ADVANCED FORM THEORY FOR FORM ENGINEERS

Chapter 6 of the Anti-thesis

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None yet.

Methodical Formalism

We have seen how the pattern schema, or template of understanding is defined in such a way that it makes the content of forms comprehensible. We now move up a rung in the Ontological Emergent Hierarchy to the Form Schema itself, which is the most basic of all schemas for our Western tradition. Contents are inscribed upon forms or exist contained within forms. Most primordial a form means a shape. It is on the topology of this shape that content abide, or it is as the material content of that form that the shape enclosed and enfolds. But from that humble beginning form in our tradition became the fundamental schema against which the other different schemas need to be compared and contrasted. We do not begin with form because we consider form well understood. And we will not be giving a history of this schema, rather we will consider form within the context of real-time software systems methodologies. Form plus behavior is equivalent to what software engineering calls an *object* with respect to object-oriented software design. At the level of pattern we saw the bits within a variable as the fundamental example of patterning. These bits came to represent ASCII letter, number, punctuation, and symbol forms via coding. Once the ASCII coding has been performed then on the basis of these rudimentary forms a whole list of higher forms are created, words, operators, numbers etc. Each of these can be seen as a computational object with its inheritance from the root object template of operators to which in a hierarchy of inheritance various other operators and attributes are added. An example of such a language might be *RUBY* in which each element is an object, like *smalltalk*. But what is said here applies to differing degrees to all programming languages that allow us to write algorithms which manipulate data based on the rudimentary patterns and forms called data structures and data contents. So what is different about our presentation of form is that it is done in a software and systems engineering context, as computational forms the most important of which will be for us those addressed by software and systems engineering methods. In other words, there has been a push to simplify the constructs needed to design software systems which has produced design formalisms with associated methods. We will consider these distilled forms as particularly relevant to our quest to understand the form schema. Another direction with is of interest is what are called Formal Methods in

Software Engineering which usually means a language for describing invariances between the inputs and outputs of algorithms. Between Software Engineering Design Methods and Formal Methods there is a well developed arena of exploration that could not possibly be covered in this chapter. Rather we will try to stick to basics and attempt to understand the schema of the form as best we can using simplified models.

In my work, Wild Software Meta-systems, I develop a fundamental theory about the nature of Realtime Software Design Methods. One thing that I am interested in doing is developing a Systems Engineering Architectural Design language based on some of the same principles used to develop that software design language. The Integral Software Engineering Design Language does not pretend to compete with Unified Modeling Language (UML) which has become an industry standard. Instead, it is meant as an experimental language in which new design methods and approaches can be easily tried out using the idea of mini-languages as a means of constructing quick and concise formalisms and then working with them in a way that is easy to understand in order to discover there usefulness. For instance, in my recent paper on Vajra Logics[1] I include Set and Mass experimental languages in order to show their duality. These languages operate on complex representations of forms which show up in design methods and attempt to make sense out of the jungle of methodologies that have inundated the software engineering marketplace of ideas. This broader background should be kept in mind when reading this chapter which will focus on the rudiments of form.

Laws of Form and Surreal Numbers

The most fundamental representation of Form is that of G. Spence-Brown called Laws of Form. This representation is based on the concept of making a distinction. The laws of form are

repeated marks = mark

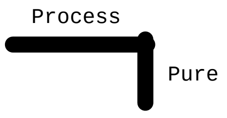
nested marks = no mark

These will here be contrast with the anti-laws of form which are the opposite of those above

nested marks = mark

repeated marks = no mark

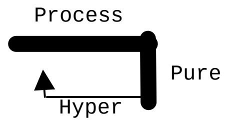
Elsewhere I have spent quite a bit of effort trying to understand the laws of form as a basis for the kinds of software formalisms described in the last section. Suffice it to say that the best presentation of the essence of the Laws of Form that I have found to date is the work of Hellerstein in terms of his Diamond Logic. In that work he makes clear the central concept of Spencer-Brown's work which is the relation between the dual paradoxes that appear as limits ***i*** and ***j*** in Laws of Form. The brilliance of G. Spencer-Brown's work is to unfold the simple algebra of distinctions in such a way as to make clear how the imaginary limits operate within them. To do that the distinctions are elaborated such that the ability to jump back into a nesting of distinctions is allowed. These jumps back or forward in a sequence of distinctions takes us to the Hyper Being level. A mark has the form:



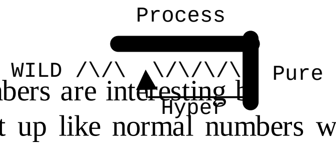
It is meant to distinguish a boundary. But we can think of its two dimensionality as being not just spatial but as being ontological in the sense that the mark signifies both in terms of process and pure Being. The standard places

[1] INCOSE 2002

a mark at a certain place, and then the overhang shows a duration that covers other forms.



