Toy Models

Explain & predict systems using the dynamic medium

dict systems
e generative ecology
sketches

@jatazak

Computery Zine Fest, 2/24/19 @ !!Con West
Explorable methods
for scientific development in an open & replicable ecosystem.

Reproducibility lets us ask ‘what-if’ questions:

What if this rule fired more often? Knock out its precondition.
What if this rule had stronger effect? Knock out its antagonist.
Etc.

Biology is living computation.
An opinionated medium that resists and generates.

Human-computer interaction techniques naturally engage us with alternative physiologies and ecologies.

everyone accesses the thing on the web

or in the wild, same difference, same chance of rotting away

Biology computes optimal self-reproduction on a physical substrate.
Every creature a canvas.

Homeostasis is robustness of oscillators, an entropy pump.
Morphogenesis is procedural generation of form, through gradients.

So we perturb our subject,
and sample its latent space.
Small Data
abhors redundant items
low input latency -> continuous deformations for free
not 10k rows but 100
not seconds but ms
salient examples lie at the boundary\textsuperscript{1} of some parameter or feature
make equations that make your solver happy

Visual Debugging
use OpenGL thru Processing
or SVG thru D3.js
or GLSL thru VisPy
etc.
visualize during development
Some bugs don't fit into the console. They're a signal with 1000 elements.
They're a misalignment of strokes.
Visualize to ground your intuition & to share with human audiences.

\textsuperscript{1} To navigate is to exploit continuity between the map and its territory, so that small changes in direction produce small changes in position.

Boundaries are narrow features over which a large change is measurable. Some boundaries on the map are invisible on the territory, or inexistent until reified. The assumption of a boundary creates a boundary.
visual parameter space + realtime feedback

parameters don’t start orthogonal, or scaled well, or bounded well
features don’t come bounded well, or scaled well, or perceptually independent

A scaffold parameterizes a manifold in artifact space: it is a latent space, a vibe². A scaffold can be stepped through by enumerating points in its parameter space.

A scaffold is a collection possessing actions and identities: it can be stepped through by successive actions on one of its points.

A scaffold is a technique for escaping basins of attraction (familiar ruts) through measured constraint.

A scaffold is a collection of properties.

‘the space of driving strategies is made of turning strategies and degrees of road bendiness³,
‘the organ is made of cells made of protein assemblages in a signalling bath’
‘the sketch is made of coherent volumes made of a gestalt of shapes built from strokes and marks’

² in @peligrietzer’s sense
³ in @worrydream’s ladder of abstraction
but you can nudge them closer.

Your mapping representation matters. Is it playful? delicate? redundant? complete?

Every input shoots a point in our **expressive range**. If automated, or dedicated\(^4\), our input may trace a path (continuous perturbation) over this curved manifold.

Thus we sketch the elephant, and declare that it is a grey and coarse thing, but also ivory and smooth.

We may sample points spanning the domain without necessarily spanning the range, if the mapping to our manifold is not 'uniform'. If we cannot sample many points, errors of omission will occur.

Thus the scaffold is truer than the utterance.

Every rhythm is a scaffold.
Every consistent ground truth is described by some scaffold.
Any scaffold that describes all ground truths returns noise.

\(^4\) in the manner of Calvino or Cage
**Model-Making Toys**

*what is rich input?*

- static plot generators: static flow, rich output
- linear notebook cells: mostly static flow, rich input

**short chunks**

An interpretable input follows one of a few possible execution paths. More than that, and you're doing work the computer is better at.

**neat representation**

Data possesses hidden structure, and a manifold over it is called intuition. This dimension reduction lets us ask high-level questions, like what-ifs. It can be encoded into a model.

Equations possess explicit structure, and can be read for intuition. More likely, the computer can read them, and represent them as data, encoded into a visualization.

**algebraic internal interfaces**

- Vector arithmetic.
- Explicit Some[T] (either T or None) types.
- More monads like these, please.

**All languages of improvisation** - motions of pointers & joints reconfigurations of inter-agent distances & social geometries cadences of overtones & stringed instruments, - **can be used as input.**

To teach these to the computer, we can't just trip on statefulness, nor be restricted to input files.
Operational Logic: Discovery

Graphics are structured data bound to a visual artifact’s parameters.

**motif**  **verb**  **idiom**
Signals are arrays of floats\(^5\) indexed by time or frequency.
Finite-length signal data is a shape.
Signal data with spatial coordinates is a field.

dataframe  sort  coherence
filter  ‘show less’
oscilloscope  trace  streaming
timeline  mark  perturbation

Dataframes are arrays of object-state, indexed by identity.
Finite-length dataframes have block-structure(s), revealed by sorting.
Dataframes with spatial coordinates are a map of features.

canvas  pan  ‘show more’
zoom  ‘go deeper’
tabletop  drag  tokens
tooltip  select  etc.

Agents are rows in dataframes, equipped with local interaction (in spacetime), which yields coherence of shape.

Their spatial relationships form a topology. Their temporal relationships form a trace.

From agents arise emergent behaviors.

\(^5\) in @galaxykate’s rephrasing of ‘vectors over the reals’
explorables are interpretable artifacts
all experiments are designed to tell a story about theory

all codes perform an experiment

an explorable is a code that tells a story through an artifact

an artifact that is interpretable affords the experimenter a useful interface

to methods that enable them to see