OPEN ACCESS

International Journal of Management and Humanities (IJMH)
ISSN: 2394–0913 (Online), Volume-4 Issue-5, January 2020

Valid Arguments and Heyting Algebra using Multi Valued Logic

R. Malathi, T. Venugopal

Abstract: *Over last three decades, multi valued logic (MVL) has been receiving considerable attention. So, we focus our concentration upon multi valued logic using some of the rules of mathematical logic, which can be used in developing artificial intelligence. Since Aristotle's logic there were only two propositions. Later it was extended to n-valued logical proposition which is greater than 2, that is popularly known as multi valued logic proposition – they are true, false and unknowns. In this paper we will discuss about multi valued logic with 27- possible using Jaina logic and some of the rules as it gives the best results. In Jaina Logic, indeterminant means something which cannot describe more than one aspect at a time. So, we are going to consider each aspect separately and assign True or False. Then according to the given condition we can either apply min or max condition to get a precise solution.*

Keywords: *Abducible Predicates, Jaina Logic, Mathematical Logic, Truth Table, Multi-Valued Logic, Primitives.*

I. INTRODUCTION

Jains form less than 1% of the Indian population. For centuries, Jains are famous as community of traders and merchants. The states of Gujarat and Rajasthan have the highest concentration of Jain population in India. Mahavira is the 24^{th} and last of the Jain Tirthankars.

Due to the limitations of the human mind, it is impossible to consider all aspect of human reality. However, we can consider each aspect at a time. Since, it is a relative approach, each prediction can be confirmed or rejected using three different possibilities.

II. MULTI VALUED LOGIC

Multi valued logic is a propositional calculus where there are more than two values. Jan Lukasiewicz is a polish logician who has introduced mathematical logic and the history of logic. He is regarded as one of the most important historians of logic. In 20th century the idea of multi value logic has been introduced successfully.

Jan Lukasiewicz has been created a system of multi valued logic which is "true", "false" and other than this he used third valued logic that is "possible" (unknowns). Several n-valued logic was developed in 1930 which is n ≥ 2.

The formula for n-valued logic is defined as

$$T_n = \left\{0 = \frac{0}{n-1}, \frac{1}{n-1}, \frac{2}{n-1}, ..., \frac{n-2}{n-1}, \frac{n-1}{n-1} = 1\right\}$$

Revised Manuscript Received on January 03, 2020.

* Correspondence Author

R.Malathi*, Dept.of Mathematics, Sri Chandra Sekharendra Saraswathi Viswa Maha Vidyalaya, Kanchipuram, India. malathilathar@gmail.com

T.Venugopal, Dept.of Mathematics, Sri Chandra Sekharendra Saraswathi Viswa Maha Vidyalaya, Kanchipuram, India. drmathtvg@gmail.com

Hence, 3- valued logic is defined as

$$T_3 = \left\{0 = \frac{0}{3-1}, \frac{1}{3-1}, \frac{2}{3-1} = 1\right\}$$

$$T_3 = \left\{0, \frac{1}{2}, 1\right\}$$

III. BASIC FORMULAS

In this section we use some of the rules of Jaina logic to Lukasiewicz Logic which is given below:

- $a \wedge b = \min(a, b)$; if min (a, b) = 0 or 1/2; then min (a, b) = 0
- $a \vee b = \max(a, b)$; if max (a,b) = 1/2 or 1; then max (a, b) = 1
- $\bar{a} = 1 - a$
- $a \Rightarrow b = \min(1, 1 + b - a)$
- $a \Leftrightarrow b = 1 - |a - b|$

To define ~, ∨, ∧, → , ⇔[13]. Here we taken totally 3^3=27 possible of combinations in the truth table given below:

Table - 1.3.1:

p	q	r	p → q	q → r	p → r	p ∨q	p ∧ q	~ p	~q	c	~ p → c
0	0	0	1	1	1	0	0	1	1	0	0
0	0	1/2	1	1	1	0	0	1	1	0	0
0	0	1	1	1	1	0	0	1	1	0	0
1/2	0	0	1/2	1	1/2	1/2	0	1/2	1	0	1/2
1/2	0	1/2	1/2	1	1	1/2	0	1/2	1	0	1/2
1/2	0	1	1/2	1	1	1/2	0	1/2	1	0	1/2
1	0	0	0	1	0	1	0	0	1	0	1
1	0	1/2	0	1	1/2	1	0	0	1	0	1
1	0	1	0	1	1	1	0	0	1	0	1

Table1.3.2:

p	q	r	p → q	q → r	p → r	p ∨ q	p ∧ q	~ p	~ q	c	~ p → c
0	1/2	0	1	1	1	1/2	0	1	1/2	0	0
0	1/2	1/2	1	1	1	1/2	0	1	1/2	0	0
0	1/2	1	1	1	1	1/2	0	1	1/2	0	0
1/2	1/2	0	1	1/2	1/2	1/2	1/2	1/2	1/2	0	1/2
1/2	1/2	1/2	1	1	1	1/2	1/2	1/2	1/2	0	1/2
1/2	1/2	1	1	1	1	1/2	1/2	1/2	1/2	0	1/2
1	1/2	0	1/2	0	0	1	1/2	0	1/2	0	1
1	1/2	1/2	1/2	1/2	1/2	1	1/2	0	1/2	0	1
1	1/2	1	1/2	1	1	1	1/2	0	1/2	0	1

p	q	r	p → q	q → r	p → r	p ∨ q	p ∧ q	~ p	~ q	c	~ p → c
0	1	0	1	0	1	1	0	1	0	0	0
0	1	1/2	1	1/2	1	1	0	1	0	0	0
0	1	1	1	1	1	1	0	1	0	0	0
1/2	1	0	1	0	1/2	1	1/2	1/2	0	0	1/2
1/2	1	1/2	1	1/2	1	1	1/2	1/2	0	0	1/2
1/2	1	1	1	1	1	1	1/2	1/2	0	0	1/2
1	1	0	1	0	0	1	1	0	0	0	1
1	1	1/2	1	1/2	1/2	1	1	0	0	0	1
1	1	1	1	1	1	1	1	0	0	0	1

IV. BASIC DEFINITIONS

A. ARGUMENT FORM AND THEIR VALIDITY

An argument in propositional logic is a sequence of propositions. The final proposition is called premises and conclusion. An argument is a valid form where it starts with premises, analyses, the syntax and finally, conclusion. Most probably if the argument is valid then the premises are true and then it implies that the conclusion is also true.

Moreover an argument form with premises 'p' and the conclusion 'q' is valid if and only if when p → q is tautology.

B. STANDARD FORM

Rules of inference are in the standard form of:

Premise#1
Premise#2
...
Premise#n
Conclusion.

These expression states that the given premises have been obtained and then it analyses its syntax and then final specified conclusion can be obtained as well. By knowing on the actual content of the derivatives we can describe the exact language that is used to describe both the premises and conclusions[1].

Here we had taken 27 possible of combinations in the truth table. These combinations are satisfied by some valid form of arguments like the main 9 rules of inference they are modus ponens, modus tollens, disjunctive addition, conjunctive simplifications, disjunctive syllogism, hypothetical syllogism, dilemma, conjunctive addition, rules of contradiction are also satisfies these conditions.

