ics 期中试卷讲解

A1

题目：Add the two hexadecimal 2’s complement integers below:

$$\begin{array}{r} \texttt{x9A6} \\ +\quad \texttt{x675E} \\ \hline \end{array}$$

A1的主要问题在于题干中的补码(complement integers)很多同学没有注意到，实际计算的时候 `x9A6` 需要被符号扩展为 `xF9A6` ，然后做补码运算，舍弃溢出的进位。

A2

题目：What is the positive range represented by the IEEE single-precision floating point representation(normalization,exponent cannot be all 1 or all 0)?

对于IEEE 754规范，其中规格化表示的情况下，指数部分不全为0或1，但是底数能够全为0，此时能表示的最小正数为

`0 00000001 00000000000000000000000`

而最大的则为

`0 11111110 11111111111111111111111`

转换为十进制为

$$[2^{-126},2^{127}\times(2-2^{-23})]\approx[2^{-126},2^{-128}]$$

题目：use it to represent 42.375

第二题中42.375可以通过如下方式转换为IEEE 754格式

首先将其转化为规格化浮点数

$$42.375=0\text{b}101010.011=0\text{b}1.01010011\times2^5$$

此时符号为0，阶码为$5=0\text{b}00000101$转换为移码后为$5+127=0\text{b}10000100$

组合可得$0\ 10000100\ 01010011$

A3

题目：I need a memory contains a total of 8G Bytes.If the size of instruction or the data stored in the memory is 16-bit, what's the address space and the addressability of the memory.

$$8\text{GBytes} = 2^{36}$$

$$\text{Address Space} = 8\text{GBytes}/16\text{bits} = 2^{32}$$

$$\text{Addressability} = 16\text{bits}$$

A4

题目：Is the pair of functions f_1, f_2 together logically complete? Prove that your answer is correct.

A	B	f_1	f_2
0	0	1	0
0	1	0	1
1	0	1	0
1	1	0	0

本题根据真值表可以推断出如下的信息

$$f_1(A, B) = \text{not } B \ (1)$$

$$f_2(A, B) = (\text{not } A) \text{ and } B \ (2)$$

根据式(1)可以得到not

根据式(2)和not可以得到

$$\text{and}(A, B) = (\text{not } (\text{not } A)) \text{ and } B = f_2(f_1(x, A), B)$$

其中x可以为任意值

由于已经有not和and

易得$\text{or}(A, B) = \text{not}(\text{not } (A) \text{ and } (\text{not } B)) = f_1(f_2(A, f_1(y, B)))$

此处的y同样为任意值

在本题中，由于各位同学已知NAND是逻辑完备的，故证明组合得到NAND同样能够得分，**但是选择证明基础的三个逻辑运算符则需要全部推出才能拿满所有分数。**

A5

题目：Consider the following LC-3 instruction (x4000 is the address where the instruction is located):

```
LDI R5,x100
```

We know the values of the following addresses

addresses	X2786	X2787	X2788	X3f00	X3f01	X3f02	X4100	X4101	X4102
value	X4100	X4101	X4102	X2786	X2787	X2788	X3f00	X3f01	X3f02

What is the value of R5 after running this instruction?

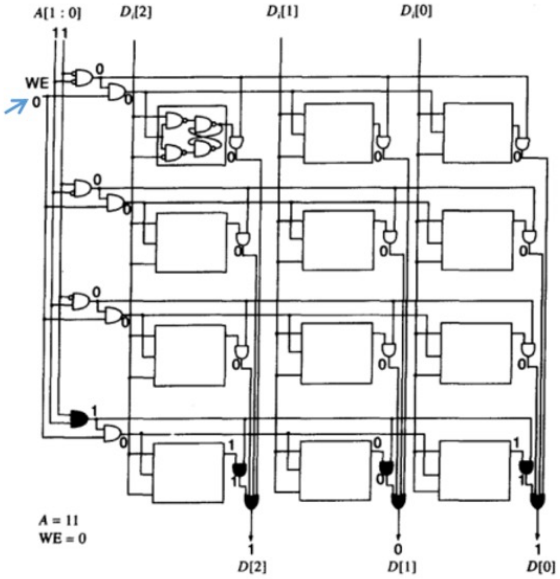
LDI的计算方式为增量PC+偏移量，且偏移量需要进行符号扩展。

本题中的偏移量为$\mathrm{x100}$，符号扩展为$\mathrm{xFF00}$，与增量PC做补码加法得到$\mathrm{x3F01}$。

根据LDI的寻址模式，R5 = mem[[x3F01]] = mem[x2787] = x4101

A6

题目：The following diagram is a gate circuit diagram of 22-3-bit memory. Memory access requires decoding the address, which means the decoder decodes input A [1:0] into 4 output lines. As shown in the figure, each word line in memory contains 3 bits (i.e. 1 word), which is the origin of the term "word line". When reading memory, as long as the address value A [1:0] is set, the corresponding word line is selected for output. Each bit in memory is ANDed with its corresponding word line, and ORed with the same bit on other word lines. Since only one word line is selected at any one time, this is actually a bit selection multiplexer switch. Three such bit level multiplexers are connected together to form a word selector switch, which reads one word at a time.



We already know the values of some memory locations

i\Di[j]	Di[2]	Di[1]	Di[0]
0	1	0	1
1	0	1	y
2	0	x	0
3	1	1	0

1. Given that setting A [0] to 1 and A [1] to 0 results in D1 being added to D2 obtained by setting A [1] to 1 and A [0] to 0, the resulting value is equal to D3 obtained by setting A [0] to 0 and A [1] to 0. x = ?, y = ?
2. What would be the impact if the value where the arrow points becomes 1?

本题第一题为一个推理题

A[1:0]=01时选择第二行

A[1:0]=10时选择第三行

同理D3为第一行

且根据题目，D3 = D1 + D2，即有101 = 01y + 0x0

解得x = 1, y = 1

第二题设置WE就是**设置写使能**，提到能够修改内存位置的答案都会给分。