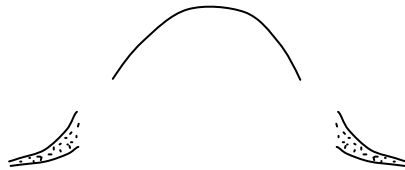


## What approximation leaves out

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The path of a ball thrown in the air is approximated by a parabola.



Parabola / approx.  $h/t$

But that leaves things out. What's missing is not just the slight drift & spin produced by the air. It's missing the tossing and the catching....

The data that doesn't fit any set model has seemed not to be useful, but also contains the information we have on transitional, unstable & complex natural systems.

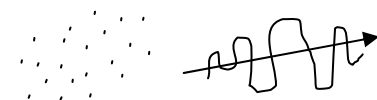
Patterns of changing structure don't fit formulas because formulas are patterns of constant structure. That data is often discarded as not useful, or represented with an approximation that proves not to be useful, but it's the model not the data that's the problem, leaving us with no more than ancient assumptions about why things begin and end or the nature of instability.

- beginnings & ends easily get lost, unique and shifting patterns, appearing & vanishing into the background, not recognized till fully developed. [But how can we be sure something is missing? What things begin and end?] If you just have the data, a parabola looking shape might not be a ball tossed in the air, might be a segment of a sin wave with it's beginning & end far away, or might be the peak a recurrent epidemic with that may never quite go away, or just an artifact of viewing a combination unconnected events that has that shape but no underlying process at all.

the unstable messy parts of nature

that mess up the formulas and science has been sweeping aside as unimportant and let us build a whole civilization with no useful knowledge of them.

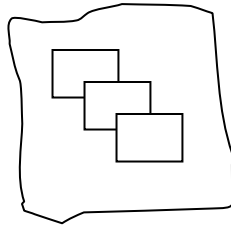
- When can you interpret dots as curves?



Irregular data looks like noise & trend, or might be complex fluctuation, start with a guess to be confirmed by

other things.

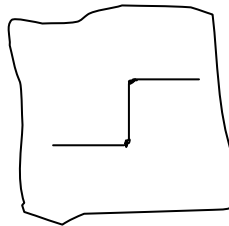
- Things to indicate kind of connection
  - obvious shape in data,
  - prior knowledge of the physical system,
  - assumptions like complex fluctuation,
  - overlapping incomplete information on independent processes (noise)




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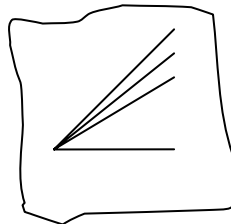
Example of separating multiple shapes for a single data set

- evidence of change that can only occur by a developmental process



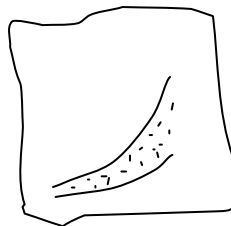

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Step changes, discontinuities, history dependent transitions, beginnings & ends




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Find or rule out random walk where the logical default assumption is accumulative random change.



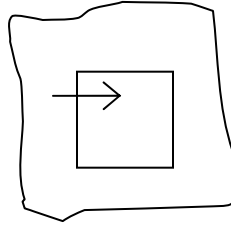

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Find or rule out developmental process, where the logical default assumption is sequences of events that fit between the upper and lower bounds formed by exponential (developmental) curves.

- a physics question,

*What is it about nature that makes it useful to describe discontinuous data of complex untraceable systems with mathematical functions, as if natural systems had derivative continuity?*

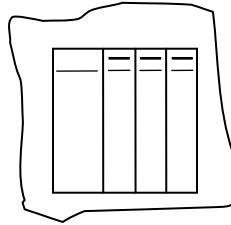
- shapes implied by the conservation laws




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Inside any perimeter, energy isn't created or destroyed, so has to travel across the boundary.

Because the flows of energy can't begin or end instantaneously, the need to develop



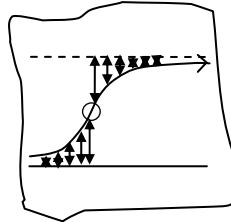

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The conservation laws can be expanded into an infinite series implying the necessity of periods when all derivatives are of the same sign at beginning and end of any energy flow.

- A general model of natural systems events

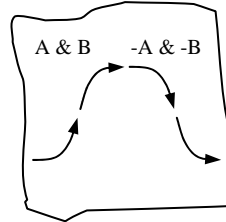
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Breaking Away +  
Homing in x1




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Breaking Away +  
Homing in x 2



— To find these transitional structures it takes a different set of tools and assumptions. Learning to watch how nature changes definitions in real time, rather than having to wait until following the old rules causes problems with operating in new worlds.

Because developmental processes have definite but feint beginnings and ends, usually hidden in the background of other events, it's important to have modeling tools that strictly minimize their imposition of structure on the data, while helping to reveal the subtle changes in regularity.

You then get to ask, what is the continuity that is developing, [the loops], why is it invisible [we're out of the loop] and why would development trigger other kinds of change [growth is a developing instability].

Flowing continuity [over time, rather than in space] seems to be the appearance of the systems scale of natural organization from the outside point of view.

Reading math in the plane of the page, reading the systems perpendicular to the page.

- Examples

Gamma Ray Burst, Plankton evolution, NYC Crack Epidemic