Bio Inspiration

Not Bio Imitation

Inspiration

A bird’s feather is inspiring in its brilliance in solving the problems of structural lightness and lift for flight

Nerve not Structure

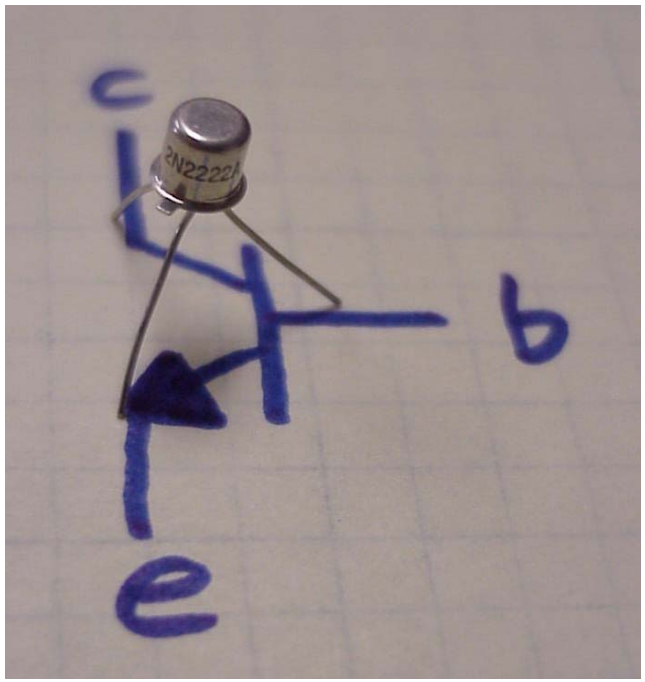
A feather is impressive, but not necessary

We should be inspired by the cognitive ability to control the wing motion

No Imitation

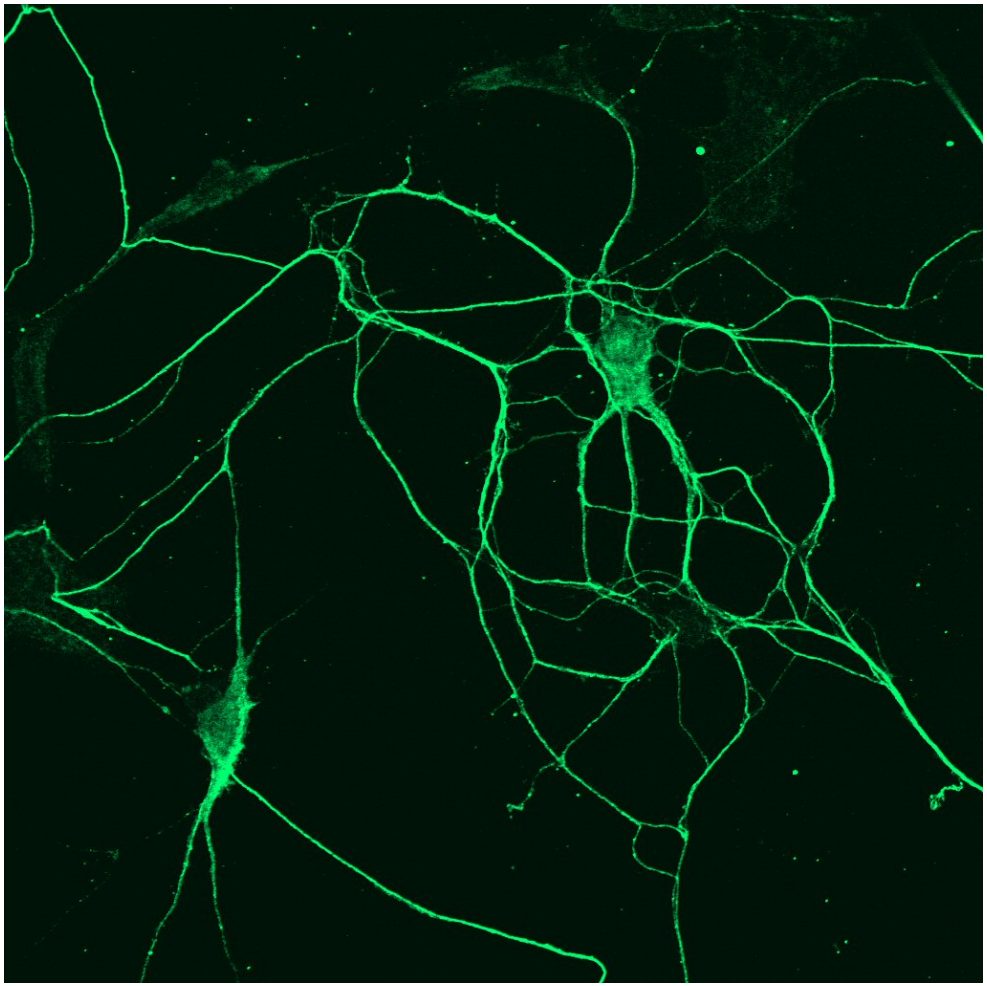
A feather tells you very little about how to build a jet fighter, except that the concept of lightweight structures will figure in there somewhere