Spencer-Brown adds the ability of the distinctions to involute which is equal to an appeal to Hyper Being. It is these involutions that give rise to the twin paradoxes of ***i*** and ***j***. It is the indecision between the two limit cycles ***i*** and ***j*** that simulates the undecidability that constitutes the essence of Hyper Being. Now it is when we get to Wild Being that the interface between Laws of Form and its content shows up. Laws of Form is equivalent to Boolean Logic, it is purely a formalism like geometry or logic in general. But we see the interface with content if we imagine that Wild Being is simulated by the addition to Laws of Form of Surreal numbers invented by Conway. Surreal Numbers are produced by an appeal to game moves. The tree of possible moves and the actual moves within that tree of possibilities can be seen as a way to produce a number system. That number system in its simplest case, a binary structure of moves is called the surreal numbers. They are constructed from a sequence of up and down arrows. We can imagine that this sequence of up and down arrows denoting a surreal number, i.e. the moves away from the start position which is zero, is contained as content within the distinctions produced by the Laws of Form. By adding the Surreal numbers as content we create a formalism that is a face of the world because it combines all four kinds of Being in a single theory.



Surreal numbers are interesting b[illegible] they are not built up like normal numbers which adds natural, integer, rational, and transcendental numbers together to obtain the real numbers. Rather these numbers are derived from game moves in one fell swoop, but they produce most of the other numbers in the process. But the surreal numbers are odd in as much as they have holes in them and do not support integration. They include infinite and infinitesimal numbers of non-standard analysis. The up and down arrows that they are derived from can be interpretations of bits in a variable, and the distinctions of form can be interpreted as the boundaries of the variable itself. So the combination of the laws of form and surreal numbers serves as a formalism for the interface between pattern and form, and also of the relations between variables and their contents, where surreal numbers may be thought of as state markers. States can be thought of as states of play or moves in a game. In this way we find a formalism that encompasses all the kinds of Being which we can use as a basis for understanding the interplay between form and pattern.

It is important to add that the laws of form is only half the story, we must consider also the anti-laws. The anti-laws along with the laws allows us to model the appearance out of nothing and the disappearance back into nothing which is not possible with either the laws of form or the anti-laws on their own. This means that we need a higher level diacritical mark which distinguishes whether a formula is from the laws or the anti-laws which are complementary realms. We want to interpret both the laws and anti-laws in the context of Hellerstein's diamond logic, and as we mentioned in the Vajra Logic paper we would prefer to apply the logic to all four aspects of Being, rather than just truth. The question is how do we get from this model of the Diamond Laws/Anti-Laws of Form plus the Surreal numbers to the formalism of the software and systems minimal methods which deal completely with forms. This is the question that will engage us in this essay. It is foundation to our study of how the minimal methods apply to systems engineering as well. Turing machines play games and can make distinctions. When we move from the Turing machine to the formal methods we are attempting to understand how the games that Turing machines play can be seen as the basis for understanding the fundamental forms of computational structures that underlie our design of both systems and software.

Relation to Pattern Theory

The first question that comes up that we must breach is the relation back down to the pattern theory established by Grenander. We noted that the pattern theory expressed each of the Peirce-Fuller categories. A set of generators with bonds produced an image in which symmetry groups were expressed. The image is the projection of the results of the computation of the generators. This is like view of the coloration of the cells in a cellular automata. The individual rule sets express the computational algorithm embodied in rules behind the scenes. On the surface there are merely the patterns seen globally by an observer which appears as a pattern which is entirely based on the local inputs around each cell. It is the variation inherent in the rules that produces the possibility of the patterns. Now when we look at the global expanse of the cellular automata array we are seeing individual monads of content as a pattern. What is missing is any forms imprinted on this surface. We can see the Laws of Form marks as the delineation of shape on the surface independent of the patterns that appear there which can be seen as circles, or any closed form equivalent to a circle, sphere or higher dimensional closed sphere. The laws of form marks have the special property of being ontologically two dimensional expressing both Pure being and Process being in one monolith. In other words we can say ***Shape Shapes*** or ***Form Forms*** (a formulation containing the same word as both noun and verb). It is this aspect of the mark that allows it to be both operator and operand at the same time which makes the Laws of Form interesting. This shaping is projected on the patterned surface of the image, or as the content within the shape. Formalism does not care about the content in the least. We do not need to consider the content as long as we do not look too deeply into the meta-levels of form. However, if we consider the undecideability of Hyper Being that appears when the monolith involutes through the separation between Pure and Process Being, then we begin to approach an interest in the content, via an application of form to the content itself as structuralism. If we create binary oppositions and work out where each piece of content appears in the hierarchy of the binary oppositions then we begin to appreciate how formalism can begin to approach content from its own vantage point. The progressive bisection we see in the surreal numbers is a way of isolating each piece of content and locating it in a space which is formally partitioned. Structuralism is the projection of a micro formalism onto content. It does not engage the content in the least. It merely corals the content and classifies it. But this is necessary because the monolith resists involution and this resistance is seen as the content. So on the one hand there is the plenum of the cellular automata which appears as presence on the surface of the image. On the other hand there is the higher meta-levels of form that attempt to isolate the content in a micro-formalism (structuralism). You can see how these two approaches are conjuncted. They stand juxtaposed but in some sense do not touch each other. Each of the schemas have this sort of conjunctive relation with the next schema.

