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PART II APPLICATIONS OF KALANGI NON-ASSOCIATIVE Γ-SEMI SUB NEAR-FIELD SPACE OF A Γ-NEAR-FIELD SPACE OVER NEAR-FIELD

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ABSTRACT

In this manuscript we introduce PART II some applications of Kalangi non-associated Γ-semi sub near-field space of a Γ-near-field space over near-field, quasi non associative Γ-semi sub near-field space, K-quasi N -Γ-semi sub near-field space, quasi ideals, etc and concepts like PART II some applications of Kalangi quasi bipotent elements and several analogous properties done in case of Γ-near-field spaces.

Keywords: *Automaton, semi – automaton, Kalangi automaton, group automaton, Non-associative Γ-semi sub near-field space, Kalangi-Γ-semi sub near-field space, Γ-near-field space; Γ-Semi sub near-field space of Γ-near-field space; Semi near-field space of Γ-near-field space, quasi Γ-semi sub near-field space, quasi non-associative Γ-semi near-field space, state graph.*

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SECTION 1: Introduction and Preliminaries on Part II some applications of Kalangi non-associative Γ-semi sub near-field space of a Γ-near-field space over near-field.

In this paper we together introduced a maiden effort to bring the two probable existing applications in PART II some applications of Kalangi non-associative Γ-semi sub near-field spaces of a Γ-near-field space over near-field.

We are not widely speaking about the applications of Kalangi non-associative Γ-semi sub near-field spaces of a Γ-near-field space we only discuss here the two applications one in automatons and the other in the construction of error correcting codes.

Here we recall the basic notions of an automaton, semi – automaton, Kalangi automaton and group automaton and give some interesting illustrations of them.

Basics on automaton and on semi – automaton.

We just recall the definitions of automaton, semi-automaton, Kalangi automaton, Kalangi semi-automaton and group semi-automaton and finally the concept of syntactic Γ-semi sub near-field spaces of a Γ-near-field space over near-field. We illustrate them with explicit examples so that it would become easy when we introduce the Kalangi equivalence of syntactic Γ-semi sub near-field spaces of a Γ-near-field space over near-field and its probable application to group semi – automaton. As it is we deals with application all basic relevant information are recalled.

Definition 1.1: Semi-automaton. A semi-automaton is a triple T = (N, B, δ) consisting of two non-empty Γ-semi sub near-field spaces N and B and a function $\delta : N \times B \to N$, N is called the Γ-semi sub near-field space of states, B the input alphabet and δ the next state function of T.

Definition 1.2: Automaton. An automaton is a quintuple B = (N, B, C, δ, λ) where (N, B, δ) is a semi-automaton, C is a non-empty Γ-semi sub near-field space called the output alphabet and $\lambda : N \times B \to C$ is the output function.

Note 1.3: A semi automaton is finite if all Γ-semi sub near-field spaces N, B and C are finite. Here several types of automaton are studied.

Note 1.4: We usually describe the semi automaton only by tables or by graphs.

Now we describe description of automaton:
Let $B = \{b_1, b_2, ..., b_n\}$, $C = \{c_1, c_2, ..., c_n\}$ and $N = \{n_1, n_2, ..., n_n\}$ where B is the input alphabet, C is the output alphabet and N is the Γ-semi sub near-field space of states. We describe δ the next state function from $N \times B \to N$ by the following table.

Input Table:

δ	b_1 .... b_n
n_1	$\delta(n_1, b_1)$ .... $\delta(n_1, b_1)$
.	.
.	.
.	.
n_k	$\delta(n_k, b_1)$ .... $\delta(n_k, b_k$

Where $\delta(n_i, b_j) \in N$).

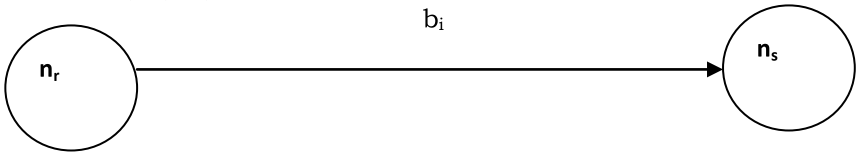
The output table in case of automaton is given by λ where, $\lambda : N \times B \to C$ where C is the output alphabet is given by the following output table.

