SMARANDACHE –BOOLEAN – NEAR –RINGS AND ALGORITHMS WITH EXAMPLES

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ABSTRACT

In this paper we introduced Smarandache-2-algebraic structure of Boolean-near-ring namely Smarandache-Boolean-near-ring. A Smarandache-2-algebraic structure on a set N means a weak algebraic structure A_0 on N such that there exists a proper subset M of N, which is embedded with a stronger algebraic structure A_1 , stronger algebraic structure means satisfying more axioms, by proper subset one understands a subset different from the empty set, form the unit element if any, from the whole set. We define Smarandache-Boolean-near-ring and obtain some of its algorithms through Boolean-ring with left-ideals, direct summand, Boolean-*l*-algebra, Brouwerian algebra and Compatibility. We refer to G. Pilz.

The study of Boolean-near-ring is one of the generalized structure of rings. The study and research on near-rings is very systematic and continuous. Near-rings newsletters containing complete and updated bibliography on the subject of near-rings are published periodically by a team of editors. Then motivated by several researchers we wish to study and analyse the substructure in Smarandache-near-rings. The substructure in near-rings play vital role in the study of near-rings. Unlike other algebraic structure we see in case of near-rings we have the substructure playing vital role in the study and analyse of near-rings. Apart from the sub near-rings and ideals of near-rings we have special substructure like N-groups, filter and modularity in near-rings. It is these study in the context of Smarandache-Boolean-near-rings will yield several interesting results. Also the Smarandache substructure in Boolean-near-rings will also yield very many results in the direction.

For the study we would be using the book of Pilz Gunter, Near-rings (1997) published by North Holland Press, Amesterdam[10], Special Algebraic Structure by FlorentinSmarandache, University of New Mexico, USA (1991) [18], Smarandache Algebraic Structure by Raul Padilla, Universidade do Minho, Portugal (1999) [13], Blackett [3] discusses the near-ring of affine transformations on a vector space where the near-ring has a unique maximal ideal. Gonshor [8] defines abstract of affine near-rings and completely determines the lattice of ideals for these near-rings. The near-rings of differential transformations is seen in [4]. For near-rings with geometric interpretation [10] or [18] and several research papers on Boolean-near-rings. We would first study and characterize the ideals and sub Boolean-near-rings in Smarandache-Boolean-near-rings. Also to study and analyse those Boolean-near-rings, which are Smarandache-Boolean-near-ring and find the conditions for Smarandache-Boolean-near-rings. Yet another major substructure in Boolean-near-rings is the notion of filters. We would extend and study the notion of Smarandache filters given in Smarandache-Boolean-near-rings.

Further the notion of Smarandache ideals in near-ring would be studied, characterized and analysed for Smarandache-Boolean-near-rings. Both the notions viz. N-groups and ideals in near-ring and Smarandache-boolean-near-rings would be compared and contrasted. Also the nice notion of modularity in near-rings, which are basically built using concepts of idempotents, will be studied and analysed in Smarandache modularity in Boolean-near-ring. Finally, Smarandache-Boolean-near-rings has constructed from Boolean-ring by an algorithmic approach through its substructures and Smarandache-Boolean-near-ring has introduced some application.

Keywords: *Boolean-ring, Boolean-near-ring, S-Boolean-near-ring, Boolean-l-algebra, Brouwerian algebra and Compatibility.*

1. INTRODUCTION

In order that New notions are introduced in algebra to better study the congruence in number theory by FlorentinSmarandache [**4**]. By <proper subset> of a set A we consider a set P included in A, and different from A, different form the empty set, and from the unit element in A – if any they rank the algebraic structures using an order relationship:

They say that the algebraic structures $S_1 << S_2$ if: both are defined on the same set; all S_1 laws are also S_2 laws; all axioms of an S_1 law are accomplished by the corresponding S_2 law; S_2 law accomplish strictly more axioms that S_1 laws, or S_2 has more laws than S_1.

For example: Semi group <<Monoid<< group << ring<< field, or Semi group<< commutative semi group, ring<< unitary, ring etc. They define a General special structure to be a structure SM on a set A, different form a structure SN, such that a proper subset of A is a structure, where SM<< SN <<.

2. PRELIMINARIES

DEFINITION: 2.1

A left near-ring A is a system with two binary operations, addition and multiplication, such that

(i) the elements of A form a group **(A,+)** under addition,

(ii) the elements of A form a multiplicative semi-group,

(iii) $x(y + z) = xy + xz$, for all $x,y,z \in A$

In particular, if A contains a multiplicative semi-group S whose elements generate (A,+) and satisfy

(iv) $(x + y) s = xs + ys$, for all $x, y \in A$ and $s \in S$, then we say that A is a distributively generated near-ring.

DEFINITION: 2.2

A near-ring **(B, +, ●)** is Boolean-Near-Ring if there exists a Boolean-ring $(A,+,\wedge,1)$ with identity such that ● is defined in terms of **+**, $\wedge$ and **1**, and for any $b \in B$, $b \bullet b = b$

DEFINITION: 2.3

A near-ring (B, +, ●) is said to be idempotent if $x^2 = x$, for all $x \in B$. If (B,+, ●) is an idempotent ring, then for all $a, b \in B$, $a + a = 0$ and $a \bullet b = b \bullet a$

DEFINITION: 2.4

A Boolean-near-ring (B, +, ●) is said to be Smarandache-Boolean-near-ring whose proper subset A is a Boolean-ring with respect to same induced operation of B.

DEFINITION: 2.5 (Alternative definition for S-Boolean-near-ring)

If there exists a non-empty set A which is a Boolean-ring such that it superset B of A is a Boolean-near-ring with respect to the same induced operation, then B is called Smarandache-Boolean-near-ring.

It can also written as S-Boolean-near-ring.

