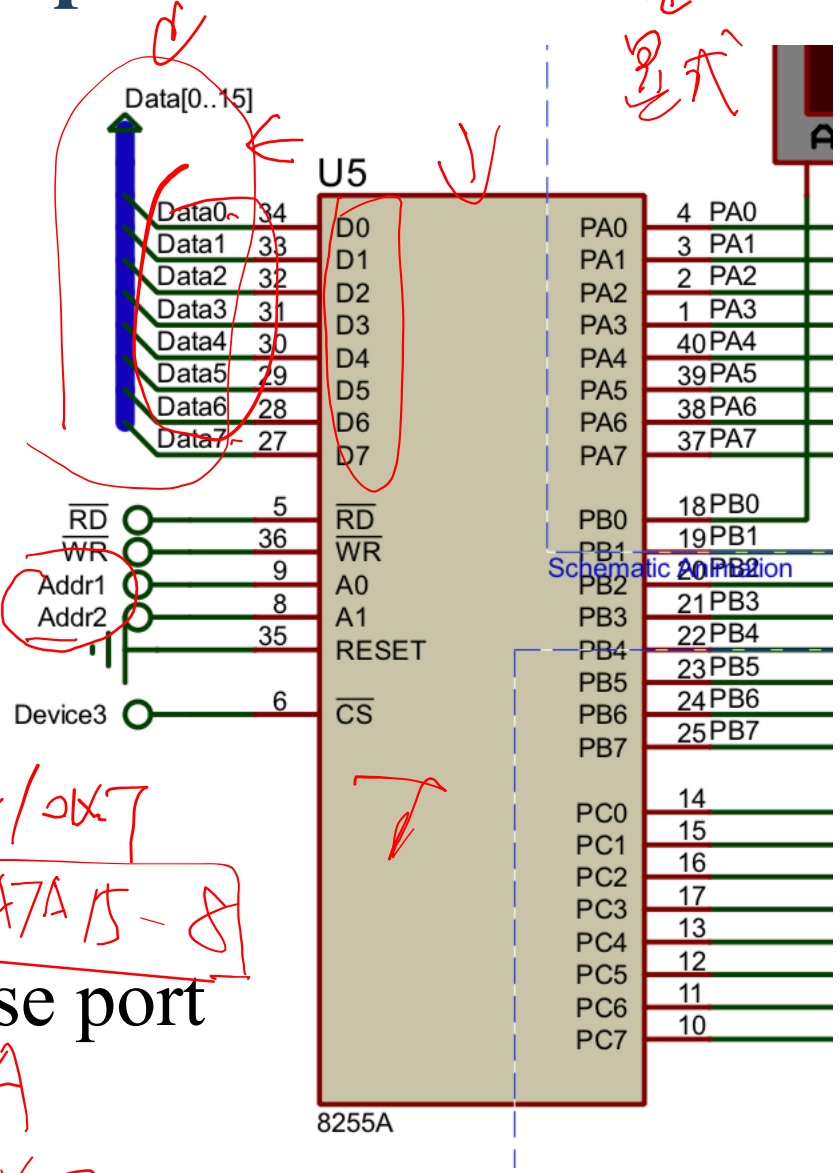
- Determine the port number according to the circuits
- Determine the control word given the requirement of each port (A/B/C) in 8255
  - As the input to read from 8 switches
  - As the output to turn on/off 7-segment LEDs