Levels of Ordering

Once we graduate to the Ontological emergent level of the form schema then the question becomes how this relates to the forms we see in Software and Systems

Design exemplified by the minimal methods (or other UML like methods). At this point we will appeal to what Klir calls the methodological distinctions of order. He delineates that there is a lattice of orderings which starts off at no order, then goes through partial ordering, then splits to give us either partial order with distance or linear order without distance and finally ends up with full ordering. No order is seen as pure distinction of the type that are seen in the laws of form. So this lattice shows us how ordering increases in rigor by stages until we get fully ordered dimensions described by real numbers along coordinate axes. We would like to note that the real numbers is an abstraction which irons out the holes and gives integration to the surreal numbers. So full ordering is an abstracted image of the surreal numbers. We build toward that abstraction step by step by introducing partial order and then distance or linearity prior to full ordering. What we have discovered previously is that the duals partial order with distance and full order without distance are prototypes of the minimal methods, and we see that full ordering occurs with respect to event and data points of view while the function and agent views remain only partially ordered. So the split between the minimal methods remains very important as part of the substructure between the partially ordered viewpoints and the fully ordered viewpoints on real-time software and systems design. It should also be noted that once the gloss of full ordering related to the real numbers is established then we can relax the properties of the algebra that relates to those numbers in order to produce the hyper complex algebras. From the real numbers there naturally unfolds the complexnions, quaternions, octonions and sedenions as lower energy states with fewer algebraic properties. These hyper complex algebras will become more important to us later because it is through them that the Special Systems are defined. What is important here is to see that there is a natural progression from the laws of form with surreal structuralist content up the latter of increasing order until the transcendental numbers can be defined with its real algebra, and then on past that to define the thresholds of complexity which define the various imaginary numbers and their algebras. When the circles of laws of form (marks) are partially ordered that occurs in a lattice of possible orderings which are one step beyond the arbitrary orderings in which each mark is completely independent. Then we introduce either linearity or distance between the marks, and finally we make the marks in a space of real numbers. These real numbers are an abstraction of the surreal numbers. The real numbers are smooth and continuous in a way that surreal numbers are not. The real numbers can be integrated. But the real numbers must be built up analytically rather than being synthetically produced by game moves.

Onward to Systems

Systems appear as sets of forms and their relations to each other that serves as the basis for gestalts by the observer. The observers project unity and totality on the sets of forms and their relations to produce the concept of the system. These systems break down into meta-systems which are their dual inverse, equal to their environments, ecosystems, milieu and contexts. Just like with the relation of form and pattern there is a conjunction between the form and system schemas. The system schemas pick out forms and look at their relations to other forms that are both static and dynamic. But systems define forms from the outside not from the inside. We can use a systemism like Gurevitch Abstract State Machine to define these relations. At the first meta-level there is the system as an abstraction. At the second meta-level there is the rules. At the third meta-level there are the properties of the objects allowed into the system. At the forth meta-level there is the anomalies that break the rules of the system.

The interface with the system is the form as an externality. Systems do not look deeply into forms but accept them as given in each case. Similarly Meta-systems do not look deeply into systems but take them at their face value.

We can now begin to appreciate the set of heuristic models that are being constructed as a way of understanding in more detail how the various schema play in relation to each other. Once the example of the variables with their values in spacetime given significance by someone was taken as the primal instance of a patterning, then we can see how that progressively unfolds into Grenander's definition of a pattern composed of generators, bonds, images and symmetry groups. When we draw a distinction on the patterned surface then we can begin to apply Laws of Form. Form can approximate content with micro-formalisms but can never produce content. The form itself as an externality is seen as a figure on a ground and by multiple gestalts appears as a system. The present-at-hand appearances approximate a ready-to-hand reality behind the scenes of the system itself. And then again at the level of the system the various kinds of Being come into play, because the system is dynamic, it has undecideable Godelian aspects, it has anomalies, it steps up through the meta-levels of Being. In general at each schematic level all the various meta-levels of Being are played out and we see a face of the world where the various kinds of Being intersect. So at the level of the laws of form we have the various orthogonal aspects of the mark related to the different kinds of Being. The distinguishing marks can be ordered in more and more complex ways until one reaches the pinnacle of full ordering after which the algebras relax their properties to produce the hyper-complex algebras related to the special systems. The real algebra itself stands in as the basis of the system, which is seen as fully ordered. As the hyper-complex algebras relax they successively produce the various special systems until they reach the threshold of the sedenion which is the first non-division algebra at which point the threshold of the meta-system is reached. So the notion of ordering and the eventual loss of algebraic properties is what takes us from the form through the system to the meta-system. The real numbers are the field on which the dynamics of the system is plotted. There are two intermediate steps between the non-ordered laws of form algebra to the real numbers coordinates of the system, and then three intermediate steps between the system and the meta-system at the level of the sedenion. This suggests that between the pattern generators and the form there should be only one intermediate step and we find that to be the case because there is the content image between the generators and the form. There is no intermediate step between the pattern generators and the monads because monads to not exist in experience. Monads are pure Firsts without any Second. What we would like to contemplate is this series of heuristic models we call schemas, or templates of understanding. It is this series that should be the basis of our schemas theory and our schemas practice. It is an odd series mainly because each part is so different from the others, but each part is a face of the world because it is a conjunction or intersection of the kinds of Being.

