

Chapter 5

The Psynet Model of Mind

"The Law of Mind is one, and but one..."
– Charles S. Peirce

1. WHAT IS THE PSYNET MODEL?

Philosophy of mind tells us what it means to say a digital system like Webmind or the Internet is a mind. Complexity science gives us a more rigorous vocabulary for saying the same things. Neither of them tells us quite enough, though. To understand in detail what it will take to push current digital systems in the direction of mind-ness, one requires a much more detailed understanding of mental structure and dynamics. For this purpose, among others, over the last decade I have created a new way of thinking about intelligent systems, which I call the “psynet model of mind.”

The psynet model is a conceptual model of the mind, created largely for AI purposes, but secondarily for the analysis of human thought processes as well (see Goertzel, 1993, 1993a, 1994, 1997 for detailed expositions of various aspects of the model, as it developed over time). It aims to capture the abstract structures and dynamics of intelligence, under the hypothesis that these are independent of the underlying physical implementation. The model can be cast in mathematical language in various ways, and validated as an empirical scientific theory in various respects; but these perspectives will not be presented here. The goal here is simply to get across enough of the model to provide a conceptual grounding for various ideas in the chapters to follow. In this chapter I will give a highly general, quasi-philosophical treatment of the psynet model, which is nevertheless much

more detailed than the philosophical ideas about the mind discussed in previous chapters. This material will then be developed in several directions throughout the rest of the book. In the following chapter I will take a bit of time to show how these ideas relate with complexity science notions developed by others, thus more thoroughly connecting the material in this chapter with material from the previous one. Later on I will show how a particular realization of this model leads to a computational model of the mind in terms of nodes, links and agents – the Webmind architecture. Application of these ideas to the Internet as a whole will be carried out across many chapters to follow.

The essential ideas of the psynet model are simple. A capsule summary is:

- A mind is a system of agents or "actors" (my currently preferred term) which are able to transform, create & destroy other agents
- Many of these actors act by recognizing patterns in the world, or in other agents, or by carrying out specific actions in the world.
- Thoughts, feelings, motivations and other mental entities are self-reinforcing, self-producing systems of actors
- These self-producing mental subsystems build up into a complex network of attractors, meta-attractors, etc.
- This network of subsystems & associated attractors is "dual network" in structure, i.e. it is structured according to at least two principles: associativity (similarity and generic association) and hierarchy (categorization and category-based control).
- Actors pass attention ("active force") to other actors to which they are related.
- Because of finite memory capacity, mind must contain actors able to deal with "ungrounded" patterns, i.e. actors which were formed from now-forgotten actors, or which were learned from other minds rather than at first hand – this is called "reasoning"
- A mind possesses actors whose goal is to recognize the mind as a whole as a pattern – these are "self"

The use of the word "actor" here is perhaps worth comment. Gul Agha (Agha et al, 1993) defines an actor as follows:

Actors are computational agents which map each incoming communication into a 3-tuple consisting of:

- a finite set of communications sent to other actors

-- a new behavior (which will govern the response to the next communication processed); and,

-- a finite set of new actors created.

In principle, my actors are more general than actors in Agha's sense, in that they are not restricted to digital computers: in a quantum computing context, for example, my actors could be stochastic, and hence send an infinite set of possible communications determined by quantum-level randomness (see the Appendix on quantum computing), violating Agha's first condition. Since the psynet model of mind is intended to apply to human brains as well as digital computers, and since human brains may well be quantum systems, Agha's concept of "actor" is not adequate for the general psynet model. However, in a digital-computing context, my actor and Agha's are basically the same. In particular, a psynet actor is an actor whose behaviors explicitly include *the ability to carry on complex dynamics within its own behavior space, in the absence of external communications*.

The psynet model coincides well with the modern tradition of distributed computing. What the psynet model also does, which nothing else in contemporary computing or cognitive science does, is to give detailed plan for how a large community of computational agents should be set up in order that the community should, as a collective, evolve highly intelligent behavior. The right mix of agents is required, as well as the right kind of "operating system" for mediating agent interactions.

