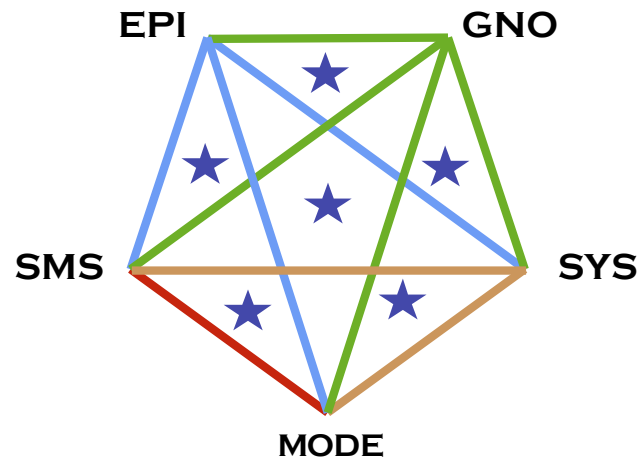


Attractor Nets 2011

Diagrams for a New Theory of Mind

William L. Benzon



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Electronic copy available at: <http://ssrn.com/abstract=1779324>

Introduction

This is a series of diagrams based on the informal ideas presented in *Attractor Nets, Series I: Notes Toward a New Theory of Mind, Logic and Dynamics in Relational Networks*, which explains the notational conventions and discusses the constructions. These diagrams should be used in conjunction with that document, which contains and discusses many of them. In particular, the diagrams in the first three sections are without annotation, but they are explained in the *Attractor Nets* paper.

The rest of the diagrams are annotated, but depend on ideas developed in the attractor nets paper.

The discussions of Variety and Fragments of Language compare the current notation, based on the work of Sydney Lamb, with a more conventional notion. In Lamb's notation, nodes are logical operators (and, or) while in the more conventional notation nodes are concepts. The Lamb-based notation is more complex, but also fuller.

Topics

Basic Stuff: Fundamental notation, discussed in the notes *Attractor Nets, Series 1*

Partitions, Simple: More fundamentals, discussed in the notes *Attractor Nets, Series 1*

Assignment: A particular types of cognitive structure, discussed in the notes *Attractor Nets, Series 1*

Variety: The “is-a” relation, with commentary

Move: Basic syntagmatic notions concerning simple movements, with commentary

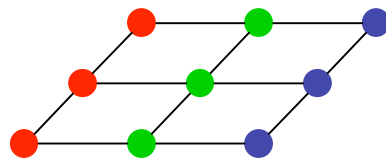
Counting, Place Notation: Some constructions useful in understanding how a child deals with elementary arithmetic, with commentary

Orientation in Time and Space: Basic notions of time and space, including the notion of a path, with commentary

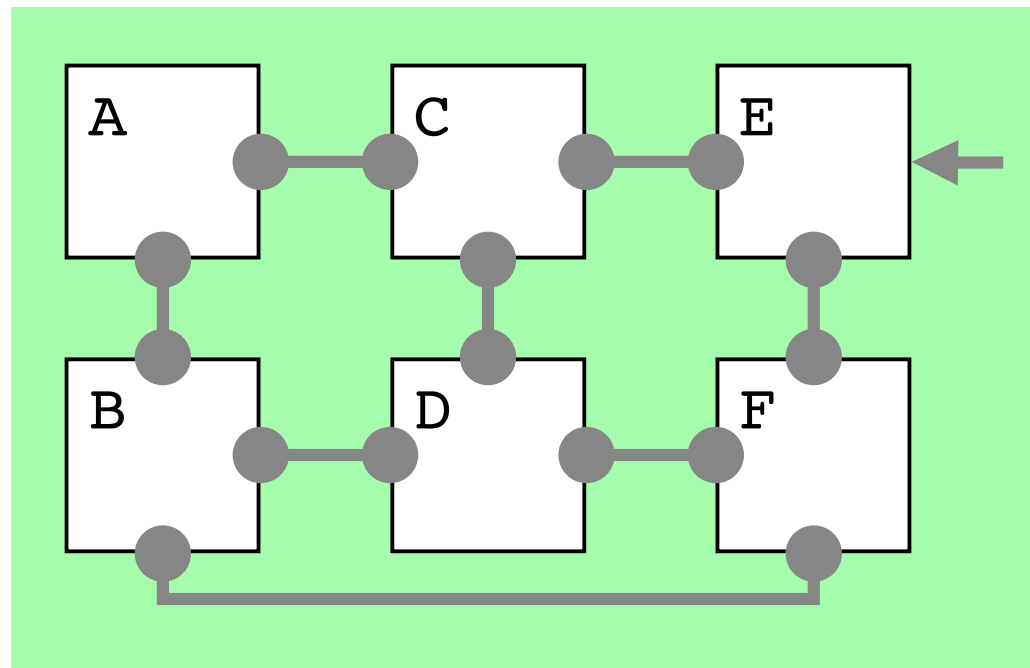
Fragments of Language: Simple relations *next*, *and*; metalingual definition; “a robin is a bird” – with commentary

Flow and Learning: Diagrams explicated in the notes *Attractor Nets, Series 1*

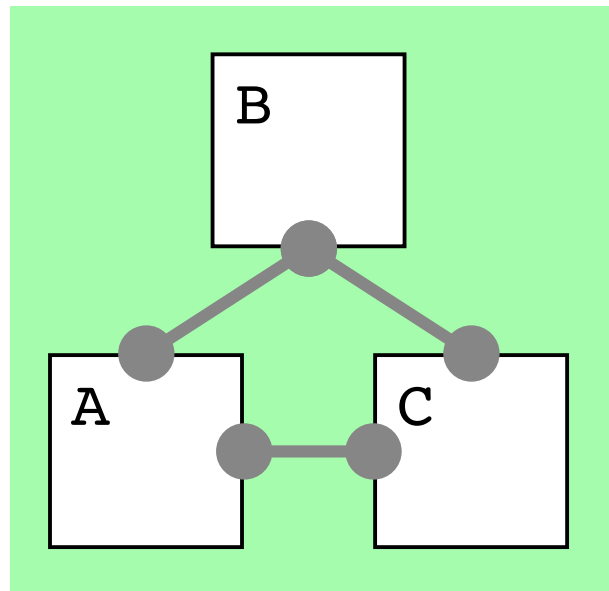
Basic Stuff



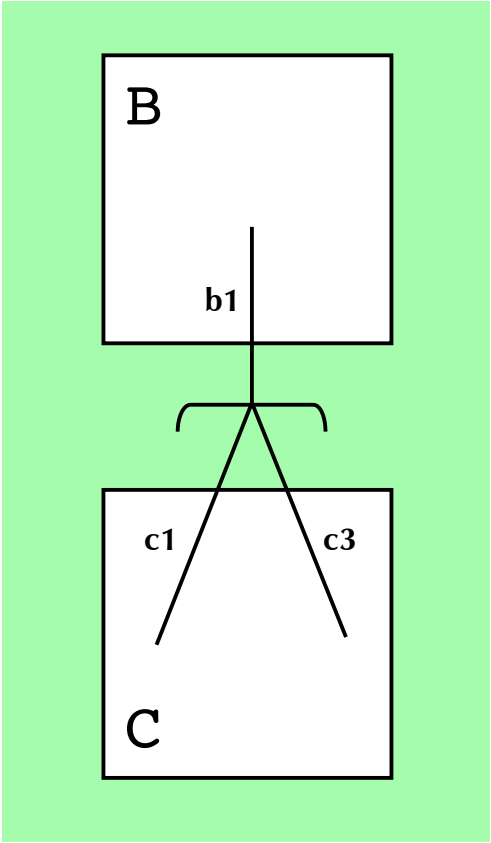
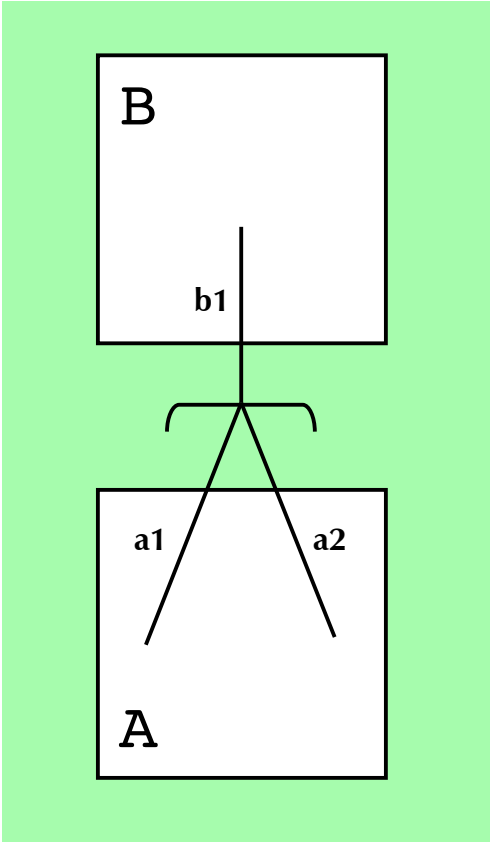
Six Interacting Neuro Functional Areas (NFAs)



Thre Interacting NFAs

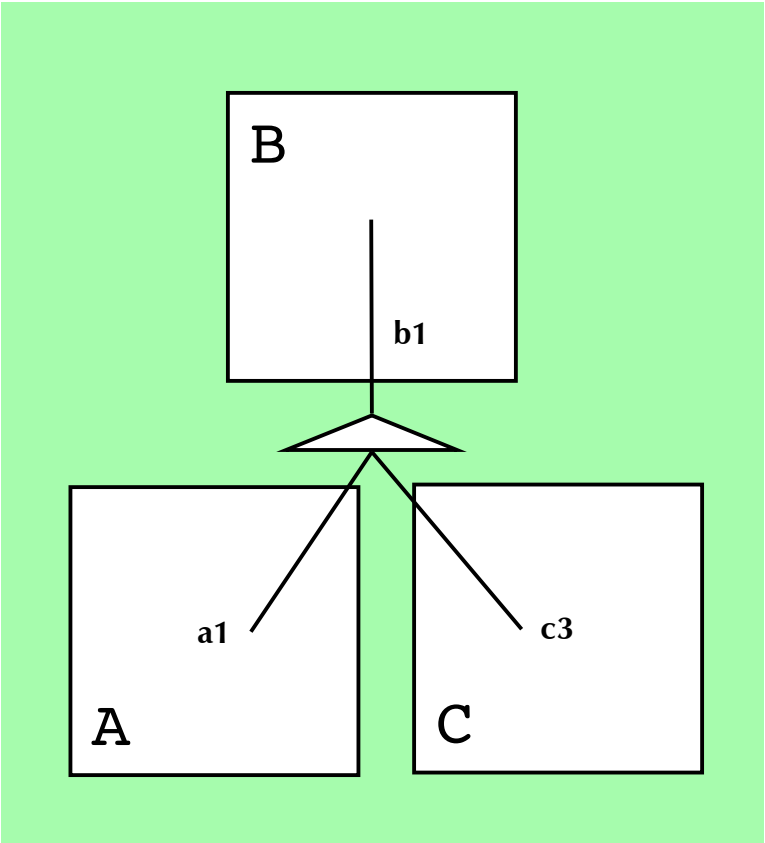


Nections*, logical OR

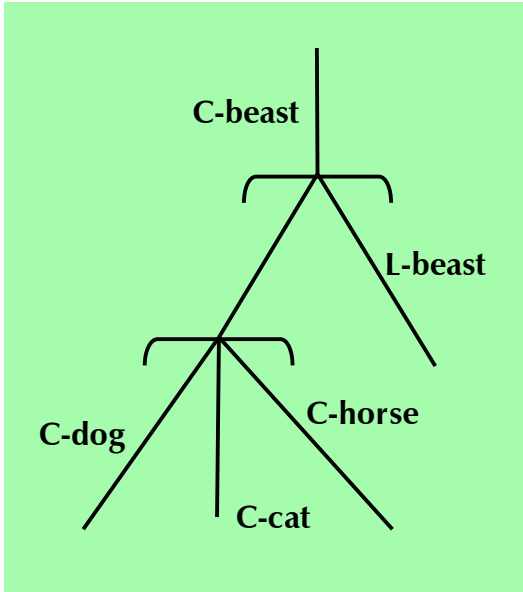
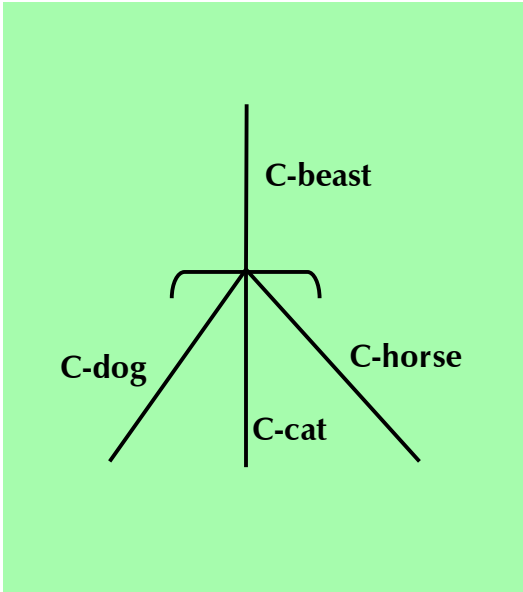
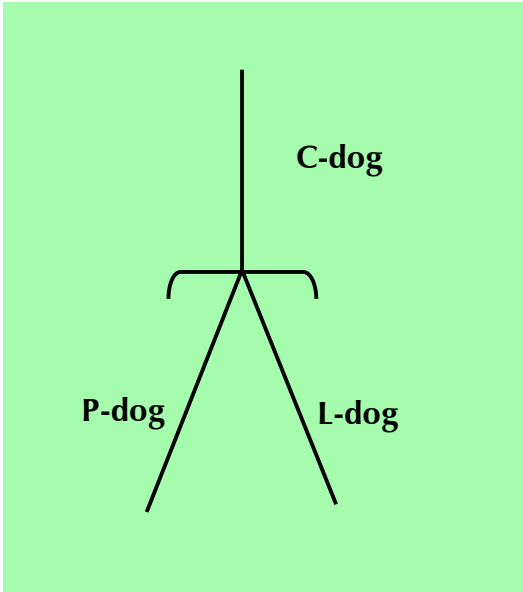


* “Nection,” from “connection” is Sydney Lamb’s term.

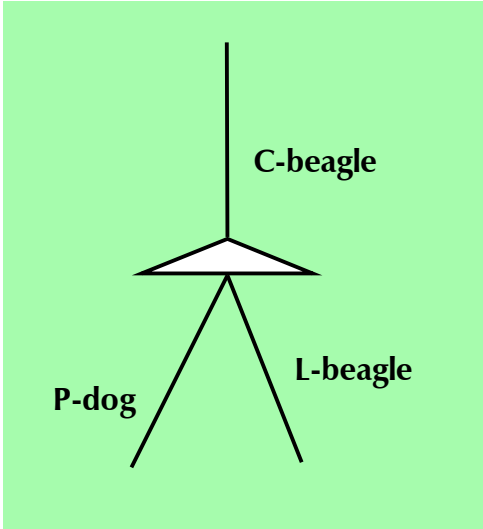
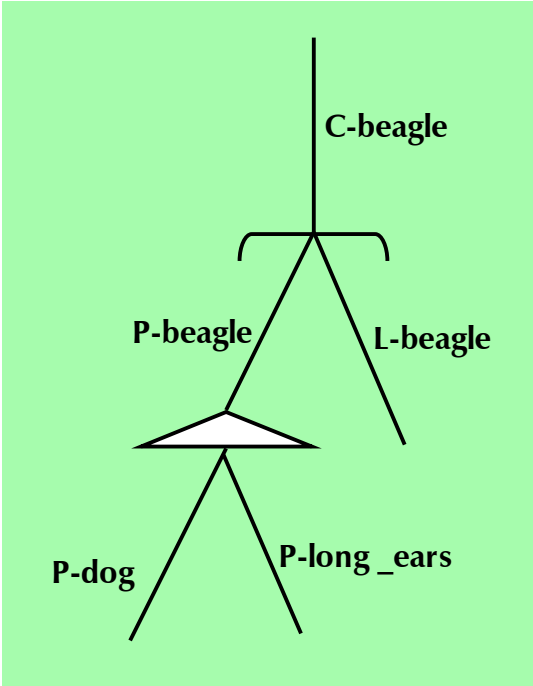
Nections, AND



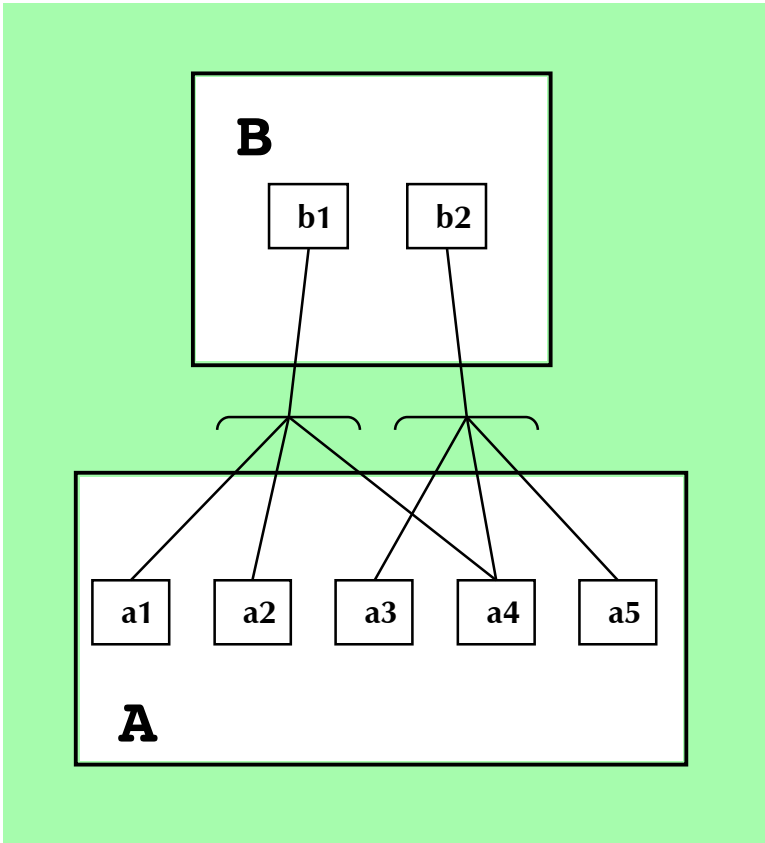
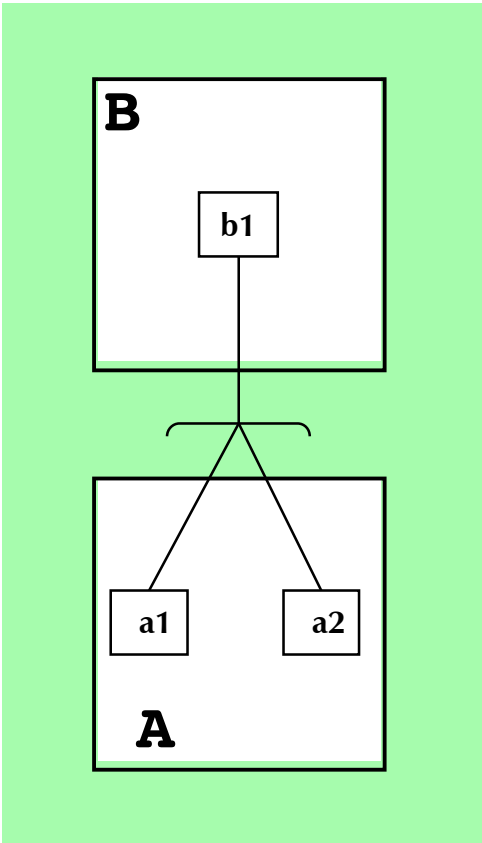
variety 1



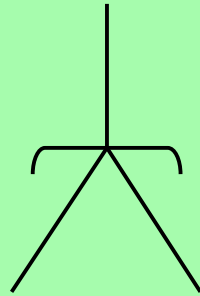
variety 2



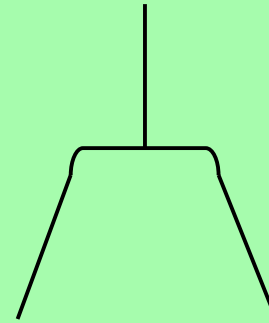
notation variants



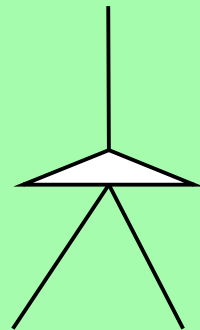
logical connectors



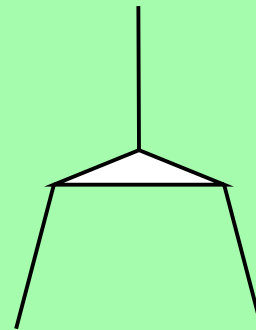
unordered-OR



ordered-OR

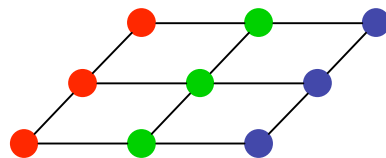


unordered-AND

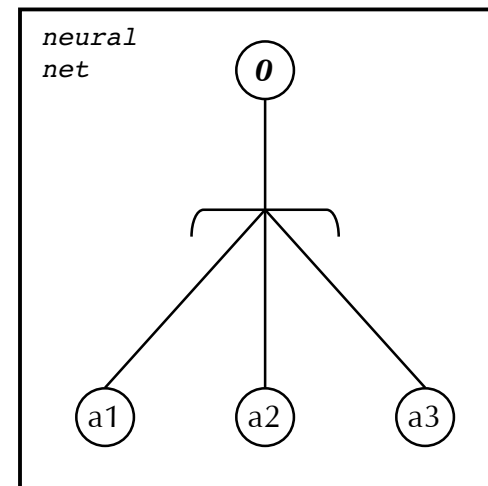
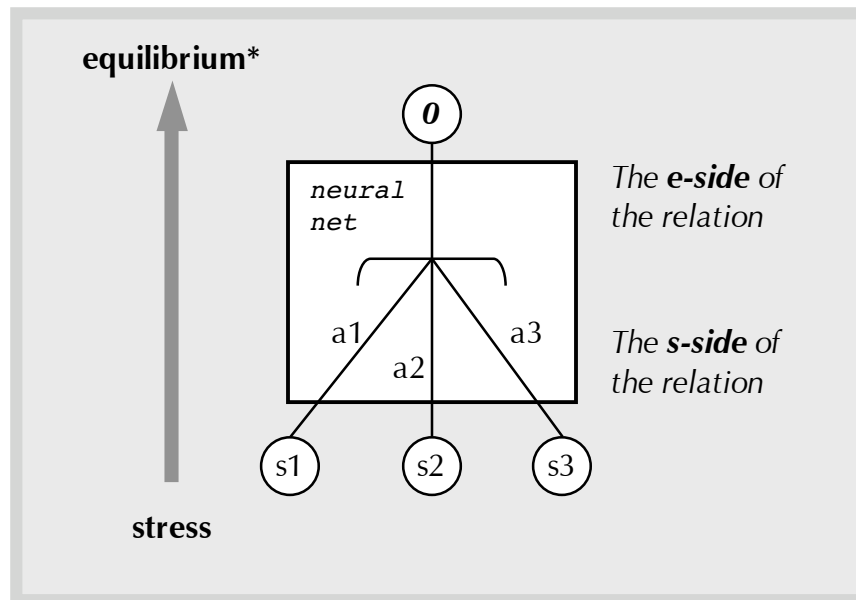


ordered-AND

Partitions, Simple Animal

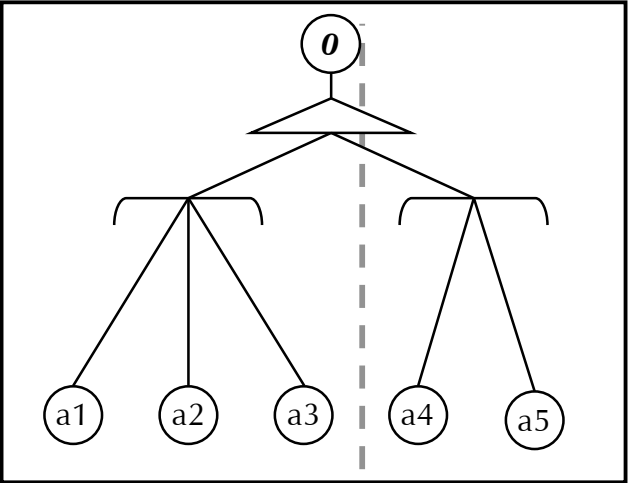


homogenous landscape

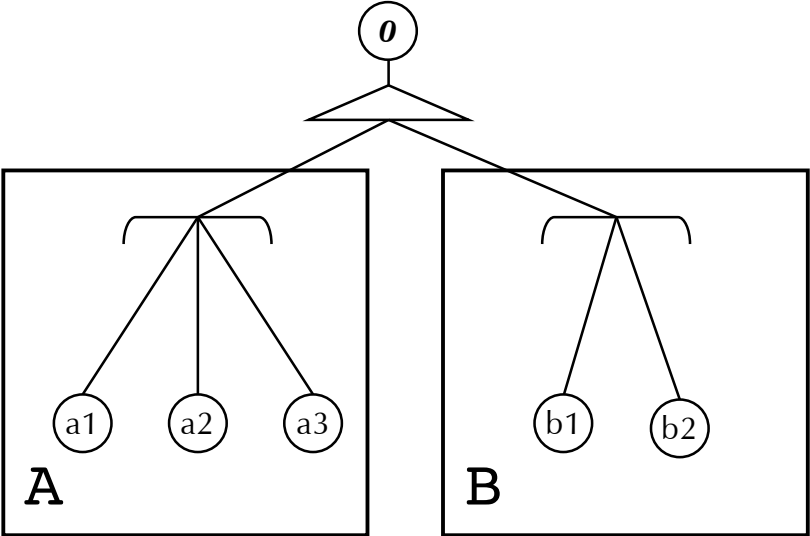


*"Equilibrium" is probably not a very good term. In the prose exposition I suggest the notion "at frame."