Output Table:

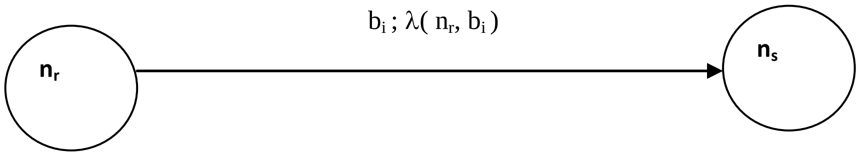
λ	b_1 .... b_n
n_1 . . .	$\lambda(n_1, b_1)$ .... $\lambda(n_1, b_1)$ . . .
n_k	$\lambda(n_k, b_1)$ .... $\lambda(n_k, b_k)$

Where $\lambda(n_i, b_i) \in C$.

Definition 1.5: State graph. The graphical representation which is called a state graph are drawn by taking the Γ-semi sub near-field space of states $n_1, n_2, \ldots, n_k$ as "discs".



if $\delta(n_r, b_i) = n_s$. In case of an automaton, we have $\lambda(n_r, b_i) = n_s$ also as the output function so that the state graph in this case is



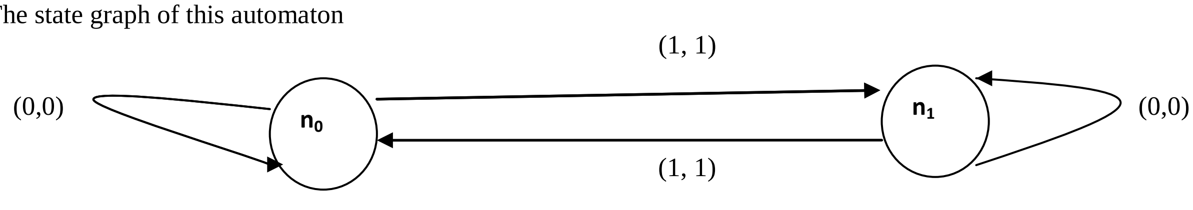
We illustrate by the following example the parity check automaton by both the tables and state graphs.

Example 1.6: Parity check automaton. Let N = N = $\{n_0, n_1\}$, B = C = {0, 1} and

δ	0	1
n_0	n_0	n_1
n_1	n_1	n_0

λ	0	1
n_0	0	1
n_1	0	1

The state graph of this automaton



This automaton has limitations for a given input it can give an output. It can not do any sequential operations so using free Γ-semi sub near-field spaces an automaton which can perform sequence of operations acting on sequence of elements. To achieve this we define the following:

Definition 1.7: $\overline{B}$ = free Γ-semi sub near-field space generated by the input alphabets B together with the empty sequence Λ.

Definition 1.8: $\overline{C}$ = free Γ-semi sub near-field space generated by the output alphabets C together with the empty sequence Λ.

Clearly the number of states N in a machine cannot be adjusted as it is constructed or designed with a fixed number of states.

We extend the next state function δ and the output function $\lambda : N \times B \to N \times \overline{B}$ by defining for $n \in N$ and $b_1, b_2, \ldots,$ $b_r \in B$ where $\delta : N \times B \to N$ and $\overline{\delta} : N \times \overline{B} \to N$ by

$\overline{\delta}(n, \Lambda) = n$
$\overline{\delta}(n, b_1) = \delta(n, b_1)$
$\overline{\delta}(n, b_1 b_2) = \delta(\overline{\delta}(n, b_1), b_2)$
.
.
.
$\overline{\delta}(n, b_1 b_2 \ldots b_n) = \delta(\overline{\delta}(n, b_1 b_2 \ldots b_{n-1}), b_n)$

And

$\lambda : N \times B \to C$ by $\overline{\lambda} : N \times \overline{B} \to \overline{C}$ defined or extended by
$\overline{\lambda}(n, \Lambda) = \Lambda$
$\overline{\lambda}(n, b_1) = \lambda(n, b_1)$
$\overline{\lambda}(n, b_1 b_2) = \lambda(n, b_1)\, \overline{\lambda}(\delta(n, b_1), b_2)$
.
.
.
$\overline{\lambda}(n, b_1 b_2 \ldots b_n) = \lambda(n, b_1)\, \overline{\lambda}(\delta(n, b_1), b_2 \ldots b_{n-1}, b_n)$.