Wrong Level



You can stare at a transistor all day, but it won't help you understand how to design a computer - a computer has a higher level organization

Again The Wrong Level

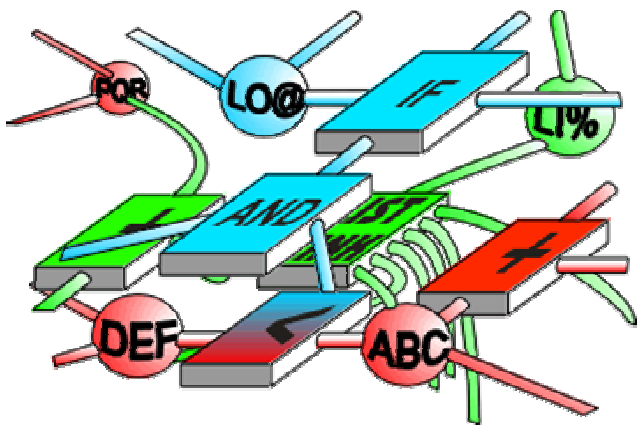


The same with a neuron - one neuron is close to a sea slug, but catching what a human does with them is at another level altogether

Reverse Engineering

We can be inspired by low level elements in the systems we aspire to building, or we can use reverse engineering to discover the underlying principles.

We have to already be at a reasonable level of sophistication for reverse engineering to work - we can't engineer a jet fighter out of stone (or feathers).



What Should Inspire Us?

Four suggestions:

- The sheer quantity
- Modus Tollens
- Structure building
- The Semantic Octopus

The Sheer Quantity

A hundred billion neurons is an impressive number, even for us, made blasé by our Gigabyte flashcards

It tells us we are going to need a lot of components, but it should also warn us that quantity is not everything, as the Gb flashcard should remind us - how the components are organized is more important than their quantity

The flashcard tells us that automation of connection is probably going to be essential

Modus Tollens?

