# Self - Organizing Modeling and Simulation

Human Intent

Some Premises

We should expect the adversary to be adaptable, to have a memory, to respond opportunistically to unfolding events, to reason about what they are doing and what we are doing, to have the same cognitive apparatus at their disposal as we have

These are very good reasons not to use an algorithm or other directed structure to represent their behavior
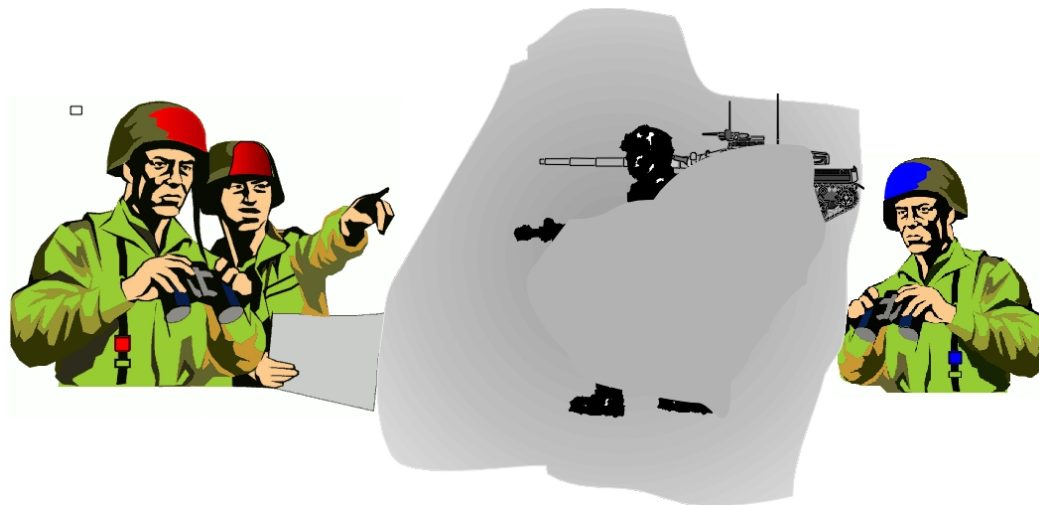
An Analog

Another system which must handle human intention, which must respond opportunistically to new situations, which must build islands of knowledge, then combine and link them:

The automated reading of a contract

Dull and Boring

You may think that reading a contract is dull and boring. Yes, but it also requires the full exercise of the abilities of the human cognitive apparatus - the abilities of

- opportunistic, synergistic behavior
- simultaneous operation at many levels
- undirected structure
- self-extensible structure
- free structure

The writer expects the reader to be a human - all these things come relatively easily to a human

If an automated system can't do these things, all it does is spew out junk for a human to clean up

Similarities

Read Contract	Adversary Intent
Cooperative (?) Counterparty	Hostile Counterparty
Unambiguous Document	Camouflage and Deception
Trading Constraints	Trading Blows
Dynamic Construction	Dynamic Construction
Many Layers	Many Layers
Huge Cognitive Activity	Huge Cognitive Activity

Not all that different

Reading a Contract

To read a sentence and then another, we need to build structure, and then build structure on top of that structure - we need self-extension.

We need close integration - we can't separate the problem into phases like grammar and semantics, they are all interwoven, so we have to be able to simulate that

We have to close couple existential, logical and temporal control, not separate them or ignore them
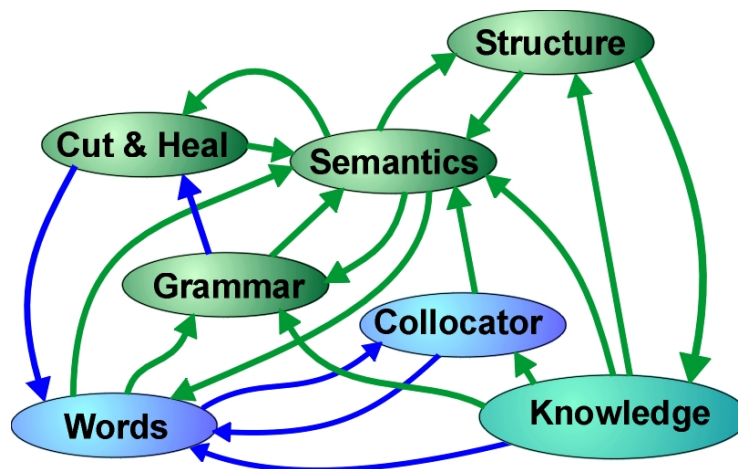
Some Useful Things