Considering Deformation

Each of the schemas has a series of meta-levels. For the form schema which is at the Pure Being level we move up to proof at the Process level, and then to axioms at the Hyper being level, and finally to anomalies at the Wild being level. Also each of the schemas has a four fold constitution. For the Form schema these four faces are the shape, behavior, state and interface. One way to think about the various lower level schemas is in term of dimension theory. In terms of dimensionality then monad is the dimensionless point. The facet is the superimpositions upon the dimensionless point. The pattern level is seen in the single line. The first cellular automata were produced as patterns of dots on lines of the computer screen. We can have pattern at the level of the line. But we cannot have form because the two endpoints of a line segment are merely other dots on the line. It is only in two dimensionality that we have real form, which is signified by the Spencer-Brown mark which is two dimensional and corresponds to circles within and adjacent to one another. However, laws of form is extremely static as the deformation of the boundaries do not count as significant. So we shall consider the work of Michael Leyton[2] in his book Symmetry, Causality, Mind[3]. In this work Leyton develops a grammar of deformations of shapes. His key insight is that *shape is time* and that one can reconstruct the temporal history of things by looking at their shapes, and in fact that this reconstruction of causal history is cognition. Everything we look at which has shape we are involved in a reconstruction or explanation of its causal historical unfolding and this is the foundations of cognition itself. This is a very challenging thesis, and we would like to explore it here as a basis of understanding the form/behavior schema. We will treat Leyton's model of the temporality of shape as the canonical description of the form schema. We notice that Leyton treats all four faces of the form, i.e. its shape, its behavior which he calls process, its states and its causal interface. He identifies four fundamental processes which he calls protrusion, indentation, squashing and internal resistance. And he says that these result in six fundamental transformations in the shaping of shape:

- Squashing continues till it indents
- Internal resistance continues till it protrudes
- A nodule develops into a lobe
- An inlet develops into a bay
- A protrusion is introduced
- An indentation is introduced

All of these are transformations of shape. The behavior is the self transformation of the shape which then expresses itself as action which may or may not cause interaction with the environment of the shape. Such transformations may leave traces in the environment in which multiple states are represented in the same instance through the interaction of forms or systems of forms. Thus multistate traces of forms are dealt with in his theory which basically traces back to less and less distinguishable prior states along a developmental arc that seeks to roll back asymmetries into symmetries eventually arriving at the single dot of origin. Leyton identifies causal explanation and computability so that his theory of form is also a theory of computation as well as perception. Leyton's theory corresponds to the series of the meta-levels of form mentioned previously[4]. It says that form is the manifestation of Pure Being which when taken to the next higher meta-level turns into proofs. Proofs are really explanations which are causal. Proofs take time to produce and so they are the underlying basic process of a formalism. What Leyton is saying is that when ever we look at a form we are really seeing its associated proof, except Leyton has broadened what he means by form by specifying shape and saying that looking at any shape really means looking back into its history of production. Proofs are a similar appeal to axiomatic units and a reduction of a form to those axiomatic units. When we go to the next higher meta-level we see the axioms at the Hyper Being meta-level. The axioms are the elementary constituents out of which the form is built. However, we know from geometry that there are problems with axioms such as that which plagues the axiom about parallel lines that generates both

[2] http://www.rci.rutgers.edu/~mleyton/homepage.htm

[3] MIT 1999

[4] Meta-systems Engineering INCOSE 2000

Euclidean and Non-Euclidean geometries. There is at the level of axioms an introduction of some undecidability. Finally there are anomalies that are not covered by axioms, which exist in the interstices between different axiom systems. For Leyton these anomalies are the source of asymmetries which he is trying to relate to symmetries in order to recover history. Anomalies relate to the reflection of alternative sets of axioms which display some symmetry, like the symmetry between Laws and Anti-laws of Form. Time enters in the as the laws and anti-laws are used to produce proofs which stand behind concrete configurations of marks or shapes represented in spacetime. Laws of form has an asymmetry if only its rules are used and not the anti-laws which is similar to that which Leyton talks about in his deformational grammar. Deformation is something which is not considered by Spencer-Brown. Spencer-Brown stops at the point where time would enter his system of the Laws of Form. Deformation is an action of time and thus Leyton in some sense takes up where Spencer-Brown leaves off. Leyton develops a framework of how process forces interact in deformed circles with one, two and three lobes. This framework shows how the six transformations are related to each other so it is possible to produce the intermediary stages between any two shapes and thus reconstruct an ideal history connecting two snapshots of a shape in the process of genetic unfolding. He is describing the axioms that control shape at the meta-essence level. But he is also describing the anomalies that appear as asymmetries at the level of Wild Being. The interaction of these asymmetries that appear in shapes with the axioms produces histories that can be reconstructed as causal explanations (proofs) which stand behind the observed shape. Thus the shape must be considered together with the shaping and the entire thing to which we must address ourselves is the ***shape shaping***, or the ***form forming***. What Leyton is pointing out is that the Wild Being and Hyper Being levels play a crucial role in this unfolding of shape as form and this concept can be extended beyond just shapes as Leyton does in his book where he considers language syntax as well. For our part it is necessary to appreciate how Leyton has extended our understanding of the importance of shape and its connection with time and perception and cognition. Rather than merely recapitulating what Leyton has said we will move on to consider the relation between Grenander's view of pattern and Leyton and Spencer-Brown's view of form. Since these are the most well known schemas it behooves us to study how they are juxtaposed with each other carefully because that hopefully will tell us something about the relations between less well known schemas, such as form and system, or system and meta-system.