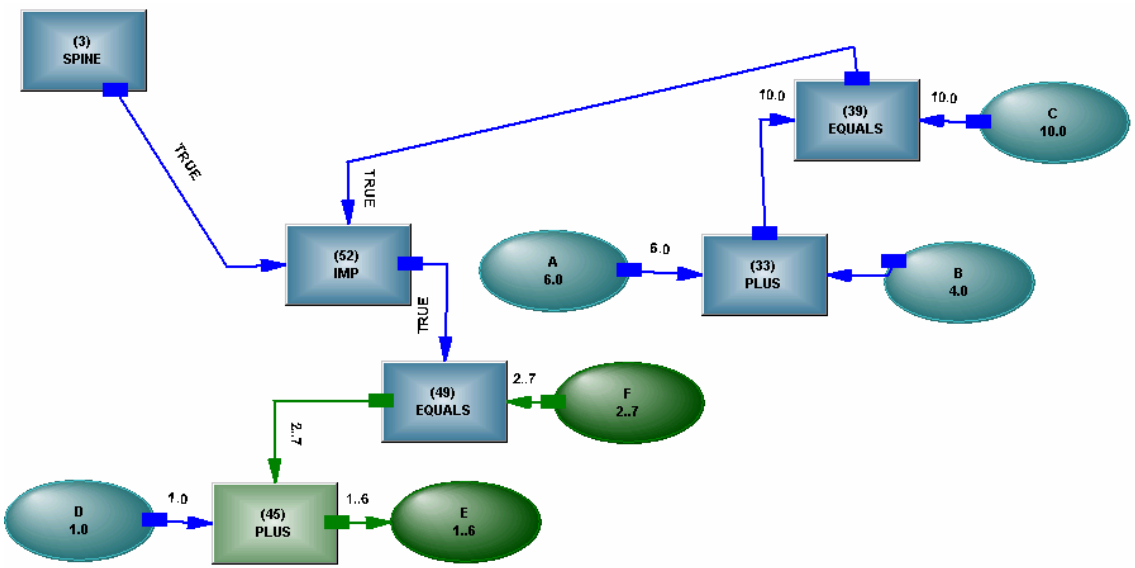
If A Then B
Not B
Therefore, Not A - *modus tollens*

Why should some logical trick inspire us?

Logic is a description of how we think, not something invented outside us.

It shows our ability to reason about reasoning - to be very many levels above the humble neuron - to have broken the paradigm of direction the neuron gives us

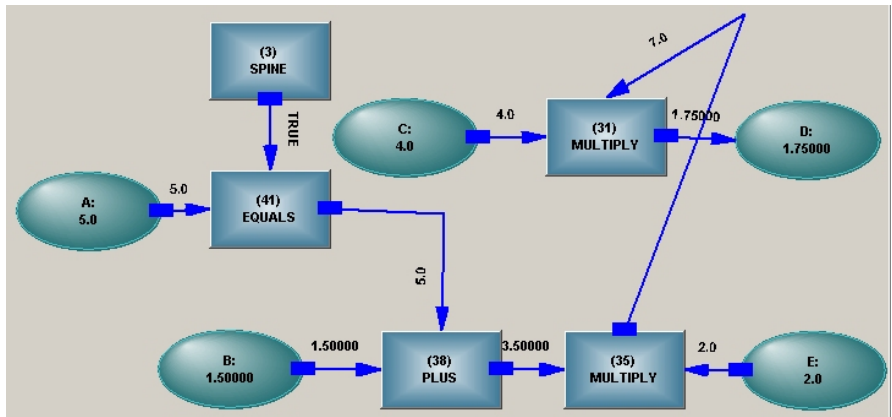
Undirected Structure



Here is a simple implication. If we make it undirected and direct it dynamically, we get Modus Tollens and we can also determine its validity - we get every possible use out of it

If we were inspired only by the neuron, we wouldn't think of doing that

Cells Have Limits

Human	Machine
We have an equation A = B + C * D / E If we want D as output, we rearrange it	 What's to rearrange?

Humans are bounded by their biology, machines can use wires, so a lot of what we do doesn't make sense for a machine

Mechanized Horse

When it came time to mechanize the horse, we had already reached the stage of a horse and carriage – we mechanized the carriage and threw the horse away.

A horse is a biological system that is beautiful within its limitations, but given a choice between reciprocation and rotation, there is no contest.

Cognitive Carriage

I am suggesting there is a cognitive carriage drawn by a neuronal horse. One of the occupants of the carriage is Modus Tollens.

We can mechanize the cognitive carriage, and throw the neuronal horse away, by using wires. When we throw it away, we also throw away the layering needed to submerge its base property.

How Does It Work

If we take on board a limitation of a cell without thought, we deserve the pain of working out how to get around it.

