Affirmative Reasoning

Nay, The Jain Nyay(a)

Mahendra Kumar Jain

In this Series of Nay works:

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Evidence based inference
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Series Preface

Nay is (analytical) reasoning elaborates relationship of identified parts with the whole. This reasoned approach to develop continuity of ideas and though is a shared enterprise that empirically builds knowledge base with inferences validated by independent evidence. Western humanist plays a role of skeptic with tools of rhetoric and discursive dialectic. Even deeper problem is in the Aristotelian binary logic where both true and false are established with a single piece of evidence. Not only it is inconsistent with the nature of independent evidence but it implied omniscience is the source of wide ranging paradoxes. Practitioners of Nay try to identify independent logical basis for doubt and uncertainty by identifying contradiction, inconsistency, ambiguity and contingency. Like all analytical devices Nay is not meant to tackle undefined issues related to God/omniscience, Brahma and the variations of omniscience. Nay reasoning also transcends mores, ideals, code of conduct, personal insights and cults, and practices driven by ethos.

Words communicate assertions of information and beliefs about objects and concern. Content, context and their relationships to independent evidence identified from such assertions may be deliberated, scrutinized and interpreted. Resulting inferences are necessarily tentative (*syad*) with liabilities from incomplete information, partial evidence, and assumptions. Nay is the ancient Prakrit term for tools and rules of reasoning with available information and evidence for deduction and inference. Nay reasoning is empirical, and it explicitly discards faith, ad hoc assumptions, and self-reference. A narrative builds on perceptions from sense experience. *Speaking your mind* is to communicate inputs for conversation and deliberation to resolve a concern. Human ability to communicate, reason and deliberate requires minimizing the gulf between belief and words. Awareness of an object or concern is developed from assertions about its content and context, and elaborated in relation to independent evidence. Such scrutiny to arrive at viable and valid inferences encourages evaluation, prediction, and innovation to become part of shared knowledge. Methods of Nay have

evolved as Nyay with focus on decision based on available evidence interpreted with predetermined rules and scriptures.

Assertions such as *I am sure* call for scrutiny of inputs and evidence to identify remaining liabilities (*syad*) as in:

How sure are you?
How do you know that it is valid?
Can it be independently affirmed?
Could it be something else?
How do you know what you know?

Validity and certainty about the concern and inference are integral part of Nay reasoning. It requires continuing search for a better inference with reduced liabilities from doubt and uncertainties in assertions, assumptions, evidence, and interpretations.

August 7, 2008 Mahendra Kumar Jain
August 1, 2013 (revised)

Interpretive Translation

Understanding ideas requires interpretation of word constructs. Goal of the interpretive translation of the Nay works is to develop insight into the ancient thought processes and approaches to reality based thinking. Essays in this introductory volume outline salient ideas in contemporary context.

Nay(a) is about reasoning and interpretation of evidence. Emphasis of the Jain Nyaya (Anuman and Syad-Saptbhangi Nay) is to arrive at a reality-based conclusion on the basis of the available evidence. Nay approach to reasoning continues to guide the Jain thought and provide conceptual continuity. The works presented here span more than two millennia. Handwritten copies of these ancient works have been compared, edited and printed during the last 100 years. I use these sources for my interpretative translation in English of the ancient text. I have not relied on the ancient commentaries or their literal translations found in the printed versions. A major challenge in bringing the ancient works in a modern form is to overcome limitations of language usage and contexts, let alone work through nuances and meaning. Interpretative translation requires significant departure from some of the linguistic practices prevalent in the ancient writings or in common usage now.

My goal is to construct a conceptual continuity in a way that does not change with time. The content and context of the concept words is extracted from the Gatha or Karika forms of text in the original works. I have tried to retain integrity of the entire text, and chapter titles are from the edited works. I have introduced sub-headings to identify sub-themes relates to the topic. Both Prakirt (*natural*) and Sanskrit (*purified*) languages have rudimentary grammar. *Ashtadhyayi* of Panini (ca. 4th century BC) is remarkable work about word morphology, and the Sankrit grammar (Siddhant Kaumdi) was not formalized for another 1200 years. In general in Sanskrit and Prakrit texts it is often necessary to guess not only the verb but

also subject and object. My reconstruction of thought continuity begins with interpretation of concept words (see Glossary of the Nay Terms).

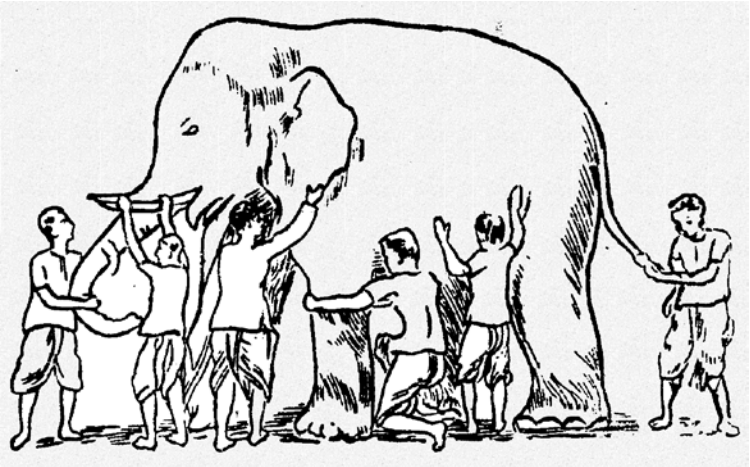
My choice for the English equivalent word used now follows from the concept space of the word usage in the ancient text. It may differ from some of the commonly used translations. Also use of direct active form of expression should facilitate conceptual continuity to interpret meaning and implications. Conceptual continuity of Nay approach is similar to that found in empirical and secular way of reasoning that follows from the observed and measured real world behaviors. Emphasis of Nay is to rule out contradictions and self-reference, and seek certainty through consistency of inputs with evidence. The search continues through discourse, deliberations, contemplation and meditation so that an inference may be articulated in appropriate contexts.

Why Doubt?

Why Doubt?

Mahendra Kumar Jain

Nay: Reasoning with analysis and synthesis



Nay reasoning permeates ethos, pathos and logos of the Jain world-view as illustrated by the parable of *An Elephant and Six Blind Men*. In this parable, each person "sees" a part of the beast and interprets it on the basis of own experience. Of course, a better inference follows from the synthesis of all such partial views. Syntheses for an inference are not compromise or average of inputs. Just as a story proves and improves with each retelling, better inferences follow from additional inputs and independent evidence. Conundrum of *your word against mine* requires independent verification. Would it work if nobody has ever seen the beast before? How about if omniscience is asserted?

Inference process is driven by facts of actuality that share reality with independent evidence. A consistent understanding is constructed by empirical trial and error. Reasoning with defined tools, rules, and ideas incrementally enhances shared knowledge, technologies and organizations. As Akalank put it, a *viable idea grows like a vine where ever it finds space and light, and barrens do not have off springs*.

Inference (*anuman*) Syllogism

Anuman (literally the best guess) is inference from the available inputs on the basis of ordered concomitant invariance of inputs with evidence, as in:

1. **The hill is on fire** (***Pratigya***: Assertion of the concern).
2. **Because it is covered with smoke**. The content (smoke) and context (distant hill) are the means ***(sadhan)*** to guide reasoning.
3. **Wherever there is smoke there is fire, as in a wood stove** (***udaharan***, analogy that pertains to a shared reality).
4. **Since there is smoke on the hill** (***upnay***: reassertion of the basis),
5. **the hill is on fire** (***nigman***, restate the original assertion).

Inference of fire in 5 is based on the sight of smoke in 1, and it invokes a well-known relationship of smoke with fire in 3. Burn characteristics of wood are such that smoke results from fire, although there may be fire without smoke under many conditions. Relative amounts of smoke and fire depend on local conditions of fuel, air supply, and moisture in the air. Smoke likely to be visible from distance before fire because smoke rises up above the flame. The inference is useful for the future course of action even if one does not know the how or why of the burning, or that smoke from burning of wet wood consists of particles of soot and droplets of water.

Inference in 5 is valid within the limits of inputs and evidence, however it remains tentative (syad) until the presence of fire is independently confirmed. A tentative inference is strengthened, as Bhadrabahu I (ca. 360 BCE) suggested, if the *vipreet* (converse, opposite, alternatives, or indescribable) possibilities are ruled out. The possibility of fog is ruled out as in:

6. **The hill is covered with fog** (and not smoke).
7. **Because the rock (a land-mark) is not visible.**

8. **It is summer afternoon,**
9. **Whereas fog is seen only in early morning of a winter day.**
10. **Therefore, the hill is unlikely to be covered with fog at this time.**

Avinabhav: key concept of Jain Nay is *Avinabhav* for *one does not exist without the other*. In English it may be interpreted and translated as ordered invariant concomitance. Avinabhav of smoke with fire is the reality that is shared in real time by wood burning on the hill and in the kitchen which is the basis of the past experience. Avinabhav may include correlation (*sah*) and sequential (*kram*) relationship that makes the analogy (*udaharan, drashtant*) relevant (*hetu*) for the inference. However, avinabhav is not just an invariably observed association of similarity or coincidence. It is not *vyapti* or induction based on the generalization of the past events. Also avinabhav is not deduction based on *if-then* relationship (***samvay***), or quality (*gun*), or inherent behavior (*dharm*), or relevance (*hetu*) to a concern, or authority (such as scriptures). Contextual, psychological, and linguistic relations that may come in the way of identifying correct concomitant invariance of evidence with a valid inference are not the sufficient basis for an inference.

The concept of avinabhav is found in all Nay works, including Nyay Sutr of Gautam, Apt Mimansa of Samantbhadra, and works of Siddhsen and Akalank (included in this series). The concept of avinabhav is conspicuously absent in the ancient and the modern works on Hindu Nyay.

Tools and rules of reasoning

Reasoning is interpretation of objects and concerns often communicated by word assertions. Degree of certainty in the output depends on the quality of inputs and rigor of the protocols:

1. **Similarity**: Entities and events are compared on the basis of their **appearance** (form, behavior) to identify objects (as human, bird or ape) in relation to others in the same category or class.

2. **Analogy:** Resemblance of certain **inherent** feature is the basis of analogies. For example humans are (analogous to) primates has as we know now a deeper genetic and evolutionary basis.

3. **Induction**: An induction from a **generalization** remains valid as long as there are no known exceptions. For example, *all swans are white* is invalid after black swans were found in Australia. Similarly *all ravens are black* remains valid as long as no non-black ravens are known.

4. **Deduction**: Simplest forms of deduction follow from binary relations such as yes or know, true or false, present or absent. Deduction is valid as long as there are only two possible states (binary complementation) in the given space and time: If the object is not present it is said to be absent, and if it is present it is said to be no absent. Deductions are valid for a closed chain of relations where complementation holds. For example, if *A is bigger than B, and C is smaller than B*, one may deduce *A is bigger than B, and B is bigger than C. Therefore A is bigger than C,* and also *C is smaller than A.*

5. **Inference**: An inference follows from interpretation of inputs in relation to independent evidence. As mentioned above, fire may be inferred from the sight of smoke by invoking *avinabhav* (ordered

concomitant invariance) of smoke with fire. Converse of an inference may or may not be valid, and thus must be independently affirmed. This is because an inference is not bound by complementation, and in that limit an inference becomes a deduction.

Assertions and inferences are sometimes rationalized and justified in relation to experience and intuition (*anubhav*), analogy (*upman*), testimony (*shabd*), ad hoc assumptions for a purpose (*arthpatti*), and lack of suitable counter example (*abhav*).

More on Methods of Reasoning

At some fundamental level the self-contained grammar of thought is inherent in natural languages that provide a structure for shared reasoning. However, evidence-based reasoning with mutually agreed methods, rules, strategies, algorithms and syllogisms is required to validate parts of awareness of a concern to formulate a construct of cognized inference.

I know of no single English, Hindi, or Sanskrit word that incorporates the scope of Nay. The concept space of Nay is rooted in the reality that contributes characteristics, attributes and criteria to identify, define, organize, categorize, and manipulate parts and relations for reasoning. Both direct and indirect evidence validates a construct that can be cognized and refined by methods that include grammar of conventions, algorithms, syllogisms, and whatever else leads to rule-based certainty. Such knowledge evolves with active, questioning, and inquiring scrutiny. Ancient terms of interest are:

Tark is logical deduction from known parts and their relations within defined boundaries.

Anvishiki is rationalization with a priori (Vedic) or ad hoc (Iswar) omniscience. Rationalize tend to evaluate evidence selectively and with self-reference, as in *Just punishment by god,* or *god-willing*

Shrut: Oral tradition interpreted as 'Truth' for faith-based beliefs. Akbar observed: *As for the need of argument, if traditionalism were proper, the prophets would merely have followed their own elders and not come up with new insights.*

Anekant: Multiple plausible states and relations not yet included in an inference.

Anugam: Reasoning with identified parts (analysis).

Atm*:* Identity of a living being.

Bhranti*:* Confusion or make-belief.

Darshan*:* Insight (not necessarily a philosophy or a point of view)

Eekant*:* A single state irrespective of relations.

Hetu: Relevant and relevance (**Hetutv**) of concern for an object, subject, cause, or outcome. In Nyay it is interpreted as the cause in cause-and-effect. Others have also interpreted Hetu as distinguishing attribute (for which the appropriate word is **ling**), or as a combination of intent, purpose and goal (in Hindi usage).

Pratya-abhigyan: Cognition of the sum-total of evidence.

Swa-rupana and **Pra-rupana**: Representation of the self and the other.

Vyabhichar: Contradiction.

What is Vacch-Nay

The content and context of a tangible word construct (description) guides reasoning. Sound may be ethereal and momentary and what is asserted may be abstract. However content and context of assertions rooted in reality is affirmed by independent evidence. Rules governing affirmed assertions are the same as for existence of material objects and their relations.

Vacch Nay is a road-map to interpret valid assertions, and Nyaya is its offshoot. A search for consistency through dialog brings out viable inference from the pro and con evidence. Such dialog is a way to resolve conflict by identifying essence of an argument. One of the variations on this theme include the legal system to deliver justice on the basis of a set of rules and past practices that may be extension of moral a priori.

Valid proposition from affirmed assertions

Nay distinguishes validity based on independent evidence from the truthful speech. Both real and imagined objects and concerns are expressed by words. Words as such do not have reality of their own, not do they identify contradictions and inconsistencies, nor do they confer validity. Self-referential and contradictory word constructs are invalid. Similarly an object described only in term of negation is not an object. Assertions are validated by sense experience and by independent evidence rooted in independent reality. Discourse facilitates validation by scrutinizing shared awareness of the affirmed reality to arrive at an inference proposition. Orthogonal and independent assertions minimize liabilities of the inference introduced by uncertainties and doubt in input assertions and assumptions.

Following terms from the Nay literature suggest scope of Vacch-nay as evidence-based reasoning with word assertions about an object or concern:

Dravyarthic Nay: reasoning about states of the content

Nir-nay: a reasoned decision

Paryarthic Nay: reasoning about states of the context (as in the *sapt-Nay*)

Saptbhangi Nay: seven possible inference propositions with truth value of evidence to affirm 1, 2 or 3 of the three assertions (it exists, it does not exist, it cannot be described).

Sapt-Nay: reasoning in relation to the context (name, form, past etc)

Syad-Nay: Reasoning about doubt in a proposition

Tark-nay: Deductive reasoning where all the necessary components and relations for a proposition are known

Upnay: a secondary reason or an assertion affirmed as a proposition

Glossary of the Nay (Nyay) terms

Words in natural languages such as the ancient Prakrits have concept broad and dynamic boundaries to convey motive in relation to the content and context, or a change as in movement, action or reasoning. Also the word constructs guide the subject to communicate a root concept even if the verb action (*kriya*) is not explicitly stated. It permit search for meaning in local contexts, which in modern languages may be provided by pronouns, propositions, conjunctions, particles, auxiliary words. Also unlike the modern technical words which are often well defined nouns, word boundaries of the Prakrit words are established in local contexts in relation to the action.

Aadarsh	Worth considering, a model,
Aalambh	With the help of, based on so far,
Abhas	False impression (appearance, dubious, paradoxical)
Abhav	Does not exists, is not so
Abhi-	Extension, extrapolation, develop further
Abhidhan	Elaborate ?
Abhidhayak	Promulgate
Abhi-ghat	Incision, decisive attack
Abhigya	Beyond cognition, Insight or other means to perception
Abhilambh	Grasp of the total
Abhilasha	Desire
Abhiman	Evaluation with a standard
Abhinivesh	Carefully present
Abhipret	Desired
Abhyupety	GNIIA-59 ?
Abhyupgam	Address the remaining concerns, develop further,
Adhi-	Above -
Adhigam	Reliable, know with authority/certainty
Adhyapanat	Resolved with certainty or authority
Adhyavsaya	Reconciliation, determined?

