Two's Complement Representation

0/1 point (ungraded)

The 8-bit binary two's complement representation for decimal -25 is

- (●) 11110110
- ( ) 10101111
- ( ) 11100111
- ( ) -00011001
- ( ) None of the above

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Two's Complement Representation

3 points possible (ungraded)

A binary function is a function whose inputs and outputs are binary values (0 or 1). To determine how many binary functions of N inputs there are, you want to consider how many unique functions can be defined for all combinations of those inputs. For example, the AND(A, B) is different from the OR(A, B) because for inputs 01 and 10 the AND function produces a 0 but the OR function produces a 1. This means that AND and OR are two distinct functions of two binary inputs. (Note: there are many more than two distinct functions of two binary inputs).

How many binary functions of two (binary) inputs are there? (You can write your answer in terms of exponents, ex: x^2) 16 Answer: 16

Explanation

A binary function is a function that takes its inputs and outputs in binary. If the function has two inputs, that means there are 2^2 possible input combinations and thus 2^2 possible outputs corresponding to those inputs. Each **set** of these 4 outputs corresponds to a binary function, so there are 2^4 possible binary functions of two inputs, one for each possible output combination.

How many binary functions of 3 (binary) inputs are there? (You can write your answer in terms of exponents, ex: x^2) 256 Answer: 2^(2^3)

Explanation
If the function has 3 inputs, that means there are 2^3 possible input combinations and thus 2^3 possible outputs corresponding to those inputs. Each **set** of these outputs corresponds to a binary function, so there are 2^{2^3} possible binary functions of 3 inputs, one for each possible output combination.

Ternary logic functions use 3-valued logic. How many ternary functions of 4 (ternary) inputs are there? (You can write your answer in terms of exponents, ex: x^2 or x^(y^2))

3^((3^4)) Answer: 3^(3^4)

Explanation
Ternary functions have inputs and outputs that are represented in 3-value logic (i.e. 0, 1/2 and 1). If the function has 4 inputs, that means there are 3^4 possible input combinations and thus 3^4 possible outputs corresponding to those inputs. Each **set** of these outputs corresponds to a ternary function, so there are 3^{3^4} possible ternary functions of 4 inputs, one for each possible output combination.

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Answers are displayed within the problem

Two's Complement Representation

2/2 points (ungraded)
What decimal integer is represented by the 5-bit two's complement binary number 00101?

5 ✔

What decimal integer is represented by the 5-bit two's complement binary number 11010?

-6 ✔

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✔ Correct (2/2 points)

Two's Complement Representation

3/3 points (ungraded)

Using a 5-bit two's complement representation, what is the range of integers that can be represented with a single 5-bit quantity?

Range of integers: min -16 ✔ Answer: -16 max 15 ✔ Answer: 15

Explanation

The smallest number that can be represented using 5-bit two's complement is 0b10000. This is equal to -16 in decimal, or -2^{n-1} where n is the number of bits. To figure this out, one can flip all the bits and add 1. Flipping all the bits results in 0b01111 and adding 1 to that results in 0b10000 which we interpret as an unsigned number in order to figure out the value of our original number. The value of this number is $2^{5-1} = 16$; hence our original number was -16.

The largest number that can be represented using 5-bit two's complement is 0b01111. This is equal to 15 in decimal, or $2^{n-1} - 1$ where n is the number of bits.

Consider the following subtraction problem where the operands are 5-bit two's complement numbers. Compute the result and give the answer as a decimal (base 10) number.

```
  10111
- 00100
```

Answer in decimal (base 10): -13 ✔ Answer: -13

Explanation

Since we are doing subtraction, the simplest thing to do is flip the sign of the second operand and then add the two numbers. To flip the sign we flip all of the bits, giving 11011, and then add 1. Then we can add the two numbers.

When performing 2's complement addition, if a carry out is produced that goes beyond the number of bits in our number, then that carry out is ignored, as long as no overflow occurred. Overflow occurs when the result requires more than 5 bits in order to be represented. In this problem there is no overflow issue.
The result of our addition problem in binary is: 10011.
To convert to decimal we multiply the highest order bit by -2^{5-1}, the next bit by 2^{5-2} and so on until 2^0, with only the highest order bit being multiplied by a negative number. This results in -13.

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Answers are displayed within the problem

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Incorrect Answer for "How many binary functions of 3 (binary) inputs are there?"	First let's assume it has 3 inputs and 3 outputs. Though number of outputs are not specified lookin...	5
could not format the html	why the html formated after completing the quiz	2
Two's Complement Representation and How many binary functions of two (binary) inputs are there?	Am I missing something or there was no mention for counting possible functions problem in the lec...	3
Binary Function	What does this explanation mean: Each set of these 4 outputs corresponds to a binary function, so...	8
Typo		2
Help: Binary Functions & Two's Complement Representation	Some questions such as the following were brought up in the "Tutorial Problems" section of Chapt...	5
"Single-valued function of single-bit binary values" seems a better definition.	For example in addition of multibit binary numbers; total 3 binary values) enter the operation and 2...	1