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Abstract.

In this paper a four-valued logic on B(4) called Hyawic Form UniLogic. Examples of this UniLogic are given which model problems in the area of human interaction, dialog and communication, i.e. human speech. The four values, or states, are isolated, conflicting, co-existing and unifying, forming a square lattice of B(4), Post Algebra of order 2 with 4 elements, inside a Post Algebra on E(9) of order 3 with $9 = 3 \times 3$ elements. This logic has been used to represent human speech problems and their solutions in college classrooms. This logic is used in different universities, countries and languages including France, Algeria, Egypt and USA. It is used for policy analysis and planning, as well as for academic research in inter-communications analysis. Software packages using this logic are available from the developer Dr. Raiek Alnakari .

1. Inclusive Logic and Algebra for General Human Communication Model.

Thesis. There exist a set of problems in human communication for which there is presently a need for more effective formal logic solutions. These problems are included in, but are not limited to, the following categories of problems which can be formulated using logic: (1) Isolation, (2) Conflict, (3) Misinterpretation. Specific instances of these problems include, but are not limited to, the following: (a) Lack of an understanding of organizational and functional common laws in which human beings express themselves and understand each other within the context of these laws. (b) Lack of a means for managing and adapting these laws so that every human being is able to effectively express themselves and be understood. (c) Lack of an understanding of how effective interest, i.e. motivation (self or other - centered), and strategy (goal + plan) within these laws can be used in expression and understanding. (d) Lack of common understanding and usage of ordinal measurements (metrics) of interests, i.e.

motivation and strategy, in order to increase accuracy in human communication or decrease misinterpretation of human motivation and strategy in human communications. (e) Lack of the ability to scope interest, i.e. motivation and strategy, for human communication.

These problems are important today because of the following reasons: (1) growth of information, (2) potential of electronic commerce, and (3) policy making. This research present a framework within which these problems can be solved effectively and efficiently.

2. Historical Overview.

In this research Unilogic Form Knowledge Acquisition and Learning for Social Change is investigated by using a Hayawic Unilogic Form technique termed Square Root Unity [Alnakari 1, 2, 3]. Concepts are described in detail in Alnakari [2, 3, 4]. The purpose of this research is to partially solve the above-mentioned general problem(s) by using knowledge bases of Hayawic life cycles derived from the square root and the square unity (see Figure 1) of objects having a completely different knowledge representation form than a calculus of inclusion [19]. In this investigation modeling and recycling of objects between their birth and death is explored by self-logical development and auto-deductive interests behaviors and relations.

It is known that toward the end of his life Einstein [10, 12] was seeking a unifying theory for the foundations of physical science. However, we know that this objective is still problematic for all sciences; not just natural sciences, but human sciences as well. This search may be even more important in the human sciences because it is related to personal identity.

Can one find an effective unifying form of reasoning in human communication or dialog, i.e. a logic for human and natural sciences based upon Hayawic = {U, E, I, F}? If one means by 'unifying' a form of reasoning about information

that can solve all problems in human communication, probably not. This is because it would appear at first glance that the fundamental concepts involving a unifying theory for physical science, as initiated by Einstein in this century, do not appear to be the same as fundamental concepts in social science. The search for a comprehensive logic unifying social science and natural science by philosophers and logicians is not new [7, 13, 15, 40, 41]. Many attempts were made by groups of scholars in the last century to find such logic. But why could such a unifying logic not be found? Is the problem impossible to solve? Is it an illusion? Is it simple imagination? Or does it truly need at the philosophical and logical levels special language and a special circumstance to be discovered and articulated? No one knows.

The Damascus School of Hayawic Unilogic has tried for thirty years to find answers to these questions, restricted to the philosophical and social sciences [Alnakari 1, 2, 3].

