221900180 周子铭 数字作业五

1.

	C	P	R
	0	0000	1011
+		0110	
	0	0110	1011
→	0	0011	0101
→	~~0~~	~~0001~~	~~1010~~
+		0110	
	0	1001	0101
→	0	0100	1010
→	0	0010	0101
+		0110	
	0	1000	0101
→	0	0100	0010

∴[X×Y]原 = −0.01000010.

2. [Y]补 = 0.1011，[−Y]补 = 1.0101，[X]补 = 1.0111.

	P	Xn	X-1
	00000	10111	0
+	10101		
	10101	10111	0
→	01010	11011	1
→	00101	01101	1
→	00010	10110	1
+	01011		
	01101	10110	1
→	00110	11011	0
+	10101		
	11011	11011	0
→	01101	11101	1

∴[X×Y]补 = 1.10111101

3.

	R	Q
	010100	00000□
+	101111	000001
	000011	000001
	000110	00001□
+	101111	
	110101	000010
	101010	00010□
+	010001	
	111011	000100
	110110	00100□
+	010001	
	000111	001001
	001110	01001□
+	101111	
	111101	010010
	111010	10010□
+	010001	
	001011	100101

商符号位为1，
数值为1.00101.

4.

```
  01001      ~~01000~~
+ 10011      00000□
-----------------
  11100      00000
← 11000      0000□
+ 01101
-----------------
  00101      00001
← 01010      0001□
+ 10011
-----------------
  11101      00010
← 11010      0010□
+ 01101
-----------------
  00111      00101
← 01110      0101□
+ 10011
-----------------
  00001      01011
```

~~[X补] = 10100~~
~~[X补] = 01010~~
[Y补] = 01101
[-Y补] = 10011

∴ [X/Y]原商 = 1.1011，（1 为符号）

余数为 1.0001 × 2^{-4}.（1 为符号位）

5. ~~X = 1.1010，Y = 0.1101.~~
[X]补 = 0.0110 ~~[Y]补 [Y]原 = 0.00~~ 0.1101，~~[-Y补]~~ 补 = ~~1.0011~~.
被除 正.

```
  ~~00110    00000~~
~~+ 01101~~
~~-----------------~~
  ~~10011    00000~~
~~← 00110    00000~~
~~+ 01101~~
~~-----------------~~
  ~~10011~~
  ~~00000~~
```

5. $X = 1.1010$，$[X]_补 = 1.0110$，$[Y]_补 = 0.1101$，$[-Y]_补 = 1.0011$.

```
  11010    11111
+ 01101
-----------------
  00111    11111
← 01111    11111
+ 10011
-----------------
  00010    1111
← 00101    11111
+ 10011
-----------------
  11000    11111
← 10000    11110
+ 01101
-----------------
← 11101    11100

  11101    11100
+ 01101
-----------------
  01010    11100
← 10101    11001
+ 10011
-----------------
  01000    11001
+ 10011       +1
-----------------
  11011    11010
```

∴ $[X/Y]_补 = 1.1010$，余 1.1011.

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6. $[X]_{补} = x_0.x_1x_2\cdots x_n$

① 若 $x_0=0$，则 $[X]_{补}=[X]_{原}=-x_0+\sum_{i=1}^{n} x_i 2^{-i}$.

② 若 $x_0=1$，$X_{原}=-0.\overline{(x_1x_2\cdots x_n-1)} = -\left(\sum_{i=1}^{n}(1-x_i)2^{-i}+2^{-n}\right)$

$= \sum_{i=1}^{n}(x_i-1)2^{-i}-2^{-n} = -1+\sum_{i=1}^{n}x_i 2^{-i} = -x_0+\sum_{i=1}^{n}x_i 2^{-i}$.

综上：$[X]_{补} = -x_0+\sum_{i=1}^{n}x_i 2^{-i}$. Q.E.D.