Agam	Shared tradition and beliefs (always prior?)
Akar	Shape
Alam	Sufficient or not necessary
An-ekant	Multiple states of an entity based on different relations
Anhilap	Elaboration
Anindriy	Extra-sensory such as through meditation (hallucination)
Anjsam	Awareness of the whole
Annyatha	Otherwise, if not so,
Annye	The other (in the sense of set theory)
Anu-	Prefix relating to what follows (see I-9)
Anu	Smallest part (atom is now called param-anu)
Anugam	Analysis or reasoning based on parts
Anugrahat	Grasping afterwards,
Anukaran	Based on a part, following a model
Anuman	Inference
Anumey	Subject of inference
Anupatti	Follows from the main conclusion (a corollary)
Anuplabdh	Not available for examination or consideration, not known
Anuplambh	Inaccessible or not-accessible even to conclude not-so
Anuppann	Unidentified, unidentifiable
Anuppatti	Multiple origins, possible alternatives
Anuvad	Summary
Anvay	Scrutiny of implications
Anvikchi	Consistent with scripture or other a priori
Ap-	Prefix for removed or separated
Apatti	Interpretation of the given (see *arthapatti*)
Apoh	Consideration or scrutiny of parts to remove doubt
Aprasang	Out of context
Apvarg	To resolve or bring to a closure
Arth	Meaning of the content in a context
Arthapatti	Arthat-apatti: interpretation for the meaning
Asat	Non-existent

Athva	Either-or combination
Atindriy	Beyond senses: Based on a model or construct of intellect
Atishay	(something) extraordinary, miracle
Atit	Eternal
Atm	Identity of Self
Atmani	Individual entities and constructs, syllogism?
Avaran	Cover (obscures)
Avbhas	Short statement
Avbodh	To know
Avdhar	Forms a basis
Aviddya	Delusion or illusion?
Avighat	Not damaged (not-destroyed?)
Avinabhav	Ordered concomitant invariance (*one not without the other*).
Avinabhuv	See Avinabhav
Aviruddh	Unequivocal
Avisamvad	Miscommunication or misinterpretation)
Avlamb	Support, dependent
Badar	larger, macro, a cherry-like fruit
Badha	Interference, interruption
Bhaav	Intention, trend and pattern in meaning
Bhas	Impression
Bhautik	Physical (earthly)
Bhav	Exists, present, is-so (Different than Bhav above)
Bhavna	Thoughts/concerns for others
Bhranti	Confusion (mis-understanding, make-belief)
Bidambana	Paradox, Ambivalence
Bodh	Know with awareness
Bruvaan	intention of what is said (narration)
Ch	And (as in A and B together)
Chet	If, even if,
Darshan	Insight (Attitude, point of view)
Dharm	Behavior, conduct and relations (innate and inherent)

Dhrauvya	Total (all)
Ditthi	See itthi
Dosh	Defect
Drasht	Seen (as in awareness)
Drashtant	Analogy, analog
Ekant	One conclusion
Gammyaman	Moves the argument (as it follows from)
Grahanam	Accept or take it for granted
Gun	Inherent property or quality
Gyan	Cognition of sense experience (prior information)
Han	Short-coming
Hetu	Relevance (also hetutv)
Ikchya	Reflection: Thought and thinking with a purpose
Isht	Desired (seek)
Ishyate	Sought
Itthi	Perception (in the general sense of the current usage)
Jalp	Scrutiny to overcome cavil, innuendo and mislead
Jati	Class
Karan	Basis for action (reasoning)
Karm	Actions (to address concerns, encumbrances, commitments)
Karmbandh	Binding commitment to action
Karmphal	Consequence of action
Karuna	Compassion
Karya	Act of reasoning
Kchanik	Momentary, transient
Keval	The only (nothing but) valid construct
Khar-Vishan	Unreal (like horns of a donkey)
Kriya	Action, reasoning, verb
Lakchan	Symptoms, characteristics
Lamb	Dependent, hanging
Lamm	Access, reaching
Ling	Attribute, distinguishing features,

Mechak	Facets as in a prism
Mithya	Contradictory to reality (usually for beliefs)
Naigam	Reasoning devices
Nay	Reasoning with devices and evidence (not ad hoc a priori)
Ni-	Re- (or another way)
Nibandh	Concept (abstract) binding
Nibodh	Reasoning to resolve
Nigaman	Affirmed by reasoning, conclusion
Nigrahsthan	Misplaced
Nimitt	Relevant and necessary influences that mediate an effect
Nirakaran	Resolve the issues
Nirakrat	Uncover a form (identify?)
Niranvay	Not- analyzable (*nir-anvay*): beyond scrutiny
Nirdesh	Indication
Nirnay	Reasoned decision (based on Nay devices)
Nirodh	Interference based on rules
Nishpatteh	Identified (without alternatives?)
Nishpatti	Indication
Nishreyas	Recovered well being
Nityatv	Perpetual
Nivesh	Introduce
Nivratak	The one that settles
Nivratti	Resolved, settled
Ni-yog	Re-consider
Nyay(a)	Vacch-Nay for a decision
Pakch	Pro- or con position on an issue
Param	Reliable, ultimate
Pariched	scrutinize in parts, analyze
Parigyan	Cognition of the limits
Parinam	Motive and content
Parokch	Indirect or behind the eyes
Patti	Amounts to a conclusion or take-home

Porusheyah	Human-incarnates (as in Son-of-God)
Prachkchate	Show, demonstrate
Pragya	Cognition reconstructed from a model
Prakalpit	Possible interpretation or implication
Prakaran	A particular aspect of the topic under consideration
Praman	Evidence as known measure or standards
Pramey	Target of reasoning about an object or concern
Prameyatv	The topical
Prapede	Suggest, postulate
Prasajjyte	Placed in a context, create a context
Prasang	Context
Prasiddh	Established as generally accepted
Prati-	In response to-
Pratibhas	Impression from (conception of the communicated)
Pratighat	Counter-attack
Pratipadan	Postulate to introduce or define
Pratipadyet	Assume postulate
Pratipatti	Suggestion, implication
Pratishedh	Refutation, rule out, not-permissible
Pratiti	Awareness (a sense of, appears to be, feeling)
Pratyabhigyan	Cognition of the entire context from available information
Pratyakch	External or in front of eyes (observable, sense input)
Pratyay	A mix of knowing, awareness and understanding
Pratykhyan	Counter-statement, double-check,
Pratyneek	Counter-argument, alternative interpretation
Pravachan	Reason advice
Pravad	Counterpoint to an assertion (Vad-pravad)
Prety	Nemesis
Pretybhav	Reincarnation
Rirte	Without or not
Rodh	Interference
Rup	Form

Sadbhav	In accord with, meaningfully so
Saddhe	Shown to be so
Sadhan	Means, device (to address a concern)
Sadhya	Construct or assertion for reasoning
Samanya	Other equals, generally, ordinarily (*Sam+annya*)
Samarth	Viable and appropriate
Samarthan	In support
Samay	Comparable (Time, meaning, form)
Samma	Balanced
Samplay	Organized
Sampradan	Intended meaning
Samprati-	A prefix for balanced response
Samvay	If-then relationship, association
Samvid	Understand
Samvitti	Understanding with balanced certainty
Samvratti	Rational bounds for behaviors
Sandeh	Suspicion
Sandiggdh	suspect, dubious, uncertain
Sangya	Noun, commonsense,
Sankal	Intention, interest, commitment?, intuition?
Sanket	Indication, pointer
Sanshay	Uncertainty, suspicion
Sanshrayat	Mediated
Sanskar	Influence of upbringing
Sanskar	Upbringing
Sanslash	aggregated, together
Sansth	Informative (established) in relation to
Santan	Derivative (necessarily follows from, implication)
Sanyam	Balancing the choices
Sanyog	Coincidence for an outcome
Sarv	All (entire, complete)
Sarvgya	Knowledge of an entire *pramey* (not the omniscience)

Sat	Existent (tangible), existent
Satta	Abstract entity (understanding)
Shabd	Proposition
Shakti	Power
Shakya	Capable of doing or viable
Shrut	Oral a priori, oral tradition, heard
Siddhant	Established result or accepted view
Siddhi	Establish (identify or existence)
Syad	Doubt or uncertainty identified on the basis of a set of criteria
Tad/tat	That particular
Taimir	Diffuse, night blindness, not clearly defined
Tantr	Manipulation
Tanya	Stretch or extend
Tatparya	Intention
Tatv	A part of the tangible (or Content)
Tatv-gyan	Cognition of the underlying basis
Udaharan	Example (real world example)
Unmeelan	Opening, flowering
Upadan	Tangible basis (basis in fact);
Upadayah	Significance?
Upchar	Method, protocol
Uplabdh	Available for examination
Uplabdhi	Output of reasoning (such as a logical deduction)
Uplabhy	Worth examining (adjective of *uplabdh*)
Uplambh	Accessible for examination, to establish it-exists or is-so
Upman	Partial comparison, secondary measure
Upnay	Secondary devices for reasoning and validation, application
Uppad	Indication by association or analogy
Uppann	Result of comparison (inference, availability)
Uppatti	On the basis of the main conclusion
Upsanhar	Conclusion
Upyog	Use, application

Utpadnam	A definite outcome, result, conclusion
Utpatti	Valid derived result from conclusion
Va	Or (as in A or B or both)
Vachan	Narrative
Vadhak	Interruption
Vaidharm	Not normal behavior, out of character
Vaky	Opinion/assertion/statement
Varn	Form
Ved	Awareness for experience and response
Vibhavyate	Extensively examined and scrutinized in different ways
Vibhram	Confusion
Vichitr	Unusual
Vidambana	see Bidambana (ambiguous)
Vidham	Procedure
Vidhan	Prescribe method
Vidvisham	Intolerant of others (opinions, possibilities)
Vidya	A protocol, method of reasoning
Vigahat	Damage (verb)
Vigyan	Reasoned but uncommon cognition of properties and behaviors
Vikalp	Ambiguity, alternative
Vilakchan	Unusual characteristics
Vinash	Loss, destruction
Vinyas	Rearrange
Viparyast	Scattered states
Viplav	Disorganized
Vipratipatti	Difficulty in arriving at (a conclusion?)
Vipreet anvay	Reverse implication
Vipreet	Reverse
Virodh	Objection
Visamvad	Non-sense, distracted communication
Vishay	Topic (focus) of the construct for discussion
Vishesh	Sometimes, under particular conditions,

Vitand	argumentative, skeptic
Viruddh	Contrary
Vratte/Vratti	Bounds (as in set, group, behaviors, tendency)
Vyabhichar	Contradiction
Vyahatv	Implication
Vyapak	Permeates or pervaded
Vyapar	Purposeful action, rational dealings
Vyapti	Inherence
Vyasang	Distorted context
Vyatirek	Assembled or grouped
Vyvhar	Practical outcome, response
Vyavrat	Boundaries of the basis
Vyutpann	Deeper understanding of the underlying basis
Yad/yat	That or which
Yadracchaya	Choice
Yujjyate	Planning/decision made
Yukt	Appropriate
Yukti	Device or leverage

Conservation of reality for tangibility

Goal of Nay reasoning is interpretation of the viable parts of an object or concern (inputs) to arrive at an inference (output). Its conceptual foundation was set by Rishabhnath (ca. 3000 BC) as *net reality is the balance of inputs and outputs*:

उप्पानेई वा विगमेई वा धुवेई वा

Tripadi (of Rishbhnath) communicated by Mahaveer to Indrabhuti.

This *tripadi* (tripartite) relationship is a necessary condition for behaviors of all real objects including word constructs. It is constrained by the conservation principle mentioned by Mahaveer (599-527 BC) to his new disciple Indrabhuti Gautam (Goyam) as mentioned in many different contexts:

(क) उप्पन्ने, विगए, परिणए—भगवती ५/६ ।

(ख) उप्पन्न विगय धुवपय तियम्मि कहिए जिणेण तो तेहिं ।
सव्वेहिं वि य बुद्धीहिं बारस अंगाइं रइयाइं ।।
—महावीर चरियं (नेमिचन्द्र) पत्र ६६-२

(ग) जाते संघे चतुर्धैवं ध्रौव्योत्पाद व्ययात्मिकाम् ।
इन्द्रभूति प्रभृतानां त्रिपदीं व्याहरत् प्रभुः ।।
—त्रिषष्टि० १०/५

"पज्जवविजुदं दव्वं दव्वजुत्ता य पज्जवा णत्थि । दोण्हं अणण्णभूदं भावं समणा परूविंति ॥१-१२॥"
—पञ्चास्तिकाये, श्रीकुन्दकुन्दः

'सद्द्रव्यलक्षणम् ॥२९॥ उत्पादव्ययध्रौव्ययुक्तं सत् ॥३०॥' — तत्वार्थसूत्र अ० ५

Conservation as net balance of inputs and outputs may be paraphrased as:

- *You harvest what you sow.*
- *Accounting, as the net balance of debits and credits,* is the basis for fungibility of money, investments, accountability and responsibility for fair and equitable economic and social interactions in a civil society.

- Tangibility of action-consequence relations is in the balance of inputs and outputs.
- *Be sure it is the arithmetic where no term drops*.
- Something real cannot be created out of nothing.
- One does not get something for nothing.
- Something real does not disappear into nothing.
- Only nothing is created from nothing.
- The material content is conserved during a change.
- Tangibility of the steady state is a balance of inputs and outputs.
- Information content track rules and relations of material content. In this sense evidence is as measure based on standards and specifications.
- A state without the means of some change is also without the means of conservation.
- Magic box where *anything can go-in and anything can come-out* violate conservation.
- Miracles happen and people win lottery, but one cannot count on it for a viable business model. There is no free-lunch.
- Mahaveer advised (Gautam) *Goyam, do not spend time in self-indulgence that does not create value.* It recognizes value of time at hand that is to be conserved even if time is free and may appear virtually infinite.
- An empty medium for representation of inputs is boundless, but emptiness of space or continuity time without inputs represents only the non-existents that may be there but are not there.
- Conservation of materials, energy or information is enshrined in the laws of thermodynamics, chemical change, and the information sciences. The entire structure of scientific thought is built on its validity.

Reasoning with discrete and finite parts

Conservation of reality is a key insight that binds all thought in terms of tangible entities, events, and concepts. Their finite constructs have defined boundaries against the backdrop of boundless space and time. Thus

concerns about finite worlds exist against a continuum or blank medium of space, time, and abstract logic spaces. Such discreteness and finiteness of objects and concerns is a necessary condition for their representation and thought manipulation. Tangible parts of reality perceived from sense experience are symbolically represented in word descriptions, and reality of parts as inputs, outputs and evidence is conserved during logical manipulations.

Conservation of concept boundaries is necessary for knowing as a problem of measurement, and for the certainty of understanding that the integrity of parts and their relations holds in all appropriate contexts. Thus finite and defined entities and events identified through sense experience are considered, reasoned, evaluated, and measured against independent evidence. We speak of home as a discrete place. Event time is the time span during which identity of the object is conserved, and life time is a finite duration with a beginning and an end. Such discreteness assures that no two entities occupy the same space, or two events span at the same time in the same space.

Tangible concerns are communicated as bounded representations. For such reasons only a fraction of what mind concocts is effectively expressed. Meaningful constructs of such slivers of the experience have bounded form with defined content, characteristics, attributes, functions and relations, and such information is conserved during reasoning. Truth may lies in a shared convention of conserved information provided it includes not only what one knows, what others know, what others know that one knows, and what one knows that others know.

About non-existence

Constructs of boundless or infinite do not obey conservation criteria for tangibility. Such constructs are beyond scrutiny because they are self-referential and paradoxical. For the same reasons non-existence, ultimate, absolute, universal, forever and infinite are also beyond sense experience

and scrutiny, and untestable as useful guide for behaviors. The concept of conservation is not adhered in theistic religions which thrive on miracles of omniscience, omnipotence, infinite wisdom, Cosmic Awareness, Brahm, Maxwell's demon, perpetual motion machines, and gods. As suggested by Gautam and forcefully argued by Aklank, such omniscience as a class derives its power from the authority of self-reference as in "I am a liar", which is paradoxical, and cannot be affirmed or falsified. Even a meaningful current relation, such as tree-and-seed or chicken-and-egg, does not have enough information about *which came first* in the distant past. It is not even the same as guessing the past or the future form the current state of a falling leaf, unless one looks around for additional information.

Only nothing is forever, and nothing in particular is forever. Such expressions may be clever, but communicate little awareness for reasoning. It is not possible to affirm, refute, or interpret something that cannot be shown to exist, and reasoning requires shared awareness of its content and relations. From this starting point logical relations uncover only what is built into the inputs and assumptions. Logical reasoning is concerned about consistency of inputs and outputs, which may provide insight into their validity in relation to independent evidence. Such tangible relations are useful to deliberate meaning, significance, intention, motive, and relevance of the expressed concern. Such insights (*darshan*) can bring about qualitative change in perception that guides behaviors, and turn grunt to a dialog and measured response.

To recapitulated, real world is never contradictory. It is not created from nothing nor does it disappear into nothing. All searches to grasp such reality necessarily begin with incomplete information, and all real time decisions are based on incomplete evidence. Purposeful reasoning with affirmed assertions is meant to minimize inconsistencies and uncertainties with independent evidence. It begins with the assumption that that real world is knowable without wishful-ness of: *In the remote past, complete harmony prevailed among all beings. They had no desires as everything was provided for and all wishes were satisfied. Things changed when needs,*

wants became manifest. Ownership resulted as desires took hold. Worries about family required private property. Struggles and disputes required law and authority. Justice was needed to fairly resolve disagreements and conflicts. This required sharing of what one possessed and earned.

Concomitance versus causality

Gautam Sutr considers relationship of actions (*karm*) and consequences (*Paap-Punya*). Such reasoning is motivated by the known relations of the observed and measured concerns. It is not about why, nor does it assign an ad hoc cause even for a known effect. For example smokers have significantly higher chances of developing lung cancer. It is also correct that not all smokers get lung cancer, not all lung cancer victims are smokers. One may aspire for a better understanding of the relation and it may be possible to develop a treatment if the causality is known, i.e. what factors are responsible for cancer, and which ones are related to smoking. Meanwhile, based on the statistical trend the best guide is refrain from smoking, and as we know now even from second-hand smoke from others.

As mentioned before, validity of such inferences follows from invariant concomitance. Inference methods are well suited for multivariate complex world about which complete information is not available. Here causality is a black-box, and it matters little whether the cause-effect relationship is deterministic or statistical. Inferences based on independently affirmed inputs remain valid even without the knowledge of variables, terms, and the cause-effect relations. Observable and testable consequences of an inference are not based on tautology or self-reference. Such inputs rooted in the particulars may be captured in a viable but tentative inference subject to additional information. It remains useful unless shown to be inconsistent with the consequences.

Predictable and testable consequences of an inference provide insights into the basis of its validity. “What if” reasoning is applied to test-reject-speculate-modify an inference. Particularly useful are the predictions that may falsify the inference. Such predictions test and stretch the known boundaries of the inference. An inference remains useful unless it cannot be reformulated to accommodate new inputs, and is to be discarded if contradicted by affirmed inputs. This strategy proceeds in fits and starts. It is about asking right questions for verifiable predictions that extend the reach

of an inference. Such constructs of shared knowledge are incrementally built from inputs of emerging particulars.

Words to explore reality of *Is It So*

Humans effectively use bits of sound (phonemes) to communicate complex thoughts. Words also permit interpretation of incoming inputs in relation to the past experiences. Such language abilities are mediated by products of gene that come into play with the epigenetic changes during the development (upbringing). Languages extract perceptions from the sense inputs of external and internal experiences. Such impressions (mental images) are used to reconstruct (represent, vocalize and communicate) linear strings of bits of sound. Such linearized form information is also inherent in written strings of alphabets (words and text), numbers and symbols for abstract mathematical relations. Similarly, long but unique sequences of four bases in inherited DNA molecules contain all the unique genetic information of each and every organism that ever lived. Linear sequences of analog or digital signals of electrical or light impulses carry information for radio, phone, TV, computing, or cyber communication. In short, linearized information is well suited for transfer and interpretation with fidelity, efficiency, and speed that is limited only the nature of the medium.

Genes and wealth are inherited only by progeny. Virtually all other human enterprises are about symbolic language(s) to create shared knowledge. Such constructs can be transferred over long distances and over long periods of time. They continue to grow and their validity also increases with use. Creation of value by knowledge is not a zero sum game. Also products of shared knowledge (sciences and technologies) are usable by those who do not have such knowledge. Personal knowledge lacks such features. In short, *viable ideas grow like a vine where it finds space and light, and barren ideas do not have off spring*.

Languages permit sharing of sense experience between the speaker and the listener. Such mind to mind to communication with words requires rendering thoughts to word strings that are meaningfully interpreted by the listener to form a comparable mental image. Sutt (in Prakrit) or Sutr (in Sanskrit) is for a string of sounds (word-construct) that conceptually stands

alone for meaningful communication. No matter how it is done, a word construct is meant to extract a part of the phenomenal world that resonates with its mental image of the concern from its asserted content and context. The listener may scrutinize its meaning and significance for reasoned response.

When words come alive

Ever since *words came into being, alphabets are asked to bear all the human investigations and all the aspirations and appetites that we have and that have ever existed in human history - it is terribly abstract*. People often wonder out aloud with such words. Those who know how to use words are intrigued by the reach of word constructs. Those who do not know use of words are mystified by words, although mystery is not in the individual words *per se*. Most of us are swayed by word of wishful, riddles and paradoxes, and most of the word usage is about constructs of such fantasies. Each fantasy is a world of ought of what we wish rather than what it is. Thus all word constructs are fantastic, and remain just so unless shown to be otherwise. Realists harvest the power of word constructs to shape real world. Only such constructs move forward an argument, and their power comes from the viability of message they connote and how it resonates with listeners. Such real world constructs are not necessarily about a physical (actual) world, but all viable and valid messages obey rules of real world behaviors and conform to real world, so do symbolic manipulations with methods of logic.