The gap between the undirectedness of a wire and the directedness of a neuron is as great as the gap between the reciprocation of a bird and the rotation of a helicopter

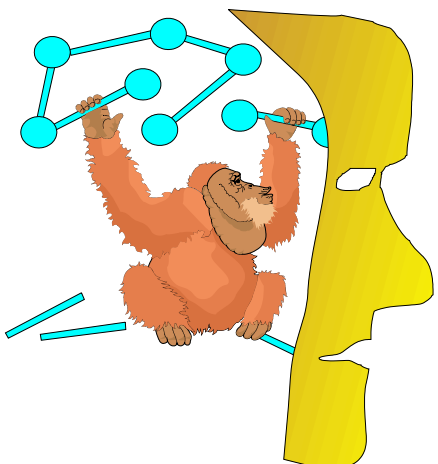
Structure Building

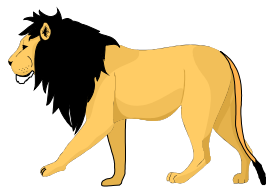
A person reads a book and converts it into internal structure.
What they have read helps them to read further
- the structure builds on itself.

How?

How do we build a structure that can build a structure that integrates with the structure already built?

The neuron could inspire us to build the structure all out of the same stuff, and propagate states through the structure, and have lots of very small components - millions of them - to have atomicity of operation