1) Determine the port number



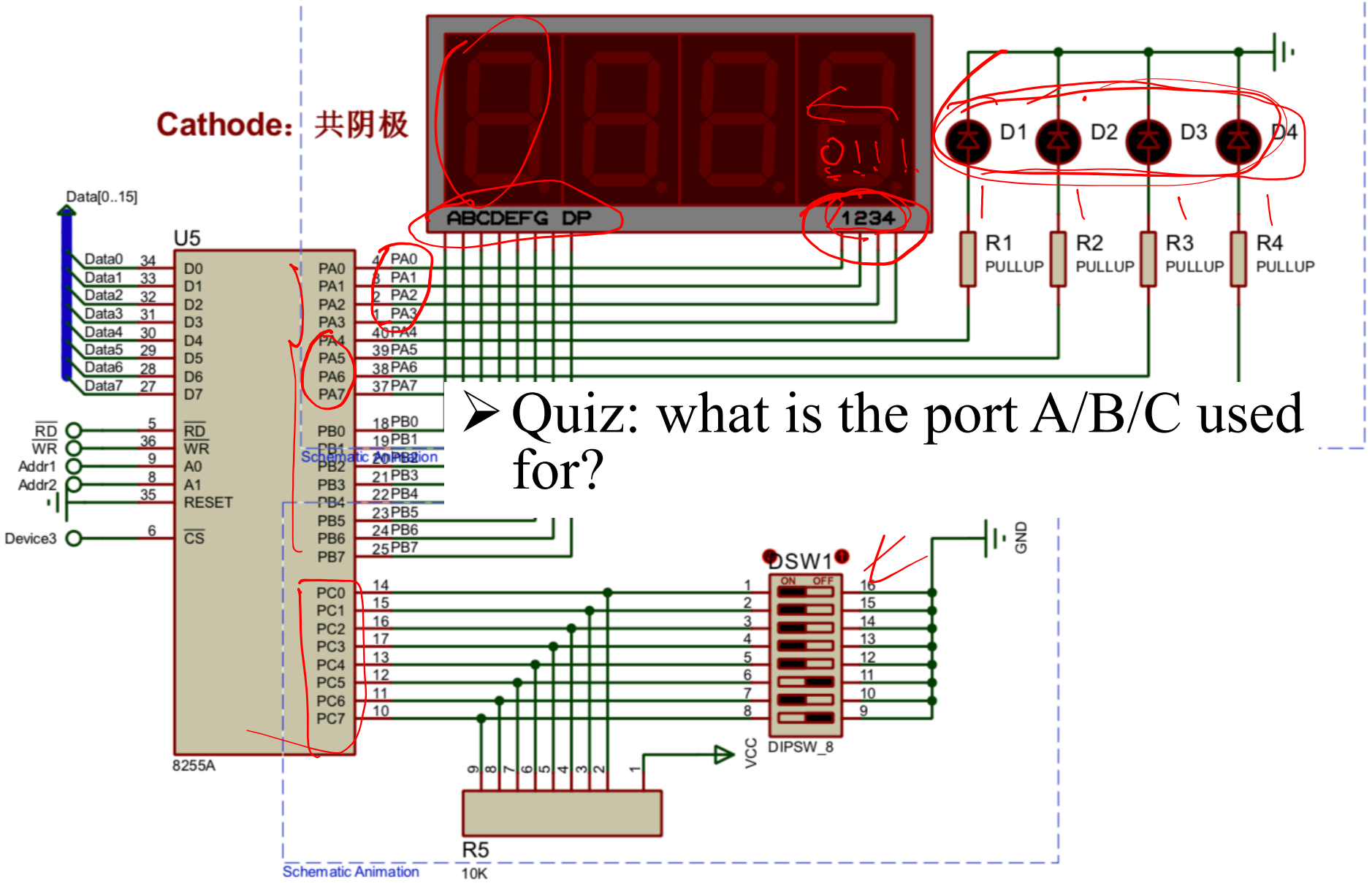
8255 Chip I/O Port Address Decoder Circuit

```
;-----------------------------------
;        符号定义
;-----------------------------------
;
; 8255芯片端口地址 (Port number) 分配:
PortA   EQU     90H
PortB   EQU     92H
PortC   EQU     94H
CtrlPT  EQU     96H
```



- Quiz: how to derive those port numbers?

2) Determine the control word



- Quiz: what is the port A/B/C used for?

2) Determine the control word

```
;
; Init 8255 in Mode 0
; PortA Output, PortB Output
;
                MOV AL,10000000B
                OUT CtrlPT,AL   ;
```

- Quiz: the example code configures A/B/C port as output; do we need to modify this?

