# ON THE CHARACTERISTICS OF SECOND ORDER LIMIT LANGUAGE

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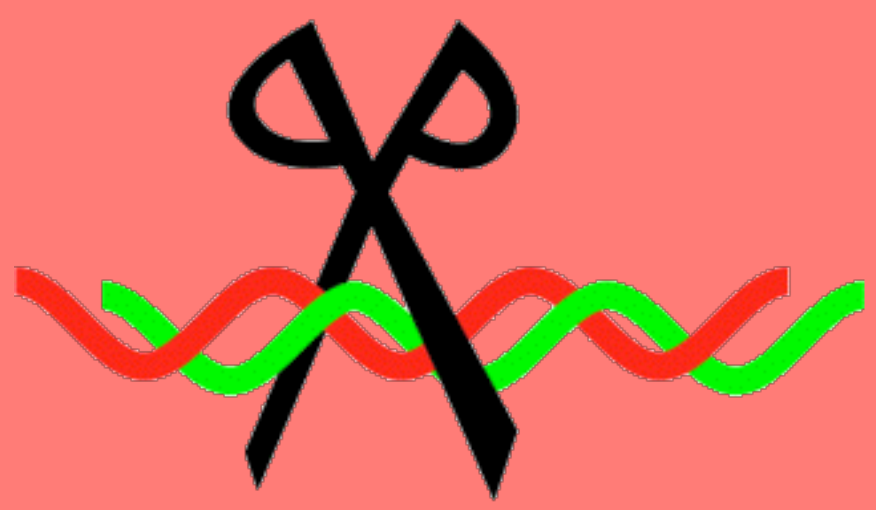
## IDEA



## INTRODUCTION

DNA molecules are known of its functions which are coding for proteins synthesis and also self-replication that ensure an exact copy is passed on to the offspring cell [1]. These molecules are made up of thousands of complementary nucleotides commonly referred to as Adenine (A), Guanine (G), Cytosine (C) and Thymine (T). By Watson-Crick complementarity [2], A is paired with T and C is paired with G and vice versa. Then, those pairs are presented as *a*, *g*, c and *t*. There is an enzyme that works beautifully with DNA molecules known as the restriction enzyme.

In this research, the definition of second order limit language is given and an example is discussed to show the existence of second order limit language. Once the formation and existence of second order limit language is shown, its characteristics are illustrated by some theorems.

## PRELIMINARIES

**Definition 1 [3]: Y-G Splicing System**

If $r \in R$, where $r = (u,x,v\!:\!y,x,v)$ and $s_1 = \alpha uxv\beta$ and $s_2 = \gamma yxz\delta$ are elements of $I$, then splicing $s_1$ and $s_2$ using $r$ produces the initial string $I$ together with $\alpha uxz\beta$ and $\gamma yxz\beta$, presented in either order where $\alpha,\beta,\gamma,\delta,u,x,v,y$ and $z \in A^*$ are the free monoid generated by $A$ with the concatenation operation and 1 as the identity element.

**Definition 2 [4]: Second Order Limit Language**

Let $L_1$ be the set of second order limit words of $L$, the set $L_2$ of second order limit words of $L$ to be the set of first order limits of $L_1$. We obtain $L_2$ from $L_1$ by deleting the words that are transient in $L_1$.

## EXAMPLES OF SECOND ORDER LIMIT LANGUAGE

**Example 1**

Let $S=(A,I,R)$ be a Y-G splicing system consisting of two restriction enzymes namely *Fau*I and *Aci*I, where $A=\{a,c,g,t\}$, $I=\{\alpha cccgcttaacg\beta\}$ such that $\alpha,\beta \in A^*$ and $R=\{(r_1:r_2)\}$ where $r_1=(cccgcttaa;cg,1)$ and $r_2=(c;cg,c)$.

The following are the splicing languages after the first splicing has taken place,

$$I \cup \left\{\begin{array}{l} \alpha cccgcttaacgttaagcggg\alpha', \alpha cccgcttaacgttaagcggg\alpha', \beta' cg\beta, \\ \alpha cccggg\alpha', \beta' cgttaagcgcttaacg\beta, \alpha cccgcttaacgcttaacg\beta, \\ \alpha cccg\beta, \alpha cccgcttaacggg\alpha', \beta' cgttaaggcg\beta \end{array}\right\}.$$

The second order limit language are

$\{\alpha cccgcttaacgcttaacgcttaacg\beta, \alpha cccgcttaacgcttaacggg\alpha'\}$.

**Example 2**

Let $S=(A,I,R)$ be a Y-G splicing system consisting of a restriction enzyme namely *Mbo*I, where $A=(a,c,g,t)$, $I=\{aagatcggcgatcttcct\}$ which consists of two recognition sites of the restriction enzyme and $R=\{(1;gatc,1:1;gatc,1)\}$.

The following are the splicing languages after the first splicing has taken place,

$$I \cup \left\{\begin{array}{l} aagatctt, aagatcttcct, aagatcgccgatctt, \\ aagatcggcgatcggcgatcttcct, aagatcgccgatctt, \\ aagatcggcgatcgccgatctt, aagatcggcgatcgccgatcttcct, \\ aagatcgccgatcggcgatcttcct \end{array}\right\}.$$

The second order limit language are

$$\left\{\begin{array}{l} aagatcggcgatcggcgatcggcgatcttcct, \\ aagatcggcgatcgccgatcgccgatcttcct, \\ aagatcgccgatcgccgatcgccgatcttcct, \\ aagatcggcgatcgccgatcggcgatcggcgatcttcct. \end{array}\right\}.$$

## MAIN RESULTS

**Theorem 1**

If the rule of a splicing system is itself palindromic, then there will be no second order limit language.

**Theorem 2**

An initial string that contains two recognition sites of two rules with identical crossing sites produces second order limit language.

**Corollary 1**

If only an initial string and a rule is involved in a splicing system, then the second order limit language does not exist.

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