Undirected cognitive structure
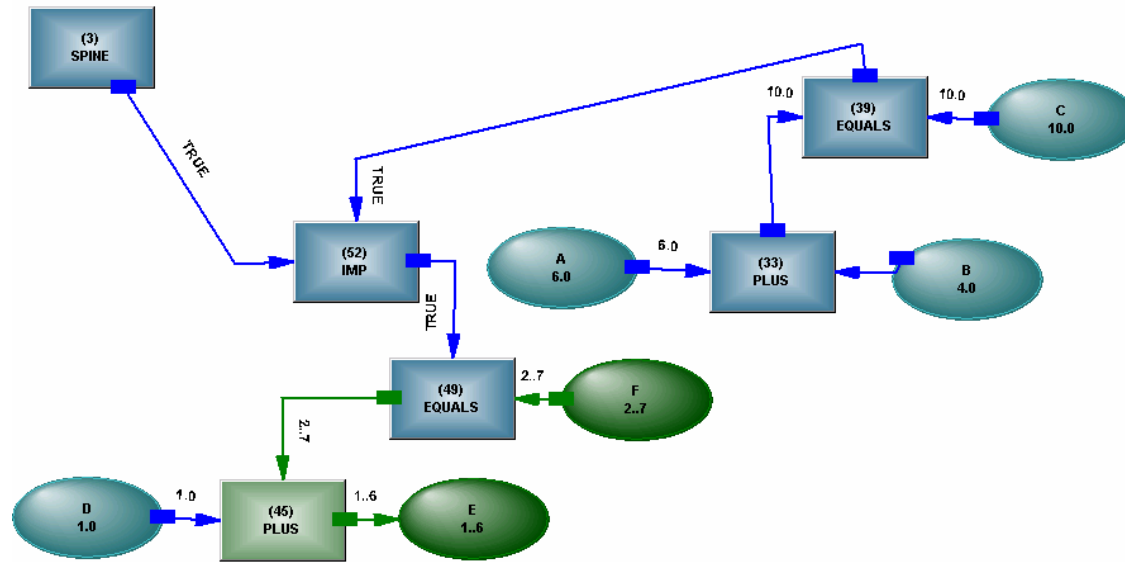
Dynamic construction

Hypothesizing

Existential and temporal control

Relations on relations

Free structure

To Be Adaptable

An undirected structure, a structure not directed to any particular purpose, has vastly more uses than a directed structure.
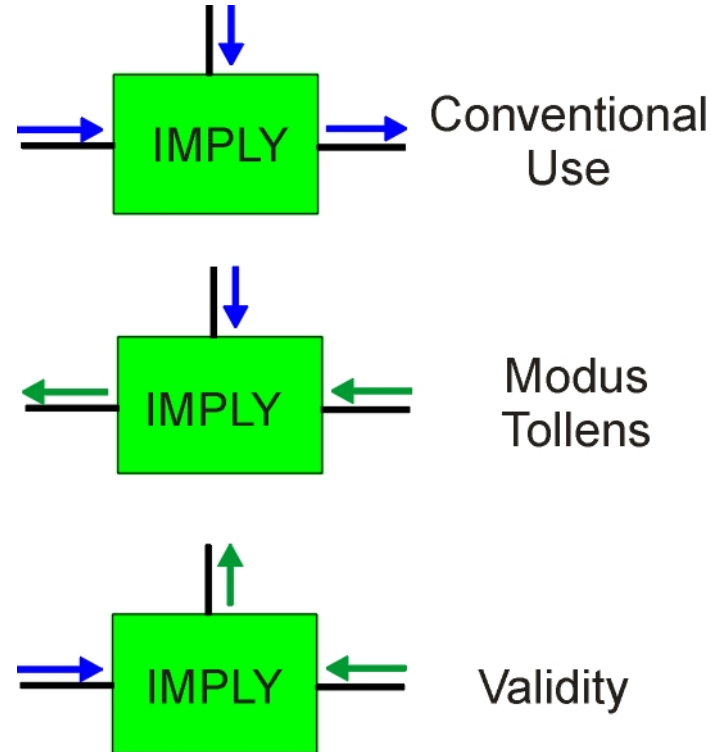If each part of the structure is multi-use, the gain is exponential.
It is easy to join undirected pieces together.