How to drive the 7-segment LEDs

```
; SEGTAB是显示字符0-F，其中有部分数据的段码有错误，请自行修正
SEGTAB          DB 3FH  ; 7-Segment Tube, 共阴极类型的7段数码管示意图
                DB 06H  ;
                DB 5BH  ;            a a a
                DB 4FH  ;          f       b
                DB 66H  ;          f       b
                DB 6DH  ;          f       b
                DB 7DH  ;            g g g
                DB 07H  ;          e       c
                DB 7FH  ;          e       c
                DB 6FH  ;          e       c
                DB 77H  ;            d d d     h h h
                DB 7CH  ; ---------------------------------
                DB 39H  ;       b7 b6 b5 b4 b3 b2 b1 b0
                DB 5EH  ;       DP  g  f  e  d  c  b  a
                DB 79H  ;
                DB 7EH  ;
```

- Quiz: what's the purpose of the above table? Is there any mistakes in it?

How to drive the 7-segment LEDs

```
;-------------------------------
;        定义数据段
;-------------------------------
                .data

DelayShort      dw      4000
DelayLong       dw      40000
```

```
;-----------------------------------
;
; Delay system running for a while
;
;-----------------------------------

DELAY   PROC
        PUSH CX
        MOV CX,DelayShort
D1:     LOOP D1
        POP CX
        RET
DELAY   ENDP
```

```
; 把数字1、2、3、4显示在数码管上
;
L1:
                MOV AL,  0FEh
                OUT PortA,AL
                MOV AL,SEGTAB
                OUT PortB,AL
                CALL DELAY          ; ？？？  此处为何需要调研DELAY子程序?

                MOV AL, 0FDh
                OUT PortA,AL
                MOV AL,SEGTAB + 1
                OUT PortB,AL
                CALL DELAY          ; ？？？Delay程序的延时对演示时的什么方面会产生影响?

                MOV AL, 0FBh
                OUT PortA,AL
                MOV AL,SEGTAB + 2
                OUT PortB,AL
                CALL DELAY

                MOV AL, 0F7h
                OUT PortA,AL
                MOV AL,SEGTAB + 3
                OUT PortB,AL
                CALL DELAY

                JMP L1
```

- Quiz1: what would happen if we comment the "CALL DELAY" instruction in the code?
- Quiz2: what would happen if we change the value of DelayShort variable?