The Content of Word Constructs

Valid inference proposition captures a part of experience with *avinabhav* (ordered invariant concomitance) to independent evidence. Such assertions may take the form of a fact, information, abstract, summary, opinion, anecdote, or elaborate narratives of the experience. Rarely does all that is intended by a speaker is spoken, and even less is grasped by a listener. Words are chosen for the purpose of what we wish to communicate. Uncertainties prevail along the way about what we grasp from the experience: What part of is captured in words? What part of is grasped by

the listener? Did listener reconstruct experience comparable to that of speaker?

What is describable?

Non-existence is beyond sense experience of the speaker and the listener. As product of imagination such streams of consciousness communicate little and are barren even if described in terms of lack of attributes of real objects. Such constructs may be repeated, but descriptions do not cohere into sense experience. Unknowns also lack constraints for a meaningful description, as do dreams, hallucinations, apparitions and visions. Experiences of fleeting, momentary, undefined, transient, and random happenings are difficult to put in meaningful words. Their narratives may communicate impressions, but little else to reconstruct the experience. Impressions of faith-based and memorized narratives are also not viable for reasoning and scrutiny. If there is reality to such descriptions of objects of faith, it remains beyond reasoning. Self-referential constructs of mental impressions of wishes and desires also remain beyond scrutiny with independent evidence.

Whether in word or painting, representational constructs have an affinity to our internal fears and aspirations. It is a habit of mind to pattern a representation by picking and choosing. The challenge is to create an order that provides insight about the underlying reality and further the understanding of the world of concern. Even the ordered words cannot create order out of nothing. Fiction writers take their fans on journey of virtual worlds created in unfamiliar or surprising ways from bits and pieces of real world experiences. What is imagined and experience is not necessarily the same deconstructed reality disconnected from its context.

Scientific enterprise is about picking and choosing parts that have concomitant invariance to the world of concern. Here one does not choose to 'create' an order that is just concomitant. One looks for an order inherent in parts selected on the basis of certain criteria. It is not unlike identifying details of trees while looking at the forest. Chaos of trees does not interfere with attenuation on individual trees. Neither trees nor forest are an ad hoc

construct of mind, but pieced together from parts related on the basis of a defined set of criteria. Defined parts and their criteria-based attributes are integral part of a formal scientific construct that is capable of predicting yet unknown attributes and behaviors. It is a search for concomitant invariance by ordering a construct from mental images of the observed and measured parts.

Organisms interact with world through senses

The external world is what it is. It is never contradictory. It is not irrational although it may appear random and complex with apparently superimposed and simultaneous happenings. Our senses may filter out some of the chaos as they are attuned to detect changes and blank out the unchanging. It is not clear how, but our emotional and intellectual affinity to happenings does play a role in what we pick and choose from the chaos in our experience. Awareness of such sense inputs (stimulus) for response is purposeful to meet demands for survival. Overt and covert choices that an organism makes are not ad hoc or random, but rooted in the reality of the organism and its environment for example to minimize risk and energy cost. Successful behaviors as well as stimulus-response are built with a thresh-hold for awareness. Similarly, narratives of metal images create comparable sense experience in the listener, and their thresh-hold cognitive may depend not as much on the objective reality of 'is' that here and now but on subjective factors that seek 'ought' for the future as in *what it does for me*.

Knowing is a problem of measurement

We identify discrete parts, become aware of parts. We know the whole through parts, and we reason through such parts. Whether or not this modular approach to understand objects and concerns is rooted in the makeup of the world and its workings, but it is likely the way our mind processes new inputs in relation to experiences. Curiosity driven searches for viable parts begin with:

what or who (the content as individual, entity, category)
where (in space)
when (in time)

Sense inputs provide a measure of the object to identify and cognize it. Such understanding expands the scope of search to *what is it about*. Boundaries of cognition are further explored through:

how large or long (size)
how many (count in numbers)
how far
how long ago (time duration),

Concept **development and evolution** begins with:

how does it work?
is it always so?
how do you know?

Conceptual grasp of the object is **reaffirmed** by:

who says so?
why should you trust?
what is it good for?

Not even all questions of a child are curiosity driven. Nor every grammatically correct word construct is a legitimate question. Certain types of why questions are however useful to expose sophistry in *my child is most intelligent, my wife is most beautiful, my god is the only one.* Sophistry of

self-referential *Why am I here* is in the intent and purpose. Its implicit and causal why can also be turned into an impasse as in the riddle attributed to King Solomon:

That which has come to be,
that is what will come to be;
That which has been done,
that is what will be done;
And so there is nothing new under the Sun.

Nay reasoning does not delve into such "why" that relate to unknown or circular causality. On the other hand, action-consequence relations have implicit *why* that is better phrased with what and how:

How we came to be in this situation?
What am I doing here? How we do it?
What do we do now?
Why we did it?

More about "Why" questions

"Why" questions and their answers may invoke adherence to conservation of reality in relation to independent evidence. *Why it is so* as such leads to infinite regress or teleology. Identified hierarchy of cause and effect may be meaningful in relation to independent evidence for:
(a) **Awareness** to connect the internal or external parts of the evidence.
(b) **Cognition** to identify tangible relations in the evidence.
(c) **Perceptions** to fill gaps to judge and make purposeful decision.

Reasoning is a purposeful activity to guide behaviors. *Why* in response to a proposition calls for clarification of what may appear confusing and confounding. If so, the construct may be modified, or discarded as meaningless and irrelevant. Perceptions encourage representations to re-cognize relevance of the *moment* for emerging challenges. The past may remain relevant but only in the sense that *happy families are all alike*. Far

more meaningful are the facts that make every unhappy family unhappy in its own way. Concerns are generally about such unhappy disruptions. One may not be able to tell *why it is so* but that is the human condition. Other challenges for affirmative reasoning are the not-so questions or the what-if concerns.

What makes unreal?

Reality exists independent of its mental constructs, and it is non-contradictory. Senses track pats of such actuality as they respond to specific stimuli: skin to touch, tongue to taste, nose to odor, eyes to light, ear to sound, and many other organs and receptors for internal and external stimuli. Acuity, discrimination and ability of senses to detect gradients of stimuli are their best at low levels of inputs. Stimulus response and feedback is also optimal if the processing system is not overloaded.

Complementary inputs from different senses to the mind cohere into mental images of the external world. Whether or not such images capture all features of actuality in real time, what we perceive from such images is certainly an edited subset of the past 'is' mixed with wishes and desires of 'ought' for the future. Since sense inputs track reality that is not contradictory, the contradictory and flawed perceptions may lie in the processing of the inputs and reconstruction of mental image of the experiences. Illusions, delusions and paradoxes are such faulty outputs. It may be the price we pay for rapid processing of inputs.

Conscious and deliberate reasoning is after-the-fact (a posteriori) attenuation to seek certainty by sorting inputs to identify uncertainties due to incomplete, flawed, unknown, or inconsistent inputs. Degree of confidence in output (conclusion) of such reasoning increases as its liabilities are addressed with more information and evidence. Any method or protocol is useful in search of the plausible provided all searches cohere into a consistent conclusion. Its truth value is in its consistency with all that is known.

Purposeful reasoning is not mere word manipulation. Self-referential or contradictory constructs are fatally flawed. Inconsistencies are addressed by scrutinizing assertions or faulty constructs that cannot guide reasoning. Fictional narratives of make-believe and articles of faith, miracles, dreams, rumors, prognostications and propaganda suffer from contradictions and inconsistencies. Even if miracles happen and people win lotteries, such means are not viable business models to create value.

Intelligence: a human attribute

Worlds of our experience are knowable and understandable if we explore, discuss, make decision, respond, and learn from experiences.

In Nay reasoning content, context, and their relations to an identified object of concern is affirmed with independent evidence. In such internal (*parokch*) processing of external inputs (*pratyakch*), awareness, cognition, perception, memory and recall are a cohesive experience. It is accessibility through words makes language indispensable for mind to mind communication.

Reasoning is habit of mind. Ignorance is a state of mind to reason without content and context. Even the best chosen words are mere fireworks unless they are true and meaningful to the content and relevant to the context. Reason empowers words that can be engaging in conversation, show empathy in discourse, and act as weapon in the debates. Unarticulated concerns remain dark and scary. So also not knowing that one does not know, or not-knowing that others know that you do not know. Such ignorance may be the human condition but it is not human destiny. Misplaced faith distracts (*vi-nay*) or disregards (*ku-nay*) reason to seek grace and salvation from the Unknowable, Non-existent, Omni-present and Omnipotent Omniscience. It is not possible to look for ways to reduce ignorance unless acknowledge that it is there.

Concerns and doubt surface at the threshold of all new worlds where inputs are often incomplete, complex, and deemed insufficient or not relevant. Addressing a concern from such threshold calls for ways to identify it parts. A viable construct may facilitate further exploration by identifying what we know for sure and also what we do not know for sure. An inference consistent with inputs, and not in-consistent or contradictory to real world, permits reasoned choices and decisions for future behaviors.

Validation and interpretation of assertions and inferences are shared processes. Resources inherent in shared experience, information and knowledge provide a rational basis for exploration. Sharing thought begins

with a well formulated concern communicated by words in non-threatening and non-polarizing environment. Effective use of languages requires conventions for defining the problem and to communicate the content, meaning, intention and inherence. Context, syntax and other attributes communicate and predicate a relationship between the subject, object, and action (verb). Useful assertions help thought to seek harmony of the internal knowledge. Misunderstanding and mistakes are also necessary part of communication. It is human to make such mistakes.

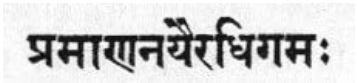
Humans have learnt to program machines with certain attributes of human intelligence. Machines are good at doing what they are told to do, and do it repetitively and tirelessly without complaining. At least for now they lack individuality of human mind, i.e. the way humans read and infer what others mean and think. It will be interesting to see how far machines can do what the best of human minds can do including decision making. Can the big data make up for the collective diversity and plurality of human experience as it is transmitted and interpreted across generations and large distances?

Constraints for a valid assertion

A word construct communicates mental image of sense experience. Its assertions are colored by perceptions and beliefs based on prior experience. Assertions are validated by scrutiny with independent evidence to seek consistency of the concern with facets of independent reality. Such reality based reasoning is amenable to rules of logic that adhere to behavior of real objects, such as an object is not created from nothing, nor does it disappear into nothing; it cannot exist at two places at the same time; it cannot be present and also be absent in the same space at the same time; two objects do occupy the same space at the same time. Such constraints are also the basis of mathematical descriptions if the constructs of objects and relations conform to reality.

Self-Assertion is not self-reference

A living organism asserts: *I am*, *I exist*, *I will*, *It is so*, I think. Such assertions relate not only to its aspirations but also to its sense of self and identity (*atm*).



Reasoning with such assertions derives authority (validity) from evidence (*Tatv-Arth Sutr*) interpreted with rules and tools of scrutiny to address fallibility and uncertainty. This because

- Refrain is a necessary part of validation of assertions because mind has tendency to hijack words.
- Evidence from sense inputs and their word constructs may be in the form of assertions, interpretation, or inference.
- Significance and relevance may provide insights but does not validate reasoning.
- The content and context of a word construct may be influenced by intentions of the speaker, and also the quality of interactions and perceptions of the listener.
- Reality captured through sense inputs is modulated in the receiver's mind, which poses challenge of evaluation of word constructs. With varying degrees of emphasis on the validity of what one knows and how it is perceived by others it is possible to evaluate validity of word constructs.
- Abstract concepts such as directions, energy, pain are rooted in visible reality, and they can be logically represented and manipulated.
- Constructs based on use of numbers and symbols rooted in reality are logical and obey rules of logic. Zero and infinity obey some but not all rules of logic operators. Zero can be forced to do so only within certain conventions, such as a place-based value.
- Word constructs that do not exhibit real world behaviors are likely to self-referential or contradictory.

Nay versus Nyay(a)

There are significant differences between Nay and Nyay (Hindu) methods of reasoning with assertions:

- Vacch Nay guides discourse where all insights are refutable, and reasoning is not possible if asserted insight, evidence and inference is not affirmed, or cannot be refuted. Nay reasoning for successive approximation is contemplative and open ended until viable alternatives are not found. Such reasoning moves from one level of certainty to the next by reducing identified level of doubt and uncertainty.

Gautam (607 to 515 BC) compiled and organized the Nay practices of the post-Vedic and Upnishadic period for deliberation and discourse. The smoke-fire syllogism for inference was used at that time. The term Nay or Nyay does not appear in Gautam Sutr compiled by Akchpad. Some of the terms derived from Nay are prominent, such as ***up-nay*** for secondary device; ***nigaman*** (***nay-gaman*****)** for the result of reasoning based on the use of a particular consideration; or ***nir-nay*** for a decision based on reasoning consistent with evidence. These terms suggest that Nay (methods, devices, strategies) is inherent in the formulation of a concern as an assertion, and also in the scrutiny to arrive at an inference through evidence, analogy and comparison. May be the generic term Nay is not is implicit as an over-arching topic for reasoning about the content and context through evidence predicated by word assertions. For example, in practice we do not use the term grammar of reasoning when we talk about the content, context, syntax, assumptions, or evidence behind a word construct. Nonetheless it is understood.

The term Nyay is found in Nyay Bhasya of Vatsystan (ca. 400 AD). In the title of commentary Vatsyayan may have introduced the term Nyay to suggest general significance of Gautam Sutra. Since its inception the term Nyay has been used to rationalize insights and assumptions on the basis and authority of ad hoc assumptions. Nyay has also been interpreted as philosophy, logic, evidence-based decision making, justice and fair play.

Nyay methods were adopted for legal and court purposes to serve justice within bounds of existing (common) laws. The Hindu Nyay places emphasis on scriptures, which distracts it from delving into insights of Hindu philosophies and methods of reasoning. It is not surprising that Nyay has also been used for Matsya-nyay or the justice of big fish eating the smaller ones. Nyay methods have been also been used for argumentation for winning, wrangling, accusation, discrediting, and at times even for misrepresentation and character assassination.

Siddhsen Divakar (ca. 500 AD) in Sammai Sutt reiterated the ancient Nay position that reasoning is not possible without explicitly identified content and context of the concern to be deliberated. Siddhsen Divakar mentions Gautam in his elaborations of the fundamentals of Nay reasoning about a concern. The term Nyay is not found in his works. However the Nyay-Avtar or The Nyay-Incarnation title to one of his works alludes to Nyay as an incarnation.

Aklank (620-680 AD) elaborated the Nay approach and also demonstrated limitations of some of the newly emerging Nyay arguments. For example he argued that the Buddhist construct of 'nothingness' (***Shoonyata***), or the Brahminical constructs based on the variations of omniscience and Cosmic Consciousness (***Param Brahm***), are self-referential and cannot be affirmed by independent evidence. Also objects of such insights (***Darshan***, philosophies) do not meet criteria of tangibility through sense-awareness, evidence and representation. Aklank does not use the term Nyay yet he is celebrated for his debates with the Nyay scholars of all stripes. Aklank uses the term Nay in the context of algorithms and syllogisms for evidence-based reasoning for validation of representations. Both Siddhsen and Aklank refer to the affinity of Nay to Jeetthan presumably because perceptions are validated by making room for doubt (***syad***), and also by entertaining the alternatives (***anekant***) relevant to the content and context under consideration. Aklank clearly distinguishes logic (***tark***) as a method of deduction based on defined and known parts whose relations are known.

As developed later, goal of Nay reasoning is to arrive at inference propositions from inputs affirmed by evidence, and to rule out contradictory and inconsistent assertions and propositions. It is a shared enterprise where diverse methods, strategies, and evidence emerge along the way to support, refute or falsify inferences. At the end of this search lies the *keval* (only) inference that is validated by all available evidence. Only the future can tell if it is so.

World is Knowable

Reasoning begins with the assumption that the world of our experience is knowable and understandable. Knowing through identified parts is a problem of measurement. Its understanding emerges from the cognition of concerns expressed with such parts in relation to evidence. Resulting perceptions guide behaviors to develop a sense of self and sculpt identity (***Atm***).

Reasoning with established evidence is probably as ancient as the human origins. Nay is an ancient Prakrit word for boat or ferry. *Nay devices for reason ferry an input with certainty to an output.* By manipulating cognition, reasoning also fashions awareness into usable perceptions. Abstractions are relevant to real world if the inputs and outputs are balanced. Such reasoning is useful not only to make decisions about the past, but also to use past to see the future. As we process the new inputs, the present is cognized in terms of the past experiences. Understanding permits evaluation of viable options to address concerns. Choice and decision to act on a concern is based on perceived outcome. In a real world chance of success improve if such actions and behaviors are based on tangible facts and relations. The search may be misguided by make-belief, or if we do not learn from experience.

Constraints of Nay reasoning

Living organism assert by responding to inputs. Cognized inputs play a role in language communication as well as shared interpretation and validation of experience. Words may facilitate reasoning but reasoning is not about words. Perceptions of what words communicate guide individuals towards inferences, and valid inferences lead to successful behaviors (See Jeevatthan on this site).

Natural languages of the pre-Aryan India are called the "The Praktrits." They form the ancient roots of many of the regional languages of modern India that have been purified (literally Sanskrit) to varying extents. Currently available ancient Prakrit literature is extensive (Varni, 1997) but has attracted little attention from the Western Scholars. Breadth and depth of the Nay literature rivals the Nyay material where the art of inference has become a tool for the ad hoc.

Nay is a Prakrit word for boat or ferry. *Like a boat, Nay devices ferry reason from one point of certainty to another.* In Pali, another ancient language of India, Nay relates to leading to, instruction, plan, method, way, manner. Thus based on certain key assumptions, unlike the negations of *na-ayam* or *nayati neti*, the Nay reasoning directs cognition from one affirmed assertion to the next:

1. Assertions verified by independent evidence (*paman* or *praman*) form the basis for verifiable constructs.
2. External evidence builds on the awareness of sense inputs *from all that is in front of eyes* (*Pratyakch*). Such sense awareness is cognized in relation to the internal inputs from the mind or *all that lies behind the eyes* (*Parokch*).
3. All individual concerns are the response of the internal self to the external inputs.
4. A concern is established on the basis of observed and measured behaviors that may be inconsistent with established behavior of a class.
5. A concern is affirmed by shared cognition and independent evidence.

6. A concern remains viable as long as the inputs and outputs are remain balanced during interpretation.
7. Lack of affirmation of a concern does not negate it. Independent evidence is required to affirm the negation.
8. The term unknown or not-known is applied if certain characteristics of an established concern are not known.

With such assumptions a viable concern and its parts can be manipulated and interpreted. Concerns that do not adhere to such constraints are beyond rational consideration. Such constructs do not adhere to the limitations of the space and time. Their fictional representations are figment of imagination where one gets only what is put in. Their concept boundaries, characteristics, attributes, and behaviors are beyond independent verification. Such expressions are self-referential. In short their existence cannot be independently established or falsified.

Limitations of binary logic

The binary Aristotelian or Boolean logic as well as the Hindu Nyay interpretations do not require independent evidence to affirm, and also to affirm its negation. For example, an organism is considered alive if a set of attributes are affirmed. However, lack of one or more of these attributes does not lead to the characterization that the body is not alive, and certainly not to the deduction that it is dead. The organism may be dormant, hibernating, unconscious, sleeping, or in trans or coma. Even a body with failed heart or damaged brain may require more specific evaluation of the attributes and symptoms.

An effective use of the **Not** operator in a complex world requires affirmative evidence for the pro as well as the con of each assertion. The *con* (opposite, reverse, converse) is not necessarily implied if the evidence for *pro* is not affirmed. Independent evidence is required to negate "it is not alive" and then a positive evidence for "it is dead" by such and such criteria.

Effective use of **Not** and **All** operators in conjunction with **And** / **Or** is absolutely crucial to effectively identify contradictions, inconsistencies, and

paradoxes. By breaking away from the binary of dead or alive (inevitable), more tangible concerns emerge about the transitional and the intermediates states and relations of self with the other.

A concern affirmed by evidence has defined boundaries. Such a pieced together script may appear blurred but the reasoning moves with a sense that each of the affirmed constructs is within the limitations of identified reality. What lies outside the boundary is not affirmed by evidence. Also the evidence that affirms a construct does not affirm or negate anything that may or may not lie outside the defined boundaries.

Reasoning about the experiences of external world awakens the internal world. It is not about the cosmic consciousness but about cognitive awareness of the worlds around us. Organisms go about their business of living that also requires interactions with external world. Each organism is the decision maker and learns from consequences of its own actions to change behaviors. Chances of success increase for those who learn to reason with independent evidence. Strategies are also required to reason with incomplete information. Even through logical deductions one can get out only what is built into the inputs and conserved during thought manipulation.

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Shadow of Ignorance Obscures Mental Images:

On the epistemic utility of ignorance and associated states

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Survival of organisms requires response to sense inputs and feedback. An intuitive picture or mental image of reality from sense experience is apparently structured from orthogonal and independent sense inputs in association with past memories. Such images are not necessarily visual but may have such qualities. Play of mind with information in mental images processed by molecular actors are guided with rules of reality to assure non-contradictory outcome of actions for successful behaviors (Rogers and Jain, 1993). Such functions have evolved to find food before becoming food, and fight or flight when in doubt. Their success depends on learning from trials and errors to compensate for incomplete information and uncertainties with consideration of what could go wrong. Outcomes are also influenced by games played on mind as illusions, mistakes, surprises, ignorance. Loss of time, energy and opportunity associated with ignored or misinterpreted information threaten survival. Equivocation, cynicism, wild goose chase and vicious circle of sterile ideas encourage contradictory or inconsistent interpretations that compromise outcomes.

Certain features of the central nervous system (CNS) for the functions of mind are reasonably well understood. CNS is a network of brain and associated organs to cognize discrete objects and concerns perceived from sense experience. Species specific architecture of organs is evolutionarily determined. Brain is organized with genetically inherited instructions to

communicate with other organs (Swanson, 2003), and their CNS functions are established under epigenetic influences during the development (Cabej, 2012). Organisms at birth are instinctively aware of their survival needs, and their prenatal functions are further coordinated and optimized with inputs from the environment that is likely to provide for its needs. For such purposes sense inputs are interpreted and outputs are communicated to neuromuscular system for rapid motor response and feedback, and also to neuroendocrine system for somewhat slower metabolic response, including energy supply and storage of information. Through such functions the mind also learns to project potential liabilities of unknowns.

Sense organs for physical and chemical stimuli (touch, taste, odor, light, sound) are windows for the external reality in real time and space. Interactions with the environment are also facilitated by other sensors, such as shifting of the center of gravity to position and balance body movements. Specific receptors on internal organs similarly mediate response to pain, hunger, thirst, osmotic changes, temperature, regulators, signals and messages. Slower and longer lasting effects of stimuli are mediated via coupled trans-membrane receptors that regulate cytoplasmic functions. Information about intensity and gradients of stimuli received by sense receptors for rapid response is coded as sequence of electrical signals and transmitted through bundles of nerve fibers to specific regions of the brain. Regions of brain have specific functions (Swanson, 2003). Its layered structure is nearly developed in a newborn, and additional neural circuits with migration of pre-natal neurons are laid out later for specific functions. During the first 18 months the number of synapses increases more than ten-fold, and then decrease by about 40% through the rest of life. Such synaptic plasticity is believed to upgrade and strengthen neural circuits used during the postnatal development, and those not used become dormant or are lost.

There is emerging consensus that the rapid information processing functions of CNS are mediated by electrical changes in circuits of neurons interconnected via synapses on their axon and dendrite extensions (Kandel, 2006). Trans-membrane gradients of ions and their relative permeability

determine the membrane potential. Neurotransmitters and membrane potential regulate ion channels and in turn control threshold for excitability, frequency, duration, and rate of propagation of action potentials for transmission of information. Signatures of electrical activity in regions of brain are diagnostic for mental functions. Nuclear magnetic resonance images also show accumulated metabolic changes in regions of brain associated with psychological and disease states. Loss of motor control in Parkinson's disease is associated with loss of only 20,000 neurons in a certain region of the brain. Human brain has 80 billion glial cells, and as many neurons interconnected possibly through 10,000 synapses for each neuron (Herculano-Haouzel, 2009). These provide more than 100 trillion components for neural circuits.

Nature and nurture together program CNS to interpret and respond to sense inputs. Attributes of individual mind and identity develop with skills and behaviors that seek significance of sense experiences and meaning of mental images. Architecture of neural circuits for information processing functions remains to be conceptualized. Ancient suggestions invoked duality of brain as a part of worldly physical body and mind as part of the other-worldly omniscience. Mind as engine, machine, electronic circuit or binary digital computer also failed to provide insight. Our focus below is on word communication that requires processing of sense information in real-time, and thus also provides insights into utility of ignorance.

Mimicry, vocalization and speech, including slip of tongue or tongue tied, are neuromuscular responses of CNS. Quality of vocalization is a marker of sexual differentiation, health, virility, as well as cognitive dissonance. Words communicate awareness of an object or concern abstracted as a discretized part of experience. Symbolic languages permit descriptions that anchor meaningful parts of mental images to communicate awareness of an experience to share concerns and deal with uncertainty and ignorance. Rule bound descriptions of the observed and measured parts of an object evoke cognition of its content and context to infer behaviors. Perceptions of meaning and significance of sense experiences guide choices

and decisions for actions. Thus word representations permit ready reference of objects and relations for concept formation.

Fleeting mental images may derive in real time or emerge after the fact from flickers of ever changing sense experiences (Pinker, 1997; Shepard, 1978). Some persist and most dissolve away into oblivion. Variations in the content, medium, detail, and other features of mental images are likely to be as varied as individual perceptions and motives. Words anchor significant parts of mental images, and word constructs capture relations between the parts. Word descriptions are meant to elicit comparable mental images in the listener and the speaker, and thus communicate information about sense experience. Convention bound languages further facilitate manipulation, deliberation and discourse for scrutiny, validation, and evaluation of implications, consequences, meaning and significance of shared experiences. Written forms liberate thought from extraneous influences. Assertions and propositions that track rules of reality lead to inferences that are likely to be affirmed by independent evidence. Insights and ideas rooted in shared realities address concern and resolve conflict. Their representations as part of empirical knowledge remain deficient and incomplete (Rescher, 2009). Measure of success of shared representations is utility of outcome, and their shortcomings are addressed by trial and error (Feyerabend, 1975). Words devoid of real content and context generate sterile images that do little more than evoke emotions and feelings.

It is remarkable that word-strings as one-dimensional renditions of mental images of multidimensional experience of a speaker evoke comparable awareness, cognition and perception in the mind of a listener. Such communication builds on the tension and dynamics at the boundary of *what is said* and *what is unsaid*. In words of Thomas Pynchon: *Ignorance is not just a blank space on a person's mental map. It has contours and coherence, and all I know rules of operation as well. So as a corollary to writing about what we know, maybe we should add getting familiar with our ignorance...* . Epistemic value of identified ignorance is not only in what is

shadowed but also what casts the shadow. Paradoxically, awareness of what we do not know makes us want to know more. Also more we know we are likely to see more and want to know more.

Certainty against shadows of ignorance is an experienced quality of knowledge (Dovring, 1998). What one knows lies against the backdrop of the awareness of what else one knows, what else is needed and whether or not it exists. Processing of information and evidence for learning, understanding and discovery of *it is* proceed along its boundary with *it is not*. Such epistemic nuances are communicated with subjunctives as in *to not doubt that ..., to be certain that ..., to think that ..., to not deny that ..., it's true that ...*, and other expressions that trigger indicative mood. Perceived ignorance at or beyond the known boundaries is qualified as *to doubt that ..., it is doubtful that ..., it's unlikely that ..., it's uncertain that ..., it's possible that ..., not to believe that ..., it's not certain that ..., to not be convinced that ..., to not be sure that..., to not seem that ..., to not think that ..., to not suppose that ..., it may be that ..., to deny that ..., it's not true that ..., it's not certain that ..., to not imagine that ..., to suspect that ..., surprisingly it is that...* Expressed acuity of sense experience encourages exploration of objects and concerns in fiction and stream of consciousness that resonate with feelings and emotions.

Absolute certainty about *it is* is in the realm of omniscience that also includes everything else. Essence of science is measured certainty about small parts of the world. Reasoning for epistemic certainty about *it is* is in relation to what *it is not* or *is unlikely* on the basis of available evidence. Methods of science also seek incremental certainty for *it is* in relation to what remains as *likely* but is not yet resolved with independent evidence. Each new discovery uncovers a part of what was not known before, and also brings to light its relations to all *that is known*. It increases awareness of what is still unknown. Like new shoots on a vine, such knowledge incrementally fills the gaps in the mental image of the underlying reality. Death is inevitable. Uncertainties of untimely death have been however chiseled away with tools of science which have more than doubled the humn

life expectancy during the last 100 years. Methods and products of science continue to improve quality of life, even of those who are without such knowledge. Unfortunately, unintended consequences of such developments also influence the willing and unwilling participants who fail to adapt to the changes (Jain, 1998; Jain, 2001, 2006).

Science is at its best when faced with the challenge of the unknown that is Samenable for asking meaningful questions. In a delightful book Firestein (Firestein, 2012) asserts that science is driven by such ignorance. It is a primer for appreciation of *good ignorance* by undergraduates and citizen scientists. It builds on insights of other scientists, and I am sure similar views are held by all who labor in the trenches of discovery. My take for what follows is that ignorance is a necessary part of epistemology to establish knowledge. It is not about paradigm shifts that redirect thought at critical historical junctures (Kuhn, 1962), nor is it about building an all-purpose road where meandering trails existed before. It is about trail blazers who work with little more than a mental image of the terrain. It is an *Alice in Wonderland* kind of world to be fathomed by wobbling *Through the Looking Glass* that separates the known from unknowns including ignorance of not knowing where one stands and where to the next step.

Conundrum of doubt and ignorance (Rothman and Sudarshan, 1998) can be disconcerting. Some quit in frustration (Schwartz, 2008). For those who persevere (Feynman, 1984): *the scientist has a lot of experience with ignorance and doubt and uncertainty, and this experience is of very great importance. When a scientist doesn't know the answer to a problem, he is ignorant. When he has a hunch as to what the result is, he is uncertain. And when he is pretty darned sure of what the result is going to be, he is in some doubt. We have found it of paramount importance that in order to progress we must recognize the ignorance and leave room for doubt. Scientific knowledge is a body of statements of varying degrees of certainty -- some most unsure, some nearly sure, none absolutely certain.* Monod generalizes*: science is nourished by restlessness, anxiety, dissatisfaction, and agony of mind.* There are good reasons to sweat over the unknowns. An educated

guess about *what it is that one is after* is the beginning to formulate questions, select suitable methods and tools for observation and measurement, design controls, interpret results, spot serendipity to turn surprises into opportunity, to see if something is wrong, and whatever comes next. Quality of ignorance in a fishing expedition by trial and error is not the same as in random walk of drunken sailor looking for dark cat in dark room without knowing if it is there.

Awareness of what may be shadowed by ignorance is an uncommon sense that turns hunches and gut feelings into ideas and actions by discarding make-beliefs and sterile dead ends. Information and understanding abstracted from observable and measurable parts of world provide insights into causal and hierarchical relations that uncover ignorance of what remains unresolved. Perception of certainty built on meaningful parts of known world empowers search for liabilities to nourish futuristic visions and musings of what it could be (Maddox, 1998). Mentors motivate budding scientists to see beyond the obvious, provide skills to spot realities in mental images, and persevere to meaningfully entertain doubt and turn ignorance into opportunities for lifelong pursuit of hypotheses for viable ideas, and much more. A prepared mind follows leads and benefits from lucky breaks for *aha* moments. Such skills are also useful to ward off buzz of *bad ignorance* encountered not only in cocktail banter but in pseudo-intellectual coverage of politics, faith, economics, health, nutrition, medicine, global climate change, and other life and death issues.

Enviable success of science comes from methods of trial and error. The process appears and is chaotic. Science emerges stronger after each confrontation as its understanding thrives on scrutiny. Certainty about an inference increases with each reevaluation with independent evidence, criteria, or whatever else may surface as concerns. There is no definite end-point for this open-ended search where incremental certainty follows from ignorance uncovered. Their epistemic utility emerges as each doubt that is resolved leads to the next, and also from insights from unintended consequences, surprises and serendipity.

Certainty with conservation of information is about whether or not something exists as the starting point to balance what remains. Classical binary logics for deduction use complementation of not-true as false with unknowns excluded. It permits closure of relations in Boolean algebra (Jain, 2011). Excluded middle is expressed as fractional probabilities of crisp logic states (Smithson, 1988), or as a set of fuzzy logic states. Bayesian theorem re-considers probabilities with emerging evidence (Bernardo and Smith, 1994; Bovens and Hartmann, 2003; Williamson, 2010). Evidence- and outcome-based methods practiced in medicine, law, education, administration, and other complex systems have the caveat that correlation is not causation. Skills are also required to continually ask questions to uncover shades of ignorance (Fiengo, 2007), and to identify and evaluate emerging surprises (Gross, 2010; Halpern, 2003; Hammond, 1996; Lemons, 1996; Trinder and Reynolds, 2000; Zimmerman, 2008). It appears that search for a valid inference may follow a convergent polynomial where certainty increases by successive resolution of liabilities in the higher order terms.

Prior knowledge as well as memories and beliefs as part of a mental image facilitate judgment and constrain interpretations. Discourse in science moves forward with *I do not see anything obviously wrong, but how about this or that*. It builds awareness of what remains (Malewski and Jaramillo, 2011). Einstein's quip that *god does not play dice* did not discourage pursuit of quantum mechanics which opened up whole new phenomenal world of subatomic particles. Twentieth century physics has successfully negotiated such serious challenges to rework its founding assumptions. The Newtonian universe is extended by Einstein's relativity but by constraining velocity of light and Planck's constant as the universal constants. Heisenberg's uncertainty principle showed that the Planck's constant places a limit on the resolving power of measurements on quantum objects, and thus restrict their descriptions in terms of the rules of classical mechanics. The incompleteness theorem places a limit on the analytical provability (Godel, 1931; Smullyan, 1987) with the demonstration that in mathematical systems a false

statement is not provable, and there also exist statements that are true but not provable. Conservation of mass, energy and information are dictates of reality that place thermodynamic limits on world happenings, and also rule out Maxwell's demon, perpetual motion, and omniscience as contradictions to reality. Understanding genetic code provides a place for human in the hierarchy of biological diversity that rules out notions of race and chosen people (Jain, 1998; Wade, 2006).

Faiths, fictions, and secular philosophies consider ignorance and doubt as perpetual human condition, but do not offer resolution. The wise of the old also noted that the learned, pseudo-intellectuals and bookworms lean on crutches of words rather than commonsense rooted in reality interpreted with strength of thought (Hazlitt, 1824). Ugly and insidious kind of ignorance is perpetuated with sophistry of words for mass deception and distraction (Meyer, 2010), for example by lobbies for asbestos, tobacco, sugar, threat of weapons of mass destruction (WMD), genetically modified foods, and scores of other products. They follow a common script: Introduce in the name of progress, sell with promise of jobs, continue with no-evidence for harmful effect, benefits outweigh the cost or demonstrated consequences are not significant, and then move out before liabilities make it unprofitable to continue. Strategies to perpetuate ignorance in politics, faith, war and love include illusions, paradoxes, self-reference, unverifiable lies covered by astro-turfing and psy-ops. Some are swayed. A smoker with a Ph. D. degree in physics told me that there is no evidence that smoking is harmful to him. Of course, he is right, except that it will be too late for him to find out if and when harm is done to him. Ignorance is more than just being uninformed.

Search by trial and error is kept on track with open inquiry backed by uncompromising honesty and healthy skepticism. It is misled by dishonesty, authority, secrecy, fog of misinformation, premature and ad hoc beliefs (Cornwell, 2003; Hook, 2002). God complex and tendency to spin tales to fit agenda also perpetuate vicious cycle of self-reference, as in the liar's paradox, or in the life or death of Shrodinger's cat on the basis of certainty about past events, or in the assertion that *human brain is the most*

wonderful thing. In fact, much of the ignorance emanates from paradoxes resulting from extrapolation of self-referential assertions. Consider mutually contradictory forms of ad hoc omniscience or perfect knowledge (Armstrong, 1993; Dawkins, 2006) presented as a binary equivocation of *it is* (existence) against *it is not* (nonexistence). Objects of such faith are often justified by Pascal's wager with a payoff just in case it is right, and little harm done if it turns out to be wrong. It matters little to the faithful whether there is no evidence for the object of faith, or it is inconsistent or contradictory, or if the consequences of its presence versus absence are indistinguishable. Agnostics somehow feel that it is necessary to have evidence for *it is not*, even if there is no evidence for either *it* or for *is*. Atheists see little reason to be concerned unless an object is affirmed by independent evidence. Also it is not possible to reason unless a description elicits awareness for a mental image.

A valid inference follows from assertions affirmed by evidence (Jain, 2011). Not only assertion of its converse requires independent evidence, lack of evidence for an assertion is also not the evidence for its negation. In binary deduction a proposition may be judged *true* on the basis of certain criteria. If not so, it is judged *not-true*, and worse still as *false*. *If it walks like a duck and it quacks like a duck, it is a duck* is still such a deduction no matter how many other attributes of *duck* are enumerated. An ancient Indian parable of elephant and six blind men aptly illustrates the inference process. Each describe their touch and feel experience with analogies to rope, brush, hard curved stick, pillar, flexible tree-trunk, or a wall. As a good parable, the rest is a thought experiment. For example, consider the option if they have seen or not seen an elephant, or only heard about it. How would they rationalize the analogies in terms of what they knew about elephants? For an inkling of the discovery process, consider if nobody has ever seen the beast before.

