Scheherazade's Will: Quantum Narrative Agency

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Abstract

Life, the ordinary kind that humans experience, has many phenomena that display quantum mechanics-like behavior. We propose a novel agent framework to support this behavior in a layered context, spanning from the human domain to the level of ordinary physics.

The Big Picture

Quantum behavior is seen in non-contiguous states, inexplicable entanglement, and ambiguous properties. Secondary effects are phenomena such as capture-repulse, sympathetic resonance, unexpected reversals and cause at a distance, perhaps in time. This behavior is common in life, with an overwhelming number of examples.

Life, the actual conduct of human endeavor, has no satisfying set of abstractions to deal with this behavior, such as is the case with physics. Well, maybe that's not true. There's the notion of narrative. Narrative is a richer notion than storytelling, though it includes the creation and recounting of story. Narrative might well be defined as the notion of coherence in life, and a strong case can be made for all human endeavor being directed toward this urge for coherence. In such a case, the dynamics of how narrative is created or adopted and used can be extremely helpful in human-sensitive models.

In this paper, we use a weaker supposition: that the coherence of communication from artificial and recorded systems conforms to much the same notion and benefits from similar strategies of abstraction. In other words, the purpose of an AI system is to create a story and the utility of that system is in how effective the narrative integrates with the humans that use it.

One of us (Goranson) is engaged in a building a novel agent system using the principles described herein. The application domain is military tactical intelligence and the operative notion is the assembly of a tactical narrative from a library of videos, facts and partially known facts. Goranson is also involved in a substantial study of the nature of QM-like effects in popular film, using mechanics he terms "folding."

The other author (Cardier) is a researcher in agent systems and writing, in the sense of literary stories. She has a novel underway that explores these notions, and within that text is a character doing likewise. The protagonist characterizes QM-like behavior according to the tenets underlying science: gaining insight into cause, effect and prediction in life. In the novel, these predictions are applied to emotional flows — quantum qualities are observed in seductive human behaviors, and their relationship to desire is modeled.

The authors are collaborating on a theory of narrative that includes these QM effects and which is fieldable by agent systems.

The Nature of Narrative

Narrative is a human-centric abstraction mechanism. It is usually expressed in natural language but seems to reflect some deeper cognitive structure. Here, when using the term, we'll intend both the expression (for instance in text, image and other signs) as well as that deep cognitive structure.

Narrative often exists explicitly in sign or text but is not limited to these representations. It may also be wholly subconscious or, more likely, be found in the space between, where dynamics are partially understood but unexamined. It is a model of this entire system, with all of its contributing mechanics, that we will present in the form of new tools for agent systems.

Our approach uses the notion of narrative to literally build a new science. This use is consonant with a long series of workshops, physical and electronic, that reconstitute theories of physics so that they are centered on notions of information. A particularly active community has been working on this approach since 1994 under the auspices of the "Foundations of Information Science (FIS)," managed by the Center for Advanced Studies and Research in Information and Communication Technologies & Society, at the University of Salzburg.

We also use the notion of narrative in the sense of "driving imperative," as a sort of force for organization, roughly satisfying the role usually handled in physics by the quantitative invention: "entropy." Of course, this concept is also deeply introspective, and any coherent conceptual framework which spans both life and particles, both consciousness and behavior, will be necessarily similar in its reflexive nature.

In our proposed agent systems, narrative mechanisms account for the agency, providing what in conventional systems is termed "reward." However, because our model uses new operators, the term "reward" does not adequately cover the mechanics involved. Rather we say that the reward is a more "complete" narrative at the target level, complete in terms of the relational logic of the system. (Later, we will define this completeness with the assistance of the Japanese concept of katachi, which we adapt for our own purposes.)

In some agent systems, that principle of reward based on relations exists, but is divided into quantities that handle softnesses in the system using probabilities. In our model, the narrative dynamics and reward are woven together.

There are quantum behaviors at two levels. One is the recognized physics domain and the other we introduce here, in the form of quantum mechanics-like behaviors in human interactions. Where numeric and probabilistic abstractions are fine for the physical domain, new richer ones are required for human systems.

Like other scientific tools, narrative describes and explains phenomena at both ends of the organizational spectrum, quantum and classical. In this paper we focus on those at the formative level, and discuss how quantum properties can ignite a narrative drive.

Examples

In this section, we give two examples. Each example will be stated in three ways. First we describe the behavior as found in human experience. Then we'll give a parallel case in the world of physics to emphasize the QM-like behavior. Finally, we describe the phenomenon in natural-language terms to illustrate some of the principles behind our approach.

Example 1: State Freezing and Flipping

The human behavior: asking, for the first time, the question *"Do you love me?"* of someone with whom you have an ambiguous relationship. This question prompts QM-like behavior: even though you might not yet love, saying *yes* can makes it true, or perhaps make it untrue, neither of which was the case before being asked.

Explanation: At the beginning of a romantic relationship, the emotional system of those involved is often soft. It is in formation, driven by half-impressions and possibilities about things that might happen, and so doesn't have a distinct identity. To ask someone if they love you under these circumstances is to extract an assessment of identity before the beloved's emotional system has arrived at one. Without a distinct answer, the askee must assess their emotional state and try to determine which pole – *yes* or *no* – most accurately accounts for it.

Committing to an answer about emotional identity can alter its nature. If the romantic feelings don't quite qualify as love before being asked, the generosity involved in committing to *yes* can raise the emotions to that level. The person may suddenly see themselves as someone who loves, or is on the verge of loving. However, it can also be that naming reverses the identity, because saying *yes* might suddenly highlight the disparity between the word and the feelings. This creates behavior that seems QM-like: saying *yes* makes it *no*.

A similar physical behavior: The general case of ambiguity here is the matter of the intercession of the observer in "measuring" — a sort of reifying of identity, and its characteristics, in order to "place the entity" in an action. Measurement is a form of freezing state that absolutely places the thing in a certain sequence of events.

The most common snaps of this kind relate to freezing particle location, but any dimension of measurement (or naming) is subject to this snapping of quantum state; not only the location, but the absolute identity of the entity in its context. Some things as basic as the fundamental identity of the entity as well as the interaction with others and its environment are included.

The physics case is "clean" because the entities, while disambiguated, are separate from the disambiguator. We assert this situation to be unique to physics and could be a definition of what distinguishes physics and makes it seem clean. It's also why we suppose there is a "larger" quantum mechanism that applies at all levels of organization and only collapses into probabilistic mannerisms in (some domains of) physics and nowhere else.

Our Dynamics: The beginning of an emotional relationship is mostly dynamic, characterized by tension, tentative equivalences and modification. The system only has enough introspective grip to know that the participants are making a story. There is almost no tangible "evidence" of the relationship — it has little residue or structure – and the absence of these concrete aspects means that identity has not yet formed, or been identified.

Answering the question *"Do you love me?"* triggers an assessment of identity. If there are not already enough clear edges in the emotional system to indicate its "shape" (shape being a specific type, which we will define later), the person being asked has to abstract their feelings into a more solid and identifiable form. Here, *love* becomes another key entity, because the question situates it as identity's benchmark. The individual might define *love* as a degree of resonance and belonging. Or they might assess how much healthy modification they are capable of in relation to their lover, now and in the future. Or perhaps they must try to measure how much of their being relates to the other in a bonded, anchored way. Or all of the above.

If the system seems to be tending toward love and the answer is *yes*, the act of naming energizes it to modify towards that identity. The shape is bestowed and the

system accepts it, exhibiting seemingly QM behavior by popping from ambiguity to certainty.

On the other hand, if the answer is *yes* but was said out of politeness instead of measurement, or was simply a misidentification, then the dissymmetry between the word and the system becomes so pronounced that the validity of both collapses. The excess tension counteracts the potential *yes*-ness. This is what produces the QM-like behavior: saying *yes* makes the answer *no*.

Example 2: Creating a New Field of Futures

The human behavior: A new friend acts with a sudden, unexplained boldness, perhaps bestowing a surprise kiss. Although the recipient might be dismissive at first, thoughts about the bold friend can't seem to be shaken, and somehow, in the person's absence, thoughts about them eventually change from disregard into attraction.