The list of these valid forms of arguments is given below with its proof via truth table:

- Modus ponens: p→q , p , ∴ q
  (as seen in table:-2.2.1)
- Modus tollens : p→ q , ~ q , ∴~ p
  (as seen in table:-2.2.2)
- Disjunctive addition: a.) p , ∴p ∨ q.
  (as seen in table:-2.2.3)
  b.) q , ∴p ∨ q.
- Conjunctive simplification: a.) p ∧ q , ∴p.
  (as seen in table:-2.2.4)
  b.) p ∧ q , ∴q.
- Disjunctive syllogism: a.) p ∨ q , ~q , ∴p.
  (as seen in table:-2.2.5)
  b.) p ∨ q , ~p , ∴q.
- Hypothetical syllogism: p → q , q → r,
  ∴ p → r. (as seen in table:-2.2.6)
- Dilemma: p ∨ q , p → q , q → r , ∴r.
  (as seen in table:-2.2.7)
- Conjunctive addition: p , q , ∴ p ∧ q.
  (as seen in table:-2.2.8)
- Rules of contradiction: ~p → c , ∴ p.
  (as seen in table:-2.2.9)

The proof via truth table:

TABLE: 2.2.1

Modus ponens*:* p→ q , p , ∴ q

Here 1/2 is true

Var	**p**	0	0	0	1/2	1/2	1/2	1	1	1
	q	0	0	0	0	0	0	0	0	0
Pre	**p → q**	1	1	1	1/2	1/2	1/2	0	0	0
	p	0	0	0	1/2	1/2	1/2	1	1	1
Con	**q**	0	0	0	0	0	0	0	0	0

Var	**p**	0	0	0	1/2	1/2	1/2	1	1	1
	q	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Pre	**p → q**	1	1	1	1	1	1	1/2	1/2	1/2
	p	0	0	0	1/2	1/2	1/2	1	1	1
Con	**q**	0	0	0	1/2	1/2	1/2	1/2	1/2	1/2

Var	**p**	0	0	0	1/2	1/2	1/2	1	1	1
	q	1	1	1	1	1	1	1	1	1
Pre	**p → q**	1	1	1	1	1	1	1	1	1
	p	0	0	0	1/2	1/2	1/2	1	1	1
Con	**q**	0	0	0	1/2	1/2	1/2	1	1	1

TABLE : 2.2.2

Modus tollens *:* p→ q , ~q , ∴~p

Here 1/2 is true

Var	**p**	0	0	0	1/2	1/2	1/2	1	1	1
	q	0	0	0	0	0	0	0	0	0
	~ p	1	1	1	1/2	1/2	1/2	0	0	0
Pre	**p→ q**	1	1	1	1/2	1/2	1/2	0	0	0
	~ q	1	1	1	1	1	1	1	1	1
Con	**~ p**	1	1	1	1/2	1/2	1/2	0	0	0

Var	**p**	0	0	0	1/2	1/2	1/2	1	1	1
	q	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
	~ p	1	1	1	1/2	1/2	1/2	0	0	0
Pre	**p→ q**	1	1	1	1	1	1	1/2	1/2	1/2
	~ q	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Con	**~ p**	1/2	1/2	1/2	1/2	1/2	1/2	0	0	0

Retrieval Number: E0538014520/2020©BEIESP
DOI:10.35940/ijmh.E0538.014520
Journal Website: www.ijmh.org

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
	q	1	1	1	1	1	1	1	1	1
Pre	~ p	1	1	1	1/2	1/2	1/2	0	0	0
	p → q	1	1	1	1	1	1	1	1	1
	~ q	0	0	0	0	0	0	0	0	0
Con	~ p	0	0	0	0	0	0	0	0	0

TABLE: 2.2.3

Disjunctive addition: a) p , ∴p ∨ q
b) q , ∴p ∨ q

In or function 1/2 is true

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
Pre	p ∨ q	0	0	0	1/2	1/2	1/2	1	1	1
Con	p ∨ q	0	0	0	1/2	1/2	1/2	1	1	1
Var	q	0	0	0	0	0	0	0	0	0
Pre	p ∨q	0	0	0	1/2	1/2	1/2	1	1	1
Con	p ∨ q	0	0	0	0	0	0	0	0	0

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
Pre	p ∨ q	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1
Con	p ∨ q	0	0	0	1/2	1/2	1/2	1	1	1
Var	q	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Pre	p ∨q	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1
Con	p ∨q	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
Pre	p ∨ q	1	1	1	1	1	1	1	1	1
Con	p ∨ q	0	0	0	1	1	1	1	1	1
Var	q	1	1	1	1	1	1	1	1	1
Pre	p ∨ q	1	1	1	1	1	1	1	1	1
Con	p ∨ q	1	1	1	1	1	1	1	1	1

TABLE: 2.2.4

Conjunctive simplification: a) p ∧ q , ∴ p
b) p ∧ q , ∴q

In and function 1/2 is false

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
Pre	p ∧ q	0	0	0	0	0	0	0	0	0
Con	p	0	0	0	0	0	0	0	0	0
Var	q	0	0	0	0	0	0	0	0	0
Pre	p ∧ q	0	0	0	0	0	0	0	0	0
Con	q	0	0	0	0	0	0	0	0	0

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
Pre	p ∧ q	0	0	0	1/2	1/2	1/2	1/2	1/2	1/2
Con	p	0	0	0	0	0	0	0	0	0
Var	q	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Pre	p ∧q	0	0	0	1/2	1/2	1/2	1/2	1/2	1/2
Con	q	0	0	0	0	0	0	0	0	0

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
Pre	p ∧ q	0	0	0	1/2	1/2	1/2	1	1	1
Con	p	0	0	0	0	0	0	1	1	1
Var	q	1	1	1	1	1	1	1	1	1
Pre	p ∧ q	0	0	0	1/2	1/2	1/2	1	1	1
Con	q	0	0	0	0	0	0	1	1	1

TABLE: 2.2.5

Disjunctive syllogism : a) p ∨ q , ~q , ∴ p
b) p ∨ q , □ p , □ q

In or function 1/2 is true.

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
	q	0	0	0	0	0	0	0	0	0
Pre	p ∨q	0	0	0	1/2	1/2	1/2	1	1	1
	~ q	1	1	1	1	1	1	1	1	1
Con	p	0	0	0	1	1	1	1	1	1
Var	p	0	0	0	1/2	1/2	1/2	1	1	1
	q	0	0	0	0	0	0	0	0	0
Pre	p ∨q	0	0	0	1/2	1/2	1/2	1	1	1
	~ p	1	1	1	1/2	1/2	1/2	0	0	0
Con	q	0	0	0	0	0	0	0	0	0

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
	q	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Pre	p ∨ q	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1
	~ q	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Con	p	0	0	0	1/2	1/2	1/2	1	1	1
Var	p	0	0	0	1/2	1/2	1/2	1	1	1
	q	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Pre	p ∨q	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1
	~ p	1	1	1	1/2	1/2	1/2	0	0	0
Con	q	1	1	1	1/2	1/2	1/2	0	0	0

VAR	p	0	0	0	1/2	1/2	1/2	1	1	1
	q	1	1	1	1	1	1	1	1	1
PRE	p ∨ q	1	1	1	1	1	1	1	1	1
	~q	0	0	0	0	0	0	0	0	0
CON	p	0	0	0	0	0	0	0	0	0
VAR	p	0	0	0	1/2	1/2	1/2	1	1	1
	q	1	1	1	1	1	1	1	1	1
PRE	p ∨q	1	1	1	1	1	1	1	1	1
	~ p	1	1	1	1/2	1/2	1/2	0	0	0
CON	q	1	1	1	1	1	1	0	0	0

TABLE: 2.2.6

Hypothetical syllogism*:* p→ q , q→ r , ∴p→ *r*

Here 1/2 is true

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
	q	0	0	0	0	0	0	0	0	0
	r	0	1/2	1	0	1/2	1	0	1/2	1
Pre	p→ q	1	1	1	1/2	1/2	1/2	0	0	0
	q →r	1	1	1	1	1	1	1	1	1
	p→r	1	1	1	1/2	1	1	0	1/2	1
Con	p→r	1	1	1	1/2	1/2	1/2	0	0	0