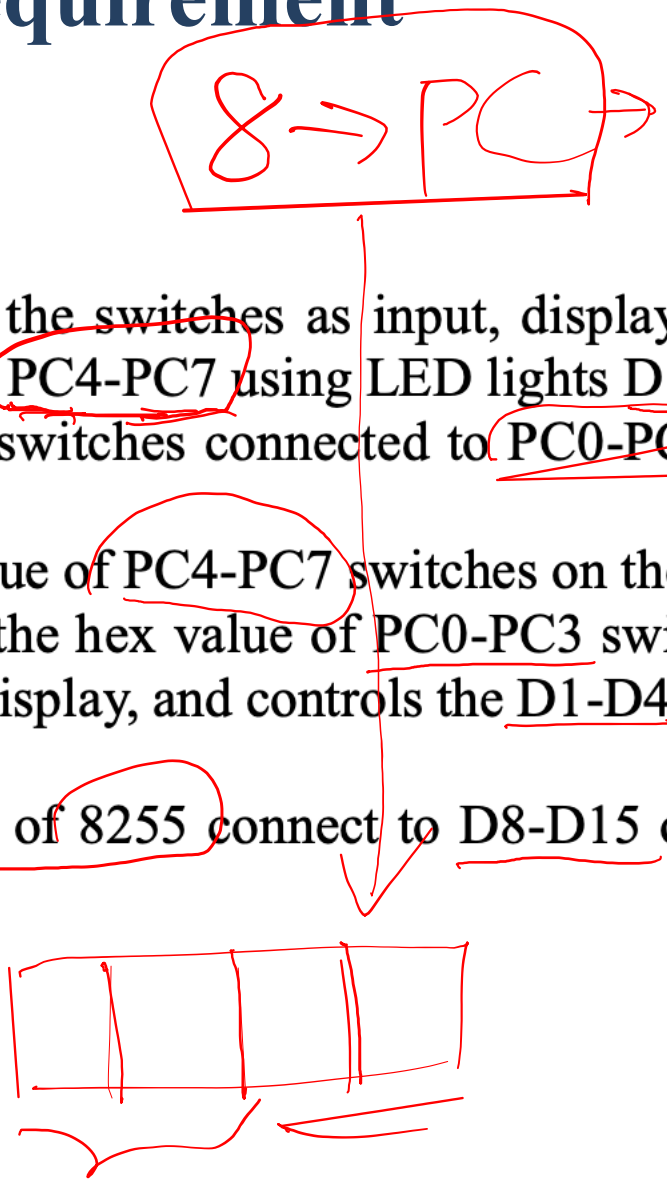
Programming Requirement

- 1) 8255 part

c) Modify the demo program so that it takes the switches as input, displays the binary status of those switches connected to PC4-PC7 using LED lights D1-D4, and displays the hex value of the rest four switches connected to PC0-PC3 on the first digit of the LED display;

d) Write a program so that it shows the hex value of PC4-PC7 switches on the first and third digits of the LED display, shows the hex value of PC0-PC3 switches on the second and fourth digits of the LED display, and controls the D1-D4 LED lights with PC4-PC7 switches.

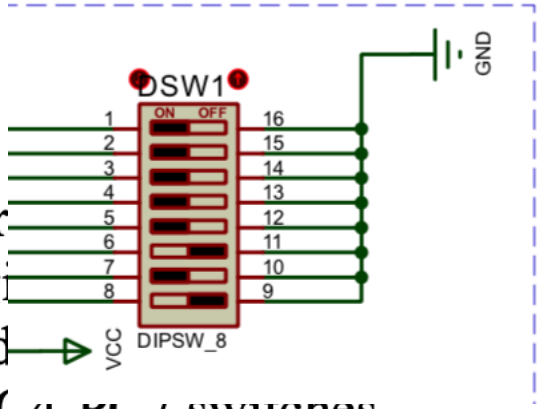
e)* Modify the schematic so that the data pins of 8255 connect to D8-D15 of the system bus, and repeat requirements b)-d).



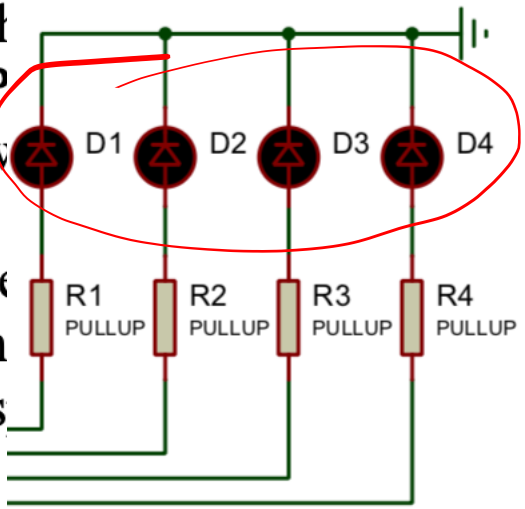
Programming Requirement

- 1) 8255 part

c) Modify the demo program so that it takes th ...splays the binary status ...ted to P...nts D1-D4, and displays ... four sw...C0-PC3 on the first digit...



d) Write a progr...ex value...on the first and third dig...hows th...3 switches on the second...LED dis...1-D4 LED lights with PC4-PC7 switches.



