

Wolfram|Alpha: Inside and Out

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Outline

- 1 What is Wolfram|Alpha?
- 2 How does Wolfram|Alpha work?
- 3 Wolfram|Alpha in education
- 4 The Wolfram|Alpha community

Wolfram|Alpha is a computational knowledge engine, a web site that computes information rather than finding it by search.

Like a search engine, it accepts free-form input.

Goal: Make computable knowledge accessible to everyone.

Development began around 2005.

Wolfram|Alpha was first released May 2009.

It is updated once per week.

What can Alpha generally do?

Wolfram|Alpha performs computations with known data.

Data include. . .

- data given by the user
- data from its database (factual information about cities, stars, rivers, animals, chemical elements, polyhedra, etc.)
- real-time data (weather, exchange rates, stock prices)

Computations include (among many others). . .

- comparisons
- statistics

What can Alpha not do?

Wolfram|Alpha cannot. . .

- determine opinions
"what is the best football team?"
- complete tasks it does not know how to do algorithmically
"prove the Pythagorean theorem"
- compute with data it doesn't have access to
"aardvark lifespan"
- perform computations that take more than a few seconds
"factor $2^{500} - 1$ "

One disadvantage Alpha has relative to search engines is that everything must be put in.

Long-term goal:

Cover all areas of systematic knowledge — knowledge computable from known data using known methods.

Wolfram|Alpha should interpret computations however the user feels is natural to describe them.

Why this has a chance of working:

A given phrase can only refer to a few different computations.

"e"

"apple"

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Wolfram|Alpha is written in *Mathematica*.

Four main components:

- linguistic processing
- curated data
- algorithms
- automated presentation

A case study: Geometry

My primary contribution has been geometry functionality.

Getting one small feature to work can be fairly simple.

The challenge is building a unified system that can handle many different computations, each in a way that is intuitive to the user.

One particular problem:

dealing with geometric objects with varying levels of information.

"triangle with vertices $(0, 0)$, $(3, 0)$, $(0, 4)$ "

"3, 4, 5 triangle"

"hyperbola with semi-axis lengths 2 and 4"

"hyperbola with eccentricity $\sqrt{5}$ "

"hyperbola with foci $(1, 2)$ and $(-1, -2)$ with semimajor axis length 1"

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Math assignments

College students are completely comfortable with computers, yet they tend to have negative reactions to *Mathematica*/Maple assignments.

Because Facebook doesn't have a rigid syntax!

The usability level of Wolfram|Alpha is much closer to a graphing calculator, so students have better reactions.

Advantages of Wolfram|Alpha:

- no fixed syntax, so much smaller learning curve
- freely available on the web
- much broader scope
- much higher output/input ratio

Wolfram|Alpha can be used. . .

- by instructors for demonstrations/visualizations in the classroom
- by students as a learning/exploration tool
- by students to check homework

- by students to **do** homework

For the first time, students can easily obtain answers — often with complete solutions — to most problems in a standard calculus textbook, and even to WeBWork and other customized problems.

We must assign homework with the expectation that students will be using tools like Wolfram|Alpha (and the internet in general).

But this is a good thing:

In the real world, mathematics is done with software; so it should be in education.

When introducing a new concept (limits, derivatives, etc.), we should compute a few examples by hand and then compute a few with Wolfram|Alpha.

What are we preparing students to do then?

The goal is not to prepare them for computing (memorizing the quotient rule or partial fractions).

Computation is a machine's job nowadays.

We should be preparing them to understand when and how to use the automated tools.

Perhaps we should even let students use software on exams!

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Other things to check out

Some ways to immerse yourself in Wolfram|Alpha:

- Wolfram|Alpha Blog
- Wolfram|Alpha Community
- Wolfram|Alpha for Educators
- apps for iPad, iPhone, and iPod touch
- Facebook
- Twitter

If Wolfram|Alpha can't yet do something it should, send us feedback!