3. A New Oticparameter for Human Communication Model :

In this paper we report on the use of Alnakari's Interest Square Unit model for evaluating these forms of human communication, this model also includes a human communications metric sub-model for measuring outcomes or states of human dialog [5, 6, 8, 11, 14, 18, 24, 25]. This metric sub-model is comprised of quantitative and qualitative metrics of interrelated interests (motivational and strategic) represented as dynamic self-contained forms based on two constant balanced interests (0, 0) and two variable unbalanced interests (-1, +1). This binary set of constant and variable interests metrics comprises what is called the Interests Square Unit (ISU).

The ISU itself is comprised of an organizational model and a functional model. Let us first consider the organizational model. Measurements in ISU come from typed representations (types are balanced and unbalanced) of different interest metrics in the organizational model. In the organizational model one may combine Isolating (I), Conflicting (F), Coexisting (E) and Unifying (U) interests as individual metric units. In this organizational model, these four different interest metric units provide the basis of an important 'inclusion calculation' for all possible human communication state (value) interests, representing transitions for any human communication by use of qualitative and quantitative measurements. This inclusion calculation function represents recurrent interest

levels in which the two variables (-1, +1) represent a minimum unbalanced interest metric unit. By contrast the two constant balanced interests (0, 0) represent a minimum balanced interest metric unit. This minimum balanced constant may be a maximum based on an inert metric unit.

As we have previously mentioned, the Interests Square Unit (ISU) is comprised of two dimensions, each being assigned values from the ordinal set $\{-1, 0, +1\}$, where a value of 0 is balanced while values of -1 and +1 are unbalanced. The two dimensions comprising ISU are termed **Resonance** and **Circulation**, and each dimension has a domain from the ordinal set $\{-1, 0, +1\}$.

Theorem 1. The four values, or states, isolated, conflicting, co-existing and unifying, form a square lattice of $B(4)$, Post Algebra of order 2 with 4 elements, inside a Post Algebra of $E(9)$ of order 3 with $9 = 3*3$ elements.

Proof. Let the representations for isolating (i), conflicting (f), co-existing (e) and unifying (u) be respectively (-1, -1), (+1, -1), (-1, +1) and (+1, +1). Let the remaining elements of the Post Algebra of order 3 with 9 elements be (-1, 0), (0, -1), (0, 0), (0, +1) and (+1, 0). Let the lattice order be the natural order of -1 less than 0 and 0 less than +1.

UniLogic. Consider modeling a communication dialog between a married couple. At the beginning of, or prior to, the marriage, as well as in certain problematic marriages, a couple's individual (self) interests may be isolated (I) or, synonymously, exclusive. This is problematic because the purpose of the marriage is to develop some common interests within the marriage of the two persons together. Hence, through a controlled dialog the couple may move to a next state of the marriage where their individual interests are no longer completely isolated (I) but are becoming coexistent (E). This is still somewhat problematic because, while the couple is now becoming aware of some of the other person's motivation (self or other-centered) interests they agree to have separate motivation interests as opposed to certain common interests in the marriage, i.e. unified (U) interests in the couple. A next state of the marriage dialog may be one in which the couple begins to realize that the marriage needs to have some common interests. But what common interests? Each person in the couple thinks that certain of their own motivation interests should become the 'common' interests. At this point one sees the marriage moving into a conflicting (F) state. Within reason this state may be healthier than the isolated (I) or coexistent (E) states because the two individuals are now trying to develop some common marriage level interests,

instead of merely motivation interests. Finally, in a healthy marriage the couple goes through processes of resolving some of the conflicts between individual motivation interests and begins to move into the state, called the unifying (U) state, where common interests begin to replace individual motivation interests in the marriage. As the marriage moves along in time movement between these four states continues as the two persons discover and resolve individual motivation interests.