Explanation: As long as the annoyance is only mild, it doesn't matter whether the surprise action is welcomed by the beloved. Instead, the seductive effect is created because a seemingly random action makes the recipient engage in a disproportionate amount of wonder about why the boldness occurred, and whether there will be related behavior in the future. Unexplained fragments of action induce an imaginative investment by others, and that commitment eventually outweighs feelings of ambivalence if it persists for long enough.

So, seduction is not inspired by engineering a particular emotional effect in another person, but instead acting in a way that makes them wonder about you, diverting their inner resources towards solving the behavioral puzzle that you have presented. Such attention places you as an unexpected focus in their life and makes further imaginative investment attractive. Future interactions and connection-building therefore become easier for the seducer, because the potential lover wants more information.

A similar physical behavior: In physics, there's a sure notion of discreteness, that there are only so many stones in the pond to stand on. In your natural state, you are a fog hovering over the pond, but when someone "looks," you settle on one of those stones (values). This notion of discrete states, that there are predetermined identities to snap to, is somewhat independent of the other QM dynamics. The principle also operates in the other direction: introducing a stone, if you can, implies a range of fields that could have preceded it, and if an observer wants to account for all the mostly likely possible fields, they will have to consider a great number of them.

When an observer "needs" a measurement, the act of observing will apparently determine the quantum state. This is the famous "snap to a value" behavior, where looking at something appears to define or set a property.

More interesting is the phenomenon where the "snapping" to a value determines the state in such a way that future states are affected. Merely "looking" at (measuring) a particle affects its future possibilities; intercession of the observer "changes" the future of the entity by freezing the state. The effect is that a new field of futures is created, including a new set of stones, possibly in new locations.

In this example, there are three QM dynamics at work: 1) the fuzziness of existence until observed, 2) the snapping to predetermined states when observed, and 3) the affecting of all future action by setting the nature of the thing by snapping to that single state.

Our Dynamics: The sudden bold action has enough identity to suggest possible future narratives but not enough to isolate which one. Its distinct and intrusive nature means it can't be ignored, so the recipient's inner system must try to build equivalences towards it, in order to identify it. They find tentative similarities between their own emotional "story" and the action fragment, trying to narrow down where it should be placed, what it means and what sort of system it could have come from.

With so little additional information, many possible identities for this fragment will be considered, and many possible futures projected with it. Introspective and modificative energy will be devoted to the antagonist by the recipient, diverting their focus towards the partial narrative element. Because these mappings will include many different scenarios, tension will be created within the wonderer as a matter of course. When the antagonist appears in the future, if they continue to provide incongruent fragments, these elements will be quickly appropriated by the wonderer as additional clues for the story they are building. If they are particularly introspective, they might also be charmed by the fact that they are being inspired to make a story.

In order for the fragment to inspire wonder (and not dismissal), an additional aspect of dissymmetry is crucial. The boldness needs to be slightly incongruent in some way. If the antagonist gives too much information, or is too conspicuous in terms of motivation or objective, they will not be the focus of wonder because their "story" will be self-evident.

This dissymmetry in terms of behavior could also seem to be a quantum flip of states from the outside: the kissee thinks they are following one trajectory, and then the bold action suddenly suggests that they are located on a completely different path.

In both examples, the quantum properties of narrative — incompleteness, discontinuity, ambiguity — drive the urge to assemble coherence. Prompting a potential lover to create a story around your behaviors is therefore an important aspect of seduction, because they will be pulled into it as it builds.

In her novel, Cardier will define seduction on these same terms: drawing another person into your story and keeping them there. Scheherazade is the heroine of this paper because her unfinished narratives had more agency than a King. In both narrative and human domains, quantum behaviors characterize the formation of a narrative drive, and this is where much of its agency lies.

A Proposed Mechanics

We propose a collection of techniques to handle the system that is introduced in the above examples, which are modeled on narrative mechanics. Here, we add another use of the word "narrative" — narrative as a dynamic constellation of elements. This notion is similar to the Japanese idea of katachi, a concept that has evolved to deal with the overlap between art and science. A somewhat large katachi society exists among Japanese scientists.

