Textile matters: a transdisciplinary manifesto

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Combining terms from different disciplines, this textile text reterritorializes multiple lines of thought that in one way or another evoke tissues, threads, lineages, braids, just as the Universe's material weaving through spacetime is bursting with self-reference.
The narrative threads that constitute a field of knowledge can also be used to reconnect the fragmented disciplines separated by the reductionist doctrine of the dominant scientific epistemology. This text sews the artificial epistemic cuts imposed by the discipline boundaries, proposing a textile approach to think about matters in between disciplines, across-through-beyond their borders. It attempts to use language as a connector instead of abusing exclusionary jargons.

Axiom I: A material point draws a line in spacetime. A material fiber. A string.

Axiom II: Encounters between fibers affect their trajectories - bending, twisting, braiding them.

Definition 0: Single fibers define a minimal territory around every point in spacetime they traverse.

Proposition I: Single fibers are the simplest building blocks for a recursive assembly process.

Definition I: When materials assemble, they become a [mobile, open, fractal] territory.

Definition Ib: A territory delimits what is internal, marginal or external relative to it.

Definition II [mobility]: A territory is braided according to all of its movements.

Definition III [openness]: A territory is always open to exchanges with other territories.

Definition IV [fractality]: A territory may be recursively composed of internal territories.

Corollary: The assembly of different braids also forms a braid.

Theorem: The entire Universe is braiding itself in spacetime.

Proposition II: This axiomatic system is open. The following lines extend it in other textures.

"The geometric method ceases to be a method of intellectual exposition; it is no longer a means of professorial presentation but rather a method of invention." (G. Deleuze, *Spinoza: Practical Philosophy*, trans. H. Hurley, San Francisco, City Light books, 1988,13.)

A Universal recipe

[Unravelling threads]

1 - Think of a system. Any material system.

A virus, a dance piece, a city, an electronic circuit, an ecosystem, a book, the world's economy, a galaxy, an oil refinery, a human body, a smartphone, a biological cell, a country's government, an atom. All systems are open territories in constant exchange with other systems.

2 - Contemplate the pieces that compose it without breaking it apart.

A carpet is woven from a multiplicity of threads. The reductionist gesture of decomposing a system is like shredding a carpet to understand its pattern. But it is only when every single twist or knot between single fibers is placed – with their specific angles, turns and tensions – that

a motif can be seen. A virus cannot be understood without its host nor without its socioeconomic impact.

3 - Observe that every piece draws a line – a fiber – as it moves, unravels in spacetime.

A triple-aspect substance: matter, energy, information.

3b - Note that the lines carry in them a direction asymmetry. The arrow of time.

Imagine every single particle would leave a trace as it traverses spacetime. We would be able to see material threads or fiber bundles instead of points or chunks of matter. Narrative threads or timelines would persist, telling us the stories of every particle, atom, molecule, cell, person, planet, galaxy, carrying information from their pasts towards the future. Every encounter would correspond to a knot – like **Feynman diagrams** at quantum scales. In fact, the whole Universe can be seen as an intricate, fractal braid, twisting and tangling, branching and merging across scales.

4 - Focus on one protagonist fiber with its trajectory-line, L_0.

Think in terms of geography-history, geologically. Imagine layering the approximately two-dimensional snapshots of a **city** or an **electronic circuit** successively, at microscopically different points in time, one on top of the next. Like a layered **puff pastry** of piled time-indexed frames. If we connect the dots – every instance of the same electron or person – between these frames, we would see fibers drawing the movement of every single entity across spacetime.

5 - Notice that the line's trajectory is affected by the other lines it **encounters** along its way.

These fibers, together, weave a characteristic **pattern**. It consists of a characteristic **braid** bundled with (Shannon) information regarding when-where-how its fibers meet and entwine themselves with one another. By redefining the **zoom** – the scale of the territories considered – one can readjust *what belongs in an encounter*.