In this way we obtain functions, $\overline{\delta} : N \times \overline{B} \to N$ and $\overline{\lambda} : N \times \overline{B} \to \overline{C}$.

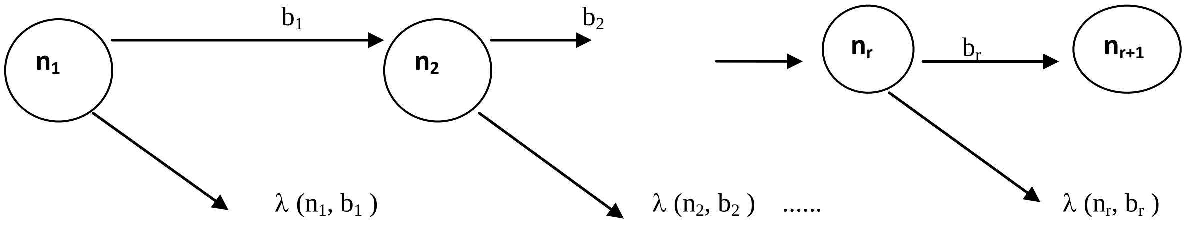
Thus the semi automaton $T = (N, B, \delta)$ is generalized to new semi automaton $\overline{T} = (N, \overline{B}, \overline{\delta})$.

Similarly, the automaton $B = (N, B, C, \delta, \lambda)$ is generalized to the new automaton $\overline{B} = (N, \overline{B}, \overline{C}, \overline{\delta}, \overline{\lambda})$.

We can describe the operation by

$n_1 = n$
$n_2 = \delta(n_1, b_1)$
$n_3 = \overline{\delta}(\delta(n_1, b_1), b_2)$
$\quad = \delta(n_2, b_2)$
.
.
.

The sectional graph of automaton is :



Now using the concept of semi automaton and automaton we define the concept of Kalangi semi-automaton and Kalangi automaton as follows:

Definition 1.9: Kalangi semi automaton. $\lambda_k = (N, \overline{B}, \overline{\delta})$ is said to be a Kalangi semi – automaton if $\overline{B}$ = <**B**> is the free groupoid generated B with Λ the empty sequence adjoined with it and $\overline{\delta_s}$ is the function from $N \times \overline{B_t} \to N$. thus the Kalangi semi – automaton (K semi-automaton) contains $\gamma = (N, \overline{B_t}, \overline{\delta_s})$ as a new semi – automaton which is a proper substructure of γ_k.

Note 1.10: equivalently we define K-semi-automaton as one which has a new semi automaton as a substructure.

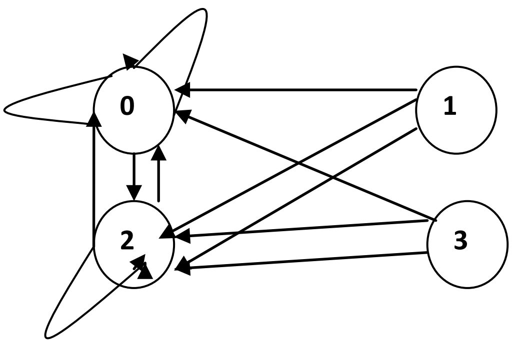
Note 1.11: Clearly, the K-semi automaton is generalized structure that the new semi-automaton as all free Kalangi Γ-semi sub near-field spaces of a Γ-near-field space over near-field are in $\overline{B}$ is the free groupoid generated by B.

Definition 1.12: Kalangi sub semi-automaton. $\overline{Y'_k}$ = (N_1, $\overline{B_k}$, $\overline{\delta'_k}$) is called the Kalangi subsemi - automaton (K-subsemi – automaton) of $\overline{Y_k}$ = (N_2, $\overline{B_k}$, $\overline{\delta'_k}$) denoted by $\overline{Y'_k} \subseteq \overline{Y_k}$ if $N_1 \subset N_2$ and $\overline{\delta'_k}$ is the restriction of $\overline{\delta_k}$ on $N_1 \times \overline{B_k}$ and $\overline{Y'_k}$ has a proper subset $\overline{K} \subset \overline{Y'_k}$ such that $\overline{K}$ is a new semi automaton.