Pascal's Triangle

We have already noted that pattern can be expressed in one dimension while form needs at least two dimensions to express itself. This is a key point. To which we must add B. Fuller's dictum that the minimal system is a tetrahedron which can only exist in at least three dimensions. This relates also to the Peircian categories in the sense that the point, line, and surface can be seen as the source of the categories of First, Second, and Third. What we can see are emergent properties that are appearing as we enter the expanded horizons of higher dimensions. Does this series continue indefinitely so that schemas are reducible to the emergent effects of dimensionality. Is the meta-system merely a version of the four dimensionality which could be seen as appearing as the pentahedron of four dimensional space. Are domains five dimensional and worlds six dimensional and so on up the series of schemas. There is much to recommend this suggestion. Dimensionality has not been thought out beyond its mathematical basis very far. What really is dimensionality. However, if it is the case that dimensionality is the basis for schematization, then what about the fact that there are infinite dimensions and only finite number of schemas? I think we would have to look very carefully at each schema to make sure that the dimensional contribution is significant in each case. There is surely a dimensional component to the various schema but the schemas are richer than the dimensionality, and so perhaps the dimensionality contributes to the emergent qualities of the schemas but does not completely determine them. But dimensionality is a clue that we need to follow up as best we can to understand the differences between the schemas as best we can. Notice that the schemas go beyond the dimensional to the dimensionless and even beyond that to the facet level. This reminds us that the Pascal Triangle has an inverted negative twin and that between these twins is the odd zero which is different from the even zero that appears within the Pascal Triangle.

1 4 6 4 1	sedenion -7d
-1 3 3 1	octonion -6d
-1 2 1	quaternion -5d
-101	complexnion -4d
-1	negative limit, source -3d
0	odd zero, void -2d
1	positive limit, facet -1d
101	even zero, monad, origin 0d
1 2 1	line segment, pattern 1d
1 3 3 1	triangle, form 2d
1 4 6 4 1	tetrahedron, system 3d

Notice that it is not dimensionality per se but the minimal figures that appear in each dimensional conglomeration as specified by the Pascal triangle that gives us the emergent sequence. Note also that there is something beyond the point to which the facet corresponds which is the merger of the two limiting ones into a single one just prior to odd zero. Dimensionality is the very image of juxtaposition, that is independent characteristics brought together in a conjunction that makes something beyond that which is brought together. But within dimensionality there is the emergence of the minimal object of that dimensionality and that minimal geometrical object somehow supports the differentiation of the schemas. The Pascal triangle is an ordering discovered by mathematics. It can be said to apply both to logic and to schemas in as much as the progressive bisection also applies to the Boolean logic as well. In a way the fact that Boolean Logic and Spencer-Brown's Laws of form are ultimately equivalent says that the Logical and the Schematic share the same roots in the non-dual of ordering. But that the Pascal triangle can be seen as a way of differentiating the emergent levels of the ontological series of the schemas too is very strange indeed. We really do not have an explanation of the fact that the Pascal triangle which is produced as a cascade of additions of adjacent numbers to produce the expanding line of numbers is of such importance. For one thing it is a pattern, but it is defining the minimal form in each dimensionality. A entire set of elements at each level is a system organized by the progressive bisection 2^n. These systems are structured in terms of reversal and substitution. The I Ching is an example of such a system. It has 20 sources beyond reversal and substitution. There are many ways to order the hexagrams of the I Ching showing how this system of signs is ordered. The dimensionalities are themselves pictures of a meta-system. In other words, the Pascal Triangle itself seems to embody an intersection of the various schemas in different ways. However, we loose track of this intersection as we go higher and higher into the triangle. It's infinity does not track with our finitude or the hypothesized finitude of the series of schemas. But at least at the beginning we can see that the Pascal Triangle accurately distinguishes the levels of the series of Ontological Schemas very well. And it calls us to interpret the tip of the triangle and recognize the difference between odd zero (void) and even zero (emptiness). Out of that void arises oneness that gathers together all the various distinctions that appear within the triangle and thus is multi-faceted internally if still seen as unified externally. Each level of the triangle is a totality. But all of them ultimately derive from this mult-faceted oneness and thus has the character of oneness which differentiates the multitude of the progressive bisection, the simplest possible set of distinctions. It is the source of a profound synergy which the higher level lattices intimate which is a model of wholeness. So perhaps we can understand the Pascal Triangle as a vision of the combination of plurality, unity, totality, and wholeness. Out of the faceted unity there is a splitting of limits which are the two ends of the lattice that each level represents. This splitting of limits makes visible even zero as the origin point between the limits. These limits gather up the points and the highest solids within the regular polytopes and give them unity. Each level is a totality of the elements generated by a progressive bisection. The lattice that we draw in as we connect the points, lines, surfaces, solids, hypersolids produce the minimal configuration at each dimensional threshold. The origin is the point. The point is dimensionless. This means that it represents zero dimension. That means that what is above it in the triangle has negative dimension. It is in that negative dimension that the sources appear. The sources appear on the other side of the void, odd zero, as a single source, and then as differentiated partial sources in a structure in accordance with the hyper-complex algebras. The sources are a key part of the meta-system which differentiates between there diffusion everywhere via negative dimensionality and the origin of positive dimensionality in which the minimal figures arise. That ever expanding horizon of the dimensions is the arena of space where embodiment occurs. So the boundaries (next higher dimension) and the arena (within a dimension) are tied together but the origin and source is separated. The origin is the monad as dimensionless point of zero dimensionality. Above it dimensionality begins and we open out to the pattern, then the form, then the system, then the meta-system etc. But as we have seen the Pascal triangle which brings together wholeness, totality, unity and plurality into a single synthetic structure does not describe all there is to be said of each of the schemas. Grenander and Leyton's descriptions of pattern or form cannot be derived from the Pascal Triangle. It takes great insight for Fuller to recognize that the Tetrahedron is the essence of a system minimal threshold of complexity. Grenander and Leyton work out minimal formalisms to describe the pattern and the deformed form. These have nothing to do with what we see in the triangle of Pascal. The triangle only defines the thresholds of complexity upon which these more detailed models might be hung.

