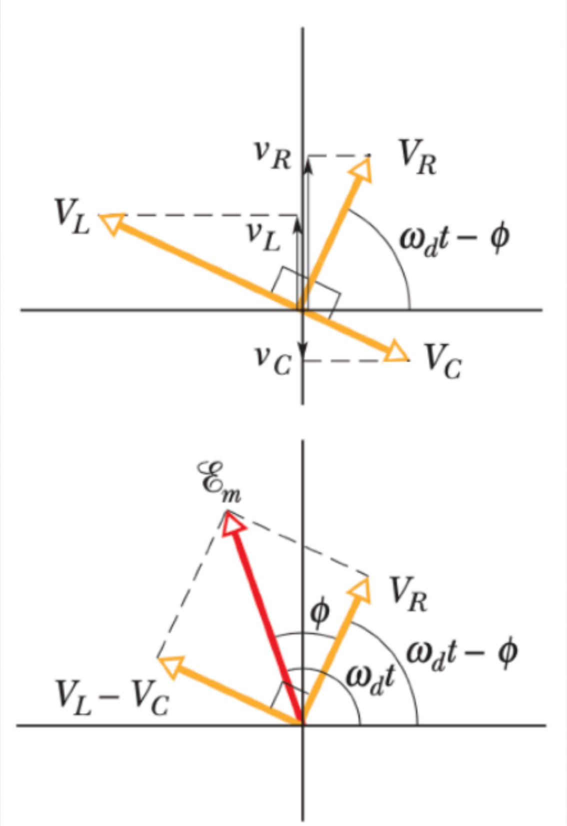
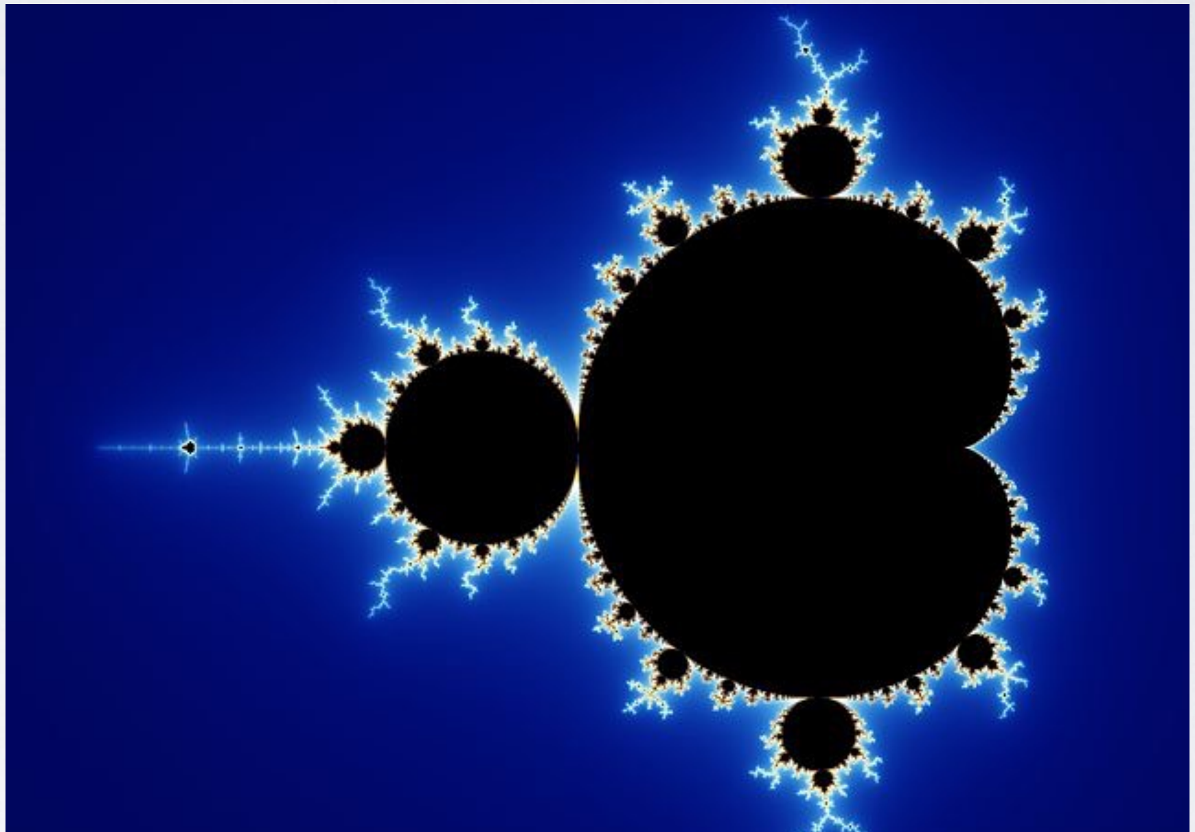
Week 2 - #1

