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Python for Bioinformatics

adventures in bioinformatics

Friday, July 15, 2011

Verification

I posted two derivations for Euler's famous equation (here and here):

$$e^{ix} = \cos x + i \sin x$$

This can be verified in a particularly simple way.
The **series** representation of the exponential function:

$$e^x = 1 + x + x^2/2! + x^3/3! + x^4/4! + \dots$$

is especially neat because each term in the series is the derivative of the term following, and the result of that is:

$$d/dx e^x = e^x$$

Which is, indeed, one definition of this function.
Substitution of ix leads to a simple shift in the pattern:

$$e^{ix} = 1 + ix - x^2/2! - ix^3/3! + x^4/4! + \dots$$

repeating with a period of 4. Powers of x like:

$4n + 1$	are multiplied by	i
$4n + 2$		-1
$4n + 3$		$-i$
$4n$		1

But remembering the **series** for sine and cosine, and multiplying the former by i :

$$\begin{aligned} \sin x &= x - x^3/3! + x^5/5! - x^7/7! + \dots \\ i \sin x &= ix - ix^3/3! + \dots \\ \cos x &= 1 - x^2/2! + x^4/4! - x^6/6! + \dots \end{aligned}$$

Adding:

$$\begin{aligned} \cos x + i \sin x &= 1 + ix - x^2/2! - ix^3/3! + x^4/4! + \dots \\ &= e^{ix} \end{aligned}$$




Jackson's Mill WV

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About Me



telliott99

I teach and do research in Microbiology. This blog started as a record of my adventures learning bioinformatics and using Python. It has expanded to include Cocoa, R, simple math and assorted topics. As bbum says, it's so "google can organize my head." The programs here are developed on OS X using R and Python plus other software as noted. YMMV

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