However, once we have realized the importance of Pascal's triangle for this purpose it gives a sort of unity to the hierarchy of Ontological schemas that it would not have otherwise. Prior to this the schemas were a hodge podge of hypotheses. Having a mathematical structure behind the scenes helps to define the hierarchy as a whole and integrate it with other well known phenomena that the triangle of Pascal organize.

Leyton makes clear that the Platonic Solids which the Pascal Triangle produces the minimal one of for each dimensionality represent a kind of source that arises as distinguishing marks are eliminated as we trace back into history of a form. And so it makes sense for us to associate these sources with schemas of varying complexity. The Platonic Solids stand on the border line between what he calls external and internal inference. External inferences relate to schemas that are all given at once while internal inferences take these apart as a series of separate traces. In other words there is a boundary where we encounter a kind of primordial symmetry that is a whole, the platonic solids in each dimension represent this wholeness, and the minimal platonic solid in each dimension is the prime example of this kind of synergistic wholeness that appears in each dimensional horizon. When we convert external inference into internal inference we have to devolve the higher polytope by producing it out of lower level polytopes until we reach the level of shapes, lines and points. The point is the ultimate origin and we can even go back behind that to the faceted unity, then to the void, then to the source, and the breakup of the sources into the various levels of hyper complex algebra that give rise to our vision of the meta-system that appears in negative dimensionality. Leyton sees this reconstruction of the genetic unfolding of asymmetrical forms from symmetrical ones as an archeology of the historical or genetic unfolding of the forms. In biological forms this follows the pattern he describes in relation to transformation of circles and spheres into along lines of dynamic symmetry by his rules of deformation. A tetrahedron may be inscribed into a sphere, and is topologically indistinguishable from a sphere. Similar things can be said for higher level minimal platonic solids and their respective hyper-spheres. In other words, the Platonic solids are merely harmonic variations of the spheres which we can see in the great circle route figures that Fuller creates. Platonic and Archemedian solids are harmonic patternings of spheres, they are levels of resonance within a particular dimensionality. But ultimately they represent symmetries as origins away from which asymmetrical objects have lapsed. Leyton says we can always think back through that history by reducing the distinguishing markers and that ultimately leads to the deconstruction of the harmonic forms as well when we switch from external inference to internal inference. Leyton says that any symmetry can be converted to a trace and vice versa[5]. With this principle Leyton would break up the harmonic wholes that appear as platonic solids into lower level schemas. But something similar can be seen in the work of Grenander on Patterns. There was always the symmetry group relating the pattern generators to each other. These symmetry groups could be convereted into pattern traces on the image is what gives unity to Grenander's definition of the pattern level. The basic difference between pattern and form is that with form one is writing the pattern in points of content which could minimally be written on a line, a thread which is multi-colored say, but with a form one is writing a distinguishing boundary minimally on a surface. But in both cases the symmetry groups are very significant with respect to generators or Platonic harmonic forms. The symmetry groups represent atemporality. Symmetry destroys time because you cannot see the results of group operations unless there is an asymmetry somewhere. At the heart of pattern and form are these atemporal symmetry groups. Schemas can be seen as atemporal templates by which temporal phenomena are understood. If Leyton is right and our cognition and even perception is essentially a seeing of these schemas within the asymmetrical objects around us then it becomes clear that the schemas are not other worldly, in the sense that they do not come from outside of perception or cognition, but are produced as the atemporal within temporality. In other words this is the aspect of things that persist, and thus they deserve to be associated with Being. Similar things could be said for logic, Logic is the structures of argumentation that persist throughout our use of language. In fact, Leyton treats language as well but does not draw the same conclusion that logic is the symmetries of arguments using language. Math similarly is the persistence of symmetries of counting and measuring. Looked at this way it is natural that Being should be seen in the midst of Becoming because Being is merely what ever persists despite the continual asymmetrical change of time. Being cannot be seen because it has no distinguishing marks, it merely is what ever

[5] p 50 Symmetry-to-trace Conversion Principle

persists, and the strongest persistence is in terms of Logic with respect to Logos, Schemas with respect to physus, and Math structures with respect to ordering which is non-dual between physus and logos. The problem comes of course when we project the homogenization onto things so we no longer see their natural asymmetry creating nihilistic plena.