Complex Numbers (II)



phasor diagram



Mandelbrot set on complex plane, $f(z)=z^2+c$

Today: Ch 1-2	Next Class: Ch 2

Ji-hoon Kim (Seoul National University)

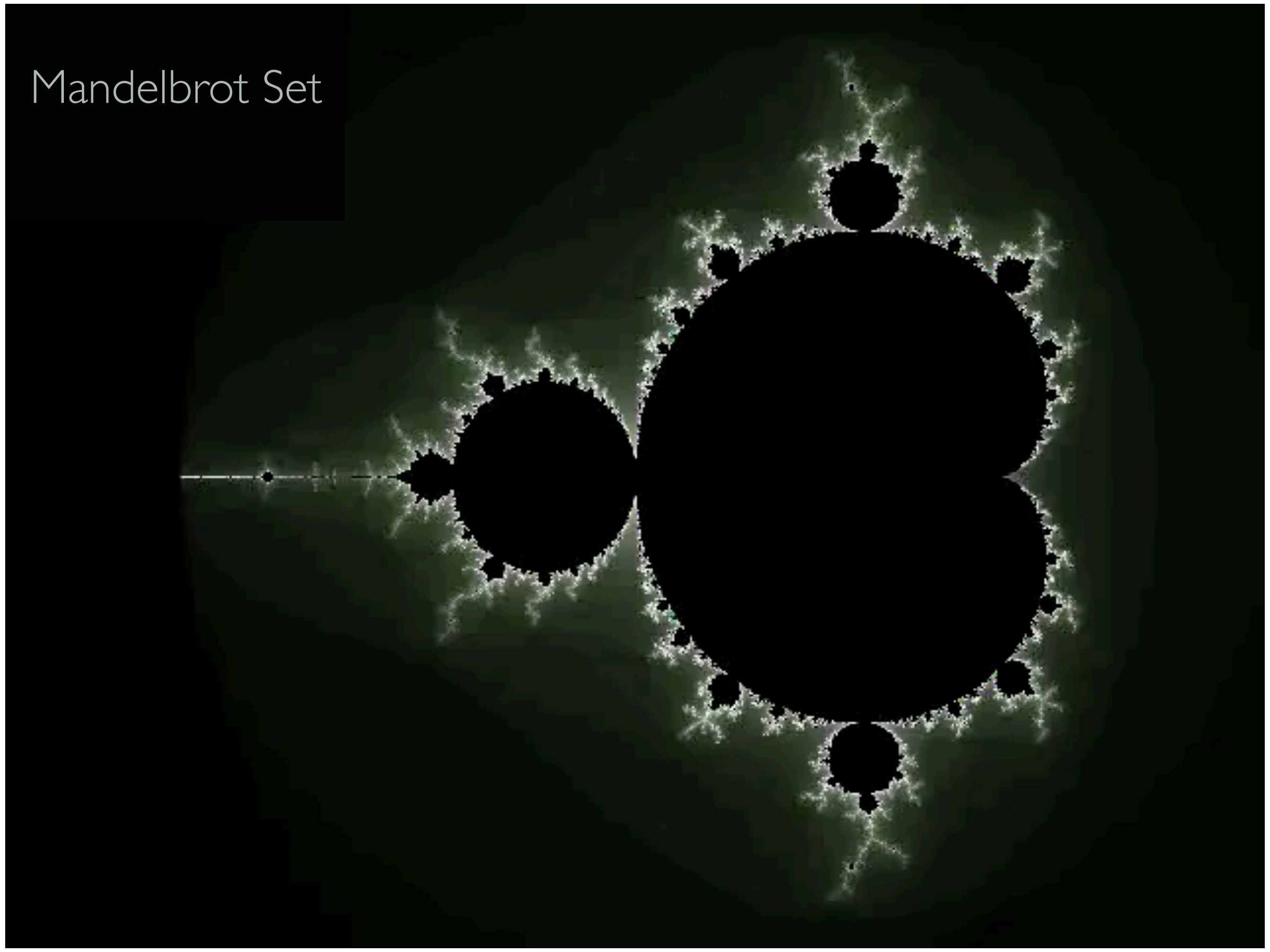
Rudimentary Mathematical Methods of Physics (Fall 2025): Quiz #2

— [open book and open note, "and" cellphone or laptop, drop it off as you leave the class] —

Please write down your name and student ID in the top right corner. (0.0 pt: no paper found with your name / 0.5 pt: paper found with your name and some answers / 1.0 pt: good answers)

1. Define "complex plane" from your textbook; then, Boas, Chapter 2, Section 5, Problem 59

2. Briefly explain the so-called Mandelbrot set demonstrated in the following movie — in particular, how this one of the most famous images in the fractal/chaos theory is plotted on a "complex plane".



youtube.com/watch?v=G_GBwuYuOOs,
Mandelbrot set on complex plane

Rudimentary Mathematical Methods of Physics (Fall 2025): Suggested Problems in Chapter 2, Boas, 3rd ed.

