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Research into knowledge representation is resulting in a new generation of techniques and tools with the ability to automatically and intelligently assist humans in analyzing complex forms of data to discover useful information. Knowledge representation requires a presumptive notion with regard to a 'model' (predictive or descriptive) against which pattern recognition and iterative algorithmic processes involving machine learning, pattern recognition, statistics, and artificial intelligence are employed. Although these are well-developed disciplines, emergence of knowledge from complex data structures may also include non-model and non-probabilistic based strategies.-

The procedural-declarative controversy of the 1970's illustrates the dialectic around model and non-model based strategies concerning how to best design knowledge representation systems. Both the procedural and declarative approaches presuppose domain expertise and a potentiality of objective, and are intended to interactively enable emergence of interesting knowledge about something specific. In the procedural view, encoded expertise is determined by domain-specific algorithms--the model is composed from a large database of information from which a specific sequence of questions asked leads towards an optimum solution represented within the domain. The declarative view involves the design of 'knowledge' acquisition within a general purpose, and most often heuristically oriented, reasoning system. Whereas, the procedural view stresses characterization of a detailed model enabling optimization of decision accuracy, the declarative approach emphasizes agencies and satisficing scenarios from which representations emerge. The declarative approach has prevailed resulting in a surge of domain specific expert systems in the 1970's and 1980's, establishing the basis for research into non-model based strategies.

Knowledge representation deals with methods for encoding data in a form that can be processed by a computer to derive interesting consequences. A notion of consequences can be interpreted to include those which are also spontaneous, non-linear, self-organizing, include high levels of uncertainty and are derived from non-causal relationships. Such an approach suggests new forms of data acquisition involving the emergence of interesting information from ambiguous (non-predictive or non-descriptive) systems. The strategy of discovering interesting information by revealing the nature of complexity present in a system is a provocative theoretical problem with implications influencing our fundamental understanding of the basis of knowledge acquisition and its representation.

Autopoiesis

"A reliable way to get the attention of others is to produce information that meets the input conditions of their domain-specific competencies."--Dan Sperber and Lawrence Hirschfeld

Autopoiesis, a term developed by biologists Humberto Maturana and Francisco Varela, is a form of system organization where the system as a whole produces and replaces its own components and differentiates itself from its surrounding environment on a continual basis. Principles of this basic system organization appear in more complex systems, what are known as third order couplings, or systems that emerge out of social interactions, such as languaging. Third order structural couplings and consensual domains, are rich in organizational concepts, and have potential applicability in knowledge discovery research. The ontogeny of a data system being an obvious starting point.

Ontogeny, as defined by Maturana and Varela, is "the history of structural change in a unity without loss of organization in that unity"; ontogeny is of primary concern in autopoietic systems analysis. Continual structural change takes place in a unity, either through external interactions from the environment or through its own internal dynamics. The complexity of a persistent unity is increased within structural couplings. In a structural coupling, interactions between a unity and another unity, or the environment, will consist of reciprocal perturbations. In these interactions, the structure of the environment only triggers structural changes in autopoietic unities, it doesn't determine or govern them, and vice versa for the environment.

Maturana refers to behavior in a consensual domain as 'linguistic behavior'. A language exists among a community of individuals, and is continually regenerated through their linguistic activity and the structural coupling generated by that activity. Autopoiesis as related to data, could potentially be realized in linguistic, consensual domains. Language, as a consensual domain, is a patterning of behavior that possesses a shared orientation. The observer is a languaging entity, operating in language with other observers, generating linguistic distinctions in a linguistic domain. Observing emanates with language as a co-ontogeny in the process of delineating. Meaning or knowledge discovery emerges as a relationship of linguistic distinctions. Patterns of recurrent interactions or minglings make possible ontogenic structural drift in a structural coupling that affords coordination of actions specified through our data minglings.

Clustering of data components emerging from these minglings, result in dynamically coherent unities. These unities or systems, profiled in a nearest neighbor array, possess similar or related ontological structure with the capacity for recurrent systems occurrence. The membrane of separation from other data unities lying in the barrier between classes, defined by classification of attribute flow.

