Java Mathlets with **Blaise**

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MAA Session on *Mathlets for Teaching and Learning Mathematics*

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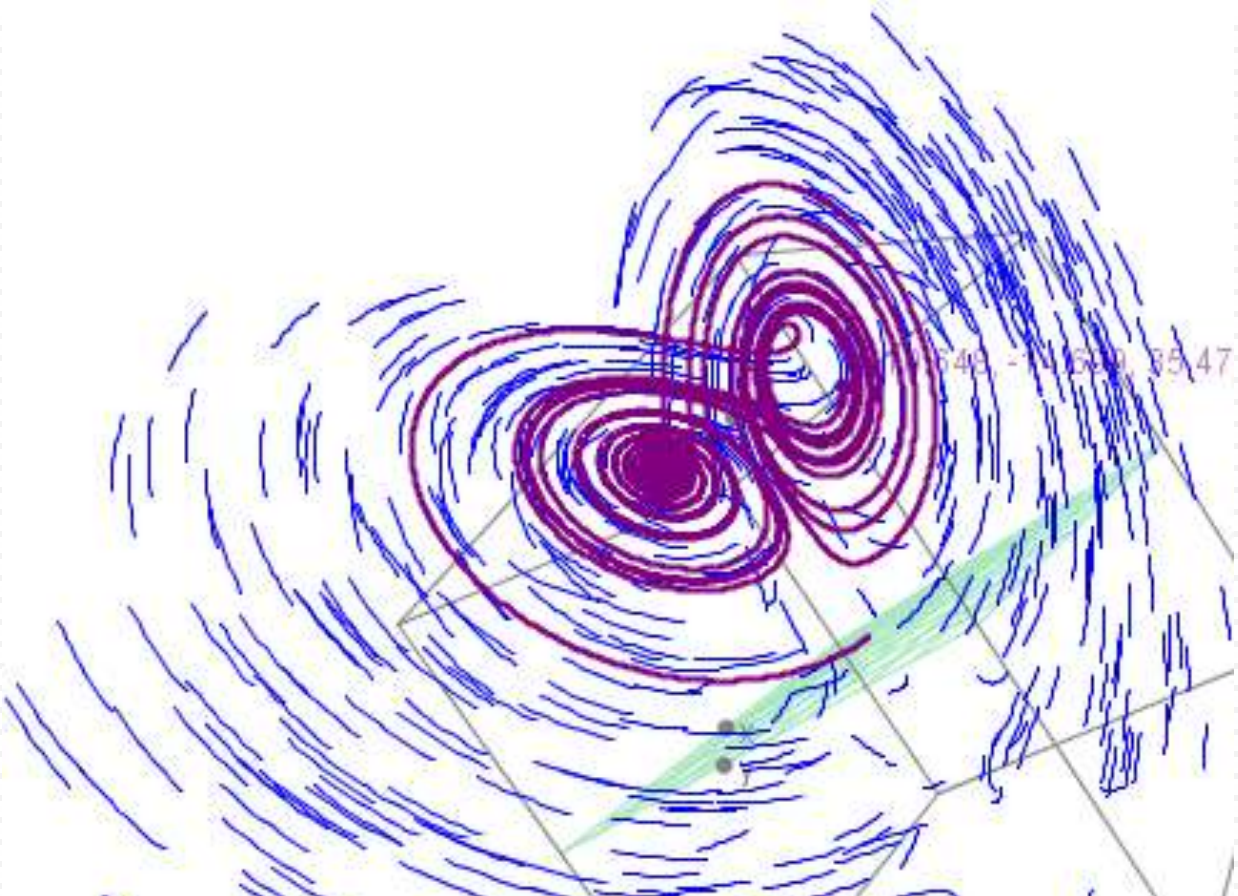


Technology "User Experience Spectrum"

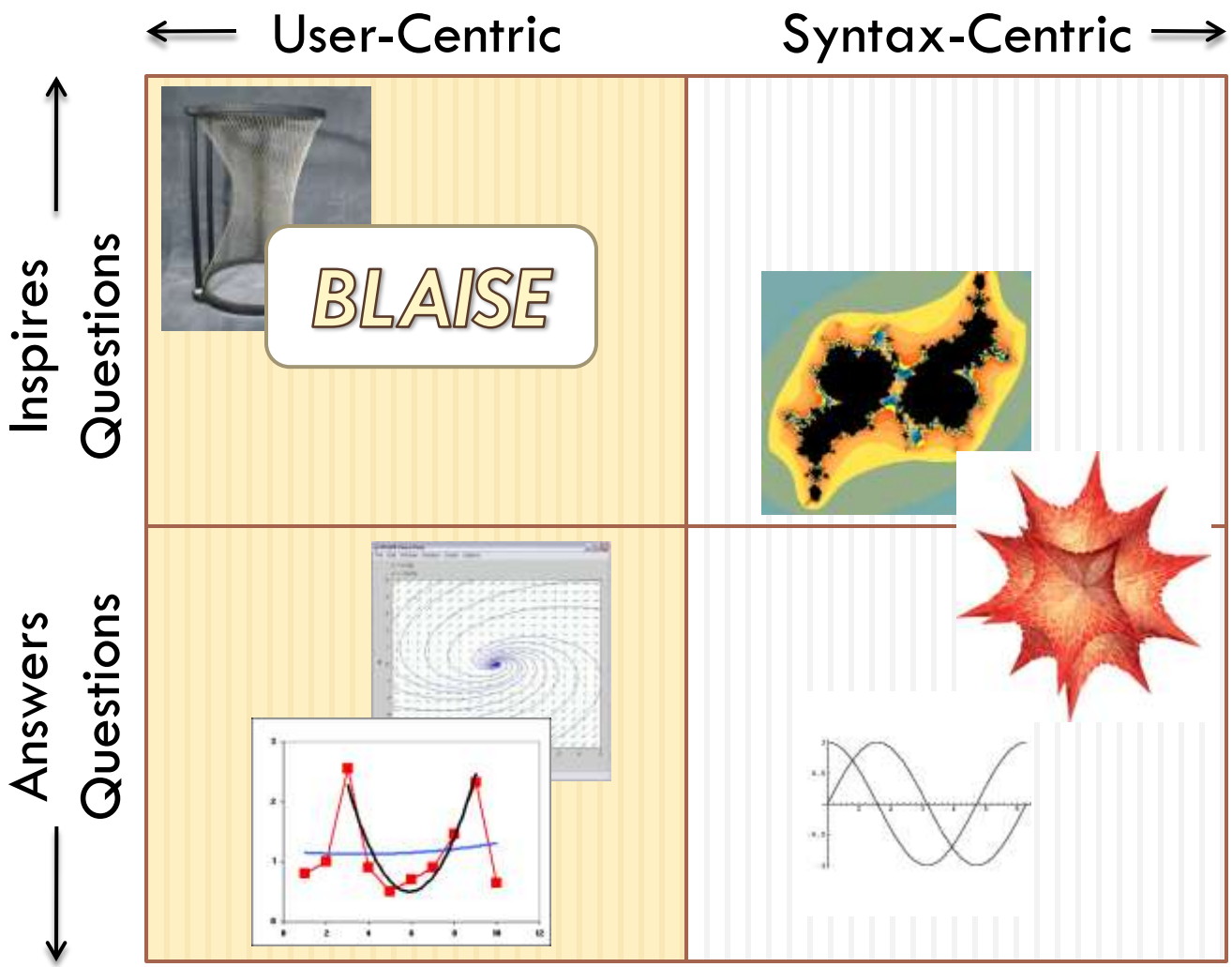
Syntax-centric **User-centric**

Should technology be designed to <u>answer</u> mathematical questions? Or to <u>inspire</u> them?

What is **Blaise**?

