Applications of Indian Logic in Modern Information Technology

Dr. V. Baby

Logic and Technology

The term Logic (nyāya) literally implies the means by which mind is led to a conclusion. Nyāya becomes equivalent ot an argument, and the system which treats of arguments more thoroughly than others cames to be known as the Nyāya system. Every science is a Nyāya, which means an analytic investigation. The system of Indian logic which studies the general plan and method of critical inquires, may be called the science of science and also stands for syllogistic reasoning, on the other sense it signifies the examinationof objects by evidences. It thus becomes a science of demonstration or of correct knowledge, प्रमाणाशास्त्र। All knowledge implies four conditions -

1. The subject of the pramātṛ, the cogniser or the substantive ground of the cognitions.
2. The object or the prameya - to which the process of cognition is directed;
3. The resulting state of cognition, or the pramiti; and
4. The means of knowledge or the pramaṇa

1. pramāṇas, (प्रमाण) or Epistemology.

The Indian logicians accept four Pramaṇas- (1) प्रत्यक्ष - sensory perception - as that knowledge which arises from the contact of a sense

organ with its object - the different factors involved in perception are :- the senses (indriyas) (2) their objects (artha) (3) the contact of the senses with their objects (सन्निकर्ष) and (4) cognition produced by this jñānaṃ - इन्द्रियार्थसन्निकर्षं - तज्जन्यं ज्ञानम् - Real knowledge or, प्रत्यक्षज्ञानम्।

2. Anumāna (Inference)

Anumāna in Sanskrit literally means measurement following something. It is the knowledge that follows other knowledge. The knowledge of the sign of the object gives the knowledge of the object signified. eg. there is fire here because ther is smoke here.

3. Upamāna (comparison)

Upamāna is the means by which gain the knowledge of the thing from its similarity to another thing previously wellknown. An argument by comparison involves two factors, viz - the knowledge of the known object and (2) the perception of similarity. Consider the example - the wild ox (gavaya) is like a cow. We infer that the animal which find to be like the cow is the gavaya. In the first case of complete resemblance, the inference need not be vaild, for a buffalo is not a cow, although there are many points of resemblance.

4. Śabda (verbal Testimony)

The theory of language is very important. The relation between śabda and artha (शब्दार्थौ) has received wide attention. Indian logicians have developed their own approach for using śabda as a Pramāṇa. It is the operative cause of valid knowledge in normal circumstances.

The Indian logic interprets the logical facts and expresses them in logical formulas which assume the form of standards or norms in all cases of the divergence of thought from its normal course of thuth seeking. Logic is the science of proof or the estimation of evidence.

Technology is the usage and knowledge of tools, techniques, crafts, systems, or methods of organization. The word technology comes from the greek -technologia, an 'art','skill' or craft and logia - the study of something or the branch of knowledge of a discipline. The term can be applied generally to specific areas like construction technology, medical technology etc. Technology signifiantly affect human as well as other animal species ability to control and adapt to their natural environments. Recent technological developments, including the printing press, the telephone and the internet home lessened physical barriers to communication and allowed humans to interact freely on a global level. however, not all technology has been used for peaceful purposes, the development of weapons of even increasing destructive power has progressed through out history, from clubs to nuclear weapons.

Technology has affected to the society and its surroundings in a number of ways. In many societies technology has helped to develop more advanced economics (global economics) and has allowed the rise of leisure class. Any way technology, information technology and artifical intelligence are be most broadly as the entities, both material and inmaterial created by the application of mental and physical effort in order to achieve some value. In this usage, technology refers to tools and machines that may be used to solve real world broblems.

Applications of Indian Logic in Modern I.T.

The concept of Indian logic have never been used for modern applicaitons as the IT and AI systems. Therefore, there is a need to familirize these concepts to make them useful in today's application context.

Current view on cognitive and Linguistics

The cognitive and linguistics offer scope for a multidisciplinary study of the mind or what might be called the natural intelligence.

Cognitive science seeks and understanding of such mental abilities as perception, recognition, categorization, memory, reasoning and problem solving, motor control, speech language and communication, Linguistics focuses on the nature of human language its theoretical, descriptive, behavioural and evolutionary bases. It also serves as a window into human cognition. The approaches of a variety of disciplines, including cognitive psychology, linguistics, artifical intelligence, neuroscience, philosophy and antropology are all brought to bear on common problems of mind, brain and language. The future of the cognitive and linguistics lies in crossing these traditional disciplinary boundaries. In linguistics and language processing theories of phonology, syntax and semantics are increasingly enmeshed with the result of formal, computational, and experimental studies. It is in this context we believe that a serious exploration of Indian philosophical views on logic and language is helpful to intergrate the classical ideas with the present day thinking. Indian logic may be used to develop IT tools and products for conducting administration business and educational activities in Indian multilingual environment though contextualizing Indic Knowledge.

Possible applications for Indian logic

1. Development of methods for knowledge acquisition, represent tion and validation using the deeper notion of knowledge in Indian logic (eg. use of petriNets for Indian logic.)
2. Development of Sanskrit word-net that would lead to sanskrit as an Indian link language (ILL) to support machine translation from one language to the other.
3. Formalization of the methodology of hierarchical semantic anal sis of sentences of ordinary (laukika) language using several laers of knowledge such as lexicons (Kośa) grammar (vyākaraṇa) logic (nyāya) and exegesis (mīmāṃsa).

4. Formalization of the methodology of semantic analysis of lite ary language (alaṅkāra),(vyañjanā, dhvani aspects) that would f cilitate machine translation and knowledge interpretation.

5. Exploration of the methodology of parārtha anumāna in tarka to train a researcher to defend a thesis, and to respond to the arg ments ofcritics.

Knowledge representation for Indian Logic

The perception through senses is the most important source of knowledge (Pramāṇa) in Indian logic. The term jñana is used in Indian logic only in the episodic sense and never in the dispositional sense. It is used in a very broad sense to include sensing, perception, memory, introspection, assumption, doubt and belief etc. Sensory knowledge acquisition is a processinitiated by a doubt and sustained by inquiry (parāmṛśa). This involves a sequence of mental episodes or events.

Cognitions have three moments.:- (a) a moment of origination, (b) a duration in which an art produces its own trace, and (c) a moment of cessation as a conseious state. Cognitions may be classified as : (1) informate (anubhava) (2) recollective (smṛti). Perception can produce either a true cognition (Pramā) or a false one leading to doubt (Saṃśaya) and false belief episodes (Viparyaya). Perception can be determinate or inderterminate and the former can either be ordinary (laukika) or special (aaukika).

The cognition process can be explained as :- an observer looks at a pot on the gound, the process is sequential in getting the knowledge of two parts of the object, pt and ground and the relation connecting them, confirming and concluding that as a true cognition, with the following steps.

1. The observer sees the object pot (ghaṭa).
2. Recalling from his (her) memory, he (she) decides that it has a dharma. Here dharma is pot -ness (ghaṭatva).
3. Then budhi links the above two (pot and potness) by a relation called समवाय (inherence).
4. So, it is then concluded by the vyāpāra (व्यापार) implied by perception that the object is ghaṭa.

This process of cognition can be represented with the help of petri Nets, which are bipartitegraph representations consisting of place and transitions representing states and events - (fig -1) This gives rise to the cognition "There is a pot".

5. The observer also recognizes that in addition to धर्म, the pot has a प्रकार, which covers its shape, size and other features. If he observes that in this case the feature seen is the blue colour related to the pot by inherence, here the resulting cognition is there is a blue pot. (Fig -2)
6. Next, for the ghaṭa to be stable and intact it has to have some su port. So look about this supporting object b. He observes that the relation is contact (संयोग) and that location ground is hte support for the superstratum pot.
7. Again from memory bhutala has its own धर्म- भूतलत्व, related to भूतल by समवाय relation.
8. This also brings in the concept of support- supported (आधाराधेय) भाव, wherein the earth is आधार (support) and the ghaṭa is (आधेय)
9. The link between the two -i.e, the pot and the floor - is established by understanding. that the pot is supported by the earth by contact or संयोग relation.

10. The final conclusion is - The blue pot as qualified by potness and blueness is related to the ground, qualified by ground-hood and that the former, the super stratum (आधेय) is supported by latter as a substratum occurrent (आधार)

Fig -2 :

Place 6: Cognition There is a pot

Place 7 : Recognition of the object as colour possessor.

Place 8: Cognition of blue colour

Place 9: Cognition of the relation of inherence of blue colour in the object pot.

T3 : The cognition There is a blue pot.

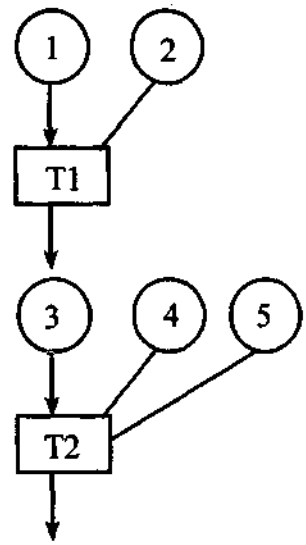

Fig 1 - PetriNet for There is a pot.

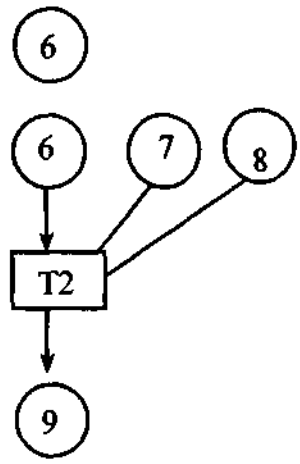

Fig -2 PetriNet for there is a blue pot

Legend for Fig -1

Place I, Desire to infer; Place -2- contact of eye with object interest; Transition - I; Perception of the object. Place -3- Recognition of the object as potness possessor Place 4:- cognition of potness; Place 5:- cognition of the relation of inherence of potness in the object pot T2: The perception process: Place -6: cognition Verbalization as there is a pot.

Example 2: Inferential cognition -inferential cognition arises from substantive reflection by a combination of hte knowledge of pervasion(व्याप्तिज्ञान) and the presence of probans (हेतु) in the subject locus (पक्ष) called पक्षधर्मताज्ञान : A proper definition of पक्षता is an important and difficult problem in Modern Indian Logic.

I. Certainty about Sādhya (साध्यसिद्धि)

II. Doubt about Sādhya (साध्यसन्देह) desire to infer and certainty

III. Desire to infer but no certainty

IV. There is absence of both the desire to inferand certainty

V. Absence of causal aggregates leading to perceptual cognition and verbal cognition

VII. Parāmarśa leading to anumiti.

By considering the input states as: design to infer, doubt regarding (साध्य),certainty or otherwise of (साध्य), perception of smoke in a locus (on the mountain) recollection, of (व्याप्ति) between smoke and fire, knowledge of (पक्षधर्मता) (or pakṣata or subjecthood),

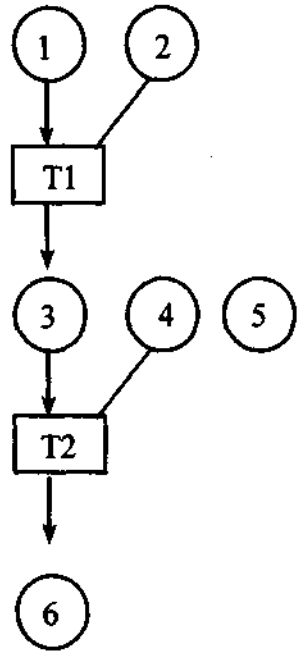

Fig -3 PetriNet for inferential cognition.

Legend for

Fig -3: Place 1; Desire to infer; Place 2: contact of eye with smoke in locus mountain, Transition -I Perception process of smoke; Place 3: Perception of smoke being Smokeness possessor; place 4; Recollection of व्याप्ति between smoke and fire; place 5; substantive reflection (परामर्श); T2; The inference process; Place 6; inference verbalizable as fiery mountain.

Conclusion

Logic used for identifying patterns of sound reasoning in the context of medical diagnosis as in the Caraka Saṃhita, in matters of law and justice as in the Artha śāstra and in philosophical and ethical issues as in the Nyāya Darśana. The Indian logic proposes perception, inference,

verbaltestimony and analogy as the four pramāṇās, or the means of obtaining valid knowledge. Technology is the usage and knowledge of tools, techniques, crafts, systems or methods of organization.

Technology, information technology and artifical intelligence are the broadest as the entities, both material and immaterial created by the application of mental and physical effort in order to achieve some value. Philosophers of the East and west have long since recognized Indian contributions to logic. On the other hand, the Indian technology and science community is by and large unaware of these developmetns, The salient features of Indian logic and the issues of perception, inference and the concept of relation are discussed in some detail.

It is certain that in near future, the present day problems of intelligent search and retrieval of information from the world wide web (www), and knowledge engineering can considerably benefit from the application of these concepts form Indian logic.

Reference books

1. S.S. Barlingay, A modern Introduction to Indian Logic
2. Dr. S. Radhakrishnan, Indian philosophy.
3. Daniel H.H.Ingalls, Materials for the study of Navya Nyaya logic
4. B.K.Matilal, perception , An Essay on classical Indian theories of knowledge.
5. Satish Chandra Vidyabhushan, History of Indian logic.