

# CSE 351 Lab 1 Helper Worksheet

## 1 Lab 1

Lab 1 is intended to familiarize you with bitwise operations in C through a series of puzzles. Many of these puzzles are hard and require some understanding of the basic ways to use logical operations. This worksheet was created to help you get started on lab 1. The exercises are either sub-problems directly from the lab or expose concepts needed to complete the lab. Start early!

## 2 Exercises

Ground rules: `if`, `else`, and other conditional syntax is not allowed. The `==` operator is also forbidden in all of the following problems.

### 2.1 Warmup: Bit Extraction

Complete the following function which returns the value (either 0, or 1) of the 19th bit (counting from the least significant bit). Allowed operators: `>>`, `&`, `|`, `~`.

```
int extract19(int x)
{
    return (x >> 18) & 0x1;
}
```

### 2.2 Warmup: Subtraction

Complete the following function which returns the value of  $x - y$ . Allowed operators: `>>`, `&`, `|`, `~`, `+`.

```
int subtract(int x, int y)
{
    return x + ((~y) + 1);
}
```

### 2.3 Warmup: Equality

Complete the following function which returns the value of  $x == y$ . Allowed operators: `>>`, `&`, `|`, `~`, `+`, `^`, `!`.

```
int equals(int x, int y)
{
    return !(x ^ y);
}
```

### 2.4 Greater than zero?

Complete the following function which returns the value of  $x > 0$ . Allowed operators: `>>`, `&`, `|`, `~`, `+`, `^`, `!`.

```
int greater_than_0(int x)
{
    /* invert and check sign */
    return ((~x + 1) >> 31) & 0x1 & ~(x >> 31);
}
```

### 2.5 Divisible by eight?

Complete the following function which returns the value of  $((x \% 8) == 0)$ . Allowed operators: `>>`, `<<`, `&`, `|`, `~`, `+`, `^`, `!`.

```
int divisible_by_8(int x)
{
    return !((x << 29));
}
```