Retrieval Number: E0538014520/2020©BEIESP
DOI:10.35940/ijmh.E0538.014520
Journal Website: www.ijmh.org

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
	q	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
	r	0	1/2	1	0	1/2	1	0	1/2	1
Pre	p → q	1	1	1	1	1	1	1/2	1/2	1/2
	q→ r	1	1	1	1/2	1	1	0	1/2	1
	p→ r	1	1	1	1/2	1	1	0	1/2	1
Con	p→ r	1	1	1	1/2	1	1	0	1/2	1/2

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
	q	1	1	1	1	1	1	1	1	1
	r	0	1/2	1	0	1/2	1	0	1/2	1
Pre	p → q	1	1	1	1	1	1	1	1	1
	q → r	0	1/2	1	0	1/2	1	0	1/2	1
	p → r	1	1	1	1/2	1	1	0	1/2	1
Con	p → r	0	1/2	1	0	1/2	1	0	1/2	1

TABLE: 2.2.7

Dilemma : p vq , q→r , ∴ r

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
	q	0	0	0	0	0	0	0	0	0
	r	0	1/2	1	0	1/2	1	0	1/2	1
Pre	p v q	0	0	0	1/2	1/2	1/2	1	1	1
	q → r	1	1	1	1	1	1	1	1	1
Con	r	0	0	0	0	1	1	0	1	1

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
	q	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
	r	0	1/2	1	0	1/2	1	0	1/2	1
Pre	p v q	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1
	q → r	1	1	1	1/2	1	1	0	1/2	1
Con	r	0	1	1	0	1	1	0	1	1

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
	q	1	1	1	1	1	1	1	1	1
	r	0	1/2	1	0	1/2	1	0	1/2	1
Pre	p vq	1	1	1	1	1	1	1	1	1
	q→ r	0	1/2	1	0	1/2	1	0	1/2	1
Con	r	0	1	1	0	1	1	0	1	1

TABLE: 2.2.8

Conjuctive addition : p , q , ∴ p ∧ q

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
	q	0	0	0	0	0	0	0	0	0
Pre	p∧ q	0	0	0	0	0	0	0	0	0
Con	p∧ q	0	0	0	0	0	0	0	0	0

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
	q	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Pre	p∧q	0	0	0	1/2	1/2	1/2	1/2	1/2	1/2
Con	p∧q	0	0	0	0	0	0	0	0	0

Var	p	0	0	0	.5	.5	5	1	1	1
	q	1	1	1	1	1	1	1	1	1
Pre	p∧q	0	0	0	.5	.5	5	1	1	1
Con	p∧q	0	0	0	0	0	0	1	1	1

TABLE: 2.2.9

Rule of contradiction : ~p → c ∴ p

Var	p	0	0	0	1/2	1/2	1/2	1	1	1
Pre	~ p →c	0	0	0	1/2	1/2	1/2	1	1	1
Con	p	0	0	0	1/2	1/2	1/2	1	1	1

2.3 HEYTING ALGEBRA

An heyting algebra is a bounded lattices with an operation '∧' and '∨' with least and greatest element 0's ans 1's equipped with an operation A → B implies that C ∧ A ≤ B is equivalent to C ≤ A → B. Like Boolean algebra, heyting algebra form a variety axiomatizable with finitely many equations and it was introduced by Arend Heyting in 1930 to formalize intuitionistic logic[10].

The list of these valid forms of arguments is given below with its proof via truth table:

- p→ p = 1
  (as seen in table:2.3.1, 2.3.2, 2.3.3 in row 4)
- p → (q ∧ r) = (p → q)∧ (p → r) (as seen in table :2.3.1, 2.3.2, 2.3.3 in row 17 and 18)
- q ≤ p → q (as seen in table :2.3.1, 2.3.2, 2.3.3 in row 2 and 5)
- r ≤ (p → q) iff p ∧ r ≤ q (as seen in table :2.3.1, 2.3.2, 2.3.3 in row 2,3,5,10)
- p→ q ≤ p → (q ∨ r) (as seen in table :2.3.1,2.3.2,2.3.3 in row 1,5,12,19)
- (p ∨ r) → q ≤ (p→ q) (as seen in table :-2.3.1, 2.3.2, 2.3.3 in row 2, 5, 20)
- (p ∨ q) ≤ ¬ p (as seen in table :2.3.1, 2.3.2, 2.3.3 in row 11 and14)
- p ≤ ¬ ¬ p (as seen in table :2.3.1, 2.3.2, 2.3.3 in row 1 and 15)
- ¬ ¬ p = ¬ p (as seen in table :2.3.1, 2.3.2, 2.3.3 in row 14 and 15)
- ¬ 0 = 1 (as seen across the table)
- ¬1 = 0 (as seen across the table)
- (p ∨ q) = ¬ p ∧ ¬ q (as seen in table :2.3.1,2.3.2,2.3.3 in row 11,14,21)
- ¬ ¬ (p ∨ ¬ p) = 1 (as seen in table :2.3.1,2.3.2,2.3.3 in row 1,14,22,23)
  :2.3.1,2.3.2,2.3.3 in row 1,14,22,23)

Retrieval Number: E0538014520/2020©BEIESP
DOI:10.35940/ijmh.E0538.014520
Journal Website: www.ijmh.org

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

TABLE: 2.3.1

p	0	0	0	1/2	1/2	1/2	1	1	1
q	0	0	0	0	0	0	0	0	0
r	0	1/2	1	0	1/2	1	0	1/2	1
p → p	1	1	1	1	1	1	1	1	1
p → q	1	1	1	1/2	1/2	1/2	0	0	0
q → r	1	1	1	1	1	1	1	1	1
p → r	1	1	1	1/2	1	1	0	1/2	1
p ∧ q	0	0	0	0	0	0	0	0	0
q∧ r	0	0	0	0	0	0	0	0	0
p ∧ r	0	0	0	0	1/2	1/2	0	1/2	1
p ν q	0	0	0	1/2	1/2	1/2	1	1	1
q ν r	0	1/2	1	0	1/2	1	0	1/2	1
p ν r	0	1/2	1	1/2	1/2	1	1	1	1
~ p	1	1	1	1/2	1/2	1/2	0	0	0
~~ p	0	0	0	1/2	1/2	1/2	1	1	1
~(p ν q)	1	1	1	1/2	1/2	1/2	0	0	0
p →(q ∧ r)	1	1	1	1/2	1/2	1/2	0	0	0
(p → q)∧(p → r	1	1	1	1/2	1/2	1/2	0	0	0
p →(q ∨ r)	1	1	1	1/2	1	1	0	1/2	1
(p ν r)→ q	1	1/2	0	1/2	1/2	0	0	0	0
~ p ∧~ q	1	1	1	1/2	1/2	1/2	0	0	0
(p ν~ p)	1	1	1	1/2	1/2	1/2	1	1	1
~~(p ν~ p)	1	1	1	1/2	1/2	1/2	1	1	1

TABLE: 2.3.2

p	0	0	0	1/2	1/2	1/2	1	1	1
q	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
r	0	1/2	1	0	1/2	1	0	1/2	1
p → p	1	1	1	1	1	1	1	1	1
p → q	1	1	1	1	1	1	1/2	1/2	1/2
q → r	1	1	1	1/2	1	1	0	1/2	1
p → r	1	1	1	1/2	1	1	0	1/2	1
p ∧ q	0	0	0	1/2	1/2	1/2	1/2	1/2	1/2
q ∧ r	0	1/2	1/2	0	1/2	1/2	0	1/2	1/2
p ∧ r	0	0	0	0	1/2	1/2	0	1/2	1
p ν q	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1
q ν r	1/2	1/2	1	1/2	1/2	1	1/2	1/2	1
p ν r	0	1/2	1	1/2	1/2	1	1	1	1
~ p	1	1	1	1/2	1/2	1/2	0	0	0
~~ p	0	0	0	1/2	1/2	1/2	1	1	1
~(p ν q)	1/2	1/2	1/2	1/2	1/2	1/2	0	0	0
p → (q∧ r)	1	1	1	1/2	1	1	0	1/2	1/2
(p → q)∧ (p → r)	1	1	1	1/2	1	1	0	1/2	1/2
p → (q∨ r)	1	1	1	1	1	1	1/2	1/2	1
(p νr) →q	1	1	1/2	1	1	1/2	1/2	1/2	1/2
~ p ∧~ q	1/2	1/2	1/2	1/2	1/2	1/2	0	0	0
(p ν~ p)	1	1	1	1/2	1/2	1/2	1	1	1
~~(pν~p)	1	1	1	1/2	1/2	1/2	1	1	1

TABLE: 2.3.3

p	0	0	0	1/2	1/2	1/2	1	1	1
q	1	1	1	1	1	1	1	1	1
r	0	1/2	1	0	1/2	1	0	1/2	1
p → p	1	1	1	1	1	1	1	1	1
p → q	1	1	1	1	1	1	1	1	1
q → r	0	1/2	1	0	1/2	1	0	1/2	1
p → r	1	1	1	1/2	1	1	0	1/2	1
p ∧ q	0	0	0	1/2	1/2	1/2	1	1	1
q ∧ r	0	1/2	1	0	1/2	1	0	1/2	1
p ∧ r	0	0	0	0	1/2	1/2	0	1/2	1
p ν q	1	1	1	1	1	1	1	1	1
q ν r	1	1	1	1	1	1	1	1	1
p ν r	0	1/2	1	1/2	1/2	1	1	1	1
~ p	1	1	1	1/2	1/2	1/2	0	0	0
~~ p	0	0	0	1/2	1/2	1/2	1	1	1
~(p ν q)	0	0	0	0	0	0	0	0	0
p → (q ∧ r)	1	1	1	1/2	1	1	0	1/2	1
(p → q)∧ (p → r)	1	1	1	1/2	1	1	0	1/2	1
p → (q ∨ r)	1	1	1	1	1	1	1	1	1
(p ν r) → q	1	1	1	1	1	1	1	1	1
~ p ∧~ q	0	0	0	0	0	0	0	0	0
(p ν~ p)	1	1	1	1/2	1/2	1/2	1	1	1

Retrieval Number: E0538014520/2020©BEIESP
DOI:10.35940/ijmh.E0538.014520
Journal Website: www.ijmh.org

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

V. CONCLUSION

In this paper, we showed that the multi valued logic using Jaina logic satisfy all the conditions of Valid arguments and Heyting algebra of mathematical logic. Problem solving is very effective by driving hypotheses on these abducible predicates as a solution to be solved. A proof is an argument from hypotheses to a conclusion where it follows the rules of logic. Whereas, writing a proof is difficult and there is no procedure which can guarantee success. Moreover, most of the rules which we have solved come from tautologies and it satisfies the conditions which is "true" and it makes sense in drawing the conclusion. It can be used to solve problems in diagnosis, planning, natural language, machine learning and it is mainly useful in artificial intelligence [1]. Jaina logic appears to be sufficient and Jaina logic will be very useful to arrive at correct decisions for the logical agent in any kind of n x n or m x n situation and to check the validity of logical conclusion in any deductive story. These works can be taken up in future along with applying Jaina logic in various other Artificial Intelligence / Machine Learning concepts.