- A set of **user-centric** Java tools for mathematical **visualization** & **experimentation**
- Dynamic, animating visualizations are supported from the ground up
- Easy to design and deploy new applets; minimal headaches with installation/operating systems

The "Math-Centric" Vision for Blaise



1. Parameter Plotters

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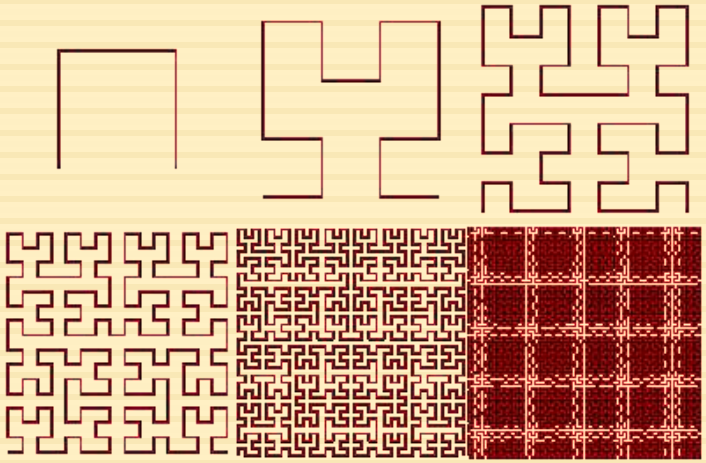

2. Fractal Curves

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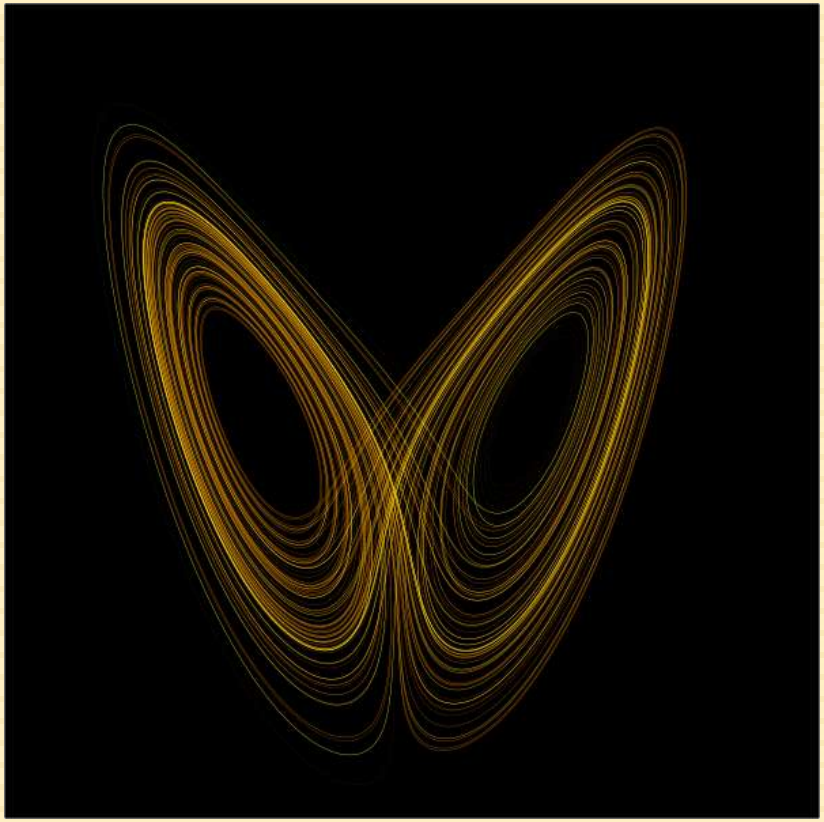

$$\frac{dx}{dt} = \sigma(y - x)$$

$$\frac{dy}{dt} = x(\rho - z) - y$$

$$\frac{dz}{dt} = xy - \beta z$$

3. The Lorenz Attractor

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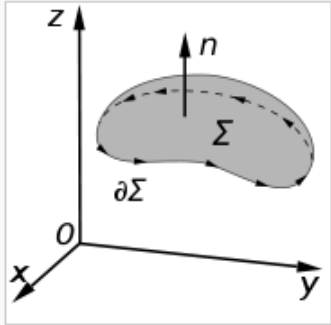
From Wikipedia:

Kelvin-Stokes theorem

[edit]

This is the (dualized) 1+1 dimensional case, for a 1-form (dualized because it is a statement about vector fields). This special case is often just referred to as the *Stokes' theorem* in many introductory university vector calculus courses. It is also sometimes known as the **curl theorem**.