The problems I suggest you to take a deeper look into include, but are not limited to, the following. The class homework assignments will mainly be from this list.

- Section 04: Problems 4, 13
- Section 05: Problems 6, 7, 27, 28, 47, 50, 57
- Section 06: Problems 11, 14
- Section 07: Problems 12, 13, 17
- Section 08: Problems 3
- Section 09: Problems 9, 24, 25, 27, 28, 37
- Section 10: Problems 23, 32, 33
- Section 11: Problems 18
- Section 12: Problems 1, 10, 14, 15, 27, 38
- Section 14: Problems 2, 7, 9, 24, 25
- Section 15: Problems 6, 7, 18
- Section 16: Problems 1, 2, 5, 8, 11
- Section 17: Problems 19, 21, 25, 30

48 problems / 337 total

Rudimentary Mathematical Methods of Physics (Fall 2025): Suggested Problems in Chapter 3, Boas, 3rd ed.

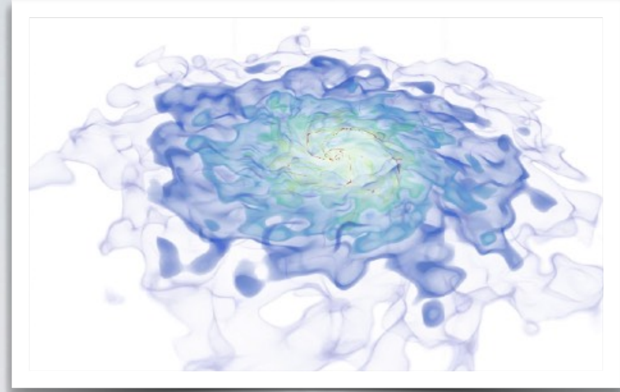
The problems I suggest you to take a deeper look into include, but are not limited to, the following. The class homework assignments will mainly be from this list.

- Section 02: Problems 8, 13, 14, 17, 18
- Section 03: Problems 2, 6, 9, 10, 13, 15
- Section 04: Problems 5, 6, 9, 21, 23
- Section 05: Problems 17, 21, 32, 36, 42
- Section 06: Problems 6, 7, 16, 18, 21, 29, 30
- Section 07: Problems 12, 27, 31, 34, 35
- Section 08: Problems 2, 10, 15, 16, 17, 24
- Section 09: Problems 3, 5, 10, 17, 19(c), 24, 25(a)(b)
- Section 10: Problems 4(c), 5(a), 7
- Section 11: Problems 9, 10, 19, 21, 31, 33, 42, 44, 50, 57, 60, 61
- Section 12: Problems 9 (for Problems 4, 7), 16, 21
- Section 13: Problems 1, 4, 7
- Section 14: Problems 13

<u>Chapter 10, Sections 1-4</u>

- Section 02: Problems 6
- Section 03: Problems 1, 2, 8
- Section 04: Problems 2, 6, 8

