

iemi

Information Economy Meta Language
Métalangage de l'économie de l'information

Purposes and Structure

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08 May 2006

Translation from french by
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ieml: purposes and structure

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I Introduction

Ieml (*Information Economy Meta Language*) is an artificial language designed to be simultaneously: a) optimally manipulable by computers; and b) capable of expressing the semantic and pragmatic nuances of natural languages. The design of ieml responds to three interdependent problems: the semantic addressing of cyberspace data; the coordination of research in the humanities and social sciences; and the distributed governance of collective intelligence in the service of human development. Indeed, the *semantic addressing* of oceans of digital documents and the *coordination of the social sciences* find their full meaning only as a function of the ultimate goal of ieml, which is to contribute to the well-informed governance of *human development*.

Because ieml is a metalanguage for describing the information economy, I will begin here by explaining what is understood by "information economy", followed by the meaning of the term "metalanguage" in this context.

The information economy

The information economy is an inclusive concept that goes considerably beyond the dimensions of a monetary economy. It designates the metastable and evolutionary ecosystem of flows of meaningful data that are produced, maintained, and transformed within a human population. We can use the term *collective intelligence* to designate this object, as long as we understand intelligence not as the opposite of stupidity, but rather as a self-sustaining and interdependent dynamic of cognitive functions (perception, memory, learning, communication, coordination of action, etc.) at the scale of a community. Because the information produced, stored, exchanged and interpreted by human societies is increasingly being coded in digital form, and the circulation of this information tends to converge in the same interconnected network, it has become possible to *observe* the

information economy in a manner that is much more subtle and integrated than was possible before the advent of computers. Nonetheless, simply taking a quantitative measure of information flows (or even of their monetary value) clearly is an insufficient basis from which to arrive at a thorough understanding of the information economy. Therefore, the research community must have access to observational and analytical instruments so that we can identify: 1) the *semantic* qualities of the data stored on servers and exchanged in networks - in other words, what the data represents - as well as 2) their *pragmatic* pertinence - that is to say, the effect and use of the data in context. Ieml has been designed to serve precisely this function of identifying and scientifically analyzing the meaning and contextual effects of information.

Metalanguage

A scientific-type ideographic script

The word "metalanguage" contained in the name "ieml" condenses several meanings. First, ieml belongs to the very general category of systems of cultural signs, or systems of symbols. In other words, we are dealing with a *convention* - or artefact - and not with a natural object.

Second, it is a *meta*-language: a language *about* language. It has been specially designed to index and characterize data and phenomena that are *already* symbolic in nature.

Further, of all the possible metalanguages, it is a system for the scientific notation of meaning, with a combinatorial structure that authorizes a broad range of automatic manipulations. Although its expressions can be pronounced (because they are expressed using alphabetical characters), ieml is not a natural language, nor is it intended to replace or simulate natural languages such as French, English, Russian, Mandarin, or Arabic. Rather, it is a *scientific script*, or a reasoned system of notation, designed to maximize the possibilities for computer calculation.

Third, ieml is also an *ideographic* script within which each symbol represents a concept. It is important to note that, during the 15 years I devoted to this project before publication, I worked by manipulating *icons* so that I would be influenced as little as possible by the natural languages I know. It was only in the final months of my research that I replaced the icons by letters of the Latin alphabet, to facilitate keyboard entry. Thus, ieml is - in principle - independent of natural languages.

Combinatorial and articulated structure

As with many other systems of signs, ieml is structured along several *levels of articulation*. For a proper understanding of the system of articulation used in ieml, it can be useful to compare it to the system used in natural languages. Therefore, I will begin with a look at the articulation of natural languages, before turning to the articulation seen in ieml.

The levels of articulation in natural languages

The first level of articulation in natural languages is the *phoneme* (phonemes are the elementary sounds of a language). Generally, phonemes have no meaning *per se*.

The second level of articulation is the *morpheme* (word roots and markers of case, gender, number, etc.). Morphemes are composed of phonemes. They constitute the first *meaningful* unit of articulation of a language.

The third level of articulation is the *word*, which is composed of morphemes. Words are not perceptible outside of writing. For cultures without a script, the distinction between word and morpheme would be meaningless.

The fourth level of articulation is the *phrase*, composed of words. The phrase is the first level of articulation to contain not only a meaning but also a *reference*. For example, the word "tree" is neither true nor false; rather, it only indicates a concept. Only the phrase "the tree grew", referring to an actual event, has the capacity to be true or false.

The fifth level of articulation is *discourse*, or the text, which is composed of phrases, etc.

Now let's have a look at the successive levels of articulation in ieml.

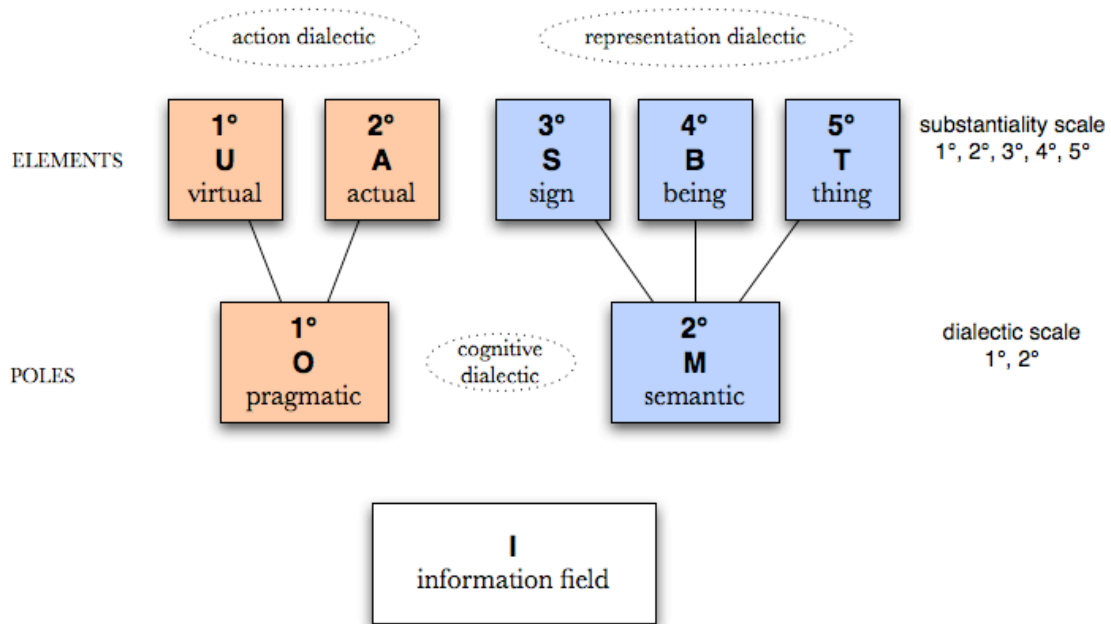
Levels of articulation and combinatorial structure of ieml

1) Five primitive *elements* form the first level of articulation. These are: the *virtual* U, the *actual* A, the *sign* S, the *being* B and the *thing* I. Their meanings will be explained in greater detail in the latter part of this text. These five elements are organized around two poles:

- the *pragmatic pole* of action, which includes the elements *virtual* and *actual*

- the *semantic pole* of representation, which includes the elements *sign*, *being* and *thing*.

ieml primitives



Here, in contrast to the case of natural languages, even the first level of articulation is meaningful.

2) The second level of articulation, the level of *events*, is formed of 25 (or 5^2) directed pairs of elements, or information flows between elements. In contrast to natural languages, *all* combinations of any two of the first units of articulation are valid and meaningful units of the second level of articulation. As we shall see in greater detail later on, *the meaning of a combination of elements results from the combination of the meaning of these elements*. For example, the directed relationship $U \rightarrow U$ (virtual to virtual) means "to reflect", the directed relationship $U \rightarrow A$ (virtual to actual) means "to act", the directed relationship $A \rightarrow U$ (actual to virtual) means "to perceive", etc. A complete explanation can be found in the third part of this text.

ieml events

ieml Alphabet

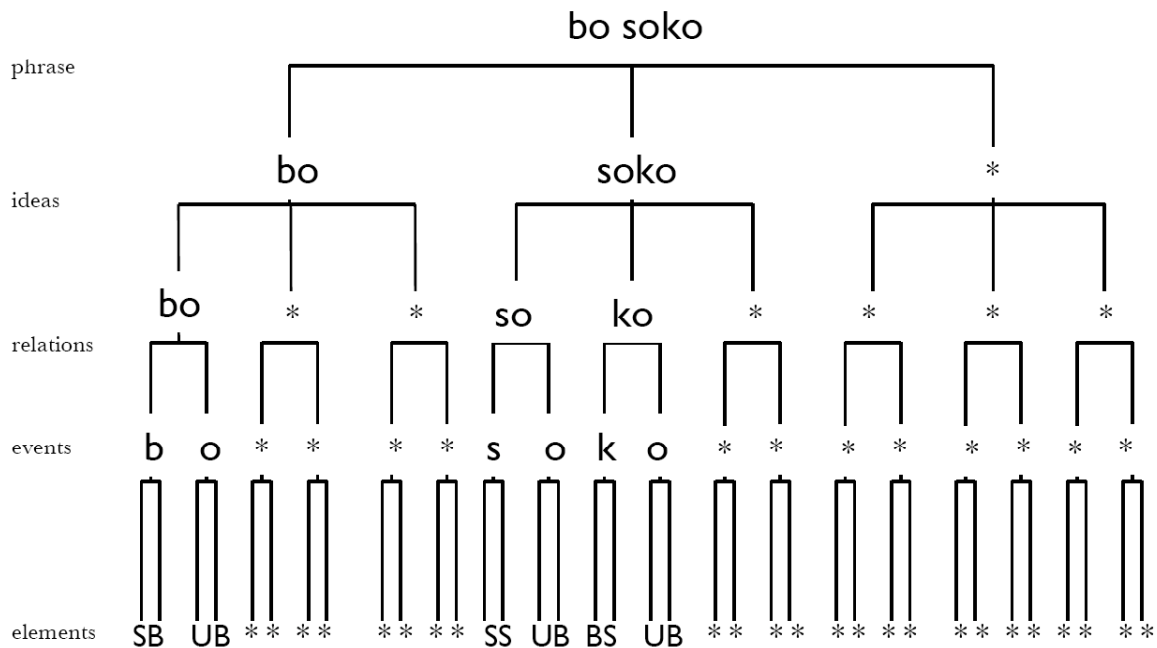
| OO energies | OM energies | MO mutations | MM concepts |
|------------------------------|------------------------|----------------------------|-------------------------|
| U-->U wo reflect | U-->S y know | S-->U j signifier | S-->S s thought |
| U-->A wa act | U-->B o want | S-->A g documentary | S-->B b language |
| A-->U wu perceive | U-->T e can | B-->U h meaning | S-->T t memory |
| A-->A we reconstitute | A-->S u express | B-->A c personal | B-->S k society |
| | A-->B a commit | T-->U p referential | B-->B m affect |
| | A-->T i do | T-->A x material | B-->T n world |
| | | | T-->S d truth |
| | | | T-->B f life |
| | | | T-->T l space |

3) The third level of articulation, the level of *relations*, is formed of 625 (or 25^2) directed pairs of events, or information flows between elements. Here again, all combinations are valid and meaningful, and the meaning of a relation is in principle the result of the meaning of the events of which it is composed.