~~7 由6: $\left[\frac{X}{2}\right]_{补} = -\frac{x_0}{2}+\sum_{i=1}^{n}x_i 2^{-i-1}$~~

~~$=-x_0$~~

7. $\left[\frac{X}{2}\right]_{补} = \frac{x_0}{-2}+\sum_{i=1}^{n}x_i 2^{-i-1}$

$=-x_0+x_0 2^{-1}+\sum_{i=1}^{n}x_i 2^{-i-1}$

$=-x_0+\sum_{i=0}^{n}x_i 2^{-i-1}$

$=x_0.x_0x_1x_2\cdots x_n$.

~~6. $[X]_{补}=x_0.x_1x_2x_3\cdots x_n$ 若，$\therefore [X]_{补}$的真值 $=x_0.\overline{x_1x_2\cdots x_n}+0.00\cdots1$~~

~~$=1.11\cdots1-0.$~~

~~$\therefore [X]_{补}$的真值 $=x_0.\overline{x_1x_2x_3\cdots x_n}+0.00\cdots1=1.0000\cdots0-0.11111+x_0.\overline{x_1x_2\cdots x_n}$~~

~~$=-x_0+\sum_{i=1}^{n}x_i 2^{-i}$.~~

7. $[X]_{补}=x_0.x_1x_2\cdots x_n$，$\left[\frac{X}{2}\right]_{补}=?$

~~$X=\overline{x_0.x_1x_2\cdots x_n}+0.00\cdots1=\overline{x_0}.\overline{x_1}\overline{x_2}\overline{x_3}\cdots x_n+0.0000\cdots x_n$~~

~~$\frac{X}{2}=\overline{x_0}\,0.\overline{x_0}\overline{x_1}\overline{x_2}\cdots\overline{x_{n-1}}x_n+0.0000\cdots0x_n$~~

~~$\left[\frac{X}{2}\right]_{补}=1.x_0x_1x_2\cdots x_{n-1}x_n=$~~

8. ~~不对~~ 对. 用原变量设计好的加法器，若将所有的输入变量和输出变量均变反，则加法器就能适用于反变量的运算. 该加法器把逻辑输入信号都取反相所产生的功能仍在集合内. $S_i=A_i\oplus B_i\oplus C_i$，$C_{i+1}=A_iB_i+B_iC_i+A_iC_i$.

$\overline{S_i}=\overline{A_i\oplus B_i\oplus C_i}=A_i\oplus\overline{B_i\oplus C_i}=A_i\oplus B_i\oplus\overline{C_i}=\overline{A_i}\oplus\overline{B_i}\oplus\overline{C_i}$.

~~且~~ $\overline{C_{i+1}}=\overline{A_iB_i+B_iC_i+C_iA_i}=\overline{A_iB_i}\cdot\overline{B_iC_i}\cdot\overline{C_iA_i}=(\overline{A_i}+\overline{B_i})(\overline{B_i}+\overline{C_i})(\overline{A_i}+\overline{C_i})$

$=\overline{A_i}\overline{B_i}+\overline{B_i}\overline{C_i}+\overline{C_i}\overline{A_i}$. Q.E.D.

9. (1) $C_1=G_1+P_1C_0$, $G_1=A_1B_1$, $P_1=A_1\oplus B_1$.

$C_2=G_2+P_2C_1$, $G_2=A_2B_2$, $P_2=A_2\oplus B_2$.

$C_3=G_3+P_3C_2$, $G_3=A_3B_3$, $P_3=A_3\oplus B_3$.

$C_4=G_4+P_4C_3$, $G_4=A_4B_4$, $P_4=A_4\oplus B_4$.

(2) $C_1=G_1+P_1C_0$, ~~G₁~~ ~~G₁、P₁同(1).~~

$C_2=G_2+P_2G_1+P_2P_1C_0$,

$C_3=G_3+P_3G_2+P_3P_2G_1+P_3P_2P_1C_0$,

$C_4=G_4+P_4G_3+P_4P_3G_2+P_4P_3P_2G_1+P_4P_3P_2P_1C_0$.

其中：$G_1\sim G_4$, $P_1\sim P_4$ 表达式同(1).

10. (1) $a_1=1$, $a_2\sim a_6$ 不全为0.

(2) ① a_1或a_2有为1的；② $a_1=a_2=0$, $a_3=1$.