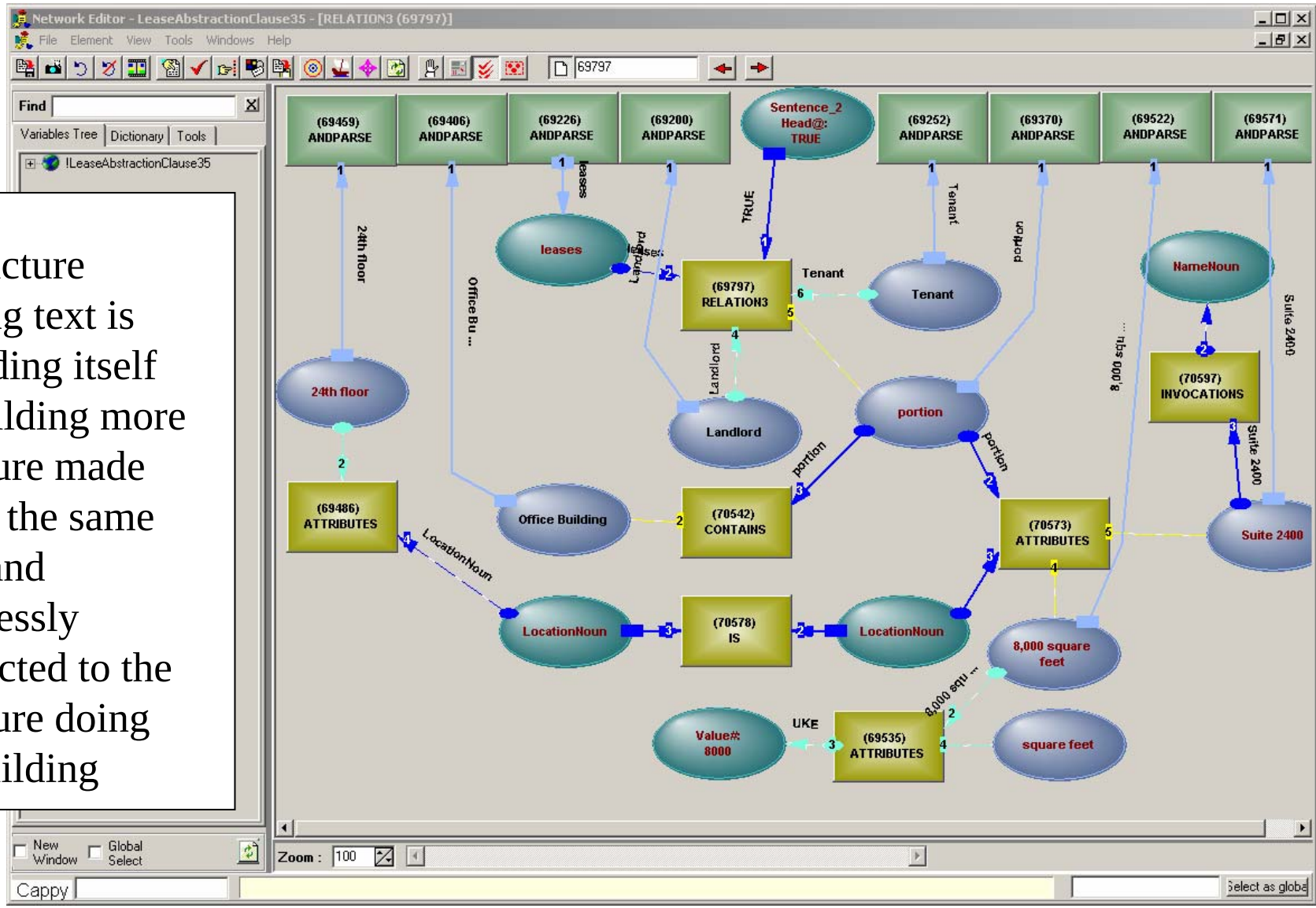
Building Structures

We can try to build large complex logical structures by hand, or we can build a structure which builds structures - just like a Jacquard loom, and for the same reason.

Unlike the Jacquard loom, we have to make everything from the same