HW#4

Computer Science: Program Your Own RPG

Instructions: Complete as much as you can in one hour and then stop. (Do your best.) Try to do #1 and #2 on your own. For #3, work with others and try to understand the algorithm.

1. Computers run using 1's and 0's. In order to understand how computers manipulate numbers, characters, and colors, one must convert the 1's and 0's that computers use to the normal numbers that humans use. Below is a table that contains numbers in binary, hexadecimal, and decimal:

Decimal	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Binary	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
Hex.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

To convert from a binary number to a decimal number we multiply each bit (*1* or *0*) by *2ⁿ* where *n* is the position of the bit. For example:

0101 base 2 → $0\cdot 2^3 + 1\cdot 2^2 + 0\cdot 2^1 + 1\cdot 2^0 = 0 + 4 + 0 + 1 = 5$ base 10
1111 base 2 → $1\cdot 2^3 + 1\cdot 2^2 + 1\cdot 2^1 + 1\cdot 2^0 = 8 + 4 + 2 + 1 = 15$ base 10
101100 base 2 → $1\cdot 2^5 + 0\cdot 2^4 + 1\cdot 2^3 + 1\cdot 2^2 + 0\cdot 2^1 + 0\cdot 2^0 = 44$ base 10

Following the example above convert the following numbers from binary (base 2) to decimal (base 10):

0000 base 2 → $\underline{\quad}\cdot 2^3 + \underline{\quad}\cdot 2^2 + \underline{\quad}\cdot 2^1 + \underline{\quad}\cdot 2^0 = \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad} = \underline{\qquad}$ base 10
1100 base 2 → $\underline{\quad}\cdot 2^3 + \underline{\quad}\cdot 2^2 + \underline{\quad}\cdot 2^1 + \underline{\quad}\cdot 2^0 = \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad} = \underline{\qquad}$ base 10
1011 base 2 → $\underline{\quad}\cdot 2^3 + \underline{\quad}\cdot 2^2 + \underline{\quad}\cdot 2^1 + \underline{\quad}\cdot 2^0 = \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad} = \underline{\qquad}$ base 10

10110011 base 2 → $\underline{\quad}\cdot 2^7 + \underline{\quad}\cdot 2^6 + \underline{\quad}\cdot 2^5 + \underline{\quad}\cdot 2^4 + \underline{\quad}\cdot 2^3 + \underline{\quad}\cdot 2^2 + \underline{\quad}\cdot 2^1 + \underline{\quad}\cdot 2^0 =$
$\underline{\qquad\qquad}$ base 10

2. To convert from a binary number to a hexadecimal number, we group the bits into sets of 4, and then replace the bits with their symbol shown in the table above. For example:

0101 base 2 → 5 base 16
11100100 base 2 = 1110,0100 → E4 base 16
10111001011011101111 base 2 = 1011,1001,0110,1110,1111 → B96EF base 16

Following the example above convert the following numbers from binary (base 2) to hexadecimal (base 16):

1010 base 2 → $\underline{\qquad}$ base 16
00011100 base 2 = $\underline{\qquad}$,$\underline{\qquad}$ → $\underline{\qquad}$ base 16
01111101100111111011 base 2 = $\underline{\qquad}$,$\underline{\qquad}$,$\underline{\qquad}$,$\underline{\qquad}$ → $\underline{\qquad}$ base 16
11111010110111101101 base 2 = $\underline{\qquad}$,$\underline{\qquad}$,$\underline{\qquad}$,$\underline{\qquad}$,$\underline{\qquad}$ → $\underline{\qquad}$ base 16

3. Below is an algorithm to convert from a base 10 number (a normal number) to a base 2 number (a number made of 1's and 0's).

```
public static void convert(int n)
{
    int i;
    for(i = 1; i <= n; i*=2);                    //find the smallest power of 2

    System.out.print(n + " base 10 = ");
    while(n > 0 || i > 0)
    {
        if(n >= i)
        {
            n -= i;
            System.out.print("1");
        }
        else
        {
            System.out.print("0");
        }
        i /= 2;
    }
    System.out.println(" base 2(binary).");
}
```

Convert these numbers to Binary:

33 base 10 → ______________________ base 2

27 base 10 → ______________________ base 2

173 base 10 → ______________________ base 2

255 base 10 → ______________________ base 2

Explain how the algorithm works: