Computation in a Connected World

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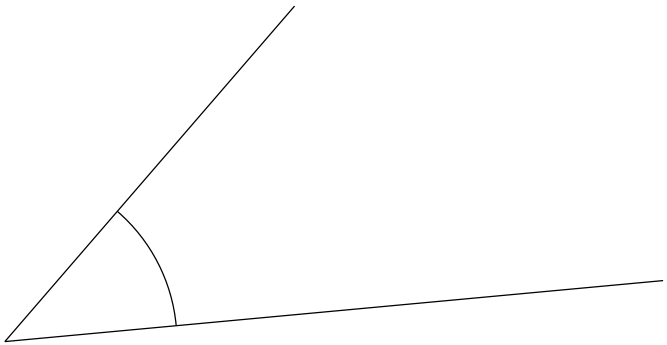
EDGY Event, ICT337

Abstract

- **Tools change** the way we think: re problems, solutions and **us**
- Digital computation is changing the wide world, and
- Changing research

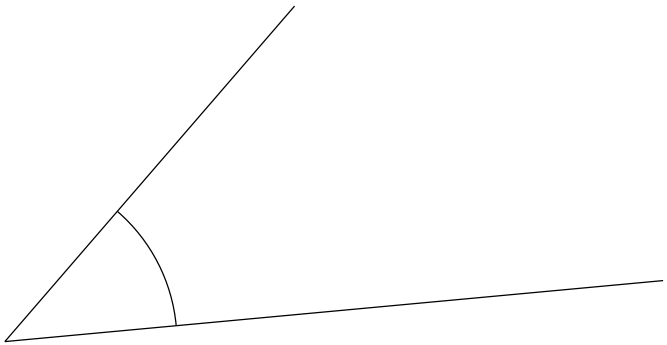
Tools influence how we think

Can I cut this angle in equal halves?



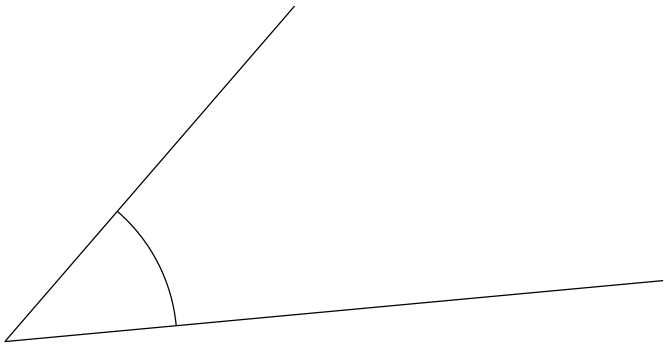
Tools influence how we think

Can I cut this angle in equal halves? **Yes!**



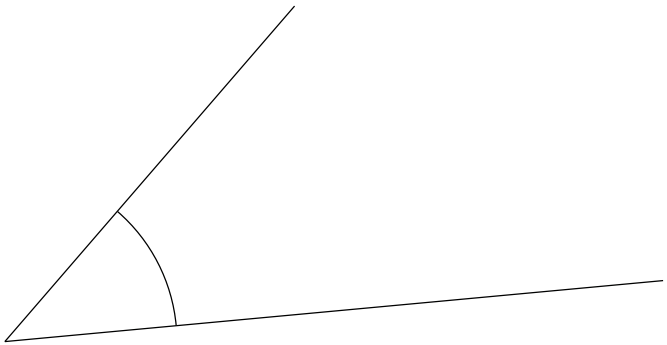
Tools influence how we think

Can I cut this angle in equal thirds?



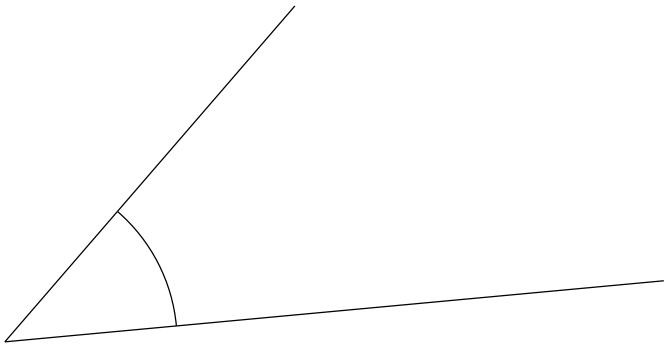
Tools influence how we think

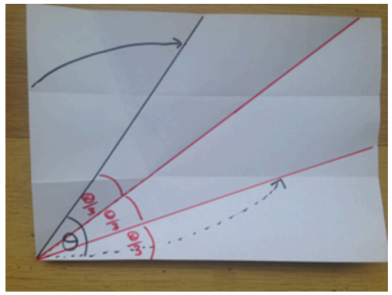
Can I cut this angle in equal thirds? **No!** *(Pierre Wantzel, 1837)*



Tools influence how we think

Can I cut this angle in equal thirds? Actually, **Yes!** *(with Origami)*

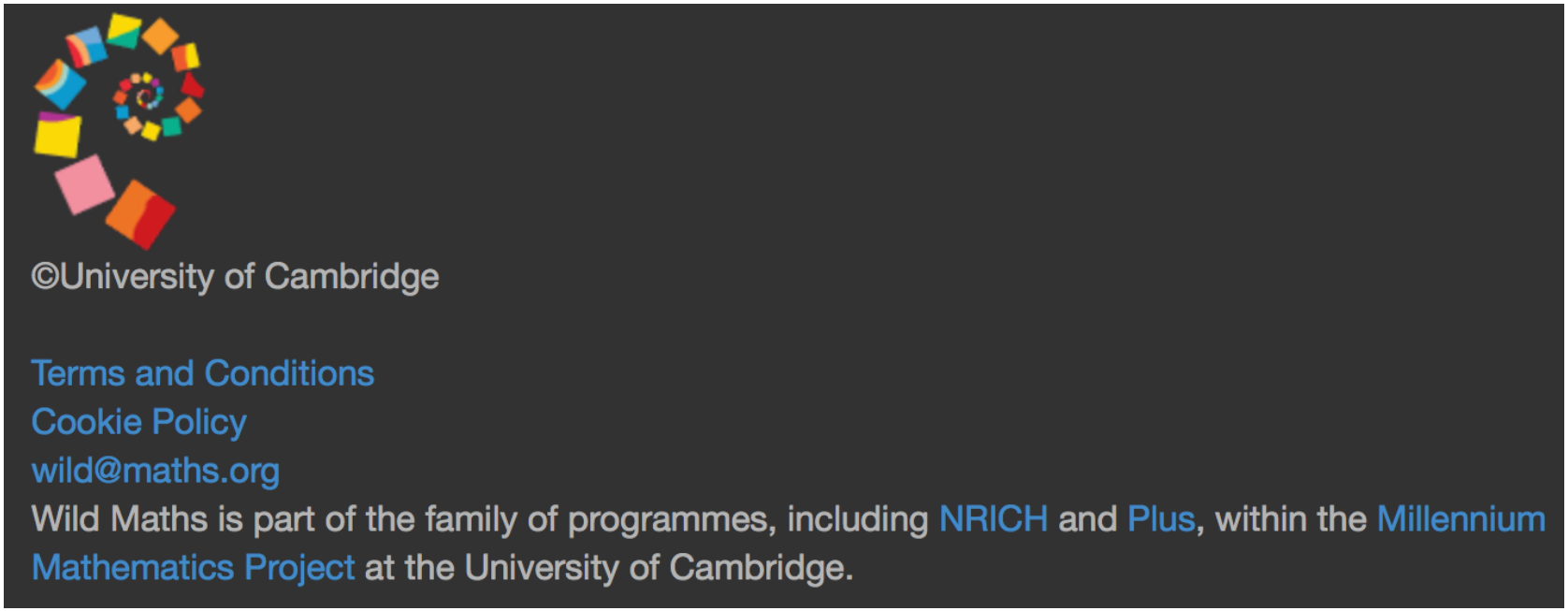




NB: angle trisection with Origami by Rachel Thomas is at:

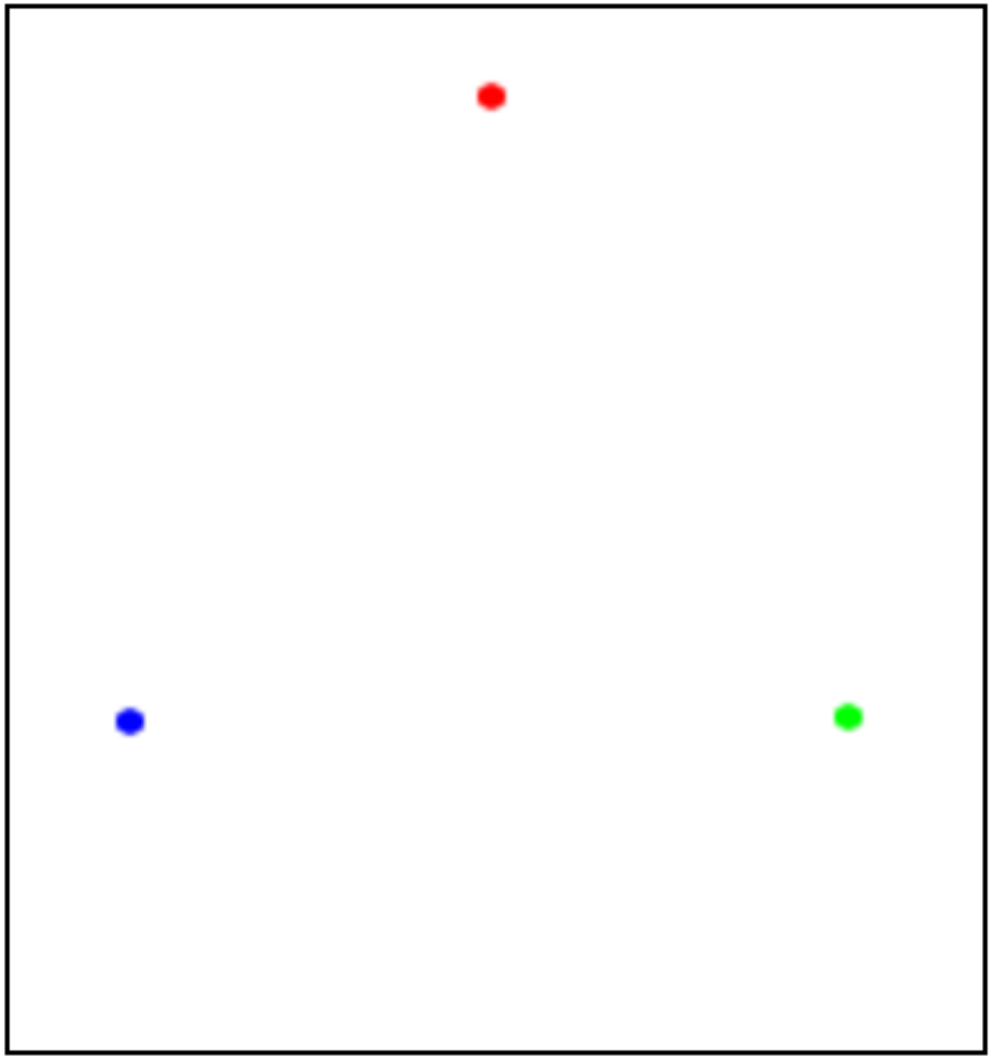
https://plus.maths.org/content/trisecting-angle-origami

This article was inspired by content on our sister site Wild Maths, which encourages students to explore maths beyond the classroom and designed to nurture mathematical creativity. The site is aimed at 7 to 16 year-olds, but open to all. It provides games, investigations, stories and spaces to explore, where discoveries are to be made. Some have starting points, some a big question and others offer you a free space to investigate.



Tools influence what we can see

Eg, the Chaos Game:



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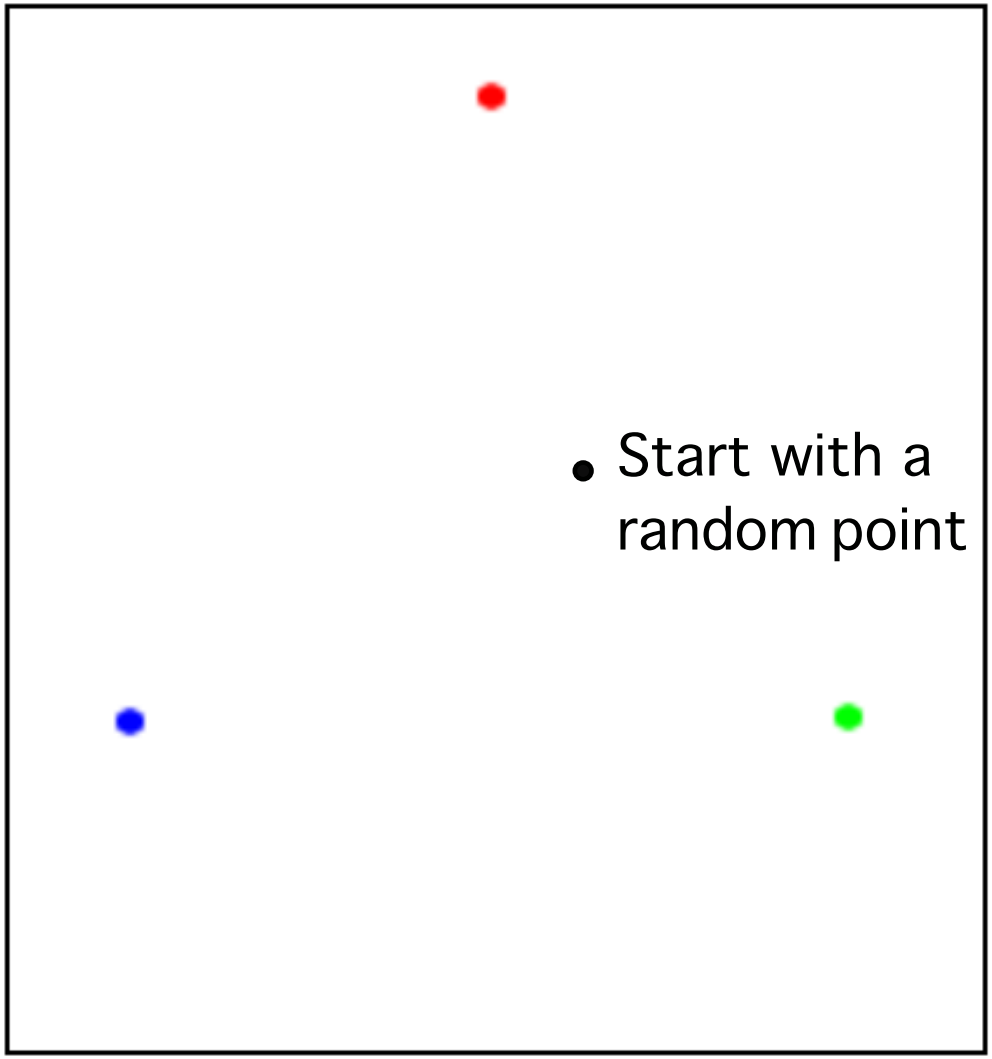

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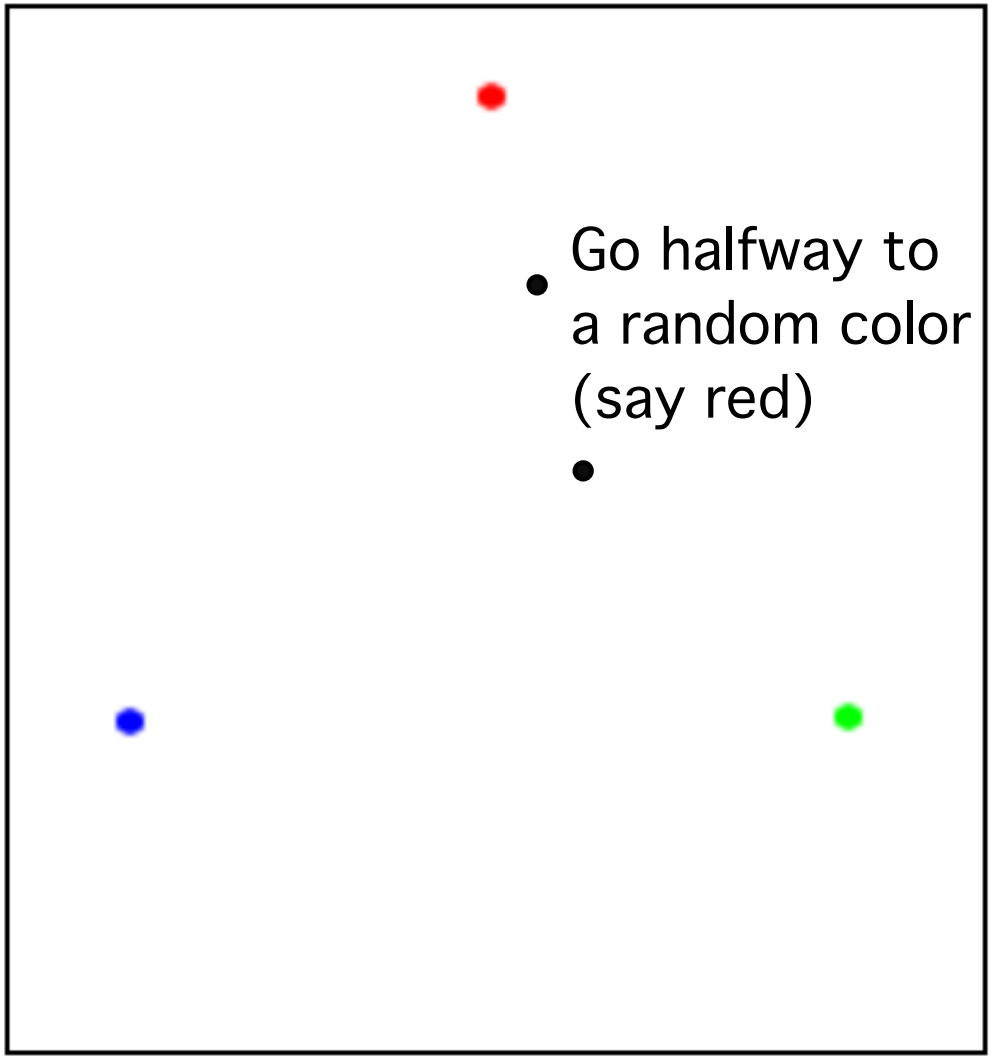

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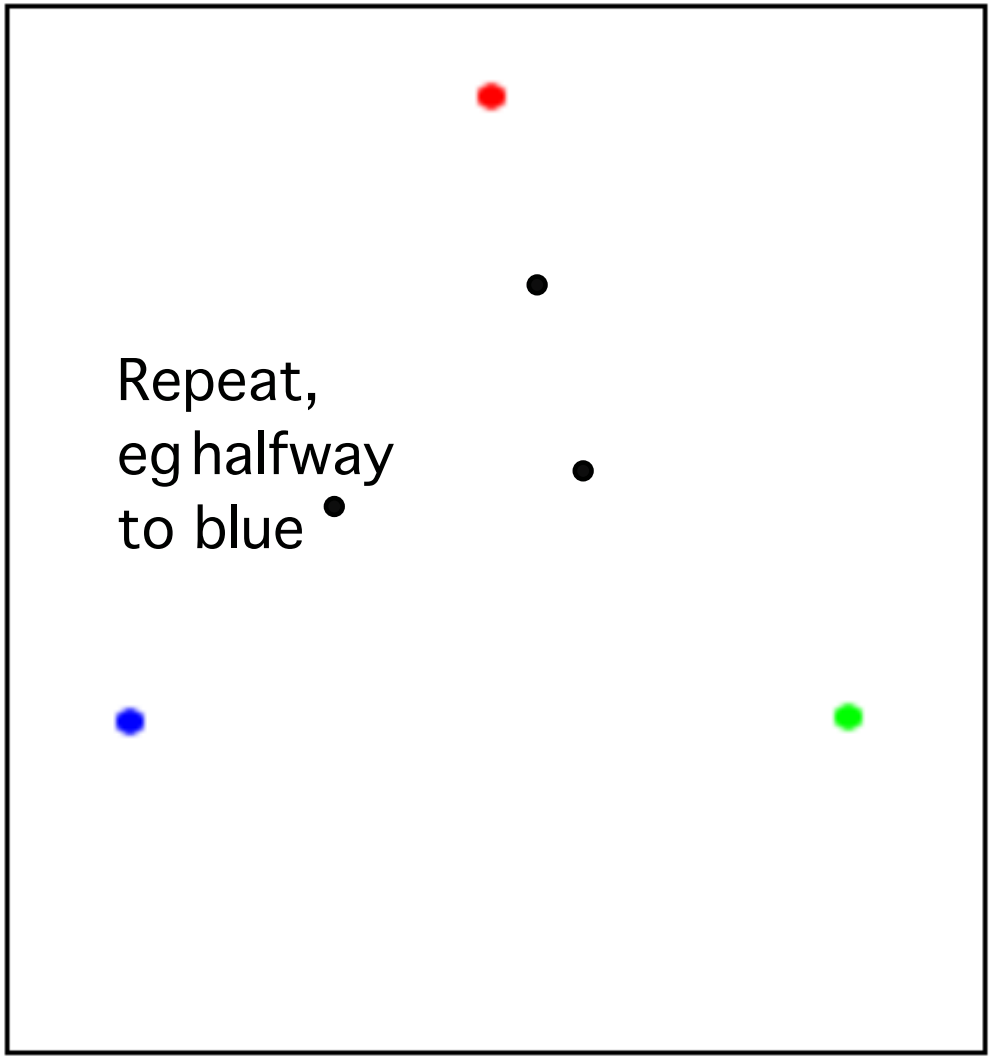

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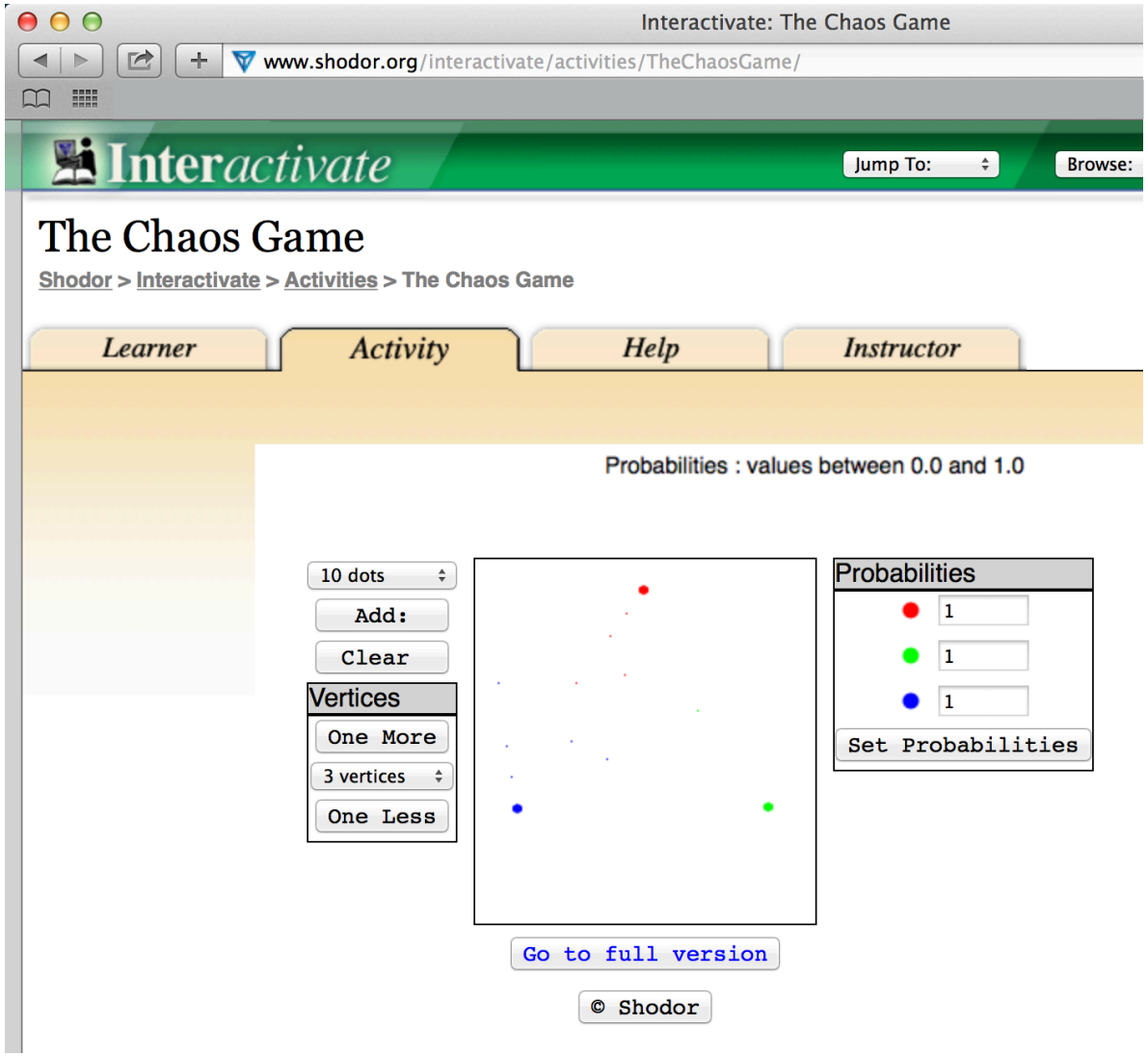

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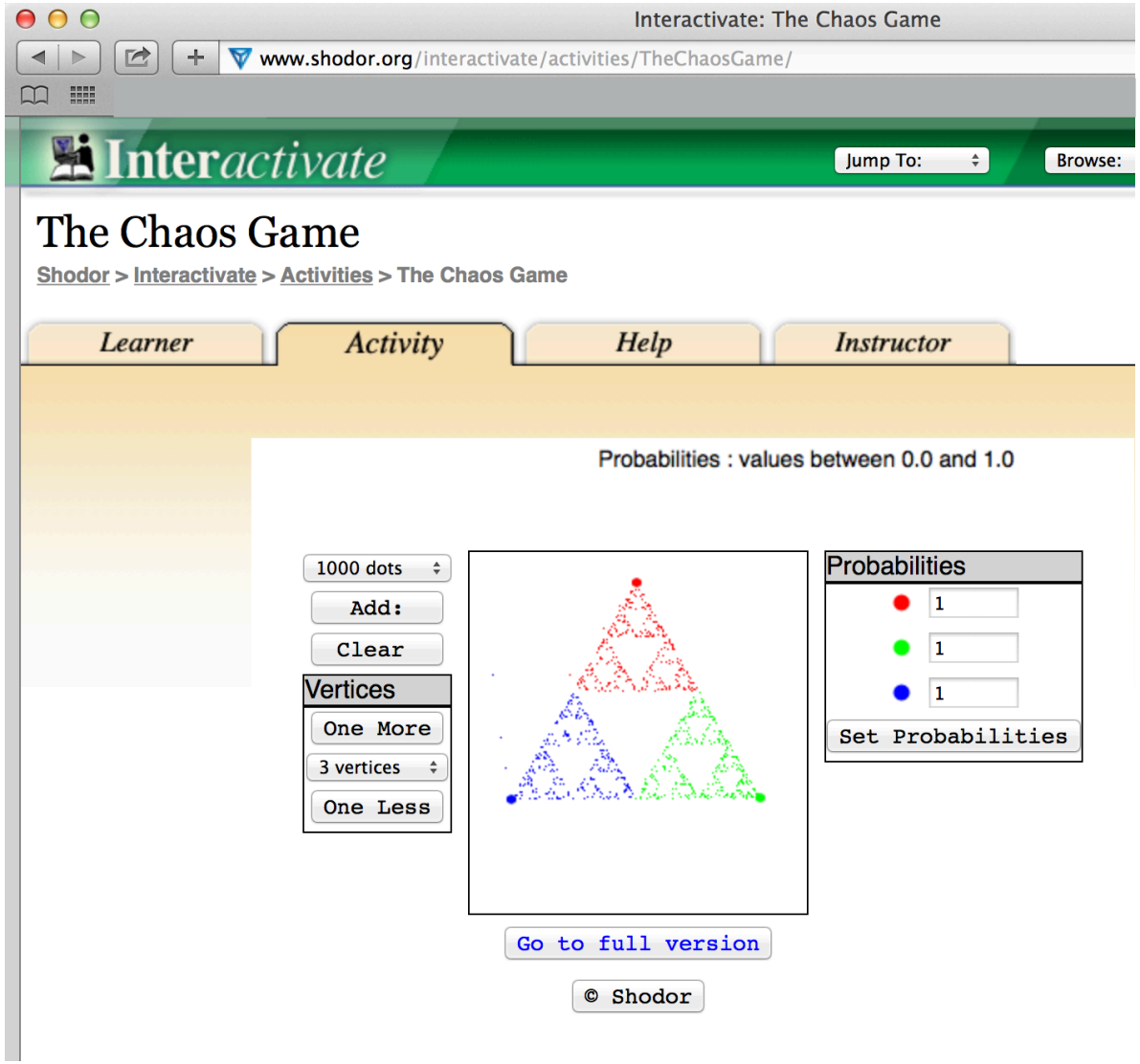

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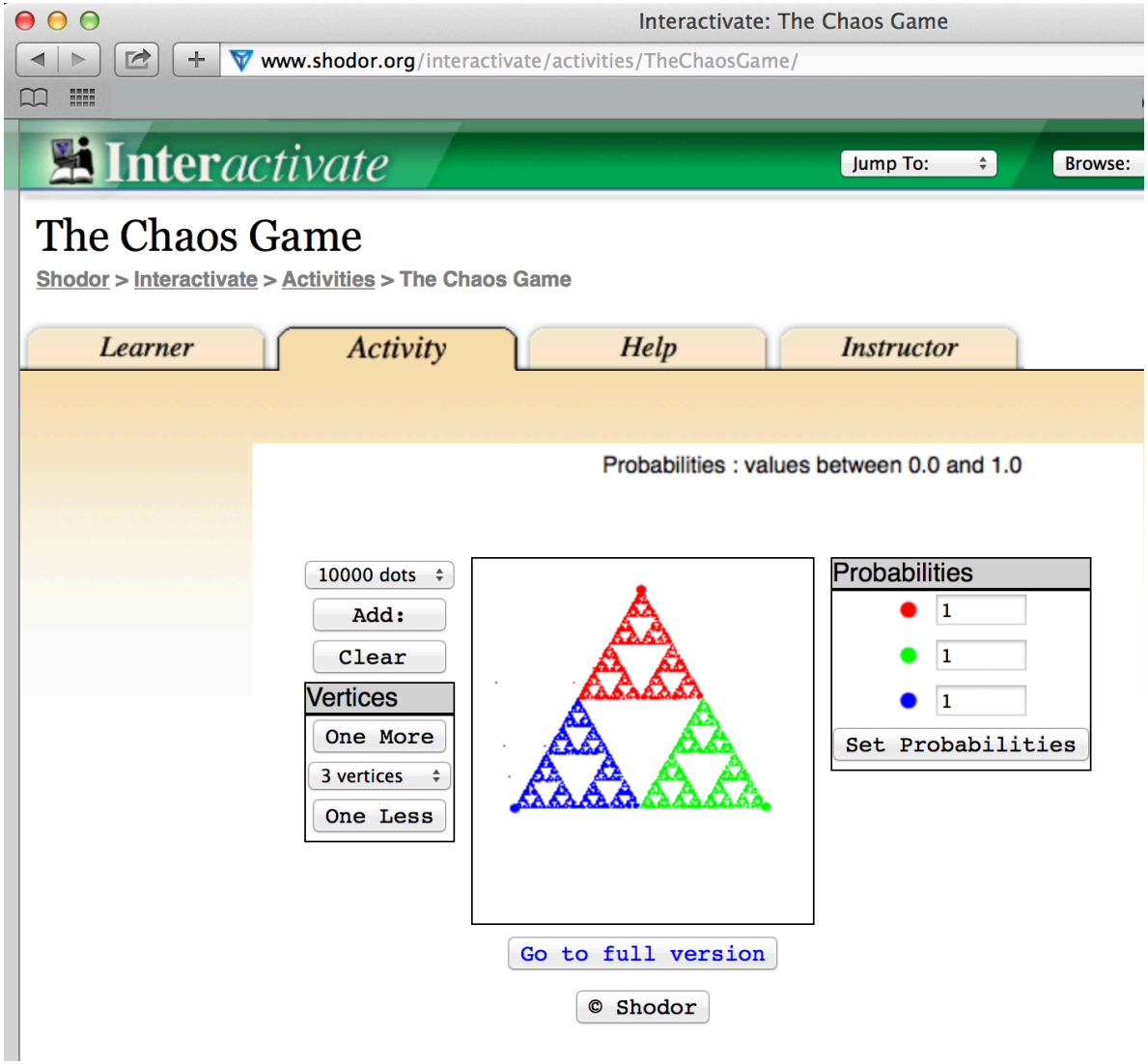
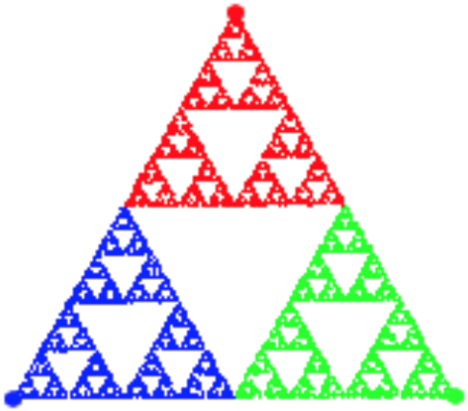


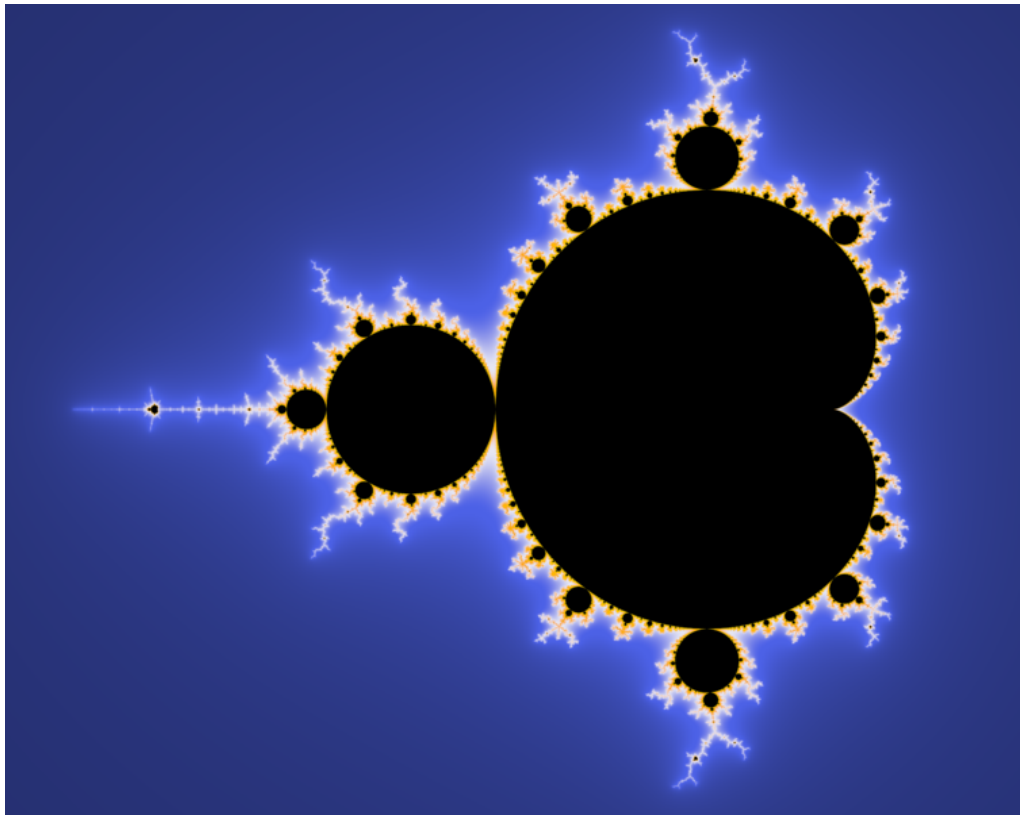
Tools influence what we can see

We can see the Sierpinski Triangle emerge from the Chaos Game because computers can do about 1000 000 000 things per second.



We can now see things we could never see before

Eg, the Mandlebrot Set



Comes from iterating $z_{n+1} = z_n^2 + c$ ...

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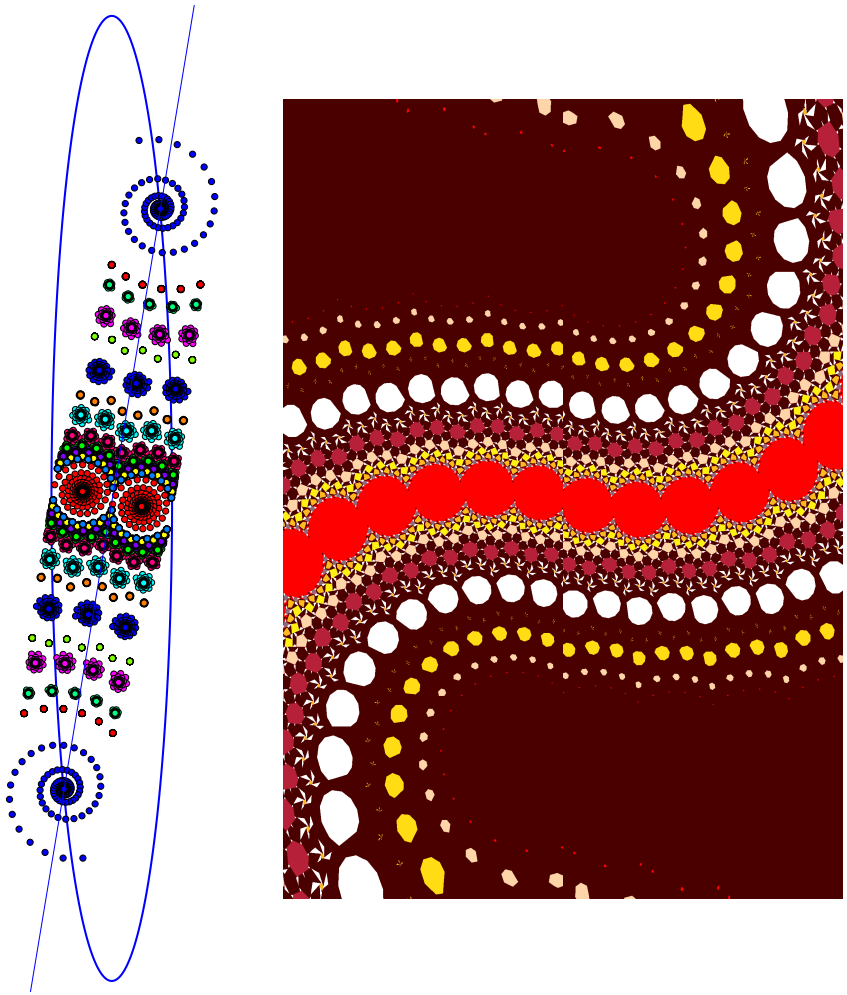
Eg, more examples of where an algorithm gets stuck or not



Jon Borwein, Scott Lindstrom, Anna Schneider, Brailey Sims, Matt Skerritt

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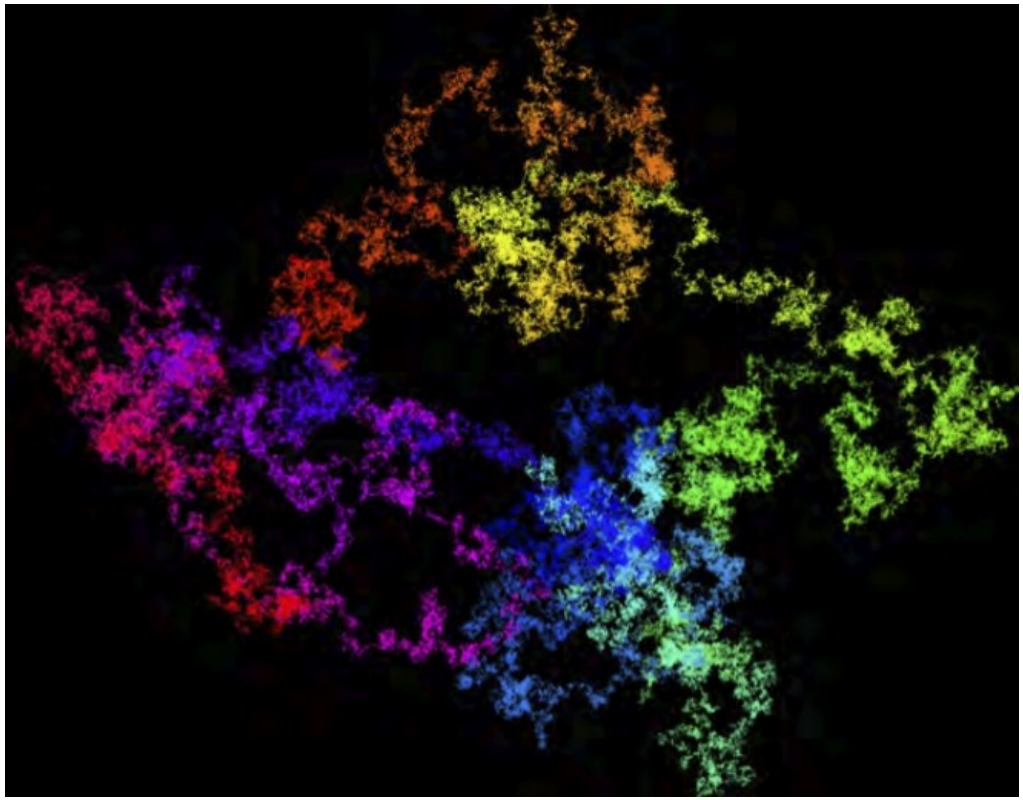
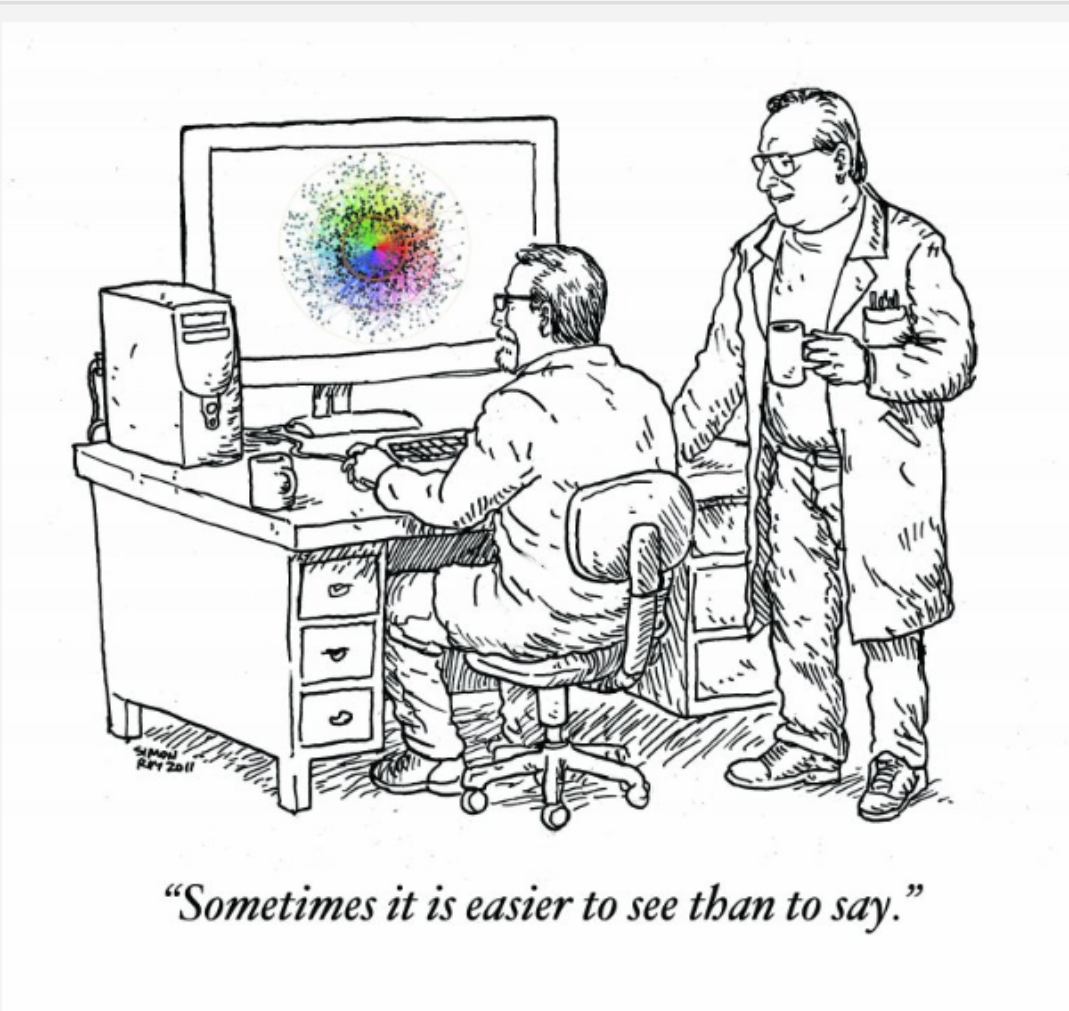
Eg, Pi in base 4



The digits are North, South, East and West

Veselin Jungic & Jon Borwein



"Sometimes it is easier to see than to say."

What implications, for a Connected World?

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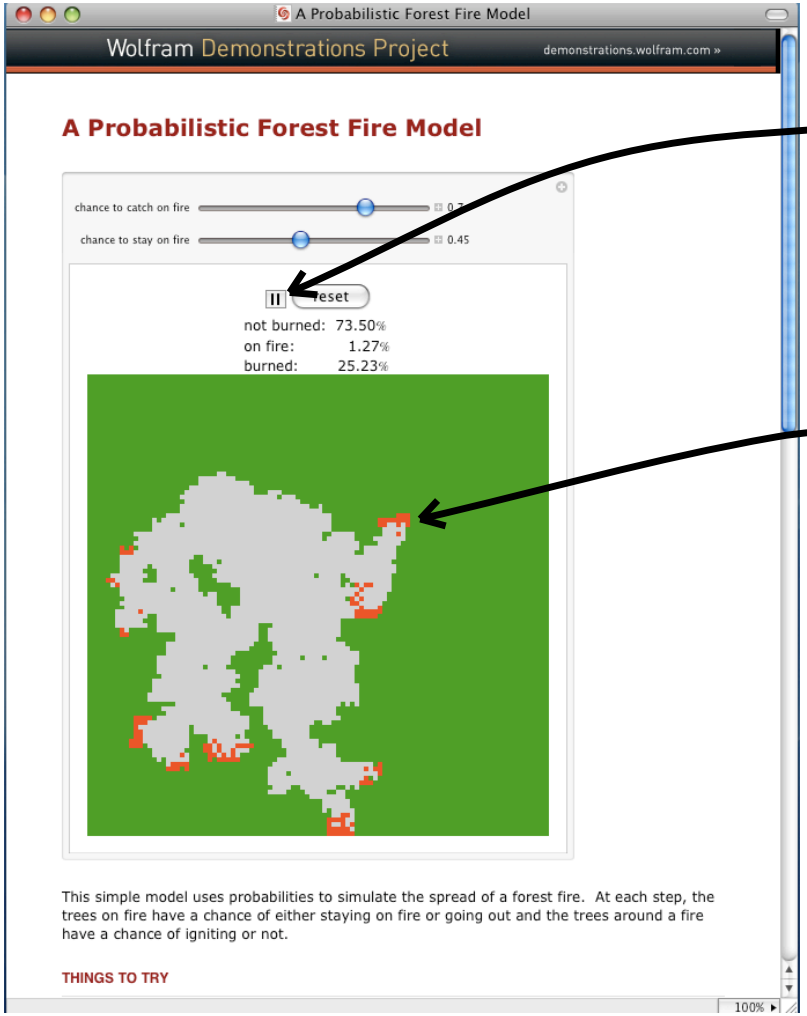
How do we get from anywhere to anywhere?

What implications, for a Connected World?

How do we get from anywhere to anywhere? *Ask google maps!*

Eg. "Computers" can now do: bushfire modelling



Hit Play

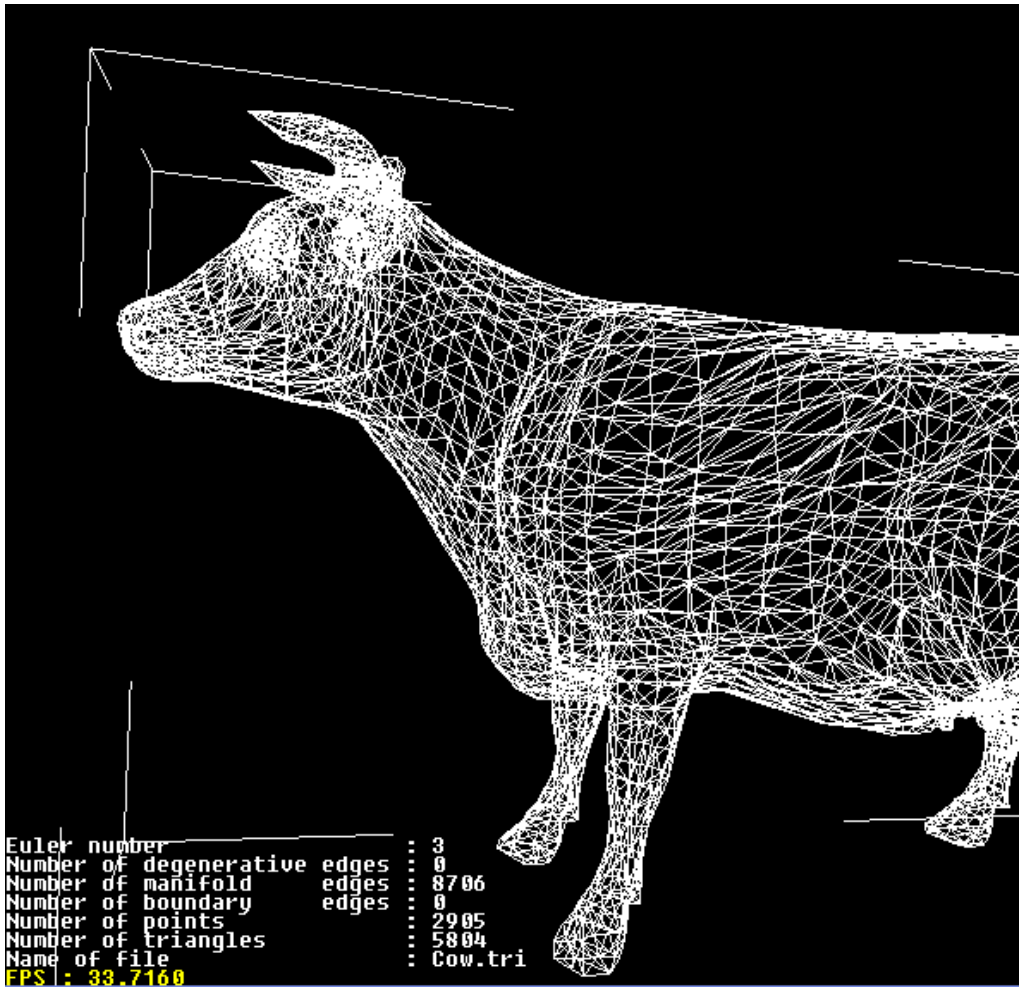
The `forest' burns

http://demonstrations.wolfram.com/

Eg. "Computers" can now do: predictive flood modelling

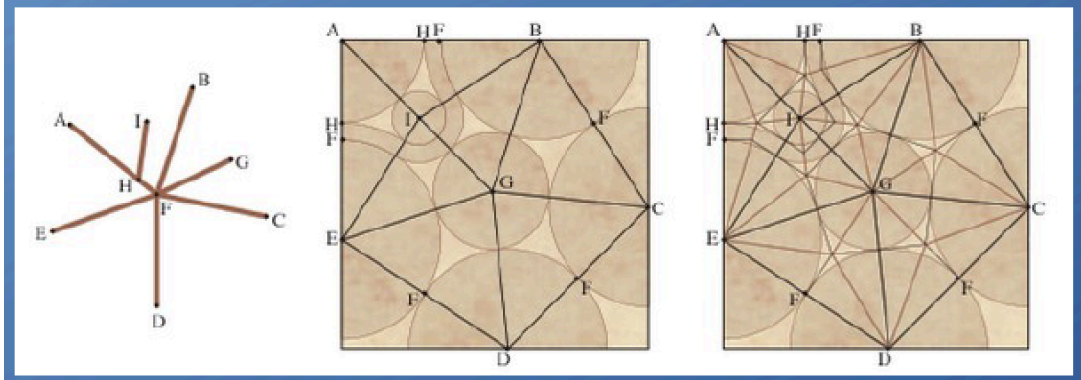
https://www.researchgate.net/publication/309683426_ANUGA-the_FREE_Ocean_Impact_model/figures?lo=1

Eg. "Computers" can now do: animation



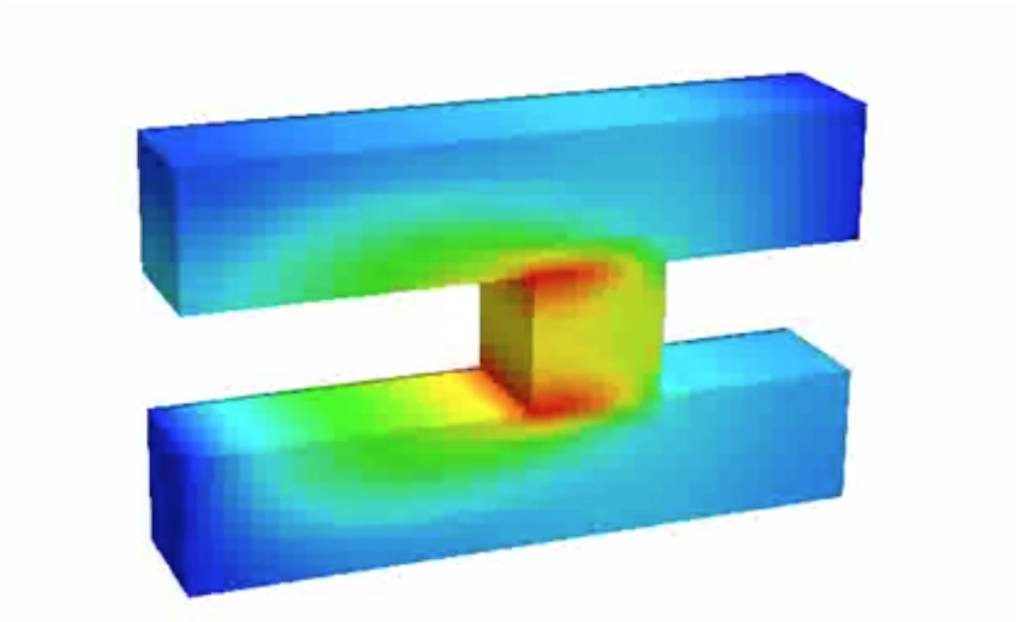
https://www.researchgate.net/publication/309683426_ANUGA-the_FREE_Ocean_Impact_model/figures?lo=1

Eg. "Computers" can now do: computational origami



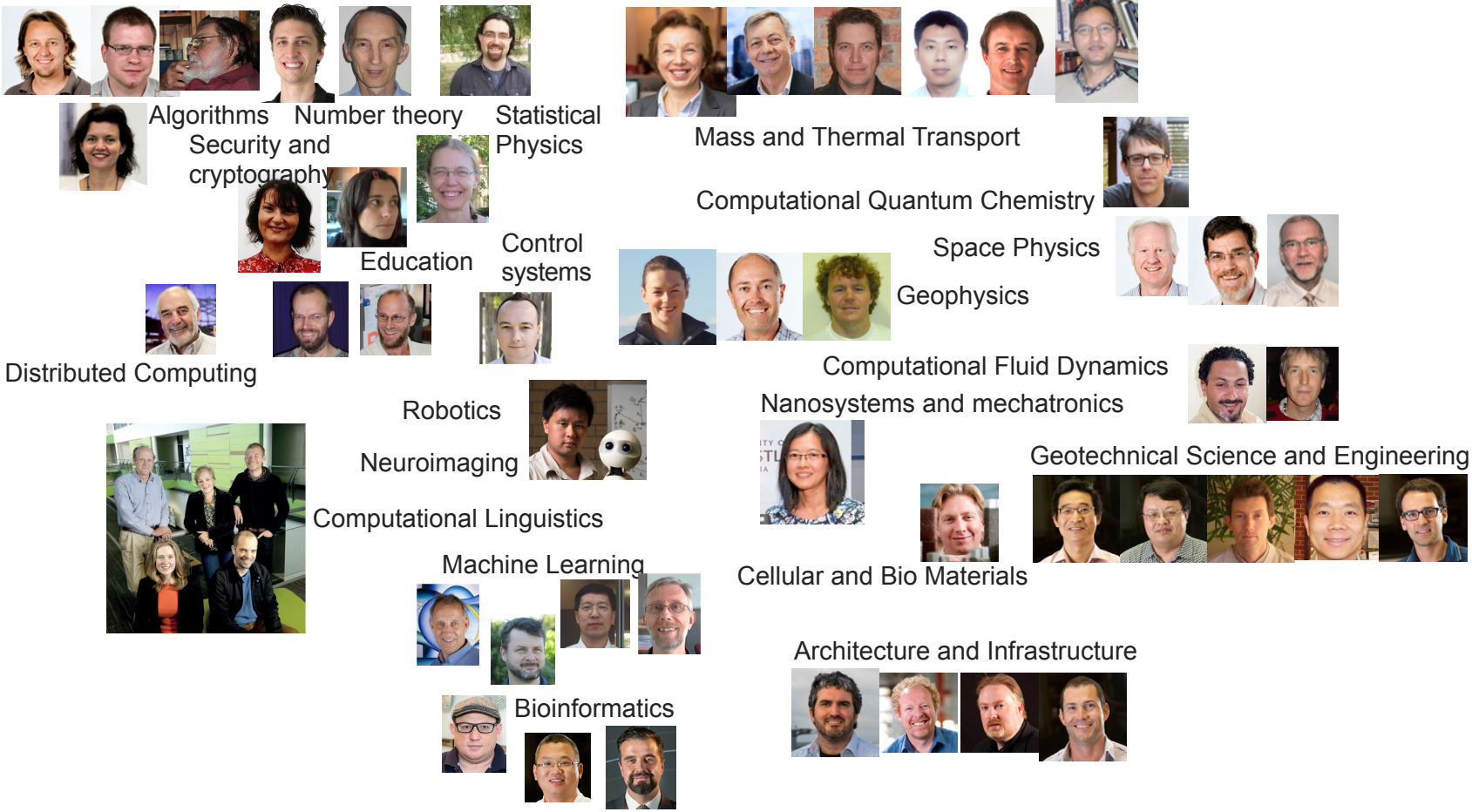
Origami Design Secrets, by Robert Lang

Eg. "Computers" can now: visualize heat from motion



From CARMA researcher Bishnu Lamichhane (finite element methods)

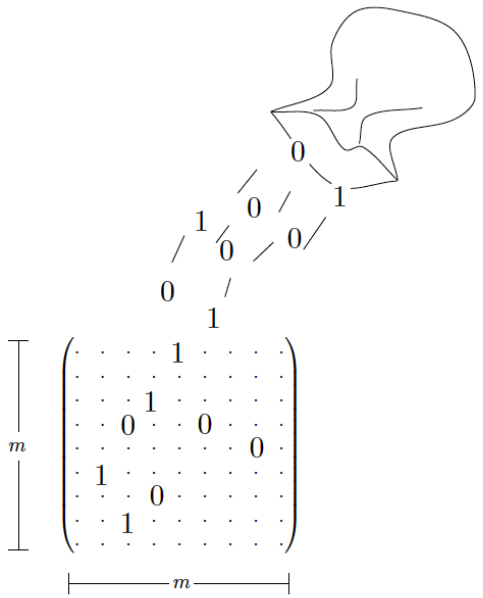
Sample: UoN Research Groups & People into Computation



A practical warning: computers still can't do everything!

Eg from my own research:

Order	max det	Time
1	1	*fast*
2	1	*fast*
3	2	*fast*
4	3	*fast*
5	5	*fast*
6	9	*order of days*
7	32	*order of years*
8	56	*order of the age of the Universe*



A moral warning (why we need computational education)

Cathy O'Neil's book "Weapons of Math Destruction" describes Mathematical Algorithms (hidden in code) that cause

- global financial instability
- inequitable access to college
- unfair discrimination in the criminal justice system
- unfair discrimination in access to health insurance
- unfair discrimination in access to employment
- social media filter bubbles possibly undermining democracy

Back on the bright side

Some quotes about computation from CARMA members

I use computation a lot in my research. Usually it suggests conjectures which might later turn into theorems. Also, I find that I make a lot of mistakes which are picked up by a computer as computer programs are rather unforgiving of mistakes or imprecision in definitions.

Professor Richard Brent

Current and expected advances in mathematical computation and scientific visualization make it now possible to do (teach, learn) mathematics in many varied and flexible ways.

the late Professor Jonathan Borwein

Some quotes about computation from CARMA members

Working on problems gives [students] the opportunity to engage in genuine mathematical activity. This can be challenging, engaging, creative and immensely rewarding.

The use of GAuSSian [Computational] tools can greatly assist in working and thinking mathematically.

Dr Malcolm Roberts

Questions?