CS 4400: Computer Systems
Problem Set 5

1. Match each of the three IA32 assembly-code routines on the left with the equivalent C function on the right. (Three of the six C functions will be unmatched.) For each routine, the parameter `x` is at `%ebp+8` and parameter `y` is at `%ebp+12`.

```
bar1:
  pushl   %ebp
  movl    %esp, %ebp
  subl    $8, %esp
  movl    8(%ebp), %edx
  movl    %edx, %eax
  addl    %eax, %eax
  addl    %edx, %eax
  addl    %eax, %eax
  addl    12(%ebp), %eax
  leave
  ret

bar2:
  pushl   %ebp
  movl    %esp, %ebp
  subl    $8, %esp
  incl    8(%ebp)
  movl    12(%ebp), %ecx
  movl    8(%ebp), %eax
  sall    %cl, %eax
  leave
  ret

bar3:
  pushl   %ebp
  movl    %esp, %ebp
  subl    $8, %esp
  movl    12(%ebp), %edx
  movl    8(%ebp), %eax
  subl    %edx, %eax
  leave
  ret
```

```
int foo1(int x, int y) {
  return ++x << y;
}

int foo2(int x, int y) {
  return 4*x + y;
}

int foo3(int x, int y) {
  return x - y;
}

int foo4(int x, int y) {
  return x++ << y;
}

int foo5(int x, int y) {
  return y - x;
}

int foo6(int x, int y) {
  return 6*x + y;
}
```

2. Problem 3.54 from the textbook.

3. Fill in the IA32 assembly code below such that it will have an effect equivalent to the C function `foo`. *Add no more than 12 instructions (i.e., lines), and provide a comment to explain each instruction.* Note that the parameter `ptr` is at `%ebp+8`, `a` at `%ebp+12`, `b` at `%ebp+16`, and

c at %ebp+20.

```
foo:
  pushl   %ebp
  movl    %esp, %ebp        int foo(int *ptr, int a, short b, char c) {
                              *ptr += a >> c;
  FILL IN                     return -*ptr & b;
                            }
  leave
  ret
```