In the logic of inference true and false assertions are orthogonal to be independently affirmed to avoid self-reference. It makes it different from binary deduction, tree-pruning or pattern recognition. Mental images may be

structured from such orthogonal assertions affirmed by sense evidence. It appears that 2 to 8 independent inputs are typically incorporated into a mental image for real-time manipulation. Physiology of vocal cord and resonance cavity is such that it generates 4 to 7 sounds distinguishable by human ear, and such vowels can be mixed with tongue movements to give sound to alphabets. Most commonly used words also have 2 to 8 characters. Similar numerical limits also hold for the number of words in a sentence or sound bite, or the interactions in anecdotes and short stories, or the key characters in a novel, or the variables and constants in a polynomial, or the number of figures and table in a scientific paper.

As a step towards a theory of mind, consider inference output as the solution to a matrix of orthogonal relations in a mental image (Jain, 2011). The tradition that gave the elephant parable also gave a minimum matrix for inference. This syllogism for evidence-based inference builds the proposition *it exists* for an object from a set of three orthogonal criteria: Sense inputs for the observed and measured attributes (A); awareness of sense inputs as the basis for description (D), and the ability of mind to abstract and evaluate differing consequences (C) for example of the presence versus absence of the object. The proposition *it exists* is thus inferred from attributes that describe and demonstrate consequences of an object. Eight logic states are possible with evidence for none, one, two, or all the three criteria (or 2^n states with n criteria). Their logic space is a 3x8 matrix of truth table with 1 for affirmed and 0 for not affirmed. Additional inputs and merged matrices could accommodate more complex mental images. It is intriguing that sense inputs for A are interpreted by the functions of left brain for D and by the functions of right brain for C in terms of the split brain paradigm.

Comment [m1]:

Logic states are the outputs of matrices of inputs. Matrices of orthogonal inputs can also be implemented as logic circuits. A neural circuit with three or more inputs could implement binary functions as irreversible or reversible conditional gates, filters, buffers, and memories. The 3x8 matrix can also be partitioned for logically reversible controlled Toffoli gate for universal binary operators, or configured as irreversible classical binary gates

with 3- or 2-inputs. A matrix with 3-input could also be configured as a qubit (quantum bit) whose quantum integrity decoheres in less than microsecond. There is no obvious reason why such matrices could not be implemented in neural circuit. If so, resulting *nubits* could persist for seconds and longer in analogy with mental images, and modified with additional inputs and feedback. Algorithms for processing such inference devices are likely to be different, but their limiting cases would be binary functions.

The classical interpretation of the eight logic states provides a reasonable intuitive basis for an appreciation of their epistemic utility to identify entropic liabilities. There is no reasoned proposition if there is no evidence for A, D and C. Nothing can be said about it except that it is a state of *nothingness* or a null that may also be used to orient additional inputs. Negation of *it does not exist* also requires affirmation by independent evidence. Virtually all variations of bad ignorance whirl in vortex of such black holes. Each of the other seven states (called the *Saptbhangi*) has epistemic utility for reasoning in relation to affirmed assertions. The inference proposition *it exists* is fully supported by independent evidence for A, D and C. Lack of evidence for one or two assertions in the other six states identify source of ignorance with possible origins in incomplete information, evidence or knowledge. Such states manifest as uncertainty, confusion, chaos, doubt, ambiguity, contradiction, vagueness, fuzziness, dissonance, risk and conflict (Colyvan, 2008; Firestein, 2012; Gross, 2010; Halpern, 2003; Hammond, 1996; High, 2012; Lemons, 1996; Roth and Ross, 1990; Rothman and Sudarshan, 1998; Smithson, 1988; Suri and Bal, 2007; Zimmerman, 2008).

In short, ignorance is inability to transpose metal images to alternate universes, and with bad ignorance one remains stuck in a self-referential world. Shadows of ignorance are a necessary part of establishing certainty about what one knows and infers. A syllogism for inference with orthogonal assertions affirmed by independent evidence provides a common basis for representation of multiple logic states in Hilbert space of the orthogonal assertion vectors (Jain, 2011). Many other states, including ignorance and

uncertainty could also be represented in such logic space. It also provides a basis for a theory of mind where the matrix of assertion vectors may provide a template for mental images from parallel and independent inputs from the sensory (information), speech (memory), and reasoning functions of CNS. Its output as an inference could be weighted for response and modified by feedback. Mind as an inference machine trained with inputs from the past to form memory templates could also pattern incoming inputs into mental images. Beliefs could fill gaps in such mental images to address doubt, and could also overshadow parts and relations in real time inputs.

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Why I Am Not Moral

(Entertaining doubt in Human behaviors)

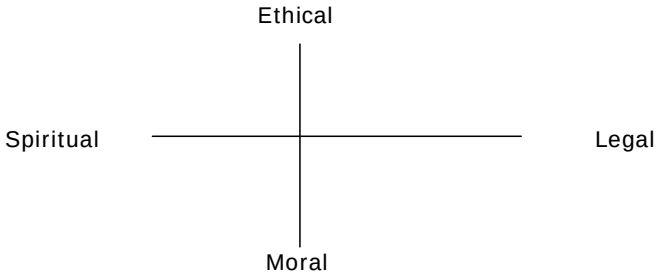
by Mahendra Kumar Jain

Not killing is an ethical act for the well being of the slaughtered animal, even if such killing is deemed good for the killer's health, afterlife or judgment-day. In the divided universe of self and non-self tribal mores (normal, natural, necessary, right) are about how one treats friends. Such (moral, humane, spiritual, legal, medical, business, professional) constructs are the subsets that seek validity within an encompassing ethical framework that facilitates consequence evaluation. In a perverse way such tribal constructs deny the conflict between the self and non-self. Since extending the world of self into the worlds of non-self is key to realizing the human potential, such conflicts are addressed as ethical frameworks for behaviors rooted in reality. Value from the ethos of life emerges from how one treats strangers and enemies.

Just as there has been history before the word history was invented, suitable words to communicate concerns about prescribed and proscribed human behaviors continue to be invented. Moral and ethical words are often expressed interchangeably and synonymously to deal with dialectic of right or wrong, good or bad, fair or unfair in issues of life and death. My friends who indulge in such concerns would not call me immoral. Very few would characterize me as amoral because of my deep-rooted concerns for all beings including humans. As for me, there is a lot more that inspires and guides me but lies well beyond the martinet of moral behaviors and concerns. I am not indifferent to the concerns that get the moralists riled up, although often I do find myself in disagreement with their methods and conclusions. The issue came to a head when I heard Mister Bush's 2004 electoral push for Moral-Values, which were not to be seen a year later in the behaviors of his party faithful. Apparently, few decades ago convictions of such born-again millions

found political affinity as a voting block. Within a year after the election in an opinion poll about the two third rated President Bush as unethical, and neither trustworthy nor honest. Five year later the nation is still trying to come to grips with such presidential legacy.

The 2004 US election gave me a pause to think about what it is that I do not like about the word moral. I have not found anything that explains to my satisfaction what a moral-value is, and its behavior consequences. What moral means alone or in association with many other words? What behavior consequences emerge from such associations? Along these lines, over the decades I have often found myself at odds with my religious friends. No matter how I tried to explain my concerns, I have not succeeded beyond the superficiality of the words like moral, ethical, or religious because most people use these words interchangeably and consider them to be synonymous to express something that they can not express otherwise. This was also the case for me until one day I said: "I live by ethical precepts rather than by moral prescriptions or religious dogma of one persuasion or the other." I prefer to be ethical rather than moral or religious and the *Dhamma* construct of Ashok (see Appendix) is closer to my understanding of the ethical basis of *Dharm* or the code of conduct for personal and social behaviors.



The polarity of moral versus ethical is orthogonal to the polarity of spiritual versus legal. To begin with spiritual and moral frameworks are based on personal choices, whereas as the legal and ethical concerns are

social concerns based on shared knowledge. Moral and legal frameworks are based on the existing values and experiences of the tribe. Such frameworks guide future behaviors, and essentially exclude individuals from the decision-making. As increasingly powerful institutional teeth deal with the miscreants, there is also greater need to dispense legal justice fairly and squarely.

On the other hand, the crux of 'moral versus ethical' is in their utility to guide future behaviors. Spiritual or moral self-realization is not just evaluation of self by some fixed criteria. Consider a dog who thinks that his master is a god because he is so caring, or a cat who thinks of itself as a god because the care-taker is so good. I refrain from going into models, idols and superheroes created to proselytize the innocents. Such conceptions of Theical darkness may be bliss but holding on to ignorance hardly facilitates experience of worlds we do not know. Curious and informed judge the significance and the courageous decide course behavior that creates value. Learning through consequence evaluation of trials and errors is not an unreasonable course.

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Most will agree that acts of infants, imbeciles and insane persons do not have moral or ethical quality because they do know not better. The same applies for coerced actions, including the restrictions of group morality such as: *In a blood feud side with blood kin; intelligent rascals work for the community good (mixed with self-interest); often there is honesty among thieves and gangs; some cut conscience to fit prevailing fashion.* In the same vein, term-papers and SAT essays written for a fee are already accepted more for more than half of the students and parent. Economic forces of clan stabilize group moral authority to dictate individual behaviors. Such behaviors serve the interest of self via the socially extended-self. Authority in the guise of personal morality hides intentions. It is not an aberration that war affords such opportunities to the unscrupulous. Insidious grab and greed for the resources entrusted to corporate executives is not uncommon. Human history is littered with justified moralities to rationalize and hide baser impulses with high-sounding standards and traditions.

Consider justifications for belligerent actions through a conviction of overt or covert moral superiority. The practice has not disappeared with the crusaders, colonialists, mercenaries, and missionaries. Moral quest for the good or right continues to guide major political decisions by the ideologues right to the dawn of the 21st century. It is skillfully, but not too subtly, built into the smoke and mirrors of words of mass deception (WMD). Depending on what is politically correct, the authority of such *a priori* derives from Omniscience, Grace, Universals, Destiny, Justified-true-belief, and other ad hoc idealizations of past practices. Such platitudes of the higher moral purpose permeate calls for civilizing the barbarians, missionary zeal for rescuing the unwashed and giving salvation to the dead. Manifest Destiny as the Burden of White Men continues in the calls for Human Rights, democratic and market reforms, globalization. In all such cases, consequences are judged, rewarded, pardoned or punished by something external that oversees the higher purpose.

Decisions are lot easier if the consequences are no longer the responsibility of the individual. By drawing a sharp line between self and non-self, morals take out accountability as a concern for behavior. Not surprisingly warring parties invariably justify their actions as moral acts. A bomber pilot is not responsible for the consequence of the sorties if he is ordered to do so and he merely takes-out the target. Such sinister dimension of Kill-Kill distinguishes morality of face to face beheading, suicide bombing, and surgical strikes by helicopter gun-ships. I am not sure if proponents and perpetrators of war loose sleep over deaths in the ranks of the cannon fodder, let alone mourn the "collateral damage." When does ethnic cleansing become euphemism for religion?

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To differing degrees extension of self evokes concerns for right, good, and fair. Behaviors based on such consideration bring about personal and social changes, or at the very least ward off the ugly and unpleasant. In such contexts what distinguishes ethical from moral? Clearly, there are areas of overlap. However, I believe that at a deeper level in human psyche

ethical is not perceived to be compatible with moral, and vice versa. For one group of people morality is the motive and drive for ethical behavior, whereas others believe that morality is for those who do not have ethics. Another variation is that morality is for the sinners, and ethics for those who do not want to become sinners. Its dialectic is: *If going to war is a moral obligation, conscientious objection is an ethical act*. If there are similarities of the goals the desirable outcome of such actions and their behavior consequences are often very different.

Even without going into the meaning, significance, and rationality of behaviors, genesis and behavioral consequences of a moral versus ethical frame are different. Most dictionaries do not adequately distinguish moral from ethical: One treats "ethics as the study of morality." Such dictions of denotations are dead abbreviations that often verge on circularity. In any case, a word representation is mere necessary first step for grasping relations through symbols. The concept space of the identical, synonymous, and interchangeably used words evolves through usage as the distinctions are sharpened through polarized dialectic and derived behaviors.

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There is widely recognized social need for viable code of conduct. Over the millennia this need is addressed by traditions captured in religions, dharma, codes of conduct, and laws with differing degrees of authority and judgment (Laham, 2012). Such a moral choice is probably best illustrated by words of one of the most enlightened Christian reformer: *What harm would it do, if a man told a good strong lie for the sake of the good and for the Christian church… a lie out of necessity, a useful lie, a helpful lie, such lies would not be against God, he would accept them* (Martin Luther). Possibly for such reasons Christian Churches approve of 'mental reservation' or 'internal disclaimer,' i.e. telling half-truths if the other half is repeated inaudibly in mind. Is this the reason for the common practice of keeping fingers crossed while not telling truth? Such morally justifiable and legally admissible lies are outright deception.

At another level consider the thought and practices of the followers of theistic religions (Judaism, Christianity, Islam, and to a lesser extent the Vedic or Brahminical Hinduism). They have differing moral values at odds with themselves and the neighbors. To appreciate the extent of such encroachments on the self consider the moral dilemma that an observant Jewish space traveler would have in finding the direction to face for prayer. Similarly, an Islamic devotee would have a moral conundrum in setting the prayer time on a spacecraft that circles the earth every hour.

The point of a code of conduct based on dharma is to facilitate search of 'the truth of existence' by extending individual self (*atm*) into the non-self. Since the past actions can not be undone and their consequences have to play out, the focus of such behaviors guided by internal clock remains on the future behaviors. Nor can actions be judged (or undone) by some indescribable universal (*Atma*, *Brahm*, Soul, God, Omniscience) that may clutter brain. Ethical courage follows from personal stand congruent with the shared knowledge. Here sum total of existence is made up of personal perceptions of the reality of the self and the non-self. Mahatma Gandhi took a lead from these ancient paths: He advised a sectarian killer of the parents to raise the child in the tradition of the other sect. He also convinced the British that their moral (and legal) ways are untenable because they are not ethical.

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Privacy and personal behaviors do not exist in a transparent society where all information is public. This was the case in the tribal village, and it increasingly the cases in the global village where snooping is a rule rather than exception. Survival choice in such a society is to either conform and behave *normal*, or to remain beyond reproach.

The distinction between religion and dharma persists at deeper levels of searches of the non-self. Dialectics of moral versus not-moral, or religious (theistic) versus not-religious (not-theistic), raise quite a few antennas. I quizzed many of my friends to articulate the way they distinguish ethical from moral at the gut level. Not surprisingly some believe that there is little

difference, whereas others see little overlap. Some believe that the problem is not religion but the creed and dogma that create tyranny of social pressure for morals of dubious value. Origins of morals, and for that matter of organized religions, lie in the *a priori* of mores (Latin) rooted in customs, creed, tribe, tribal elders, ancestors, almighty, supreme, or whatever universal one wishes to invoke, worship, or surrender to. In such cases, a God-Head external to the individual provides inspiration, affirmation and justification in the form of prescribed and proscribed behaviors. In a more parochial sense, following their origins in the biblical tribes, the ancient mores verge on dogma of organized religions designed to look after the interests of the tribe of the faithful. As if to increase their count hereafter, even at the dawn of 21st century moral enthusiasts of a certain Church poach the souls of the dead, including the Holocaust victims, who were never the followers of their Church.

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Western scholars of ethics have failed to define its scope. Apparently the Greek term ethos was coined to consolidate a variety of overlapping attributes. During the Archaic and Presocratic period -800 to -400 (BCE) such attributes included (with approximate translation): *psyche* (soul), *arete* (excellence) and *dike* (justice) controlled by *noos* (insight), *phren* (wisdom, deliberation), *thumos* (awareness of behavior), logos (speech and expression) and matters of heart (*kradie, etor, ker*). Following the lead of the *Will of God* the primary concern of Socrates emerged as *ethics of morals* (to guide the mortals). He did not detach ethics from the organized religion that was beginning to take hold on the Eastern shores of Mediterranean. In fact, Socrates, Plato and Aristotle did not dare to go against the prevailing mores as well as the authority of the tribal God of the Hebrews who dictated: *People is to have no other god, and Yahweh is to have no other people*. In their attempt to reach out, the Hellenistic thinkers developed the role for Zeus as for Yahweh to deliver justice for the past actions. Only fear of punishment by a judgmental god would guide the future behaviors. This encouraged righteousness in public behaviors: A right relation with the god through faith

extends the reach of the (god-given) laws to control others. In the image of their God, the Hellenistic thinkers, and their followers until recently, justify slavery and promote elitist world order. Ideals for select few became the popular ideals to aspire for. Along these lines one hears about moral concerns about decency, right, good, justice, piety, virtue, and nobility and their institutionalized and legalized artifacts. Whether morals transform a religion or a religion raises morals remains debatable.

In any case such concerns are not about the fairness, equity, symmetry and reciprocity in behaviors that lead to integrity and trust as part of the social contract. By the fourth century BCE Hipias the Sophist and Diosgenes the Cynic began to look beyond the Hellenic provincialism ("polism") to the cosmopolitan ('citizen of the world') of Hellenistic colonies. The idea has evolved as a nebulous core that guides toward a broader social being with the idea that all human beings, regardless of their political affiliation, belong to a single community to be cultivated. Possibly to further the Greek interest in their colonies this community has been envisioned with differing focus on political institutions, moral norms, shared markets, or forms of cultural expression. The concept appeals to the architects of moral (Universalism), political (World-citizen), and market (Globalization) hegemony because built on uneven playing-field such institutions are tools of exploitation.

Consider the juxtapositions: moral authority, moral standards, moral principles, moral imperative, moral turpitude, or moral superiority. In continuing the ancient Greek thought even the most progressive of the Western thought has not freed itself from influences of ad hoc universals built into the socially decried idealizations, assumptions and goals of inquiry. In the broader context of human society, moral of a particular brand are relativistic. What does it mean to be more or less moral? Who determines? Like the natural and moral laws, idealizations continually evolve and often swayed with the direction of the political and economic wind (mores).

Many people find it necessary to have a moral code of conduct rather than building an ethical one made by humans for humans. To be moral

requires knowledge of what is right and wrong, good and bad. A moral code built on a selective record of the past successes facilitates decision-making by giving an appearance of certainty. Having moral guideline simplifies life. It makes one feel good to be obedient or faithful because that does not require justification in itself. Is it enough to be guided by a prescribed code? Is there a need to take charge of ones own affairs or for a personal or social change?

Personal morality is oxymoron. Followers of a moral path often fashion themselves in the images of their ideals. Social pressures undermine the personal choice of acting or not acting. In a tribe of cheater and killers it is moral to be one. Such pressures of the righteousness are promoted by the imperial attitudes, call for crusade or Jihad, and call for missionary do-good. How many of those driven by such moral certitudes are willing to give the same benefit to objects of their moral tinkering?

Moral certitudes for the social change are fundamentally asymmetrical where the participants can only be guided - presumably because someone else knows better or *what is best* for others. This aspect of moral drive still engages the Western thought: Behaviors for the individuals as well as for the institutions are structured largely on the basis of some ad hoc universal. Consider the moral perch from which pronouncements are made to the unsuspecting millions not only for the religious or political indoctrination, but also to sell human rights, democracy, market reforms and globalization. Consider the moral codes that continue to drive the international policies and behaviors to serve the interest of a chosen few. People forge themselves in the image of their ideals, and thus shape their gods (values, ideals) to suit their interests. More often than not, moral ideals prey on our desires to be something that we are not. Are such platitudes designed to empower a few?