Undirected cognitive structure

To Reason About

An undirected structure can reason about itself - it doesn't have to create another graph, just a different flow direction in the same structure. The structure can use itself to extend itself.

Segmentation is Death

"We have to segment the problem - it is too complex otherwise"

Physical problems can be segmented - lift and propulsion for a plane, engine and wheels for a car
Cognitive problems are conceptually different - it all happens together, seamlessly, or it doesn't happen

"But we can't handle the complexity"

If the complexity is overwhelming, it is being handled the wrong way

Undirected cognitive structure

Not a Graph

An active structure is not a graph - it reasons about itself and it changes itself - there is nothing outside that is reading the structure, as there is for a graph

By making it complete, we give it self-extension and eliminate the need for an omniscient graph-reader
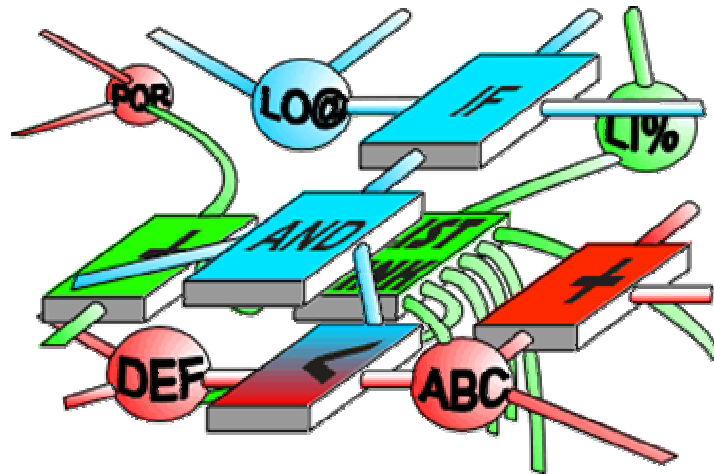
Undirected cognitive structure

Opportunistic Behavior

We need to replicate the opportunism of an adversary - we can do that with pattern structures - structures that recognise patterns and build structure, and then other pattern structures recognise what they have built and build more, until it succeeds, or it all collapses and tries again later when something changes that makes it want to try again - including the passage of time

If these sound like grammar structures, they are - we are parsing the battlefield situation and building a plan from it - the adversary's plan, intermixed with our plan, and we are doing it dynamically

Dynamic construction

Dynamic Construction

In responding to words, we have thousands of pattern structures jostling to match, with associative searching
If a pattern matches, it builds a clone of itself and a piece of relational structure
The new structure causes associative searching on other patterns
We build a structure which exactly suits what we have encountered, the patterns assembling themselves
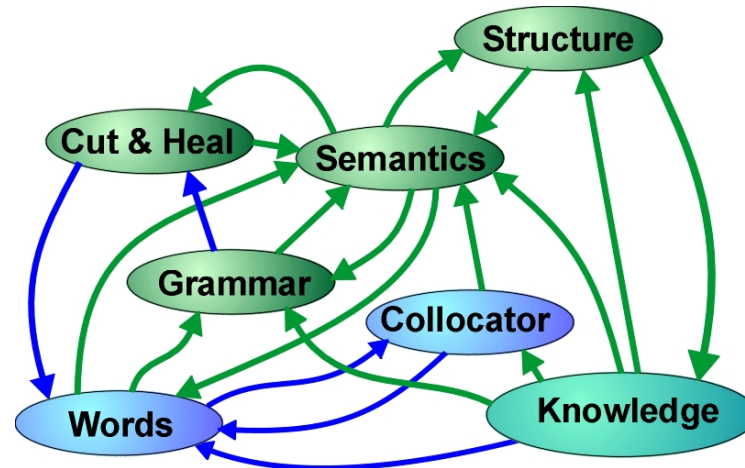
Hypothesizing

Hypothesizing is a powerful, even essential, means of solving. Couple it with dynamic structure building and we can explore a much larger space than with fixed structure.

All the semantics are in the structure, nowhere else.
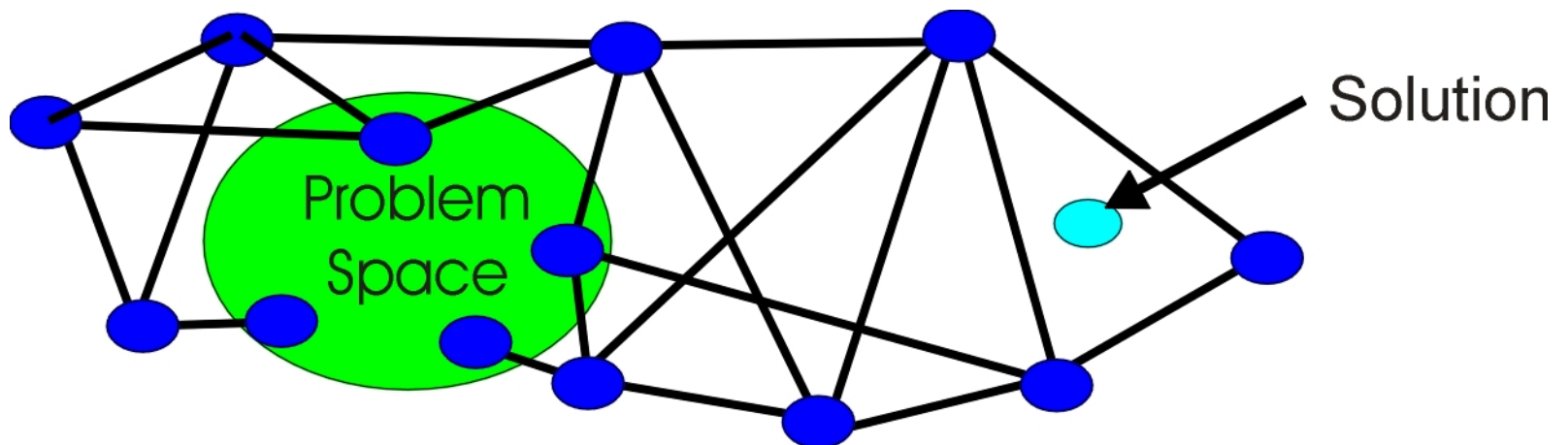
Lake Trasimene

We are suggesting the use of Constraint Reasoning to determine the adversary's plan, by pruning away impossibilities.

The problem with that is that some of the most brilliant battle plans seemed impossible.

If our estimation of the adversary's plan is shallow, we expose ourselves to defeat by brilliance, or defeat by our own stereotypical response.