4) The fourth level of articulation, the level of *ideas*, is formed of simple relations, and by directed pairs or ordered triplets of relations. There are 240 million possible ideas (or $625 + 625^2 + 625^3$). Of these, only slightly more than one thousand have been identified (status as of 01 May 2006). In other words, the - necessarily collective - worksite is open for construction.

5) Finally, the fifth level of articulation, of *phrases*, is formed by simple ideas, or by pairs or even ordered triplets of ideas. The number of possible phrases is astronomical, on the order of 10^{25} . Below is a diagram mapping out the structure of an ieml phrase, using the example *bo soko*, which in ieml means "language of collective intelligence". In this diagram, the stars * mark the *empty roles* within a structure that is exactly the same for all ieml phrases. Each phrase fills this structure to a greater or lesser extent depending on its particular composition.

A phrase in ieml



Thus, the *elements* (1st level), *events* (2nd level), *relations* (3rd level), *ideas* (4th level) and *phrases* (5th level) of ieml are ideograms of five levels of nested complexity, all constructed in a regular and combinatorial fashion.

In order to avoid any confusion with the particular level of ideas, I propose that we call the ideograms in ieml "*glyphs*". The known connotation of the word glyph is for the hieroglyphs used in ancient Egyptian writing (actually, these characters were mixed in nature - part ideogram, part phonetic).

As a general rule:

- All symbols in ieml are composed using symbols from a lower level of articulation, at least up to the simple, or non-compound, symbols, which are the elements.

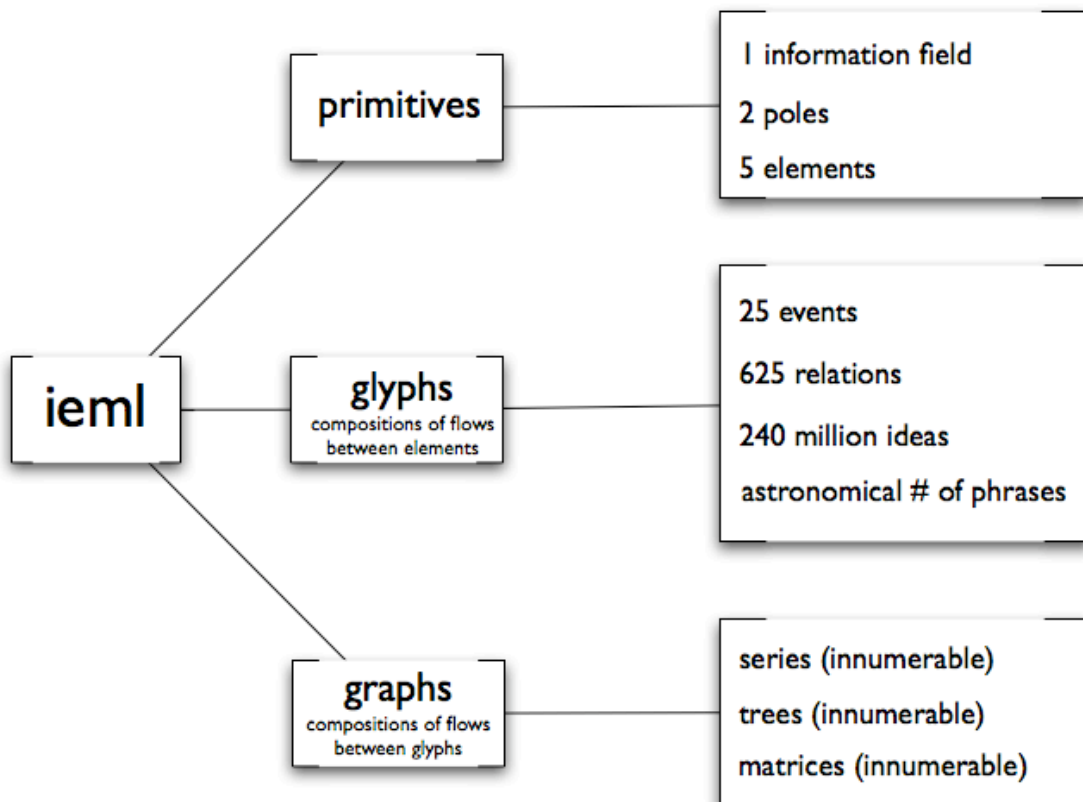
- The *meaning of a combination* of symbols results from the *combination of the meanings* of the combined symbols.

Digital addressing

Each glyph in ieml is permanently associated with a set of numbers that form the specific *digital address* for that glyph. The digital address of the glyphs is formed of *degrees* on *scales*. The principle of scales in ieml is explained in greater detail in the final part of this text, but it is important that I introduce the idea here so that I can justify the claim that ieml allows automatic semantic analysis, and makes semantic

distances calculable. An element, for example, is associated with two degrees, with each of the two degrees marking a position on a different scale. A phrase is associated with a combination of 200 degrees situated on 200 distinct scales distributed over 5 levels. Each scale represents a particular dimension of analysis of the meaning of the glyph.

Primitives, glyphs and graphs



Finally, the glyphs (or ideograms) in ieml can be assembled into “texts” of innumerable quantity, called *graphs*. The graphs in ieml can take three main forms, which can in turn be combined: series (linear orders of glyphs), trees (hierarchical or genealogical orders of glyphs) and matrices (Cartesian orders of glyphs that cross rows and columns). The graphs can serve to describe or index documents and phenomena of all sorts, and to express ideas, theories, classifications, and more.

Dynamic properties

Ieml offers systematic coherence, digital addressing and computational capacities, making it a *dynamic script* with remarkable properties. Of note, ieml graphs can be used as “building blocks” for the modelling and simulation of information economies according to various rules.

- Once certain criteria have been selected and combined, it is simple to automatically generate and re-order complex graphs.
- The “semantic distances” between graphs can be calculated automatically from their digital address according to a large palette of criteria and an indefinite quantity of points of view.
- Each graph or set of graphs can play any of three distinct roles.
 - 1) First, an ieml graph can play the role of the object to be analyzed, of the *text to be read* and interpreted.
 - 2) Next, an ieml graph can play the role of a *reading grid*, a tool for interpretation or analysis. In other words, an ieml graph is capable of displaying data about other graphs, *depending on the cognitive perspective it represents*. The cardinal importance of the fact that each graph can be positioned as a centre of reference, and of control, of the semantic space, reflects one of the foundational principles of this metalanguage: at a given level of composition, no concept is more important than any other, and they all can be considered virtual centres.
 - 3) Finally, an ieml graph can also play the role of *compositional instrument* for other graphs. That is, matrices can serve as keyboards. Ordered lists and trees can serve as dictionaries or classifications that make it possible to select concepts judiciously.

Early intuitions toward ieml.org

Starting in the late 1970s, I began to anticipate that computers would become the medium of intellectual technologies, technologies that would profoundly transform and expand our ways of thinking and communicating. My early background was in philosophy, history and, more generally, in the humanities, which I studied in Paris from 1975 to 1985. I especially felt the influence of the French historical and anthropological schools, just as surely as I was marked by the philosophical excitement bubbling through Paris in the 1970s and 1980s. Still, this did not keep me from quenching my thirst at *other* sources as well (positivist, analytical, Anglo-Saxon, Oriental, etc.). In parallel explorations, I took an interest in the beginnings of computer science and artificial intelligence, as well as the connections between information theory, the cognitive sciences, and biology. I studied the Macy Conferences, read the works of Turing, Shannon, Wiener, von Neumann, McCulloch and von Foerster. I retraced the path blazed by the pioneers of augmented intelligence - Douglas Engelbart, Joseph Licklider,

Theodore Nelson. I was a passionate observer of the birth of personal computing and the Internet. In 1990, three years after the Web went public thanks to the genius of Tim Berners Lee, I published a book entitled *Les Technologies de l'intelligence* (Intelligence Technologies), which analyzed the philosophical and cultural meaning of the convergence of networks of computers with hypertextual networks. My work on the hypothesis of a dynamic ideography, published in 1991 as *Idéographie Dynamique* and the invention, together with Michel Authier, of a computerized system for the visualization of collective dynamics of knowledge (Trees of Knowledge, or *Les Arbres de connaissances*, 1992) bear witness to the fundamental intuitions that would eventually lead to the formation of ieml.

By the late 1980s, I was convinced that, in order to take best advantage of the unprecedented possibilities made available by cyberspace for the manipulation of symbols, we needed an intellectual technology that hypertextually links all possible concepts within a calculable network - yet without granting any particular privilege to any of them. In other words, we needed to extend the form "P2P" (which, although not common knowledge at the time, was nonetheless implicit in the structure of the Internet and hypertexts) to include the relationships between concepts. In order to retain this neutrality and equality of design, the generative motor for the new digitally-based thought instrument could be nothing other than the logical analysis of meaning itself. That way, no concept could be excluded or marginalized. It was an article by François Rastier that put me on the path of the semiotic triad (sign S, being B, thing I) as the possible foundation of the metalanguage to come. My subsequent work on collective intelligence (*L'intelligence Collective*, 1994) and the virtual (*Qu'est-ce que le virtuel?*, 1995) helped me refine my initial hypotheses and add complexity to the semiotic triad, with the pragmatic dyad (virtual U, actual A). Yet it was not until I was awarded a Canada Research Chair at the University of Ottawa that I was able, from 2002 to 2006, to dedicate my full-time efforts to detailed plans and the formation of ieml.

The site www.ieml.org will publish the various successive and augmented versions of the metalanguage. It will also offer open source downloads that make use of ieml, and publish reports and scientific studies on its use. In time, a community of developers and users could organize their efforts, and pool their various suitable means of collaboration (wikis, real-time P2P data-sharing, etc.).

For now, at the time of its inauguration in May 2006, the ieml language exists only as a *core* structure. And while its dictionary does

make it possible, even now, to describe a broad range of ideas and phenomena, it remains limited to a few hundred lexical units. The editing and automatic indexing tools for using the dictionary are in the prototype or planning stages. So, for the time being, ieml remains a scientific research project. Its growth and future success will depend on the commitment and collaboration of many partners: public and private research laboratories, governments, international agencies, and user companies and communities.

In the next section, I will expand on the reasons that led me to design ieml, after which - in the third section of this document - I will describe in greater detail the fundamental structure first outlined in the introduction.

II The purposes of ieml

The problem of the humanities

The first problem that ieml is intended to address is the contemporary state of the humanities and social sciences.

