CS414: Recitation #4. Your Name:____

You are free to work together with other students, but you should turn in your own copy of your work. You can use a computer, but try to figure it out first.

1. To convert a number to binary (base 2), divide by 2 repeatedly, keeping track of the remainder each time.
   Example: what is 25 base 2?

   $25 \div 2 = 12$ remainder 1
   $12 \div 2 = 6$ remainder 0
   $6 \div 2 = 3$ remainder 0
   $3 \div 2 = 1$ remainder 1
   $1 \div 2 = 0$ remainder 1

   Reading the digits from bottom to top, we get $25_{10} = 11001_2$

   That's what this python function does:

```
def int_to_bits(num):
    bits = []
    while num > 0:
        bit = num % 10
        num = num / 10
    bits.reverse()
    return bits
```

   Convert these two numbers to binary:

   a) 12_{10} =

   b) 30_{10} =

2. To get the value of a binary number, multiply each bit by a power of 2, and add up.
   Example: what is 1101_2 ?

   $1101_2 = 1 * 2^3 + 1 * 2^2 + 0 * 2^1 + 1 * 2^0 = 8 + 4 + 0 + 1 = 13_{10}$

   What is the decimal value of these two binary numbers?

   a) 1011_2 =

   b) 11111_2 =

3. Consider a cellular automaton that uses this rule to get the next generation:

3 bits above	000	001	010	011	100	101	110	111
decimal number	0	1	2	3	4	5	6	7
new value	1	0	0	1	0	0	0	1

Start with the generation of the automaton shown below.

a) For the first row, treat the three bits above as a binary number, and get its decimal value

b) Write the second generation. I filled in the leftmost and rightmost entries with **1**.

c) Repeat for generations 3, 4, 5, and 6.

Gen. 1	0	1	1	0	1	0	0	0	1
decimal value	X								X
Gen. 2	1								1
Gen. 3	1								1
Gen. 4	1								1
Gen. 5	1								1
Gen. 6	1								1

4. What is printed by the following python code?

```
import copy
a = [10, 20, 30, 40, 50, 60]
b = a
c = copy.copy(a)
b[2] = 99
c[2] = 99

print a                    ______________________________


print b                    ______________________________


print c                    ______________________________
```