CS132 Quizzes - Data Representation

May 2021

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1 Briefly describe why binary code is commonly used in computer hardware

Computer use electricity to send signals around the components. These signals can be of varying voltages. There are levels of voltage that determine whether the signal is high or low. We only have a high and a low because noise can make the voltage amount vary slightly. Having binary code where the voltage is either high or low limits the affect of noise in a system.

2 How many bits in a byte

8

3 In the binary number 10101010_2 what is the value of the MSB?

1

4 Make a table counting upwards from 0 to 16_{10} in decimal, binary, octal and hexadecimal.

Binary	Octal	Decimal	Hexadecimal
0	0	0	0
1	1	1	1
10	2	2	2
11	3	3	3
100	4	4	4
101	5	5	5
110	6	6	6
111	7	7	7
1000	10	8	8
1001	11	9	9
1010	12	10	A
1011	13	11	B
1100	14	12	C
1101	15	13	D
1110	16	14	E
1111	17	15	F
10000	20	16	10

Table 1: numbers from 1 - 16

5 Briefly explain the difference between value and representation, giving an example.

Representation is how we show values and can change with different representations. Whereas the value is set and even though you can represent a value in different ways the value will remain constant. E.g. 13 in decimal is 1101 in binary or 15 in Octal.

6 Which of the following are not valid hex values?

a - valid
b - valid
c - invalid
d - valid
e - invalid

7 What is 2742_8 in binary?

010 111 100 010

8 Convert 1011001011111001_2 to hex

B2F9

9 Convert 42_{10} to binary

101010

10 Convert 73_8 to hex.

111

11 Convert 1101100100_2 to decimal.

868

12 Convert 4000_{10} to octal.

111110100000_2
7640_8

13 Calculate the following binary sum: 10100111+01110001

100011000
assuming we are allowing an overflow

14 Calculate the following binary sum: 10111+11011

110010
assuming we are allowing an overflow

15 Show the binary representations for -13_{10} in
a. signed magnitude and
b. two's complement.

a. 11101 b. 13 = 01101 Flip the bits
10010

add 1
10011

16 a. Find the binary two's complement representations of $+12_{10}$ and -10_{10}. b. Use your answers to subtract 10 from 12. Show your working

12 = 01100
10 = 01010
flip bits
= 10101
add 1
-10 = 10110

$12 - 10 = 12 + (-10) = 01100 + 10110 = 00010$
Remember we remove the overflow.

17 Do the following statements describe fixed or floating point representations, both or neither? a. It's fast b. Provides the best resolution c. Copes with a wide range of numbers d. Implementation is complicated e. Can't represent some values f. Is described by an international standard g. Can represent any value h. Allows simple multiplication by two

a - fixed b - fixed c - floating d - floating e - both f - floating g - neither h - both

18 Using 4 bit binary arithmetic, illustrate overflow error with an example.

1101 + 0100 = 10001
the MSB is an overflow error in this example.

19 Describe IEEE 754 single precision floating point representation using a labelled diagram.

The MSB represents the sign of the number 1 for negative 0 for positive (we'll denote this as s).
The next 8 MSB's are the exponent (we'll denote as e)
The final 23 bits are the fraction (we'll denote as f)
We then calculate the value using the following formula:
$(-1)^s \times 1.f \times 2^{e-127}$

Sign bit	Exponent	Fraction
1	10001010	1101000000000000000000
1	11	0.8125

Table 2: example

$(-1)^1 \times 1.8125 \times 2^{11} = -3712$
There are also some special values.