REFERENCE

1. Bergmann, Merrie (2008). An introduction to many-valued and fuzzy logic: semantics, algebras, and derivation systems. Cambridge University Press. p. 100. ISBN 978-0-521-88128-9.
2. Boolos, George; Burgess, John; Jeffrey, Richard C. (2007). Computability and logic. Cambridge: Cambridge University Press. p. 364. ISBN 0-521-87752-0.
3. F. Borceux, Handbook of Categorical Algebra 3, In Encyclopedia of Mathematics and its Applications, Vol. 53, Cambridge University Press, 1994. ISBN 0-521-44180-3OCLC 52238554.
4. Dubrova, Elena (2002). Multiple-Valued Logic Synthesis and Optimization, in Hassoun S. and Sasao T., editors, Logic Synthesis and Verification, Kluwer Academic Publishers, pp. 89-114.
5. Dubrova, Elena (2002). Multiple-Valued Logic Synthesis and Optimization, in Hassoun S. and Sasao T., editors, Logic Synthesis and Verification, Kluwer Academic Publishers, pp. 89-114.
6. S. Ghilardi. Free Heyting algebras as bi-Heyting algebras, Math. Rep. Acad. Sci. Canada XVI., 6:240–244, 1992.
7. Hajek, Petr: Fuzzy Logic. In: Edward N. Zalta: The Stanford Encyclopedia of Philosophy, Spring 2009.
8. Hurley, Patrick. A Concise Introduction to Logic, 9th edition. (2006).
9. Heyting, A. (1930), "Die formalen Regeln der intuitionistischen Logik. I, II, III", Sitzungsberichte Akad. Berlin: 42–56, 57–71, 158169, JFM 56.0823.
10. John C. Reynolds (2009) [1998]. Theories of Programming Languages. Cambridge University Press. p. 12. ISBN 978-0-521-10697-9.
11. Stanley, Jason (30 August 2000). "Context and Logical Form". Linguistics and Philosophy.
12. Susanne Bobzien (2002). "The Development of Modus Ponens in Antiquity", Phronesis47, No. 4, 2002.

AUTHORS PROFILE

Dr.R.Malathi, M.Sc., M.Phil., Ph.D in Mathematics. Published 21 papers and Presented 23 papers in both National and International Level. Editorial Board Member in IJESIRD, JECET and GJRF. Have acted as Book Editor, Associate Editor, Judge, Chairperson, Deputy Warden, Resource Person, Organizing Secretary, etc. Membership in AMTI, ISIAM and IAENG. Have published 3 books with ISBN and 5 books without ISBN in National and International level. Have received 7 awards in which 2 are International. Research Work entitled, "Design of knowledge discovery and decision support system using Jaina logic". Guided 25+ M.Phil and M.Sc students. Participated in Various Activities actively like thesis scrutinizer, reviewer of International Conference, ICACM, Answer Script Evaluator for PG/UG, Research co-ordinator, Anti-Ragging and hospitality committee, ICC, etc.

Dr.T.Venugopal, M.Sc., Ph.D., PGDCA, MIMS, MISIAM, MISTE, MAMTI.Controller of examinations, Formerly Director (Research and Publications), Formerly Professor and Head, Department of Mathematics, Formerly Dean (Arts and Humanities).Published 47 papers in both International and National Level. Membership in IMS, AMTI, ISIAM and ISTE. Won "Best Teacher Award". Editorial Board Member in IJAMSS, IJHSS and Asia Mathematika. Acted as Chief Editor in National/International Conferences. Reviewer of IJAIP, IJCSM and IJMOR. Research Work titled "Studies in Integral Transforms of Generalized Functions".Guided 21 M.Phil students and 10 Ph.D students. Did many Mathematical and General talks. Have participated in many programs like Hands on Workshops, Demonstrative Workshops, Lecture Series, etc.

Retrieval Number: E0538014520/2020©BEIESP
DOI:10.35940/ijmh.E0538.014520
Journal Website: www.ijmh.org

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication