LE1.4.1: Convert Decimal Numbers To Binary

pontos 6 / 6 (sem classificação)

Convert the following decimal numbers to 6 bit 2's complement representation binary numbers. Provide the binary numbers using the format 0bXXXXXX.

15 = 0b 001111 ✔ Answer: 1111

-15 = 0b 110001 ✔ Answer: 110001

6 = 0b 000110 ✔ Answer: 110

-6 = 0b 111010 ✔ Answer: 111010

21 = 0b 010101 ✔ Answer: 010101

-21 = 0b 101011 ✔ Answer: 101011

Explanation

Binary numbers are represented in the same manner as decimal numbers with the least significant bit representing the 2^0 position, the next bit to the left being the 2^1 position, the next 2^2 and so on. So to represent the positive number 15 which is equal to 8 + 4 + 2 + 1 = 2^3 + 2^2 + 2^1 + 2^0 = 0b001111. There are 1's in the 0, 1, 2, and 3 positions and 0's in

the 4, and 5 positions. Similary, 6 = 4 + 2 = 2^2 + 2^1 = 0b000110 indicating that the only positions that are non-zero are the 1 and 2 bits. Finally, 21 = 16 + 4 + 1 = 2^4 + 2^2 + 2^0 = 0b010101 with 1's in the 0, 2, and 4 positions and 0's elsewhere.
In order to convert these numbers to a negative numbers, the way to do that in binary is to first flip all the bits and then add 1.
So -15 = 0b110000 +1 = 0b110001.
-6 = 0b111001 + 1 = 0b111010.
Finally, -21 = 0b101010 + 1 = 0b101011.

Enviar

Answers are displayed within the problem

LE1.4.2: Binary, Octal, and Hex Representations

pontos 6 / 6 (sem classificação)

Binary representation:

Convert the following integers to 6-bit 2's complement binary numbers. Binary numbers are prefixed with the string `0b` to indicate that you are specifying a binary number.

- 5 = 0b 000101 ✔ Answer: 101

  Explanation
  5 = 4 + 1 = $\mathbf{2^2 + 2^0}$, so you have 1's in the 0 and 2 positions which correspond to the rightmost bit, and the third bit from the right. The other positions have 0's.

- 23 = 0b 010111 ✔ Answer: 010111

  Explanation
  23 = 16 + 4 + 2 + 1 = $\mathbf{2^4 + 2^2 + 2^1 + 2^0}$, so you have 1's in the 0, 1, 2, and 4 positions and 0's elsewhere, where 0 is the rightmost bit.

- -12 = 0b 110100 ✔ Answer: 110100

  Explanation
  12 = 8 + 4 = 0b001100. To get -12, you flip all the bits, and add 1. Flipping all the bits results in 0b110011. Remember that you must use the correct number of bits in your representation which in this case is 6. Now adding 1, results in 0b110100.

Octal and hexadecimal representation:

For the following problems, use 24 bit precision when answering the problems.

Convert the following integers to octal (base 8) representation using octal digits 0, 1, 2, 3, 4, 5, 6, and 7. Octal numbers should be prepended with the string `0` to indicate that you are specifying an octal number.

- 21 = O 025 ✔ Answer: 25

  Explanation
  21 = 16 + 5 = $2^4 + 2^2 + 2^0$ = 0b000...010101 = 0b 000 000 000 000 000 000 010 101 = O00000025. An octal character represents 3 binary bits so the least significant octal character is 5, and the next octal character is a 2.

Convert the following integers to hexadecimal representation. Hexadecimal numbers should be prepended with the string `0x` to indicate that you are specifying a hexadecimal number.

- 73 = 0x 49 ✔ Answer: 49

  Explanation
  73 = 64 + 8 + 1 = $2^6 + 2^3 + 2^0$ = 0b000...01001001 = 0× 0000 0000 0000 0000 0100 1001 = 0×000049. A hex character represents 4 binary bits, so the least significant hex character is 9, and then next one is a 4.