Between the 16th and 20th centuries, the natural sciences acquired a unique and infinite physical space, equipped with a system of universal coordinates and units of measure. The observational instruments in the natural sciences today are very elaborate in their engineering, and undergo constant progress. The language (that is, the set of all symbolic and conceptual instruments), of the natural sciences is highly formalized, logically coherent, and largely shared within the scientific community. The mathematicians have their sets, relations, numbers, and functions. Physicists have their mass, energy, and particles. Chemists have their elements, molecules and reactions. Biologists have their biomolecules, DNA, and their intracellular and intercellular pathways of exchange. The theories may abound and diverge, but the language, just like the system of coordinates and measures, remains common to them all, which enables dialogue, controlled testing and an articulated accumulation of discoveries. In terms of knowledge management, we can say that the natural sciences have been successful in making a significant portion of their knowledge explicit, so that it can be shared and thus offer mutual enrichment.

By contrast, the humanities and social sciences do not share a cultural space that is unique, infinite, coordinated and measurable. The disciplines are fragmented. Within the disciplines, conflicts between paradigms often limit fruitful dialogue. It is sometimes even difficult to agree on the nature of the disagreements. The observational instruments are not well developed in terms of their engineering. Except in certain, highly formalized sub-disciplines, the calculability, predictive capacity, and testability of the theories are weak. The main result of this situation is that the greater part of the considerable knowledge accumulated by the community of researchers in the humanities remains "implicit". That is to say, in terms of knowledge management, that the knowledge and expertise accumulated by the humanities are difficult to share in contexts that differ from the initial environment in which they emerged. And yet, a resolution of the difficult problems confronting contemporary humanity demands the effective collaboration of the cultural sciences.

With ieml, I am proposing that we approach the epistemological problem of the humanities from a symbolic, or linguistic, angle. The hypothesis that underlies the construction of ieml is the following: better management of knowledge in the humanities implies a coordination of the meaningful information (theories and empirical data) by means of a common scientific language. Metalinguistic fragmentation is one of the main obstacles to collaboration in humanities research. It is for this reason that ieml was designed as a *formal script for the notation* of phenomena and ideas from the cultural sciences. In order to usefully fill its role, this scientific script must meet two main constraints. First, it must be capable of distinctly *addressing* an open infinity of “subjects” of discourse *and* of connections between these subjects. Second, it must subserve, to the greatest extent possible, the power *and* the variety of the automatic interpretation of the addresses and their connections.

Only a script that is multiply articulated, and thus intrinsically complex, can respond simultaneously to these two constraints. Given this complexity, it was highly improbable that a metalanguage such as ieml could have been used (or even invented) before electronic calculators had *amplified* the capacity to manipulate and exchange human symbols. Indeed, ieml was designed precisely to put the cyberspace powers of memory, calculation, and communication in the service of the collective intelligence of the scientific community. In a tangible way, ieml was intended to facilitate data crossing, the description, simulation and exchange of models, and the rapid identification of new ideas and observations. But the price to pay for these benefits would be the assimilation of a symbolic formalism. The ultimate perspective of ieml is to become the logical platform for an “intelligent” virtual multimedia library that is cultivated and harvested by the different disciplines and paradigms of the cultural sciences, which are free to develop their own original research programs.

Thus, the ambition of ieml also defines its limit. Specifically, it is not the intention of this metalanguage to describe the phenomena and ideas of the natural sciences, which already have their system of coordinates, units of measure, and elements.

The problem of human development

Closely linked to the first problem (the contemporary state of the humanities and social sciences), the second problem that ieml is intended to address is that of human development.

Today, what we generally understand by “human development” is a continuous, balanced improvement in a population’s conditions of existence, the main indicators of which are:

- education,
- health,
- economic prosperity,
- human rights,
- good democratic governance,
- peace and security,
- the transmission of cultural heritage,
- scientific research in the service of society,
- technical and institutional innovation.

Through the intermediary of its various agencies, the United Nations officially promotes a policy that is geared toward holistic human development, as more desirable than simple economic development. In this vein, even a quick glance at the list of indicators in the preceding paragraph suggests that there are strong causal relationships between the phenomena they measure. Nonetheless, economic figures, epidemiological data, statistics on education, reports on human rights, and the like are generally collected using different methods, depending on separate theoretical and practical approaches, which prevents the causal relationships from being clearly demonstrated. To make this fragmentation even worse, this information is administered and used by *distinct* offices at multiple levels of government. Thus, despite the abundance of data, it is not surprising that it is difficult today to construct coherent, calculable models of human development for the simulation and study of causal circuits in their entirety. By way of comparison, there are standard indicators in the field of economics (gross national product, growth, employment, etc.) that are accepted on an international scale and thus enable *comparisons* across the various measures. By contrast, nothing equivalent exists for human development, which is considered a holistic entity. Worse still, while governments and international agencies officially promote the information society or economy, no systematic set of data clearly expresses the fundamental cycles of this economy, nor the functional relationships between its different factors. There are statistics on the communications and high-tech industries, marketing data on information consumption, and tables of figures reporting the number of persons who have completed primary, secondary, and post-secondary education. Various international organizations, such as the OECD, publish lists of

countries categorized by the number of patents pending or royalties collected. But it is rare to find coherent sets of empirical data that make it possible to test *causal models*, while maintaining a transverse profile across disciplines and departments.

You will recall that, by “information economy”, I am referring to the metastable and evolutionary ecosystem of flows of meaningful data, which is produced, maintained, and transformed within a human population. Since the advent of cyberspace, it has become technically possible to observe this economy. The technical possibility for observation and measurement grows all the more as interhuman communications and transactions adopt the digital network, and as relationships outside the network are increasingly recorded, described, and commented upon in the network. Yet while the existence of the digital network may be a *necessary* condition for the scientific observation of the information economy, it nonetheless is not *sufficient*. This possibility can only be realized by means of a coordinated system of indexing that makes the data commensurable. Such is the function of ieml: to serve as a *semantic system of coordinates* for the information economy.

Ieml is based on the hypothesis that a relationship of interdependence exists between, on the one hand, the human development of a population and, on the other hand, the sustainable growth and qualitative differentiation of its information economy. By enabling the identification, observation, measurement, accounting and modelling of the information economy, ieml can become a powerful instrument in the service of human development.

In developing the ieml language, priority will be given to the translation of, terminologies, ontologies and documentary languages that cover the key domains of human development. This translation will take place in collaboration with experts in these fields. The goal is to decompartmentalize the digital data that is already available, and promote the construction of integrative models.

The following is a list of these interdependent key domains of human development:

1) Knowledge

Research

- Scientific research and development,
- Research management,
- Innovation and innovation management in the economic, administrative, social, and aesthetic fields.

Education

- Transmission of cultural heritage,
- Libraries,
- Museums,
- School and university curricula,
- Continuing education,
- On-line learning support (learning objects),
- Credit for experience-based learning, e-portfolios.

2) Collective values

Governance

- Peace,
- Human rights,
- Democracy,
- Governmental transparency,
- Rule of law, philosophy of law,
- Respect for environmental balance.

Social capital

- Security,
- Trust,
- Social networks,
- Diversity of civil society,
- Intercultural awareness.

3) Power

Economic prosperity

- Basic infrastructures (water, electricity, transportation, communication),
- Access to ownership,
- Encouragement of initiative,
- Production and distribution networks,
- On-line commerce and transactions.

Public health

- Physical and mental health,
- Well-being,
- Access to health services,
- Prevention,
- Health information.

Again I would like to point out that the premise behind the translation of ontologies into ieml is that these different factors of human development are *interdependent* and that, accordingly, they should be piloted in a coordinated fashion. But this coordination can only proceed from a nuanced understanding of their interactional dynamic, which is necessarily different from one environment to another. This need to grasp and subtly define the dynamics of interdependence requires that the data be commensurable, and thus expressed in the same scientific language.

The problem of information architecture

In addition to the problems surrounding the fragmentation of the humanities and the piloting of human development, the third problem that ieml is intended to address involves the information architecture in cyberspace.

Despite the rapid progress made since the 1950s, cyberspace is still in its early stages of growth. In the years to come, photonics, massively distributed informatics, and new multimedia interfaces will multiply even further still the powers for calculation, memory, and communication. Yet today there still is no universal protocol for the *addressing of data according to their meaning*, nor a *semantic system of coordinates* in cyberspace that would make it possible to fully harness the new possibilities offered by the power of the hardware.

In order to understand the nature of the problem surrounding the information architecture, we must begin by taking stock of the new technical conditions of communication. The virtual world of digital data is characterized by three properties that work in combination, each reinforcing the other(s): ubiquity, interconnection and automation.

1) First, every piece of data that is available *somewhere* in the network is virtually available *everywhere* in the network. This is the property of the ubiquity of digitized information.

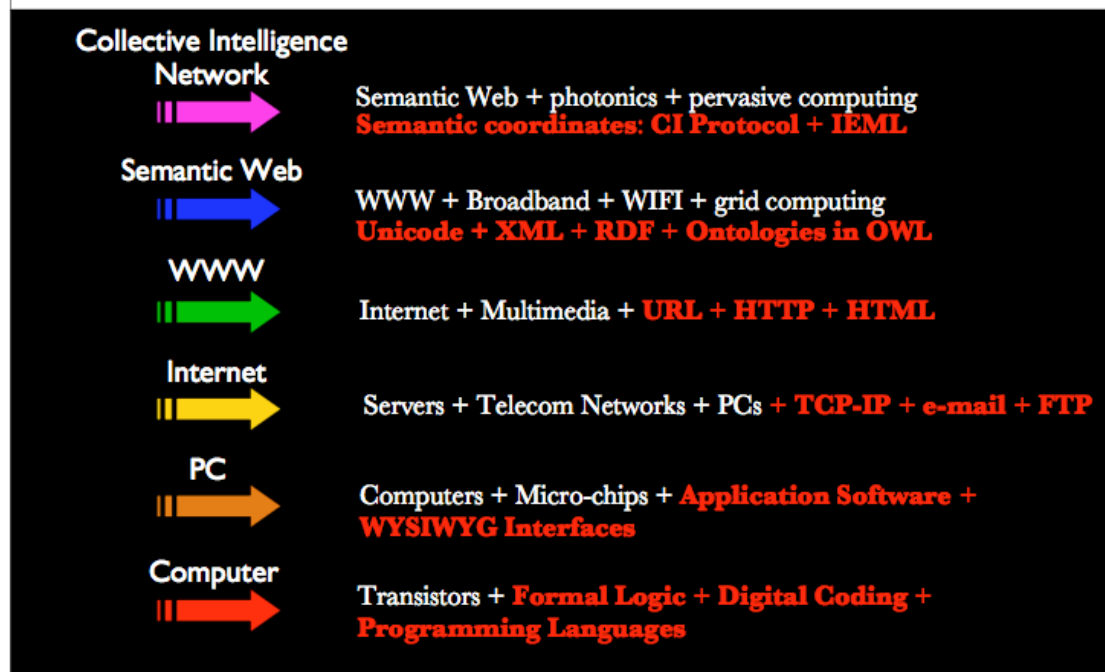
2) Second, whatever their nature (image, sound, text, software, etc.) all digital documents are *interconnected* virtually, whether directly (via hypertext links) or indirectly (through automatic processing by search engines and intelligent agents). Thus, cyberspace is the receptacle for a hypertext metadocument that gathers together all digital documents. This metadocument, which is unique, growing and constantly being reorganized, is produced and used by a multilinguistic, multicultural, and multidisciplinary community whose centres of interest and ideas are indefinitely varied.