EXAMPLE FOR SMARANDACHE-BOOLEAN-NEAR-RING: 2.6

Boolean-ring:

A Boolean-ring is an algebraic structure (A, +, ●) together with two binary operations addition and multiplication defined as follows

(A, +) is a group,

For,(i)Closure under addition :

For all a, b ∈ A, then a + b ∈ A

(ii)Associativity under addition :

For all a, b, c ∈ A, then (a + b) + c = a +(b + c) ∈ A

(iii)Commutativity of addition :

For all a, b ∈ A, then a +b = b + a ∈ A

(iv)Identity element for addition :

For all a ∈ A, then there exists 0 in A such that 0 + a = a + 0 = a ∈ A

(v)Characteristic 2 for addition :

For all a ∈ A, then a + a = 0 ∈ A

(A, ●) is a semigroup :

(vi)Closure under product :

For all a, b ∈ A, then a● b ∈ A

(vii)Associativity of product :

For all a, b, c ∈ A, then(a ● b) ● c = = a ● (b ● c) ∈ A

(viii)Identity element for product :

For all a in R then there exists 1 in R such that 1 ● a = a ● 1 = a ∈ A

(ix)Idempotent of product : For all a ∈ A, then a ● a= a ∈ A

Product is distributive over addition **:**

(x) Left-distributive law holds: For all a, b, c ∈ A, then a ● (b + c) = (a ● b) + (a ● c) ∈ A

Example for Boolean-ring :

Let A = {0, a} ⊂ B, be a finite-Boolean-ring.
Defined by

+	**0**	a
0	0	a
a	a	0

●	0	a
0	0	0
a	0	a

Boolean-near-ring :

A near-ring (B, +, ●) is said to be Boolean-near-ring if there exists a Boolean-ring (A, +, ∧, 1) with that that ● interms +, ∧ and 1, and for any b ∈ B,

b ● b=b

+	**0**	**a**	**b**	**c**
0	**0**	**a**	**b**	**c**
a	a	**0**	**c**	**b**
b	**b**	**c**	**0**	**a**
c	**c**	**b**	**a**	**0**

●	0	a	b	c
0	0	a	b	c
a	a	a	a	a
b	b	b	b	b
c	c	c	c	c

Therefore, the above conditions are satisfied, then we write B is a Boolean-near-ring.

Smarandache-Boolean-near-ring :

A Boolean-near-ring (B, +, ●) is said to be Smarandache-Boolean-near-ring whose proper subset A is a Boolean-ring with respect to the same induced operation of B.

Verify that, B is a Smarandache-Boolean-near-ring under '+' and '●',

For check the following conditions,

(B, +) is a group,

For, (i) Closure under addition :

For all a, b $\in$ B, then a + b $\in$ B

(ii)Associativity under addition :

For all a, b, c $\in$ B, then (a + b)+ c= a +(b + c) $\in$ B

(iii)Commutativity of addition :

For all a, b $\in$ B, then a +b= b + a $\in$ B

(iv)Identity element for addition :

For all a $\in$ B, then there exists 0 in B such that 0 + a = a + 0 = a $\in$ B

(v)Characteristic 2 for addition :

For all a $\in$ B, then a + a = 0 $\in$ B

(B, ●) is a semigroup :

(vi)Closure under product :

For all a, b $\in$ B, then a● b $\in$ B

(vii)Associativity of product :

For all a, b, c $\in$ B, then (a ● b) ● c = a ● (b ● c) $\in$ B

(viii) Identity element for product :

For all a in R then there exists 1 in R such that 1 ● a = a● 1 = a $\in$ B

(ix) Idempotent of product :

For all a $\in$ A, then a● a = a $\in$ B

Product is distributive over addition :

(x) Left-distributive law holds, for all a, b, c $\in$ B, then a ● (b + c) = (a ● b) + (a ● c) $\in$ B

Here A is satisfied idempotent condition of B, then we write A is a Boolean-ring, for a in A then a ● a = a $\in$ A

Hence, the proper subset of Boolean-near-ring is a Boolean-ring and therefore, B is a Smarandache-Boolean-near-ring.

3. ALGORITHMICSTRUCTUREOF SMARNADACHE-BOOLEAN-NEAR-RING:

In this section, Algorithms to construct the S-Boolean-near-rings from its characterization are obtained.

THEOREM : 3.1

If a non-empty set B contains a unique minimal Boolean-*l*-algebra contained in all other non-zero Boolean-*l*-algebras. Then B is a Smarandache-Boolean-near-ring.

proof : Consider a Boolean-ring $I_0 \neq \{0\}$, since a Boolean-ring itself is a Boolean-*l*-algebra. Then I_0 is a Boolean-*l*-algebra. Let B be non-empty set in which A is a proper subset. Now to find subsets of B which contains I_0 such that they are Boolean-*l*-algebras with respect to the same induced operations of A.In Gunter Pilz [] in section 1.60. The Theorem by Gratzer and Fain is given by the following conditions for a Boolean-near-ring B $\neq$ {0} are equivalent

1. $\cap I \neq \{0\}$, $\{0\} \neq I \subseteq N$

2. B contains a unique minimal Boolean-*l*-algebra, contained in all other non-zero Boolean-*l*-algebras.

Hence, consider the non-empty set B is a Boolean-near-ring. Now by Theorem [1], B is a Smarandache-Boolean-near-ring.

By similar argument by the Theorem[1], We have the following results

THEOREM : 3.2

If a non-empty set B contains a unique minimal Browverian algebra contained in all other non-zero Browverian algebras. Then B is a Smarandache-Boolean-near-ring.

Since in a Boolean-ring, Browverian algebras are Boolean-l-algebras. Hence by Theorem [4] gives

THEOREM : 3.3

If a non-empty set B contains a unique minimal compatibility contained in all other non-zero compatibilities. Then B is a Smarandache-Boolean-near-ring. Also by theorem [1], we have the following results

ALGORITHM : 3.1.1

BOOLEAN-*l*-ALGEBRA

Step 1 : Consider a Boolean-ring A

Step 2 : Verify that A is a Boolean-ring with respect to same induced operations

For, Check the following conditions,
'+' is defined as follows,

1. For all $n_1, n_2 \in A$, then $n_1 + n_2 \in A$
2. For all $n_1, n_2, n_3 \in A$, then $n_1 + (n_2 + n_3) = (n_1 + n_2) + n_3$
3. For all $n \in A$, there exist e $\in$ A $\Rightarrow$ n + e = e + n = n
4. For all $n \in A$, there exist n' $\in$ A $\Rightarrow$ $n + n' = n' + n = e$

Let $A^* = A / \{0\}$

5. For all $n_1 \in A^* \Rightarrow n_1 \bullet n_1 = n_1 \in A^*$,
6. For all $n_1, n_2, n_3 \in A^*$, then $n_1 \bullet (n_2 \bullet n_3) = (n_1 \bullet n_2) \bullet n_3$
7. For all $n \in A^*$, there exist e $\in$ A $\Rightarrow$ $n \bullet e' = e' \bullet n = n$

8.For all $n \in A^*$, there exist n' $\in$ A $\Rightarrow n \bullet n' = n' \bullet n = e'$

9. For all $n \in A^*$, then $n \bullet n = n$
10. For all n, m $\in A^*$, then $n \bullet m = m \bullet n$
11. For all $n_1, n_2, n_3 \in A^*$, then $n_1 + (n_2 \bullet n_3) = (n_1 + n_2) \bullet (n_1 + n_3)$
12. For all $n_1 \in A \Rightarrow n_1+n_1 = 0$

The above conditions are satisfied, then we write (B, +, $\bullet$) is a Boolean-ring.