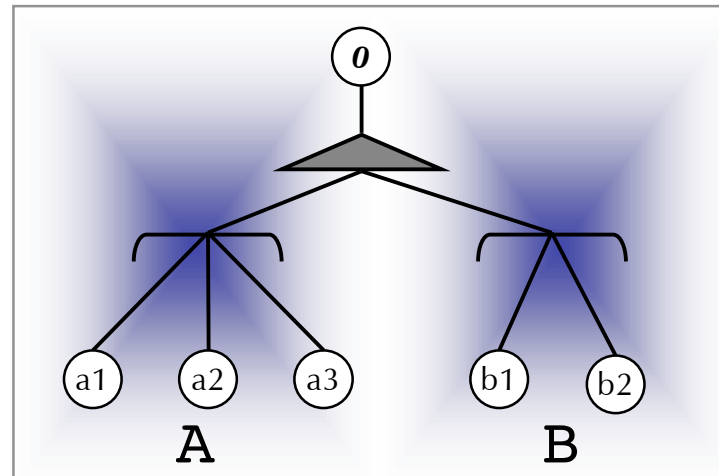
partitioned landscape 1



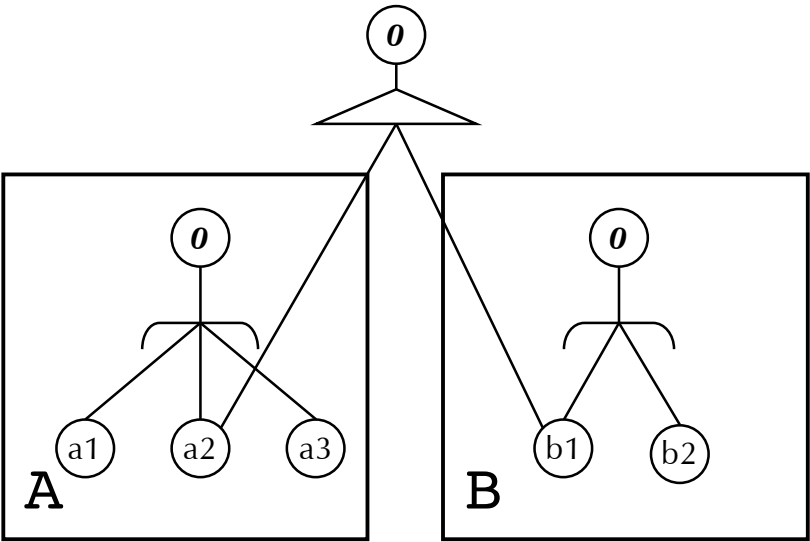
partitioned landscape 2



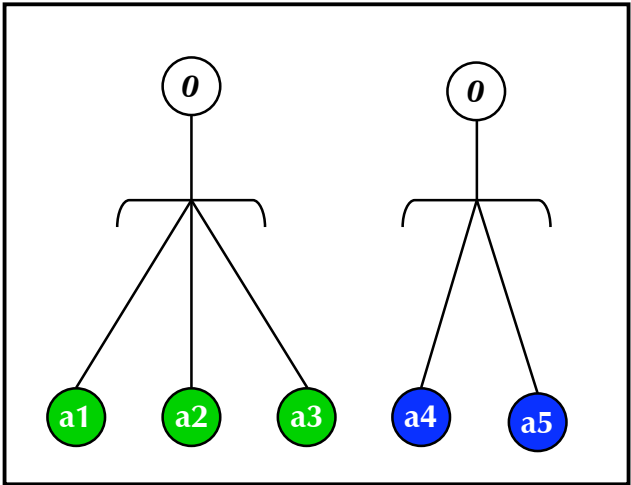
partitioned landscape 3



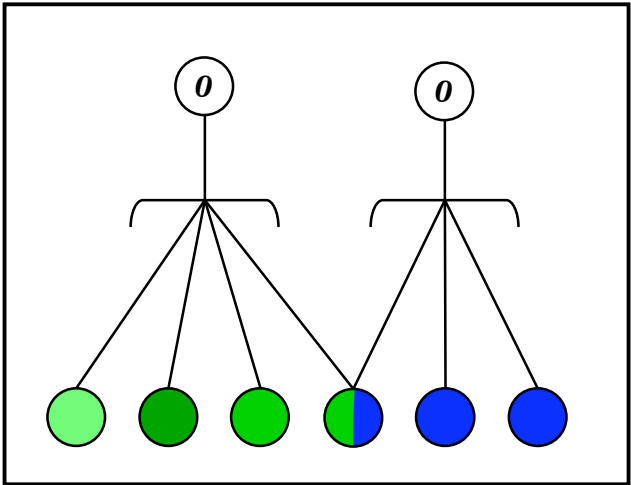
partitioned landscape 4



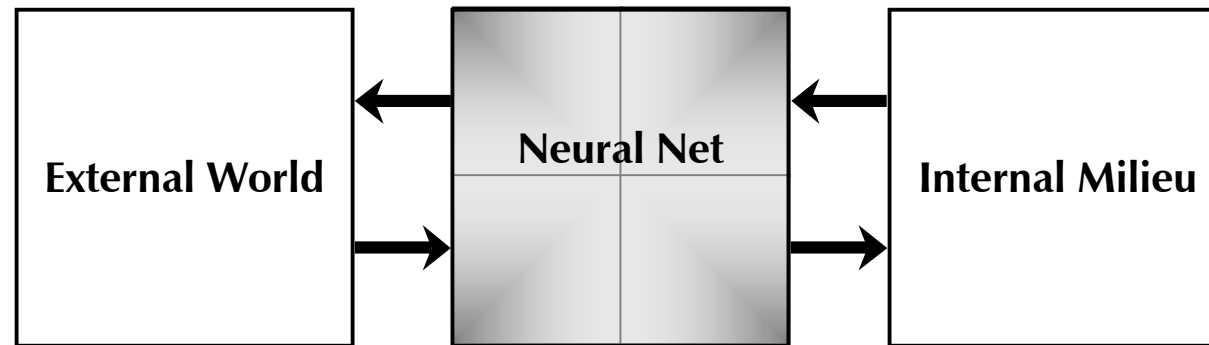
modal coloring 1



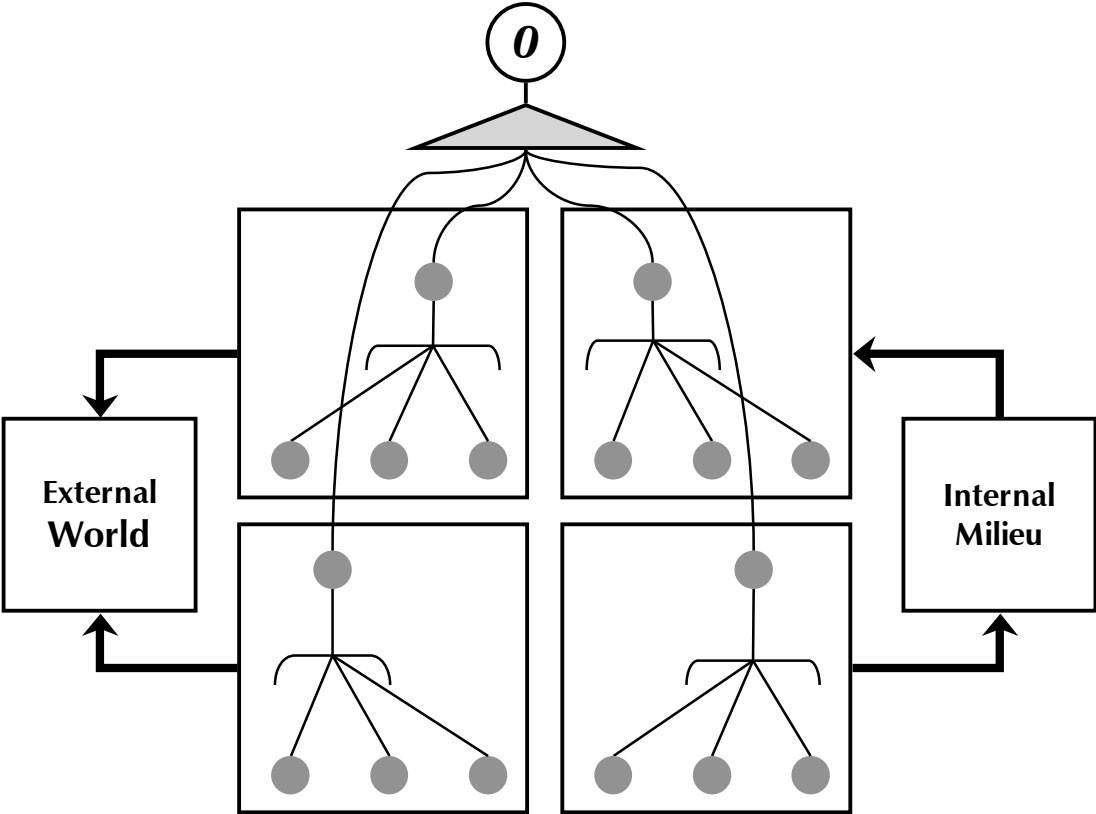
modal coloring 2



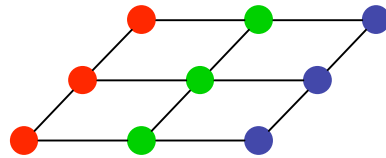
Simple Animal



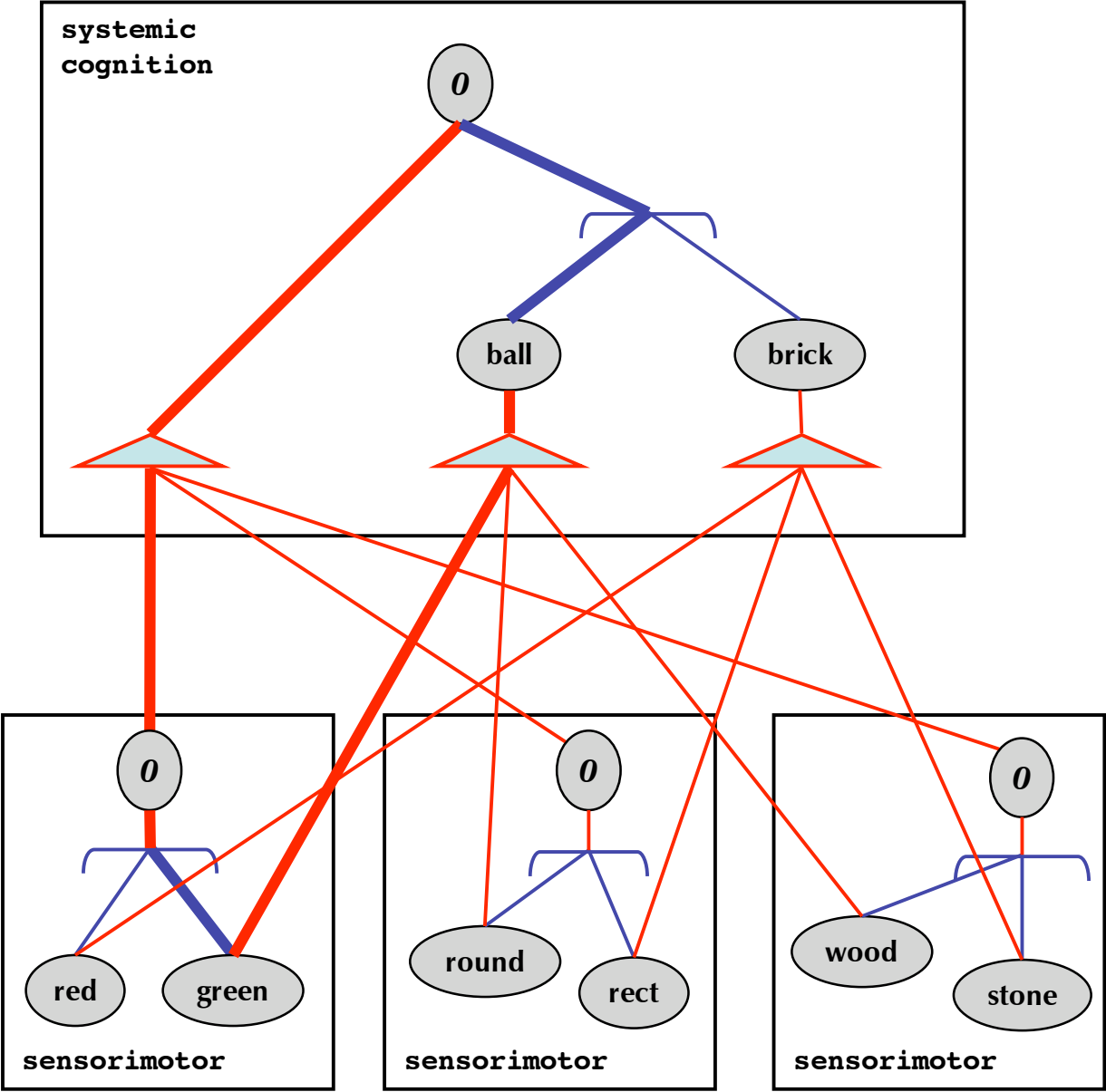
Life in the net



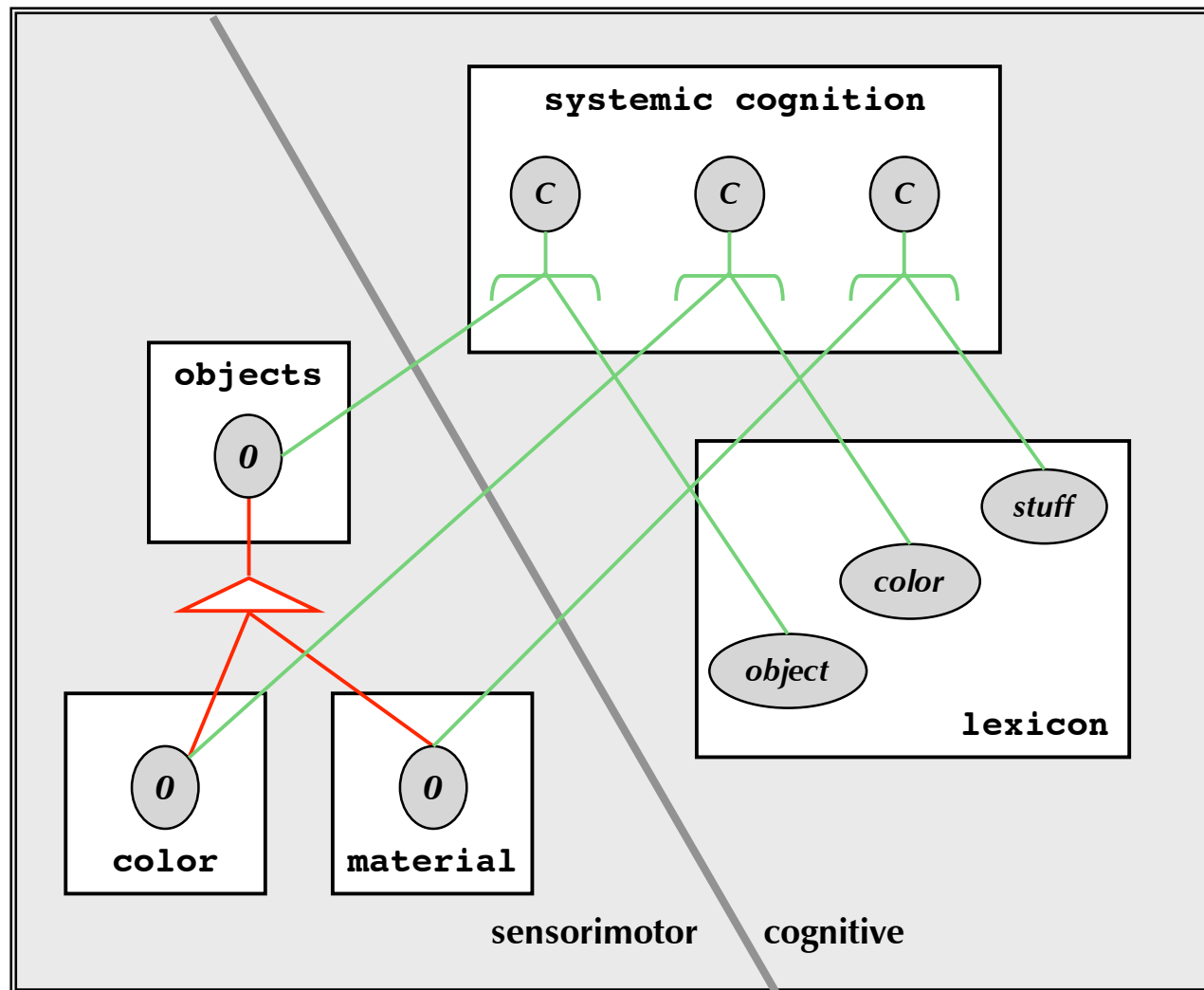
Assignment



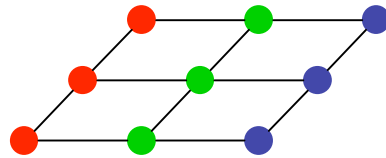
2 blocks -- assignment



“color” and “object”

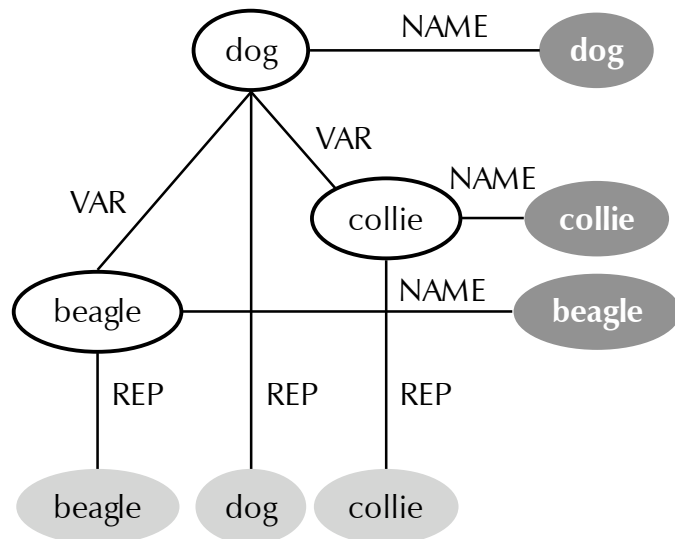


Variety



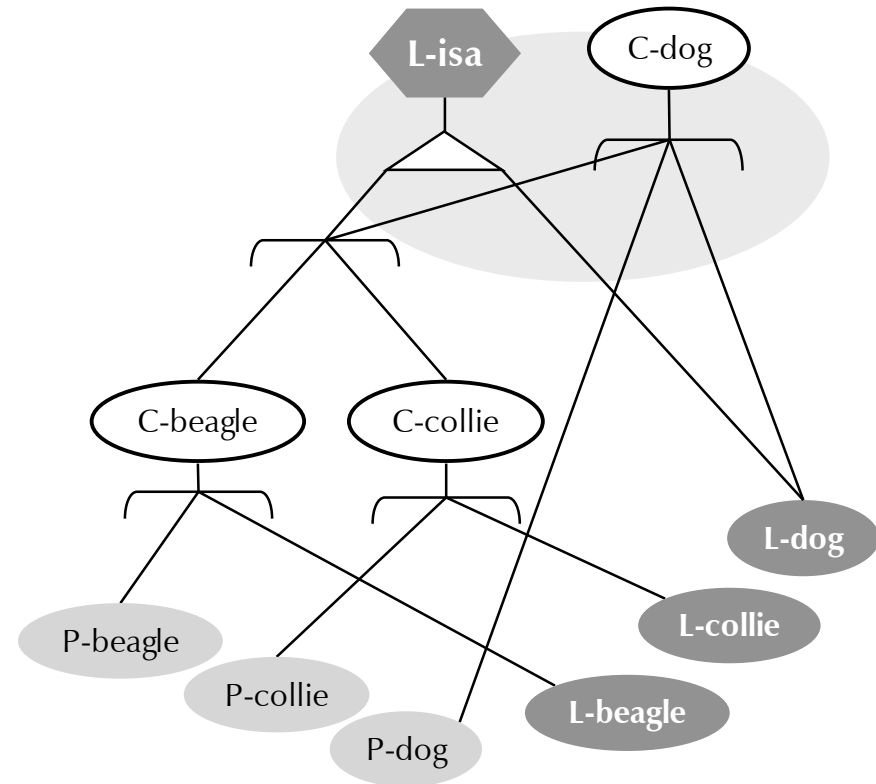
Is-a dog

"standard" notation



To the left we have a bit of paradigmatic structure as it would have been represented in the Phase 2 system. To the right we have the representation I am currently proposing. In this notation ISA would appear to be a lexical (L) item of the functor class. It helps regulate choice among alternatives in a systemic paradigm.

A-net notation

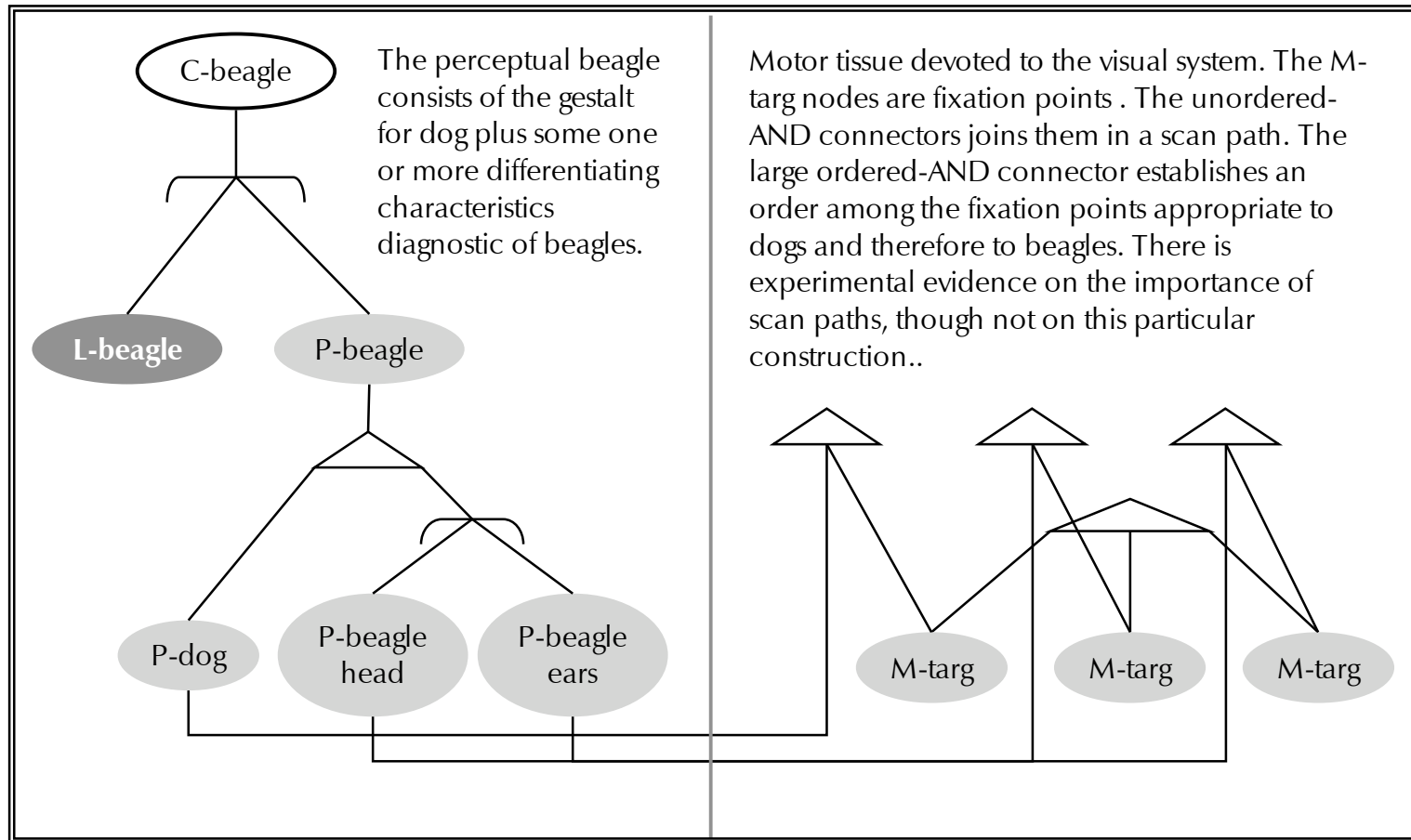


C: cognitive
P: Perceptual
L: Lexical

Note that there are perceptual correlates to dogs and kinds of dogs.

