CSc 352
Bit Manipulation

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Bit Operations

C supports a number of operations to manipulate the ones and zeros in memory

Shifting:	`>>` `<<`
Masking:	`&` `|` `^`
Flipping:	`~`

Shifting

```
uint8_t x = 21;       // x = 00010101
x = x << 2;           // x = 01010100
x = x >> 4;           // x = 00000101
printf("%u\n", x);    // what does it print?
```

Shifting

```
uint8_t y;
y = 1;      // 00000001
for (int i = 0; i < 8; i++) {
  y = y<<1;
  printf("%u\n", y);
}
```

Viewing bits on stdout

Implement the function

```
void print_bits(uint8_t data);
```

Should print out the 1s and 0s stored in **data** to standard output

For example:

```
uint8_t x = 4;
print_bits(x); // Should print 00000100
```

```
void print_bits(uint8_t data){
  for(int j = 0; j < 8; j++){
    uint8_t temp = data;
    temp = temp<<(7-j);
    temp = temp>>7;
    printf("%u", temp != 0 ? 1 : 0);
  }
  printf("\n");
}
```

Viewing bits on stdout

Implement the function

```
void print_bits(uint8_t * data, int size);
```

Should print out the 1s and 0s stored in the array of length **size** that **data** points to

For example:

```
uint16_t x = 4;
print_bits(x, 2); // Should print 00100000 00000000
```

```c
void print_bits(uint8_t * data, int size){
  uint8_t* copy = malloc(size);
  memcpy(copy, data, size);
  for(int i = 0; i < size; i++){
    for(int j = 0; j < 8; j++){
      uint8_t temp = copy[i];
      temp = temp<<(7-j);
      temp = temp>>7;
      printf("%u", temp != 0 ? 1 : 0);
    }
    printf(" ");
  }
  printf("\n");
  free(copy);
}
```

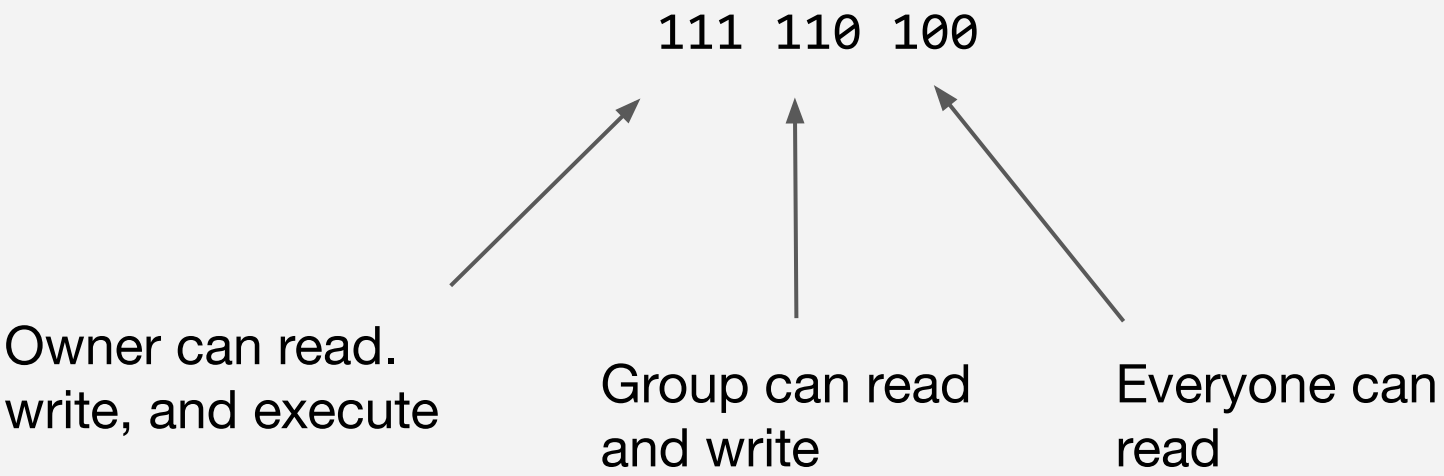
xxdb

Implement a program: **`xxdb.c`**

- Similar to **`$ xxd -b`**
- Gets file name from command line
- Prints out 8 bytes per line, keeps track of byte offset
- Does not need to print out ascii values
- Use **`print_bits`** function

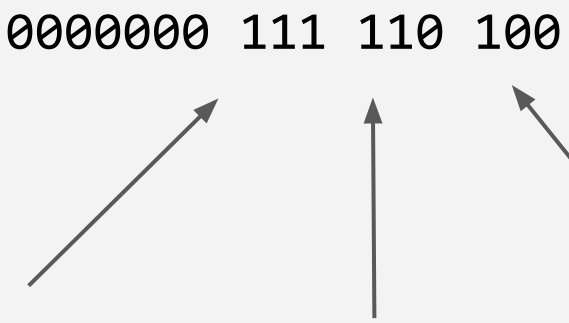
Permissions

Recall that permissions for files can be represented as a binary sequence:



Permissions

Could represent this with a uint16_t



Owner can read. write, and execute

Group can read and write

Everyone can read

Permissions

Implement the function

```
uint16_t owner_permissions(uint16_t * permissions);
```

Should take the Owner permissions and set those same permissions as the group and every permissions too, return the number
For example:

```
uint16_t x = 272; // 000000000 100 010 000
owner_permissions(x); // Should return 000000000 100 100 100
```

Setting File Permissions

Set the file permission using **`chmod`** function and **`mode_t`**

Use **`<sys/stat.h>`** and **`<sys/types.h>`**

```
$ man 2 chmod
$ man 7 inode
```