6 - Ask yourself: How many lines are involved in one encounter? How do they meet: is it a twist, a detour, a shock, a knot? Do they glue to one another, assemble, moving together? How long does it last? How doe their paths change after the encounter? Does it affect the subsequent encounters?

Proteins constitute the weft of biological self-organization. They are molecular machines moving within, at the border and outside cells executing specific biological functions: catalyzing chemical reactions, transporting components, transducing signals. Proteins rarely act alone. Often, they must form a multiprotein complex to become operational. Therefore, it must be guaranteed that the molecular machines that need to cooperate will meet and properly assemble in order to function. A virus, also, only becomes functional after assembly. Molecular **self-assembly** is indispensable for the recipes of the living.

implex (*plural* **implexes**)
A genealogical coefficient of a given genealogical tree; defined as the difference between the number of theoretical ancestors of a person and the number of their real ones in a given generation.

Etymology
From *in-* ("in") and *plectere* ("to weave, braid").

Synonyms: pedigree collapse

7 - Focus on one specific point P_0 on that line L_0. Note that P_0 lies in one specific time frame.

For example, you at the exact moment you were born. Or the first time the word "complex" was used in English, borrowed from another language. Reconstruct its genealogy.

8 - Identify all the encounters (E_1, E_2, ...) in **previous time frames** that caused L_0 to move the way it did until it reaches P_0. Highlight these encounters along L_0.

Start with an individual. Check their mother and father. Repeat the process recursively for both parents and you get a tree. A binary tree, which grows exponentially. If we go back, say, thirty-three generations, the number of grand^{33}parents for each of us is 2^{33} (approximately 8.58 billion) – more than today's world population.

The problem is: back then, the total world population was definitely smaller than 2^{33}. And, in fact, the more we go to the past, the bigger the number of branches in our trees and the smaller the world population. So, the problem gets even harder to explain and a question begs to be answered: if the world's entire population was smaller than the set of your ancestors, where did you come from? How can we explain this apparent paradox? Have you ever tried to figure out the maths behind that?

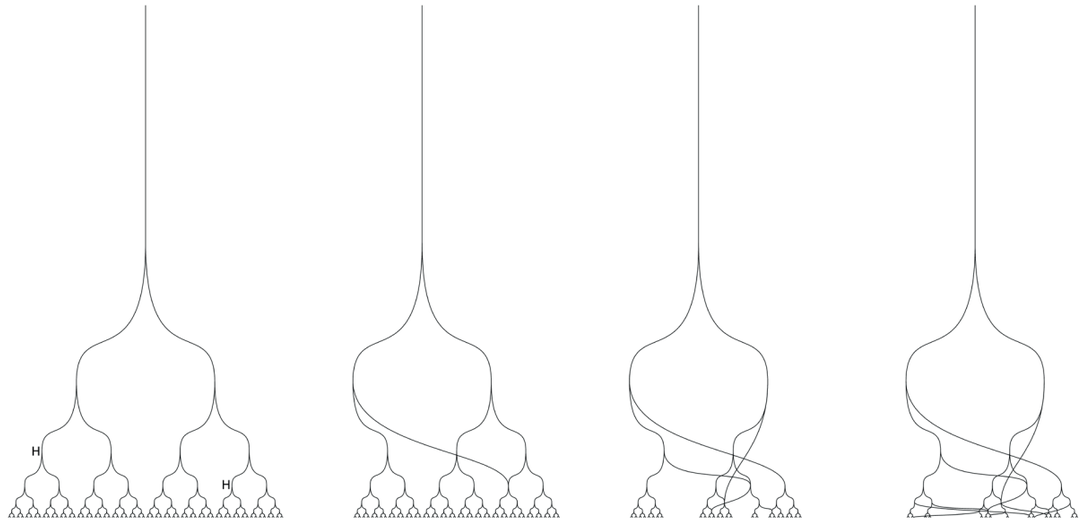
9 - For every highlighted encounter E_n, list all the lines involved in that encounter.

Words also partially carry their ancestries along with them – as ideas do. Surviving remnants of the past. A citation is a line to be followed upstream, towards the past, pointing to a certain region of the intellectual fabric's geography-history. A text is, therefore, woven from its ancestors. The structure of citation networks is a good image to keep in mind: a **directed acyclic graph**. And, by **reachability**, a **partial order**.

9b - For every line involved in E_n, repeat steps 7-9 recursively, with E_n as the focal point of that line. Note that the causal architecture of P_0 **branches** like a tree going backwards in time.

So, where did you come from? To understand the solution to the apparent genealogical paradox, imagine a hypothetical person H has had more than one child and that two of H's children have also become your direct ancestors through different lineages. In other words, H is your ancestor twice, a "double ancestor". A trace of **inbreeding**. So, if we draw a "classical" (binary) genealogical tree upside down – *it's about time! Why are the roots still pointing to the skies?* –, H will appear twice in your **roots**. A duplicate.

Not just that, but H's entire roots will appear twice in your roots too, at two different places. So, if H has a "triple" ancestor K, this person K will appear three times *twice* along your roots (i.e. six times). Roots multiply, a "house of mirrors" effect. Digging deeper, the number of repetitions grows exponentially, explaining where all those extra people came from. Repetitions, **multiplied**. Look up Cleopatra's genealogy as an example.



A point is a line is a lineage is a vein is a braid is a tissue. {10} Implex: duplicate subtrees merging, producing loops and reducing the genealogy's diameter.

10 - Contemplate the tree **merging** back into itself, like veins. For most ancestor-encounters, there are multiple paths connecting them to P_0. So, P_0 owes its existence to the entire collection of ancestor-encounters, whose existences were transmitted as a causal flow through the veins visited by iterating steps 7-9.

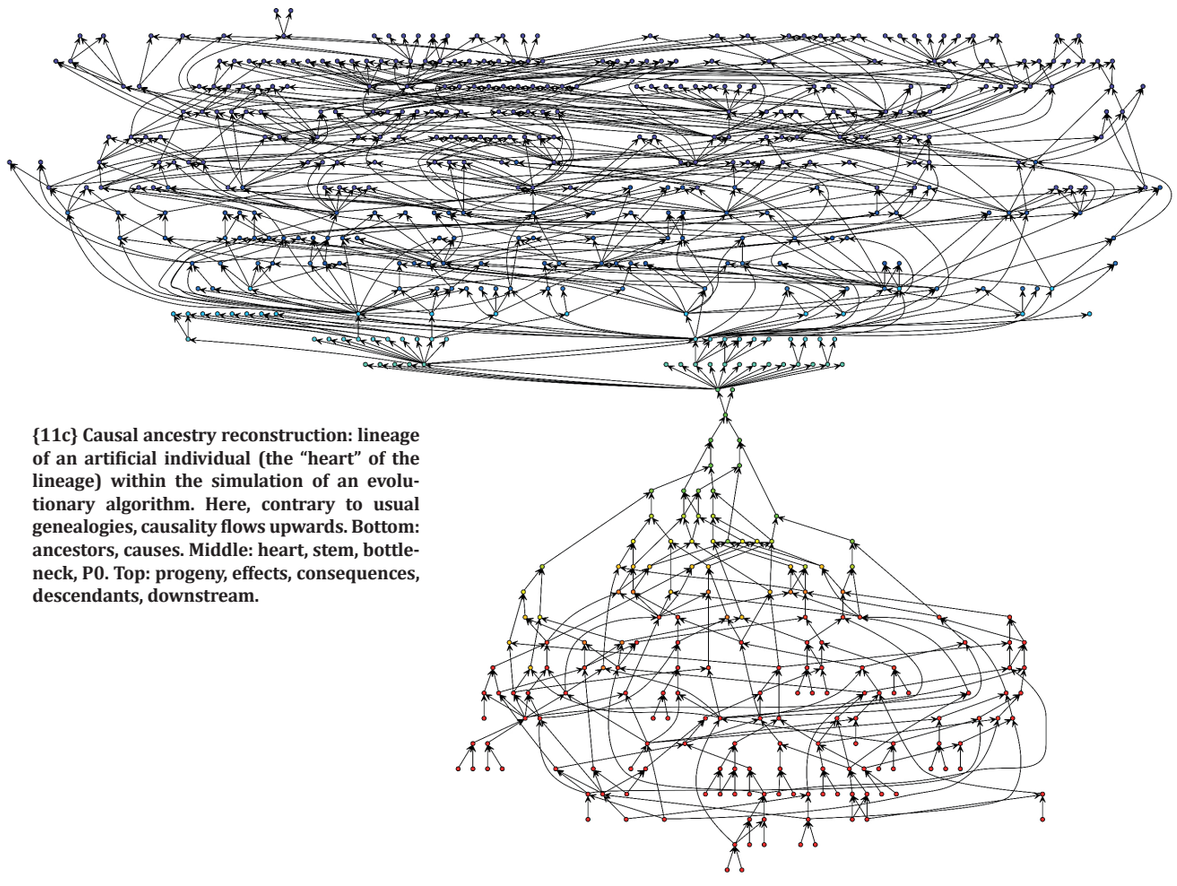
To eliminate all repetitions, everytime a tree duplicate is detected it should be folded and glued to its copy, **merging** all copies together. As a consequence, loops are produced – not **directed cycles** (that would represent forbidden **causal loops**), but something like islands in a flowing causal river. It destroys the property that topologically defines trees: trees cannot have loops of any kind. But the repetition elimination also reduces the diameter of the genealogy considerably, limiting it to the actual population size as time elapses, solving the

apparent paradox. **Genealogies are not trees, they are veins**. Our roots' diameters do not grow exponentially, they are always limited by the total population size at different points in history.

There is more to it than meets the eye: **bottlenecks** abound going backwards, drastic reductions in the diameters of our roots. Check Maynard Smith's and Szathmáry's *Major Transitions in Evolution*. The mitochondrial Eve or the Last Universal Common Ancestor. **Seeds** producing **big-bangs**.

Some of these revolutionary seeds emerge precisely because of the merging of branches. Chloroplasts and mitochondria probably originated through **symbiogenesis** – merging branches. Sexual reproduction is an intrinsic branch merger. A virus can transpose genetic excerpts between species, affecting their evolution. **Horizontal gene transfers**. Ecological interactions consist of extensive matter-energy-information exchanges, tangles between species, braiding co-evolutionary branches together. Biological evolution is not a tree. Language evolution is also not a tree.

Why isn't English considered a **creole language** with its mixed germanic, greek, celtic, latin roots? Colonization and lexical borrowing operate as horizontal transfers, branches merging, partly erasing cultures, eliminating some of their traces. This mechanism also allows decoupling languages from ethnicities, cultural from biological evolution.



{11c} Causal ancestry reconstruction: lineage of an artificial individual (the "heart" of the lineage) within the simulation of an evolutionary algorithm. Here, contrary to usual genealogies, causality flows upwards. Bottom: ancestors, causes. Middle: heart, stem, bottleneck, P0. Top: progeny, effects, consequences, descendants, downstream.

11 - From now on, think of any point P on a line as stretching from its veiny ancestry.

By changing the course of history, poisoned apples and train delays have certainly been somebody's ancestor, much like grand^{n}parents. Genealogy becomes a real tangle, re-injected back into itself, interwoven. Genealogical veins. Like **git** version control, branching and merging.

11b - The same causal reconstruction [steps 7-10] going upstream towards the past can be applied downstream to the future. The unfolding **consequences** of any point P percolate like a river that repeatedly branches and merges into itself through a rugged potential landscape. Like cosmic rays entering the Earth's atmosphere.

You should watch a video of the slime mold **Physarum polycephalum** if you haven't yet.

11c - Combine P_0 + its veins upstream + its veins downstream: a heart and its lineage. The heart is a bottleneck where all flows merge.

The material equivalent of the **light cone** representing the causal structure of Einstein's spacetime: every point is the heart of its own lineage, pumping the causal flow forward.

11d - Interlace all neighboring lineages, unveiling a multitude of hearts with common ancestries.

The Þjórsá river in Iceland or the whole water cycle are good examples. Money flow is another.

We, humans, share most of our ancestries. The consequences of our actions overlap, also.

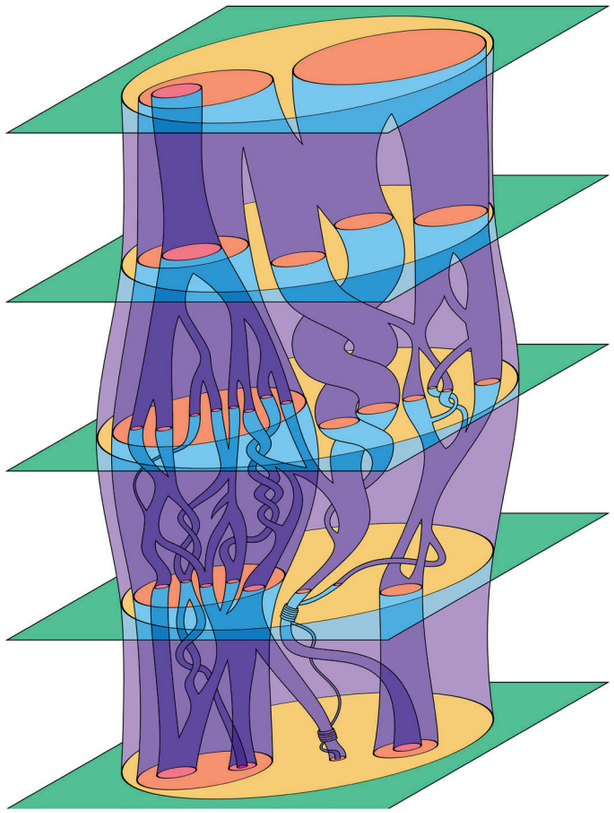
12 - Let these ideas rest.

[Composing, weaving, computing]

Enter now the **electronic circuit** inside a smartphone. The ways cables, wires, and hardware elements connect considerably resemble links between **streets** within and between cities. Bifurcations. Traffic. Crossroad tangles and road interchanges. When circuits execute a program, bulky rivers of electron-cars flow through the wires. They ride along these tracks towards higher electric potential destinations, branching and merging with other streams. Transistors act like traffic lights, defining when the electrons are allowed to flow or when they must wait for a green signal. **From now on, think of the execution of a program as weaving electron braids.** A form of tapestry.

13 - Connect the loom to a power supply.

Most **transactions** require energy. An electronic circuit is connected to a power supply and ground. The thermodynamics of molecular biology is based on the potential difference supplied by energy providers such as ATP molecules. A matter-energy-information throughput to sustain Prigogine's **dissipative structures** far from equilibrium. A **universal basic income**.



Nested territories, braiding, in-breeding, and the cobordism between their borders: branching-merging, traversing chronological strata. Simplex, implex, complex, multiplexing multiple manifolds across scales. Geological, genealogical, onto-epistemological, terminological, methodological, morphological, topological, ecological, cosmological, tautological... Tautological?

13b - Pull a few threads of your interest. Remember they carry their ancestries.

Let me reclaim the textile character of a text, beyond etymology. If you follow my zigzagging lines of thought, you will notice how they entwine, forming a tissue. Multiple lines coming from diverse lineages of thought, branches of different fields, contexts. Pulling threads from field-places, progressively forming a new piece of fabric. **Space-filling curves**.

14 - Combine, braid, weave them in a specific pattern. Write down a recipe for later replication.

Context is the ensemble of threads that, assembled in a specific way, form a fabric.

It is not just a coincidence that the origin of computers is tied to looms. **Every braid can be associated with a particular calculus or computation.** Just as we follow lines of thoughts, computers often process information in “threads”. Ada Lovelace probably noticed that weaving could be abstracted and performed in all sorts of **symbols** – after all, similar operations are

also used to manipulate numbers, images, sounds or words. Alan Turing figured out the requirements a system would need to fulfill in order to flexibly perform any kind of computation. A universal computer. This conceptual device – the universal Turing machine – is composed of:

I. [encoded instructions] a **tape** containing a sequence of symbols (e.g. 0/1 or A/U/C/G),
II. [adapters] a table of correspondences, indicating how to **translate** the tape,
III. [weaver] a head (with an internal state) that **executes** the tape’s instructions.

The resemblance between a Turing machine and the biological **translation machinery** is striking. Both operate like a **Jacquard loom** that converts the binary **code of the punched cards** into a particular **tapestry motif**. A music score into sound. A code-pattern correspondence ubiquitous in different forms of computing.

14b - For more complexity, compose existing braids to form new braids. Fractal territories. Pay special attention to how these braids fit together, interlock. Repeat this step as long as more emergence of complexity is desired.

Your eyes are reading this sentence. Exactly like a pinhole camera, the image you’re seeing now is projected upon your retina – upside down. The photons, hitting different pixels of the retina, trigger electric currents sent through a bundle of **optic nerve fibers.** The signal will, then, undergo multiple processing layers – braiding inside your visual cortex, really – until it finally activates the regions of your brain that **recognize the patterns** you are seeing. Like **deep learning**, like evolution. A virtual fabric of associations that not only resemble the architecture of the real tissue they are inscribed on, but needs it to be woven. Complex ideas and memories in our minds are braided from their basic ingredients. Grouped together, merged, combined, like a **Hasse diagram** of an **abstract simplicial complex**.

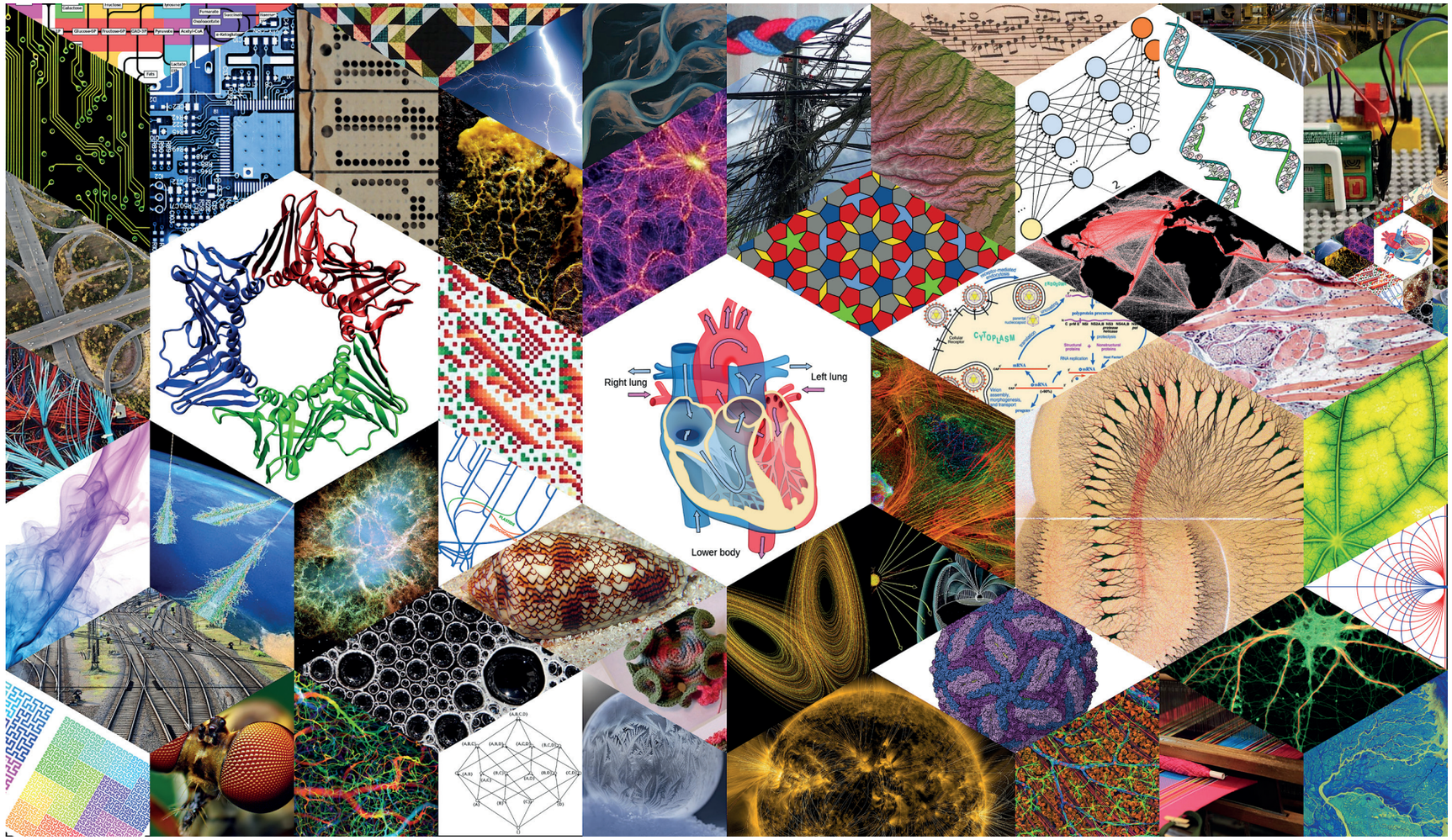
And a human body, can a reductionist break it apart? Pulling out a single thread (*e.g.* a point mutation) may remove essential relations. **Ontological emergence**, agency and **downward causation** require acknowledging **finitary relations** between parts. Transcend the network representations of binary-only relations! What about the ternary and quaternary and…? Think in terms of a **simplex**. Or a **hypergraph**. **An assemblage becomes an individual**, indivisible. Atom for many possible materialisms.

15 - Observe the resulting fabric. When the threads meet, assemble, how do they look? Do they operate? Do they operate on you or on someone/something else? How?

Biological computing is multi-threaded, wet and asynchronous. Still, a form of tapestry. Choosing a government has a great deal of influence on the social fabric.

16 - Repeat steps 13-15 differently.

Poetic language and fiction materialize: ideas woven together become the foundation for the next generations of ideas to come. We can weave a different reality.



In a patchwork, the ensemble of singular patches - with their patterns, contexts, textures, textualities, temporalities, trajectories, adjacencies, ancestralities - upon juxtaposing-sewing, turns the anachronic or diachronic into synchronic and synergetic. Like when the geological activity, pushing older layers to the surface and burying younger others, mixes material remains that were previously in different layers, allowing an encounter between them and breaking the linear temporal order. Relations combinatorially emerging.

[Origin of subject, origin of life, origin of mind: agency, self-replication and self-awareness]

When assemblages themselves become autonomous assemblers, they acquire some degree of independence. **Agency**. They actively and carefully distinguish, choose and pick from multiple threads that enter their territories, weaving according to their own protocols. Output becomes input.

17 - Draw attention to the assemblages produced in steps 13-16 that were also assemblers themselves. Reserve the **self-replicating automata** – weavers that weave weavers.

Aren't memories in our minds autonomously weaving new memories? **Memes**, jumping between people's minds, self-replicate.

18 - Let them evolve until they start collaborating, inventing recipes for group coordination. Observe the transition to multicellularity, the emergence of new levels of complexity.

As you read my text, a giant tangle is formed between your body, your surroundings and my thoughts. We become tangled. My thoughts expressed here will connect to ideas you have formed by reading other authors. Our thoughts, besides being electronic braids within our brains, are part of a bigger collective braid. We materialize knots as we read.