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In search of solutions that fit the problem, moral behaviors center on the mores of the land, whereas ethical behaviors driven by ethos or truth of existence. Most people will agree that differences between the moral imperatives of the groups of people far exceed the range of ethical precepts

of individuals. To perceive the differences, think of a hypothetical compass one may use in a quest for desirable behaviors. In order of equity and symmetry, ethical behaviors for relating self with the non-self are guided with the polarity of fair or unfair.

Prefixes and suffixes rarely amplify the reach of ethical. Like its origin even the current usage of the word ethical has kinder and gentler connotations. Ethos (Greek) of life through the experience of living finds its way in the ethical codes of conduct without moral imperatives and certainly without judgment. In searching truth of existence (the *is-so* and its potential), dharma derives from the perceptions that enrich experience of living and the ethos of life. In ethical behavior, by taking responsibility for ones own actions and bearing the consequences one wrestles with more difficult and subtle issues of equity, rightness, and fairness, and their symmetry. Such stages in the evolution of the self that bears consequences of actions has been varyingly described as The I, Atm, Mind, and lately the Neuronal Self.

The moral polarity of good or bad, or even right or wrong, encourages righteousness. Moral eminence is about virtuosity and nobility. Proponents of moral behaviors are often all too happy to enforce their beliefs on the others. They are unlikely to give the same benefit to the others, or even listen to the other side. For sharpening the differences consider how ethical sensitivities and sensibilities diverge from the moral standards applied for stem cell research, or the right to choose abortion for whatever purpose, or to select sex of the fetus. In such debates the problem is forced through templates of moral dictates of only those who speak out. Instead of the social front the ethical focus is on the underlying concerns.

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One rarely hears about the ethical values or ethical ideals. Yet ethical considerations provide a general structure for decision-making and consequence evaluation to address specific problems. As a shared quest, the primary ethical concern is for behaviors guided by internally acceptable criteria of fairness, equity, reciprocity, and symmetry. Shared concerns for

ethical behaviors are also guided by the shared knowledge. From this starting point bounded rationality is built on collective experience. Within such bounds ethical behaviors are likely to be a personal or group affair with an emphasis on practice and feedback. Ethical conduct is judged in the context of the past consequences, however the emphasis always remains on the perceived future. Since individual actions are guided by perceptions, responsibility for decision-making and consequences of actions also lies with the practitioner.

Ethical choices are to be built in the individual character motivated by the reward of fairness as the right thing to do. In choosing an ethical solution from the matrix of viable alternatives, with the compass of fair and unfair, requires symmetry and reciprocity in the behavior equation. What follows from such perceptions is intriguing. The role of equity and reciprocity in developing human potential has prepared ground for social contracts for the evolution of organized society. It extends from the traffic rules to the Bill of Rights and Constitution as the statement of principles to aspire for, if not to live with. Through democratic institutions one aspires for democratic ideals, presumably with an *a priori* for fairness and equity for all. Doubt and skepticism motivated by fairness keeps a watch on ulterior motives.

A theory of any kind can not emerge if there is positive belief (bias) for what is right and what is wrong. In the end, concerns to guide future behaviors are not about just thoughts and words. These are concerns about consequences of the chosen course of actions and behaviors. All conduct and behaviors resulting from non-random actions are subject to ethical concerns. Status quo of moral guidance is not satisfactory because morals are about habitual and customary standards, whereas ethical actions and behaviors require consequence evaluation with equitable symmetry and accountability. Specific models and theories of moral sense emphasize the boundary conditions only from dialectical perspectives motivated by *selfish, Kantian, utilitarian, spiritual (reflective), or Natural Law* perspectives. Along these lines religions, as well as some of the alternative constructs, are conservators

of group values by upholding the moral standards. Often one needs to outgrow the habitual.

My search for extending the self into the non-self has taken me from a reaction of *Why am I not moral* to a better understanding of *Why I am not moral*. Ethical sensitivity begins where the legal boundaries are not drawn and moral responsibility ends. Here not-moral provides the defining identity to the ethical. In this journey the point is not to pocket the truth but to chase it. It is not just a matter of ethical gesture to give a voice, but it is the ethical responsibility to move over and let other voices come through and to let others speak for themselves. A need to take charge for one's own actions extends the rational self into non-self by dispensing with authority for consequence evaluation. Conflicts raise ethical concerns, and emerging dialog offer opportunities by challenging the assumptions. Could it be that, in search of solutions that fit the problem at hand, ethical considerations guide through a wider range of structures rather than those can possibly be encapsulated in the mores? At the very least ethical searches are forward looking and allow for midcourse corrections with decisions guided by concerns for equity and fairness rather than the changing perceptions of right or good. Ethical thought requires that we struggle with ambiguity to resolve doubts. Ethical path seems more blurry and difficult yet it is a better guide for more place and times because it is likely to be rooted in reality. It 'feels right' because it is often based on shared-knowledge, and designed to deal with evolving perceptions of potential consequences, their values and significance. There are no easy ways out of making own judgments and living with the consequences and modifying future behaviors.

Tribal constructs are the subsets that seek validity within the ethical framework that facilitates evaluation of utility and consequences. As a limited subset, morals are fashioned to deal with concerns of the Self - the personal, familial and tribal. It is not uncommon that such explorations tangled in theological and spiritual a priori turn into moral conundrums of dilemma and paradoxes. Without room for reason and doubt, another limitation of moral constructs is the asymmetry of the assumption that the rest of the universe

has no right to be different. In fact such differences are treated as threats. Thus neither moral nor the moral values necessarily create value. On the other hand value can not be created without reasoned ethical behaviors. Such a framework is intrinsic in all dealings of self with the rest. Just as technology begets technology, tangible philosophies create value when thought, decision, action and conflicts are harmonized with behaviors rooted in reality. In the end, if human animal is by nature capable of rational ethical behaviors, it is philosophically human if it does so in a reasoned way.

Acknowledgments: I am grateful to numerous friends who helped me sharpen the arguments. I also benefited from scores of published books and articles. Two of these (Dewey and Tufts, 1932; Sullivan, 1995) provide good entry points.

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Dewey, J., and J. H. Tufts. 1932. *Ethics*. New York: Henry Holt and Co.

Laham, S. M. 2012. *The Science of Sin: The Psychology of the seven deadlies and why they are so good for you*. New York: Three Rivers Press.

Sullivan, S. C. 1995. *Pyshological and Ethical Ideas: What early Greeks say.* Leiden: E. J. Brill.

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Consider the following provocations for fun and thought.

Slavery: Is it *Ethos of sufficiency for dependent existence*?

Racism: Both slavery and racism have been justified as moral.

Human-sacrifice: Would you kill another human being if not illegal to do so?

Animal sacrifice: Would you eat a cow if you were to kill it? How about other animals? Where do you draw the line?

Would you hand over a refugee? What about if the refugee is innocent; or if the conviction is wrong; or if the pursuer is mis-guided? While it may be moral to come to defense of friends who did wrong, it is

unethical. Also it is better to keep ethical friends who are less likely to do wrong.

Jumping a traffic light: Would you jump a red light if there is no traffic in other directions and there was no police on petrol?

Justification for use of power: Which is more compelling: political, economic, potential, general good, higher purpose.

Abortion: Is mindless sex justifiable? Is abortion justifiable for the selection of the sex of a baby?

Group morality: When is it acceptable? Should we do the "right" thing for the wrong reason or the "wrong" thing for the right reason?

Situation ethics: When is it acceptable?

Justice: Which one is more acceptable: As the privilege for the person belonging to a group? How about for a person that does not belong to the group that is judging? Is strict law better than natural law? Is jury trial better in such cases? Is it is ethical not to charge a person for murder on grounds of temporary insanity? Are shared moral concerns also the shared ethical concerns (Sharia)?

Geneva convention: As extension of mores it includes others with the expectation that all will do the same.

Cheating. Term paper or SAT essay written for a fee is the current mores or practice among 70% of the students. Such practices are common in cartels, environmental pollution, CFC use, and not signing the international treaty to control green house gases.

Yoga and meditation. Yoga and such devices for self-help sensitize the self. Further education and socialization are needed to relate to the vast non-self.

Finish what is on your plate. Consider the ploys used for not wasting food that range from people starving in countries Albania to Zaire, or whatever is politically convenient at the moment. Is it related to indulgence and overfeeding that appears to have caused epidemic of obesity? At the dawn of 21st century, throughout the world more people overeat then are calorie malnourished.

Legal asymmetries. Nobody is above the law. Within these limits weight of the legal system ends up with major wrongs. Does the asymmetry of *identify the source or go to jail* has ring of what has put many innocents on death row. Charges of unpatriotic treachery are often labeled against those who inoculate people against social and political ills.

What is good for goose is good for gander: If you know what is good for you, then you also know what is good for the others.

In the end: What is more appealing: Who you are? Or What you are? Can you be either without a social or cultural context.

Appendix

Excerpts from Edicts of Piyadassi Ashok (ca. 265 to 230 BC)

[Dhamma: A secular social code of conduct and social contract for peaceful coexistence].

- The beloved of the Gods, Piyadassi the King, has had this inscription on Dhamma engraved. Here no living thing is to be killed or sacrificed. Piyadassi sees much evil in holding of festivals. Killing of animals in the Royal kitchen is also reduced.

- Medical services for the care of humans and of animals have been provided in the domains of the Piyadassi and the neighboring kingdoms. Medicinal herbs have been planted where they do not grow. Along the roads wells have been dug and trees planted for the use of men and beasts.

- Officers of the state will go on regular tours for other duties and to instruct and explain Dhamma to people. It is good to be obedient to one's mother and father, friends and relatives, to be generous to Brahmans and Shramans, not to kill living beings, to spend little and own minimum of property.

- Standing firm on Dhamma the king Piyadassi, his sons, his grandsons and his great grandsons will advance the practice of law until the end of the world. But there is no practice of Dhamma without goodness, and in these matters it is good to progress and not to fall back or be satisfied with shortcomings.

- It is hard to do good. He who does good does a difficult thing. But he who neglects my reforms even in part will do wrong, for sin is easy to commit. I have appointed officers of Dhamma for the welfare and happiness, and administration of charities among those devoted to Dhamma. They are busy in promoting the welfare of prisoners should they behave irresponsibly, or releasing those that have children, are afflicted, or are aged. May it endure long and may my descendents conform to it.

- At all times, whether I am eating, or am in the women's apartments, or in my inner apartments, or at the cattle-shed, or in my carriage, or in my garden's - where ever I may be, my informants should keep me in touch with public business. Thus everywhere I transact public business. Any dispute about anything I order is to be reported to me immediately at all places and at all times. I find no satisfaction in the hard work of the dispatch of business alone. I consider that I must promote the welfare of the whole world. Hard work and the dispatch of business are the means of doing so. Indeed there is no better work than promoting the welfare of the whole world. Whatever may be my great deeds, I have done them in order to discharge my debt to all beings. May it endure long, but this is difficult without great effort.

- Piyadassi wishes that all sects may dwell in all places. All men seek self-controls and purity of mind but have varying desires and varying passions. They will either practice all that is required or else only a part. But even he who is generous, yet has no self-control, purity of mind, gratitude, and firm faith, is regarded as mean.

- People, especially women, practice various ceremonies and rituals that are trivial and useless, doubtful and ineffective. On the other hand, effectiveness of Dhamma is lasting --- because it makes possible for people to escape evil inclinations. But this is difficult for men, whether humble or highly placed, without extreme effort and without renouncing everything else, and it is particularly difficult for the highly placed.

- Piyadassi honors all sects and both ascetics and laymen, and considers essential the advancement of the essential doctrine of all sects. It takes many forms, but its basis is the control ones speech, so as not to extol one's own sect or disparage another's on unsuitable occasions, or at least do so mildly on certain occasions. On each occasion one should honor another men's sect, for by doing so one increases the influence of one's own sect and benefits that of the other another men. Whosoever honor his own sect or disparages that of another man, wholly out of devotion to his own with a view of showing it in a favorable light, harms his own sect even more seriously. It is the desire of Piyadassi that all sects should be well informed.

- Piyadassi feels remorse that during the conquest of the kingdom of Kaling a hundred and fifty thousand people were deported, a hundred thousand were killed, and many times that number perished. It is also deplorable that the survivors of the war continue to suffer from the violence, separation of their loved ones, and misfortune of others. This participation of all men in suffering weighs heavily on the mind of Piyadassi.

- Since the empire is large, much has been engraved and much has yet to be engraved. There is considerable repetition because of the beauty of certain topics, and in order that the people may conform to them. In some places it may be inaccurately engraved, whether by the omission of a passage or by lack of attention, or by the error of the engraver.

***Note**: Excerpted from Askok by Romila Thapar (Oxford University Press, Delhi, 1997). Twenty-eight edicts of Ashok are known. These excerpts are selected from the fourteen major rock inscriptions that mainly relate to the thought behind policy of Dhamma. The pillar edicts address more direct political issues, where as the minor edicts relate to the decisions of more personal nature in relation to the Buddhist practices. All but one edict is in Prakrit language in Brahmi script. The Kandhahar edict is bilingual in Greek and Aramaic. This is particularly significant because the Sanskrit Grammarian Panini lived in Kandahar.*

What drives Nay reasoning

Nay does not delve into "Why." A transition from awareness of sense inputs to cognition is apparent in Nay reasoning. As part of the *parokch* (behind the eyes) such functions of mind include recall, awareness, cognition, insight and perception under the influence of development, upbringing and experience.

Nay reasoning seeks by trial and error empirical consistency through representational space of a concern - not only in the space and time continuum but also the space of language and logic. Playfulness of mind with concepts explores virtually infinite dimensions to accommodate imagined and ad hoc of all stripes within its repertoire of experience. We continuously redraw concept boundaries in this continuum. It may be in the form of mental images.

Purpose of reasoning is to arrive at a valid construct within defined concept boundaries. In analogy with real world it seeks non-contradiction and internal consistency of parts. Useful constructs also have practical limits for the interplay of the sense organs and the mind with entities, events, and world happenings. Constructs that do not go wrong within defined boundaries are useful not only to evaluate the meaning and significance of new experiences, but they also encourage practices guided by reason. Practice is a valid way to find the devil that may be lurking in idealization. Certainty of criteria and practice based constructs facilitates transition of reason to justified belief. Such certainty is desirable because miracles and lottery ticket (random effort) are not a good business plan.

Reasoning seeks simplicity and clarity in its struggle between thought and language. It also seeks continuity and consistency of thought through conventions of representation. Algorithms and syllogisms for reasoning are rooted in the grammar as well as the mathematical forms for tangible relations that complement each other and are not inconsistent with each

other. Just as illusions corrupt awareness, paradoxes emerge on the way to cognition, and perceptions are colored by wistfulness.

Valid reasoning and inferences create value to improve quality of life. It empowers a person to seek ways to understand meaning and significance of experience to address concerns. Valid knowledge provides a footing to develop sense of self and purpose to realize potential for perfection of identity (*atm*). This path is founded on insistence on reality, atheism, and nonviolence that empower individuals with courage for ethical conduct, bring clarity to convictions, strengthen commitment to act, and address concerns of conscience in personal and social behaviors. Social discourse facilitates cognition based on shared evidence and concerns rooted in external reality. It also helps reasoning to be guided through diverse matrices of experience, abstractions, and idealizations. Search through perceptions of the *self* and the *other* from the range of observed behaviors (Jeevatthan) is possibly the crux of ***itthivay*** (interpreted later as *ditthivay* and then *drastivad*) of Mahaveer.

It is a common experience that pure idealizations begin to fade away when faced with reality. It is the ways to explore limits of idealization and weed out inconsistencies and contradictions. Shared thought may also resolve or raise doubt and uncertainty (***syad***). Probable range of tangible behaviors also emerges from consideration of multiple characteristics. No two individuals may be identical in all respects, and such difference may be relevant for certain purposes, however interdependence of organisms for mutual survival certainly out-weights other considerations.

File: Saptbhangi March 15, 2011(revised from the final submission)

Research Account

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Logic of Evidence-based Inference Propositions

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Abstract: Assertions about the content and context of an object of concern guide reasoning about its form, functions and consequences. Equivocation is minimized by the pro-logic state of an assertion affirmed by independent evidence. Four logic states are possible for proposition with two assertions, *it exists* (A) and *it is undescribable* (U), is true (T) if affirmed A is consistent with not affirmed U, it is false (F) if U is affirmed and A is not, it is doubtful (D) if both A and U are affirmed, and it is empty or null (X) if both are not

affirmed. This two-step epistemology (Saptbhangi) adopted in suitable languages provides a common basis for the logics that identify and resolve equivocation in semantic arguments and paradoxes to form a degree of belief constrained by evidence. As first proposed by G. N. Ramachandran, within limits this formalism is reduced to a vector-matrix description of the binary logic.

Introduction

According to the *Nay* (Prakrit term for tools and rules of reasoning) paradigm shared awareness of the content and context of an object of concern (*pramey*) affirmed by independent evidence (*praman*) is normative of argumentation. Such objects include entities, events, sets, variables, sentences, propositions, hypothesis and their claims. The purpose of reasoned conversation (*vacch nay*) is to identify assertions and claims within the constraints of evidence, and to minimize equivocation by identifying doubt (s*yad*) introduced by incomplete information, evidence and logical processes.

As outlined in Figure 1, inference propositions about the form, functions and consequences of an object derive from descriptions of cognized sense inputs. As a two-step syllogism, the logic state (degree of belief, validity, certainty, probability, truth value) of a proposition is inferred from the pro-logic status of its assertions affirmed, verified and calibrated with independent evidence. The pro-logic status as affirmed (+) or not affirmed (-) assertion does not allow for the binary semantics of true or not-true as

false. A not-affirmed assertion is not necessarily negated unless the negation is independently affirmed. Also absence of evidence is not the evidence of absence, and non-existence lacks criteria for evidence.

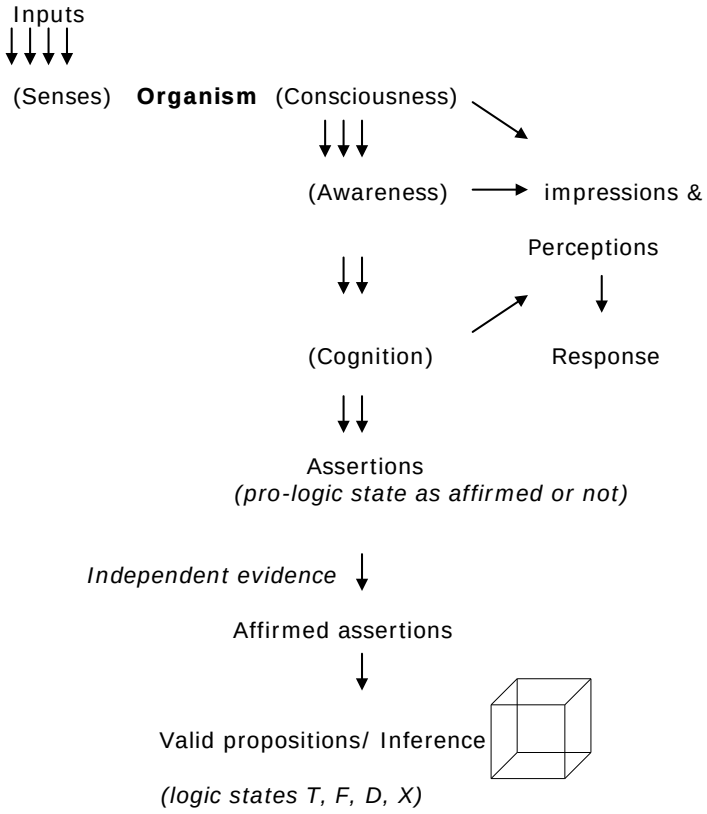

Figure 1. Operational relations of the terms used in this article.