3) Third, digital documents can be animated and manipulated by softbots (software robots), which gives them plasticity, interactivity, storagibility and the possibility of dynamic reorganization and, finally, a real (if limited) capacity for *autonomous decision-making* that was unknown before computers.

The problem in information architecture is to maximize the increase in knowledge and collective intelligence that enables the three factors mentioned above. After years of reflection and study, I arrived at the hypothesis according to which, in order to resolve this problem, we have to consider a "semantic space" or an "informational nature" that is interdependent (and, thus, unique) and potentially infinite, both qualitatively and quantitatively (and, thus, multiple), and that is conceptually distinct from the physical or material nature studied by the natural sciences. The coherence of this space, or of this nature of the meaningful information, must be secured by a universal addressing system for digital data (and their relationships) as a function of their pragmatic and semantic *meaning*. A system of symbols (metascript, metalanguage or system of coordinates) that is capable of addressing data by meaning and is designed to take advantage of the ubiquity, interconnection and possibilities for automatic processing offered by cyberspace seems to me to be the indispensable foundation of a digital information architecture worthy of its name. The main reason we don't *already* have such a system of symbols is that we are the *first* generation of human beings confronted with large-scale digital communication.

To set the foundation stone for the digital information architecture, it is by no means necessary to disqualify the software tools currently in use. On the contrary, the history of cyberspace shows that growth and technical complexification in the new communication environment most often occurs through the addition of new layers. Seen this way, ieml is intended simply as a supplementary layer on the rich software foliation that already makes cyberspace.

Successive **Linguistic** Layers in the Evolution of Cyberspace



At the base, we find the fundamental linguistic layer of programmable machines that are capable of manipulating symbols: formal logic, the abstract machines of Turing and von Neumann, digital coding, programming languages. Up until the 1970s, computers were large, rare, costly, run with primitive transistors, and could only be operated by specialists for the purposes of statistics, accounting, and scientific calculations.

In the early 1980s, microprocessors, convivial interfaces for communication with machines, and the multiplication in the number of software applications available on the market gave rise to the second layer of cyberspace, personal computing. Ever since, the computer has become an increasingly powerful and adaptable instrument for information processing, creation and communication, one that can also be used by non-specialists.

Then, from the 1960s to the 1990s, various networks of communication between computers were tested, with the Internet emerging as a federative network, thanks to the TCP-IP communication protocol, which is flexible, free of major constraints, and independent of any proprietary software or hardware. At this stage in the development of cyberspace, electronic mail and file transfer were the most frequently

used services. It was during this period that the first virtual communities began to become prevalent. Still, until the 1990s, the Internet was still reserved for a very small minority of researchers, engineers, and enthusiasts.

The World Wide Web, which appeared in the mid-1990s, was to popularize the Internet, while at the same time multiplying the number and variety of virtual communities. By making it possible to visualize, at a distance, documents located on interconnected servers, and to navigate from one document to another through hypertext links, the Web turned cyberspace into a global, public, multimedia space. In logico-linguistic terms, the WWW is based on:

- URLs (Web page addressing),
- the HTTP standard (management of hypertext links) and
- the HTML language (normalization of page visualization).

The fifth layer of cyberspace, currently under construction, is called the semantic Web. The ambition of the semantic Web is to form a sort of operating system for exploiting Web data in the service of search engines and "intelligent agents". The main symbolic tools of this new layer are:

- XML (*eXtended Mark-up Language*), which is derived from Charles Goldfarb's SGML language; it can be used to universally describe the structure of data,
- RDF (*Resource Description Framework*) which can be used to catalogue data from the Web,
- OWL (*Ontology Web Language*), which can be used to describe "ontologies", in other words the *conceptual* structure of the various knowledge domains.

The main function of this descriptive and marking apparatus is to promote the automation of data search processes and the execution of operations that are entrusted to intelligent agents or softbots. The development of the semantic Web is contemporaneous with: the generalization of wireless communication; with an explosion in tools for on-line editing and collaboration (blogs, wikis, P2P instruments for file sharing and information exchange); with the increasing power of multi-user games in virtual universes; and with the development of large-scale knowledge management within administrations and businesses.

Yet for all this, certain difficulties remain. Today, for example, if we wish to enter the topic of a document into a search engine, we have to use the title of the document, or a set of keywords, or certain "metadata", including RDF. All of this information is necessarily written in

a particular natural language, with the result that various documents on the same topic - but in different languages - will be indexed differently. Contemporary search engines compare *chains of characters*, not concepts! Even if an agreement were reached with regard to synonyms and correspondences between languages, words in natural language form do *not* automatically allow the relationships between concepts to be calculated.

To calculate the relationships between concepts, computers need to be equipped with "ontologies", which are semantic networks (or thesauri, or taxonomies) that formalize the conceptual structure of knowledge domains. Unfortunately, as computer technology currently stands, these calculations are only possible *within* an ontology. But there are *thousands* of different ontologies.

Even though they have to address urgent, far-reaching needs, information management and information architecture still have not yet passed the stage of a collection of tools and empirical recipes. As a result of this theoretical weakness, the digital universe remains semantically fragmented despite its technical interconnection. This means that the available data cannot be fully exploited.

To escape from this labyrinth, I am suggesting that a sixth layer, based on ieml, be constructed above the semantic Web. Ieml proposes a semantic system of coordinates that is independent of natural languages, capable of addressing an infinity of different subjects and suited to serve as a basis for calculating the relationships between concepts. Ieml was designed to translate each of the most diverse ontologies into the other(s), and to interconnect divergent disciplines and points of view *within the same addressing system*.

The ieml language uses XML and translates ontologies. Thus, it is not in competition with the semantic Web on which it rests, at least not in technical terms. It is the ambition of ieml to *resolve problems* of communication between ontologies and of compatibility between local information architectures, issues that the semantic Web was able to raise but not answer address its current level.

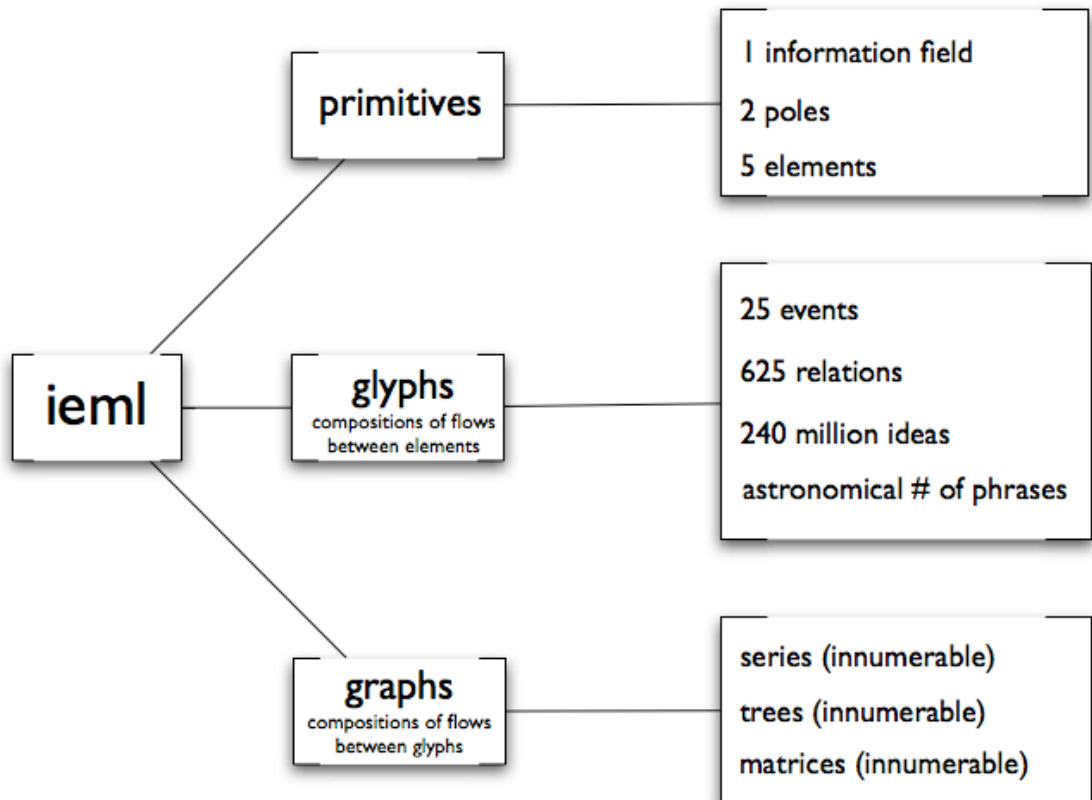
In sum, then, the ieml language, with the collective intelligence protocol (CIP) that organizes its digital addressing, is intended to form a *new software level in cyberspace*, opening the way to a renewal of cognitive computing (semantic and pragmatic calculations) as well as to new uses of the Internet that are geared toward the development of collective intelligence, the distributed piloting of the information

economy and the self-organizing governance of a human development that is (itself) multifactorial and interdependent.

III The structure of ieml

Overview

Structural diagram of ieml:



Levels of composition

In ieml, all expressions are composed of five elements (virtual U, actual A, sign S, being B, thing T) located at two primitive poles, or sets of elements: pragmatic O and semantic M.

Within the metalanguage are the *glyphs*, a fixed number of “ideograms”. They are constructed on the basis of successive, nested levels of composition. The 25 events combine the 5 elements in pairs of two. The 625 relations combine the 25 events in pairs of two. The millions of ideas associate one, two or three relations. Finally, an astronomical number of phrases associates one, two or three ideas.

The *graphs* are “texts” composed of glyphs. For reasons of clarity and mathematical convenience, graphs can only be structured according to three types of figures: series (linear orders), trees (hierarchical or genealogical orders) and matrices (dialectic coordination in columns and rows). There is an innumerable quantity of possible ieml graphs.

Flows

The glyphs and graphs in ieml are constructed as *information flows* - at various levels of complexity - between primitive poles or elements. A flow is a directed relation (an arrow) that departs from a *source* (origin of the flow) and heads toward a *destination* (target of the flow): "source → destination". In certain cases, the flow can also mobilize a third role, that of *translator*, which qualifies or modifies the link between the source and the destination: "source → destination / translator". The term flow is a convention. I could just as well have named this directed relation "arrow" or "unidirectional link". The term flow is intended to evoke the fluid and dynamic character of the information, which is understood as the propagation of difference.