Highly Dynamic

We aren't talking about lumbering through a few possibilities - we are talking about thousands of possibilities presenting themselves, an attempt to build something out of them, falling back, trying again - the opportunistic reasoning of a resourceful adversary, looking for any weakness - all done through pattern matching
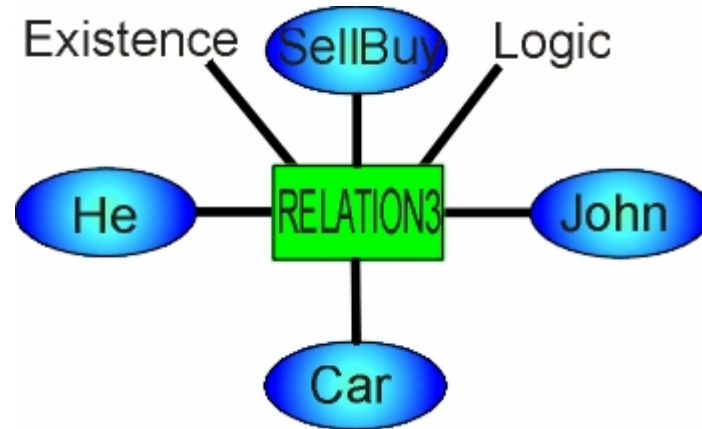
Patterns to Plans

Weaknesses have to be turned into a structured plan - for that we need

- Relations as objects

- Existential control

- Temporal control

- Relations on relations

Existential Control

Logical modeling is usually very crude - we are suggesting that relations have two state connections:

    I can scale the cliff - connection to existential control
    I scaled the cliff - logical control

The relation operator maintains validity between the two states - the logical state cannot be truer than the existential state
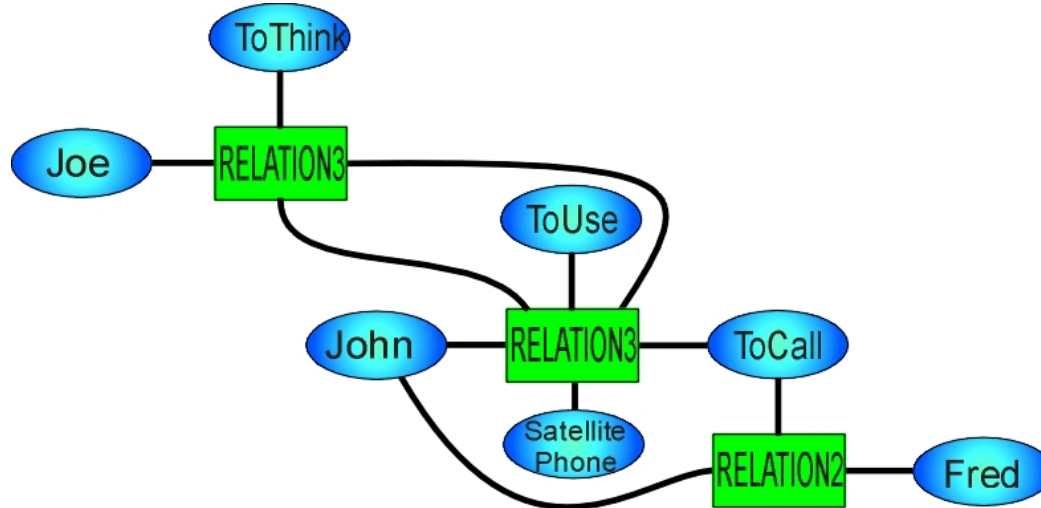
Temporal Control

Both existential and logical states are under temporal control - the relation has attributes, some of which are temporal. There can be a window of existence, and a window of logic - possibility and probability.

Both of these windows are under constraint from other relations and current time

Relations on Relations

Human intention acts as a control layer on other relations. To model it effectively requires relations on relations without limit

The resulting structure, with its fine grained logical and temporal control, gets much closer to the problem of intent

Emergence of a Plan

A plan may not be a simple extension of what already exists, but a new structure, built in the air until it can be seen how it fits with what else is afoot

This is the province of free structure

Islands in the Sky

We see a possibility - build a structure in the air, then another structure, link them together, finally see where they would fit

Humans have an ability we liken to an octopus - move to the location of a cognitive discontinuity, orient themselves, gather up the loose ends, tie a knot, move off