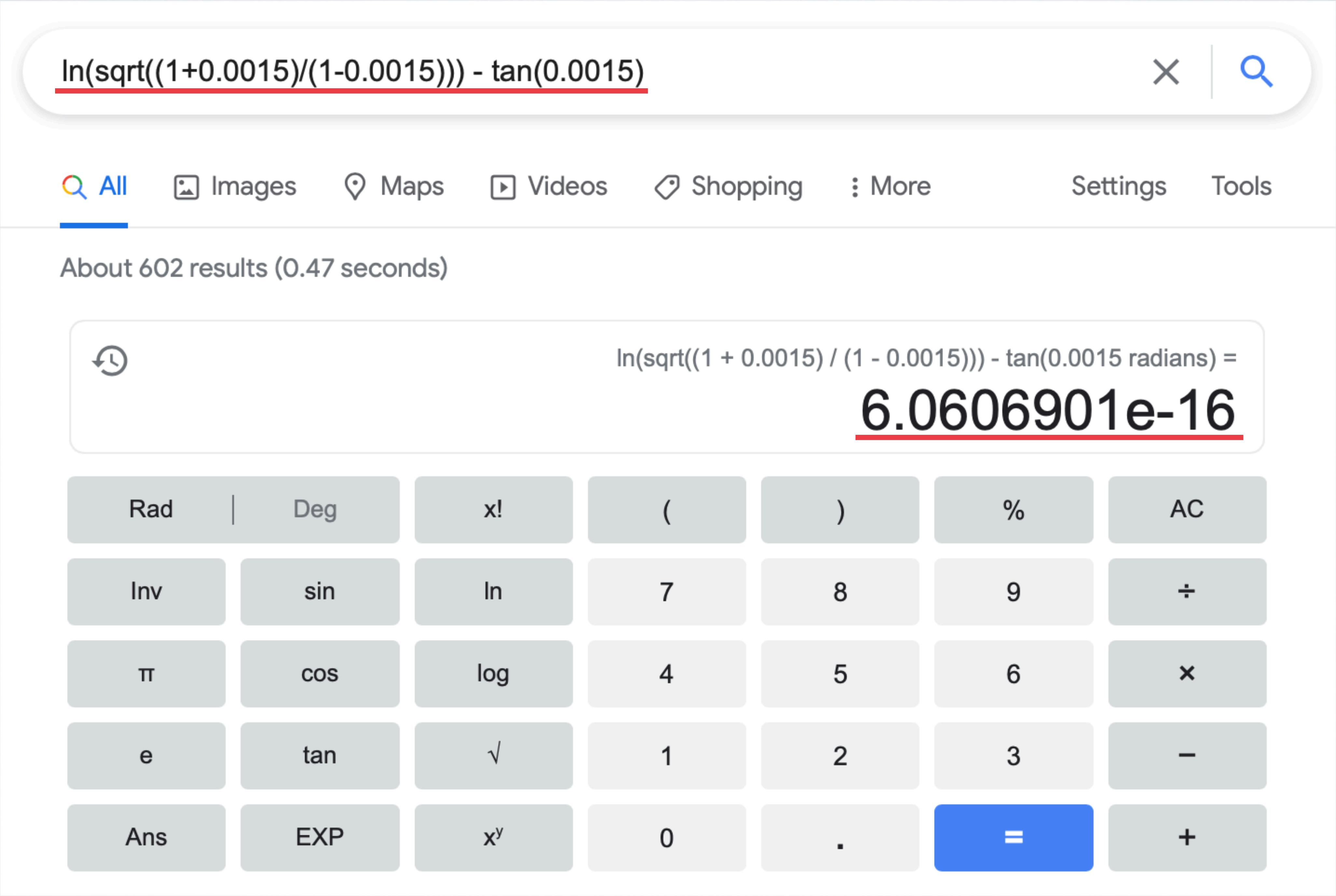
64 problems / 399 total



Pitfalls of Blind Computation

Pitfalls of Blind Computation

- Inaccurate estimation on Google:



Pitfalls of Blind Computation

- Inaccurate estimation on Python:

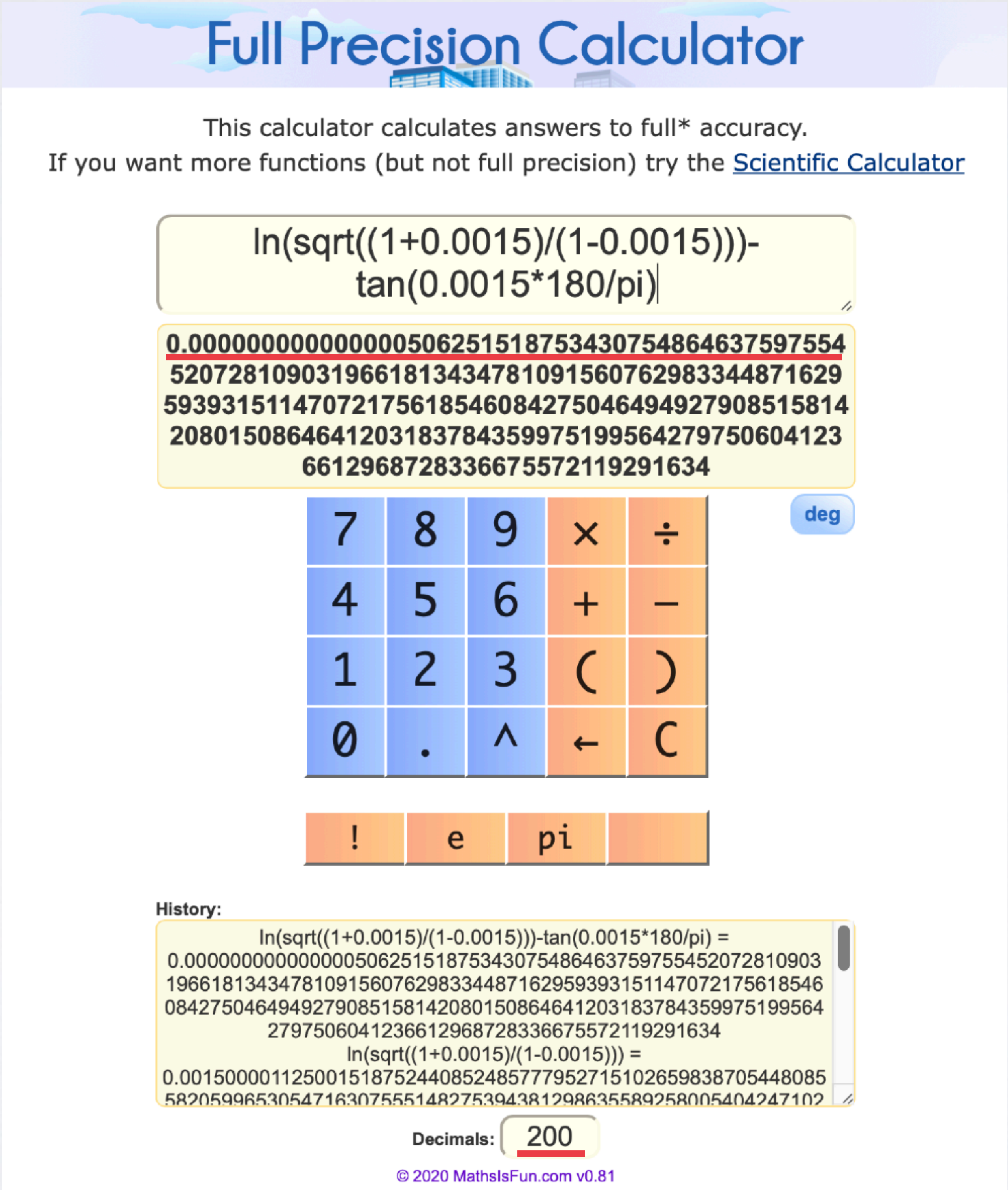
```
bash-3.2$ python
Python 2.7.9 (default, Sep  9 2015, 22:07:15)
[GCC 4.2.1 Compatible Apple LLVM 6.1.0 (clang-602.0.53)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> import math
>>> math.log(math.sqrt((1+0.0015)/(1-0.0015))) - math.tan(0.0015)
6.06069014419397e-16
```