stuff, so both the process and the output look exactly like the input

All the Same Stuff

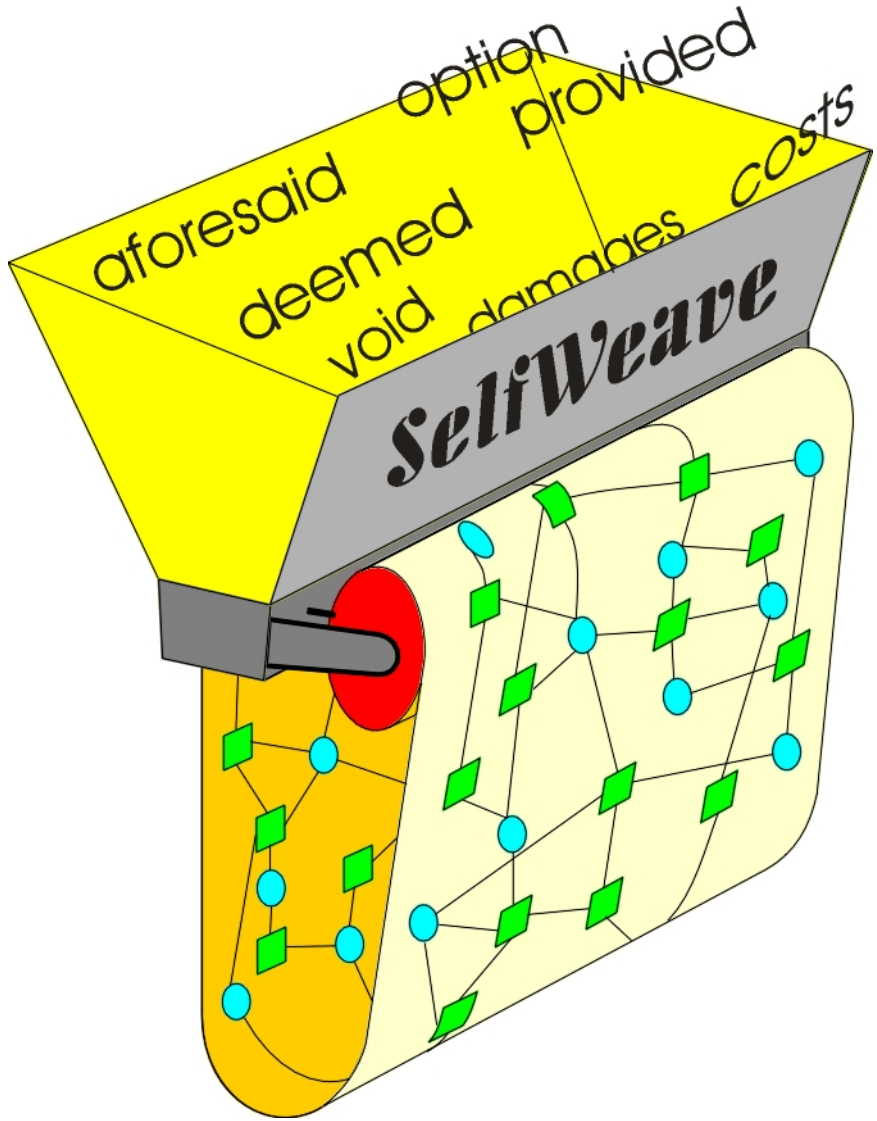
A structure reading text is extending itself by building more structure made out of the same stuff and seamlessly connected to the structure doing the building



SelfWeave

A machine which uses a structure to read text, extends its structure, then uses that structure to read more text

It is all made out of the same stuff

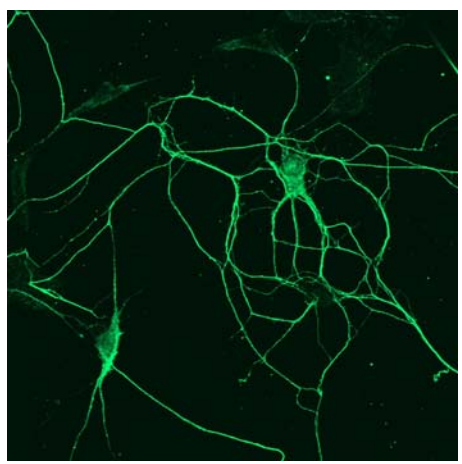


The Semantic Octopus

The neuron gives us two things - direction and connection

We have broken the paradigm of direction by using notional wires in the structure - a cell can’t do wires, so it needs many layers for the same effect

We also have to break the paradigm of direct connection



Joining Discontinuities

Humans are very good at repairing gaps and other faults in the cognitive structures they build.

We compare it to an octopus, moving to the site of a discontinuity, grasping the loose ends, tying a knot, then moving away. Humans have about the same range - a maximum of six to nine loose ends.

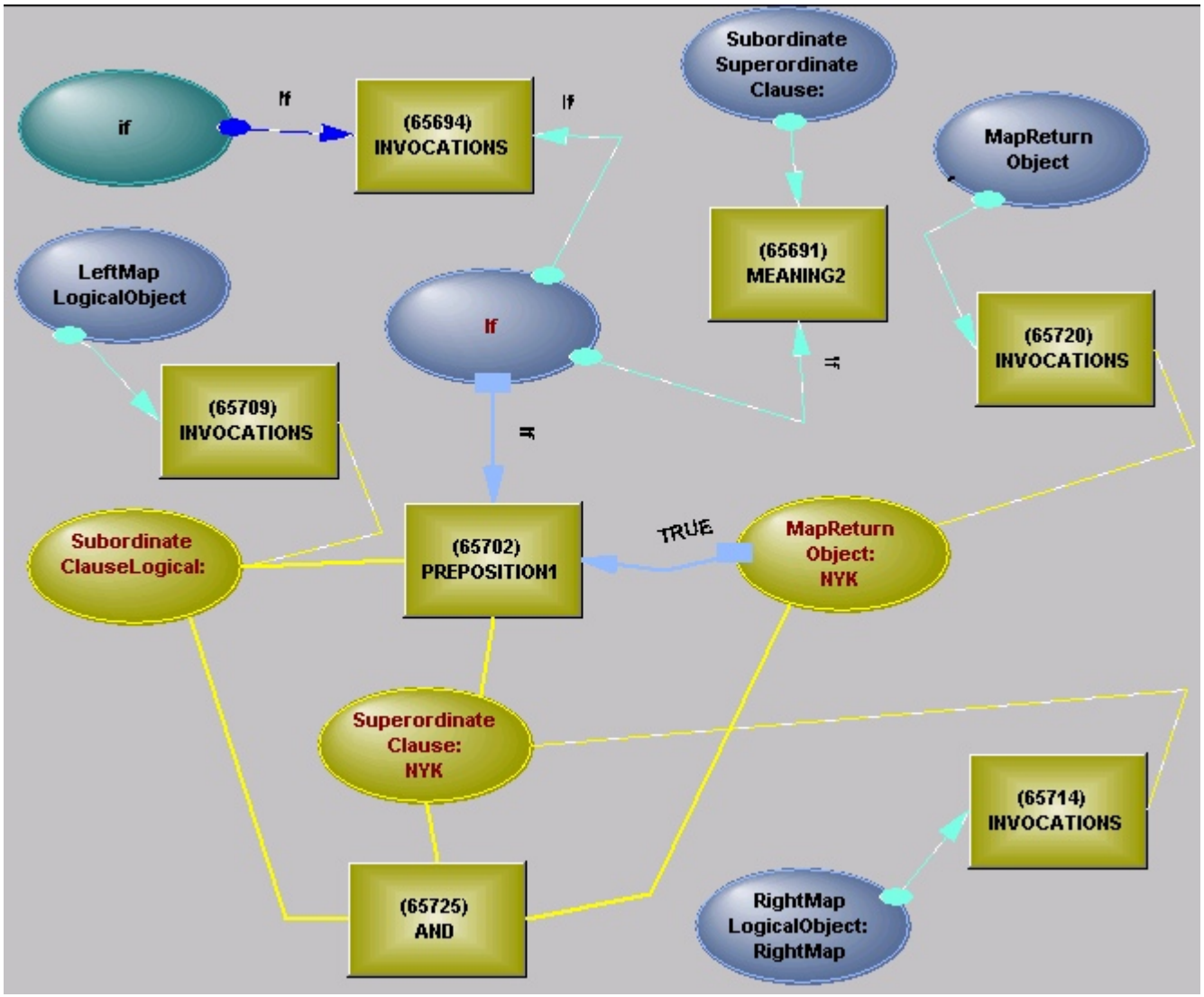
Our analog of this behavior is an active map - a free structure capable of crawling over another structure.

Active Map

An active map is brought to the site of a discontinuity and uses constraint reasoning to check whether it matches the things to be connected. If so, it connects itself, it adds, rearranges or destroys some structure, then disconnects itself and is put back on the shelf.

It breaks the connection paradigm, even though there is an implicit connection to some of the things it will connect.

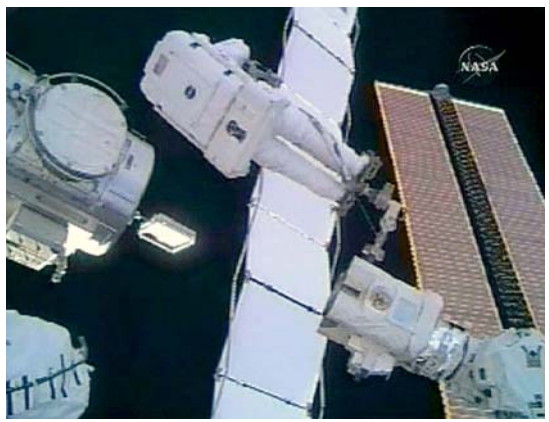
Active Map for Joining Clauses



Joins subordinate and superordinate clause

Get Out and Get Under

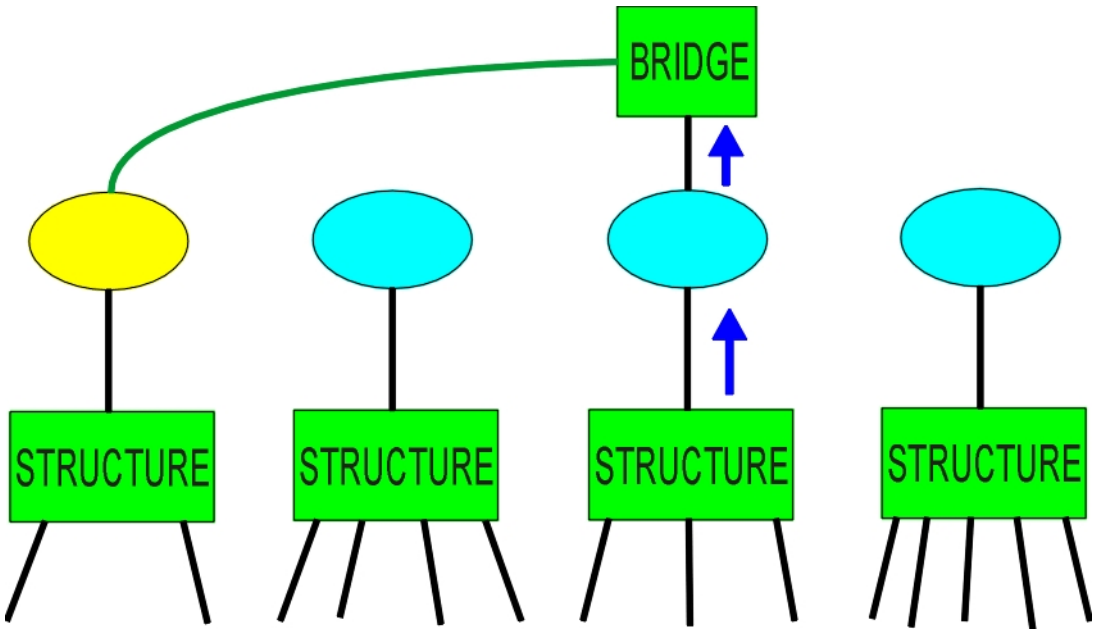
Just as the space station flying in a barren environment needs to be repaired as it goes, not come back into dock, so a structure flying in cognitive space needs to extend itself and repair itself as it goes.



What does our biological inspiration tell us - lots of pieces, each having universality of purpose - we can’t call home for a special part, we have to make it on the spot out of things at hand

Throwing a Connection

If something inspires us, it should be like a theory
- it tells us more the more we look at it

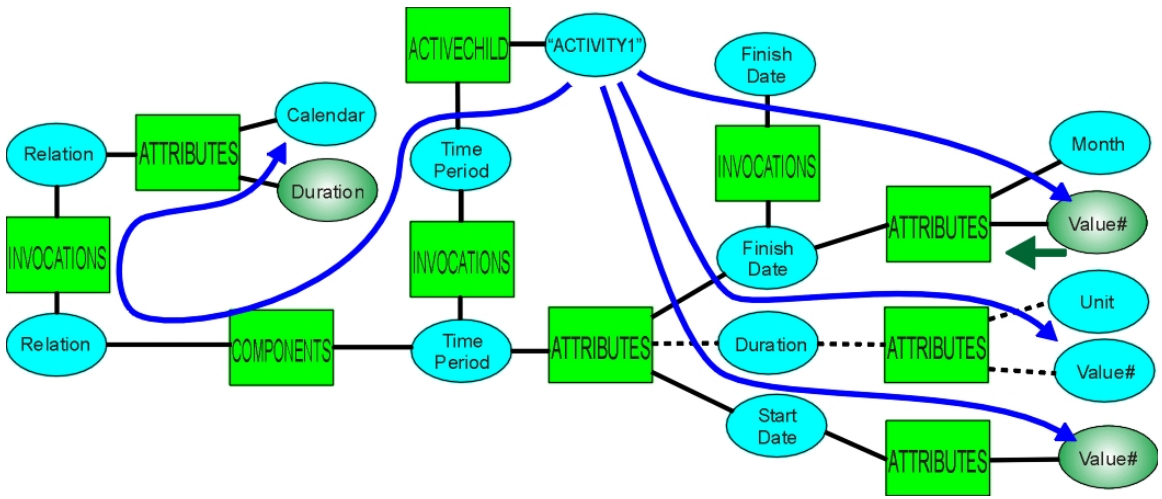


Problem: We have been prompted to search, but one connection is not ready - how do we restart when it is ready
Solution: Make a connection, wait for the change of state to tell us it is ready - use the paradigm and extend it

What Isn’t Inspiring

Watching a whole area of neurons light up with massive parallel activity isn’t inspiring, it’s dispiriting

We can’t do anything like that, so we use diffuse operators - operators constructed on the moment - to simulate parallelism for time estimation



Bio Inspiration

We can be inspired by biological systems, but if we attempt to imitate their properties including their limitations, we go down a dead end

A neuron itself is at too low a level to be useful for direct imitation - but the high level organization it allows is not