Interiority/Exteriority

Gilles Deleuze states, "Everything is everything that happens, no matter what happens." Or in other words, everything has a concept, that is, everything has an outside. The ontogenically based identity of a unity is a mere definition posited by one term (the defined) with at least two other terms (definers or reasons). Unlike the traditional semiotic model of signifier/signified, ontogenic identity is a composite of attributes that exist as predicates, which serve to characterize the defined. The unity is, of course, irreducible, its predicates constituting the whole and the parts of the defined. The defined is real, as any subject is real, yet whose predicates are mere relations along the intermediary between the functions of the inside and the outside, the barrier between classes. According to Deleuze, "the inner character of the defined can be understood from the outside, through successive experiments, which permit the predicates to abandon being attributes in order to become relations."

Severing the relations of the inside from the outside reveals an infinity of possible codes, which form the unity's definition. The autonomy of the inside, an inside without an outside, and the autonomy of the outside, without an inside, results in two infinite code sets as relations, not predicates. Clarity endlessly plunges into obscurity. Our perception of things is limited to the composiblity of these relations. That is, the prolongation of continuation of code as series, a mingling of one into the other, a wholeness of an interiority and exteriority, but only divisible by itself, a composite as identity derived from the complexity of auto-inclusionary relations as predicates.

Based within codes of ambiguity, ontogenic identity is promoted via associations with domains of unities that possess more than one meaning. Unities often belong to more than one organization and are operational on multiple levels. The appearance of membranes clarifying interiority from exteriority results in a blurred distinction, in an entailment of multiple linguistic associations among consensual domains that place the membrane as lexicon into the world. Explication of this lexical placement, as a set of operations or regularities determining the relations of code within codes, illuminates an ontology of organization as system derived from the autopoietic nature of data.

Prehension

In that a discrete data object (datum) can be considered a (unity), it is a unity having parts (or the potential for parts) and yet is simultaneously a part. The datum is a prehension of its antecedents and concomitants and, by degrees, acts to prehend a larger system which prehends itself. Like the eye is a prehension of light or the body a prehension of person, the discrete datum is a prehension of its own organization and the domain to which it belongs, a domain constituted within a network of consenual relations.

In a unique twist of semiotic fate, to be a data object implies that the unity of another datum, must therefore prehend it (if A prehends BCDEFG then BCDEFG prehends A). In other words, datum expect other datum, data classes expect other data classes, unities other unities, domains other domains, networks other networks. This notion is critical, for prehension based systems illustrate the reciprocal and self-referencing nature of data unities. As is implied, these unities tend to evolve in complex, self-organizing and auto-catalytic class systems which exhibit behaviors which can be understood as code relations resulting from their actions as attributes or predicates, including echoes, reflections, iterations, traces, deformations, thresholds, and folds.

As theoretical agencies, prehensions somehow anticipate themselves as members of a domain class and are evidenced by their formation in clusters shaped as specific networks of coded relations. Fluctuating between predicate or attribute status, the unity as a data object enables emergence of actions, which define its identity within a member class domain, which in turn enables organization through relations with other organizations, which ultimately formulate into networks. Operating in both first and third person capacity, the datum is self-referencing, establishing identity within the membranes of separation where coded relations are evidenced. Each localization of a data object represents a new prehension status for the data class and the organization to which it is a member. The organization in turn, is also considered a unity, and emerges as a member of a network domain. Unities and domains are therefore continuous. In a formal sense, every organization is composed of unities shaped as coded relations which necessarily prehend their other. A substantiation of these relations is clear evidence of the public nature of data and serves to suggest that no meaning of organization outside of the prehensive nature of code exists. Appearance of functionality or purpose is but a mere reflection of the expectation of data expecting other data.

All A expect B If A thinks that B thinks about C.
No B are C And B is unaware of C, but realizes A is thinking.
All C expects B B and C meet , A thinks about it.
All A expect C B and C are aware of A thinking about them.

Further investigation of theoretical structures enabling prehension, including predication, extensors, irreducibles, inclusionaries, exclusionaries, permeables and entailments, may illuminate our understanding of the ontology of organization as system. Applications, which might be informed from research into these topics, include desktops that organize themselves relative to profiling user organization including potentials for interaction, self-organizing of memory, and machine to machine dialectics.

Predication:

Predicate logic represents the structure within propositions themselves through quantifiers and the attributes and predicates that they bind, including representation between propositions and the codification of relations referencing the minglings of interiority/exteriority. Application of predicate logic is used in linguistics, philosophical logic and the philosophy of language to represent natural language processing.

Extensors:

In stable organizations enlargement of scope or operation is specific to expansions in the population of unities or collective enhancement of individual unities of the member class as networks. In complex systems, those that exhibit non-linear and self-organizing tendencies, extensors are those attributes enabling auto-catalytic clustering into dramatically complex organizations.

Irreducibles:

Nearly decomposable systems are those in which the hierarchical associations of elements comprising the system can never be fully reduced to autonomous relations. Irreducibles are evidenced in object oriented computational environments in which coded relations are defined by stratification of actions within agencies in the form of increasingly smaller structures of interaction.

Inclusionaries:

Inclusionary knowledge is a socially and materially embodied activity arising within the specific details of a particular domain through abstracted and non-optimized forms of rationalization. Essential in constraint satisficing, inclusionaries are those attributes that can be formally incorporated into the domain to influence the evolution of heuristic searches enabling an organization to learn.

Exclusionaries:

Exclusionary knowledge is a socially and materially embodied activity arising external to the specific details of a particular domain of organization through non-probabilistic, abstracted and non-optimized forms of rationalization. Exclusionary attributes bar from participation specific unities, thus pruning those non-essential unities from the member class domain, stimulating the transformative identity of an organization.

Permeables:

Code relations between unities are defined by classification of prehensive attribute flow. The membrane of separation, the interiority/exteriority of one unity formed as a coded relation to the interiority/exteriority of other unities, acts as both inhibitor and filter. Networks composed of organizations require permeables, which enable actions of diffusion through clustering.

Entailments:

An entailment is a set of rules pertaining to the emergence of self-organization by a system in which uncertain conditions and influences are present. Entailment meshworks are coded into patterned actions of unity behavior, entailment being the product and feedback of meshwork conditionals (auto-catalytic patterns) which are signified only by the computational behavior of data.

Self-organization and non-linearity

Organization cannot be stopped. The prehensive relation of interiority to exteriority is to blame.

Self-organizing systems are those in which spontaneous ordering tendencies are observed. Complex systems (artificial or natural) are composed of excessively large numbers of elements that interact simultaneously and in a parallel fashion, including certain computational systems, networks and databases. Such systems exhibit self-organizing behavior, are auto-catalytic, are nearly decomposable and are sensitive to initial conditions when they are in the chaotic regimen. A significant phenomena observed in complex systems is their non-deterministic bifurcation evidenced in dynamic trajectories, which emerge as higher-level processes and include adaptive properties resulting from interactions between simpler ones.

Exactly how elements comprising a complex system cooperate to form higher-level processes and bifurcations leading toward adaptation is the subject of intense research. At present it would seem that autopoieses is fundamental to this research.

Most, if not all, complex systems exhibit deterministic chaos as a principal feature of their adaptive and evolutionary nature. In classical non-linear theory, a system arrives at a stable equilibrium or oscillates permanently in a limit cycle. A chaotic system however, may arrive at state in which it would remain permanently unless affected by a strange attractor. Complexity theory identifies attractors (static, periodic, and chaotic) as perturbations that influence direction and course of a system's evolution.

Conceptualizing attractors as perturbation patterns of linguistic activity suggests redirection of attention from a simple structural orientation to one in which the state transitions of an organization as system is more fully explored. This is particularly true in complex organizations such as databases or networks, which are clearly deterministic yet unpredictable. It would seem, for example, that chaotic patterns of prehensive activity emerge in specific clustering and nearest neighbor representations. Based on the features of deterministic chaos, a prehensive-based interpretation may illuminate how an organization is bound to seek new pattern as well as sustain its tendency for adaptation.

Clustering and Nearest Neighbors

All of this implies that the study of organizations as systems requires a phase of investigation preceding any specific analysis of the unities from which it is comprised. The ontology of an organization is not necessarily the ontology of its elements. Initial research is exemplified as interaction with the organization as an act of archeology, an act of directed experimentation intended to lead to a hypothesis. Allowing the organization to lead the way is critical.

The primary goals of knowledge representation are prediction and description. Prediction involves sampling unities (elements) from the domain (database) to predict unknown or future values of other relations (variables) of interest. Description focuses on finding human-interpretable patterns that illuminate solutions to problems that can be defined within the domain. In highly complex systems where non-linearity is a factor, the techniques of clustering and nearest neighbor may be employed to reveal multiple ontological assessments of a particular system without determining its purpose or function.

A cluster is a set of elements grouped together because of their similarity or proximity. The elements are often deconstructed into an exhaustive and/or mutually exclusive set of clusters, resulting in a multi-dimensional mapping of their coded relations. The nearest neighbor method of representation is non-parametric, that is, a model-free method sustaining non-model constrained elements for visualizing proximity estimation through discrimination between unities and unity domains. These forms of representation respond well to local variations enabling informative visualization of specific associations of data without concern for probabilistic and causal quantification, techniques particularly useful in systems where high degrees of uncertainty are present. Whereas, clustering is a common descriptive technique for representing the emergent actions of a finite set of categories, the nearest neighbor technique enables estimation of these relations which result from the diversity they contain.

Data Public

There is no discrete computer. Broadcast television, radio and more recently the Internet have redefined the notion of 'public', necessitating that architectonic views be complimented by the information. Every computer is a mirror of every other computer and every computer is capable of emulating any other computer or computer network, but the distinction between interiority and exteriority is arbitrary. Nevertheless, the ontology of organization as system often creates the semiotic illusion of a distinct computer: what is contained within the plastic shell as commodity. But, every networked computer is by necessity a continuum and must therefore be considered as public.

The specificity of coded relations with regard to unities among other unities, organizations among organizations, databases among databases, systems among systems, and networks among networks is meaningful only in the sense of their 'public' implementation as data classes. New data classes will inevitably emerge as a result of autopoiesis (search, navigation, browsers, cache, cookies, and spiders...). Operating in an algorithmic meshwork of consensual relationships, the emergence of new data classes necessarily reflects the non-linear dynamics and self-organizing tendencies of complex systems. This may be precisely the case in organizations of information in which the interactions of data classes and their constituent data objects are enabled algorithmically.

This social-like semantic functionality implies cooperation and competition among data objects and data classes. Competition clearly plays a central role in evolutionary theory and is therefore not at all puzzling, but the very existence of cooperation among the components of organizational systems is more difficult to ascertain and requires a discourse formed from an alternative theoretical framework. The dynamics of cooperation (which are well characterized in complexity and game theory) embrace competencies within data itself to bifurcate codes of relations as self-organizing tendencies. Suggesting that datum are autopoietic requires that a new semiotic model be developed accounting for how the coded relations between data objects and classes give rise to complexities of organization that seem to have a life of their own.

Conclusion

No one doubts the capacities of organizations to sustain meaning in and of themselves. Prediction of systems behavior of an organization from knowledge of its goals and its outer environment, with only minimal assumptions about the inner environment is delimited to perceptions based on assumptive models and causal functionality. The ontological status of an organizational system also stems directly from its public nature which is contextualized in relation to other organizations containing similar unities. Certain organizations can only be studied through knowledge representation techniques generated by experimental interaction with the organization's domain (the networks of coded relations), with little or no regard for function or purpose. Such experimental research may or may not reveal a hypothesis regarding the nature and implications of a particular organization. Let us not forget that the primary goal of knowledge representation is to reveal something interesting from something unknown.

Organization leads, directs, and emerges what data wants to be. Ontological characterization does and should remain elusive and ultimately independent of highly specific models about why 'something interesting' is the way it is. Non-model approaches represent a unique approach to formulating hypotheses based on experimentation, not to predict or describe, but rather to reveal.

::CrossReference

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