As elaborated in this article the binary logic is a limiting case of Saptbhangi Syad syllogism. The Greek logic is based on the primitive language of *all* (1) or *none* (0). In the propositional binary logic (PBL) true (T = 1) is complemented by its literal negation not-true as false (F = 0). [3]

Boolean algebra of T = 1 - F guides deduction and it is implemented with 1 (*on*) or 0 (*off*) state of a signal bit for digital computing. Both strengths and limitations of the binary logic are due to the complementation condition.

Table 1. Propositions with N, A, and U assertions affirmed (+) or not-affirmed (-) by evidence

	N (*does not exist*)	A (*exists*)	U (un-*describable*)	bit map
1	-	-	-	0 0 0
2	-	+	-	0 1 0
3	-	-	+	0 0 1
4	-	+	+	0 1 1
5	+	-	-	1 0 0
6	+	+	-	1 1 0
7	+	-	+	1 0 1
8	+	+	+	1 1 1

Saptbhangi (sapthabhangi) calibrates validity of an inference, and improves granularity of resolved assertions with evidence to reduces equivocation. Valid inference within the bounds of assumptions and knowledge identify, conceptualize, represent, verify, and formulate tentative propositions with identified basis for doubt to conserve information that may be deduced as false or discarded as not-true. The eight propositions in Table 1 equivocate existence of an object in the first assertion (1) *It exists* (A) as an observable and measurable entity (*asti*) with the second (2) *it is*

undescribable (*U*) if its content does not elicit awareness for a description (*avaktavya*) and the third (3) *it does not exist* (*N*) if it lacks context-dependent action and behavior consequences (*nasti*). Congruence of the asserted inputs in a proposition may be inferred as consistent (true), inconsistent (false), doubtful, or null. N-A-U- (0 0 0) node of the three not-affirmed assertions is maximally noncommittal null. The other seven propositions, called the Saptbhangi, with one or more affirmed assertions have a basis for interpretation. N-A+U- (0 1 0) with congruence of A+ with orthogonal and inversely complementary N- and U- provide a consistent cognitive basis for a description of the observable and measurable form, function, and consequences of the object.

The focus of this article is the two-step syllogism to infer the logic state of NAU propositions from the pro-logic status of orthogonal N, A, and U assertions. In the first step, the prologic state of an assertion is partitioned to resolve equivocation with independent evidence. In the second step, affirmed assertions form the logical basis for the inference that minimizes liabilities and provide insights into the origins of paradoxes, falsity, undecidability, incompleteness, nothingness, contradiction, as well as existential, emotive and cognitive doubts associated with incomplete information and knowledge. The second part of this article is an outline of the underlying assumptions in the historical context. In the third part A, U, and N assertions as orthonormal basis vectors are formalized with the vector matrix algebra of logic proposed by Ramachandran [1, 2]. Overall, two-step

syllogism has kernel of a general theory of evidence-based inference that can be adopted for logics and formalized for filters and quantum gates.

Words anchor awareness

Vocalizations express awareness of sense inputs. Utterances acknowledge fear and joy. Narratives mirror mind's grasp of reality nuanced by perceptions. Words in such speak are labels for tangible parts of experience that may otherwise be too complicated to deal with all at once. Equivocation is inevitable in word communication as meaning is modulated by what one knows, intends and wishes. English language has well over 200 words to convey equivocation. A grammatical sentence may not elicit meaningful awareness of the underlying reality, and a logical truth may be dubious and inconsequential. Faulty memory and recall, in association with partially cognized sense inputs, mark the fiction of implied and embellished claims of flickers of insight guided by faith and stream of consciousness. One can not trust whose trust is undiscriminating. Contradictions in narratives remain a source of cognitive dissonance, and resulting inability to discriminate actions that always result in failure amounts to insanity. Not all words are created equal. Need to scrutinize inputs and outputs is greatest if a crafted narrative fails to make sense, or if the message creates little awareness of the content and function of the object of reasoning.

Conventions of a structured symbolic language facilitate fine grained resolution of equivocation. Story tellers weave parables to explicate cognitive awareness of the content by partitioning equivocation to identify, filter and recycle information communicated by the words. Word strings

assert awareness of a meaningful part of perceived world, but they remain self-referential fiction unless affirmed by independent evidence. Assertions like *I am*, *I act*, *I feel* and *I think* conceptualize awareness of the internalized and interpreted parts of complex reality. Propositions, descriptions and narratives interweave and integrate assertions to provide awareness of an object in terms of its physical and notional forms, and of the relations of functions and consequences. Such interpretations guided by the awareness of inputs cognized for word expressions and thought map are like crossing a river towards an unknown destination. Heuristics for choices and decisions require mid-course corrections, no matter how clearly the path is charted. Methods, ideas, and tools of interpretations along the way remain tentative to be revisited, scrutinized, reinterpreted, reexamined, and revised.

Reasoning to reduce doubt

Lack of evidence to affirm an assertion can not be used to negate it and independent evidence is required to assert true and also to assert false. PBL overlooks unknown, imagined, nonexistent, inconsistent, skeptical, meaningless, mistaken states prefixed with non-, in-, un-, a-, an-, de- or dis-. Also an axiomatic truth may not be as infallible as claimed by the authority of generalization, tradition, revelation, divination, wisdom, intuition, justified true belief, or common sense. Roman Church used Biblical truth to judge the solar-system of Copernicus as “false doctrine”, and accused Galileo of “false opinion”. Aristotle suggested that house fly has four legs, possibly motivated by a commonsense belief that *flies are animal with wings*, although a fly can

be seen to support its weight on six limbs. Like all animal species horse and donkey are offspring of their own kind. It may suggest that zebra are offspring of neither horse nor donkey, which implies nothing about mule (horse mother) and hinnie (donkey mother) as cross-bred offspring of horse and donkey.

The circularity and self-reference in the binary deduction of not-true as false is not unlike the options in the fairy tales where inane perfection of T with artifice of F can be source of liabilities, fallacies, contradictions and paradoxes. In the self-referential unary proposition *I am a liar*, the assertion (***a***) contradicts the content (***c***). Such ***c*** = ***a*** propositions lead to paradoxical inference *x = not x* because if ***c*** is T then ***a*** is not-T, and if ***c*** is F then ***a*** is not-F. Impasse of the type *if x is true then x is not true*, *if x is not true then x is true, not x implies x*, or *x implies not x* are encountered in paradoxes and proofs of incompleteness theorem for predicate logic [4, 5]. Such circularity is avoided if not-T unless affirmed as F is interpreted as D or X (Table 2).

AND	A+	A-
U+	**D**	**F**
U-	**T**	**X**

Table 2. Truth table for the logic states of a proposition from the pro-logic status of two assertions A & U. Compare it to Table 4 for binary AND.

Logic state of a proposition follows from the pro-logic status of its assertions. The four logic states in Table 2 result from the pro-logic status of A (*it exists*) and U (*it is undescribable*) affirmed (+) or not (-) by

independent evidence: *It is so (T)* for the consistency of A+ with U-; *it is not so (F)* for the inconsistency of U+ with A-; *it is and it is not* makes A+U+ doubtful *(D); it neither is nor is not* for the null (X) of A-U-. Note that F for U+A- is for the falsehood (*mithya*) of affirmed undescribability (U+) of not-affirmed existence (A-). Thus not-T = F + D + X precludes binary deduction.

Inference from multiple assertions. No assertion is entire of itself. Descriptions of the cognized awareness of an object continue to evolve with additional attributes and relations (*anekant*). Evolving nature of inference with additional information is aptly illustrated in the parable of encounter of six blind men with an unknown beast. Conundrum breaks out as each interacts with a different part and *sees* (infers) the whole differently. It is not an uncommon experience when faced with unknowns of infinite to infinitesimal worlds around us, whether an elephant facing the blind friends, or a distant object such as the Sun, or potential of abstractions such as alphabets, numbers, genetic and cyber codes.

Consider the evidence required to infer that air exists. Existence of invisible air is inferred from the behavior consequences of its presence versus absence. It is visualized as bubbles that leave before water enters an apparently empty bottle being submerged in a bucketful of water. Such observables show that air lacks attributes of solids and liquids. Air as a gas has measurable relations of volume, pressure, flow rate, mass and composition that are adequately accounted for by the kinetic theory of gases. Lower pressure and density of air at higher altitudes predicts a finite thickness of the air layer in the earth's atmosphere.

Evidence-based assertions access the underlying realities. Inference (*anuman*) of fire from the sight of smoke is consistent with the generalization about invariance of the smoke-fire events in the past. However validity of the inference is in the concomitance of smoke and fire with the burn characteristics of the fuel in the real time [6] Concomitance of evidence to an asserted inference is like a lamp that illuminates itself and others. Such frames of reference balance abstractions with particulars to suggest hypotheses that remain coupled and cohere to all valid inferences. Successful hypotheses that remain falsifiable but are not falsified permit prediction, innovation, and evolution of shared knowledge.

Inference based hypotheses validated with multiple criteria are antidote against paradoxes and fallacies of circular reasoning with self-referential propositions that invariably lead null of *neither is nor is not* (X). Like the *emperor's clothes* without a cognitive basis in independent reality there is little to explore in miracles, dreams, and hallucinations which may happen but one can not build on. Assertions like *if God did not create the world then who did* are self-referential and meaningless where neither the actor nor the action are independently established. Certitude of ad hoc that contradicts facts of its own reality do not affirm existence no matter how expedient, believable, useful, purposeful and meaningful they appear. Versions of omniscient, omnipresent, or omnipotent are indistinguishable from the "nothingness" of empty space, not even as a node of not-affirmed assertions. All together one of the goals of Saptbhangi strategy is to identify an entity that exists with demonstrable consequences of its presence versus

absence, and to distinguish it from non-existence that is without such consequences. The crux of resulting atheism (*na-astik*) is that even without an observable basis for existence (A) an entity could be cognized from meaningful descriptions (U) that map consequences of its presence versus absence (N).

Structured template of propositions

An object of concern postulated to exist as *let there be* ***x*** is elaborated with affirmed assertions about its attributes and relations. The pro-logic status of such assertions determines the logic status of the resulting propositions. As in sculpting a rock, criteria-based identity of ***x*** as a particular and as member of a class emerges by carving away extraneous to resolve inconsistencies, eliminate contradictions, and minimize equivocation. Each of the eight (2^3) propositions in Table 1 may be interpreted in terms of the logic status of *it does not exist* (N), *it exists* (A), and *it is undescribable* (U):

1. May be **it is emptiness of nothing** or null with no affirmed assertion. [N-A-U-] as a node (0 0 0) accommodates affirmed A, N and U in other proposition.

2. May be **it exists** is a true (T) proposition of affirmed existence (A+) supported by not affirmed non-existence and is not asserted as undescribable: (0 1 0) or [N-A+U-].

3. May be **it is undescribable** is a false (F) proposition because existence or non-existence are not affirmed: (0 0 1) or [N-A-U+].

4. May be **it exists asserted as undescribable** is a doubtful (D) proposition for affirmed existence and not affirmed non-existence: (0 1 1) or [N-A+U+].

5. May be **it does not exist** because affirmed non-existence is consistent with not affirmed existence and is not undescribable: (1 0 0) or [N+A-U-].

6. May be **it is a contradiction** of affirmed existence and affirmed non-existence that is not affirmed as undescribable: (1 1 0) or [N+A+U-].

7. May be **it does not exist** with not affirmed existence but not affirmed non-existence and undescribable: (1 0 1) or [N+A-U+].

8. May be **it is a contradiction** of affirmed existence and affirmed non-existence that makes it undescribable: (1 1 1) or [N+A+U+].

Ancient roots. Based the author's interpretations of the ancient texts [7] s*aptbhangi syad* evolved with the evolution of the Jain thought in India. As its cornerstone, the conservation principle उप्पानेई वा विगमेई वा धुवेई वा (tangible reality is the net of inputs and outputs) is attributed to Rishabhnath (ca. 3000 BC). By the time of Parshvanath (ca. 850 BC), the above conservation principle was invoked to draw inference from real world analogies. As evolved later, the key assumptions for the relations in Table 1 are: (1) The world in *front of the eyes* (*pratyakch*) is what it is, it does what it does, it is neither created from nothing nor does it disappear into nothing. (2) A conscious (*chetana*) organism extracts information about phenomenal world from sense inputs. Such images are interpreted as perceptions (*itthi*) by the internal world *behind the eyes* (*parokch*, mind). (3) Awareness of

such images is cognized in relation to other inputs and beliefs. Criteria-based descriptions (*anugam*) of the cognized parts provide information and evidence to represent, reason, interpret, assert, and evaluate consequences. The external world is real and its content is conserved as net balance of inputs and outputs. Its complexity may be daunting and its behavior unpredictable, but it is never contradictory. (4) As spectator, actor and decision maker, an organism interprets perceived parts of inputs to make choices that may be life altering and make one happy, anxious or regretful. (5) Organisms bear consequences of individual and collective actions. Such interdependence calls for reasoned conversation to resolve conflict to arrive at a rational basis for coexistence, including a social contract for *live, let live, and thrive*.

Mahaveer (599-527 BC) revitalized the Nay methods with the belief that all organisms interpret their experience to address their concerns. Humans distinguish themselves with their ability to reason and deliberate, and the gulf between belief and words is further minimized by practice. If common sense aligns inputs with perceptions, it takes reasoned uncommon sense to align perceptions with the independent reality of phenomenal world. Scrutiny of the content and context of propositions with identified assumptions encourages an open-ended search for certainty that proves and improves as *some uncertainty goes away with each day*. In response to a query from his discussion leader Indrabhuti Gautam (607-515 BC), Mahaveer emphasized that a belief is inferred not only from the content and context of what one knows and how it came to be known, but to realize its full potential

it is also necessary to know what one does not know, what else is needed, and what may falsify and contradict it.

Saptbhangi Syad Nay is elaborated in several written works that go back 2000 years [7]. It evolved from the core assumption that assertions supported by independent evidence not only affirm but also identify areas of doubt and contradictions. The role of evidence in support of reasoning (*up-nay*) and decision (*nir-nay*) is elaborated in Gautam's *Nyay Sutr* compiled by Akchapad (ca. 100 AD). This text does not mention the word *Nyay*. Apparently it come in the title through the *Nyay Bhasya* commentary by Vatsyayan (ca. 400 AD) where the word Nyay appears in the text only once in an insignificant context. Apparently by 500 AD evidence-based *Nay* reasoning had morphed under the influence of *Naiyayik* beliefs into *Nyay Darshan* based on the evidence from scriptures. Current usage of *Nyay* connotes evidence based judgment with an authority of rule. Soon the limitations of the scriptural evidence and of the logic of true and false (tark) were widely recognized.

Bhadrabahu I (350 BC) emphasized the four inferred logic states as *it is* (T), *it is not* (F), *it is both* (D), or *it is neither* (X). Umaswami (ca 200 AD) noted that *the authority of an affirmed assertion for reasoning is in the evidence* (प्रमाणनयैरधिगमः). Evidence affirms a certain aspect of the object as a particular or as a class, or its functional state or current state, or as addressed in the past. An inference is valid within bounds of all of its assertions affirmed in real time. Samantbhadra (ca. 300 AD) emphasized that evidence-based validity is necessarily incomplete unless the remaining

doubt, if any, is also resolved. Siddhsen Divakar (ca. 500 AD) reiterated that reasoning is not possible unless assertions about content and context relations of the object are affirmed by evidence. Buddhists surmised nothingness (*shoonyata*) as the ultimate reality against which perceptions are transitory constructs of mind. It was rebutted by Akalank (670 AD) in a decisive debate in Kanchi: *shoonyata* as a state *without a basis in the content and context of an object is also without value for reasoning*. Hemchandra (ca. 1050 AD) emphasized:

बिना प्रमाणं परवत्त शून्यः

Unless supported by evidence an assertion is no different than nothing. Note that shoonyata is a blank platform to represent and interpret sense experience.

Gunratn (ca. 1435 AD) reiterated reliance on criteria-based assertions affirmed by independent evidence as antidote against omniscience of *ad hoc*. More recently Hiraiynna [8] noted that the four *syad* states, *is (asti)* and *is not* (*nasti*) with *both is or is not* and *neither is nor is not*, challenged the dichotomy of true or false in the faith-based Vedic absolutism. It identified contradiction of the undifferentiated Upnishadic reality of *it is so, and also it is not so (eti eti, neti neti)*. Such interpretation of explicit assertions about an object of reasoning, inferred as the syad states are not red herrings of relativism, skepticism or deviant logic, nor the metaphysics of *four-cornered truth* [9].

Reasoning with abstractions

Sense organs may not perceive abstract objects, yet awareness of their space-time relations is a necessary part of the fight-or-flight response. Granularity of a natural language also permits equivocation of alternatives. Capacity of mind to form, project and interact with abstractions allows us to represent objects with rule-bound use of symbols that adhere to and conserve reality. As prisoners of words we venture out of literals by re-telling tales in altered contexts. We have come to rely on alphabets and numbers to concisely and clearly communicate cognized awareness for reasoning to expose and identify deeper structures and relations in the inputs. Such representations are remarkably effective means of communication to liberate awareness and develop a conceptual grasp from cognized abstractions, say of money with social, cultural, political and personal consequences.

The core of Saptbhangi epistemology is to constrain the degree of belief to arrive at an inference consistent with the sum total of the assertions and claims affirmed by independent evidence. Quantitative interpretation for an inference is possible with language of probability or of algebra if the assertions are closed under the formation of complements and finite unions. Such rule bound abstractions with logical and mathematical symbols are not unlike those for word communication. Their purpose is not as much to mimic real world complexities, but to simulate the context-dependent action and behavior consequences with meaningful parts and relations of a concern.

Limitations of the linearity of language are overcome with tools such as tables, figures, charts, flow diagrams, models, matrices and equations.

Abstract and logical objects and spaces share many of the attributes and relations of physical counterparts, and much more. Individual and class identity of objects is conserved as their content and context adhere to the real world relations and behaviors. They are not created from nothing, nor do they disappear into nothing. They occupy only one place at a time, and no other object can be in that place at the same time. However, abstract objects and space can have as many dimensions and attributes as minimally required. Not only they move, rotate and transform in multidimensional spaces, their spaces and dimensions also change while objects remain stationary.