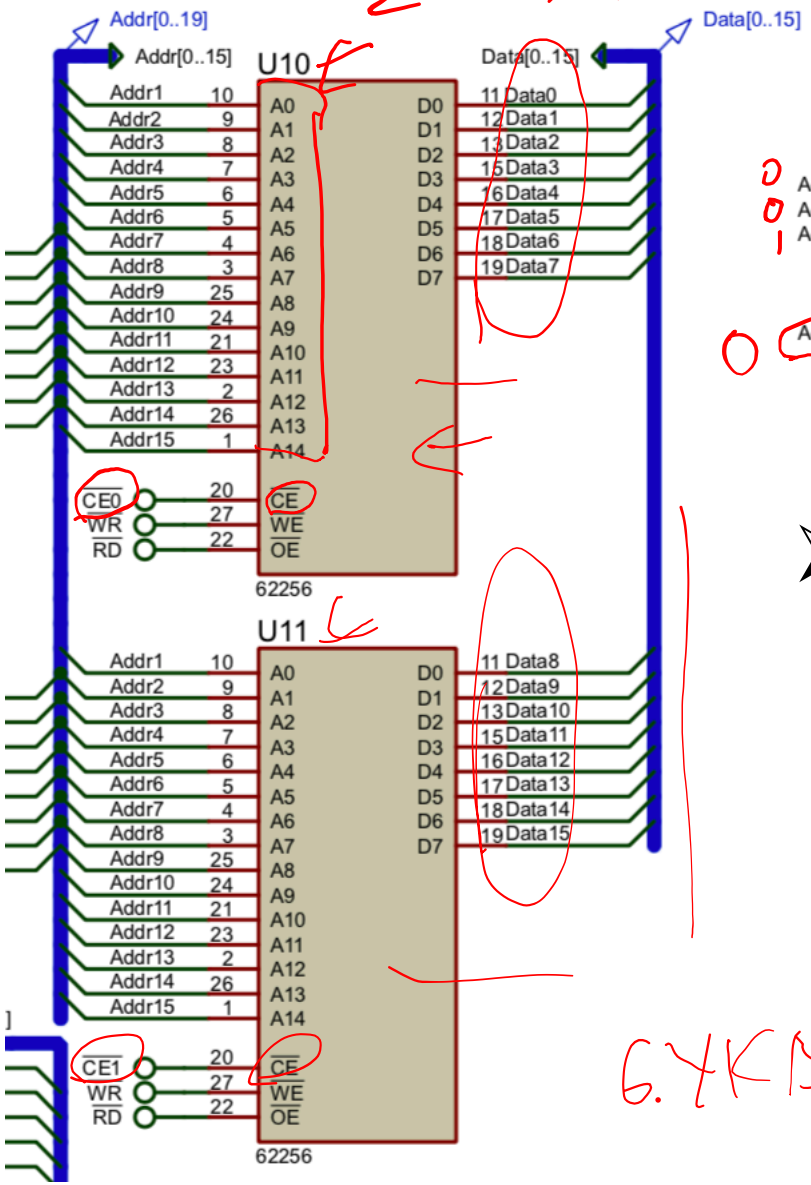
e)* Modify the schematic so that the data pins of 8255 connect to D8-D15 of the system bus, and repeat requirements b)-d).

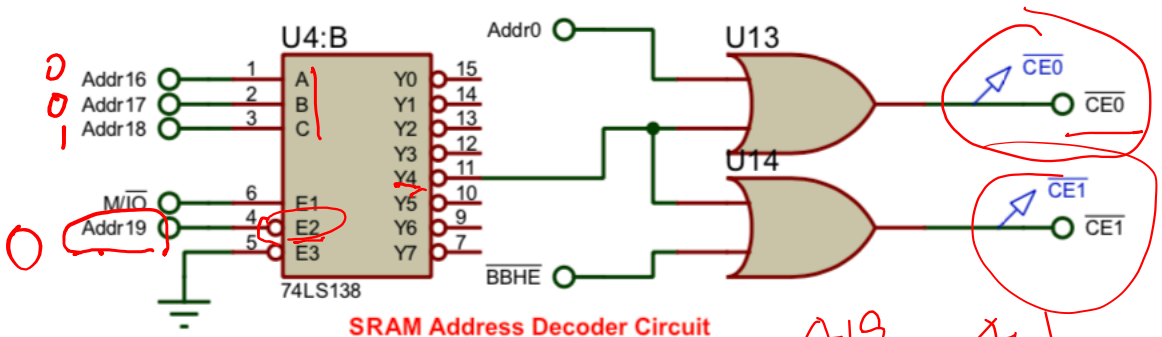
- Read the switch status
- Turn on/off 7 segment LEDs correspondingly
- Turn on/off the four colorful LEDs

Programming Requirement

- 2) memory module part
  - How to determine the memory range for each chip
  - How to decide even/odd banks
  - How to write to the given address range

Memory Module Design

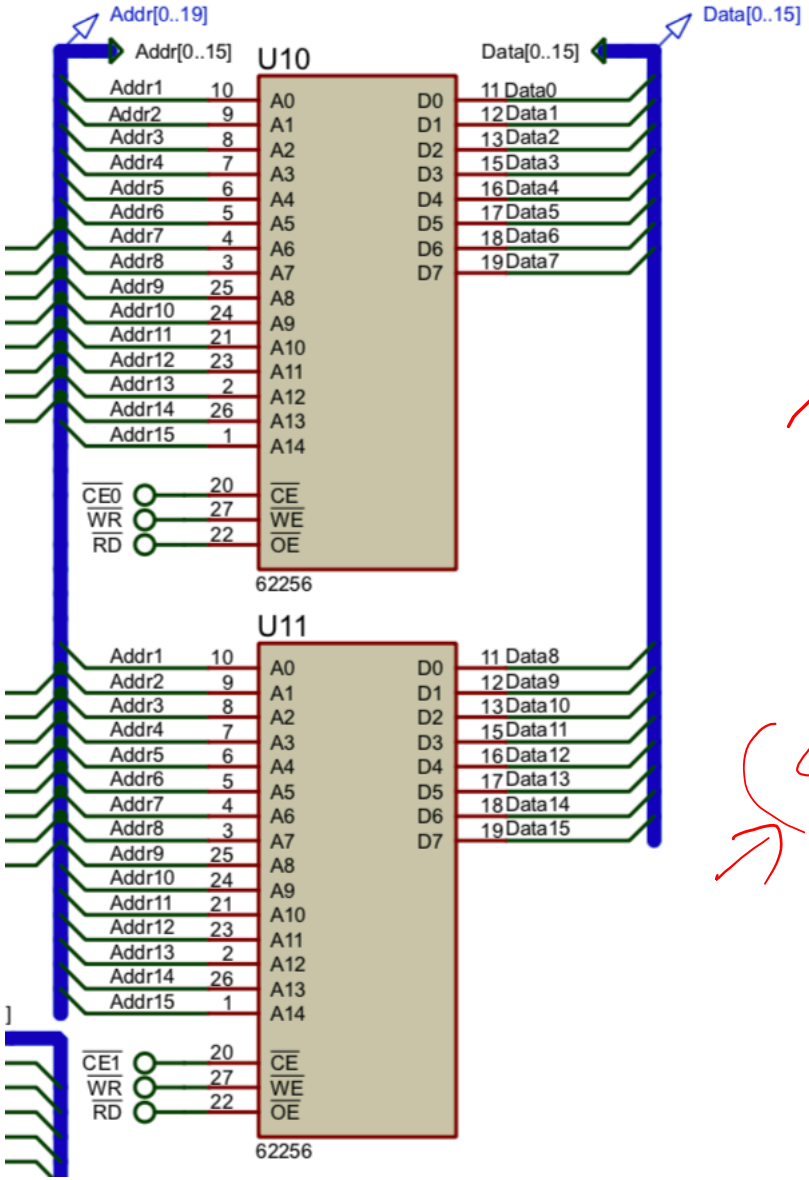




SRAM Address Decoder Circuit

- Quiz: how to decide the memory address range of U10 and U11? How to decide the segment address for data segment?

```
MOV AX,4000H
MOV DS,AX
MOV BX,0H
```



Quiz:

What is the address in the U10?

【the even or odd address in xxxxH-xxxxH (64KB)】

(40001H + 64KB)

What about U11?

The Error in the Example Code

- MOV BYTE PTR [BX],0FFH
- MOV [BX],0FFH

- Quiz: if we want to write a byte to the address, which instruction is correct and why?
  - How does the assembler know the size of memory access?

Programming Requirement

b) Compile and run the memory_extension_demo.asm program. You should be able to observe the content of those two 62256 chips (i.e., U10 and U11 in the diagram). Specifically, after running the demo program for a while, pause the execution of the program and check the memory content by select the "Debug" menu and select "Memory Contents –U10" and "Memory Contents –U11". Now you are asked to write a program which uses byte-memory operation to write odd numbers (e.g., 1, 3, 5 …) into odd address bytes and even numbers (e.g., 0, 2, 4 …) into even address bytes. Check with your results using above method;

c) Modify the original schematic so that the address range of U10 an U11 starts from 80000h and repeat the above requirement b).

d)* Write a program to use word-memory operation to fill those memory chips with value 66BBh.

- Simple loop that we have done before!