I have not indicated the *differentia specifica* for beagles and collies, That construction is in an earlier diagram.

Is-a/CMP beagle

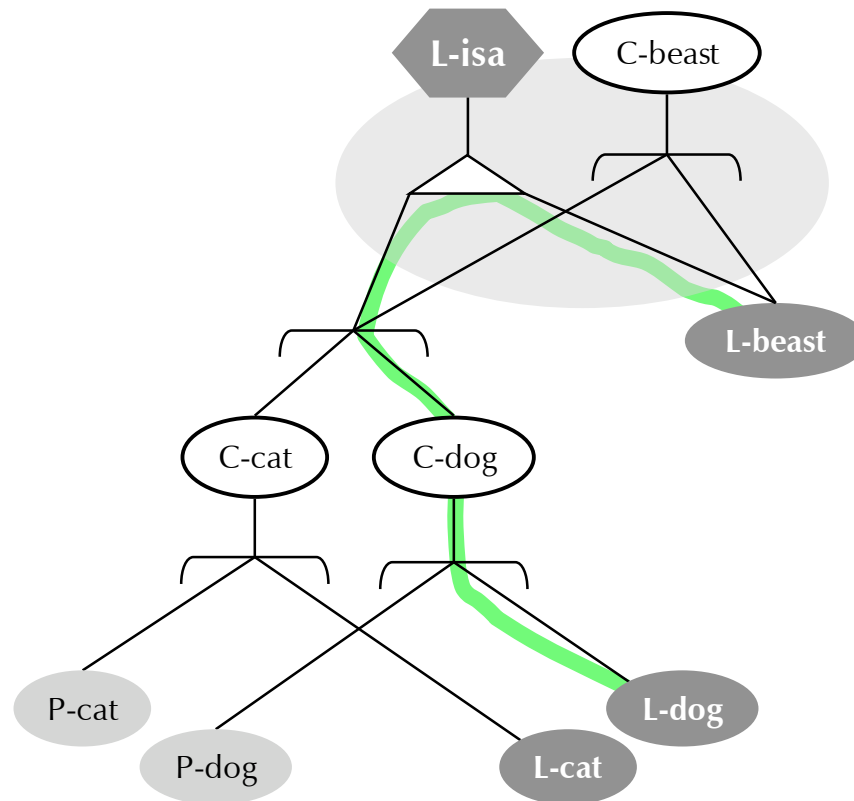


Is-a beast

Note that there is no perceptual correlate to a beast. We never see “beasts” directly. Rather, we see dogs or cats, and recognize them as being beasts.

Notice the paths traced in green. Because its two legs are on either side of an ordered AND those legs must be activated in succession. Thus one steps up or down a paradigm as needed. That is to say, one’s attention moves up or down the paradigm.

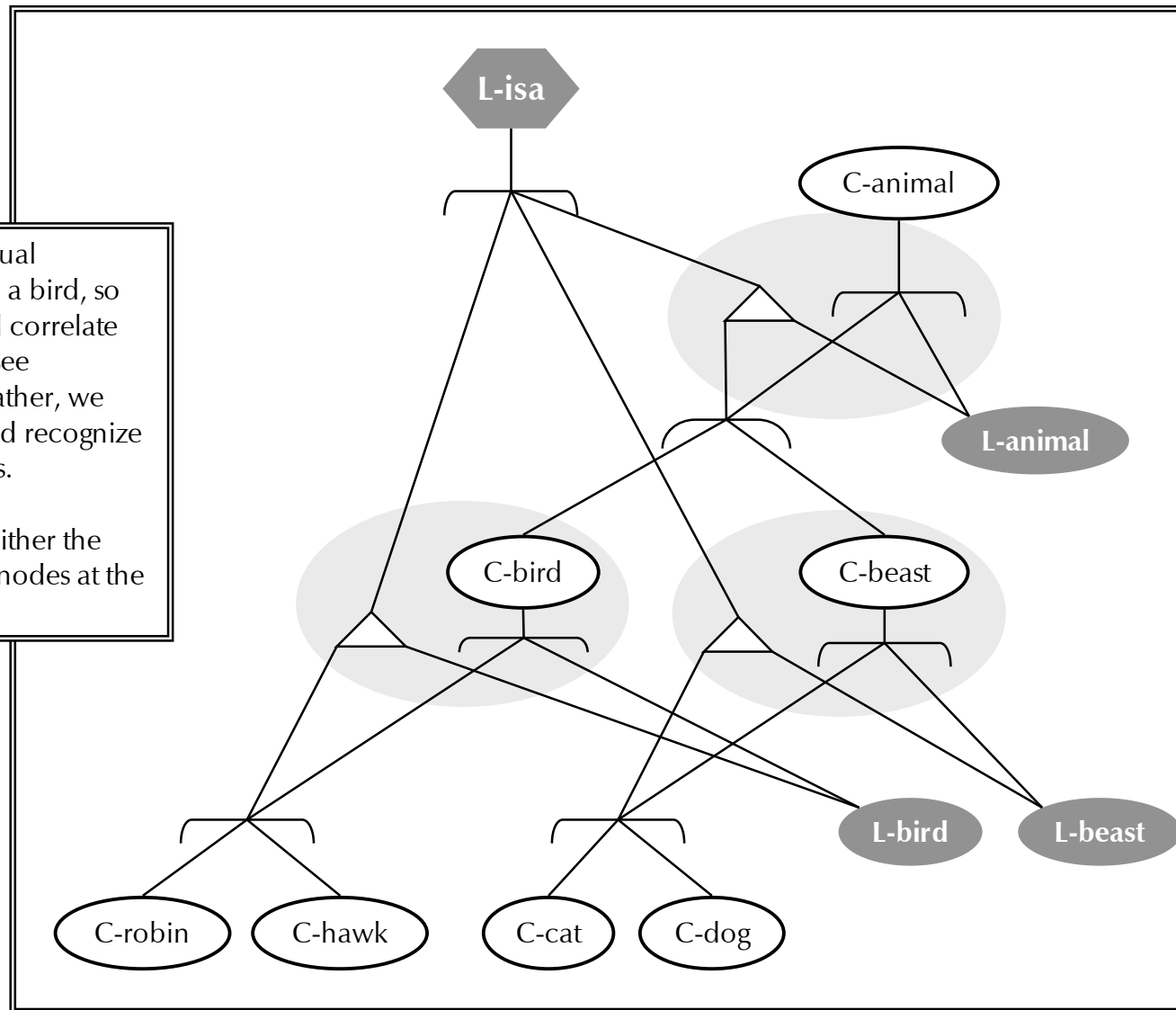
If one is moving up the paradigm, there is only one node to choose, in this case C-beast is up from both C-cat and C-dog. If one is moving down, one needs some (partial) activation from below in order to pick a path. This, I suspect, is why it is natural to move up the paradigm — “dogs are beasts” — but not down — “beasts are-inverse dogs.”



Is-a animal

As there is no perceptual correlate to a beast or a bird, so there is no perceptual correlate of animal. We never see “animals” directly. Rather, we see dogs or robins, and recognize them as being animals.

I have not indicated either the perceptual or lexical nodes at the lowest level.



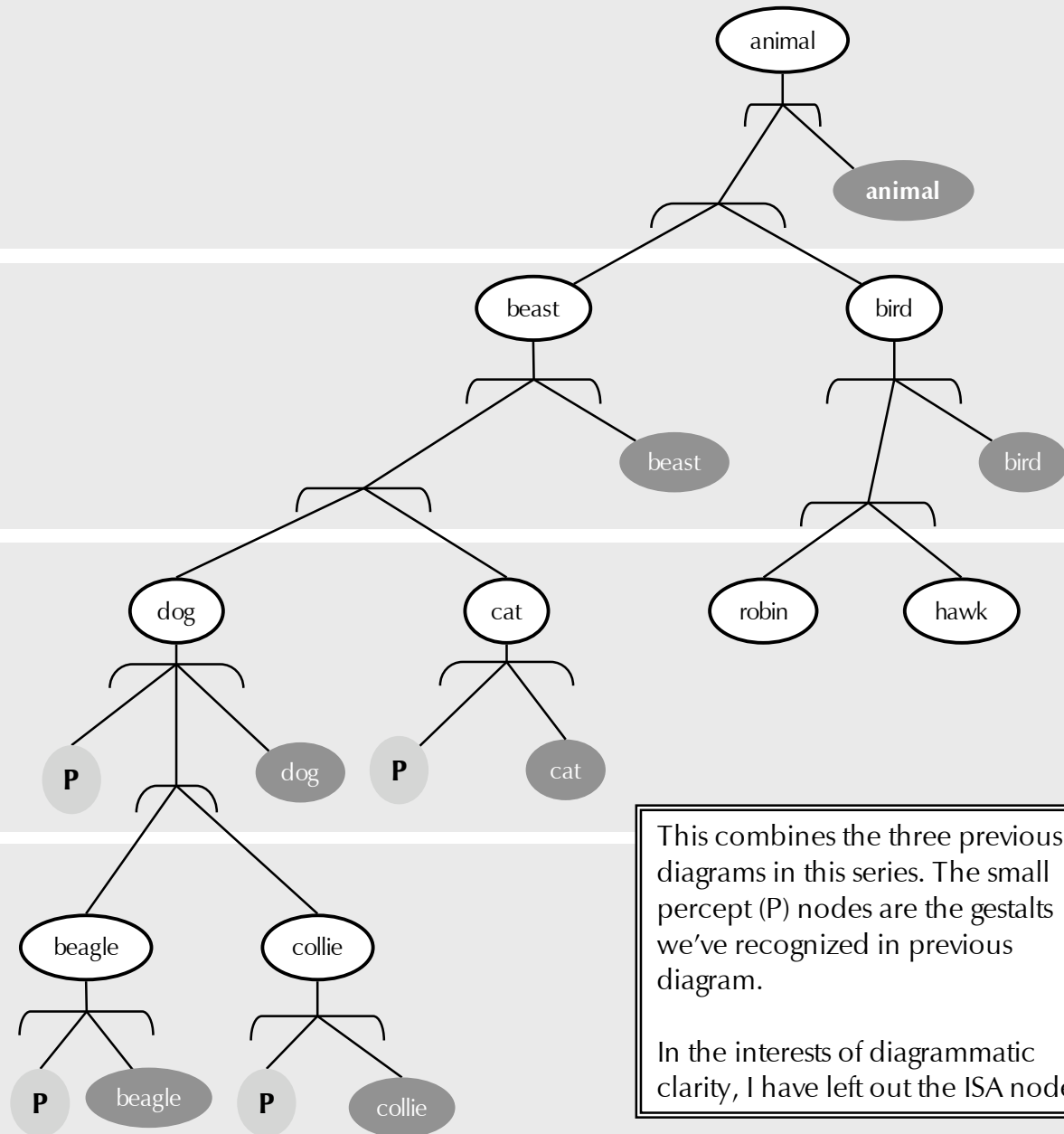
4 Level Paradigm

Top level (unique beginner): The concept is given meaning by either the concept tree below it or by the lexeme.

2nd level: The concept is given meaning by either the concept tree below it or by the lexeme.

3rd level (genus, basic): The concept is given meaning by either the concept tree below, by the lexeme, or **by a perceptual gestalt**. *These gestalts are the basic linkage between cognition and the world.*

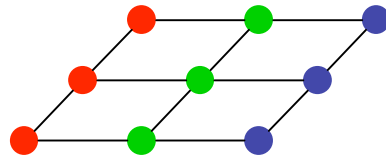
4th level: The concept is given meaning by either the percept or the lexeme. Not that, at this level, *the percepts are complex*, composed of the basic gestalt plus differentiating features.



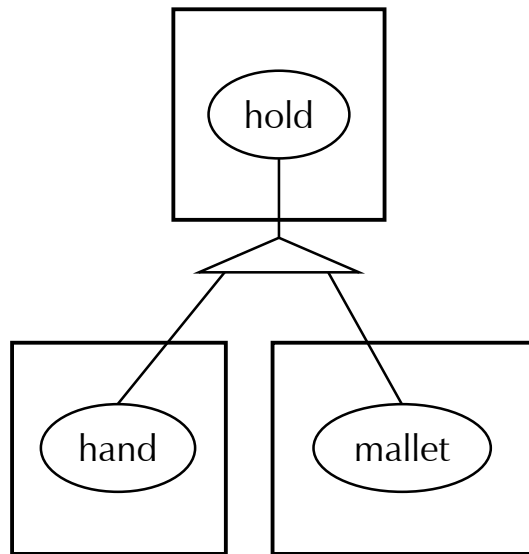
This combines the three previous diagrams in this series. The small percept (P) nodes are the gestalts we've recognized in previous diagram.

In the interests of diagrammatic clarity, I have left out the ISA nodes.

Move



hand hold racket



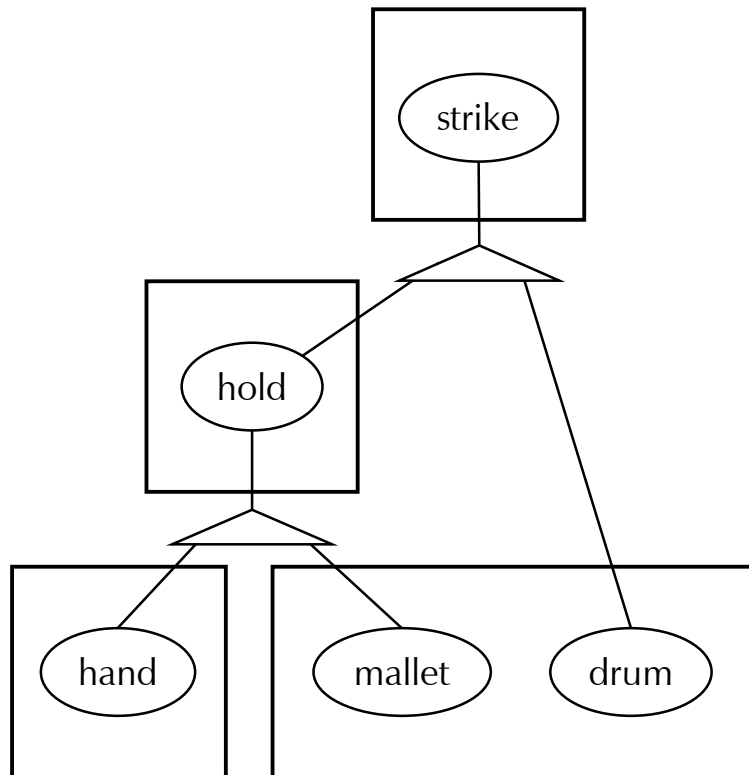
hold (hand, racket)

It is not immediately clear to me whether “hold” is of a higher order (in Powers’ sense) than either “hand” or “mallet” or whether they are all of the same order. If the former, we’re dealing with events and entities: a hold is an event that makes the racket an extension of the hand. If the latter, they’re all entities: a hold is an entity that couples the hand and the racket. In the SMS degree, a hold is simply a configuration of the hand in relation to the racket.

This construction seems consistent with the logician’s practice of treating (things like) hold as a relation over (things like) hand and racket. The different roles for racket and drum seem appropriately depicted through ordered AND.