(3) $a_1=0$:
- $a_2=0$:
  - $a_3=1$或$a_4=1$或$a_3=a_4=1$
  - $a_3=a_4=0$, $a_5=a_6=1$
- $a_2=1$, $a_3=a_4=a_5=a_6=0$.

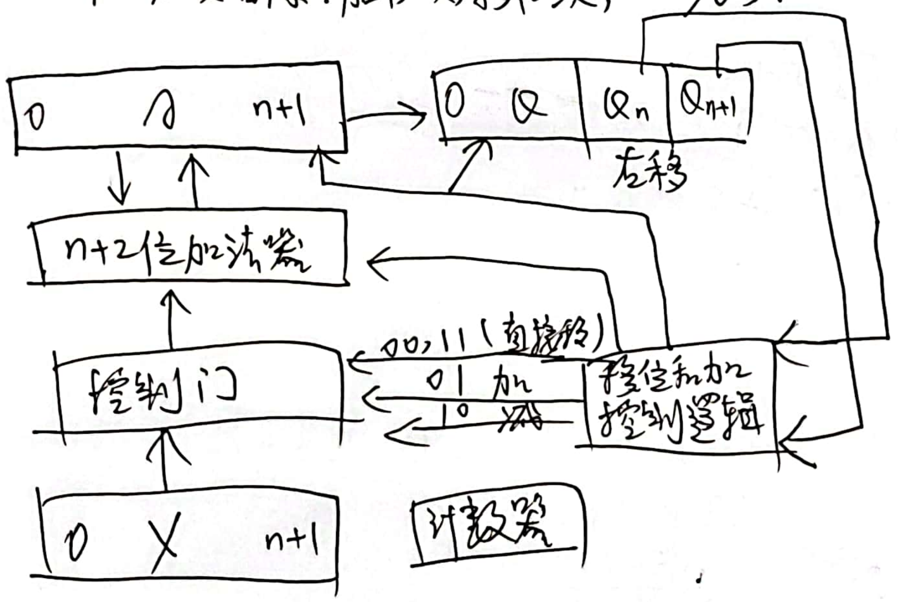
11. ①原码一位乘：加15次，移15次，15×2=30μs. 16位(1位符号位) 移位1μs，加法1μs.

②补码一位乘：加16次，移15次，16×1+15=31μs.

③原码加减交替除：(试商)2+1+15+15=33μs.

④补码加减交替除：加15次，移15次，30μs.

12.



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~~3. Carry = a1·b0 + b1·a0 + a1·b1.~~

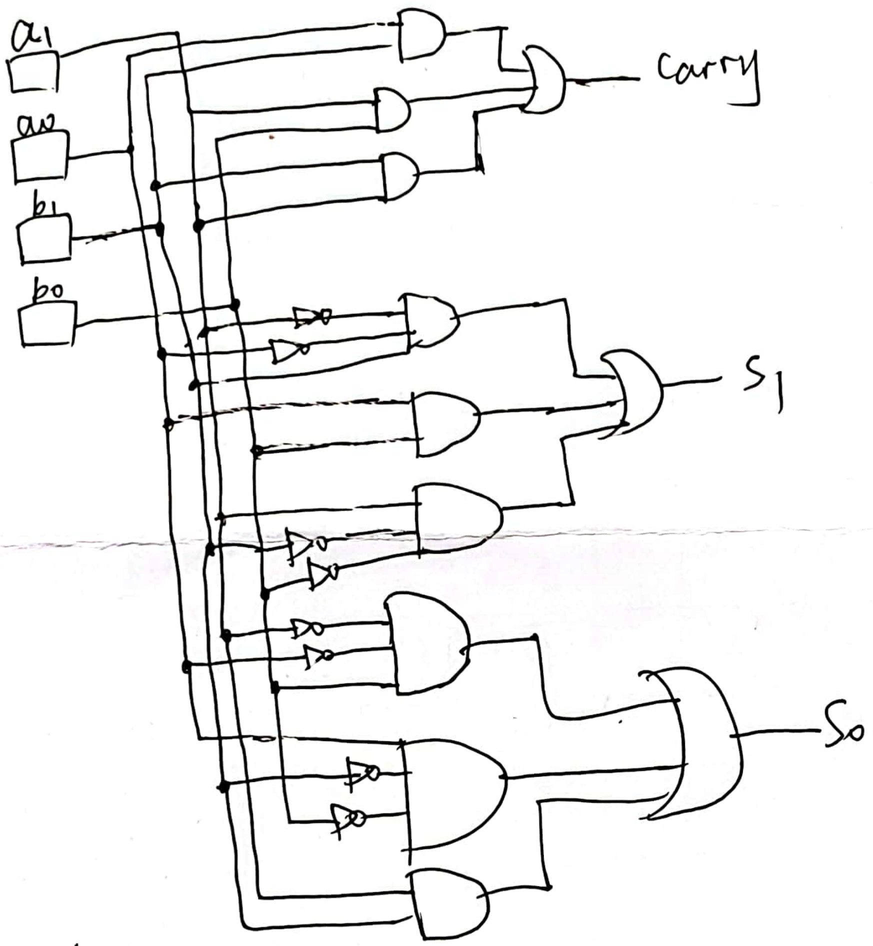
$\cancel{S_0 = \overline{a_1}\,\overline{a_0}\,\overline{b_1}\,b_0 + \overline{a_1}\,a_0\,\overline{b_1}\,\overline{b_0} + a_1\,\overline{a_0}\,b_1\,\overline{b_0}}$