The notion of katachi is almost self-defining. In katachi, the flows build the world, so the rule of structure is katachi. It references itself to decide what is logical. The whole system twists and contracts based on an inner balance — one part moves and so the rest must. Its elements form a kind of constellation, which can also be thought of as a form or "shape."

Narrative uses this sense of form in order to determine its own logic and assemble itself in a coherent manner. There is an important difference between story logic and katachi, however. The Japanese concept emphasizes beauty, and refers to the idea of elegance, a constraint that would be detrimental to the notion of narrative. As a consequence, we will term our narrative version of katachi logic "H-achi," referring to the principle of connected yet oppositional poles.

H-achi is behind the value logic of our agent system, in the sense of a desire for a self-aware place. This self-assembly occurs according to definable principles, the more novel of which are described below.

Storybuilding as a "Belonging" Value

Narrative is a relational network, so its structure can be thought of in terms of symmetry principles. A fundamental factor in artistic narrative is the idea of dissymmetry because the relationship among dissimilar networks creates the tension that, in turn, creates a story. Our reward structure grows from this notion.

Narrative entities are defined according to their position and influence (or lack of each) in a system. Agents are rewarded by either behaviors that result in selfish reinforcement or behaviors that are in accord with the system as a whole, activities which reinforce belonging within that society. In a narrative, it is the oscillation between poles of symmetry and dissymmetry, in relation to two motivators, belonging and selfishness, that drives growth, evolution and self-organization.

Metaphorically, this value determines that each agent strives to be part of a story, to somehow create or engage itself in a story that gives it value by "belonging." In existing methods, a practical difficulty of this is that context, in an agent world, is hard for any member to adequately see without extreme cost. So how does an agent know what belonging is?

We resolve many difficulties by introducing situation theory into the system. Below, we note how this logical machinery supplants the ordinary modal logics and helps capture various notions of "softness." Until this point, we have simply mentioned that agents in the system interact with each other in the same manner that stories are created — all sorts of stories. Multiple stories will be referenced, both inside and outside the system, with multiple, dynamic, inter-related story perimeters.

With the introduction of situation theory, the notion of narrative as a constellation of elements becomes particularly useful. Stories and story fragments exist, are being created, interact on many levels, and co-exist in miniworlds within the system. This notion of layering is described below; for the moment it is enough to note that some stories will be local and result from intimate agent interaction. Other stories will be more global and might have quite different abstractions and effects. Because these multiple levels of story are simultaneously evolving, they will interfere with each other.

Surely many situations will exist where an agent moves to enhance the belonging value in a local story, which will then bring with it effects in other stories that will decrease the overall belonging value. An example might be an agent that negotiates a homosexual partnership with another. Building that self-interested local story may create disturbing dissonance in a surrounding narrative and build all sorts of contradicting drives that we term "dissymmetries." Our agents are equipped to measure and decide on changes in action, and this will often produce QM-like behaviors.

Many such QM-like effects result from trying to belong to overlapping stories. This is how it is for human beings in life, and it will be how we recreate these effects in an agent system. The QM-like behavior comes from the inherent ability of situation theoretic evaluation to handle ambiguous situations, plus the way we accommodate multistory dissonance through the notion of dissymmetry. Happily, QM-like behaviors in life are also a key aspect in the ignition of a narrative drive.

Desire as Agency

Most agent systems are built on some sort of actor model. This is a simple and intuitive notion where an actor takes action in a system and collects value from that action. The conventional way to include non-monotonic behavior (and perhaps QM-like dynamics) is to introduce the notion of non-modal logics or something similar (even probabilistic logics like the so-called fuzzy logic) and more complex value dynamics like belief, desire and intent.

We are suggesting a more fundamental revisiting of what an agent is. At this point, there is some uncertainty in how far we will push this notion, but we are tending toward redefining agents as "desires," or less lividly as impulses or urges. So instead of an actor with an "urge," we have an urge with an actor (or perhaps several) attached. Urges are generated in the course of a process we have defined as Narrative Dynamics, which can be broken down into a series of primitives.

The benefits of this approach are significant as it allows the practical advantage of coding agents as functions and

inheriting all the wonderful formal support of functional programming, monads (as situations) and automata theory.

There is a robust body of theory in the theatrical disciplines relating to human actors, but the elements of this "actor" system are different from those of conventional agents. To an outsider, a theatrical production seems to consist of people (as agents) doing stuff. But human actors understand their activities based on narrative logic and "impulses." The Stanislavsky method, perhaps one of the most often-cited acting theories, teaches performers to articulate their actions as verbs, verbs that carry actions. Their job is to build a vocabulary of behaviors until they form a network of relationships with the other actors. These will eventually genesize an entire emotional world, unique to each production, for which the script is only a structural outline.

An actor's impulses are played out against those of another actor in order to achieve an emotional objective. All of these elements are articulated as verbs. An acting technique taught by dancer-actor Yat Malgrem encourages an actor to pursue this analysis to such a fine degree that a verb is chosen for every sentence of the script: *To be or not to be* (I am encouraging you), *that is the question* (I am soothing you). Accomplishing an emotional objective is only a means to an end, however, because the script guarantees that the play will continue regardless of the actor's ability to manipulate their fellow performer. The key lies in *how* the objective is achieved, the turns of the wheel that reveal two inner landscapes. That rich negotiation will join others, which themselves negotiate, and eventually become a powerful theatrical "story."

Even though it falls within the domain of the arts, this is applied theory. Just like an agent system, it has to stimulate those involved to form real bonds with each other, and the commercial aspects of the production are even timed to coincide with the systems' expected stages of evolution. The techniques of human actors is therefore a good source of understanding for where the agency in a living system actually resides.

A story begins when impulses surge forth, collecting words and guiding actions. An external observer, an audience member or readers, watches them manifest as a conflict. If the interplay is emotionally resonant, the reader will empathize with it and engage in response. The interaction among the impulses, in the form of the actor's behavior, is the fulcrum of agency in this system. It accrues action, and in real-life, causes people to choose words that are not scripted. For our purposes, this shifts the focus from a noun-oriented view to a verb-oriented one. The notion of text (residue) remains important to stories, however, so the verb approach will be extended to include behaviors of nounness. This combined philosophical outlook will manifest in tools based on our notions of 'Relations.'

At this writing, we are working on how to practically balance the notion of actorless agency in programming terms with those that use object metaphors. We believe this will be assisted by the dynamics associated with residue, which supports its own range of behaviors in the same way that the other Narrative Primitives do. Behaviors associated with residue will likely include aggregation and decay – plus other qualities that nouns already display. The dynamics associated with residue will be part of the complex lattice of processes within the agent system, but will play a less dominant role than is currently posited by science.

For the purposes of this description, we feel comfortable with the notion that the agency is attached to and motivated by urges, and that agents can be described functionally (though the functional world is complicated by the adoption of situation theory and some group theoretic abstraction in the layers). The internal structure of a typical agent is likely to be as complex in the way the urges carry actors, as the current model is in how actors carry urges. Beneath that complexity, however, the system will operate according to Narrative Dynamics.

Dissymmetry in Layers

Our initial introduction to this modeling approach was the need to deal with what we call "multilayer" or multilevel systems. Goranson has this need in his intelligence environment where sensor features evolve through pools of features as tentative facts, into quite different pools of facts in different worlds, and ontologically, into tactical narratives.

A similar problem faces the FIS community. In this case, the problem is one of layers that have distinct everyday identities. The world of physics has a certain dynamics, caught more or less by current theories. Similarly, we have other layers that can be said to sit "above" this: the worlds of chemistry, biology, organisms, selves (in the human sense) and societies. (Goranson encountered very similar layers just in the "society" layer in his work in virtual enterprise dynamics: individual, workcell, plant, firm, enterprise and the "consuming" society.)

These levels in science each have their own systems of abstraction, their own ontologies, notations, logics and dynamics. In general, these do not transport gracefully from one layer to another. The problem is that, if there are evolutionary mechanisms at work in any one layer, in any place in the whole universe, one would expect to find them everywhere, and that includes the "evolution" of one system from another.

Actually, evolutionary mechanisms are a common aspect of the arts. In this domain, the boundaries between the levels of a system are interpermeated, so the awareness of layers is a tool instead of a problem. Across each artistic field, layers make introspection and narrative growth possible, providing different leverage points throughout.

Now back to human actors for an example; they employ this same awareness of layers to steer their impulses. Though an actor behaves in a way that, in the world of the play, is openly selfish and antagonistic, they may act in an opposite manner in other layers, such as supporting their fellow performers on-stage in order to enable a strong

ensemble performance. Not only are the arts able to embrace multiple levels and conflicting objectives, but they employ them as an integral part of their logic.

The authors presented the notion of using artistic tools to address the problem of layers to the Washington Evolutionary Systems Society at NSF in 2006. A brief summary is that complexity in narrative at one level creates new primitives for the beginning of a different level (not necessarily the one we consider "higher"). In physics-coded systems this is a notion of QM-like coiling in negentropic systems. In our less quantitative universe it is a matter of category theoretic refinement, perhaps usefully using notions similar to Leyton's wreath product abstraction mechanism. (More about this later.)

At any rate, we are disposed to think of shifts in such layers as a dynamic where stories at one layer (read: local situation) are intimately linked to stories elsewhere, and surely stories in apparently larger situations. So we have this notion that agents interact with many different stories, also that stories are linked in some dynamic way, but not in a deterministic aggregation. In fact, the opposite is often the case: an agent building or interacting with one story changes another, or encounters another in a new way.

The business of "pulling" in one story and having it "push" in another, sometimes in an unexpected, disruptive and QM-like manner is captured by us in the notion of dissymmetry.

This essential notion was influenced by work the authors have done independently through the International Society for the Interdisciplinary Study of Symmetry, which presumes symmetry to be a primitive in many useful abstraction cosmologies. In particular, the group theoretical mathematical tools and intuitive notions of mis-fit are both leveragable, not only in the context of capturing humanlike dynamics but also in subsuming rather than emulating the QM-like mechanisms of physics.

Metaphorically, the notion is simple: agents encounter the world and strive to increase their sense of place within it by interacting with and building stories. Because they encounter several stories that have complex internal generative dynamics, they cannot completely harmonize their sense of belonging. The mismatch produces dissonance in the form of dissymmetry, and feeds the values of selfishness and self-narrative instead, which may then alter the larger "story." The notion of dissonance as dissymmetry is a departure from the evaluative values of the traditional notion of katachi which stresses symmetry as the "belonging" value.

Residue and Story

Life is not simple. We are probably lucky it is not.

The next shift from conventional, object-orientated approaches is our notion of "residue." Residue is a tangible remnant that can be seen, detected or measured, a noun or object that is left behind after an interaction. We also see it as the proto-material of self and story and can attach to, and be carried by urge, narrative or both. Where conventional approaches have objects that result in action, we have action that produces objects.

It is easy to understand how residue contributes to the process of a writer's construction of a story. By recording initial impressions on a page, the author is free to temporarily step away from the nascent text and into other narratives, invest in other networks. When the writer finds similarities, or complementary elements, these can be drawn into the new story, each piece negotiating its place within the new system.

In the same way, "residue" in agent systems creates a kind of ledge for the other dynamics to grip onto or strain against. Not only does the residue act as a springboard for introspection, a stable place within a whirl of flows and dissymmetries, but also as a token for exchange by those impulses that helps transactions occur.

How is residue organized, if it is only a by-product? Again, the answer comes from the arts. An impulse has an urge to connect, a desire to bridge distance by pulling on residue. As urges and their associated actors interact, a "mark" is left, either in the form of a fuller network or more remnants. "Crossing space" is a metaphor for an agent evaluating its local situation, based on the logic of H-achi, which is a symmetry evaluation. The typical agent will use locations in the story that have high symmetry to address perceived dissymmetries in some way. As a network develops its bonds, so too does the residue accrue more consequence and influence in a system.