Step 3 : Let I_i, i = 0,1,2,3 be supersets of I_0.

Step 4 : Let B = $\cup I_i$

Step5 : Choose the sets I_j from I_i's subject to for all i_{j_1}, $i_{j_2} \in I_j$ such that $i_{j_1} \leq i_{j_2}$ implies $i_{j_1} \cap (i_{j_2} - i_{j_1}) = 0$

Step 6 : Verify that $\cap I_j = I_0 \neq \{0\}$

Step 7: If step (6) is true, then we write B is a Smarandache-Boolean-near-ring.

EXAMPLE :BOOLEAN-*l*-ALGEBRA 3.1.2

Step 1 : Consider a non-empty set A ={0, n_1}

Step 2 : Verify that A ={0, n_1} is a Boolean-ring with respect to same induced operations

For, Check the following conditions,
'+' is defined as follows,
$0+0= 0$, $0+n_1= n_1$, $n_1+0=n_1$, $n_1+n_1=0$

(i) Closure law : For all 0, $n_1 \in A$,
$0+0 = 0 \in A$, $0+n_1=n_1 \in A$,
$n_1+0=n_1 \in A$, $n_1+n_1=0 \in A$

(ii)Associative law :For all 0, $n_1 \in A$,
$0+ (0+0) = (0+0) + 0 / n_1+ (0+0) = (n_1+0) +0$
$0+ 0 = 0+0$ / $n_1+0 = n_1+0$
$0 = 0/n_1 = n_1$

$0 + (0+n_1) = (0+0) +n_1/n_1+ (0+n_1)= (n_1+0) +n_1$
$0+n_1 = 0 + n_1$ / $n_1+ n_1 = n_1+ n_1$
$n_1 = n_1/0= 0$

$0 + (n_1+ 0) = (0+n_1)+0$ / $n_1+ (n_1+0) = (n_1+n_1) +0$
$0+n_1= n_1+$ / $n_1+ n_1= 0 + 0$
$n_1= n_1$ $0 = 0$

$0+(n_1+n_1) = (0+n_1)+ n_1/ n_1+(n_1+n_1) = (n_1+n_1)+n_1$
$0 + 0 = n_1+ n_1$ / $n_1 + 0 = 0+n_1$
$0 = 0$ / $n_1 = n_1$

(iii)'0' is the additive identity element : For all 0, $n_1 \in A$
$0+n_1= n_1+0 =n_1$ / $n_1+0 = 0+n_1= n_1$

(iv) The inverses of 0, n_1 are respectively 0, n_1 in A under addition.
(v)Commutative law : For all 0, $n_1 \in A$
$0 + 0 = 0 + 0$ / $0+n_1 = n_1+0$
$0 = 0$ / $n_1 = n_1$

$n_1+0 = 0+n_1$ / $n_1+n_1= n_1+n_1$
$n_1 = n_1$ / $0 = 0$
Therefore, the commutativity satisfied under addition.

(vi)Characterstic 2 for addition is defined as,
For all 0, $n_1 \in A$,
$0 + 0 = 0$ / $n_1+n_1= 0$

Now '$\cap$' is defined as follows :
If $n_i \leq n_j$ then $n_i \cap n_j = n_i$ and $n_i \cap n_i= n_i$,
$0 \cap 0 = 0$, $0 \cap n_1=0$, $n_1 \cap 0=0$, $n_1 \cap n_1 = n_1$,

(vii)Closure law : For all 0, $n_1 \in A$,
$0 \cap 0 = 0$, $n_1 \cap n_1 = n_1$,

(viii)Associative law : For all 0, $n_1 \in A$,
$0 \cap (0 \cap 0) =(0 \cap 0) \cap 0$/
$0 \cap 0 = 0 \cap 0$
$0 = 0$

$n_1 \cap (n_1 \cap n_1)=(n_1 \cap n_1) \cap n_1$
$n_1 \cap n_1 = n_1 \cap n_1$
$n_1 = n_1$
Similar way, we proceeds another associate laws.

(ix)Commutative law: For all 0, $n_1 \in A$,
$0 \cap 0= 0 \cap 0$ /$n_1 \cap n_1= n_1 \cap n_1$/ $0 \cap n_1= n_1 \cap 0$,
$0 = 0$ / $n_1 = n_1$ / $0 = 0$
$n_1 \cap 0 = 0 \cap n_1 = 0 = 0$

(x)Idempotent law : For all 0, $n_1 \in A$
$0 \cap 0 = 0$ and $n_1 \cap n_1 = n_1$

(xi) $0 \cap (0 \cup 0) =(0 \cap 0) \cup (0 \cap 0)$
Similar way, the right distributive law holds
Therefore, (A,+, $\cap$) is a Boolean-ring.

Step 3 : Let $A = A_0 = I_0$
Let $I_0 = A = \{0, n_1\}$

Step 4 : Consider the supersets I_i, i = 0,1,2,3 of I_0.
$I_0 = \{0, n_1\}$
$I_1 = \{0, n_1,n_2\}$
$I_2 = \{0, n_1,n_3\}$
$I_3 = \{0, n_1,n_2, n_3\}$

Step 5 : Let B = $\cup_{i=0}^{n} I_i$

Step 6 : Choose set I_j's from I_i's subject to $n_i \leq n_j$, implies $n_i \cap (n_j - n_i)= 0$, for all $n_i, n_j \in I_j$

Step 7 : (B,+,-,$\cap$) is defined as follows :
+ and $\cap$ is defined as follows,
'+' is defined by
$0+0 = 0$, $0+n_1 =n_1$, $0+n_2 = n_2$, $0+n_3 = n_3$,
$n_1+0 =n_1$, $n_1+n_1 =0$, $n_1+n_2 =n_3$, $n_1+n_3 =n_2$,
$n_2+0 =n_2$, $n_2+n_1 =n_3$, $n_2+n_2 =0$, $n_2+n_3 =n_1$,
$n_3+0 =n_3$, $n_3+n_1 =n_2$, $n_3+n_2 =n_1$, $n_3+n_3 =0$.