Departing from Forms in Minimal Methods

For us form is exemplified in Software Design Minimal Methods as seen in the Integral Software Engineering Method (ISEM) which could be just as easily understood as a System Architectural Design Language as it hopefully will be with ISEM 2. These minimal methods are things like state machines, petri nets, data-flow diagrams, use cases, virtual machines, darts diagrams, worldline-scenario diagrams, etc. These are the sorts of diagrams similar to those found in UML or the recent SEI book on software architectural documentation[6] where they are called *architectural styles*. In each of these minimal methods, or *style diagrams*, there are a series of forms that signify crucial features of the software or systems architecture which are linked together using certain conventions. With our new understanding we would expect that these shapes could undergo similar reduction to symmetry that we have already seen with geometric forms. In other words these are crucial asymmetries that are being signified and that behind them are symmetries in which there configuration does not matter to the architectural design. Going from asymmetries they represent to the background symmetries is a significant explanatory path that produces a history of the architectural design. As has been said already in Wild Software Meta-systems, software systems represent what Naur calls theories about the essence of manifestation which is a non-representable core around which the minimal methods cluster. The methodological distinction lattice of order that Klir points out structures these minimal methods in relation to each other. But ultimately the ordering is based on distinctions which are like those we see in Laws of Form. However, these distinctions are not frozen, but organic and dynamic in the way that Leyton discusses. This is because systems and processes are duals of each other. The forms and behaviors that we produce as design objects must function within the flow of execution and within the conceptual gestalts generated by the entire design. We attempt to understand these mechanically based on the Turing Machine and the Universal Turing Machine, but ultimately because we are organisms and these are figments of our imagination, not merely rational specters, there is an organic life to the concepts and gestalts by which we try to understand systems and processes though gestalts and flows by which we relate perceptually to the world, and ourselves through the mediation of the computing environment.

Forms with their Behaviors (as eventities) that with their defined interfaces and internal states appear as "objects" in object-oriented computing systems. The systems and processes that contain these eventities are designed in a count mode, but they execute in a mass mode. We design one object but it is replicated during execution time and interacts with myriad other copies of other objects we have designed. We use Software Pattern Language to attempt to understand how the forms themselves are patterned. But we also use design formalisms that attempt to capture generalized relations between design elements. However, in execution all bets are

[6] Documenting Software Architectures: Views and Beyond by Paul Clements, Felix Bachmann, Len Bass, David Garlan, James Ivers, Reed Little, Robert Nord, and Judith Stafford.

off, and we must use extreme practices to verify and validate that the system is indeed doing what it was suppose to do and also is useful in the actual environment. All this mass like behavior needs to be compared to the count like design. The emergent properties appear in the system as a whole when executing as a mass like attribute of the entire running system. It is important then to attempt to move toward the non-dual center and prior state by identifying the juxtaposed ipsities in the conglomeration. We do that by moving back toward the symmetries as Leyton says. Leyton talks about the role of blurring and unblurring as a way to see what was primordially prior to the present asymmetries. When we blur, i.e. render fuzzy, we move also back toward the higher meta-levels of Being beyond the determinate and the stochastic. That fuzzy outline is contrast to the highly asymmetric chaos and complexity of the behaviors, and individual forms in the executing system which is signified by Wild Being. The architectural forms are those gross contours that the design styles pick out as important as high level asymmetries that are given as design templates at a high level of abstraction. When we approximate the ipsities in juxtaposition we move into a realm between design and execution, and prior to it. We get there by getting rid of distinctions that are both of the count and the mass variety attempting to approximate a symmetry on the boundary between design and execution yet prior to them. On the one hand there is the distinction between shape and behavior, and on the other between fuzzy and asymmetrical. The juxtaposed ipsities of the conglomerate appear between these distinctions and prior to them. They are in the interspace between the essence of manifestation, i.e. the non-representable core and the representations. Notice that Plato in his divided line distinguishes between the representable intelligibles and the non-representable intelligibles. The former are related to order and right non-duals while the latter are related to good and fate non-duals. Between these two cognitive realms there is emptiness, just as void exists between faith and opinion on the other side of the major divided line. When we talk about emptiness or void then what is really being indicated are the sources that lie beyond them. So the ipsities of the juxtaposed conglomerates are related to the Special Systems that are based on the hyper complex algebras which exist in the negative dimensionality in which the sources differentiate. They are neither representable nor non-representable, neither intelligibles nor non-intelligibles. They are something between count and mass yet prior to them. They are something between design and execution yet prior to them. For instance in a Smalltalk system the system continues to run as you are designing. You create an object and then invoke it. The difference between design and execution is minimized. In small talk it is the ultimate template of object that becomes the umbrella that reconciles all differences between the various kinds of software objects that are created within a smalltalk system. These root objects are the symmetries for all the distinguished marked instances of object the object template in the system. So what we are talking about is something like the smalltalk root object. Via the smalltalk system various instantiated objects are juxtaposed and form a conglomerate of ipsities, i.e. *particular instances* within the discrete-countable executing-mass. But the object template is a symmetry back to which the interacting instantiated particular objects can be traced and reduced. Perhaps other nodes in the inheritance hierarchy operate in the same way as nodes of reduction towards the ultimate symmetry of the universal source object template. In some languages there is multiple inheritance not just single inheritance, in which case these nodes are able to be very complex in their interweaving. We can also see that in the Pattern Language these various different objects can come together in a pattern of forms which is another special type of nexus in this reduction to symmetry. The object templates serve as sources for computational instances which when they are given resources have an origin within the system and when these resources are taken away from them then that is their destination. If we take the object inheritance hierarchy as on type of hierarchy within the system, could be aspects are another one, then we see that what we are talking about could be the interweaving of different types of hierarchy under the perview of the Grid or some other similar means of tracking multiple hierarchies that interact in the rhizome of the system/meta-system (Turing Machine/Universal Turing Machine) interaction as we move inward toward the "essence of manifestation" i.e. the non-representable heart of the computing system/meta-system as we head toward symmetry on multiple fronts simultaneously.

The whole purpose of producing ISEM in the first place was to study the design elements that appear in different views of the minimal methods, many times under different names or in various guises. This redundancy is very interesting as a phenomena and perhaps that is what indicates the presence of the nodes of the ipsities between representability and non-representability. The fact that non-represenablity can be seen as a collapse into symmetry and that there are stages on the way to this collapse as Leyton points out is significant. The schemas seem to be key points in these stages of blurring where we switich from external inference to internal inference because there are major harmonic symmetries that signify the synergy of wholeness that need to be overcome to further reduce distinguishables. The question is how do we introduce the schemas as a way to understand the relation between representable and the non-representable. Is it through the special systems? Minimal systems are slices of the Turing machine. Leyton wants to identify the Turing machine and the causal explanation of forms. We assume that the Turing Machine can be a face of the world, i.e. reducible to an intersection of the Kinds of Being. In that case we could see the special stems as the distinctions between the kinds of Being in the Turing Machine. The state machine of the Turing Machine is something purely present as is the tape. The running of the Turing Machine is its claim to Process Being. It is in Non-computability of say the halting problem that Hyper Being appears. But real-time systems are never expected to halt. So this is what makes them have the essence of Hyper Being, and thus have a non-representable core. Wild Being shows up in Artificial Intelligence, Artificial Life, Virtuality, all the conundrums of software are located in these disciplines that go beyond software engineering. So the Turing machine is definitely a face of the world with the multiple kinds of Being intersecting in it. Thus we can speculate that what distinguishes the kinds of Being are the Special Systems and thus they form the basis of ipsity juxtaposed in conglomerates that are non-dual between count and mass approaches.

Forms of Logos

Leyton also talks about forms in language by discussing what is wrong with Chomskys gernerative grammar. Thus he deals with both physus and logos in terms of his principles of symmetry and asymmetry as a means of getting to the way sentence shapes embody time. We can use Leyton's analysis as a potential ground for ISEM. What ISEM attempts to do is state each fact about the system design in a form which is reminiscent of Wittgenstein's Tractatus. Each fact about the design is a structured sentence. We have given an example of such sentences in the Vajra Logic paper and in the ISEM portion of Wild Software Meta-systems. We consider design in a way similar to the later Wittgenstein's concept of '*language games*' concerning theories. Both *languages* and *games* are representative examples of systems. For our own part we prefer

Gurvitch's Abstract State Machine (ASM) Method as a means of representing systemisms. Proofs are arguments that take on an if...then... format. Thus with nested rules it is possible to capture the interpretation of the requirements for a system which leads toward systems architectural design. What is important about the Gurvitch ASM is that it exemplifies proof by existence not in terms of the manipulation of truth values. We can execute the rule set in order to discover if it runs. We can bounce it off a dual rule set that represents the environment (universal Turing machine) in order to test it. And in general we can construct rules of the type that Leyton sees as necessary to represent full generativity which the rules of Chomsky lack. Leyton sees it as the difference between internal and external inference. Chomsky's system only allows external reference where Leyton would combine Syntax, Semantics and Pragmatics into a single descriptive device. Pragmatics talks about inter-sentence structure. He sees it in terms of the process of building up new information content on the basis of old information content already revealed. He says that the rules should cover the relation between pragmatic the *topic* and *comments* as well as the rules that distinguish syntax within the sentence. To these rules would be added movement rules as well that specify alternative transformations across clause boundaries. For our own part, we think that the points he makes that semantics are the built up explanations represent the time bound in the sentences are very significant. In other words syntax and semantics are bound up together and also cannot be separated from semantics. All of these can be represented by rules of the type we see in Gurevich abstract state machines.