Pitfalls of Blind Computation

- Accurate estimation on WolframAlpha:

Pitfalls of Blind Computation

- Accurate estimation on Full Precision Calculator:

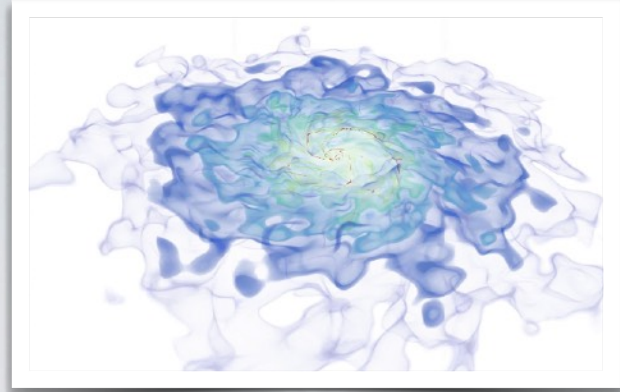


www.mathsisfun.com/calculator-precision.html

Pitfalls of Blind Computation

- Inaccurate estimation on Python:

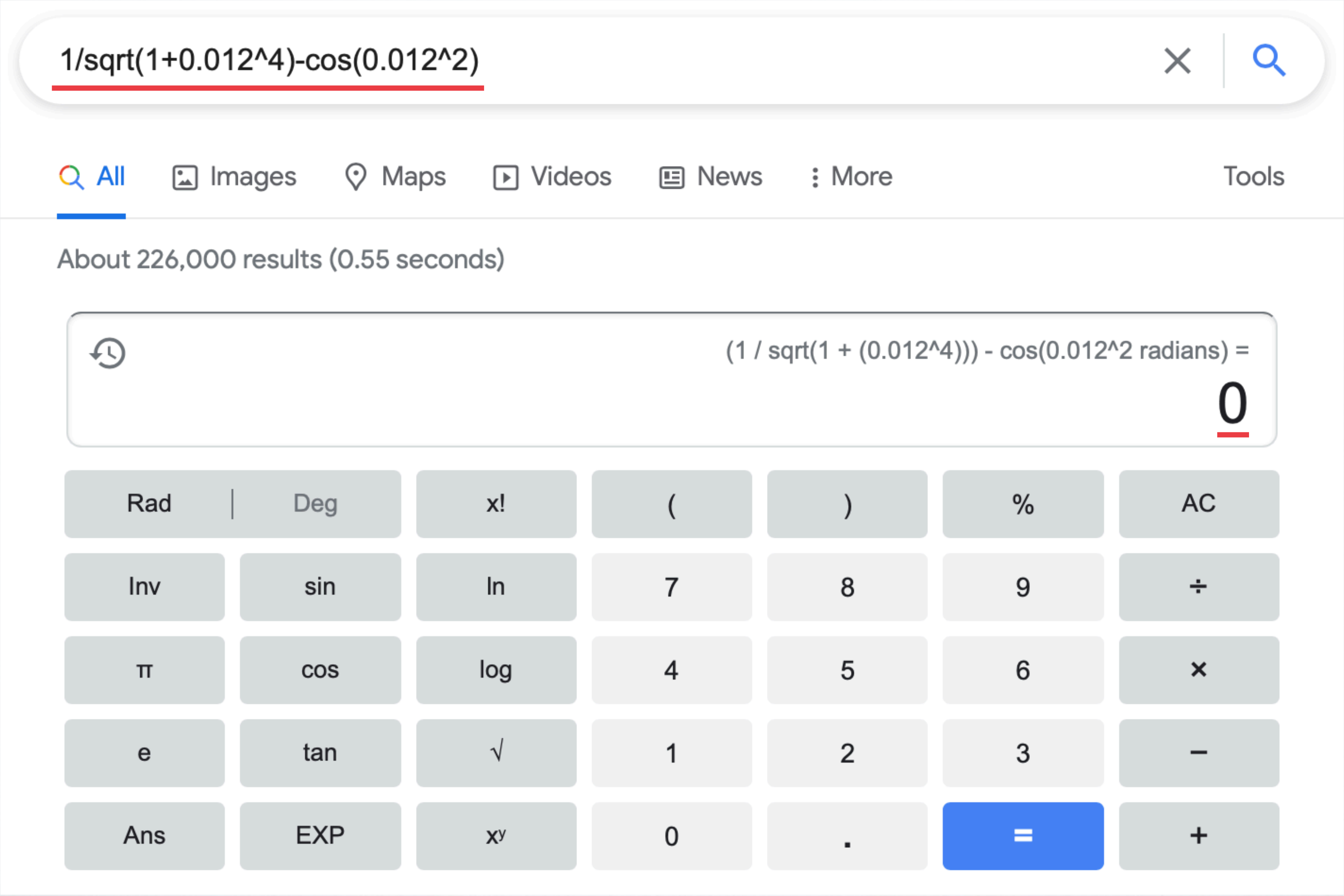
```
bash-3.2$ python
Python 2.7.9 (default, Sep  9 2015, 22:07:15)
[GCC 4.2.1 Compatible Apple LLVM 6.1.0 (clang-602.0.53)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> import math
>>> math.log(math.sqrt((1+0.0015)/(1-0.0015))) - math.tan(0.0015)
6.06069014419397e-16
>>> math.log(math.sqrt((1+0.0015)/(1-0.0015)))
0.0015000011250016186
>>> math.tan(0.0015)
0.0015000011250010125
>>>
>>>
```



Pitfalls of Blind Computation (Another Example: Problem 15.2)

Pitfalls of Blind Computation

- Inaccurate estimation on Google:



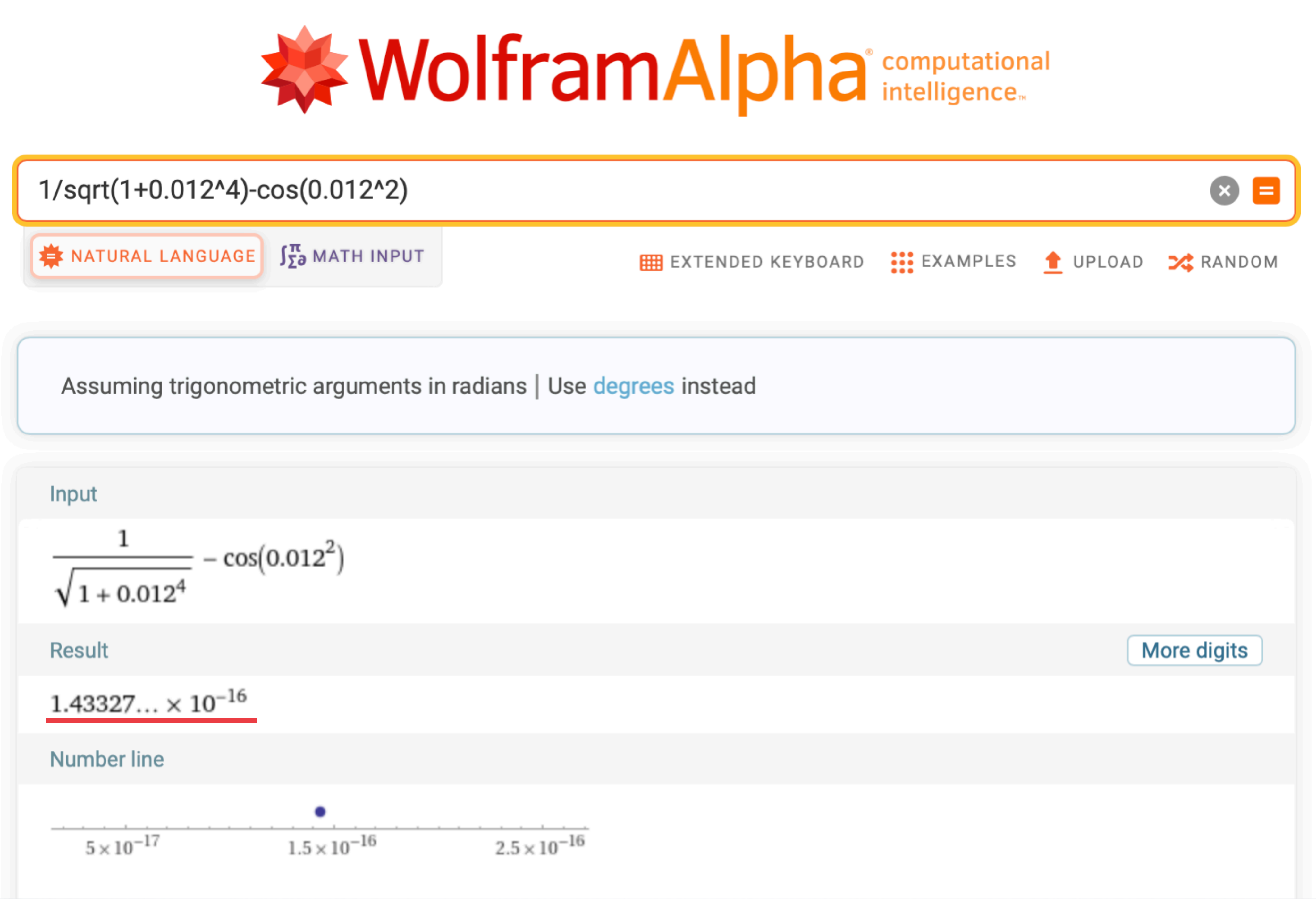
Pitfalls of Blind Computation

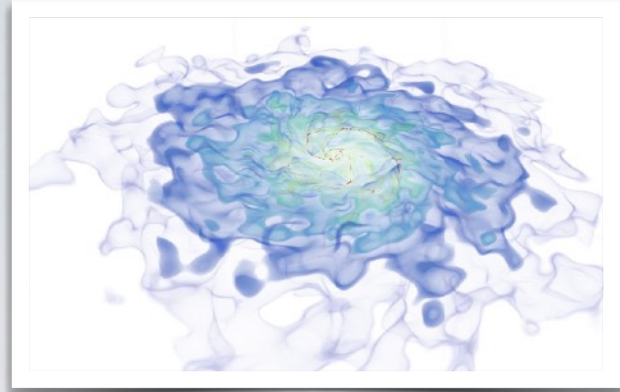
- Inaccurate estimation on Python:

```
bash-3.2$ python
Python 2.7.9 (default, Sep  9 2015, 22:07:15)
[GCC 4.2.1 Compatible Apple LLVM 6.1.0 (clang-602.0.53)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> import math
>>> 1/math.sqrt(1+0.012**4) - math.cos(0.012**2)
1.1102230246251565e-16
>>>
```

