An open source program for studying iterated dynamical systems

Brainstorming, developing and using an open source software in order to help mathematics students dealing with iterated systems

Guilherme Silveira - gas@linux.ime.usp.br
Eduardo Colli - colli@ime.usp.br

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Freshman: learning math

New friends   Sports

Politics

Girls

Boys

Academic Life

Study math

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The end

Contact Info:

Guilherme Silveira

gas@linux.ime.usp.br

Eduardo Colli

colli@ime.usp.br

Iterador's homepage:

http://www.linux.ime.usp.br/~gas/iterador

Very soon moving to Grupo Arca: http://www.arca.ime.usp.br

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The future awaits

- Using it in the classroom
- Ask for its use on homeworks
- Watch its effects over the class
- We are looking for other Math teachers available to test it with us

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Numerical Analysis or Math Lab

- Differential equations or dynamical systems
- Qualitative analysis
- Using some iterative method
- Examples: Newton, Euler etc

- We will give a series of systems which will not be explained througly while we focus on their solutions

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What are the student's needs?

- Develop a graphical software

- Operational System

- Logic + language → C#
  → C++
  → Java?

- Display graphics?

- What about a dictionary?

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New challenges

- How to extend it? What about the mandelbrot set? What about Euler's method? Newton's? Runge Kutta? Can I calculate the fractal dimension? Liapunov's coefficient?

- All in one solution: use what was developed until now to change its behavior or create your own plugin

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Other features

- Plugin system
- Java hotspot (just in time compiler)
- Janino (might change to BCEL)

Most common result

- Stereotype #1
- Will find a way to cheat
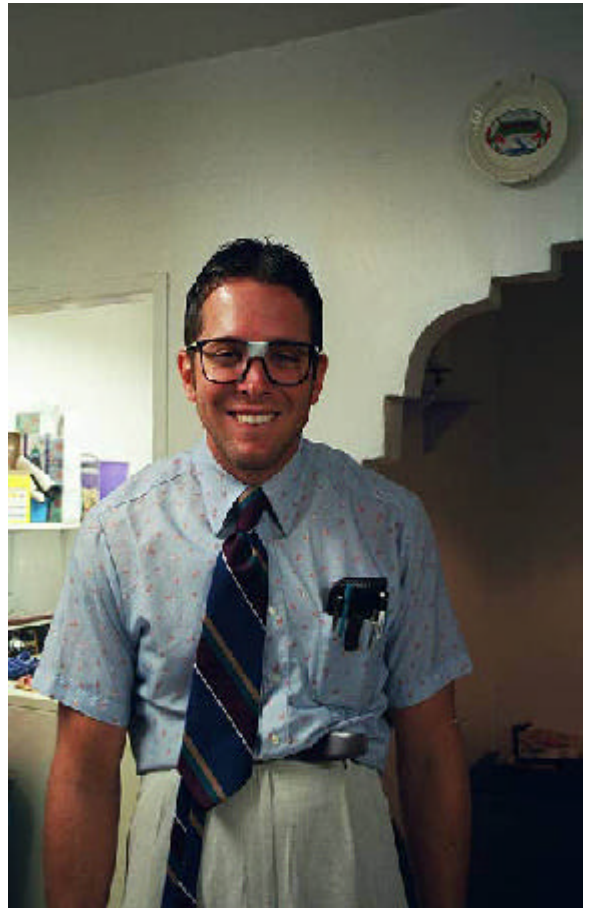- Copy from a friend
- Steal from a friend
- Deliver it later

Result #2

- Really common
- Feels incapable of studying
- Give up the class
- Give up Math

Bifurcations Diagram

- Question #7: by using a parameter, what is the relation between this parameter and the system's dynamic?
- Solution #7: studying the bifurcation diagram
- Example: The quadratic family

Studying the parameter's space

- Question #6: how does a parameter change the dynamics of a system?
- Solution #6a: creating cuts
- Solution #6b: creating 2D movies
- Solution #6c: who will create a 3D plugin?
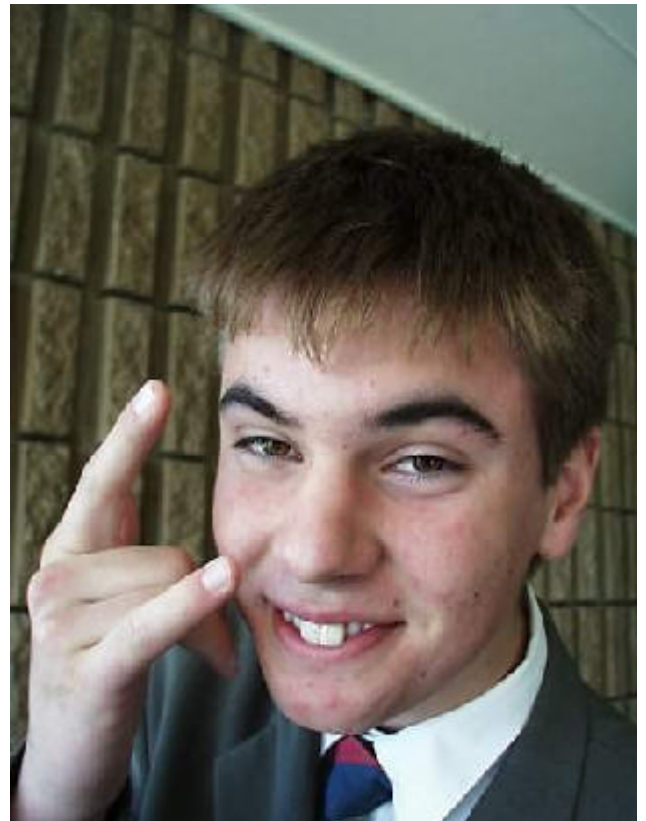- Example: Ugly map, with c in [1,1.6]