NOTE: This is a semantic/cognitive construction, not a linguistic one. We have no linguistic entities here. Linguistic case roles would seem to follow naturally from this underlying semantics.

strike drum



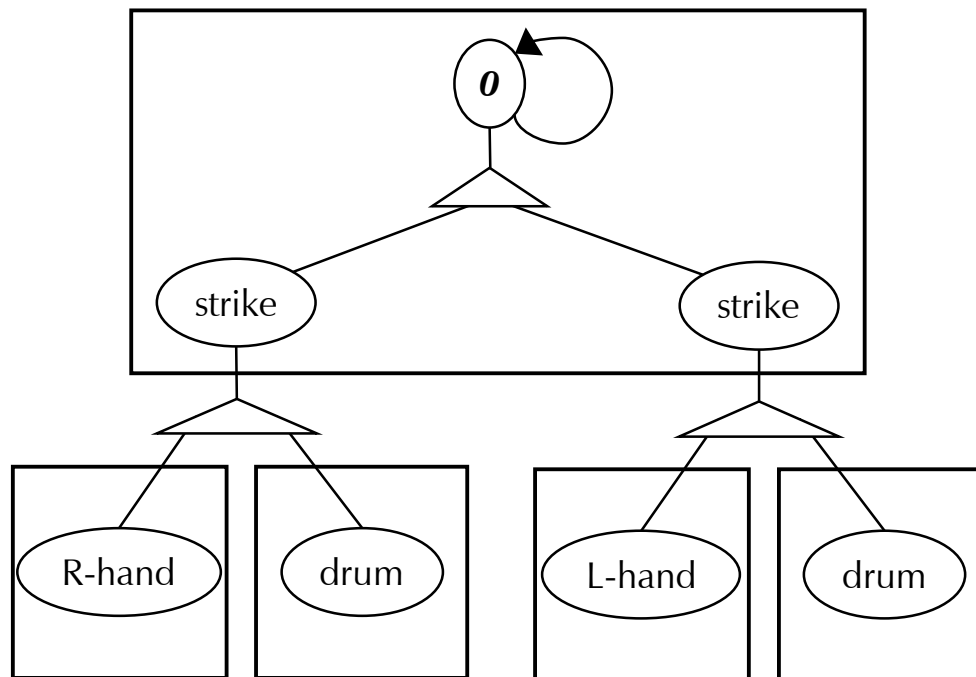
strike [hold (hand, mallet), drum]

“Hold” and “strike” are of different orders (in Powers’ sense). This construction, in effect, treats the mallet as an extension of the hand. The different roles for mallet and drum seem appropriately depicted.

Strike is a relation over ‘hand hold mallet’ and ‘drum.’

NOTE: This is a semantic/cognitive construction, not a linguistic one. We have no linguistic entities here. Linguistic case roles would seem to follow naturally from this underlying semantics.

alternate and repeat

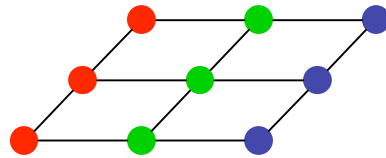


Below: Right hand strikes drum, then left hand.

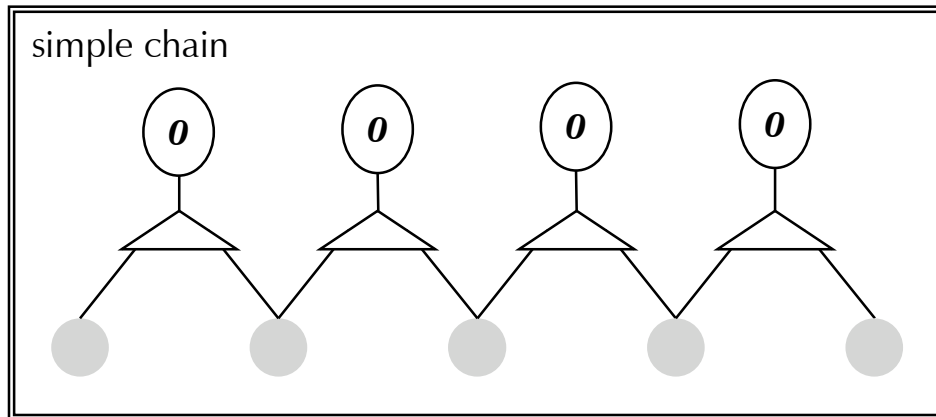
Above: R-hand and L-hand strikes are linked with ordered-AND. Using unordered-AND would indicate a simultaneous strike. Linkage through unordered-OR would mean one or the other; using ordered-OR would establish priority.

At the very top the equilibrium point is linked to itself through an arrow. This signifies repetition.

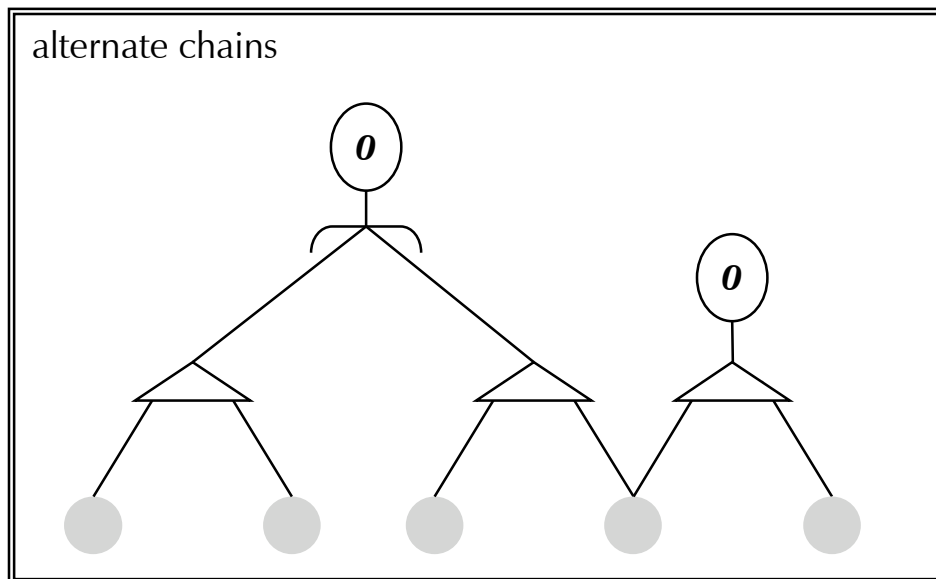
Counting, Place Notation



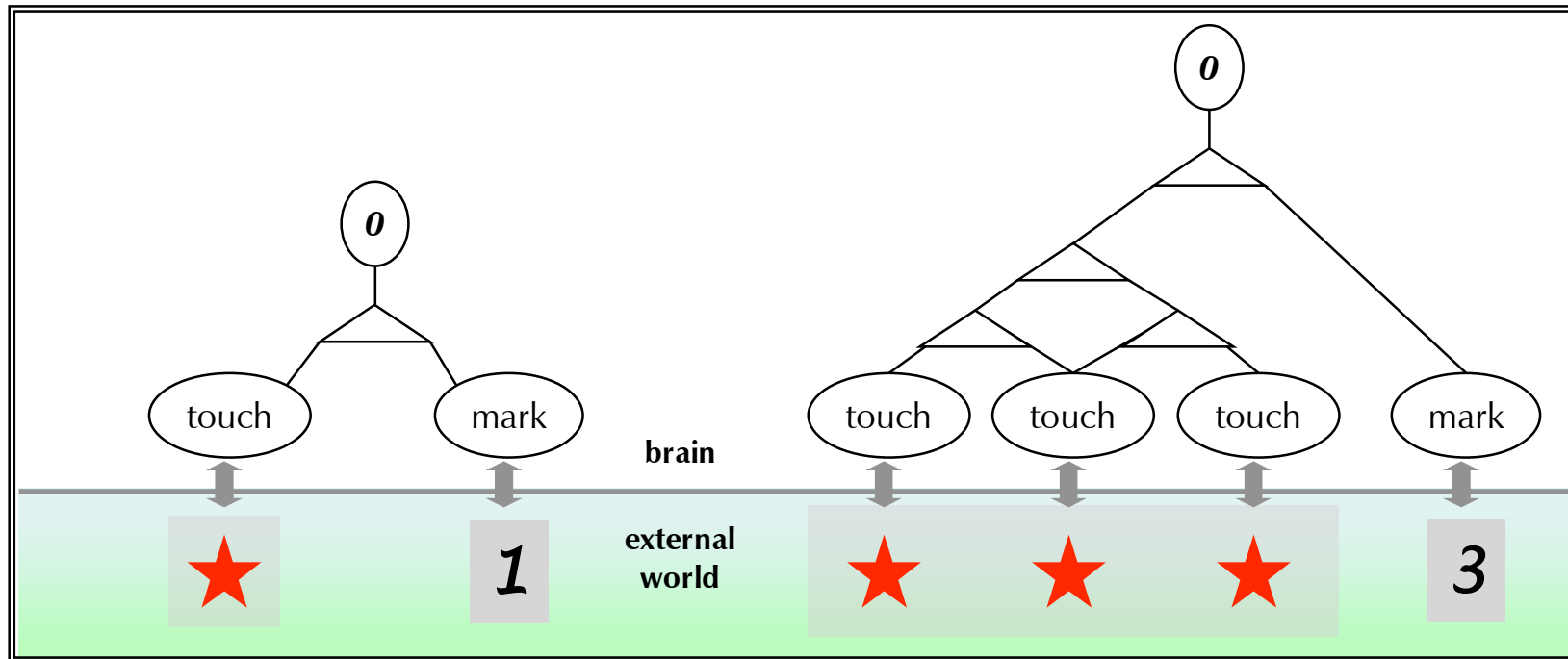
sequence



A child can use a sequence of finger touches to enumerate, e.g., the number of marbles in a box. Hence simple chains of repetitive acts are an essential component of the behavioral underpinnings of simple arithmetic.



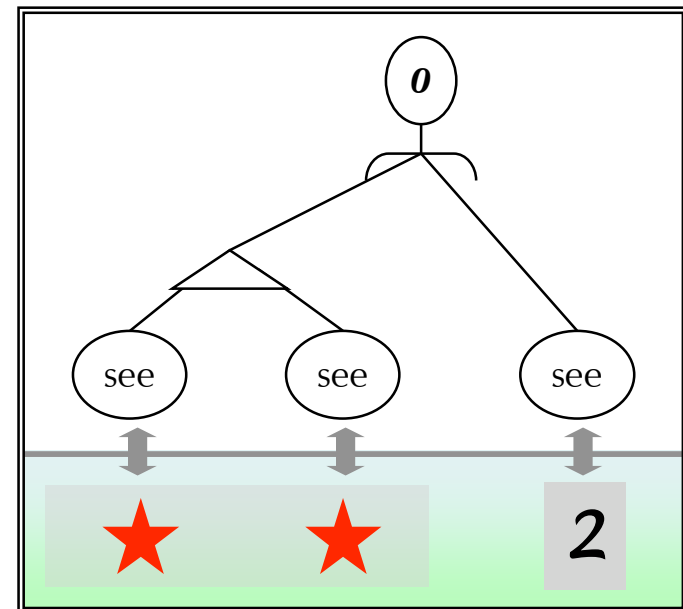
count



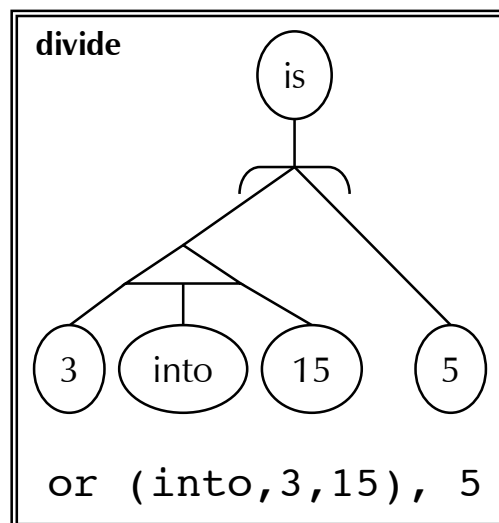
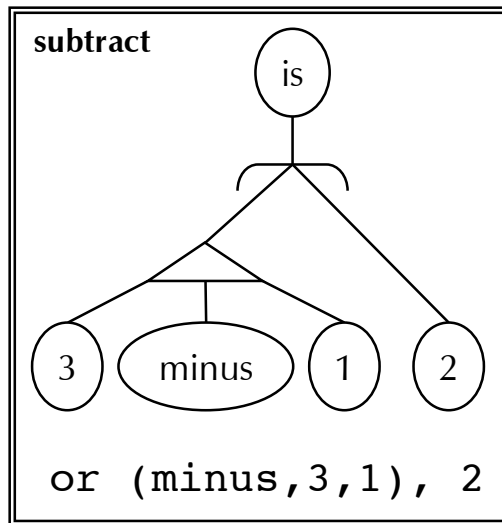
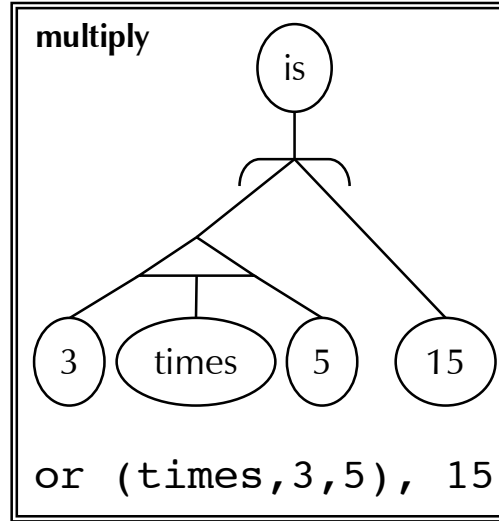
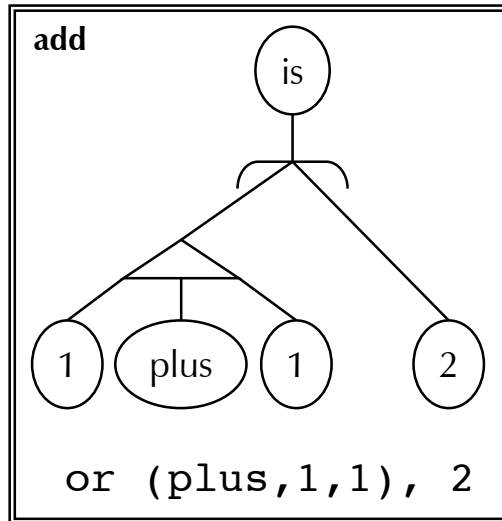
The purpose of these diagrams is to indicate how we might represent the act of enumerating a collection of objects, as, for example, a child might do in learning how to count. The idea is that one touches each object in the collection, and then makes the appropriate mark.

At the left, there is one item in the collection. So the numeral "1" is the appropriate mark. At the upper right we have three items in the collection so "3" is the appropriate mark. Notice the operators are all ordered-AND's.

At the lower right we have a slightly different construction using unordered-OR to link the act of visually inspecting a collection with the appropriate numeral.



arithmetic primitives



These panels illustrate the elementary propositions of arithmetic. These are the propositions that form the various “tables” one memorizes.

I suspect one memorizes these as pure symbols either verbal-auditory and visual-motor. These tables have no cognitive content other than their form. Their basic cognitive content is given in the procedure that relates numerical values to the act of enumerating some collection, as illustrated on the previous slide. Beyond this, I suspect one develops arithmetic intuition of a cognitive nature in the process of working many many problems; there is evidence in the literature that seems to point in this direction.

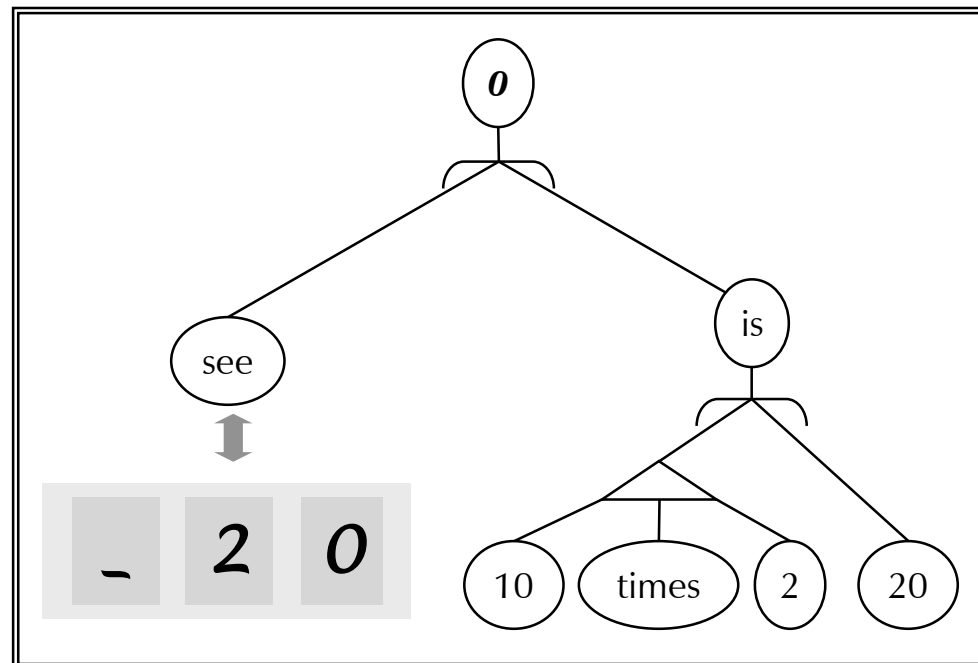
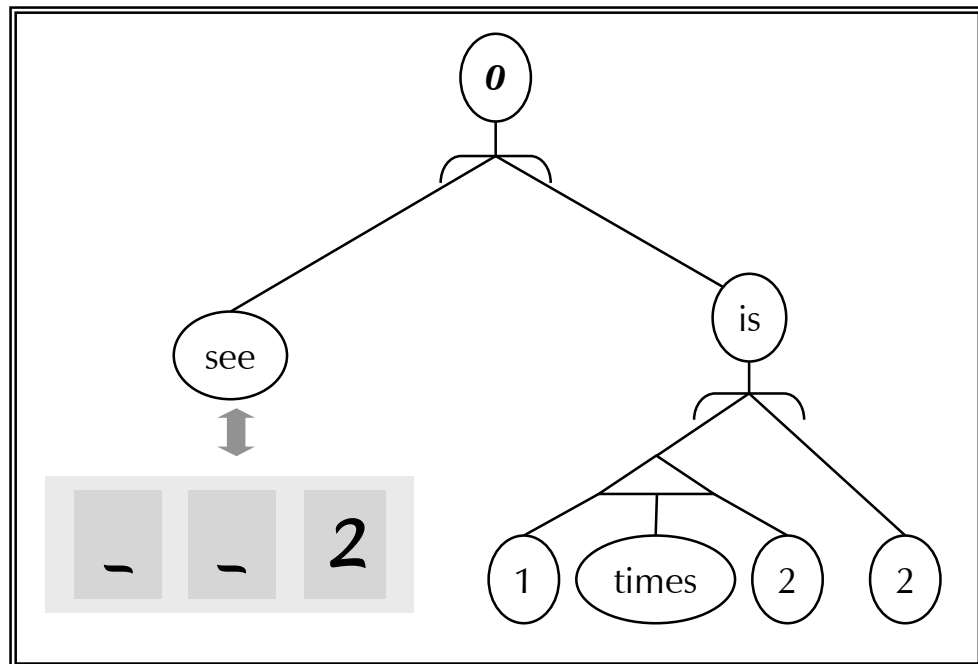
The perceptual substance of these propositions are so similar that they are easily confused. The purpose of all that drill is to tune the neural nets so that they do not confuse these otherwise highly similar objects.

zero & place notation

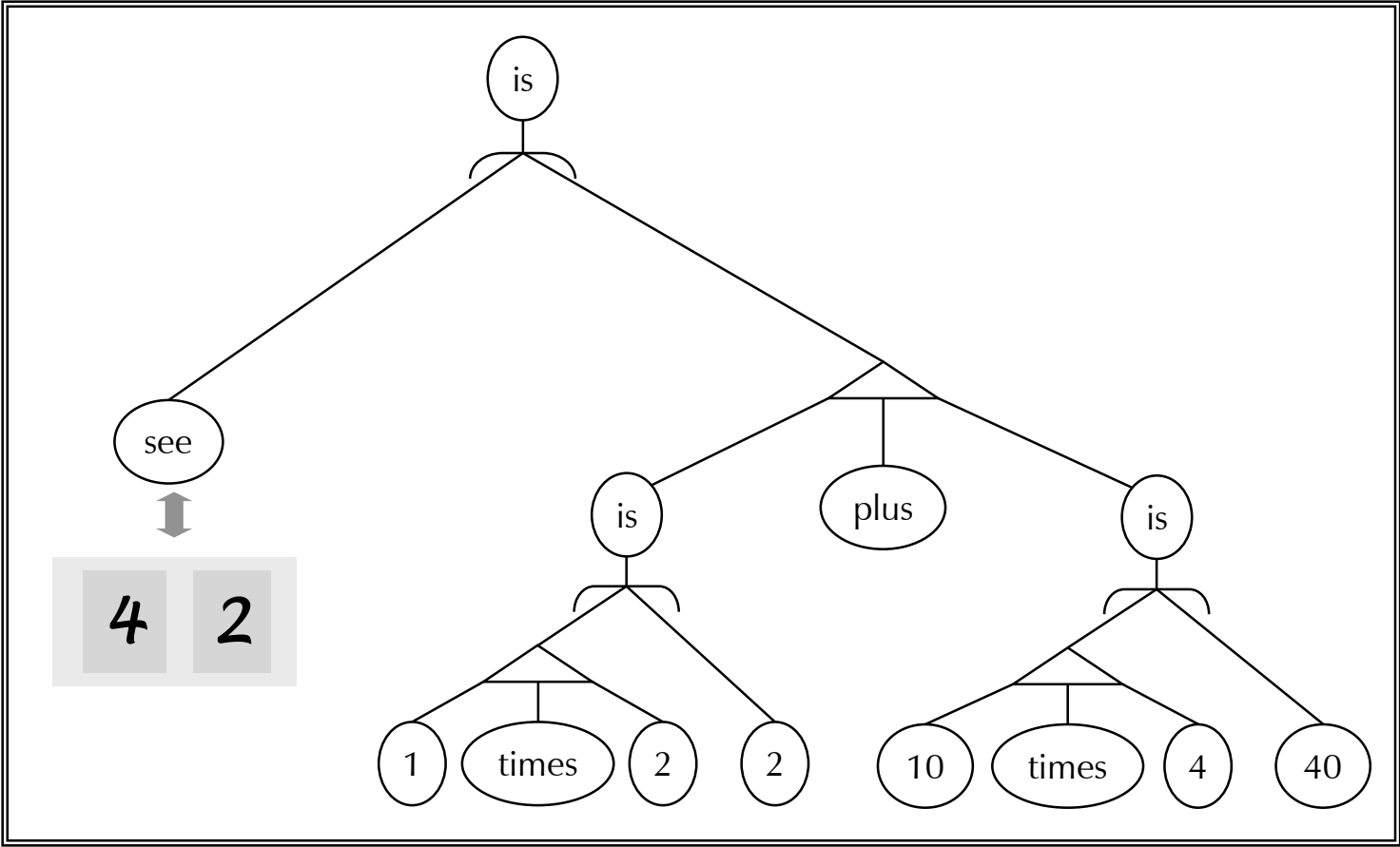
or (plus,0,0), 0
or (plus,1,0), 1
or (minus,0,0), 0
or (minus,1,0), 1
or (times,1,0), 0
or (into,1,0), “#%\$!”

Here's a take on place notation. The notion of zero must, of course, be developed. I've indicated some of the basic propositions above. The meaning of those, of course, must ultimately be grounded in the action of counting collections. Zero corresponds to an empty collection.

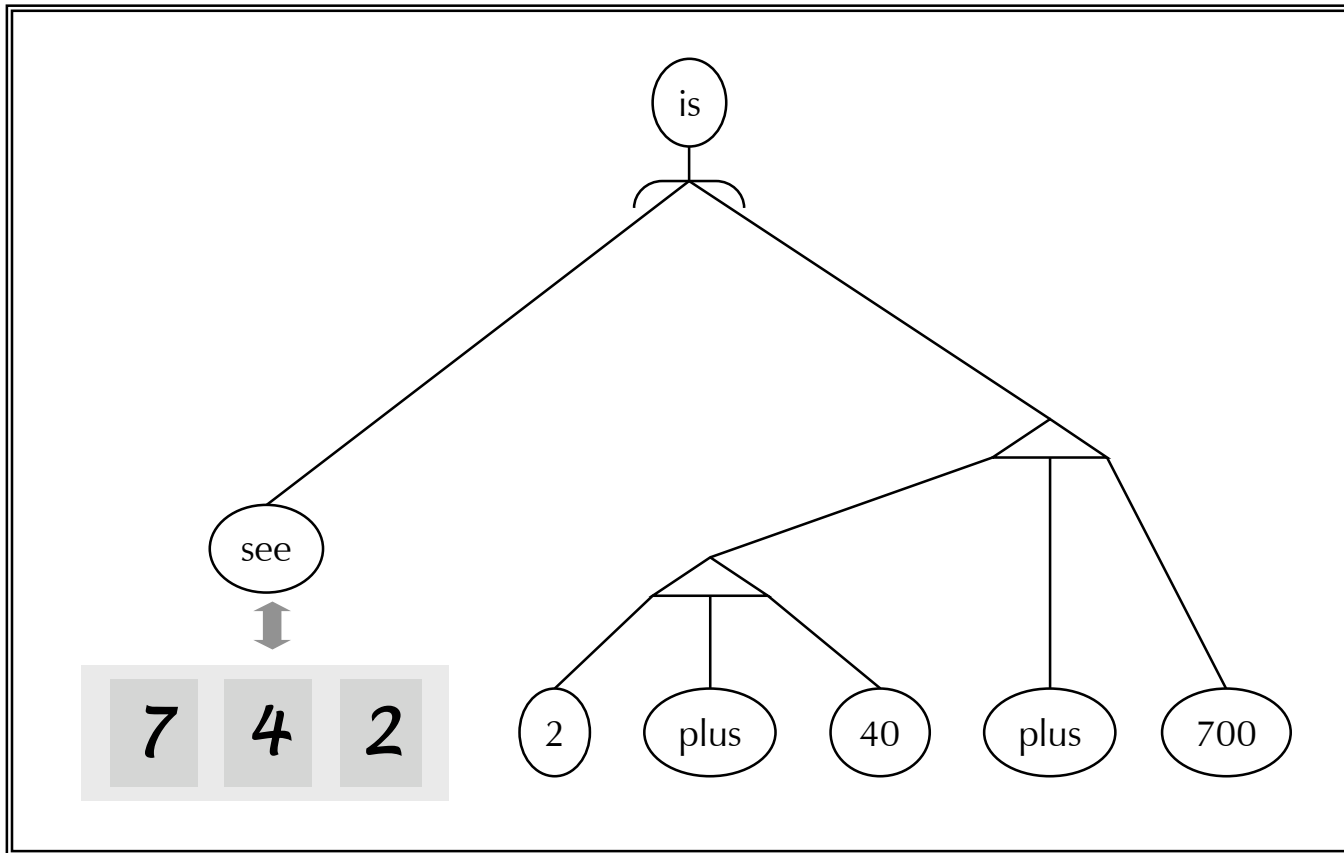
To the right we have two diagrams illustrating how, given zero, the meaning of place can be established.



place notation, 42

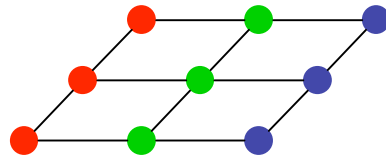


place notation, 742

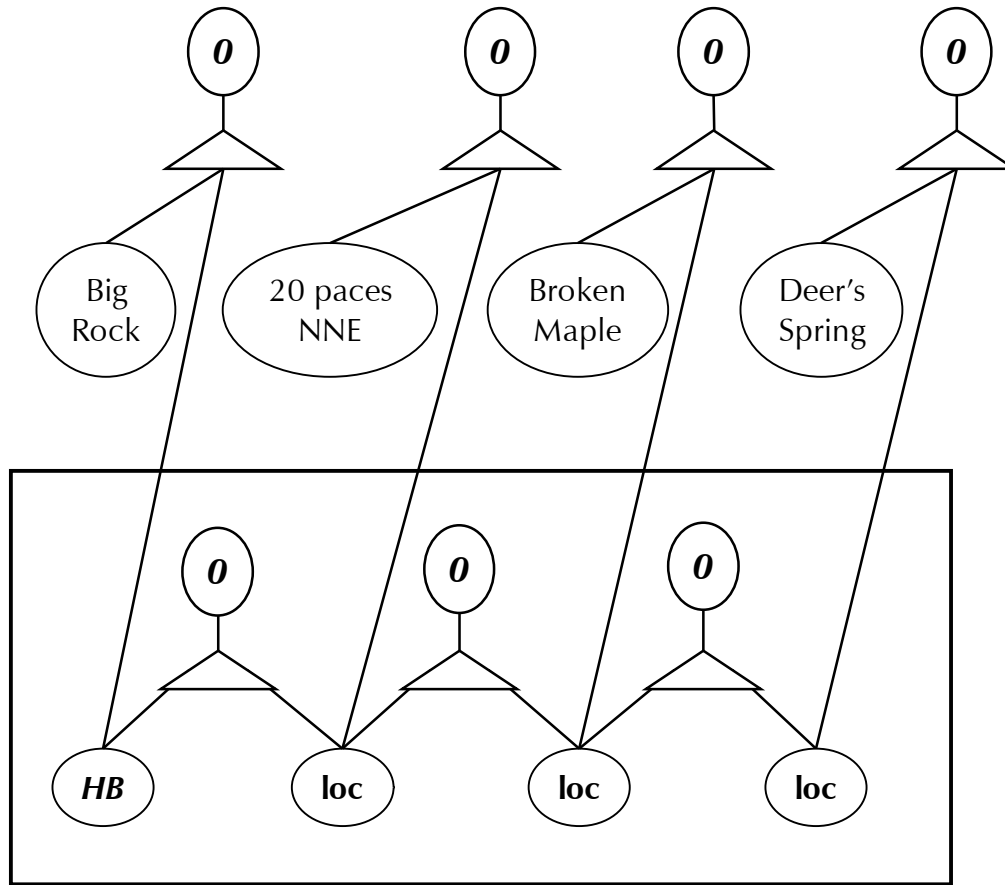


Note that I have slipped into using “is” in the same way as the node for the equilibrium state. Considering the derivation of “**being**” from “**to be**”, this has philosophical implications. But that requires the development of the gnomonic degree and of abstraction. Later.

Orientation in Time and Space



path, home base



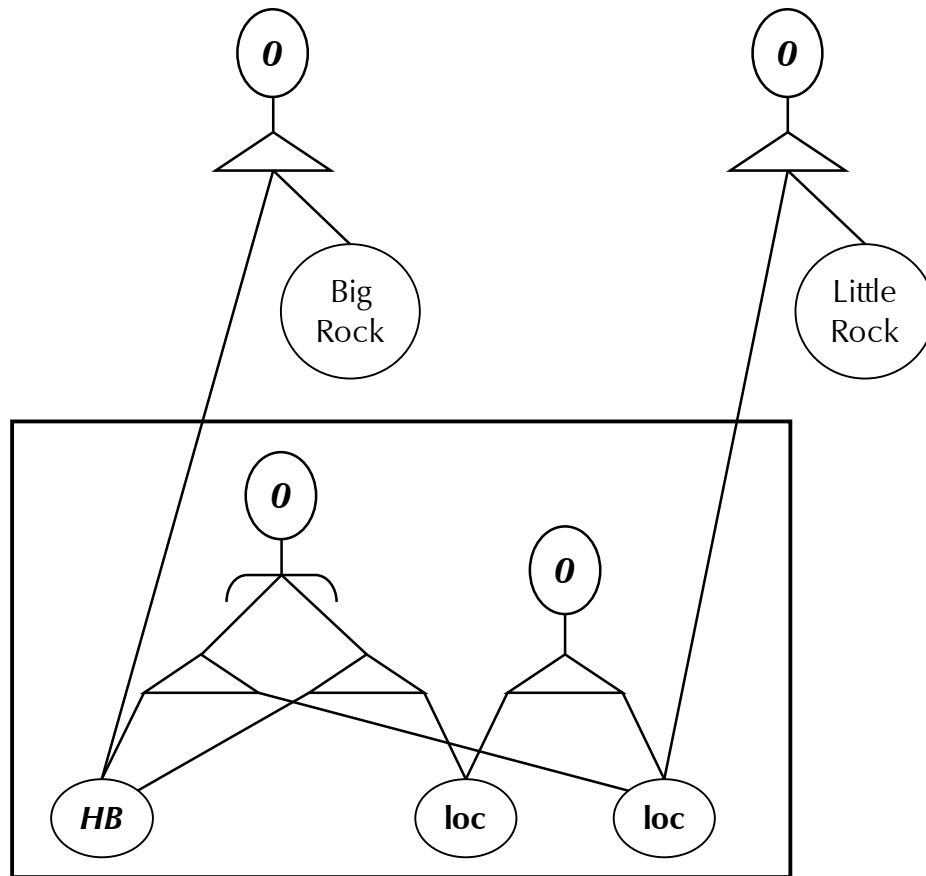
HB: home base, a special location node. This is a privileged location in one's personal geography. All paths through the environment are specified with respect to this location.

loc: location. "Loc" nodes are locations in physical space. Location nodes are linked with one another, thereby creating chains of locations. A chain of locations is a path.

Loc nodes may be associated with various kinds of information. Three of the loc nodes in the diagram are associated with land marks. One is associated with an *heading* of "20 paces north-northeast." The orientation is with respect the *previous* loc node in the chain. In effect: "This point is 20 paces NNE of Big Rock." This heading is itself a complex chunk of information requiring structure not here represented..

I suspect loc nodes are either in or created by the hippocampus. Finally, both the animal and human literature indicate that *dead reckoning* is perhaps the most important navigation technique among mammals. Dead reckoning does not rely on landmarks. Rather, it is based on time and distance calculations along each heading.

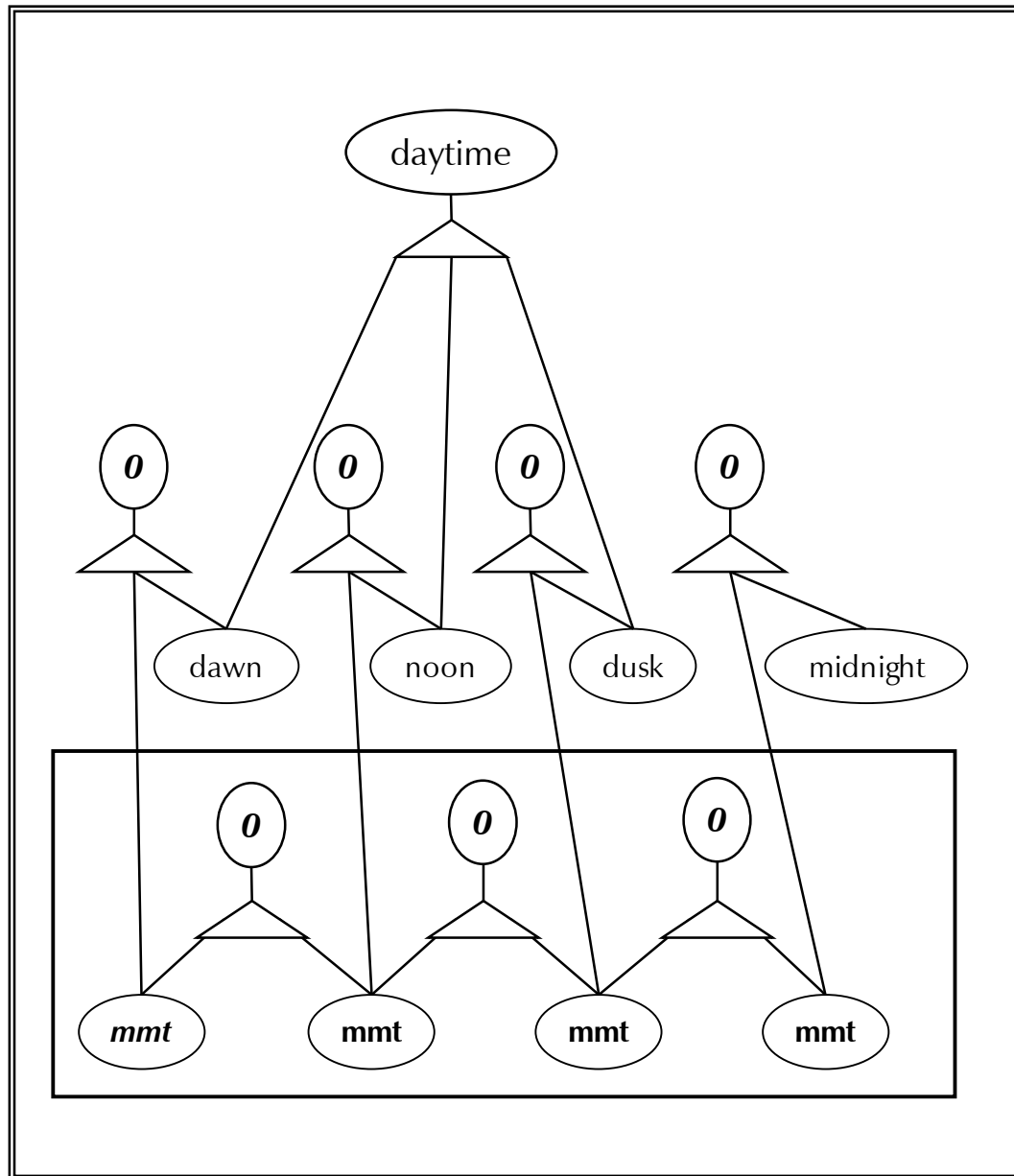
branching



Two different paths from Big Rock to Little Rock. Notice the way the loc nodes are connected to the AND-nodes.

(Note: The absence of any information associated with the middle loc node is purely a matter of visual convenience.

time, a day



mmt: moment. A moment is a relatively short, but indefinite period of time.

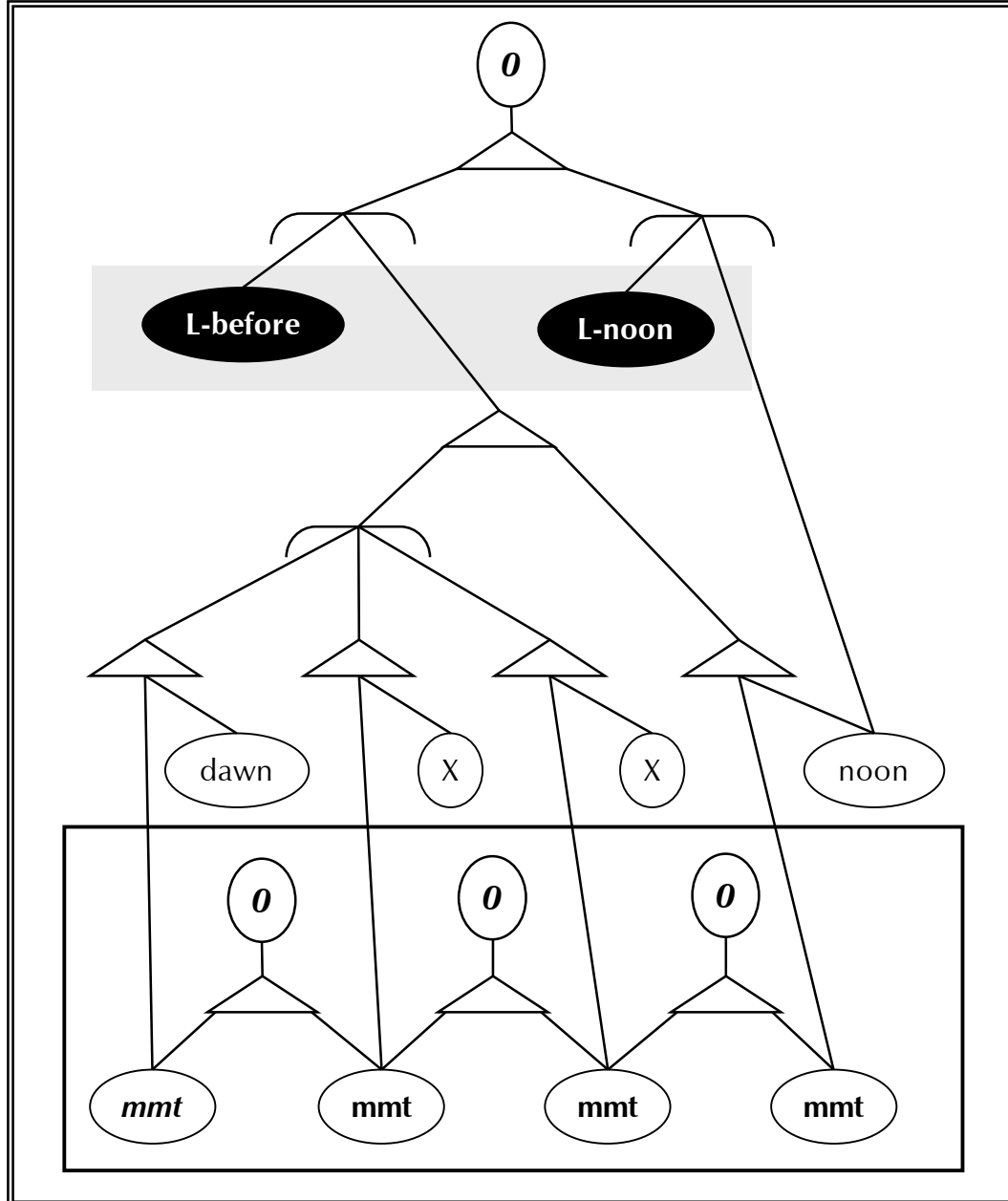
The temporal “landmarks” are standard designations for the cardinal points of the day. In a fuller account each would be specified by appropriate perceptual cues, e.g. sun rising above the horizon, more light, etc.

Notice that daytime has been defined by an ordered-AND over dawn, noon, and dusk. Night time could be defined in a similar fashion.

Notice that this diagram is rather like the diagram for specify a path through space. One simply replaces loc-nodes with mmt-nodes. Given the intimate relationship between time and space in the act of traveling, this is not surprising.

One can imagine a temporal use for the branching construction. Given two or more different ways of specifying temporal landmarks, one can have a branch for each method. For example, one can reckon time in hours and minutes by the clock or by the duration of typical activities.

“before noon”



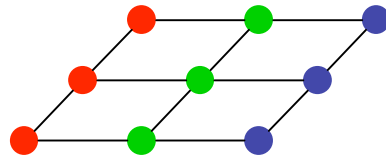
The two nodes in the shaded area are lexical items. The shaded area thus represents the phrase “before noon.” The two words are linked through ordered-AND, for that particular word order is obligatory in English. The two words are linked to cognition through unordered-OR nodes, meaning that, for cognitive purposes, one side of the relation is equivalent to the other.

Notice the logical structure that gives “before” its meaning. Similar constructions could be used for similar temporal words.

Consider the implications of this construction for representing the meaning/usage of other linguistic functors.

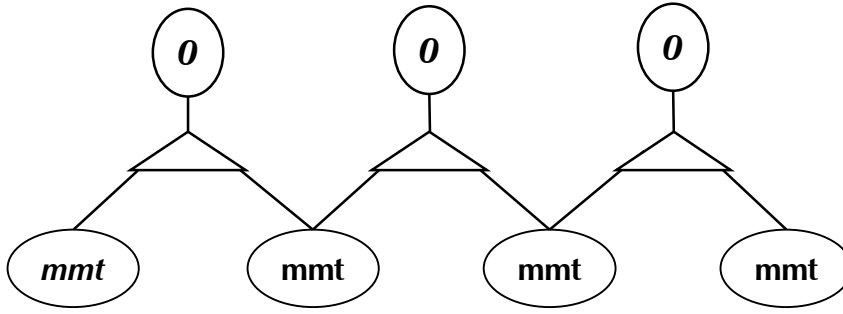
I suspect we might do well to think of the navigation system as operating in undifferentiated time-space in its most primitive mode. One cannot make instantaneous movements from one place to another.

Fragments of Language

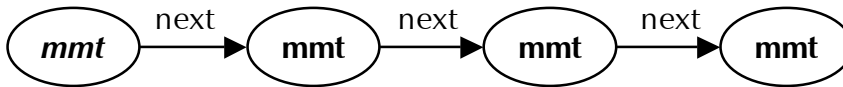


chain notation, "next"

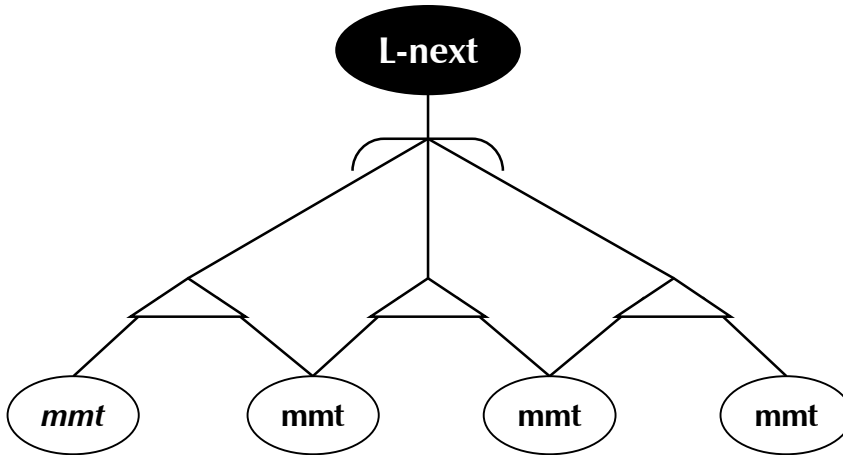
1a



1b



2



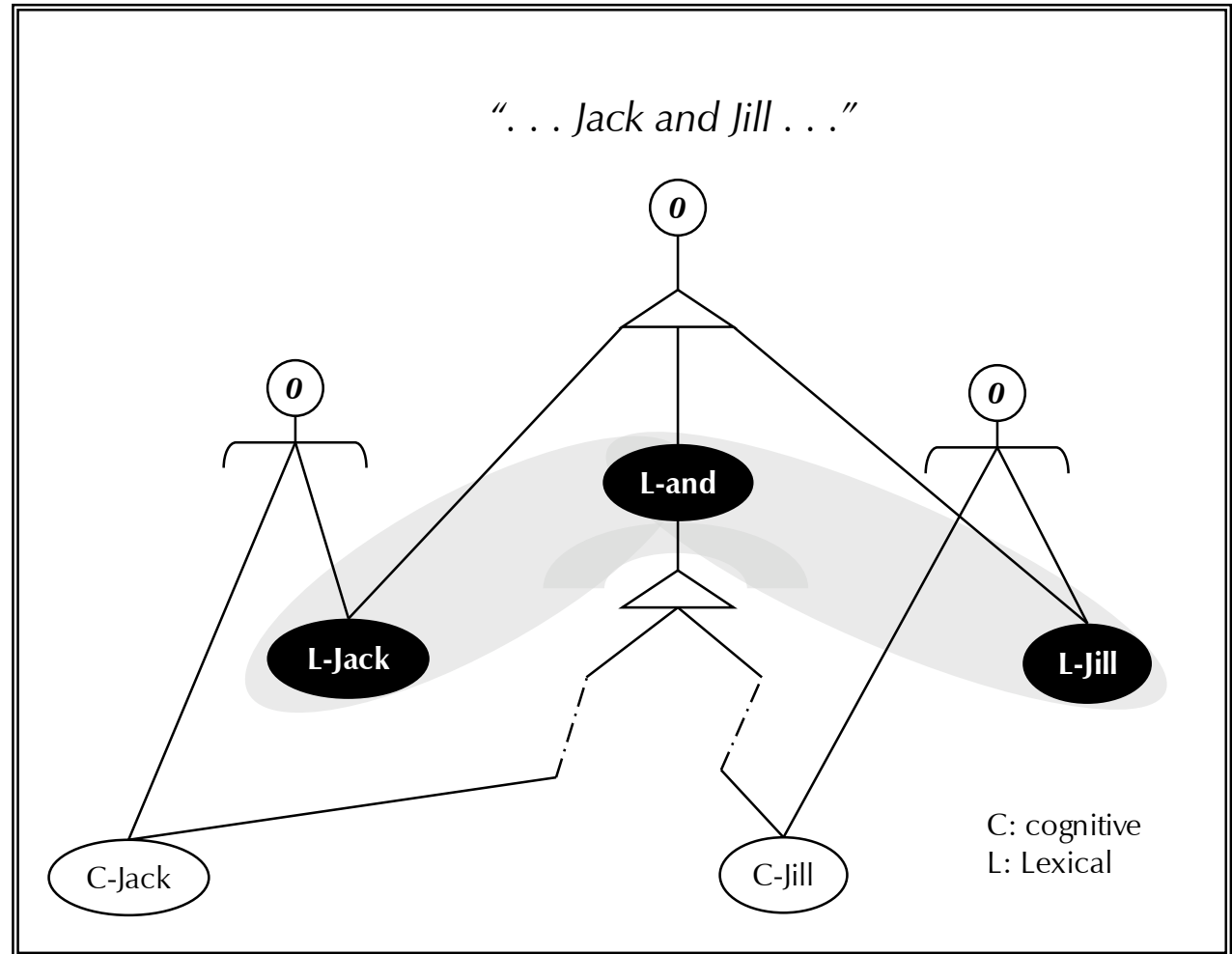
1a is the basic way to represent a chain of moments.

