Course Work 1:

1.Convert 203_{10} into binary, octal and hexadecimal

- binary:$203_{10} = 11001011_2$

	Quotient	Remainder
203 ÷ 2	101	1
101 ÷ 2	50	1
50 ÷ 2	25	0
25 ÷ 2	12	1
12 ÷ 2	6	0
6 ÷ 2	3	0
3 ÷ 2	1	1
1 ÷ 2	0	1

- octal:$203_{10} = 313_8$

	Quotient	Remainder
203 ÷ 8	25	3
25 ÷ 8	3	1
3÷ 8	0	3

- hexadecimal:$203_{10} = BA_{16}$

	Quotient	Remainder
203 ÷ 16	12	11
12 ÷ 16	0	12

2.Convert FAB_{16} into binary, octal and decimal

- binary:$FAB_{16} = 1111, 1010, 1011_2 \begin{cases} F_{16} = 1111_2 \\ A_{16} = 1010_2 \\ B_{16} = 1011_2 \end{cases}$
- octal: $FAB_{16} = 1111, 1010, 1011_2 = 111, 110, 101, 011_2 = 7653_8 \begin{cases} 111_2 = 7_8 \\ 110_2 = 6_8 \\ 101_2 = 5_8 \\ 011_8 = 3_8 \end{cases}$
- decimal: $FAB_{16} = 16^2 * 15(F), +16 * 10(A) + 11(B) = 4011$

3.add the following 20-bit binary numbers

1st number 1111 0000 1111 0000 1010;

2nd number 1010 1010 1011 1111 0101

- $1111, 0000, 1111, 0000, 1010 + 1010, 1010, 1011, 1111, 0101 = 1, 1001, 1011, 1011, 0011, 10$

4.subtract the two binary numbers in 3.

- $1111, 0000, 1111, 0000, 1010 - 1010, 1010, 1011, 1111, 0101 = 01, =^{overflow} \Rightarrow 1001, 1011, 1$

5.What is the square of 10101_2 in base 2?

$10101_2 * 10101_2 = 10000_2 * 10101_2 + 100_2 * 10101_2 + 1_2 * 10101_2 = 110111001$

$$
\begin{array}{ccccccccc}
 & & & & 1 & 0 & 1 & 0 & 1_2 \\
\times & & & & 1 & 0 & 1 & 0 & 1_2 \\
\hline
1 & 0 & 1 & 0 & 1 & & & & \\
 & 0 & 0 & 0 & 0 & 0 & & & \\
 & & 1 & 0 & 1 & 0 & 1 & & \\
 & & & 0 & 0 & 0 & 0 & 0 & \\
 & & & & 1 & 0 & 1 & 0 & 1 \\
\hline
 & & & & & & & & \\
1 & 1 & 0 & 1 & 1 & 1 & 0 & 0 & 1
\end{array}
$$

6.What is 12_5 in base 1(Unary)

Unary numbers consists only of 1

so it is $\underbrace{1111111}_{7\ 1\mathrm{s}}$

7.how many natural numbers can be represented by

8bits

a bit is 8 bytes so that is $2^{8*8} = 2^{64}$

12bits

$2^{8*12} = 2^{96}$

16bits

$2^{8*16} = 2^{128}$

8.For an 8bit group, work out the representation for -42_{10} in

sign & magnitude

for this method -0 is 1000 0000, $42_{10} = 101010_2$, therefore, $-42_{10} = 0 - 42_{10} = 1000\ 0000_2 - 0010\ 1010_2 = 0110\ 1010_2$

one's complement

for this method -0 is 1111 1111, $42_{10} = 101010_2$, therefore, $-42_{10} = 0 - 42_{10} = 1111\ 1111_2 - 0010\ 1010_2 = 1101\ 0101_2$

the least value represented in the method is -127,$-42 - (-127) = 85_{10} = 1010101$, so $-42_{10} = 11010101_2$

two's complement

for this method -1 is 1111 1111, $42_{10} = 101010_2$, therefore, $-42_{10} = -1 - 41_{10} = 1111\ 1111_2 - 0010\ 1001_2 = 1101\ 0110_2$

the least value represented in the method is -127,$-42-(-127)=85_{10}=1010101$, so $-42_{10}=1101\ 0110_2$

excess-256

In excess 256, because $2^8 \ =256$,so the largest number in excess-256 is 0, therefore $-42_2=0-42_2=1111\ 1111-101010_2=1101\ 0101$

excess-128

In excess 128, becuase $128=256/2$, so $0=1000\ 0000_2$
$-42_2=0-42_2=1000\ 0000-101010_2=0101\ 0110_2$

9.For a 12-bit group, what range of integers can be represented using

sign & magnitude

This begins with +0 and increses monotonically, so the range is$[0,2^{12} \ -1]$ or $[0,4095]$

one's complement ¶

The first half increase monotonically from 0, and the second half increase monotonically to 0,so the range is $[-2^{11} \ +1,2^{11} \ -1]$, or $[-2047,2047]$

two's complement

The first half is the same plus one additional number, and the rest increse monotonically to -1,so the range is$[-2^{11} \ +1,2^1 1]$,or $[-2047,2048]$

excess-512

this one is the range of sign & magnitude - 512, which is $[-512,2^{12} \ -1-512]$, or $[-512,3583]$

10.Subtract the following 12bit two's complement numbers(2nd from 1st)

$$
\begin{array}{r}
1001,0011,1011 \\
-\quad 1001,1100,1101 \\
\hline
\end{array}
$$

$$
\begin{aligned}
1001,0011,1011-1001,1100,1101 &= 1001,0011,1011+(1,0000,0000,0000-1001,1100,11 \\
&= 1001,0011,1011+0110,0011,0011 \\
&= 1111,0110,1110
\end{aligned}
$$

11.Express 87654_{10} in binary coded decimal(BCD)

since the max digit of 87654 is $8 \in [2^3, 2^4]$, it is sufficient to use 4 digits for every number

then

$87654_{10}=1000,0111,0110,0101,0010_{BCD}$

12.Translate the following 6-character string E=mc^2 to8-bit ASCII codes

normally, the ascii code for each character is 69, 61, 109, 99, 94, 50,

binary:

$0100\ 0101; 0011\ 1101; 0110\ 1101; 0110\ 0011; 0101\ 1110; 0011\ 0010$

hex:

$0000\ 0045; 0000\ 003D; 0000\ 006D; 0000\ 0063; 0000\ 005E; 0000\ 0032$

In [ ]:

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