In terms of implementation, the residue can be seen as a sort of cache, not quite history (or else it would be a story) rather the collection of stuff that accrues around agent interactions, eventually becoming the exoskeleton of the story. Residue is the system's inner workings that in a visualized form, its relational logic made concrete. It is the links built between video image fragments. And the statements later made about those links.

Situations Handling Softness

We've mentioned our appropriation of situation theory. Our use is a bit problematic for situation theorists. Situation theory was developed to allow a more robust evaluation of facts, to "situate" them and provide for reasoning about facts and contexts in a unified logical system. The focus was on the right hand side of the equation, where the facts and their representation as "infons" reside.

We turn the mechanics around and use the facts to reason about situations, something that seems just as possible without unduly breaking the logical machine. Once this conceptual jiu-jitsu is performed, "situation" becomes a valid container for a variety of soft elements that are ungracefully (to our mind) handled in other logics.

Softness is of various types, most apparently not related. A comprehensive taxonomy exists from workshops Goranson hosted in connection with the virtual enterprise work. A common soft area is tacit knowledge, the problem from linguistics originally addressed by situation theory. This is knowledge that is implicit but is presumed to be

capable of being made explicit by what Devlin calls "zooming."

But there are other types. Facts about non-deterministic futures are also a common softness encountered in agent systems. This includes future states from ordinary chaotic behavior as well as the more slippery QM-like behavior, which is the focus here. There is also a collection of unknowns of higher order that result from different degrees of incompleteness in the system. We have not yet addressed these in this agent architecture and they may be subsumed as we adapt situation theory to a true transcendence mechanism.

A particular sort of softness comes from social dynamics. It has long been noted that any science that addresses societal and cultural dynamics seems inherently soft. Naturally, we include this in our scope.

Some tacit knowledge, though theoretically accessible through examination could be explicitly folded into the system, will never be because the cost is in some way prohibitive. Or there may be other constraints, like privacy or security, or even ontological complexity (where the semantic distance is so great the ontological qualifications in mapping explode).

But there is another sort of vexing softness in these situations. We call it the "Stalin's Dreams" problem where something is absolutely unknowable both in content and nature. The phrase 'Stalin's Dreams" was invented to describe the following premise: suppose Stalin has a bad dream and awakes, not recalling it. Yet he is irritable and arbitrarily selects ten thousand people for execution, the selection somehow informed by the dream. These hapless individuals will never know a key element of why their stories were disrupted, nor even have an inkling of where the unknown is. Indeed, Stalin himself may not know.

We have a notion of "coiled" narrative dynamics that may relate to this, as well as some QM-like effects. In this case, we have a narrative that has some substantial parts that are hidden to an observer. They may be a part of the story, but not accessible or comprehensible to the reader. Or more interestingly, they may sit in the story and not be an active part until triggered, in which case they unexpectedly uncoil and become part of the narrative. An analogy may be dormant genes that suddenly become active through some context switch, possibly disrupting the system.

At any rate, all of our soft dynamics are captured primarily in the use of situations, either in the normal way of stories in context, or residue in a parallel set of contexts.

So QM-like effects and softness are two of the problematic areas we attempt to address with our notions. Goranson also has a study underway that incorporates introspection in film narratives. Key to our dynamics is this notion of introspection, which in QM terms has agents in two roles, inside the system and outside as observer. In a narrative system, however, introspection sits on the brink between inside and outside, between one story and another. Instead of behaving as a barrier, a new context is instead used as a foothold to draw on previous information and create the logic structure of new "level" from it. This boundary-straddling will be an important key to creating emergence.

Goranson's film study explores (mostly) popular movies based on the notion that art is where society plays with emerging notions of structured abstraction and popular art is where this exhibits as societal evolution. Films, as it turns out, exhibit a wonderful array of narrative folding.

"Folding" is where the narrative is structured so that simultaneous realities, entities, perspectives or drives are presented in such a way that they enhance the narrative or vice versa. They usually seem to be used because they have the effect of drawing the viewer deeper into engagement with the movie, though more artistic intents are also obvious.