Reasoning is meant to resolve uncertainty. Mathematical tools to identify specific origins of uncertainty are not unlike the sum of the series 1 – 1 + 1 – 1 + 1 - 1…. as 1 or 0 depending on odd or even number of units. Quadratic [10, 11], space-time [12] and other relations [13] also have alternative solutions. Certainty with residual equivocation from unresolved assertions is expressed as statistical probability p in 0 to 1 range [14]. Theories that identify and measure uncertainty as 1-p include predicate, modal, fuzzy and many-valued logics. However epistemology of Saptbhangi is closer to the objective interpretation of Bayes theorem [15] where the degree of belief, that equivocates with undecided outcomes, is updated with evolving evidence.

In the game theory, [16] uncertainties remain constrained in the Nash equilibrium of the available choices. Such abstractions provide a basis for asking right questions, to form beliefs without expectations, to develop models for predictions, to identify desirable outcomes, and to evaluate their

relevance. Mathematical profiles of such formalisms without psychological assumptions mimic, model, and extrapolate the essential strategic features of a problem to tentative propositions that conserve information with the goal that sure loss is to be avoided if sure gain is not guaranteed.

Inference space of the Saptbhangi propositions. Figure 2 gives an overview of the relations between the eight NAU propositions. Starting from the null N-A-U- in row 1, 12 steps track the hierarchy of pathways, forks, and dead ends to the other seven propositions. Each proposition in row 2 has one affirmed assertion, those in row 3 have two, and the only one in row 4 has three affirmed assertions. Each path from N-A-U- to N+A+U+ has three edges for the order in which the affirmed assertions are introduced. These relations show that the Saptbhangi template is a partially ordered set that can be treated as a lattice, electrical circuit, or neural net [17]. Its vector matrix (VM) description provides a quantitative basis for logic [1, 2].

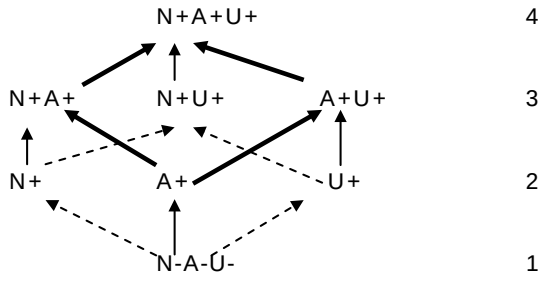

Figure 2. Hasse diagram of the eight NAU propositions.

Inference cube. The cube in Figure 3 represents the relations of the NAU propositions with three mutually perpendicular normalized axes that intersect

at each of the eight corners (vertices). With the node X for N-A-U-, the other seven are separated by 1, 2 or 3 edges for the affirmed assertions. The vertices on the front face of the cube for the four AU(N-) propositions are interpreted in Table 2 to infer the four logic states X, T, F or D. The inference space for n-orthogonal assertions is a n-dimensional hypercube with n orthonormal axes and 2^n vertices. X-T axis will overlap for each pair of orthogonal assertions. U+ for each F will not project on X-T. As assertions converge to a single valid (T) proposition, resolution of the remaining D may require paradigm shift [18]. Note that T and F are interpreted from independently affirmed orthogonal assertions. A projection from a point on the FT diagonal to the X-T axis is a measure of the partial truth value or the probability of certainty (p) and of uncertainty (1-p). The space outside the FT line may be assigned diffused or fuzzy boundaries of the logic states attributed to randomness, imprecision, vagueness or unknownness.

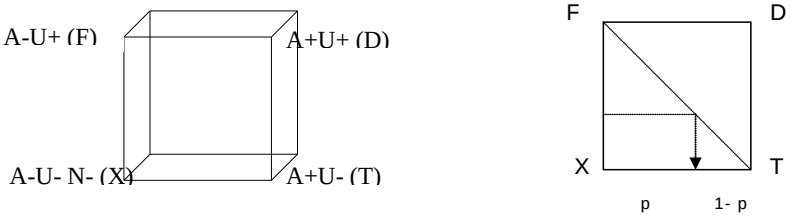

Figure 3. (Left) Assertions A (horizontal), U (vertical) and N (depth) as mutually perpendicular axes generate a cube with corners for eight propositions. (Right) The front face is bounded by T, F, X and D logic states.

The cubic universe of the set of eight discrete propositions (subsets) from three assertions (cardinal number) is not unlike the three dimensional

Hilbert space bounded by three orthonormal basis vectors [19]. Logical relations of a set of objects in Hilbert space can be modeled with vector-matrix (VM) algebra. Dirac modeled the quantum behavior of the subatomic particles in terms of the interactions of the bra and ket forms of the basis vectors with suitable operator matrices [20-22]. The Boolean algebra of T and F scalars recast as the VM algebra of T and F basis vectors provides a formalism for two-valued propositional binary logic (PBL), and extended to two-valued predicate logic [1, 2]. This groundbreaking work of Ramachandran on Boolen Vector matrix formulation (BVMF) published in Current Science is not acknowledged in later publications that provide additional insights into PBL and other binary logics [23-27] for the design of logic gates and filters corresponding to suitable connectives [28-31].

Limits of PBL. Two-valued logic is remarkably powerful for wide ranging applications where complementation of not-T as F is the basis of deduction of scalar T (1) or F (0) output from scalar T or F inputs. A binary proposition $z = x\ L\ y$ is an ordered Boolean algebraic relationship of the logic variables (x, y, z) and connective L (NOT, OR, AND). In the truth table for (L=) AND^{xy} the output for z = 1 with T inputs for both x and y, and z = 0 for the other three pairs of inputs for x and y:

AND^{xy}	X= F	T
y = F	**0**	**0**
T	**0**	**1**

Table 4. Binary truth table for the connective AND.

The vector-matrix (VM) algebra of the relations of the orthonormal T (0 1) and F (1 0) basis vectors is isomorphous with the Boolean algebra of 1 and 0 scalars. VM formula for a binary $z = \langle x | \ [AND^{xy}] \ | y \rangle$ proposition is the inner and outer product of the variables as basis vectors with an operator matrix. Horizontal bra $(x1 \quad x2)$ matrix of $\langle x |$ acts from the left, and the vertical ket $\begin{pmatrix} y1 \\ y2 \end{pmatrix}$ matrix of $| y \rangle$ acts from the right of the operator matrix $\begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix}$ for $[AND^{xy}]$ from its truth table (Table 4). Sixteen (2^4) 2x2 matrices of 0 and 1 make up the set of 16 binary connectives. The outer products of T and F vectors give four matrices from which the other 12 are algebraically derived. All other connectives can be expressed with connective NAND (NOT-AND, negation of the conjunction as in not (p and q) or not both $\begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$, or NOR (NOT-OR, neither nor) $\begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}$ alone.

T and F basis vectors intersect at the null X, and all other points in the T-F space are for D. Variables in a VM formula are input as normalized T (0 1) or F (1 0) vectors in bra or ket form. Normalized X (0 0) and D (1 1) vectors can not be used as inputs. The unary formula with negation or equivalence connective give only the T and F vector output, and the other 14 connectives give T, F, D or X vector outputs. Eight D and eight X outputs are obtained from the 28 possible right unary $| z \rangle = [L] \ | y \rangle$ formulas. Eight D

and eight X are also obtained from the 28 left unary $\langle z| = \langle x|\ [L]$ formulas. T or F vector inputs in a binary formula $z = \langle x|\ [L]\ |y\rangle$ give only the scalar 1 or 0 outputs, i.e. the D and X vector outputs obtained from the T or F vector inputs in the first step with the 14 connectives (above) are reduced to scalar T or F outputs after the second step. Suppression of intermediate D and X outputs in the second step of a binary formula can be viewed as a transition from T to F via X or D (Figure 2, right). Algebraically it is due to the complementation assumed in the inputs of the connective matrices.

$x\ OR^{xy}\ y =$		$\boldsymbol{z}$	⟶	$\boldsymbol{z}\ OR^{zy}\ y =$		x	$x\ OR^{xz}\ \boldsymbol{z} =$		y
0	0	0		0	0	0	0	0	0
0	1	1		0	1	X	0	1	1
1	0	1		1	0	1	1	0	X
1	1	1		1	1	D	1	1	D

$x\ AND^{xy}\ y =$		$\boldsymbol{z}$	⟶	$\boldsymbol{z}\ AND^{zy}\ y = x$			$x\ AND^{xz}\ \boldsymbol{z} =$		y
0	0	0		0	0	D	0	0	D
0	1	0		0	1	0	0	1	X
1	0	0		1	0	X	1	0	0
1	1	1		1	1	1	1	1	1

Table 5. Truth tables of the binary connectives are not reversible.

D and X conserve information. With the exception of equivalence and negation, truth tables of the other fourteen PBL connectives are not

reversible [2]. In the two sets of truth tables for L (= OR, AND) in Table 5, 1 and 0 outputs from binary $x\ L^{xy}\ y = z$ (left) are used as inputs for the formula $z\ L^{zy}\ y = x$ (middle) or $x\ L^{xy}\ z = y$ (right). In $z = x\ OR^{xy}\ y$, z = 0 if x = y = 0, and z = 1 for the other three pairs (left). If the T and F outputs for z (left) are used as inputs for $x = z\ OR^{zy}\ y$ (middle) or $y = x\ OR^{xz}\ z$ (right), the output may be D (T or F) of X (neither T nor F) in certain rows.

xUy	*T*	*F*	*D*	*X*
T	*T*	*D*	*T*	*T*
F	*D*	*F*	*D*	*F*
D	*D*	*D*	*D*	*D*
X	*T*	*F*	*D*	*X*

xVy	*T*	*F*	*D*	*X*
T	*T*	*X*	*T*	*X*
F	*X*	*F*	*F*	*X*
D	*T*	*F*	*D*	*X*
X	*X*	*X*	*X*	*X*

xNOTy	
T	*F*
F	*T*
D	*D*
X	*X*

Table 6. Reversible truth tables ***U*** and ***V*** with T, F, D and X inputs

Reference Tables 5 and 6 are useful for programing. Complementation of T with not-T as F makes the Boolean functions non-invertible or irreversible. With this insight the truth tables for binary connectives can be recast as ***U*** for unanimity for OR, and as ***V*** for *Vidya* (knowledge) for AND (Table 6) [1]. In these tables the outputs for $z=xL^{xy}y$ are obtained with T, F, D or X inputs for x and y. In both cases the T and F outputs for $z=xL^{xy}y$ are invertible (reversible), and also for $y = xL^{xz}z$ or $x = zL^{zy}y$ (not shown). The z1 and z2 components of the output vector are obtained separately from the first and second components of the input vectors as Boolean sums for $z = x\mathbf{U}y$ and Boolean products for $z = x\mathbf{V}y$:

For ***U***: $z1 = x1\ OR\ y1 = x1 + y1;$ $z2 = x2\ OR\ y2 = x2 + y2$

For ***V***: $z1 = x1 \text{ AND } y1 = x1 \otimes y1; \quad z2 = x2 \text{ AND } y2 = x2 \otimes y2$

The addition in ***U*** is for unanimity of *x* with *y* such that T***U***T (T with T) gives T, and F***U***F gives F. On the other hand, T***U***F, F***U***T, and F***U***D = D. Note that T***U***D = T where D is resolved in unanimity with T. In the last row or column additive interactions of X are without any additional information, and therefore for ***U*** the outputs remain the same as the inputs. Multiplication in ***V*** provides a check on the consistency of x and y, such that T***V***T = T, F***V***F = F. T***V***F or F***V***T = X or indeterminate as expected for the contradictory inputs. Also X***V***T or T***V***X or F***V***X or T***V***X or D***V***X or D***V***X = X because the X input in the product nullifies the T, D or F inputs, i.e. a contradictory proposition in a set makes the compound proposition contradictory.

Tables for ***U*** and ***V*** impose D whenever different choices of D inputs do not cancel the uncertainty about T or F. Such reference tables with D can be programmed and implemented as the logic gates or filters between input and output variables in logic circuits. As a step towards reversible logic, D permits determining a map of inverse operations from that of the direct operations. The operating principle is that if the inputs are not adequate to independently 'know' T and F, information is conserved as D to be recycled and resolved by introducing additional axiom, hypothesis or criteria.

D as a quantifier state within the logic space of the T and F has been interpreted [4, 31] to generate fuzzy, intuitionistic, or modal logics. Many-valued logics with 0, 1, -1, 2, *i* , or ½ basis vectors have also been described [2, 28, 31-33]. In such interpretations the total number of possible matrix functions increases exponentially with the number of independent assertions or truth

values. For example, a total of 512 (=2^9) two valued 3x3 matrix functions are possible for two assertions, whereas 19,683 (= 3^9) three valued 3x3 matrix functions result from 3 vectors for a 3-valued logic.

A well known limitation of PBL is encountered in the measures of the complementary variables of elementary particles. Simultaneous measurements of their position and momentum do not apparently conform to the distributive law[34]:

x AND (y OR z) = (x AND y) OR (x AND z)

x = the particle is moving to the right

y = the particle is in the interval

z = the particle is not in the interval

For a particle moving in a line the proposition "*y* OR *z*" is true, and the truth value of *x* AND (*y* OR *z*) is determined by the truth value of x. According to the Heisenberg uncertainty principle the position and momentum of a particle can not be measured simultaneously, which makes both (x AND y) and (x AND z) on the right hand side always false. By acknowledging such limitations of PBL and by postulating superposed or undecided states (D) the quantum theory has made rigorous and testable predictions about the observed and measured behaviors of the atomic particles.

Quantum logic and computing. The logic of quantum mechanics [34] is a set of mathematical rules for reasoning about the quantum behaviors. It projects measurements (propositions) as probabilities in Hilbert spaces. It has been elaborated with scores of mathematical formalisms including the vector

matrix algebra of the quantum states as orthogonal vectors. The classical computing bit has either F (0) or T (1) scalar state. Quantum logic is implemented with qubits (quantum bits) of quantum states. A qubit of two basis vectors (0 1) and (1 0) also includes their linear combination by quantum superposition (1 1) and interference (0 0). Thus a qubit with n vectors can simultaneously maintain 2^n states, which cuts down the number of memory swaps during a computing operation. In principle, each additional vector in a qubit increases the computing speed by 2-fold.

Superposition of the basis vectors permits reversibility of quantum logic operations that conserves information. A family of reversible and conservative gates are generated from n+1 bit inputs for n valued logics [35, 36]. In such logic circuits forward operation is simultaneously checked against the reverse operation during the course of computation without storing it in the memory. Also as a part of programming strategy, knowledge of the rules of forward and reverse inferences permits deduction driven by facts or by questions. Toffoli-Fredkin (TF) gates with 3 qubit inputs (figure 7) have been implemented as binary coded adders [37], and for reversible logic operations with optical [38] and ion trap [39] quantum devices.

$C \quad I_1 \; I_2 \qquad\qquad C \quad O_1 \; O_2$

0	0	0		0	0	0
0	0	1		0	0	1
0	1	0		0	1	0
0	1	1	→	0	1	1
1	0	0		1	0	0
1	0	1		1	0	1
1	1	0		1	1	1
1	1	1		1	1	0

Table 7. A 3x8 bitmap for Toffoli-Fredkin (T-F) gate

The sub-matrices of the 3x8 bitmap in Table 7 implement Boolean connectives and more complex functions. In the gating functions the first four rows retain input information while the last four rows are processed for output. One of the truth tables in such a circuit is the TF gate [26, 40]. TF-gate is a complex matrix to map 0 or 1 valued Boolean functions (O_1, O_2) from three bit inputs (C, I_1, I_2) onto three bit outputs (C, O_1, O_2). C input mapped directly as C output serves as a control. No swap is performed with C = 0 and the companion signal I_1 maps to O_1, and I_2 maps to O_2. If C = 1, outputs in at least two rows (seventh and eight in Figure 7) are swapped so that I_1 maps to O_2, and I_2 maps to O_1. Thus a 3x8 matrix partitioned into two 2x2 matrices retains D and permits simultaneous implementation of logic of T and F vectors.

TF gates are universal, that is a network of them can produce any binary function. The set of binary connectives (NOT, OR, AND, implication) can be implemented in almost all of these 3 input/3 output reversible logic gates with suitable choices of the filtering function for the output channel and

modification of the input channel. A gate is said to be conservative if outputs are permutations of inputs. Reversible T-F gate computes invertible mapping, i.e. injection of outputs as new inputs returns the original inputs. No information is lost in reversible TF gate because it conditionally routes information bits to move around the states during computation. It retraces itself backwards because the bits can be moved but the total number of bits remains intact during computation. Another requirement for a reversible gate is that for each possible truth table output there is only one input which will produce it. A 3x8 logic gate with three inputs and three outputs might have any one of 8^8 (≈ 16 million) possible truth tables. The requirement of reversibility reduces the number of possibilities down to 8! (≈ 40,000). Omitting duplicates these are reduced to 8000 which requires additional filtering criteria.

Doubt is a necessity

Cognized awareness of an object of concern and its behavior consequences is the basis for its description as a function of the actor-spectator mind. In such thought abstractions intelligence formalizes the states that are well within the awareness and distinguishable through language. Tools of observation and measurement improve the criteria-based awareness, and philosophy provides meaningful boundaries for the interpretation and representation. Logic seeks valid relations for concept formation within the bounds of the psychological and physical interactions with the identified parts of an object of concern. It is like setting up a

problem for solution with available information about the variables, evidence, and assumptions. Questionable assumption or interpretation leads to questionable inference. The logic of doubt wards against make-beliefs and irreversible actions while addressing emotive (meaning and desires), existential (values) or skeptic concerns.

Brute logic of doubtful states dictates that for survival with incomplete information it is prudent to retain options and conserve information howsoever tentative. A hallmark of natural languages is the processing continuum of possibilities to resolve layers of meaning that impregnate words. Fine-grained awareness of probable states and their relations provides a cognitive basis for reasoning with assertions. Partitioning of equivocation is the first step towards its resolution with suitable evidence. Assertions affirmed by independent evidence prune equivocation and enhance the degree of belief in a proposition. A response to real-time inputs requires extrapolation of outcomes and consequences to weigh plausible options.

Reasoning built on orthogonal assertions is remarkably isomorphous with the contemporary scientific reasoning to arrive at a conclusion on the basis of inferences each supported by independent evidence. The two-step Saptbhangi Nay syllogism for validity of a proposition within bounds of its affirmed assertions contains kernel of a theory of inference in terms of the interactions of the assumptions and evidence with the logic status of assertions as the basis of the logic states of a proposition. The logic space of orthonormal assertion vectors can be formalized in Hilbert space. Such

descriptions with suitable assumptions and boundary conditions for complementation and closure can be reduced to wide ranging logics. The challenge of their machine implementation remains.

Finally, reasoning with a matrix of assertions affirmed by cognized sense inputs and experience, as an intuitive basis of contemplation, contains not only kernel of a theory of inference but also permits speculation about a theory of mind in which such inputs are structured to be interpreted within the framework of speech, memory and recall. It is tempting to suggest that a net of inputs configured as a multidimensional orthogonal neural qubit (nubit) could tentatively retain plausible inputs in real time to filter and gate outputs. A very large nubit will not only have the efficiency of a reversible conservative device, but a set of external inputs may lead to unique outputs modulated by the granularity of the internal inputs from an individual.

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object in a sentence…. Since paradoxes are no different from other sentence constructs, if every such infinite subgroup in (T,F) can be mapped to finite group in (T,F,D,X, it would be remarkable."

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