CSCI-UA.0201

Computer System Organization

Homework Assignment 2

(Total: 40 points)

1. [5 points]

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

2. [5 points]

```
void set_bits(unsigned x, unsigned l, unsigned r){

    int i;

    for( i = l; i <= r; i--)
        x |= (1<<i);
}
```

3. [2 point]

The function counts the number of bits set to 1 in k;

4. [3 points]

N-bit number means it can present a range 0 → 2^N-1
Let's assume x = 2^N-1
Now, the largest number that a*b+c can produce is: x^2+x
After doing some simplification, we reach: $2^N(2^N-1)$
This is the largest number we can get. To know the number of bits, we need to take log to the base 2 of that number: $\log[2^N(2^N-1)]$
= $\log[2^N] + \log[(2^N-1)]$ ~= 2N

5. [9 points] From what we studied in class, the bias = 2^{w-1}-1 where w is the number of bits in the bias. In this problem w = 3, so the bias = 3;

a) The smallest non-zero will come from a denormalized form, because this form is made to represent 0 and very small numbers.
In binary, this number will be 0 000 1
sign = +ve
E = 1 – bias = 1 – 3 = -2
Mantissa = 0.1 = 0.5
The number in decimal is then: + 2^{-2} * 0.5 = +2^{-3}

b) Largest is: 0 110 1   (note that the exponent cannot be 111 otherwise we will be in the special values part).
Sign is +ve
Exponent is 6-3 = 3
Mantissa = 1.5
So the number is $+2^3$* (1.5)

6. [6 points]

a) y = 7*x;

y = (x<<3) – x;

b) y = 27*x;

y = (x<<5) – (x<<2) – x;

c) y = 67*x;

y = (x<<6) + (x<<1) + x;

7. [5 points (-0.5 for each mistake)]

Expression	Decimal	Binary
zero	0	000 000
-	-6	111 010
-	+18	01 0010
ux	47	101 111
y	-3	111 101
TMax	+31	011 111
-TMin	-32	100 000

-TMin and TMax are the minimum and maximum two's complement numbers.
For signed two's complement the range goes from $-2^{n-1} \rightarrow +2^{n-1}-1$
For unsigned the range goes from $0 \rightarrow +2^{n}-1$
In this problem n = 6

8. [A: 1 point, B: 2 points, C: 2 points]

A. On a x86 32-bit machine, Alice intends to use the expression `if ((x & mask) !=0))` to test if the 5th bit of x ~~from the right~~ is one or not. (The rightmost bit of x is considered as the 0-th bit). The value of `mask` should be $\boxed{32}$ (decimal).

B. Which of the following expressions generate the desired `mask` value in Question (A)? Select all that apply.

(a) `1 << 6`
(b) `1 << 5`
(c) `~(1<<6)`
(d) `~(1<<5)`
(e) `1 >> 26`
(f) `1 >> 27`

C. Please give the expression which sets the 5th bit of x to be one and leave the rest of the bits of x unchanged. Your expression should only use the `mask` value in Question (A) and no other constants.

(32 | x)