This freedom to move to an unconnected structure is necessary to read text, and seems necessary to model the emergence of a plan which is initially anchored nowhere - we call it an active map
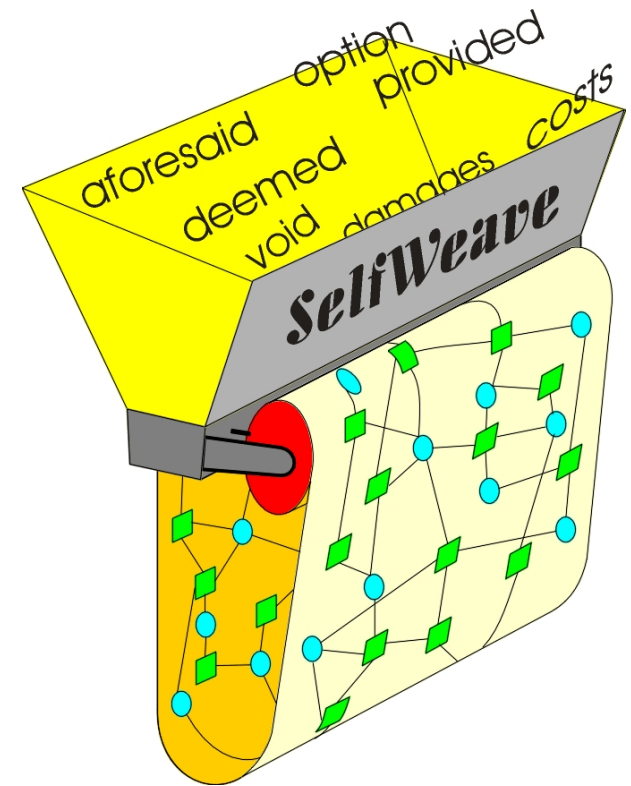
Free structure

Dense Models
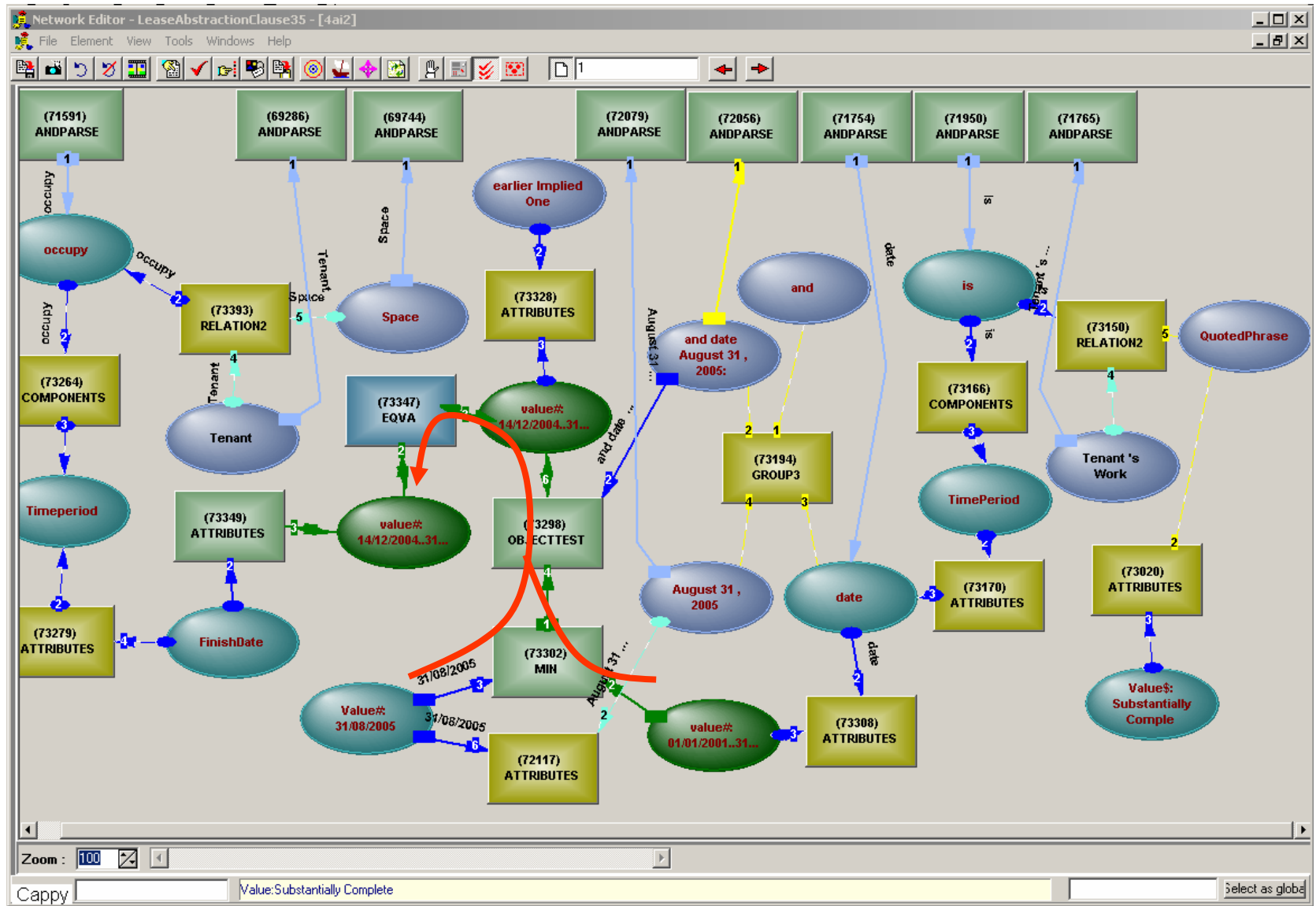
Hundreds of thousands or millions of elements