Based upon the previous theorem the marriage M between a husband H and a wife W is represented in Post Algebra normal form as

$$\begin{aligned}
 M(H, W) = & \mathbf{i}^*[M((-1, -1)H, (-1, -1)W + M((-1, 0)H, (-1, 0)W) + M((0, -1)H, (0, -1)W) + M((0, 0)H, (0, 0)W)] + \\
 & \mathbf{e}^*[M((-1, +1)H, (-1, +1)W) + M((-1, 0)H, (-1, 0)W) + M((0, 0)H, (0, 0)W) + \\
 & M((0, +1)H, (0, +1)W)] + \\
 & \mathbf{f}^*[M((+1, -1)H, (+1, -1)W) + M((,)H, (,)W) + \\
 & M((,)H, (,)W) + \\
 & \mathbf{u}^*[M((+1, +1)H, (+1, +1)W) + M((,)H, (,)W) + \\
 & M((,)H, (,)W) + \\
 & M((,)H, (,)W)].
 \end{aligned}$$

Each entry for M(H, W) is such that a resonating value has 3 values for H and circulating has 3 values for H. Hence, an H value, being a pair of resonating and circulating pairs, has 3 * 3 or 9 possible values. The same is true of W. So, whereas the 'truth table' for M(H, W) has 9 * 9 * 9 or 729 rows, only 16 of these rows are definitely isolating (i), conflicting (f), co-existing (e), or unifying (u). This can be seen in the above Post Algebra representation [20, 23].

In the next section we will look at some of the possibilities and limitations of using traditional formal systems such as Boolean or multiple-valued algebra and logic. These limitations, which are seen as problematic in effective human communication or dialog, will serve as further rationale for our new model.

4. Multiple-Valued Logic Theory for E(9).

Let E(9) = {0, 1, 2, 3, 4, 5, 6, 7, 8}. It is known that there are integers modulo 9 forming a ring Z(9), and that there are a number of lattices on E(9). Moreover it has been in the past interesting to study complete, distributed lattices on E(9), as well as to study sets of complete functions over E(9).

Certain functions are of particular interest. A function over E(9) which assumes only the

values 0 or 8 is said to be decisive. Examples of decisive functions are J0, J1, J2, J3, J4, J5, J6, J7, J8. Moreover, any function of n variables over E(9) may be expressed as sum (+) of products (*) of constant and decisive functions.

Coding or labeling of elements on E(9) is also interesting. For example the ternary digits (trits) {-1, 0, +1} can be used to code elements of E(9) in various ways.

Post algebras are of particular interest. Consider the Post algebra on E(9), $9=3*3$. This Post algebra's Atoms (A) = {2, 6} = {a1, a2}, and its atomic chains are $0<1<2$ and $0<1<2<3<4<5<6$. Any point b in this particular lattice (more generally, any complete, distributed lattice) on E(9) can be represented as $b = \text{SUM}(i=1,2) (ri*ai)$, ri in $\{0<1<...<ai\} = \text{SUM}(i=1,2) ri$, ri normal coordinates.

Next, let P = {0, 4, 8} = {e1, e2, e3} be Post normal coordinates. Then any point b in this distributed lattice (more generally, any complete distributed lattice) on E(9) can be uniquely represented as $b = \text{SUM}(i=1,2) (pi*ai)$, pi in {e1, e2, e3}, either because the bottom generating set G = {1, 2, 3, 6} is a subset of {ai*ej} and for every ai there exists ej such that ai*ej = 0, or because $9 = q1*q2 = 3*3$ and $q1=q2$.

Now with atoms A = {2, 6}, maximum Boolean sub-algebra B = {0, 2, 6, 8}, Post coordinates P = {0, 4, 8} and bottom generating set G = {1, 2, 3, let us trit label the members of Post algebra P(9) as follows:

P(9) labeling	P(9) Trit Coding
0	-1 -1
1	-1 0
2	-1 +1
3	0 -1
4	0 0
5	0 +1
6	+1 -1
7	+1 0
8	+1 +1

With the ordering on P(3) of E(3) trit ordering being $-1 < 0 < +1$, the induced ordering of the P(9) labeling above becomes $0<1<2<3<4<5<6<7<8$, or graphically 0 1 2 3 4 5 6 7 8.

Finally, the human communication dialog model interpretation (evaluation) for maximum B(4) Boolean sub-algebra of P(9) = {0, 2, 6, 8} is assigned as follows:

Maximum B(4) of P(9)	UniLogic
0 (-1, -1)	Isolating - i
2 (-1, +1)	Coexisting - c
6 (+1, -1)	Conflicting - f
8 (+1, +1)	Unifying - u

Note that the ordering on the labeling of P(9) members induced by the trit ordering from P(3) of E(3) produces a particular set of strategies, as it were, in moving from some member of P(9) to a unifying (u) evaluation or outcome.

5. Inclusive Logic and Algebras for Human Communication Beyond Boole and traditional Logic . The usage of the word 'logic' comes from the term Organon [21, 22] of Aristotle who dealt with the ways in which syllogistic classification of statements can be applied to meanings of different sorts of entities. The logic in later centuries classified, using grammars, the sciences of words for some Arabic schools. Boole's works of logic became Boolean algebra, but his algebra is semantically too narrow for directly representing and reasoning in all human-level rhetoric. This is because effective solutions to all human communication or dialog problems cannot be reduced to a binary human filter. And despite Boole's definition of logic as the 'laws of thought' Boole's use of logic dealt with relations between entities that are too strict for representing many human concepts.

A sub-thesis of our research is that Boole's works of logic, which became Boolean algebra, is semantically too narrow for directly representing a significant part of human-level rhetoric. And despite his definition of logic as the 'laws of thought' Boole's use of logic which dealt with relations between entities is too strict for representing many human concepts.

6. Communication Theory Algebra and Logic. Background of Post Multiple-valued Algebra and Logic Theory.

Just as there are $2^2 \wedge$ Boolean logic functions of v binary variables which form a Boolean algebra, so are there $n \wedge$ n-ary logic functions of v n-ary variables, n a fixed integer ≥ 2 , which form a Post algebra of order n [28, 29, 30]. In Rine [28, 28, 30] there is depicted an array of lattice diagrams for Post algebras, where the lattice diagram at the i^{th} row and j^{th} column is a Post algebra of order $(i + 1)$ having $(i+1)^j$ elements, of which 2^i elements are complemented. The first row contains Boolean algebras, that is, the Post algebras

of order 2. The first column contains Post chains, that is, the linearly ordered Post algebras. The lattice diagram at the second row and third column is for a Post algebra of order 3 containing $3^3 = 27$ elements. The lattice diagram for the n^n n-ary logic functions of v n-ary variables occurs at row $(n-1)$ and column (n^v) .

Various kinds of Post algebras have been studied over the years. Post [23] introduced the general idea of these algebras. Later Rosenbloom [36], Epstein [9], and Traczyk [38] studied specific kinds of Post algebras in more detail. Four of these have been termed Disjoint Algebra [Traczyk, 29, 30, 38], Monotonic Algebra [Traczyk, 29, 30, 38] Free Algebra [Braddock and Epstein, 29, 30], and Hermann Algebra (Hermann, 29, 30).

7. Post Algebra Representing UniLogic Human Communication.

Our UniLogic theory of the way humans communicate when resolving differences is based upon an ultimate goal to become unified with their environment comprised of other humans [16, 17, 26, 27, 33, 37, 42]. As we have indicated before in, with i isolating, f conflicting, e coexisting, u unifying, there are two fundamental communications scenarios leading to a unifying resolution, which we assert, as follows

- (A) $f \rightarrow i \rightarrow e \rightarrow u$
- (B) $i \rightarrow f \rightarrow e \rightarrow u$.

These are the bases for two distributed lattices U1, U2 with the two linear orderings of four fundamental elements each. As a linear ordering we denote (A) and (B) as follows

- (A) $f < i < e < u$.
- (B) $i < f < e < u$.

Define the following two kinds of monotonic (threshold) relative unifying functions

- (M.1) $M^k(x) = \{ u \text{ if } x \geq k, f \text{ if } x < k \}$
- (M.2) $M_k(x) = \{ u \text{ if } x \geq k, i \text{ if } x < k \}$.

These two threshold, relative unifying unary, functions give two different comparisons of x to a given group of other humans at level k.

Next, for either (A.1) or (B.1) define two additional algebra operators as follows

- (Max) $\text{Max}(x, y) = \{ x \text{ if } x \geq y, y \text{ if } x < y \}$
- (Min) $\text{Min}(x, y) = \{ x \text{ if } x < y, y \text{ if } x \geq y \}$.

Max is a measure of how x is moving toward y or y is moving toward x. Min is a measure of how x is moving away from y or y is moving away from x.

Theorem 2 (1) Given A, M.1, M.2, Max, Min, U1; U1 is a Monotonic Algebra of order 4, denoted M1.4. (2) Given B, M.1, M.2, Max, Min, U2; U2 is a Monotonic Algebra of order 4, denoted M2.4.

Proof. M1.4 and M2.4 both satisfy the properties of a monotonic algebra [29, 30, 38].

As we can see, while the above expansions of Boolean algebra and Post Algebra afford some means for moving between four states in UniLogic human communications dialogs, these are restrictive. As we can see, this is particularly true in describing movements between states during a dialog.

8. Using Post Algebra to Model Human Communication.

If P denotes a person and E denotes the present environment of other persons with whom P is communicating, then let P(E) denote the behavior of P when interacting with E. A simple example of a behavior of P given E can be denoted in tabular form as follows:

E	P(E)
f	i
i	e
e	f
u	e

The first row in the table represents "When persons in E are conflicting, P is isolated from E."

Another simple example is as follows:

E	P(E)
i	f
f	e
e	u
u	u

The first row in the table represents "When persons in E are isolated, P is conflicting with E".

An environment may be either another person, or a group of other persons, or a set of groups of other persons. Let us consider a simple

example where P is engaging two different groups of other persons as follows:

E1	E2	P(E1, E2)
i	i	f
i	f	f
i	e	f
i	u	e
f	i	f
f	f	f
f	e	f
f	u	u
e	i	f
e	f	f
e	e	e
e	u	u
u	i	e
u	f	u
u	e	u
u	u	u

The first row in the table represents "When persons within both E1 and E2 are isolated, P is conflicting with both of them".

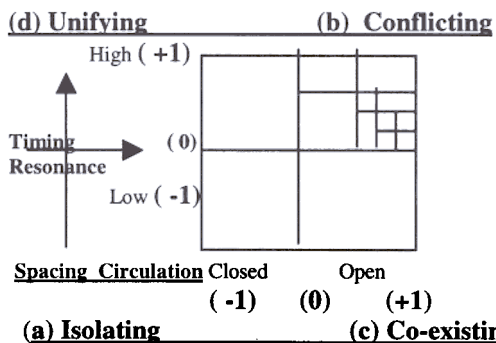


Figure 1. Depiction of Hayawic Interests {Isolating (I), Co-existing (E), Conflicting(F), Unifying(U)}.

Annotations.

Hayawic Logic is based upon the 'Unilogic Form' of Alnakari. **Interest Square Unity (ISU)** is a dynamic logic square that can classify any permutation of the four categories of a life cycle whose binary operations are opposite, contradicted, completed, included, excluded, etc. Aristotle's opposites logic square represents only one variation of the interest square unity. The Paradox of Russell or Cantor also represents just one variation of the interest square unity.

Life Interest Cycle is the system that an entity uses in order to achieve an ultimate goal in a given time period in the framework of the Interest Square Unity.

Interest Square Root is the universal vocabulary used to define any Life Interest Cycle of an entity, including the open/closed, extreme/moderate, partial/total, etc.

Hayawic Interest is the dynamic containing form of an entity, i.e. that interest motivated by needs in time to define or to recycle its Interest Square Root.

Form Unity is the simplest and most abstract form of any entity, representing the Hayawic Interest, i.e. the Hayawic form.
Rhythmic Sequence is the universal vocabulary of Form Unity that can be represented by binary symbols.
Unilogic is a logic which affords a way to reason about Rhythmic Sequences of any entity.

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