AQA Computer Science A Level
4.5.4 - Binary number system

Flashcards

Which type of binary can represent negative numbers: signed or unsigned?

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Signed

What is the range of decimal numbers that can be represented using unsigned binary with four bits?

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0 to 15

= 0 to 2^4-1

How many unique bit patterns can be made with 8 bits?

How many unique bit patterns can be made with 8 bits?

256

$= 2^8$

Add the unsigned binary integers 1101 and 110

Add the unsigned binary integers 1101 and 110

10011

$$\begin{array}{cccccc} & & 1 & 1 & 0 & 1 \\ + & & & 1 & 1 & 0 \\ \hline 1 & 0^{1} & 0 & 1 & 1 \end{array}$$

Multiply the unsigned binary integers 11001001 and 110

Multiply the unsigned binary integers 11001001 and 110

10010110110

Guide: 1 1 0

		1	1	0	0	1	0	0	1	0
+	1	1	0	0	1	0	0	1	0	0
1	0^{1}	0	1	0	1	1	0	1	1	0

`01101011011`0 is a two's complement signed binary number with an eight bit mantissa and four bit exponent. What is the number in decimal?

What is the number in decimal?

53.5

Exponent = $0110_2 = 6_{10}$

0.1101011 becomes 0110101.1

$0110101.1_2 = 53.5_{10}$

Which of the following could be a normalised two's complement number?

A	B	C
11010110	01101101	00010101

Which could be a normalised two's complement number?

B

Normalised numbers must start 01 or 10.

`01101101` is a fixed point number with four bits before and four bits after the binary point. What is the decimal equivalent of the number?

What is the decimal equivalent of the number?

6.8125

0110.1101 = 4 + 2 + ½ + ¼ + 1/16

Convert the number 38.75 to floating point binary with an eight bit mantissa and a four bit exponent

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010011010110

38.75 = 0100110.11

Move binary point 6 positions to get 0.10011011

$6_{10} = 0110_2$

Mantissa is 010011011 and exponent is 0110

Convert the number -17.625 to floating point binary with a nine bit mantissa and a four bit exponent

Convert the number -17.625 to floating point binary with a nine bit mantissa and a four bit exponent

1011111010101

-17.625 = 101111.101

Move binary point 5 positions to get 1.01111101

$5_{10} = 0101_2$

Mantissa is 101111101 and exponent is 0101

Why might fixed point and floating point representations of decimal numbers be inaccurate?

Why might fixed point and floating point representations of decimal numbers be inaccurate?

Rounding errors can occur in values that cannot be represented exactly by binary.

The number 12.53_{10} is represented in fixed point binary as `1100.1`

Calculate the absolute error in the representation.

Calculate the absolute error in the representation.

0.03

1100.1 = 12.5

12.53 - 12.5 = 0.03

The number 18.48_{10} is represented in fixed point binary as `10010.1`

Calculate the relative error in the representation.

Calculate the relative error in the representation.

0.00108 (=0.108%)

$10010.1_2 = 18.5_{10}$

18.5 - 18.48 = 0.02

0.02 / 18.48 = 0.00108...

Which allows for the greatest range of numbers with a given number of bits: fixed point or floating point?

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Floating point

Why are floating point numbers normalised?

Why are floating point numbers normalised?

To provide the maximum level of precision for a given number of bits

What error occurs when a number is too large to be represented with the available bits?

What error occurs when a number is too large to be represented with the available bits?

Overflow