$\cancel{S_0\ \overline{a_1}\,\overline{a_0}\,b_0 + a_0\,\overline{b_1}\,\overline{b_0} +}$

13. $Carry = a_0 \cdot b_1 + a_1 \cdot b_0 + a_1 \cdot b_1$.

$S_1 = \overline{a_1} \cdot \overline{a_0} \cdot b_1 + a_0 \cdot b_0 + a_1\,\overline{b_1} \cdot \overline{b_0}$.

$S_0 = \overline{a_1}\,\overline{a_0} \cdot b_0 + a_0 \cdot \overline{b_1} \cdot \overline{b_0} + a_1 \cdot b_1$.



14. ~~将[illegible]~~

14.

A		B		Cin	Carry	Sum	
a_1	a_0	b_1	b_0			s_1	s_0
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1
0	0	1	0	0	0	1	0
0	1	0	0	0	0	0	1
0	1	0	1	0	0	1	0
0	1	1	0	0	1	0	0
1	0	0	0	0	0	1	0
1	0	0	1	0	1	0	0
1	0	1	0	0	1	0	1
0	0	0	0	1	0	0	1
0	0	0	1	1	0	1	0
0	0	1	0	1	1	0	0
0	1	0	0	1	0	1	0
0	1	0	1	1	1	0	0
0	1	1	0	1	1	0	1
1	0	0	0	1	1	0	0
1	0	0	1	1	1	0	1
1	0	1	0	1	1	1	0

$Carry = b_1\cdot cin + a_0\cdot b_0\cdot cin + a_0\cdot b_1 + a_1\cdot cin + a_1\cdot b_0 + a_1\cdot b_1$

$s_1 = \overline{a_1}\cdot\overline{a_0}\cdot b_0\cdot cin + \overline{a_1}\cdot\overline{a_0}\cdot b_1\cdot\overline{cin} + a_0\cdot\overline{b_1}\cdot\overline{b_0}\cdot cin + a_0\cdot b_0\cdot\overline{cin} + a_1\cdot\overline{b_1}\cdot\overline{b_0}\cdot\overline{cin} + a_1\cdot b_1\cdot cin$

$s_0 = \overline{a_1}\cdot\overline{a_0}\cdot\overline{b_1}\cdot\overline{b_0}\cdot cin + \overline{a_1}\cdot\overline{a_0}\cdot b_0\cdot\overline{cin} + a_0\cdot\overline{b_1}\cdot\overline{b_0}\cdot\overline{cin} + a_0\cdot b_1\cdot cin + a_1\cdot b_0\cdot cin + a_1\cdot b_1\cdot\overline{cin}$

电路图见下(logisim)(方法一)

方法二) 利用13中HA

$Carry = Carry + s_1 cin$

$s_1' = cin\, s_0 + cin' s_1$

$s_0' = s_0 \oplus Cin$