1)

What are the values of w, x, y, and z after the following code snippet? Input your answers as exactly 8 binary digits with no additional characters (so like 00001111 and not like 0b00001111 or 0x0F).

```
uint8_t a = 0b11110000;  // Assigns 11110000 to a
uint8_t b = 0b00111100;  // Assigns 00111100 to b
uint8_t w = a ^ b;
uint8_t x = a | b;
uint8_t y = a & b;
uint8_t z = (a << 2) | (b >> 2); // rotate circular shift
```

```
   1 1 1 1 0 0 0 0
⊕  0 0 1 1 1 1 0 0
w= 1 1 0 0 1 1 0 0
```

```
   1 1 1 1 0 0 0 0
&  0 0 1 1 1 1 0 0
y= 0 0 1 1 0 0 0 0
```

```
   1 1 1 1 0 0 0 0
+  0 0 1 1 1 1 0 0
x= 1 1 1 1 1 1 0 0
```

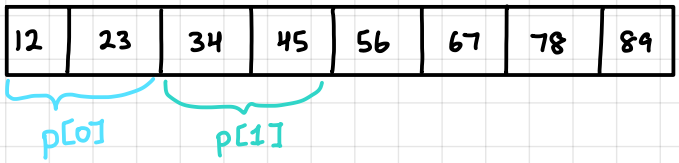
```
1 1 1 1 0 0 0 0
0 0 1 1 1 1 0 0
```

```
=> 1 1 0 0 0 0 1 1
=> + 0 0 0 0 1 1 1 1
z = 1 1 0 0 1 1 1 1
```

2)

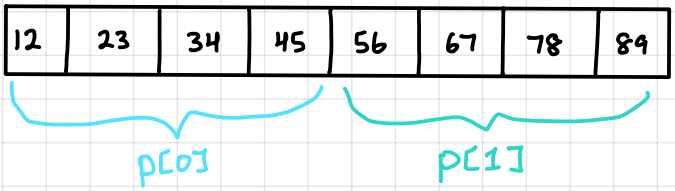
Let's say that p is a pointer to memory and the next eight bytes in memory (in hex) beginning at p's address are: 12 23 34 45 56 67 78 89. What are the values of w and x after the following code snippet is run on a **little-endian** computer? Input your answers as hex with no additional characters or spaces (so like aabb and not like 0xaabb).

```
uint16_t *q = (uint16_t *)p;
uint16_t w = q[1];
uint32_t *r = (uint32_t *)p;
uint32_t x = r[1];
```




w = {34, 45} but in little endian the order is reverse

∴ w = {45, 34}

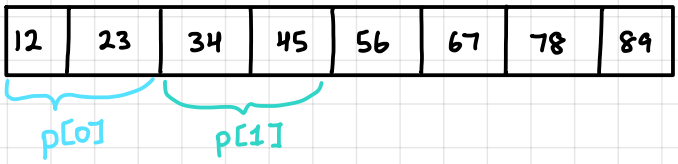



x = {56, 67, 78, 89} but in little endian the order is reverse

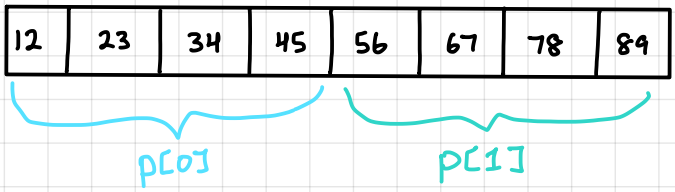
∴ x = {89, 78, 67, 56}

3) Let's say that p is a pointer to memory and the next eight bytes in memory (in hex) beginning at p's address are: 12 23 34 45 56 67 78 89. What are the values of w and x after the following code snippet is run on a **big-endian** computer? Input your answers as hex with no additional characters or spaces (so like aabb and not like 0xaabb).

```
uint16_t *q = (uint16_t *)p;
uint16_t w = q[1];
uint32_t *r = (uint32_t *)p;
uint32_t x = r[1];
```




$w = \{34, 45\}$




$x = \{56, 67, 78, 89\}$

4) How many functions exist with the signature $Z_5 \rightarrow Z_5$? Express your answer as an exact integer without any punctuation (eg, 1024 and not 1,024 or $2^{10}$). You may use a calculator if you wish.

$Z_5 \rightarrow Z_5$ $\quad Z_5 = \{0, 1, 2, 3, 4\}$

$Z_A \rightarrow Z_B$

# of functions exist = $B^A$ ← # of possible mappings

↖ domain elements

$5^5 = 3,125$

5) How many permutation functions exist with the signature $Z_5 \rightarrow Z_5$? Express your answer as an exact integer without any punctuation (eg, 1024 and not 1,024 or $2^{10}$). You may use a calculator if you wish.

$Z_5$ contains 5 elements

There are 5! number of bijective functions defined on $Z_5$

$\therefore 5 \times 4 \times 3 \times 2 \times 1 = 120$ permutations

6) Let $f : Z_5 \to Z_5$ be a random function. What is the probability that f(0) = f(1)? Express your answer as a reduced fraction without any spaces (eg, 1/10 and not 2/20 or 0.1), or as 0 or 1, if appropriate.

Each row is independent of each other, repeats are allowed

$\therefore \Pr[f(0) = f(1)] = \frac{1}{5}$

7) Let $f : Z_5 \to Z_5$ be a random permutation function. What is the probability that f(0) = f(1)? Express your answer as a reduced fraction without any spaces (eg, 1/10 and not 2/20 or 0.1), or as 0 or 1, if appropriate.

A permutation function must be one-to-one and onto; no repeats.

$\therefore$ zero

8) Let $f : Z_5 \to Z_5$ be a random permutation function. What is the probability Pr[ f(2) = 2 | f(0) = 0 and f(1) = 1 ]? Express your answer as a reduced fraction without any spaces (eg, 1/10 and not 2/20 or 0.1), or as 0 or 1, if appropriate.

When defining f there are 5 candidates for f(0), 4 unused candidates for f(1), and 3 for f(2).

Therefore, $\Pr\left[\frac{f(2)=2}{f(0)=0 \cap f(1)=1}\right] = \frac{1}{3}$