The Webmind AI system is a particular implementation of the psynet model, which provides a general "agents operating system" for managing systems of software actors that share meaning amongst each other, transform each other, and interact in various ways; the actors may live in the RAM of a single machine, may be run on multiple processors, and may live across many machines connected by high-bandwidth cable. It provides mechanisms for actors to represent patterns they have recognized in other actors, and patterns they have recognized in the overall actor system of Webmind. And it also provides an appropriate assemblage of actors, specialized for such things as

- text processing
- numerical data processing
- text-numerical interrelation
- supervised and unsupervised concept formation
- reasoning
- social interaction
- language processing

In the psynet model, actors have their own localized behaviors but achieve their true intelligence only in the context of the whole actor system – - Webmind, the Internet as a whole, or whatever it is.

Finally, for the engineers in the audience, it should be noted that the psynet model is a conceptual model, not a software architecture. Making an agents-based architecture work efficiently on a von Neumann hardware platform is not an easy thing. In Webmind Inc. we created a Webmind version (Webmind AI Engine 0.5) that adhered very closely to the “mind as an actor system” philosophy in its architectural details, but this architecture turned out to have severe performance problems. Now we have moved to a software architecture that still implicitly performs as an actor system, but under the hood pays more heed to the realities of von Neumann scheduling. This sort of issue is very, very important when one sets about the task of actually creating intelligent software systems, but it’s on a different level of granularity than the one considered in this book.

2. THE PSYNET MODEL OF MIND IN 37 EASY LESSONS

There are many ways to view the psynet model. Here it will be presented here as a series of 37 Observations about the nature of mind. No attempt, in this exposition, will be made to determine the extent to which the observations are axiomatic as opposed to derived from other observations, assumptions, etc. These are interesting questions, but beyond the scope of a document whose main focus is the use of the Psynet model and its general implications for Internet AI. Later on, we will return to these 37 observations and specifically indicate how each one is realized in the Webmind architecture. The observations will be related to Internet intelligence in various subsequent chapters, in a more diffuse way.

Let’s begin with the general “complexity theory of mind” roughly outlined in the last chapter. The first 8 observations I’ll give here basically just recapitulate those

Observation 1. Mind is a set of patterns, where a pattern is defined as "a representation as something simpler".

Observation 2: To be able to have patterns, one must have entities that can transform entities into numbers (or some other ordered domain, to give simplicity judgements), and one must have entities that transform entities into other entities (so as to enable representation)

The space of entities in which patterns exist – mindspace -- must be a space of entities that can be considered as transformations, mapping entities into other entities. The optimal name for entities of this sort is not clear; in some past writings on the psynet model these entities have been called "actors," in others they have been called "agents" or "actors." Here we will stick with the term "actor", which is a whimsical terminology intended to evoke images of intertransformation: each actor, each entity in the mind, has the ability to transform other actors by a variety of methods ("magic spells," one may fancifully consider them). The mind is envisionable as a community of actors constantly magicking each other into different actorly forms.

"Pattern" on the surface seems like a static, structural term, but really the psynet model of mind is highly dynamical in focus:

Observation 3: Mind is intrinsically dynamical. A pattern is a process, a pattern, implies a "change." A mind is a vast network of interacting processes.

And, as emphasized in the previous chapter, the space of mind actors is not just an abstract set – it's a quasi-physical space, supporting the operation of joining together two mind-entities into a whole. This doesn't mean mindspace is 3D physical space, but of course, in the human mind, the joining of ideas into wholes is closely tied to the 3D relationships between the brain regions supporting the ideas. In the Internet, joining of software fragments into wholes has meaning in many different ways, including the creation of very close communication channels (e.g. sharing source code) between programs.

Observation 4: Actors can be combined in a way other than transformation; they may be combined in space. The result of joining A and B in space may be denoted $A\#B$ or $\text{join}(A,B)$.

Observation 5: Spatial combination gives rise to the possibility of emergent pattern: patterns that are there in $A\#B$ but not in A or B individually

Another way to look at mind is in terms of meaning, or significance. We humans understand things in terms of certain patterns, which for us make up the world's meaning. A nonhuman intelligent will find different things meaningful, because of having a different set of patterns:.

Creating Internet Intelligence

Wild Computing, Distributed Digital Consciousness, and
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