Model Building

The combination of propositional logic, existential logic, temporal control and relations on relations leads to dense models which are too detailed to be easily or quickly built by hand. They can be the contributions of many hands, or they can be built automatically using self-extension

Integrated Plan
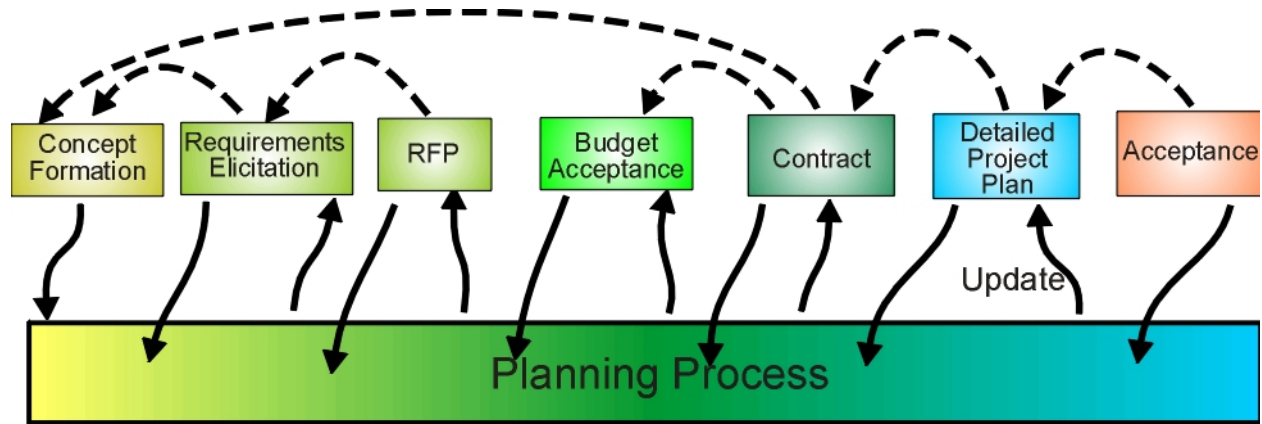
Many influences - different directions, different times, considerable back-connection
We struggle to do this even when there is no threat

Modeling Human Intent

We can use undirected structure, dynamic construction, free structure, relations on relations, to give an adversarial intent model far greater fidelity.

With that fidelity comes the ability to be adaptable, to be opportunistic, to display cognitive activity.