This study involves a large community of participants and is being hosted on-line. We do not discuss here some of the folding techniques discovered. But it is the intent of the authors that as this work continues, the narratives used by the agent system will have some of the narrative mechanics we encounter in life, including many of these folding techniques. We intend to characterize these as we can in terms where the symmetry component is apparent so that the H-achi evaluator can recognize them.

Functional Mechanism

The final element to touch upon is the functional mechanism. By this we mean the structure of the agent world in terms of the functional architecture.

We've already mentioned that there is a sort of equivalence among desires, agents, infons and functions. Here we just talk about the functional side, though we still keep our metaphoric notions.

We have an evolving cosmology of functions in the system. Elements in this cosmology are largely contributed by Cardier and have some foundations, as already mentioned, in contemporary acting theory. "Actors" in this context means humans engaged in theatrical endeavors, and the theories in question concern modeling multilevel narratives in such a way that actors can "discover" the narratives in a process of interaction.

You can see from this where other of the metaphoric components of the approach come from, elements like seeking to "belong" to a narrative, the usefulness of tension in a system and the appearance of QM-like behavior. Most likely if we had started from a different theoretical background, say psychoanalysis, we would have discovered something similar.

The cosmological forces at work are notional only and still evolving as we discover additional aspects, as designers of the system. Moreover, we expect that the more useful agent systems based on these notions will evolve in this cosmological sense as well as the ordinary senses. This notion of "deep emergence" would in any case be necessitated by our intent to have one agent system that spans all phenomena, human to elementary particles and how the systems relate to one another.

So far, the key notions in the system (let's call them generative functions) are: residue, dissymmetry and belonging. We've already indicated what we mean by these. Other notions are conservation, stasis and growth. There is also a third triad: equivalence, tension and opposites (duals), with introspection cutting through everything. Among these elements, we have functional dependence, each function related to and defined in terms of others. Some not mentioned are more ontological notions, like being, identity and modification.

Almost certainly, the system will qualify all the functional definitions using a method of "rewriting;" after all, the cosmology is a narrative too and if you want true introspection you have to be fearless enough to let the agents "touch God."

It may not be necessary to express and host these functions in a lazily evaluated system. Goranson is particularly interested in avoiding this for practical reasons in his application, but for the time being it seems that laziness particularly helps in carrying situations through the system as unevaluated functions. This has the benefit that situations, narratives, and all sorts of soft stuff including QM-like possibilities and complete unknowns can be carried as first class citizens.

While not central to the matter of the symposium, there are two other dynamics of interest that come from having the very handy fact that agents are expressed functionally. Our functions are defined in a way that the order of terms is significant and the expression, including a truth value and the functional call, can be collected in the infon tuple that is native to situation theory.

Infons in this form (whether they are of agent, residue or narrative origin) individually and collectively have a "shape" that can be readily exploited by considering the topology of the system or zones. This seems useful in supporting categorical abstraction of the system to derive new types to populate a higher "level," such as we find in the shift from physics to chemistry.

(In previous experiments in multilevel emergence, Goranson relied heavily on this mechanism to accommodate QM-like and soft behavior, behavior now handled by the situation machinery. So its appearance in the system may be residual and unnecessary. We don't yet know.)

The other potentially useful device is some of the notions of Leyton. He exploits something like this in group spaces with the intent of formalizing causal cognition and (in another application) recording causal history. This latter is the dual of what we are about in generative agent systems and some of the core ideas of Leyton seem congruent, especially the cognitive mechanisms being driven by considerations of symmetry.

It may be that his notion of wreath products and resulting fibre bundles can be stretched beyond the original intent, just like we have the stuff of situation theory.

Summary

We believe we have a promising approach to non-monotonically goaled agent systems that would have many advantages. One of these is the ready accommodation, in a natural manner, of QM-like behavior in ways apparently not possible otherwise.

We are still working on this at the conceptual level and present this summary as tentative conclusions. Goranson intends to field systems with these ideas in a practical agent system for a real, pressing application. Cardier will develop these in the near term as narrative mechanisms in fiction, including the content of a work in progress.

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