Example 1.13: Let N = N_4 = (2, 2) and B = N_3 (1, 2) we define δ (n, b) = n^* b (mod 4) ‘ * ’ as in N. The table for the semi-automaton is given by

δ	0	1	2
0	0	2	0
1	2	0	2
2	0	2	0
3	2	0	2

The graph for it is



Thus this has Kalangi subsemi-automaton Γ-semi sub near-field space N_1 given by N_1 = (0, 2) states.

Note 1.14: A machine equipped with this K-semi automaton Γ-semi sub near-field space can use any new automaton as per need. Now proceed on to recall the definition of group semi-automaton.

Definition 1.15: Kalangi automaton. $\overline{M_k}$ = (N, $\overline{B_k}$, $\overline{C_k}$, $\overline{\delta_k}$, $\overline{\lambda_k}$) is defined to be a Kalangi automaton (K-automaton) if $\overline{M}$ = (N, $\overline{B_k}$, $\overline{C_k}$, $\overline{\delta_k}$, $\overline{\lambda_k}$) is the new automaton and $\overline{B_k}$, $\overline{C_k}$, the Kalangi free groupoids so that $\overline{M}$ = (N, $\overline{B_k}$, $\overline{C_k}$, $\overline{\delta_k}$, $\overline{\lambda_k}$) is the new automaton got from M, and $\overline{M}$ is strictly contained in $\overline{M_k}$.

Note 1.16: Thus K-automaton enables us to adjoin some more elements which is present in B and freely generated by B, as a free groupoid, that will be the case when the compositions may not be associative.

Secondly, by using K-automaton we can couple several automaton as

$N = N_1 \cup N_2 \cup N_3 \cup .... \cup N_n$
$B = B_1 \cup B_2 \cup B_3 \cup .... \cup B_n$
$C = C_1 \cup C_2 \cup C_3 \cup .... \cup C_n$
$\delta = \delta_1 \cup \delta_2 \cup \delta_3 \cup .... \cup \delta_n$ and $\lambda = \lambda_1 \cup \lambda_2 \cup \lambda_3 \cup .... \cup \lambda_n$

Where the union of $\lambda_i \cup \lambda_j$ and $\delta_i \cup \delta_j$ denote only extension maps as “ ∪ “ has no meaning in the composition of maps, where $M_i = (N_i, B_i, C_i, \delta_i, \delta_j)$ for i = 1,2,3,..., n and $\overline{M} = \overline{M_1} \cup \overline{M_2} \cup \overline{M_3} \cup ..... \cup \overline{M_n}$. Now $\overline{M_k}$ = (N, $\overline{B_k}$, $\overline{C_k}$, $\overline{\delta_k}$, $\overline{\lambda_k}$) is the K-automaton.

Example 1.17: Let N = N_4 (3, 2), B = C = N_5 (2, 3) M = (N, B, C, δ, λ) is a K-automaton defined by the following tables where δ (n, b) = n * b (mod 4) and λ (n, b) = n * b (mod 5).

λ	0	1	2	3	4
0	0	3	1	4	2
1	2	0	3	1	4
2	4	2	0	3	1
3	1	4	2	0	3

δ	0	1	2	3	4
0	0	2	0	2	0
1	3	1	3	1	3
2	2	0	2	0	2
3	1	3	1	3	1

We obtain the following graph:

Thus we see this automaton has two Kalangi subautomatons given by the states {0, 2} and {1, 3} as above.

Definition 1.18: Kalangi sub-automaton. $\overline{M_k}'$ = ($\overline{N_1}$, $\overline{B_k}$, $\overline{C_k}$, $\overline{\delta_k}$, $\overline{\lambda_k}$) is called Kalangi sub automaton (K-sub automaton) if $\overline{M_k}$ = (N_2, $\overline{B_k}$, $\overline{C_k}$, $\overline{\delta_k}$, $\overline{\lambda_k}$) denoted by $\overline{M_k}' \subseteq \overline{M_k}$ if $N_1 \subseteq N_2$ and $\overline{\delta_k}'$ and $\overline{\lambda_k}'$ are the restrictions of $\overline{\delta_k}$ and $\overline{\lambda_k}$ respectively on $N_1 \times \overline{B_k}$ and has proper Γ-semi sub near-field space $\overline{U} \subseteq \overline{M_k}'$ such that $\overline{U}$ is a new Kalangi automaton (K- automaton).

SECTION 2: Basics on Kalangi automaton homomorphism, epi-morphism or isomorphism and on semi – automaton Part II some applications of Kalangi non-associative Γ-semi sub near-field space of a Γ-near-field space over near-field.

Here in section 2, we recall the basic notions of Kalangi automaton homomorphism, epi-morphism or isomorphism and on semi – automaton and give some interesting illustrations of them.

Definition 2.1: Kalangi automaton homomorphism. Let $\overline{M_1}$ and $\overline{M_2}$ be any two K-automaton where $\overline{M_1}$ = ($\overline{N_1}$, $\overline{B_1}$, $\overline{C_1}$, $\overline{\delta_1}$, $\overline{\lambda_1}$) and $\overline{M_2}$ = (N_2, $\overline{B_k}$, $\overline{C_k}$, $\overline{\delta_k}$, $\overline{\lambda_k}$). A map ϕ : $\overline{M_1} \to \overline{M_2}$ is a Kalangi automaton homomorphism (K-automaton-homomorphism)
if ϕ is restricted from M_1=(N_1 , B_1, C_1, δ_1, λ_1) to M_2=(N_2 , B_2, C_2, δ_2, λ_2) denoted by ϕ_r is an automaton homomorphism from M_1 to M_2 . ϕ is called a Kalangi monomorphism (epi-morphism or isomorphism) if there is an isomorphism ϕ_r from M_1 to M_2 .

Definition 2.2 The direct product of the automaton. Let $\overline{M_1}$ and $\overline{M_2}$ be two K-automatons of Kalangi non-associative Γ-semi sub near-field space of a Γ-near-field space over near-field where $\overline{M_1}$ = ($\overline{N_1}$, $\overline{B_k}$, $\overline{C_k}$, $\overline{\delta_k}$, $\overline{\lambda_k}$) and $\overline{M_2}$ = (N_2, $\overline{B_k}$, $\overline{C_k}$, $\overline{\delta_k}$, $\overline{\lambda_k}$). The Kalangi automaton direct product (K-automaton direct product) of $\overline{M_1}$ and $\overline{M_2}$ denoted by $\overline{M_1} \times \overline{M_2}$ is defied as the product of the automaton M_1=(N_1 , B_1, C_1, δ_1, λ_1) and M_2 = (N_2 , B_2, C_2, δ_2, λ_2) where $M_1 \times M_2$ = ($N_1 \times N_2$, $B_1 \times B_2$, $C_1 \times C_2$, δ, λ) with δ ((n_1, n_2), (b_1 , b_2)) = (δ_1(n_1 , b_2), δ_2(n_2 , b_2)), λ ((n_1 , n_2), (b_1 , b_2)) = (λ_1(n_1 , b_2), λ_2(n_2 , b_2)) ∀ (n_1, n_2) ∈ $N_1 \times N_2$ and (b_1, b_2) ∈ $B_1 \times B_2$.

Note 2.3: Here in $M_1 \times M_2$ we do not take the free groupoid to be generated by $B_1 \times B_2$ but only free groupoid generated by $\overline{M_1} \times \overline{M_2}$.
Thus the K-automaton direct product exists wherever a automaton direct product exists.
We made this in order to make the Kalangi parallel composition and Kalangi series composition of automaton extendable in a simple way.

Definition 2.4: Kalangi groupoid. A kalangi groupoid L_1 divides a Kalangi groupoid L_2 if the corresponding Kalangi non-associative Γ-semi sub near-field space of a Γ-near-field space over near-field M_1 and M_2 of L_1 and L_2 respectively divides, that is , if M_1 is a homomorphic image of a Kalangi non-associative Γ-semi sub near-field space of M_2.

Note 2.5: In symbols $L_1 \setminus L_2$ the relation divides is denoted by "\".

Definition 2.6: Equivalent K-automaton. Two K-automaton $\overline{M_1}$ and $\overline{M_2}$ are said to be equivalent K-automaton if they divide each other. In symbols we denote it as $\overline{M_1} \sim \overline{M_2}$.

Definition 2.7: Let M_1 and M_2 be any two K-automatons where $\overline{M_1} = (\overline{N_1}, \overline{B_k}, \overline{C_k}, \overline{\delta_k}, \overline{\lambda_k})$ and $\overline{M_2}$ = (N_2, $\overline{B_k}$, $\overline{C_k}$, $\overline{\delta_k}$, $\overline{\lambda_k}$) with an additional assumption $B_2 = C_1$.

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