- -7 = 0x FFFFF9 ✔ Answer: FFFFF9

  Explanation
  7 = 0×000007 = 0b 0000 0000 0000 0000 0000 0111. To get -7, you flip all the bits, and add 1. Flipping all the bits results in 0b 1111 1111 1111 1111 1111 1000. Remember that you must use the correct number of bits in your representation which in this case is 24. Now adding 1, converts the bottom four bits to 1001 in binary, and converting back to hex results in 0xFFFFF9.

Enviar

ℹ Answers are displayed within the problem

LE1.4.3: Two's Complement Addition

pontos 5 / 5 (sem classificação)

Perform the following addition problems using 6-bit 2's complement arithmetic. Provide your answer using the format $0bXXXXXX$ if the problem can be solved using 6 bit 2's complement representation. Otherwise provide the answer "overflow".

$$\begin{array}{r} 0b001101 \\ 0b001010 \\ \hline \end{array}$$ 0b

010111 ✔ Answer: 010111

Explanation

Binary addition follows the same rules as decimal addition where you begin by adding the numbers in the rightmost (least significant) column, keeping track of any carry's into the next column, and repeat this process moving to the left until all column additions have been computed.

For this problem:

Column 0: 1 + 0 =1

Column 1: 0 + 1 = 1

Column 2: 1 + 0 = 1

Column 3:1 + 1 = 0 Carry = 1

Column 4: 0 + 0 + 1 (Carry from column 3) =1

Column 5: 0 + 0 = 0

So sum = 0b010111 = $2^4 + 2^2 + 2^1 + 2^0 = 16 + 4 + 2 + 1 = 23$ as expected since the two binary numbers being added were 13 (= $2^3 + 2^2 + 2^0 = 8 + 4 + 1$) + 10 (= $2^3 + 2^1 = 8 + 2$).

$$\begin{array}{r} 0b001111 \\ 0b101110 \\ \hline \end{array}$$ 0b

111101 ✔ Answer: 111101

Explanation

Binary addition follows the same rules as decimal addition where you begin by adding the numbers in the rightmost (least significant) column, keeping track of any carry's into the next column, and repeat this process moving to the left until all column additions have been computed.

For this problem:

Column 0: 1 + 0 = 1

Column 1: 1 + 1 = 0 and Carry = 1

Column 2: 1 + 1 + 1 (Carry from Column 1) = 1 and Carry = 1

Column 3: 1 + 1 + 1 (Carry from Column 2) = 1 and Carry = 1

Column 4: 0 + 0 + 1 (Carry from Column 3) = 1
Column 5: 0 + 1 = 1
So the result is 0b111101.
To double check ourselves, we verify that the two numbers being added are:
0b001111: 8 + 4 + 2 + 1 = 15.
0b101110: Flipping all the bits and adding one which results in 0b010001 +1 = 0b010010 = 16 + 2 = 18.
So the problem we are trying to solve is 15 + (-18) which we expect to result in -3.
Looking at our result of 0b111101, flipping all the bits and adding 1 we get 0b000010 + 1 = 0b000011 = 3. So as expected our answer was -3.

$$\begin{array}{r} 0b011011 \\ 0b111010 \\ \hline \end{array}$$ 0b

010101 ✔ Answer: 010101

Explanation
Binary addition follows the same rules as decimal addition where you begin by adding the numbers in the rightmost (least significant) column, keeping track of any carry's into the next column, and repeat this process moving to the left until all column additions have been computed.
For this problem:
Column 0: 1 + 0 = 1
Column 1: 1 + 1 = 0 and Carry = 1
Column 2: 0 + 0 + 1 (from Carry) = 1
Column 3: 1 + 1 = 0 and Carry = 1
Column 4: 1 + 1 + 1 (from Carry) = 1 and Carry = 1
Column 5: 0 + 1 + 1(from Carry) = 0 and Carry = 1
The last carry is dropped because we are using 6-bit 2's complement, so we do not want to go into the 7th column.
So sum = 0b010101. To double check ourselves, we verify that the two numbers being added are:
0b011011 = 16 + 8 + 2 + 1 = 27.
0b111010: Flipping all the bits gives you 0b000101. Ading one results in 0b000110 = 6. Therefore, the second number is a -6.
27 + -6 = 21.
Looking at our answer:
0b010101 = 16 + 4 + 1 = 21. Everything checks out.

$$\begin{array}{r} 0b111010 \\ 0b110001 \\ \hline \end{array}$$ 0b

101011 ✔ Answer: 101011

Explanation
Binary addition follows the same rules as decimal addition where you begin by adding the numbers in the rightmost (least significant) column, keeping track of any carry's into the next column, and repeat this process moving to the left until all column additions have been computed.
For this problem:
Column 0: 0 + 1 = 1
Column 1: 1 + 0 = 1
Column 2: 0 + 0 = 0
Column 3: 1 + 0 = 1
Column 4: 1 + 1 = 0 and Carry = 1
Column 5: 1 + 1 + 1 (Carry from column 4) = 1 and Carry = 1
The last carry is dropped because we are using 6-bit 2's complement, so we do not want to go into the 7th column.
So sum = 0b101011. To double check ourselves, we verify that the two numbers being added are:
0b111010: Flipping all the bits gives you 0b000101. Adding one results in 0b000110 = 6. Therefore, the first number is a -6.
0b110001: Flipping all the bits gives you 0b001110. Ading one results in 0b001111 = 15. Therefore, the second number is a -15.
-6 + -15 = -21.
Looking at our answer:
0b101011: Flipping all the bits gives you 0b010100. Adding one results in 0b010101 = 21. Therefore, the sum is -21 as expected.

$$\begin{array}{r} 0b011111 \\ 0b001100 \\ \hline \end{array}$$ 0b

overflow ✔ Answer: overflow

Explanation
In this problem, the numbers being added are:
0b011111: 16 + 8 + 4 + 2 + 1 = 31 and
0b001100: 8 + 4 = 12.
If you add these two numbers up you get a number that is larger than what can be represented using 6 bit 2's complement which is $2^5 - 1 = 31$. Therefore, the correct answer is overflow.
Another way to see that overflow occurs is that if you try to add the two binary numbers up, you get the following:
Column 0: 1 + 0 = 1
Column 1: 1 + 0 = 1
Column 2: 1 + 1 = 0 and Carry = 1
Column 3: 1 + 1 + 1 (from Carry) = 1 and Carry = 1
Column 4: 1 + 0 + 1 (from Carry) = 0 and Carry = 1
Column 5: 0 + 0 + 1 (from Carry) = 1

Resulting in 0b101011.
This indicates that you took two positive numbers (their most significant bit was 0) added them up and ended up with a negative numbers (because now the most significant bit is a 1). Since this cannot occur, something else must have gone wrong, and the answer is that overflow occured that that 6 bits is not enough to perform this addition in 2's complement arithmetic.

Enviar

Answers are displayed within the problem

Discussion

Ocultar discussão

Topic: 1. Basics of Information / LE1.4

Adicionar publicação

Show all posts by recent activity

Misleading info : they say using format 0bXXXXXX They say you must provide your answer using format 0bXXXXXX, but actually, you get erros if y...	5
Can someone please explain better how to detect an overflow in binary addition? Under section LE1.4.3: Two's Complement Addition how is the last question's answer an overflo...	3
Easy to understand video on two's compliment (includes addition and subtraction) https://youtu.be/sJXTo3EZoxM	3
typo LE1.4.1 Solution text: "Similary" should be "Similarly"	1
Overflow I get this error message "Overflow" at the Show Answer bit of the last question - and even thou...	5
[typo] in Solution of 1.4.3, "Ading" should be "Adding"	1
LE 1.4.2 Hex value for -7 The exercise asks for us to "Convert the following integers to hexadecimal representation". Sho...	2
Where should I learn the material needed to solve these problems? I watched the presentation video and then went on to solve the problems in LE1.4 as supposedl...	4
Prerequisite Course Comment: A prerequisite class should be required to fully appreciate the knowledge gained her...	6

?	Question about the LE1.4.3 LE1.4.3 says that 'Perform the following addition problems using 6-bit 2's complement arithmeti...	2
☑	Negative hex representation What does F stand for or why do we change is to F?	3
💬	Wrong answers in LE1.4.1 It seems the answers for the 2's complements of 6 and -6 in LE1.4.1 are incorrect.	5
☑	How to know that an overflow occurred on the negative side?	6