

Math 155 - Day #2: Number bases

Our Arabic Numeral system is written in base 10

What does that mean?

An Arabic numeral keeps track of how many 1's, 10's, 100's, 1000's, etc

Where 1 =

10 =

100 =

1000 =

So, the numeral $3,456 = 3000 + 400 + 50 + 6 =$

Ex: Expand the number 4729 into powers of 10.

4729 =

Ex: Expand the number 208 into powers of 10.

208 =

Note: 0×10^1 acts as a place holder

Try some on your own!

275 =

3647 =

2017 =

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What if we had a different base than 10?

A numeral shows how many of each power of the base is in the number.

Let's look at base 3

In order to do this, we need to know the powers of 3

$$3^0 = 1$$

$$3^1 = 3$$

$$3^2 =$$

$$3^3 =$$

$$3^4 =$$

Using this let's count in base 3:

1, 2, 3, ...

In base 3, the number 3 = $1 \times 3^1 = 10_3$

Notice the subscript 3 in the lower right hand corner so we know that this number is not the usual base 10 but written in base 3.

$$4 = 1 \times 3^1 + 1 \times 1 = 11_3$$

$$5 = \quad \quad \quad \text{and } 6 =$$

$$7 = \quad \quad \quad 8 = \quad \quad \quad 9 =$$

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Example: Change the number 112_3 to base 10

$$112_3 = 1 \times 3^2 + 1 \times 3 + 2 \times 1 = 1 \times 9 + 1 \times 3 + 2 \times 1 = 9 + 3 + 2 = 14$$

So, our usual base 10 number $14 = 112_3$

Example: Change the number 121_3 to base 10

$$121_3 =$$

Example: Change the number 1021_3 to base 10

$$1021_3 =$$

Example: Change the number 2111_3 to base 10

$$2111_3 =$$

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Try some on your own:

Change the following numbers to base 10

$$211_3 =$$

$$2021_3 =$$

$$23_5 =$$

$$1101_2 =$$