An illustration of Kelvin-Stokes theorem with surface Σ, its boundary ∂Σ, and orientation *n*.

The classical Kelvin-Stokes theorem:

$$\int_{\Sigma} \nabla \times \mathbf{F} \cdot d\mathbf{\Sigma} = \oint_{\partial\Sigma} \mathbf{F} \cdot d\mathbf{r},$$

which relates the surface integral of the curl of a vector field over a surface Σ in Euclidean three-space to the line integral of the vector field over its boundary, is a special case of the general Stokes theorem (with $n = 2$) once we identify a vector field with a 1 form using the metric on Euclidean three-space. The curve of the line integral (∂Σ) must have positive orientation, meaning that $d\,\mathbf{r}$ points counterclockwise when the surface normal ($\mathbf{d\,\Sigma}$) points toward the viewer, following the right-hand rule.

It can be rewritten for the student acquainted with forms as

$$\iint_{\Sigma} \left(\frac{\partial R}{\partial y} - \frac{\partial Q}{\partial z}\right) dy\,dz + \left(\frac{\partial P}{\partial z} - \frac{\partial R}{\partial x}\right) dz\,dx + \left(\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y}\right) dx\,dy = \oint_{\partial\Sigma} P\,dx + Q\,dy + R\,dz$$

where P, Q and R are the components of **F**.

4. Stoke's Theorem

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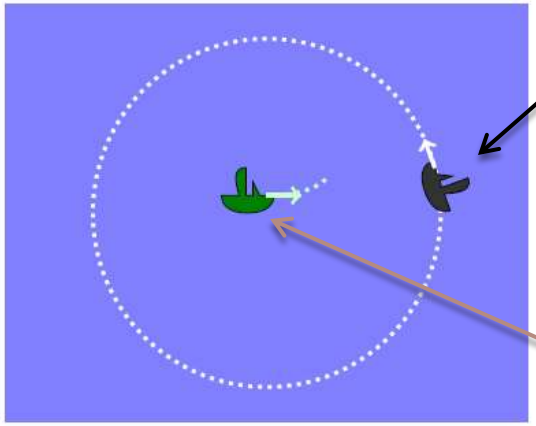
Problem 15: Concentric Chase

Two boats are traveling in open water in circular patterns. One boat is traveling in a circle along the parametric curve $\mathbf{x}(t) = \langle 10\cos(\pi t), 10\sin(\pi t)\rangle$ (constant speed 31.41592653589793 knots). The second boat can travel at half that speed, and *always heads exactly towards the other boat.* Find the location of the two boats when $t = 200$.



$$\vec{x}_1(t) = \langle 10\cos(\pi t), 10\sin(\pi t)\rangle$$

$$\vec{x}_2{}'(t) = 5\pi \frac{\vec{x}_1(t) - \vec{x}_2(t)}{|\vec{x}_1(t) - \vec{x}_2(t)|}$$

(Note: assuming that the two boats are relatively close to begin with, you do not need to know the starting location of the second boat. A numerical solution is okay, but an answer will only receive full credit with some sort of analysis.) *This problem was inspired by my 1-year old son and a remote control Hummer.*

5. A Chase Problem

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Creating a Blaise Applet in Netbeans

..\..\..\ pseudo-desktop\creating a parametric curve plotter.swf

The Future: Encouraging Exploration

- New user-interface technologies
  - XML input/output to save & restore files
  - Drag-and-drop
  - Gestural interface
  - Multi-touch screens
  - WII remotes

Questions?

Applets:

- http://www.dean.usma.edu/math/people/Peterson/blaise/

Source Code:

- http://blaisemath.googlecode.com

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