Pitfalls of Blind Computation

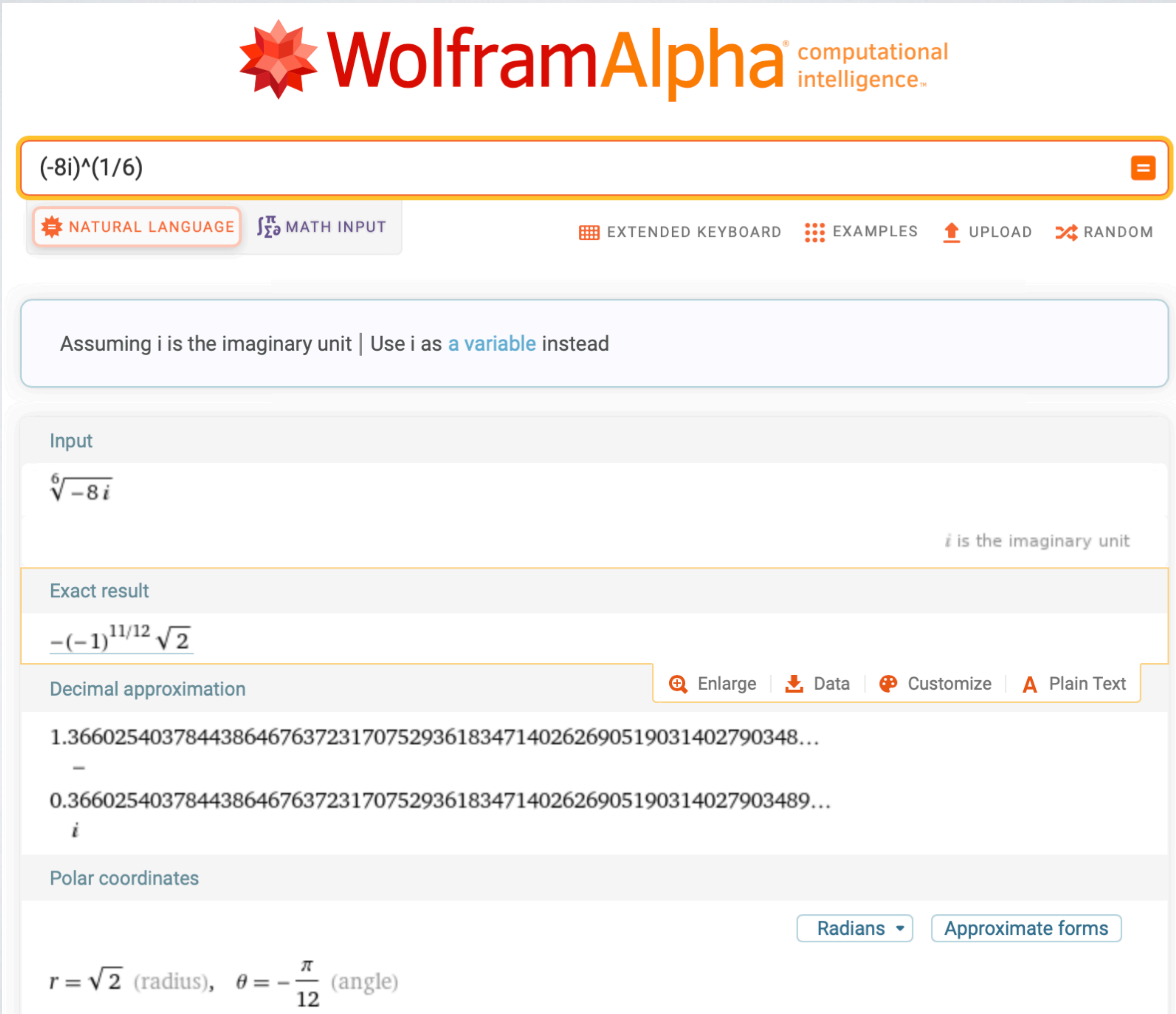
- Accurate estimation on WolframAlpha:





Roots of Complex Numbers

Roots of Complex Numbers



Roots of Complex Numbers

WolframAlpha computational intelligence.

(-8i)^(1/6)

NATURAL LANGUAGE | MATH INPUT | EXTENDED KEYBOARD | EXAMPLES | UPLOAD | RANDOM

All 6th roots of -8 i — Fewer roots | More digits | Polar form

$\sqrt{2}\, e^{-(i\pi)/12} \approx 1.36603 - 0.36603\, i$

$\sqrt{2}\, e^{(i\pi)/4} = 1 + i$ (principal root)

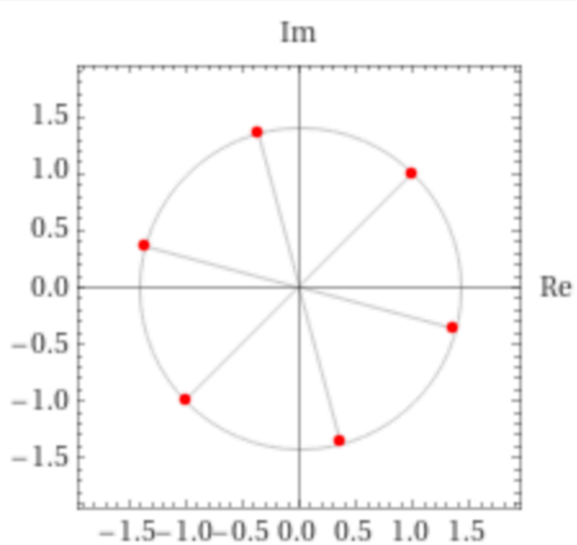
$\sqrt{2}\, e^{(7 i\pi)/12} \approx -0.3660 + 1.3660\, i$

$\sqrt{2}\, e^{(11 i\pi)/12} \approx -1.3660 + 0.3660\, i$

$\sqrt{2}\, e^{-(3 i\pi)/4} = -1 - i$

$\sqrt{2}\, e^{-(5 i\pi)/12} \approx 0.3660 - 1.3660\, i$

Plot of all roots in the complex plane



→ Boas Ch2 Fig10.4