Week 1: Binary Numbers and Operations

SOLUTION

January 23-25, 2023

1. Consider a **5-bit** unsigned integer representation. Fill in the empty boxes in the following table. Addition and subtraction should be performed based on the rules for 5-bit, unsigned integer arithmetic.

Expression	Decimal Representation	Binary Representation
13	13	01101
21	21	10101
n/a	10	01010
n/a	19	10011
13 & 21	5	00101
13 && 21	1	00001
13 | 21	29	11101
13 || 21	1	00001
13 ^ 21	24	11000
~13	18	10010
!21	0	00000
13 << 1	26	11010
13 << 2	20	10100
21 >> 1	10	01010
21 >> 2	5	00101
13 + 21	2	00010
13 * 21	17	10001

2. In the following questions assume the variables `a` and `b` are unsigned 32-bit integers. Also assume that `UMAX` is the maximum unsigned 32-bit integer, `UMIN` is the minimum integer, and `W` is one less than the word length (i.e.., W = 31, since we're dealing with 32-bit integers).

Match each of the descriptions on the left with a line of code on the right (write in the letter).

1. a

   b

2. ˜a

   e

3. a & b

   a

4. a * 5

   d

5. a / 4

   f

a. ˜(˜a | (b ^ UMAX))

b. ((a ^ b) & ˜b) | (˜(a ^ b) & b)

c. 1 + (a << 3) + ˜a

d. (a << 2) + a

e. a ^ (UMIN + UMAX)

f. a >> 2

g. (a << 4) + (a << 1)