'$\cap$' is defined by, $n_i \leq n_j$ implies $n_i \cap n_j= n_i$ and $n_i \cap n_i = n_i$,
$0 \cap 0 = 0$, $0 \cap n_1 = 0$, $0 \cap n_2 = 0$, $0 \cap n_3 = 0$,
$n_1 \cap 0 =0$, $n_1 \cap n_1= n_1$, $n_1 \cap n_2 = n_1$, $n_1 \cap n_3= n_1$,
$n_2 \cap 0 =0$, $n_2 \cap n_1 = n_2$, $n_2 \cap n_2 = n_2$, $n_2 \cap n_3= n_2$,
$n_3 \cap 0 = 0$, $n_3 \cap n_1 = n_3$, $n_3 \cap n_2 = n_3$, $n_3 \cap n_3= n_3$,

a-b is defined by $a-b = a+(a \cap b)$
For all $0 \in B$, $n_1 \in I_0$ then
$0 \cap (n_1 - 0) = 0 \cap (n_1 + n_1 \cap 0)$ /
$= 0 \cap (n_1 + 0)$
$= 0 \cap n_1$
$= 0 \in I_0$

For all $n_1 \in B$, $0 \in I_0$ then
$n_1 \cap (0 - n_1) = n_1 \cap (0 + 0 \cap n_1)$
$= n_1 \cap (0 + 0) = n_1 \cap 0$
$= 0 \in I_0$

For all $n_2, 0 \in B$, then,
$n_2 \cap (0 - n_2) = n_2 \cap (0 + 0 \cap n_2)$
$= n_2 \cap (0 + 0)$
$= n_2 \cap 0$
$= 0 \in I_0$
For all $n_3 \in B$, $0 \in I_0$ then,
$n_3 \cap (0 - n_3) = n_3 \cap (0 + 0 \cap n_3) = n_3 \cap (0 + 0)$
$= n_3 \cap 0$
$= 0 \in I_0$
For all $n_2 \in B$, $n_1 \in I_0$ then,
$n_2 \cap (n_1 - n_2) = n_2 \cap (n_1 + n_1 \cap n_2) = n_2 \cap (n_1 + n_1)$
$= n_2 \cap 0$
$= 0 \in I_0$
For all $n_3 \in B$, $n_1 \in I_0$ then,
$n_3 \cap (n_1 - n_3) = n_3 \cap (n_1 + n_1 \cap n_3)$
$= n_3 \cap (n_1 + n_1) = n_3 \cap 0$
$= 0 \in I_0$

For all $n_1 \in B$, $n_1 \in I_0$ then /
$n_1 \cap (n_1 - n_1) = n_1 \cap (n_1 + n_1 \cap n_1)$
$= n_1 \cap (n_1 + n_1)$
$= n_1 \cap 0 = 0 \in I_0$
For all $0 \in B$, $0 \in I_0$ then,
$0 \cap (0 - 0) = 0 \cap (0 + 0 \cap 0)$
$= 0 \cap (0 + 0) = 0 \cap 0$
$= 0 \in I_0$
Hence, I_0 satisfies all the requirements.
Therefore, we choose I_0 as I_j.
Hence for $I_1 = \{0, n_1, n_2\}$ and $B = \{0, n_1, n_2, n_3\}$

$n_i \cap (n_j - n_i) = n_i \cap (n_j + n_j \cap n_i) = 0$, for all $n_i, n_j \in B$, and $0 \in I_1$.
Therefore, I_1 also choose asI_j.

Similarly, for $I_2 = \{0, n_1, n_3\}$ and $B = \{0, n_1, n_2, n_3\}$

$n_i \cap (n_j - n_i) = n_i \cap (n_j + n_j \cap n_i) = 0$, for all $n_i, n_j \in B$, and $0 \in I_2$.
Therefore, I_2 also choose asI_j.

Similarly, for $I_3 = \{0, n_2, n_3\}$ and $B = \{0, n_1, n_2, n_3\}$

$n_i \cap (n_j - n_i) = n_i \cap (n_j + n_j \cap n_i) = 0$, for all $n_i, n_j \in B$, and $0 \in I_3$.
Therefore, I_3 becomesI_j.

Step 8 : Verify that $\cap I_j = I_0 \neq \{0\} \subset B$

$I_0 \cap I_1 \cap I_2 \cap I_3 = \{0, n_1\} \cap \{0, n_1, n_2\} \cap \{0, n_1, n_3\} \cap \{0, n_1, n_2, n_3\}$
$= \{0, n_1\} \neq \{0\} \subset B$

Step 9 : If step (8) is true, then we write B is a Smarandache-Boolean-near-ring.

ALGORITHM : 3.2.1
BROWERIAN ALGEBRA

Step 1 : Consider a Boolean-ring A

Step 2 : Verify that A is a Boolean-ring with respect to same induced operations
For, Check the following conditions,
'+' is defined as follows,
1.For all $n_1, n_2 \in A$, then $n_1 + n_2 \in A$
2.For all $n_1, n_2, n_3 \in A$, then $n_1 + (n_2 + n_3) = (n_1 + n_2) + n_3$
3.For all $n \in A$, there exist $e \in A \Rightarrow n + e = e + n = n$
4.For all $n \in A$, there exist $n' \in A \Rightarrow$ $n + n' = n' + n = e$

Let $A^* = A / \{0\}$

5.For all $n_1 \in A^* \Rightarrow n_1 \bullet n_1 = n_1 \in A^*$,
6.For all $n_1, n_2, n_3 \in A^*$, then $n_1 \bullet (n_2 \bullet n_3) = (n_1 \bullet n_2) \bullet n_3$
7.For all $n \in A^*$, there exist $e \in A \Rightarrow n \bullet e' = e' \bullet n = n$
8.For all $n \in A^*$, there exist $n' \in A \Rightarrow n \bullet n' = n' \bullet n = e'$
9.For all $n \in A^*$, then $n \bullet n = n$
10.For all $n, m \in A^*$, then $n \bullet m = m \bullet n$
11.For all $n_1, n_2, n_3 \in A^*$, then $n_1 + (n_2 \bullet n_3) = (n_1 + n_2) \bullet (n_1 + n_3)$
12.For all $n_1 \in A \Rightarrow n_1 + n_1 = 0$

The above conditions are satisfied , then write $(B, +, \bullet)$ is a Boolean-ring.

Step 3 : Let I_i, i = 0,1,2,3,…… be the supersets of I_0.
Step 4 : Let $B = \cup I_i$

Step 5 : Choose the sets I_j from I_i's subject to for all $x \in B$ such that $x \leq a$ then $a = x \cup (a-x)$, for all x and $a \in I_j$

Step 6 : Verify that $\cap I_j = I_0 \neq \{0\}$

Step 7: If step (6) is true, then we write B is a Smarandache-Boolean-near-ring.

EXAMPLE : BROWVERIAN-ALGEBRA 3.2.2

Step 1 : Consider a non-empty set $A = \{0, n_1\}$

Step 2 : Verify that $A = \{0, n_1\}$ is a Boolean-ring with respect to same induced operations,

For, Check the following conditions,
'+' is defined as follows,
$0+0 = 0$, $0+n_1 = n_1$, $n_1+0 = n_1$, $n_1+n_1 = 0$
(i)Closure law : For all $0, n_1 \in A$,

$0+0 = 0 \in A$, $0+n_1 = n_1 \in A, n_1+0 = n_1 \in A$, $n_1+n_1=0 \in A$

(ii)Associative law : For all $0, n_1 \in A$,
$0+(0+0) = (0+0)+0$ / $n_1+(0+0) = (n_1+0)+0$
$0+0 = 0+0$ / $n_1+0 = n_1+0$
$0 = 0$ / $n_1 = n_1$

$0+(0+n_1) = (0+0)+n_1$ / $n_1+(0+n_1) = (n_1+0)+n_1$
$0+n_1 = 0+n_1$ / $n_1+n_1 = n_1+n_1$
$n_1 = n_1$ / $0 = 0$

$0+(n_1+0) = (0+n_1)+0$ / $n_1+(n_1+0) = (n_1+n_1)+0$
$0+n_1 = n_1+0$ / $n_1+n_1 = 0+0$
$0 = 0$ / $n_1 = n_1$

$0+(n_1+n_1) = (0+n_1)+n_1$ / $n_1+(n_1+n_1) = (n_1+n_1)+n_1$
$0+0 = n_1+n_1$ / $n_1+0 = 0+n_1$
$0 = 0$ / $n_1 = n_1$

(iii)'0' is the additive identity element :
For all $0, n_1 \in A$
$0+n_1 = n_1+0 = n_1$ / $n_1+0 = 0+n_1 = n_1$

(iv)The inverses of 0, n_1 are respectively 0, n_1 in A under addition.

(v)Commutative law : For all $0, n_1 \in A$
$0+0 = 0+0$ / $0+n_1 = n_1+0$
$0 = 0$ / $n_1 = n_1$

$n_1+0 = 0+n_1$ / $n_1+n_1 = n_1+n_1$
$n_1 = n_1$ / $0 = 0$
Therefore, the commutative law satisfied under addition.

(vi)Characterstic 2 for addition is defined as,
For all $0, n_1 \in A$,
$0+0 = 0$ / $n_1+n_1 = 0$

Now '$\cap$' is defined as follows :
If $n_i \leq n_j$ then $n_i \cap n_j = n_i$ and $n_i \cap n_i = n_i$,
$0 \cap 0 = 0$, $0 \cap n_1 = 0$, $n_1 \cap 0 = 0$, $n_1 \cap n_1 = n_1$,

(vii)Closure law : For all $0, n_1 \in A$,
$0 \cap 0 = 0$, $n_1 \cap n_1 = n_1$,

(viii)Associative law : For all $0, n_1 \in A$,
$0 \cap (0 \cap 0) = (0 \cap 0) \cap 0$ /
$0 \cap 0 = 0 \cap 0$
$0 = 0$
$n_1 \cap (n_1 \cap n_1) = (n_1 \cap n_1) \cap n_1$
$n_1 \cap n_1 = n_1 \cap n_1$
$n_1 = n_1$
Similar way, we proceeds another associate laws.

(ix)Commutative law: For all $0, n_1 \in A$,
$0 \cap 0 = 0 \cap 0$ / $n_1 \cap n_1 = n_1 \cap n_1$ / $0 \cap n_1 = n_1 \cap 0$ /
$0 = 0$ / $n_1 = n_1$ / $0 = 0$ /
$n_1 \cap 0 = 0 \cap n_1 = 0 = 0$

(x)Idempotent law : For all $0, n_1 \in A$
$0 \cap 0 = 0$ and $n_1 \cap n_1 = n_1$

(xi)For all $0, n_1 \in A$
$0 \cap (0 \cup 0) = (0 \cap 0) \cup (0 \cap 0)$ /
$n_1 \cap (n_1 \cup n_1) = (n_1 \cap n_1) \cup (n_1 \cap n_1)$
Similar way, the right distributive law holds

(xii) Define, the complement: For all $0, n_1 \in A$, $0' \cap n_1 = 0$
Therefore, $(A, +, \cap, \cup)$ is a Boolean-ring.

Step 3 : Let $A = A_0 = I_0$
Let $I_0 = A = \{0, n_1\}$

Step 4 : Consider the supersets I_i, $i = 0,1,2,3$ of I_0.
$I_0 = \{0, n_1\}$
$I_1 = \{0, n_1, n_2\}$
$I_2 = \{0, n_1, n_3\}$
$I_3 = \{0, n_1, n_2, n_3\}$

Step 5 : Let $B = \bigcup_{i=0}^{n} I_i$

Step 6 : Choose set I_j's from I_i's subject to $x \leq a$ implies $a = x \cup (a - x)$, for all $a, x \in I_j$

Step 7 : $(B, +, -, \cup)$ is defined as follows :
+ and $\cup$ is defined as follows,
'**+**' is defined by
$0+0 = 0$, $0+n_1 = n_1$, $0+n_2 = n_2$, $0+n_3 = n_3$,
$n_1+0 = n_1$, $n_1+n_1 = 0$, $n_1+n_2 = n_3$, $n_1+n_3 = n_2$,
$n_2+0 = n_2$, $n_2+n_1 = n_3$, $n_2+n_2 = 0$, $n_2+n_3 = n_1$,
$n_3+0 = n_3$, $n_3+n_1 = n_2$, $n_3+n_2 = n_1$, $n_3+n_3 = 0$.

'$\cap$' is defined by, $n_i \leq n_j$ implies $n_i \cap n_j = n_i$ and $n_i \cap n_i = n_i$,
$0 \cap 0 = 0$, $0 \cap n_1 = 0$, $0 \cap n_2 = 0$, $0 \cap n_3 = 0$,
$n_1 \cap 0 = 0$, $n_1 \cap n_1 = n_1$, $n_1 \cap n_2 = n_1$, $n_1 \cap n_3 = n_1$,
$n_2 \cap 0 = 0$, $n_2 \cap n_1 = n_2$, $n_2 \cap n_2 = n_2$, $n_2 \cap n_3 = n_2$,
$n_3 \cap 0 = 0$, $n_3 \cap n_1 = n_3$, $n_3 \cap n_2 = n_3$, $n_3 \cap n_3 = n_3$,

'$\cup$' is defined by
$0 \cup 0 = 0$, $0 \cup n_1 = n_1$, $0 \cup n_2 = n_2$, $0 \cup n_3 = n_3$,
$n_1 \cup 0 = n_1$, $n_1 \cup n_1 = n_1$, $n_1 \cup n_2 = n_2$, $n_1 \cup n_3 = n_3$,
$n_2 \cup 0 = n_2$, $n_2 \cup n_1 = n_1$, $n_2 \cup n_2 = n_2$, $n_2 \cup n_3 = n_3$,
$n_3 \cup 0 = n_3$, $n_3 \cup n_1 = n_3$, $n_3 \cup n_2 = n_3$, $n_3 \cup n_3 = n_3$,

n- m is defined by $n - m = n$ if $n \leq m$
For all $0 \in B$, $n_1 \in I_0$ then / For all $n_1 \in B$, $0 \in I_0$ then
$0 \cup (n_1 - 0) = 0 \cup (n_1 + n_1 \cap 0)$
$= 0 \cup (n_1 + 0)$
$= 0 \cup n_1 = n_1 \in I_0$

$n_1 \cup (0 - n_1) = n_1 \cup (0 + 0 \cap n_1)$
$= n_1 \cup (0 + 0)$
$= n_1 \cup 0$
$= n_1 \in I_0$

For all $n_2 \in B$, $0 \in I_0$ then, /
$0 \cup (n_2 - 0) = 0 \cup (n_2 + n_2 \cap 0)$
$= 0 \cup (n_2 + 0)$
$= 0 \cup n_2 = 0' \cap n_2' = n_3 \cap n_1$
$= n_1 \in I_0$

For all $n_3 \in B$, $0 \in I_0$ then,
$n_3 \cup (0 - n_3) = n_3 \cup (0 + 0 \cap n_3)$

$= n_3 \cup (0 + 0)$
$= n_3 \cup 0 = n_3' \cap 0' = 0 \cap n_3$
$= 0 \in I_0$

For all $n_2 \in B$, $n_1 \in I_0$ then, /
$n_2 \cup (n_1 - n_2) = n_2 \cup (n_1 + n_1 \cap n_2)$
$= n_2 \cup (n_1 + n_1)$
$= n_2 \cup 0$
$= n_2 \in I_1$

For all $n_3 \in B$, $n_1 \in I_0$ then,
$n_3 \cup (n_1 - n_3) = n_3 \cup (n_1 + n_1 \cap n_3)$
$= n_3 \cup (n_1 + n_1)$
$= n_3 \cup 0 = n_3' \cap 0' = 0 \cap n_3$
$= 0 \in I_1$

For all $n_1 \in B$, $n_1 \in I_0$ then /
$n_1 \cup (n_1 - n_1) = n_1 \cup (n_1 + n_1 \cap n_1)$
$= n_1 \cup (n_1 + n_1)$
$= n_1 \cup 0$
$= n_1 \in I_0$

For all $0 \in B$, $0 \in I_0$ then,
$0 \cup (0 - 0) = 0 \cup (0 + 0 \cap 0)$
$= 0 \cup (0 + 0)$
$= 0 \cup 0$
$= 0 \in I_0$
Hence, I_0 satisfies all the requirements.

Therefore, we choose I_0 as I_j. Hence for $I_1 = \{0, n_1, n_2\}$ and $B = \{0, n_1, n_2, n_3\}$
$n \cup (m - n) = m$, for all $n, m \in B$, and $0 \in I_1$.
Therefore, I_1 also choose as I_j.

Similarly, for $I_2 = \{0, n_1, n_3\}$ and $B = \{0, n_1, n_2, n_3\}$
$n \cup (m - n) = m$, for all $n, m \in B$, and $0 \in I_2$.
Therefore, I_2 also choose as I_j.

Similarly, for $I_3 = \{0, n_2, n_3\}$ and $B = \{0, n_1, n_2, n_3\}$

$n \cup (m - n) = m$, for all $n, m \in B$, and $0 \in I_3$.
Therefore, I_3 becomes I_j.

Step 8 : Verify that $\cap I_j = I_0 \neq \{0\} \subset B$

$I_0 \cap I_1 \cap I_2 \cap I_3 = \{0, n_1\} \cap \{0, n_1, n_2\} \cap \{0, n_1, n_3\} \cap \{0, n_1, n_2, n_3\}$

$= \{0, n_1\} \neq \{0\} \subset B$

Step 9 : If step (8) is true, then we write B is a Smarandache-Boolean-near-ring.

ALGORITHM : 3.3.1
COMPATIBILITY :
Step 1 : Consider a Boolean-ring A

Step 2 : Verify that A is a Boolean-ring with respect to same induced operations
For, Check the following conditions,
'+' is defined as follows,
1.For all $n_1, n_2 \in A$, then $n_1 + n_2 \in A$
2.For all $n_1, n_2, n_3 \in A$, then $n_1 + (n_2 + n_3) = (n_1 + n_2) + n_3$
3.For all $n \in A$, there exist $e \in A \Rightarrow n + e = e + n = n$
4.For all $n \in A$, there exist $n' \in A \Rightarrow n + n' = n' + n = e$

Let $A^* = A / \{0\}$
5.For all $n_1 \in A^* \Rightarrow n_1 \bullet n_1 = n_1 \in A^*$,
6.For all $n_1, n_2, n_3 \in A^*$, then $n_1 \bullet (n_2 \bullet n_3) = (n_1 \bullet n_2) \bullet n_3$
7.For all $n \in A^*$, there exist $e \in A \Rightarrow n \bullet e' = e' \bullet n = n$
8.For all $n \in A^*$, there exist $n' \in A \Rightarrow n \bullet n' = n' \bullet n = e'$
9.For all $n \in A^*$, then $n \bullet n = n$
10.For all $n, m \in A^*$, then $n \bullet m = m \bullet n$
11.For all $n_1, n_2, n_3 \in A^*$, then $n_1 + (n_2 \bullet n_3) = (n_1 + n_2) \bullet (n_1 + n_3)$
12.For all $n_1 \in A \Rightarrow n_1 + n_1 = 0$
The above conditions are satisfied, then write (B, +, •) is a Boolean-ring.

Step 3 : Let I_i, i = 0,1,2,3,…… be the supersets of I_0.

Step 4 : Let $B = \cup I_i$

Step 5 : Choose the sets I_j from I_i's subject to for all $a, b \in I_j$ such that $ab^2 = a^2b \in I_j$

Step 6 : Verify that $\cap I_j = I_0 \neq \{0\}$

Step 7: If step (6) is true, then we write B is a Smarandache-Boolean-near-ring.

EXAMPLE : COMPATIBILITY 3.3.2
Step 1 : Consider a non-empty set $A = \{0, n_1\}$

Step 2 : Verify that $A = \{0, n_1\}$ is a Boolean-ring with respect to same induced operations
For, Check the following conditions,
'+' is defined as follows,
$0+0 = 0$, $0+n_1 = n_1$, $n_1+0 = n_1$, $n_1+n_1 = 0$
(i)Closure law : For all $0, n_1 \in A$,
$0+0 = 0 \in A$, $0+n_1 = n_1 \in A$, $n_1+0 = n_1 \in A$, $n_1+n_1 = 0 \in A$

(i)Associative law : For all $0, n_1 \in A$,
$0+(0+0) = (0+0)+0 / n_1+(0+0) = (n_1+0)+0$
$0+0 = 0+0$ / $n_1+0 = n_1+0$
$0 = 0$ / $n_1 = n_1$

$0+(0+n_1) = (0+0)+n_1 / n_1+(0+n_1) = (n_1+0)+n_1$
$0+n_1 = 0+n_1$ / $n_1+n_1 = n_1+n_1$
$n_1 = n_1$ / $0 = 0$

$0+(n_1+0) = (0+n_1)+0 / n_1+(n_1+0) = (n_1+n_1)+0$
$0+n_1 = n_1+0$ / $n_1+n_1 = 0+0$
$n_1 = n_1$ $0 = 0$

$0+(n_1+n_1) = (0+n_1)+n_1 / n_1+(n_1+n_1) = (n_1+n_1)+n_1$
$0+0 = n_1+n_1$ / $n_1+0 = 0+n_1$

$0 \quad = 0 \quad / n_1 \quad = n_1$

(iii)'0' is the additive identity element : For all $0, n_1 \in A$

$0+n_1= n_1+0 =n_1 \quad /n_1+0 = 0+n_1= n_1$

(iv)The inverses of 0, n_1 are respectively 0, n_1 in A under addition.

(v)Commutative law : For all $0, n_1 \in A$

$0 + 0 = 0 + 0/ \quad 0+n_1 = n_1+0$
$0 \quad = 0 \;/ \quad n_1 \quad = n_1$

$n_1+0 \;= 0+n_1/ \quad n_1+n_1= n_1+n_1$
$n_1 \quad = n_1 / \quad 0 \quad = 0$

Therefore, the commutativity satisfied under addition.

(vi)Characterstic 2 for addition is defined as,

For all $0, n_1 \in A$,
$0 + 0 = 0 \quad / \quad n_1+n_1= 0$

Let $A^*= A / \{0\} = \{0, n_1\} = n_1$,
Now '●' is defined as follows,
$0 \bullet 0 = 0,\ 0 \bullet n_1 =0,\ n_1 \bullet 0 = 0,\ n_1 \bullet n_1 = n_1$

In general, we define $n \bullet m = n$, for all $n, m \in A$
(vii)For all $n_1 \in A^*$, $\quad n_1 \bullet n_1 = n_1 \in A^*$,
(viii)For all $n_1 \in A^*$,

$n_1 \bullet (n_1 \bullet n_1) = (n_1 \bullet n_1) \bullet n_1$
$n_1 \bullet n_1 \quad = n_1 \bullet n_1$
$n_1 \quad = n_1$

(ix)'n_1'is the identity element of A^* under multiplication

(x)For all $0, n_1 \in A^*$,

$0 \bullet 0 = 0 \;/ \quad n_1 \bullet n_1 = n_1$

Hence, the idempotent law is satisfied under multiplication.

(xi)Product is distributive over addition as follows:

For all $0, n_1 \in A$,
$0 \bullet (0+0) = 0 \bullet 0 + 0 \bullet 0 \;/$
$0 \bullet 0 \quad = 0 + 0$
$0 \quad = 0$
$n_1 \bullet (n_1+ n_1)= (n_1 \bullet n_1) + (n_1 \bullet n_1)$
$n_1 \bullet 0 \quad = n_1+ n_1$
$0 \quad = 0$
$n_1 \bullet (0+ 0)= n_1 \bullet 0 + n_1 \bullet 0$
$n_1 \bullet 0 \quad = 0 + 0$
$0 \quad = 0$

$n_1 \bullet (0+ n_1) \;= n_1 \bullet 0 + n_1 \bullet n_1$
$n_1 \bullet n_1 \quad = 0+ n_1$
$n_1 \quad = n_1$

$n_1 \bullet (n_1+ 0)=n_1 \bullet n_1+ n_1 \bullet 0/ \;\; 0 \bullet (n_1+ n_1) \;= 0 \bullet n_1+ 0 \bullet n_1$
$n_1 \bullet n_1 \quad = n_1+ 0 \;\; / \quad 0 \bullet 0 \quad = 0 + 0$
$n_1 \quad = n_1 \quad 0 \quad = 0$

$0 \bullet (n_1+ 0)=0 \bullet n_1 + 0 \bullet 0 \;\; /0 \bullet (0+ n_1) \;= 0 \bullet 0 + 0 \bullet n_1$
$0 \bullet n_1 \quad = 0 + 0 \;\; / \quad 0 \bullet n_1 \quad = 0 + 0$
$0 \quad = 0 \;/ \quad 0 \quad = 0$

Similar way, the right distributive law holds.