1b is a simplified notation for a chain of moments.

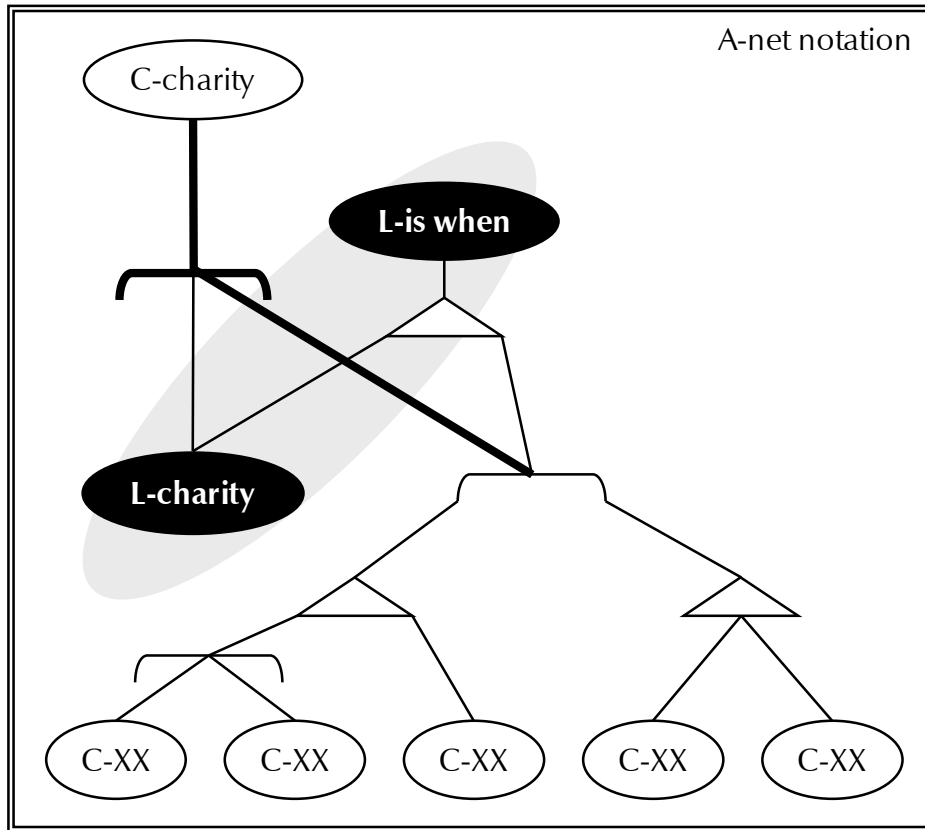
2 shows how the lexeme /next/ is given meaning.

language, “and”

Jack and Jill are involved in some enterprise where they act conjointly. In describing that enterprise one will naturally use the phrase “Jack and Jill.” That phrase consists of three lexemes conjoined by ordered-AND. The conjunction is linked the conjoined fragment of that activity — noticed the dashed lines, indicating some unspecified network structure asserting just what J&J were doing together.

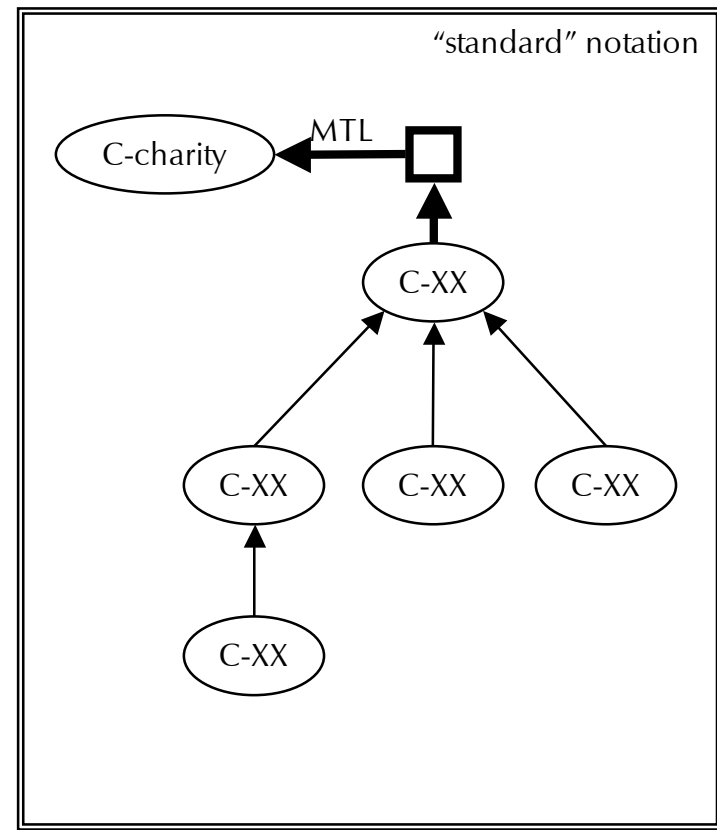


metalingual definition, “is when”



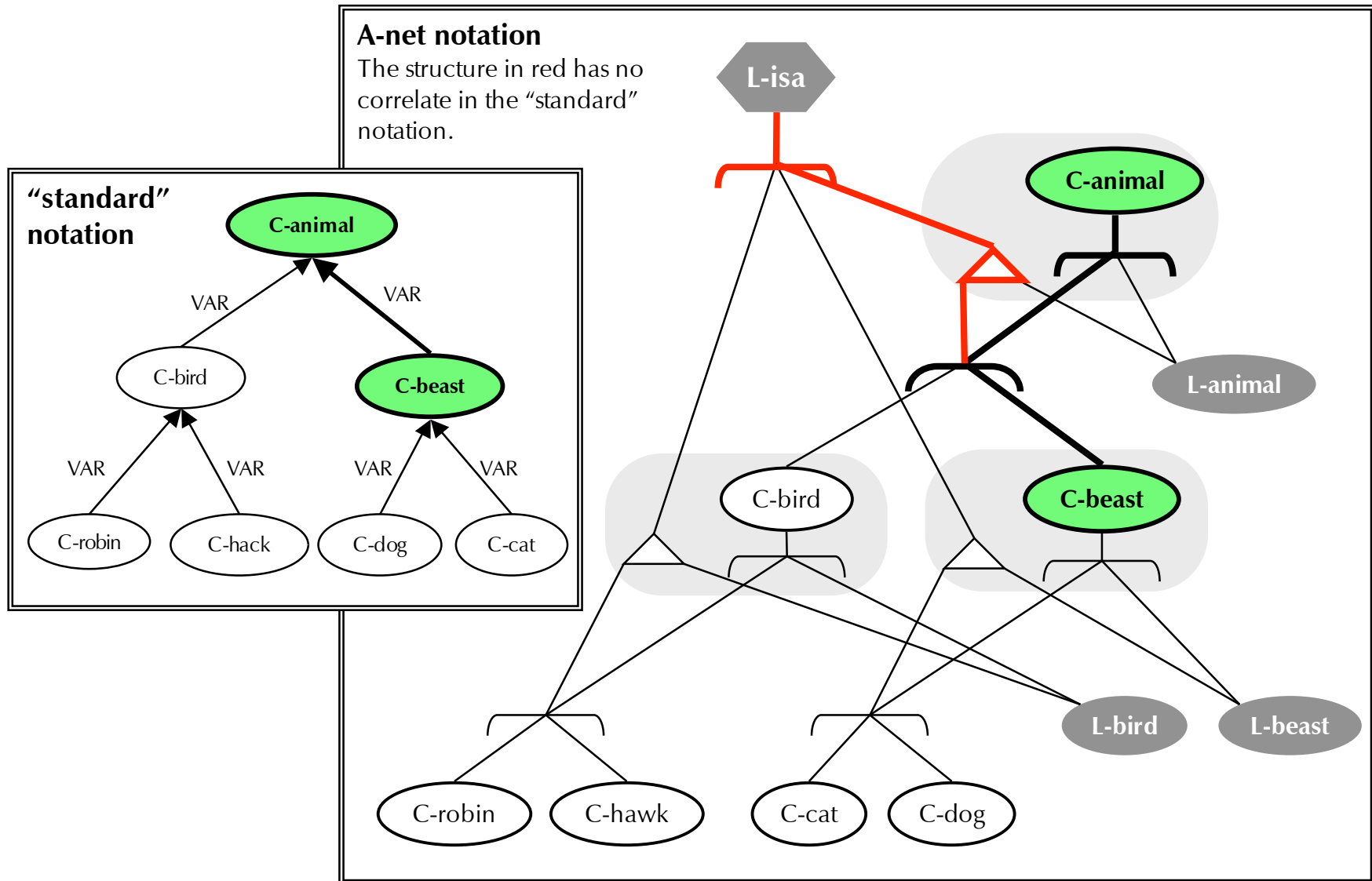
The old metalingual arc (MTL, right) corresponds to the red OR nexus on the left. Note how the C-charity node gets its meaning. It is OR-ed with L-charity, on the one hand, and the abstract pattern on the other.

Note that I have neglected the AND node which establishes word order between L-charity and L-is-when. Note also that this diagram obscures the recursive nature of the MTL connection.

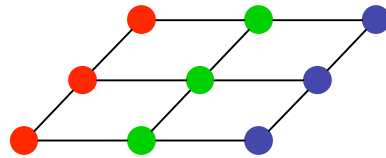


In both diagrams the structure indicating the definiens is obviously just dummy structure. It's there to fill-out the diagram and does not represent a serious attempt at representing the abstract concept of charity.

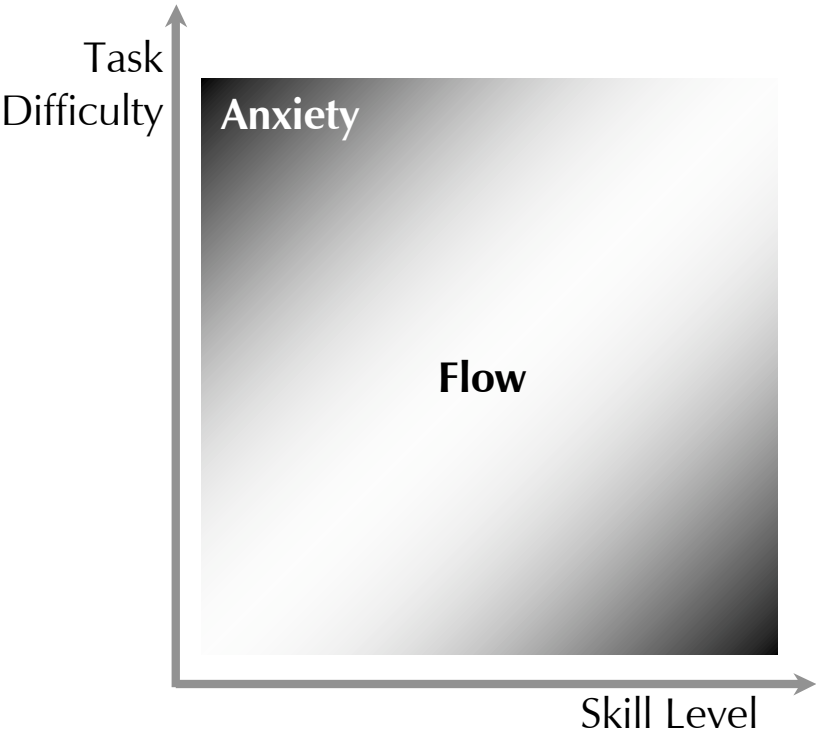
Is-a animal, notation



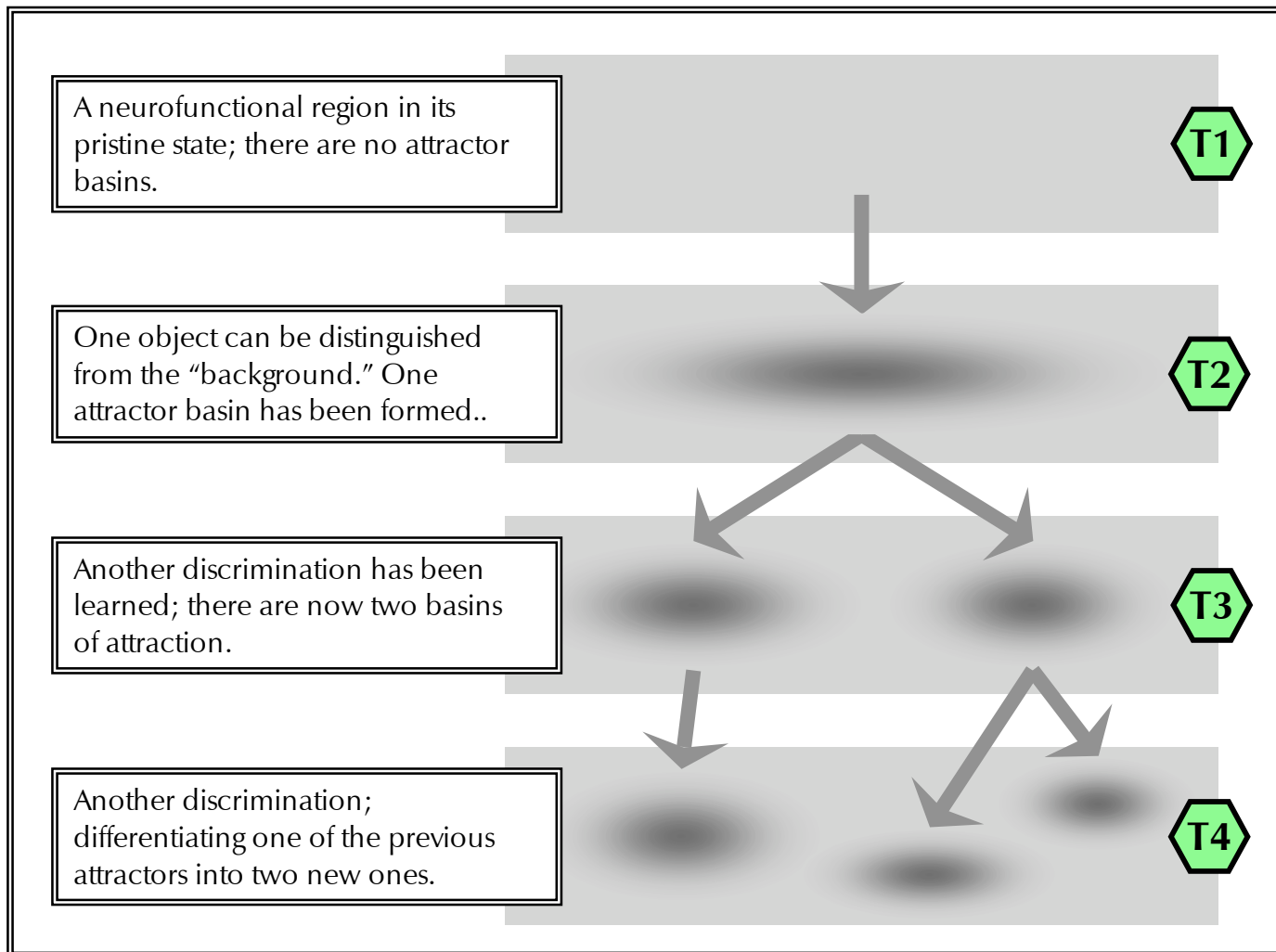
Flow and Learning

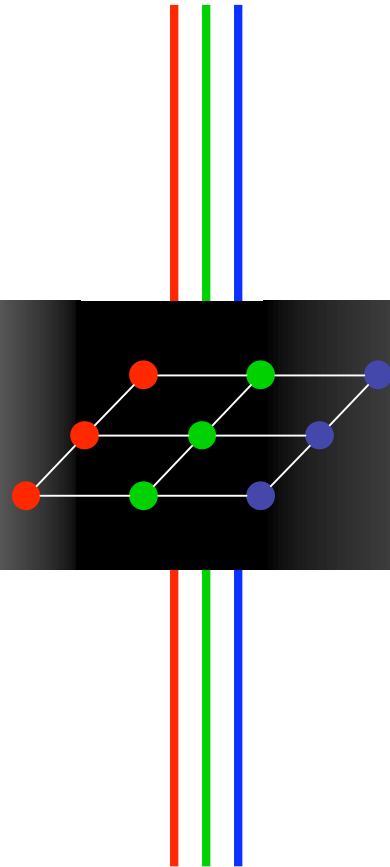


Flow



Learning





series 1: the end