#### Problem Set 1: Number Systems

#### **Number System Conversions**

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Problem Set due May 6, 2023 10:37 PDT Completed

Decimal to Binary

1/1 point (graded)

Express the decimal number  $1000_{10}$  as a binary number. Only use the exact number of bits required (i.e., no leading zeros). Do the math with paper and pencil to get used to your powers of 2.



#### Decimal to Hexadecimal

1/1 point (graded)

Express the decimal number  $1000_{10}$  as a 3-digit hexadecimal number. This should be straightforward by referring to the previous question.



#### Hexadecimal to Binary

1/1 point (graded)

Express the hexadecimal number  $BEEF_{16}$  as a binary number. Do not use a calculator; this problem should be easy if done properly.



### Hexadecimal to Decimal

1/1 point (graded)

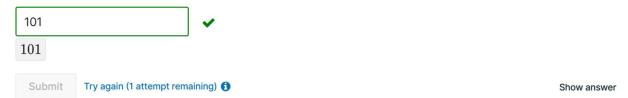
Express the hexadecimal number  $BB8_{16}$  as a decimal number. Do the math with pencil and paper to get used to your powers of 2.



# Binary to Decimal

1/1 point (graded)

Express the binary number  $1100101_2$  as a decimal number. Do the math with pencil and paper to get used to your powers of 2.



# Range of Numbers

1/1 point (graded)

What are the most positive values that can be represented with 16-bit unsigned, sign-magnitude, and 2's complement numbers, respectively.

Submit Try again (1 attempt remaining) (1	Show answer
○ {65536, 32768, 32768}	
○ {32768, 32768, 32768}	
○ {32768, 32768, 32768}	

# Range of Numbers

1/1 point (graded)

What are the most negative values that can be represented with 16-bit unsigned, sign-magnitude, and 2's complement numbers, respectively.





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Problem Set due May 6, 2023 10:37 PDT Completed  Addition
1/1 point (graded)
Compute 1010 <sub>2</sub> + 0111 <sub>2</sub> and write your result as a 5-bit binary number.
10001
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Unsigned Interpretation
1/1 point (graded)
If the numbers in the addition problem above are unsigned, interpret the addition in decimal.
○ -2 + 7 = 5
○ -6 + 7 = -15
○ -6 + 7 = 1
O 10 + 7 = 1
10 + 7 = 17



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### Two's Complement Interpretation

1/1 point (graded)

If the numbers in the addition problem above are signed 2's complement (4-bit for the addends and 5-bits for the sum), write an expression for the addition in decimal.

- $\bigcirc$  -2 + 7 = 5
- $\bigcirc$  -6 + 7 = -15
- $\bigcirc$  -6 + 7 = 1
- $\bigcirc$  10 + 7 = 1
- $\bigcirc$  10 + 7 = 17



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### Carry out

1/1 point (graded)

Interpreting the numbers as 2's complement, how can you recast the addition problem above to give a sensible result?

Check all that apply.

- ✓ Truncate the 5 bit output to 4 bits like the inputs: 1010 + 0111 = 0001 (-6 + 7 = 1)
- Sign-extend the inputs to 5 bits and interpret the output as 5 bits: 11010 + 00111 = 00001 (-6 + 7 = 1)
- Sign-extend the inputs to 5 bits and interpret the output as 6 bits: 11010 + 00111 = 100001 (-6 + 7 = 1)
- Because of overflow, information is lost and the answer cannot be made sensible.
- Addition of 2's complement numbers never produces sensible results.



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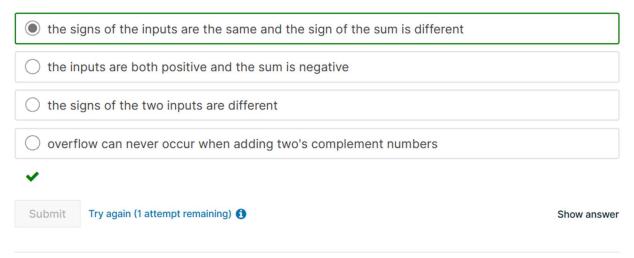
Try again (1 attempt remaining) 1

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### Overflow

1/1 point (graded)

When adding a pair of N-bit two's complement numbers to get an N-bit sum, overflow occurs if and only if:



#### Subtraction

1/1 point (graded)

Using 6-bit two's complement arithmetic, compute  $001000_2$  -  $010010_2$  and express your answer as a 6-bit binary number.



#### Zero Extension

1/1 point (graded)

Extend the 6-bit unsigned binary number 101111<sub>2</sub> to be an 8-bit unsigned binary number.



# Sign Extension

1/1 point (graded)

Extend the 6-bit signed 2's complement binary number  $101111_2$  to be an 8-bit 2's complement binary number.



# Sign Extension

1/1 point (graded)

Extend the 8-bit 2's complement hexadecimal number  $AD_{16}$  to 16 bits. Express your result in hexadecimal.

