Some Characterizations of Permanent Splicing Systems

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The concept of mathematical modeling of splicing system was introduced by Head in 1987 [1]. Since then, splicing system has been modeled under the framework of Formal Language Theory and theoretical computer science. This theoretical splicing system models the biological process of the cutting and pasting of double-stranded DNA molecules by restriction enzymes and ligase respectively. With every splicing system, there corresponds a splicing language. The type of resulting splicing language depends on the corresponding splicing system.

Different types of splicing systems have been established since 1987, and some of these splicing systems have also been experimented in the wet-lab. For instance, strictly locally testable languages have been extensively presented in detail in [2 - 5]. The notion of simple splicing systems was introduced by Mateescu *et al.* in 1998 [6]. Fong introduced some concepts involving simple splicing system using Formal Language Theory in [7]. Some characterization of semi-simple splicing languages have been presented in [8, 9].The sequence of language families S_kH was introduced in 1998 [2]. In 2008, Fong reducethe families of S_kH splicing system to simple splicing system using the concept of solid codes [10].

In this paper, a particular type of splicing system namely the permanent splicing system will be discussed. Permanent splicing system is actually a subset of persistent splicing system which has been discussed in [11, 12].In this research, some characteristics of permanent splicing system are investigated, and some sufficient conditions in which splicing systems are permanent are provided in the following theorems.

Theorem 1. Let $S = (A, I, B, \varnothing)$ be a splicing system such that $B = \{(c_i, x_i, d_i): 1 \le i \le n\}$. If elements of B do not have the same crossing and c_i (respectively d_i) is not a factor of c_j (respectively d_j) $\forall\ 1 \le i,j \le n\ (i \ne j)$, then S is permanent.

Theorem 2. Let $S = (A, I, B, \varnothing)$ be a splicing system such that

$$B = \{(c_i, x_i, d_i): 1 \le i \le n\} \cup \{(1, x_i, 1) : 1 \le i \le n\}.$$

Then S is permanent.

Theorem 3. Let $S = (A, I, B, \varnothing)$ be a splicing system such that

$$B = \{(c_i, x_1x_2, d_i): 1 \le i \le n\} \cup \{(1, x_1x_2, 1), (x_1, 1, x_2)\},\ c_i, d_i, x_1, x_2 \in A^*$$

such that x_1 is not a factor of x_2 and vice versa. Then S is permanent.

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