The polarity between the pragmatic and the semantic is found at every compositional level in ieml. This polarity is governed by the rule according to which *a flow inherits the polarity of its source*.

Alphabetical code

In order to facilitate computer keyboard entry and computer processing, ieml expressions are written using the *Latin alphabet without accents*.

As a general rule, *primitives* are represented as *capital* letters, while *events* (first level of composition using primitives) are represented as *lower-case* letters. For primitives and events alike, *pragmatic* terms are expressed as *vowels* and *semantic* terms are expressed as *consonants*.

Digital addressing protocol, alphabetical order, distances

The numbers that make up the *digital addressing* of ieml glyphs (the collective intelligence protocol or CIP) are *degrees* on *scales*.

The two primitive scales are:

- a two-degree *dialectic* scale (1st degree for the pragmatic pole O and the 2nd degree for the semantic pole M),
- a *substantiality* scale attached to the elements (1st degree for the virtual U, 2nd for the actual A, 3rd for the sign S, 4th for the being B, and 5th for the thing T) .

As for the rest of the ieml language, the scales associated with the higher levels of composition are derived from the primitive scales.

Five basic types of scales arise from the primitive scales.

- The *dialectic* scales result from the successive compositions of the primitive dialectic scale.

- The scales for the *source*, *destination* and *translators* of the successive levels of flow result from the substantiality scales for the elements.

- The *substantiality* scales for the flows (or of the categories of flow) result from the *sum* of the degrees of the source, destination and translator scales.

Given that the role of degrees on the scales in ieml is to arrange or organize flows and categories of flow, it is less their absolute values than their *differential ratios* that are important. As a general rule, the distance between two flows of the same level of composition on a given scale is equal to the absolute value of the difference in degrees.

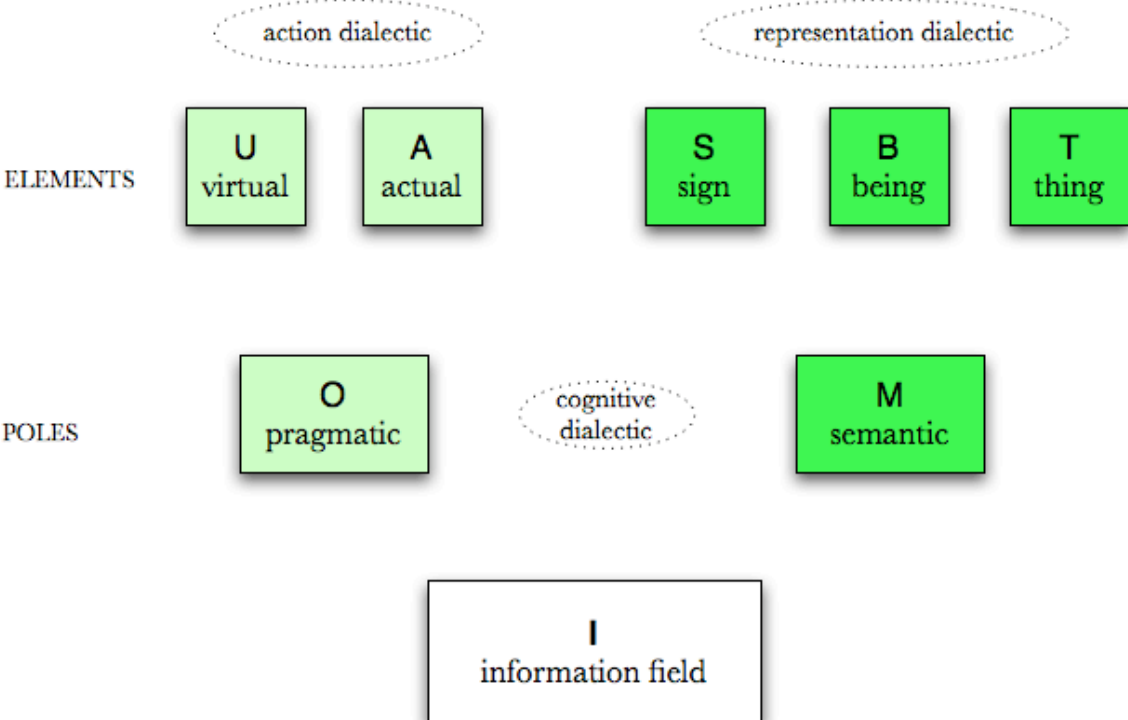
Starting from the five basic types of scales (dialectic, substantiality, source, destination, translator), it is possible to compose more complex scales.

Primitives

Cognitive dialectic

Now I will describe in detail the primitives from which all the rest of the language is logically composed.

IEML PRIMITIVES



The meaningful information unfurls its complex circuits of propagations of differences in an environment, or medium, of cognition that is called *the informational field* in ieml.

The fundamental polarity that affects the informational field, the peaks and troughs of its waves, if you will, opposes the directions of *semantic* M and *pragmatic* Q. This distinction and this interdependence between a pole of *representation* and a pole of *action* characterizes the *cognitive dialectic* of ieml. We can see that this tension between the pragmatic and the semantic is reflected in the structure of *all* natural languages, in the grammatical distinction between *nouns* and *verbs*. The opposition and interdependence of nouns and verbs was raised by Plato in *The Sophist* and persists today in the verbal and nominal clauses of Chomsky's universal grammar. In terms of cognitive grammar (Langacker), we are looking at the distinction between and inseparability of *processes* and *entities*.

Pragmatic dialectic

The pragmatic pole Q contains two elements which are in turn opposite and interdependent: the *virtual* U and the *actual* A.

The virtual covers the universe of possibilities, things to come, potentials, competencies, problems, universals, classes and general types that are intangible. The virtual element is characterized by an absence of spatio-temporal coordinates.

The actual occurs in time in space. These are singular individuals. original events, born forms, solutions to problems, exemplars of the universal, phenomena and data that are sensitive.

The dialectic of action organizes an exchange of information, a circulation of differences between the virtual and the actual: each actualization transforms the virtual and each transformation of the virtual engenders a new actuality.

This dialectic of the *virtual* U and the *actual* A is found in numerous philosophical and cultural traditions: the heavens and earth of the earliest philosophies, the transcendence and immanence of theologies, the yin and yang of Taoism, the intelligible and sensible of Platonism, Kant's noumenal and phenomenal, the void and phenomena of Mahayana Buddhism, etc.

Semantic dialectic

The semantic pole M includes three elements that together maintain the dialectic of symbolic representation: the *sign* S, the *being* B and the *thing* I.

The *sign* corresponds to the signifier in linguistics. It is a symbolic instrument whose primary operation is to point toward the referents of human discourse. Signs are the sounds of the word, the characters of the writing, gestures and signs, images and signals of all kinds, generally symbols that can be interpreted. "The finger points to the moon. The idiot looks at the finger", as the Zen proverb says. In this example, the finger represents the signifier (in other words, the *sign*) S, while the moon is the referent (in other words, the *thing*) I.

Now, except in the case of proper nouns that designate singular realities, it is impossible to link a signifier to a singular reference of speech, without first passing through an intermediary concept associated with the sign: the signified. In turn, the signified can only signify *for an interpretant*. This signified, which is indissociable from its subjective interpretant, is called *being* in the ieml language. The *being* accomplishes the cognitive movement that passes from the finger (the *sign*) to the moon (the *thing*).

The *semantic elements* of ieml (*sign* S, *being* B and *thing* I) are the three distinct and interdependent factors of representation. But attention here: they are distinguished by their function and not by their intrinsic nature. Depending on the various cognitive perspectives, a person, for example, can play the role of *sign* (the signifier of the discourse), or *being* (the interpretant of the discourse) or *thing* (the object of the discourse).

The semantic dialectic of the sign, the being and the thing were called *vox*, *conceptus* and *res* in the medieval university. In the philosophy of CS Peirce, these are translated as sign (or *representamen*) interpretant and object. Their variants in modern linguistics are the signifier, signified and referent. This semantic dialectic is found in logic (propositions, judgments, states of thing), in economics (price, ownership, utility), and in theology (teachings, community, ultimate reality). This ternary dialectic can even be detected in the *trivium* of the liberal arts in antiquity and the Western Middle Ages: *grammar* develops mastery of the language (the wielding of signs), *dialectic* offers an introduction to rational dialogue (between beings), *rhetoric* is concerned with the practical construction of discourse with a view to its memorization and real effects (in things).

Thus, the primitives of ieml - a language for the addressing of digital data according to their meaning - are, not surprisingly, the very structures of meaning. These structures have been described by ancient and numerous traditions belonging to various cultures and disciplines. I

merely saw fit to gather them together up and draw connections between them.

Digital addressing of primitives

| | | | | dialectic scale | substantiality scale |
|--------------------------------------|-----------------------|---------|----------|-----------------|----------------------|
| E L E M E N T S | O pragmatic set | virtual | U | 1° | 1° |
| | | actual | A | 1° | 2° |
| | M semantic set | sign | S | 2° | 3° |
| | | being | B | 2° | 4° |
| | | thing | T | 2° | 5° |

Dialectic scale

The fundamental cognitive dialectic between the poles O (pragmatic dialectic) and M (semantic dialectic) forms the basis of the *dialectic scale* in ieml.

At the level of the primitives, this scale has only two degrees: one for the pragmatic pole and the second for the semantic pole.

At the higher levels of articulation, the dialectic scale expresses the composing polarity (polarity of sources, destinations and translators) and the composed polarity (semantic or pragmatic result) of the flow.

Substantiality scale

The five elements of ieml: *virtual*, *actual*, *sign*, *being* and *thing* are arranged on a scale that goes from the least substantial to the most substantial, or from the most subtle to the least subtle.

It is important first to note that the processes or verbs (pragmatic pole O) are by definition less "substantial" than the entities or nouns (semantic pole M). At the very core of the pragmatic pole, the virtual clearly is less substantial than the actual. Within the semantic pole, the sign is less substantial than the thing and the being is located in an intermediary position.

Difference between the dialectic scale and the substantiality scale

The dialectic scale of the poles is rather “discontinuous”; it organizes a system of controlled swinging between poles, while the substantiality scale of the elements is rather “continuous”, functioning in an additive manner. As we shall see, the substantiality scale controls the scales of source, destination and translator. These two primitive scales - dialectic and substantial - form the basis of the digital addressing system in ieml, which is called the *collective intelligence protocol* or CIP. The CIP makes it possible to measure the cognitive positions and distances between the combinations of elements of which the glyphs are formed (ideographic characters in ieml).

Events

The first level of composition starting from the primitives combines all the possible directed flows between elements, each of them alternatively playing the role of source or destination. These first 25 flows are called *events*.

Event types

The events are arranged into four categories of flow, or “polar flows” depending on whether their sources and destinations belong to one or the other of the two primitive poles: $O \rightarrow O$, $O \rightarrow M$, $M \rightarrow O$, $M \rightarrow M$. To simplify the notation, the convention is used that the flow always proceeds from left to right, giving OO, OM, MO and MM.