Result #3 – The uncommon freshman

- Hardcore type
- Sleeps less and studies more than enough
- Might learn it
- Might not learn it
- Will have his work copied by someone

Result #4 – Really rare

- He already knows how to program
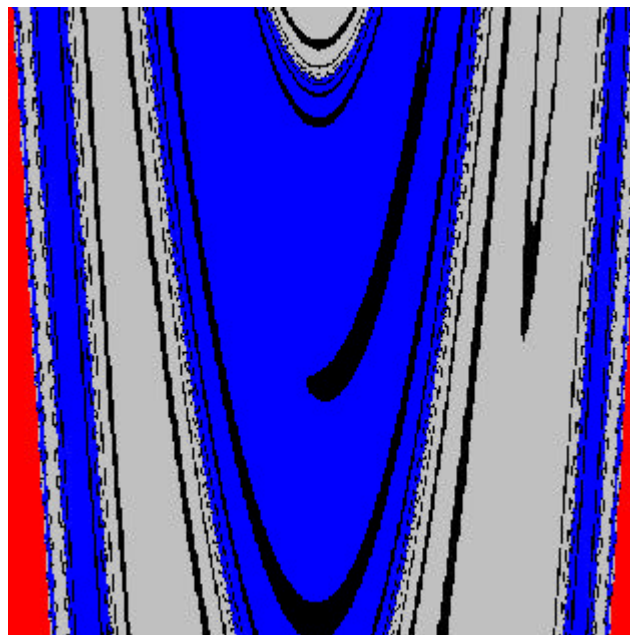- He has no problem with the english language

Nobody was found

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Henon – Basin of Attraction Plugin

Basin of Attraction (BoA)

- Question #4: what is the dynamics of the entire space related to each other?
- Question #5: existence of attractors
- Solution: for each initial condition use the BoA plugin to relate its asymptotic limit with the others
- Example: Henon with a = 1.2, b = 0.2

Due to those problems

- Developed an open source software
- Use it in the classroom
- Improve the students success rate
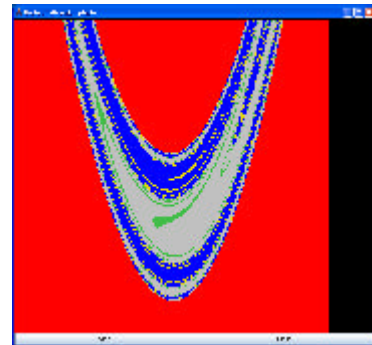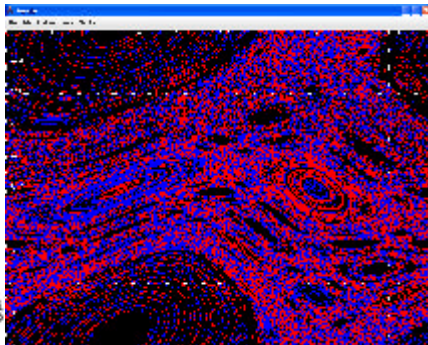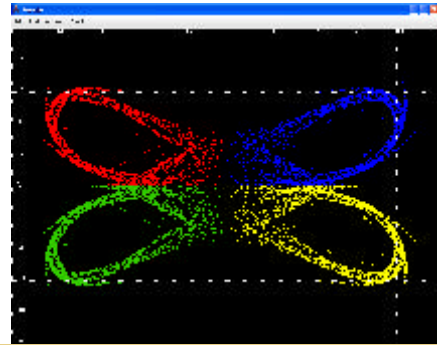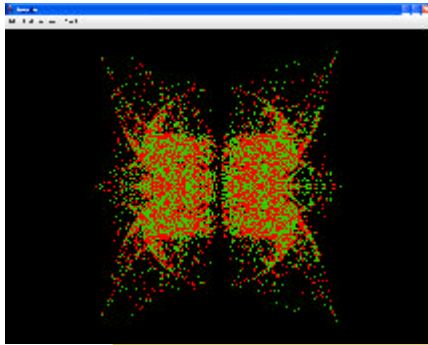- Learn a programming language: not at all, basic or advanced

Iterador was born

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Initial Conditions and Intermediate Expressions

- Question #3: what is the result of different initial conditions when studying their asymptotic limit?
- Solution 3: initial conditions plugin

- Question #4: what to do when we have smaller functions
- Solution 4: intermediate expressions
  - Example: Ragazzo - Zanata

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Henon

Iteration:

- x1 = 1 – a * x1 * x1 + b * x2 * x2
- x2 = x1

- Draws 20.000 points discarding the first 100

- Initial condition: (x1,x2) = (0.3, 0.1)

Asymptotic limits

- Question #1: what is the asymptotic limit of the orbit?
- Question #2: existence of periodic orbits
- Example: Henon with a = 1.4, b = 0.3