(xii) Commutative law : For all $0, n_1 \in A$

$0 \bullet 0 = 0 \bullet 0 \quad /0 \bullet n_1 = n_1 \bullet 0$
$0 \quad = 0 \quad /0 \quad = 0$

$n_1 \bullet 0 \;= 0 \bullet n_1 \quad /n_1 \bullet n_1= n_1 \bullet n_1$
$0 \quad = 0 \quad /n_1= n_1$

Hence, all the requirements of Boolean-rings are satisfied.
Therefore, $(A,+, \bullet)$ is a Boolean-ring.

Step 3 : Let $A = A_0 = I_0$
Let $I_0 = A = \{0, n_1\}$

Step 4 : Consider the supersets I_i, $i = 0,1,2,3$ of I_0.

$I_0 = \{0, n_1\}$
$I_1 = \{0, n_1,n_2\}$
$I_2 = \{0, n_1,n_3\}$
$I_3 = \{0, n_1,n_2, n_3\}$

Step 5 : Let $B = \bigcup_{i=0}^{n} I_i$

Step 6 : Choose set I_j's from I_i's subject to for all $a, b \in I_j$ such that $ab^2 = a^2b \in I_j$

Step 7 : $(B,+, \bullet)$ is defined as follows :
+ and ● is defined as follows,
'+' is defined by

$0+0 = 0,\ 0+n_1 =n_1,\ 0+n_2 = n_2,\ 0+n_3 = n_3,$
$n_1+0 =n_1,\ n_1+n_1 =0,\ n_1+n_2 =n_3,\ n_1+n_3 =n_2,$
$n_2+0 =n_2,\ n_2+n_1 =n_3,\ n_2+n_2 =0,\ n_2+n_3 =n_1,$
$n_3+0 =n_3,\ n_3+n_1 =n_2,\ n_3+n_2 =n_1,\ n_3+n_3 =0.$

'●' is defined by
$0 \bullet 0 = 0, 0 \bullet n_1 =0, 0 \bullet n_2 = 0, 0 \bullet n_3 = 0,$
$n_1 \bullet 0 = n_1, n_1 \bullet n_1 = n_1, n_1 \bullet n_2 = n_1, n_1 \bullet n_3 = n_1,$
$n_2 \bullet 0 = n_2, n_2 \bullet n_1 = n_2, n_2 \bullet n_2 = n_2, n_2 \bullet n_3 = n_2,$
$n_3 \bullet 0 = n_3, n_3 \bullet n_1 = n_3, n_3 \bullet n_2 = n_3, n_3 \bullet n_3 = n_3,$

$nm^2 = n^2m$ is defined by
For all $0 \in B$, $n_1 \in I_0$ then / For all $n_1 \in B$, $0 \in I_0$ then
$0\, n_1^2 = 0^2\, n_1 \qquad n_1 0 = n_1^2 0$
$0\, n_1 = 0\, n_1 \qquad n_1\, 0= n_1\, 0$
$0 \quad = 0 \qquad 0 \quad = 0$
$\quad = 0 \in I_0 \qquad = 0 \in I_0$

For all $n_2, 0 \in B$, then, / For all $n_3 \in B$, $0 \in I_0$ then,
$n_1\, 0 \;= n_1^2\, 0 \qquad n_3^2\, 0 = 0^2\, n_3$
$n_1\, 0 = n_1\, 0 \qquad n_3\, 0 \;= n_3^2\, 0$
$0 \quad = 0 \qquad 0 \quad = 0$
$\quad = 0 \in I_0 \qquad = 0 \in I_0$

For all $n_2 \in B$, $n_1 \in I_0$ then / For all $n_3 \in B$, $n_1 \in I_0$ then,
$n_2\, n_1^2 = n_2^2\, n_1 \qquad n_3 n_1^2 \;= n_3^2\, n_1$
$n_2 n_1 \;= n_2\, n_1 \qquad n_3\, n_1 \;= n_3\, n_1$
$n_1 n_2 \;= n_1\, n_2 \qquad n_1\, n_3 \;= n_1\, n_3$
$n_1 \quad = n_1 \qquad n_1 \quad = n_1$
$= n_1 \in I_0 \qquad = n_1 \in I_0$

For all $n_1 \in B$, $n_1 \in I_0$ then /For all $0 \in B$, $0 \in I_0$ then,
$n_1\, n_1^2 = n_1^2\, n_1 \qquad 0\, 0^2 \;= 0^2\, 0$
$n_1 n_1 \;= n_1 n_1 \qquad 0\, 0 \;= 0\, 0$
$n_1 \quad = n_1 \qquad 0 \quad = 0$
$\quad = n_1 \in I_0 \qquad = 0 \in I_0$

Hence, I_0 satisfies all the requirements.
Therefore, we choose I_0 as I_j. Hence for $I_1 = \{0,n_1,n_2\}$ and $B = \{0, n_1,n_2, n_3\}$

$n_i n_j^2 = n_i^2 n_j$, for all $n_i, n_j \in B$, and $0 \in I_1$.

Therefore, I_1 also choose as I_j.

Similarly, for $I_2 = \{0,n_1,n_3\}$ and $B= \{0, n_1,n_2, n_3\}$

$n_i n_j^2 = n_i^2 n_j$, for all $n_i, n_j \in B$, and $0 \in I_2$.

Therefore, I_2 also choose as I_j.

Similarly, for $I_3 = \{0,n_2,n_3\}$ and $B = \{0, n_1,n_2, n_3\}$

$n_i n_j^2 = n_i^2 n_j$, for all $n_i, n_j \in B$, and $0 \in I_3$.

Therefore, I_3 becomes I_j.

Step 8 : Verify that $\cap I_j = I_0 \neq \{0\} \subset B$

$I_0 \cap I_1 \cap I_2 \cap I_3 = \{0,n_1\} \cap \{0, n_1,n_2 \} \cap \{0, n_1, n_3\} \cap \{0, n_1,n_2, n_3\}$

$= \{0,n_1\} \neq \{0\} \subset B$

Step 9 : If step (8) is true, then we write B is a Smarandache-Boolean-near-ring.

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