OO Energies

The event type OO, “energies” assembles the four interdependent moments of the fundamental cycle of action: 1) *reflection* or cogitation, 2) *action* after reflection, 3) the *reconstitution* or transformation of the environment as a result of the action, and 4) the *perception* of the transformed environment, which leads to a new reflection, and so on.

| | |
|--|--|
| OO event type energies | |
| $U \rightarrow U$ wo reflect | $U \rightarrow A$ wa act |
| $A \rightarrow U$ wu perceive | $A \rightarrow A$ we reconstitute |

The four energies in ieml are represented by *long vowels* (o, a, u, e preceded by w). Although there are 10 pragmatic events (verbs) in ieml, there are only 5 or 7 (if we count y and w) vowels in the Latin alphabet. It would have been possible to use accents to increase the number of distinct vowels, but this solution would only have complicated matters, given the diversity of keyboards used in different countries and languages. For this reason, I adopted the solution of using a two-lettered long vowels, with "w" being used for no other purpose than this.

wo Reflect U→U

Here, information moves from the virtual U toward the virtual U (from the mind toward the mind). This evokes the *reflective energy* of cognition.

wa Act U→A

This informational flow runs from U (thought, intention) toward the actual A (equipped with spatio-temporal coordinates). In other words, it incarnates the *energy of action*.

wu Perceive A→U

In symmetry to the wa of action, this information flow proceeds from the actual A toward the virtual U, carrying the *energy of perception*.

we Reconstitute A→A

Here, information moves from the actual A toward the actual A. This evokes the *reconstitution of the environment* that closes the causal chain between past action and future perception.

Note on the significance of flows.

Clearly, the attribution of signifieds in natural language to the flows of information between elements in ieml is a matter of *convention*. In other words, other choices and other directions of interpretation would have been possible. As will be clear from browsing the dictionary, this conventional character becomes all the more marked as we move farther away from the primitives and rise up through the levels of composition. Often, it will be difficult to deduce the meaning of a flow by looking only at its components. To understand the attribution of a given meaning to an expression in ieml, *it will be necessary to take into account the general coherence of the flow matrix - the "table" - from which this expression arose*. And yet, "conventional" doesn't necessarily mean "entirely arbitrary". Indeed, the interpretations must respect the constraints of parsimony (avoid redundancy and the needless multiplication of concepts), coherence with the initial choices, general systematicity, and correspondence with the digital addressing. In all, even though it cannot automatically be deduced from their composition, the meaning of ieml expressions belongs to the category of *reasoned, systematic conventions*.

OM Acts

| OM event type acts | | |
|------------------------------|-----------------------------|--------------------------|
| U → S y know | U → B o want | U → T e can |
| A → S u express | A → B a commit | A → T l do |

The O→M *acts* unite the six elementary flows that take their *source* in the pragmatic dialectic (O = U, A) and their *destination* in the semantic dialectic (M = S, B, T). With a virtual source, the three semantic destinations produce the main modalities: know, want, can. With an actual source, the three semantic destinations produce the semiotic, social, and material worlds: enunciate, commit, make.

y Know U→S

Here, the modal verb “know” corresponds to the production of a representation S that is virtual U.

o Want U→B

The virtual production U of being B (the subject, the interpretant, the signified) corresponds to the modal verb *want*.

e Can U→T

The virtual production U of the thing T, or capacity, corresponds to the modal verb *can* (or: to be able).

u Express A→S

The actual production A of signs or messages S corresponds to the act of *enunciation*.

a Commit A→B

The actual auto-production A of social beings B corresponds to the act of *commitment*.

i Do A→T

The actual production A of real things T corresponds to the act of *doing*.

MO Mutations

| MO event type mutations | | |
|---|---|--|
| S → U j mutation of signifier | B → U h mutation of meaning | T → U p mutation of referent |
| S → A g documentary mutation | B → A c personal mutation | T → A x material mutation |

The *source* of the M→O mutations are the three semantic elements (M = S, B, T), and the two pragmatic elements are their *destination* (O = U, A). Because their source is semantic, the mutations are nouns. And yet, because their destination is pragmatic, these are nouns of process or transformation. Their source determines the semantic nature of the mutations (mutation of signs, interpretants, or objects), while their destination specifies their virtual or actual character.

j Mutation of signifier S→U

The information flow from the sign element toward the virtual element indicates a transformation of the *language*, a mutation of the signifying form.

g Documentary mutation S→A

The information flow from the sign element toward the actual element indicates a transformation of the *message*, a mutation of the materiality of the document.

h Mutation of meaning B→U

The information flow from the being element toward the virtual element indicates a change in the *signified*, a mutation of meaning.

c Personal mutation B→A

The information flow from the being element toward the actual element indicates a transformation of the *person* of the interpretant or of the human interpretant community.

p Mutation of referent T→U

The information flow from the thing element toward the virtual element indicates a transformation of the referent, in other words a mutation of the *object* of the discourse or of the action.

x Material mutation T→A

The information flow from the thing element toward the actual element indicates a *transformation of the physical universe*, a material mutation.

MM Concepts

| MM event type concepts | | |
|--|---|---|
| $S \rightarrow S$ s thought | $S \rightarrow B$ b language | $S \rightarrow T$ t memory |
| $B \rightarrow S$ k society | $B \rightarrow B$ m affect | $B \rightarrow T$ n world |
| $T \rightarrow S$ d truth | $T \rightarrow B$ f life | $T \rightarrow T$ l space |

The $M \rightarrow M$ *concepts* have as their source *and* destination the three semantic elements ($M = S, B, T$). Because their source is semantic, the nine concepts of ieml are nouns, and because their destination is also semantic, the nouns are reified or substantivized *entities*. Those concepts whose source is the sign element S inscribe a signifying quality in each of their three destinations (*thought* in the sign, *language* in the being, and *memory* in the thing). Those concepts whose source is the being element B imply a subjective and interpretant quality within their destination (*society* in the sign, *affect* in the being, and *world* in the thing). Finally, those concepts whose source is the thing element T infuse an objective and referential quality at the heart of their destination (in the sign for *truth*, in the being for *life*, and in the thing for *space*).

s Thought $S \rightarrow S$

Information flows between signs beget signs in the process of *thought*: deduction, induction, interpretation, imagination, etc.

b Language $S \rightarrow B$

A combination of signs \underline{S} emits an information flow in the direction of a being \underline{B} (interpretant of language). Any phenomenon can take the role of a sign and thus function as a *signifying message*. Here, language is the connection of the being to the signs that it receives.

t Memory S→T

The information flow from the sign toward the thing manifests the elementary gesture of *inscription* without which memory, and thus any notion of time, is inconceivable.

k Society B→S

The information flow goes from the being toward the sign that implies that being. We commit ourselves to promises and contracts. We obey the law. The members of a clan have the same totemic animal as ancestor. We fight for the same flag. We exchange economic goods by agreeing upon their value. Our obligations and conventions tie us to shared symbols: in this way, we form *society*.

m Affect B→B

Desire, love, hatred, indifference, compassion, equanimity are *affects* that circulate between beings. Emotions and sentiments, whatever their quality, constitute the bonds of human relationships.

n World B→T

Human beings inform their physical environment. They *inhabit* it, they *work* there with tools, they *name* objects and attribute a *value* to them. There are as many figures of information flow from the being to the thing, creating an ordered *world*, or cosmos.

d Truth T→S

A discursive message is true if it contains a correct description of a state of things. Truth indicates that the sign effectively received the information from the thing.

f Life T→B

The information flow from the thing toward the being evokes the physical incarnation, or the body, of the living beings. Eating and drinking are among the most obvious modes by which information is transferred from the thing to the being. By acquiring and maintaining physico-biological qualities, a subjective interpretant can exist and act in the world.

I Space T→T

An information flow between things, physical space is constructed of relations and proximities. The reciprocal envelopment of things creates the topological space. Space emerges from operations of folding and unfolding, connection and disconnection, limitation and extension.

Ecumenical note on the nine concepts in ieml

The nine concepts in ieml were chosen in order to resonate with the major philosophical choices that build on them.

- The Western idealist tradition (Plato, Hegel, etc.) - like a large part of the major (meditational) philosophies of India - start from the concept of thought(s).

- The philosophy of language and communication specializes in an approach founded on the word, the script, and the media. Wittgenstein made his entire philosophy revolve around the problem of the limits of language (b).

- Bergson (the author of *Matter and Memory*) and with him the evolutionists, or the philosophies of impermanence and *karma* (such as Buddhism) underscore the passage of time and its inscription. Likewise, the grand universal religious traditions are based on *sacred writings* that fall within the archetype of inscription (t).

- Rousseau, Comte, Marx, Durkheim, Mauss, and Weber, like sociology in general, highlight the essential symbolic function that consists of *forming society* (k).

- After the poets, the pious, and the actors, Freud, psychoanalysis and a large part of clinical psychology have insisted on the importance of the "affect" and the emotional functions (m).

- Nietzsche (who accorded a central role to the creation of values), and all anthropological thought, primarily base their approach on the concept of "world", or the organized cosmos (n).

- The empirical, phenomenological, and biological traditions base their ontological point of view on the living body and its functions (f).

- The logical tradition and analytical philosophy are primarily interested in the concept of "truth" and in problems tied to reference. Epistemology and the cognitive sciences place at foundation of their approach the construction of true knowledge (d).

- Geometers, topologists, atomists, materialists and physicists base their concepts on space (l).

For the *meta*-language of ieml (which is neither a philosophy nor a particular ontology), each philosophy appears as the partial exploration of an integral semantic or cognitive space that accommodates them all. A given philosophy represents an “ontological point of view” that is equally as valid as any other.

Table of ieml events

| | →U | →A | →S | →B | →T |
|----|-------------------------------|------------------------------|--------------|---------------|-------------|
| U→ | wo reflect | wa act | y know | o want | e can |
| A→ | wu perceive | we reconstitute | u express | a commit | i do |
| S→ | j mutation of signifier | g documentary mutation | s thought | b language | t memory |
| B→ | h mutation of meaning | c personal mutation | k society | m affect | n world |
| T→ | p mutation of referent | x material mutation | d truth | f life | l space |

Digital addressing of events

As we have just seen, the 25 events organize the *first* level of composition of the flows between elements. The 25 events are organized around two poles (pragmatic verbs and semantic nouns) and four types that correspond to the four possible flows between the poles: energies, acts, mutations and concepts.

The table here below shows the events organized by category, with the corresponding digital addresses (degrees on scales).

| | poles | types | | dialectic scale | substantiality scale | source scale | destination scale |
|----------|----------------------|--------------|-----------|-----------------|----------------------|--------------|-------------------|
| EVENTS | O ₁ verbs | O | U, A | 1° | 1°, 2° | 1°, 2° | 0° |
| | | OO energies | wo | 2° | 2° | 1° | 1° |
| | | | wa | 2° | 3° | 1° | 2° |
| | | | wu | 2° | 3° | 2° | 1° |
| | | | we | 2° | 4° | 2° | 2° |
| | | OM acts | y | 3° | 4° | 1° | 3° |
| | | | o | 3° | 5° | 1° | 4° |
| | | | e | 3° | 6° | 1° | 5° |
| | | | u | 3° | 5° | 2° | 3° |
| | | | a | 3° | 6° | 2° | 4° |
| | i | | 3° | 7° | 2° | 5° | |
| | M ₁ nouns | M | S, B, T | 4° | 3°, 4°, 5° | 3°, 4°, 5° | 0° |
| | | MO mutations | j | 5° | 4° | 3° | 1° |
| | | | g | 5° | 5° | 3° | 2° |
| | | | h | 5° | 5° | 4° | 1° |
| | | | c | 5° | 6° | 4° | 2° |
| | | | p | 5° | 6° | 5° | 1° |
| | | | x | 5° | 7° | 5° | 2° |
| | | MM concepts | s | 6° | 6° | 3° | 3° |
| | | | b | 6° | 7° | 3° | 4° |
| t | | | 6° | 8° | 3° | 5° | |
| k | | | 6° | 7° | 4° | 3° | |
| m | | | 6° | 8° | 4° | 4° | |
| n | | | 6° | 9° | 4° | 5° | |
| d | | | 6° | 8° | 5° | 3° | |
| f | 6° | | 9° | 5° | 4° | | |
| l | 6° | 10° | 5° | 5° | | | |

Source and destination scales

The *source* and *destination* degrees for an event correspond *exactly* to the degrees of substantiality of the elements of which the event is composed.

Substantiality scale

The *substantiality* degree for an event results from the *sum* of its source and destination degrees.

Dialectic scale

Recall that the dialectic scale expresses the composing polarity (polarity of sources, destinations, and translators) and the composed polarity (semantic or pragmatic pole) of a flow.

Reflecting the primitive dialectic scale, the dialectic degree of a *pragmatic* event is always lower than the dialectic degree of a *semantic* event.

Note also that, in ieml grammar, the *elements* can be considered *events of zero destination*. Accordingly, there are two levels of complexity of events, depending on whether they include *one* or *two* full roles. The flow is *less* complex if it involves *only one* full role, and *more* complex if it involves *two*. For the same polarity, the dialectic degree rises with the complexity of the flow.

For the same polarity *and* for an identical degree of complexity, flows that have a pragmatic *destination* have a lower degree on the dialectic scale than flows with a semantic *destination*.

Relations

Categories of relations

The two-by-two combination (source → destination) of the 25 first flows gives 625 combinations at the second level of articulation; these are called *relations*. Details about relations can be found in the dictionary at www.ieml.org.

These relations are organized into two poles: pragmatic relations (which have verbs as their source) and semantic relations (which have nouns as their source). The two poles are in turn subdivided into four types, as a function of the polarity of their *destination*. At the last grammatical subdivision, relations are grouped into 16 *cycles*, according to the two-by-two combinations of the four types of events. The 16 cycles function as *matrices* of relations. For a given cycle, the source-events of its relations are drawn from a single given type of event, and

the destination-events of its relations are also drawn from a single given type of event.

The table below shows the categories of relations, with the corresponding digital addresses.

Digital addressing of categories of relations

| | | poles | types | cycles | dialectic scale | substantiality scale | source scale | destination scale |
|-------------------------|------|----------------------------|-------|-----------|-----------------|----------------------|--------------|-------------------|
| CATEGORIES OF RELATIONS | O2 | O1 | | O, OO, OM | 1° | 0°,1°,2° | 0°,1°,2° | 0° |
| | | O1O1 verb to verb | | OOOO | 2° | 2° | 1° | 1° |
| | | | | OOOM | 2° | 3° | 1° | 2° |
| | | | | OMOO | 2° | 3° | 2° | 1° |
| | | | | OMOM | 2° | 4° | 2° | 2° |
| | | O1M1 verb to noun | | OOMO | 3° | 4° | 1° | 3° |
| | | | | OOMM | 3° | 5° | 1° | 4° |
| | | | | OMMO | 3° | 5° | 2° | 3° |
| | | | OMMM | 3° | 6° | 2° | 4° | |
| | M2 | M1 | | M, MO, MM | 4° | 0°,3°,4° | 0°,3°,4° | 0° |
| | | M1O1 noun to verb | | MOOO | 5° | 4° | 3° | 1° |
| | | | | MOOM | 5° | 5° | 3° | 2° |
| | | | | MMOO | 5° | 5° | 4° | 1° |
| | | | | MMOM | 5° | 6° | 4° | 2° |
| | | M1M1 noun to noun | | MOMO | 6° | 6° | 3° | 3° |
| | | | | MOMM | 6° | 7° | 3° | 4° |
| | | | MMMO | 6° | 7° | 4° | 3° | |
| | MMMM | | 6° | 8° | 4° | 4° | | |

Above the level of composition of the event, the scales of source, destination, translator, and substantiality no longer measure flows, but rather *categories of flow*.

Source and destination scales

At the level of *categories (cycles) of relations*, the source and destination scales describe the *types of events* of which they are composed:

- Energies OO = 1°,
- Acts OM = 2°,
- Mutations MO = 3°,
- Concepts MM = 4°

Here, the degree value attributed to a *type of event* results quite simply from the sum of the dialectic degrees of the primitive poles that compose it.

Substantiality scale

For the categories of relations, the degrees of the substantiality scale result from the *sum* of the corresponding source and destination degrees.

Dialectic scale

By uniformly following the rule that has applied since the beginning, the dialectic degree of a category of relation that is *pragmatic* (O₂) is always lower than the dialectic degree of a category of relation that is *semantic* (M₂).

Note that, in ieml grammar, *events* can be considered *relations of zero destination*. A relation with two full roles is considered to be more complex than a relation with a single full role. As in the preceding case of events, for the same polarity the dialectic degree rises with the complexity of the category of relation.

Finally, for the same polarity and for an identical degree of complexity, those categories of relation that have a pragmatic *destination* have a lower degree on the dialectic scale than categories of relation with a semantic *destination*.

Ideas

Categories of ideas

The solitary use (source), the two-by-two combination (source → destination), and the combination of threes (source → destination / translator) of the 625 relations gives on the order of 240 million possible ideas.

As for the other levels of composition, the ideas are pragmatic (O₃) or semantic (M₃), depending on the polarity of their source.

- Ideas made of a single relation are called *simple ideas*. Thus, the 625 relations (655 if we count the elements and events that are relations of zero destination) are also (simple) ideas according to the grammar of ieml.

- Ideas made of two relations are called *root ideas*. Just as relations were organized into matrices called "cycles", ideas are organized into matrices called "paradigms". The paradigms of root ideas combine two cycles of relations. For a given paradigm, the source-relations of its ideas are drawn from a single source-cycle and the destination-relations of its ideas are drawn from a single destination-cycle.

- Roots accompanied by a translator are called *inflected (or declined) ideas*. Thus, when they are in the position of translator, relations function as *inflections, cases* or *declinations* that modify the meaning of the root idea. The paradigms of inflected ideas combine *three* cycles of relations (source-cycle, destination-cycle and translator-cycle). Numerous examples of this **interaction** of the **third** relations can be found, **as declinations of the root ideas, by consulting the paradigms of ideas found in the dictionary**. Here are a few examples:

- the paradigms of *organized knowledge* as declinations of the paradigms of *objects of knowledge*,
- the paradigm of *competencies* as declination of the paradigm of *accomplishments*,
- the paradigm of *social actors* as declination of the paradigm of *social functions*, etc.

Although the millions of ideas possible in ieml can be **automatically generated** in a **combinatorial fashion**, the dictionary only includes those ideas that have indeed been described in natural language to date. These ideas have been carefully selected for their capacity to index the major organizing dimensions and the principal agents of the information economy, while reflecting the greatest possible variety of paradigmatic and theoretical points of view. The available ideas (including the simple ideas that are the relations) provide a basis that makes it possible henceforth to compose a large number of more complex ideas.

Below we see a table of the categories of ideas, with the corresponding digital addresses.

Digital addressing of categories of ideas

| | poles | grammatical classes | categories of paradigms | dialectic scale | substantiality scale | source scale | destination scale | translator scale |
|---------------------|----------------|---------------------|---|-----------------|----------------------|--------------|-------------------|------------------|
| CATEGORIES OF IDEAS | O ₃ | simple | O ₂ | 1° | 1° | 1° | 0° | 0° |
| | | root | O ₂ O ₂ | 2° | 2° | 1° | 1° | 0° |
| | | | O ₂ M ₂ | 3° | 3° | 1° | 2° | 0° |
| | | inflected | O ₂ O ₂ -O ₂ | 4° | 3° | 1° | 1° | 1° |
| | | | O ₂ O ₂ -M ₂ | 5° | 4° | 1° | 2° | 1° |
| | | | O ₂ M ₂ -O ₂ | 6° | 4° | 1° | 1° | 2° |
| | | | O ₂ M ₂ -M ₂ | 7° | 5° | 1° | 2° | 2° |
| | M ₃ | simple | M ₂ | 8° | 2° | 2° | 0° | 0° |
| | | root | M ₂ O ₂ | 9° | 3° | 2° | 1° | 0° |
| | | | M ₂ M ₂ | 10° | 4° | 2° | 2° | 0° |
| | | inflected | M ₂ O ₂ -O ₂ | 11° | 4° | 2° | 1° | 1° |
| | | | M ₂ O ₂ -M ₂ | 12° | 5° | 2° | 2° | 1° |
| | | | M ₂ M ₂ -O ₂ | 13° | 5° | 2° | 1° | 2° |
| | | | M ₂ M ₂ -M ₂ | 14° | 6° | 2° | 2° | 2° |

Scales of source, destination and translator

For categories of ideas, the degrees of source, destination and translator describe the polarity of the categories of relation that compose them.

Pragmatic relations O₂ = 1°

Semantic relations M₂ = 2°

Substantiality scale

For the categories of ideas, the degrees of the scale of substantiality are the *sum* of the corresponding degrees of source and destination.

Dialectic scale

As elsewhere, the dialectic degree of a *pragmatic* category of idea (pragmatic source) is always less than the dialectic degree of a *semantic* category of idea (semantic source).

For the same polarity, the *more complex* the idea (involving one, two, or three full roles), the *higher* the dialectic degree. This follows the same principle as for events and relations, with the difference that there are three levels of complexity instead of two.

For the same polarity and for an identical level of complexity, those categories of ideas that have a pragmatic *destination* have a lower degree on the dialectic scale than those categories of idea with a semantic destination.

Finally, categories of ideas with a pragmatic *translator* have a lower dialectic degree than those categories of ideas with a semantic translator.

Phrases

Categories of phrases

Used alone, in pairs, or in triads, ideas in turn form phrases, with the number of possibilities on the order of 10^{25} . Just as the matrices of relations are called "cycles" and the matrices of ideas are called "paradigms", the matrices of phrases are called "motifs".

O_4 pragmatic phrases are called "performatives" and M_4 semantic phrases are called "propositionals".

The source-ideas for propositional phrases play the grammatical role of *action*, the destination-ideas play the role of the *object* of the action, and the translator-ideas fill the role of the *medium* of the action.

The source-ideas of propositional phrases have the grammatical role of *subject*, the destination-ideas the role of attribute or *predicate* of the subject, and the translator-ideas the role of the *condition* or the circumstance of the proposition.

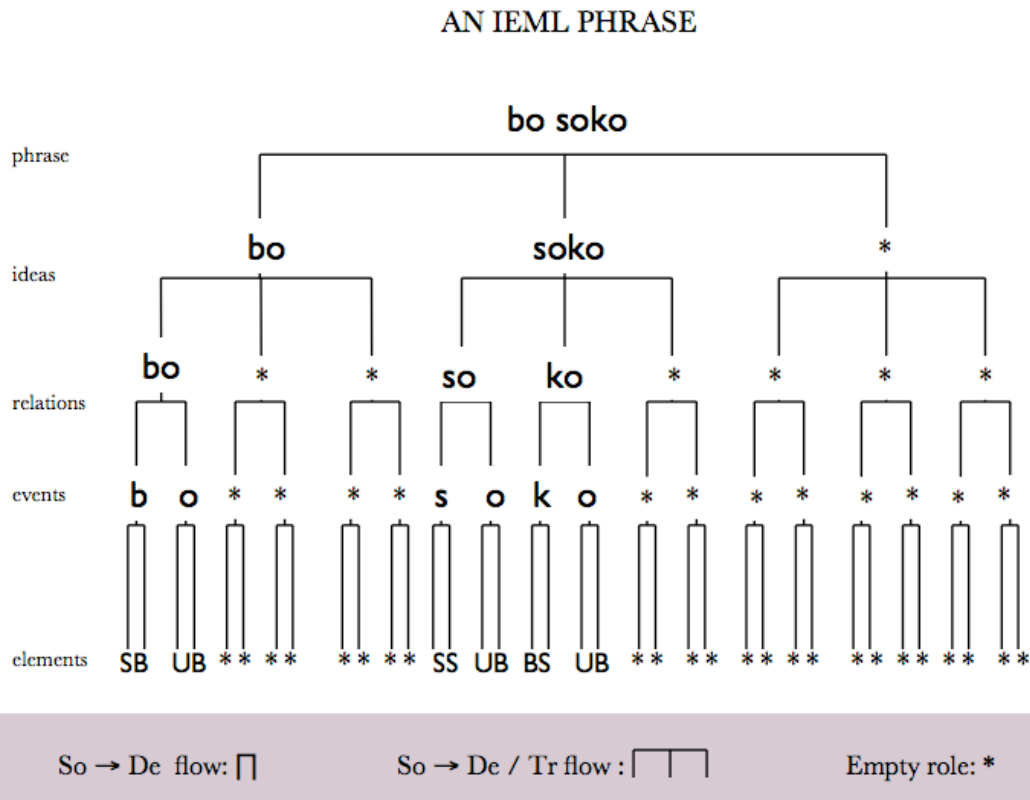
Digital addressing of categories of phrases

| | poles | grammatical classes | categories of motifs | dialectical scale | substantiality scale | source scale | destination scale | translator scale |
|-----------------------|----------------------------------|-----------------------------|---|-------------------|----------------------|--------------|-------------------|------------------|
| CATEGORIES OF PHRASES | O ₄ performatives | action | O ₃ | 1° | 1° | 1° | 0° | 0° |
| | | action-object | O ₃ O ₃ | 2° | 2° | 1° | 1° | 0° |
| | | | O ₃ M ₃ | 3° | 3° | 1° | 2° | 0° |
| | | action-object-medium | O ₃ O ₃ -O ₃ | 4° | 3° | 1° | 1° | 1° |
| | | | O ₃ O ₃ -M ₃ | 5° | 4° | 1° | 2° | 1° |
| | | | O ₃ M ₃ -O ₃ | 6° | 4° | 1° | 1° | 2° |
| | | | O ₃ M ₃ -M ₃ | 7° | 5° | 1° | 2° | 2° |
| | M ₄ propositionals | subject | M ₃ | 8° | 2° | 2° | 0° | 0° |
| | | subject-predicate | M ₃ O ₃ | 9° | 3° | 2° | 1° | 0° |
| | | | M ₃ M ₃ | 10° | 4° | 2° | 2° | 0° |
| | | subject-predicate-condition | M ₃ O ₃ -O ₃ | 11° | 4° | 2° | 1° | 1° |
| | | | M ₃ O ₃ -M ₃ | 12° | 5° | 2° | 2° | 1° |
| | | | M ₃ M ₃ -O ₃ | 13° | 5° | 2° | 1° | 2° |
| | | | M ₃ M ₃ -M ₃ | 14° | 6° | 2° | 2° | 2° |

The principles that organize the structure of the *scales of categories of phrases* are exactly the same as those for the categories of ideas, just transposed to a higher level of composition.

Structure of an ieml phrase

In the diagram below, we see the general structure of a phrase, using the example of **"bo soko"**, which means: "the language of collective intelligence".



Digital address of an ieml phrase

The digital address of an ieml phrase is articulated in 5 layers.

- The first layer gives the address of the *category of phrase* (5 degrees).
- The second layer gives the addresses of the *categories of ideas* that compose the phrase (3 times 5 degrees).
- The third layer gives the addresses of the *categories of relations* that compose the ideas (9 times 4 degrees).
- The fourth layer gives the addresses of the 18 *events* that compose the relations (18 times 4 degrees).
- Finally, the fifth layer gives the addresses of the *elements* that compose the events (36 times 2 degrees).

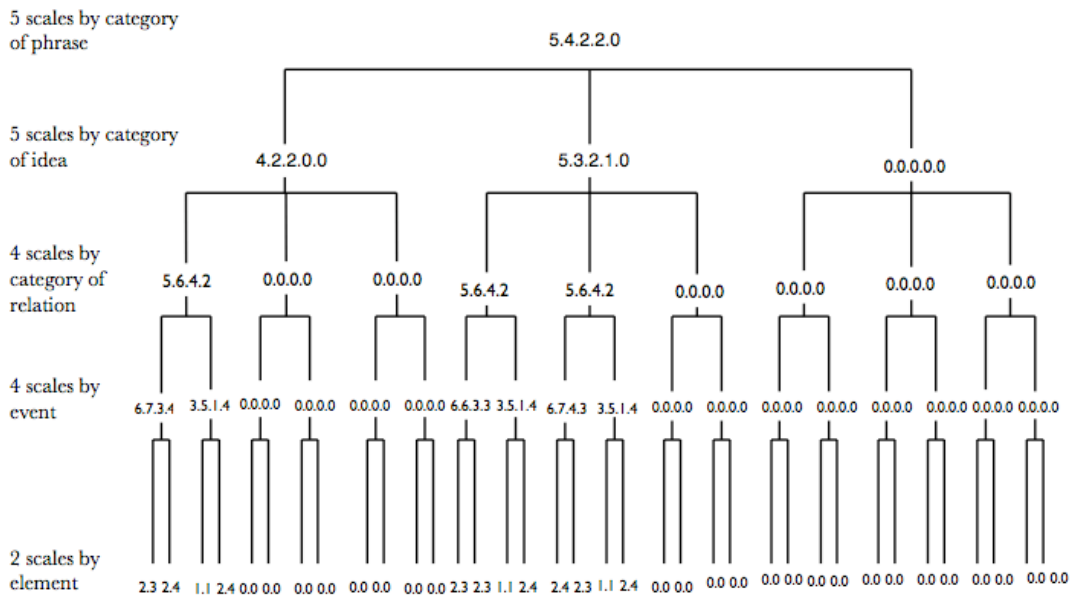
Thus, digital addresses are constructed from *degrees* on 200 *distinct simple scales*, all derived, as we have seen, from the two

primitive scales. The 200 simple scales of the collective intelligence protocol make it possible to construct combined scales that are more complex. Each scale, whether simple or complex, reflects a specific point of view that is tied to a certain level of analysis. The scales in ieml make it possible to *rank* phrases and/or to calculate the *cognitive distances* between phrases according to the perspective and level of analysis that corresponds to them.

For example, we can create a scale based with a priority on (1) the dialectic degrees, then on (2) the degrees of source (to rank flows of the same dialectic degree), and then on (3) the degrees of destination (to rank flows of the same dialectic degree and the same source degree). The compound scale I have just described is in fact the specific, 25-degree scale that defines *alphabetical order* in ieml for the following events: wo, wa, wu, we, y, o, e, u, a, i, j, g, h, c, p, x, s, b, t, k, m, n, d, f, l.

Here below, we see an example of a phrase coded according to CIP. In this diagram, the groups of numbers are arranged in the following manner: dialectic degree, substantiality degree, source degree, destination degree, translator degree. The groups of four numbers have no translator, and the groups of two numbers (in the case of elements) only have dialectic degrees and substantiality degrees.

BO SOKO CIP ADDRESS



Each number is a degree on a scale.
An ieml phrase is represented by 200 degrees

Graphs and games

Phrases constitute the ultimate compositional level of ieml glyphs. Beyond them extends the infinite domain of *graphs*, which articulate glyphs in the form of series, trees, and matrices.

Series correspond to glyphs organized in linear order. The origin of this order can be highly diverse in nature (frequency, weight, importance, chronological order, scale, etc.).

Trees correspond to genealogical orders, to property inheritance structures, to hierarchies of *directories*, to part-whole relations, to set-subset relations, set-element relations, etc.

Finally, *matrices* (Cartesian tables organized into columns and rows) correspond to coordination structures, or to complex dialectics between glyphs of the same level of composition.

To conclude this text, let's look at future horizons. The quantities of information (or volumes of flow) circulating in and between graphs can be described by formal rules that define any number of different "games" or "information economies". Furthermore, in certain applications of the metalanguage, ieml graphs can be considered the "genetic codes" of elementary intelligent agents that are capable of associating into

complex hypertexts, and of exchanging information according to various collective intelligence games. Here we see the glimpse of an opportunity to enrich the formal methods of game theory and artificial intelligence, with the *complexity* and *depth* of the human symbolic universe, both reflected by ieml.

Ottawa, 08 May 2006

Acknowledgements

The research behind the creation of the ieml metalanguage would not have been possible without the assistance of the Canada Research Chairs Program and the financial support of the Social Sciences and Humanities Research Council (SSHRC). I am deeply grateful to Darcia Labrosse for her contribution to the design of ieml, Emil Petriu for his insistence on formal grammar, Abed El Saddik for his sustained interest over many years, Michel Biezunski and Steve Newcomb for their availability and expertise in connection with the dictionary of ieml, and Andrew Roczniak for his unshakable composure in the face of a succession of different versions of the theory.

References

A bibliography of contemporary works can be found at www.ieml.org, along with information on historical sources, in the list of links.

12943 = provisional word count