

DNA Computing

DNA Computing is the computational technology that uses the biomolecules DNA in the place of silicon based chips. DNA computing is otherwise known as the **Bio molecular computing** is a fast growing **interdisciplinary field** that uses molecular biology and computer techniques in research and bio informatics areas.

The **DNA computing technique** was developed by **Leonard Adleman** of the University of **South California** in 1994. In 2002 a programmable bio computing machine was developed using DNA as the major element. In 2004, a DNA computer was designed to study the changes in cancerous cells. In 2009 a **bio computer** coupled with **silicon chips** was introduced which was based on enzyme systems and silicon chips. This marked great advancement in the field of **Synthetic biology** to use integrated systems of biological molecules and electronic chips.

About DNA

DNA computing exploits the functional properties of DNA. All living organisms except a few viruses carry DNA in the cells as **genetic material**. The DNA encodes all the information regarding the development, growth and functioning of organisms. DNA molecule consists of Nucleotides having nitrogen bases –**Adenine, Guanine, Cytosine and Thymine**– pentose sugar and Phosphate group. The DNA has two **anti parallel strands** which dissociates and recombines when heated. DNA uses **ATP** (Adenosine Tri Phosphate) as **fuel** for the dissociation or re association of the strands. The energy in the form of ATP in DNA can carry out quick dissociation or recombination of the strands.

Technique of DNA computing

DNA computing uses different techniques for computational analysis. The most common methods are construction of **logic gates** such as **AND, NOT, OR** etc. from the DNA bases. Other methods in DNA computing includes use of **DNAzymes, DNA tilling, PCR** etc.

DNA as Enzyme

DNAzymes are DNA molecules with catalytic property. They catalyze the reaction when make contact with oligonucleotides. So the DNAzymes can be treated as the “**input system**” which can be used to create **logic gates** similar to **silicon chips**. The DNAzymes logic gates change its structure when make contact with the oligonucleotides. Two commonly used DNAzymes are **E6** and **8-17** which are the best DNAzymes to create DNA logic gates.

Stem loop DNA

A **Single stranded DNA** with a loop at the end is called **Stem loop DNA**. It is highly dynamic and the loop opens and closes when a DNA segment is attached to it. This property is also used to create logic gates.

Sticky ends of DNA

The **broken ends** of DNA shows “**sticky**” nature and this property is used in DNA computing. The sticky DNA segment binds with another DNA molecule and displaces the segments apart. This property is exploited to create logic gates like **AND**, **OR** and **NOT** gates.

DNA tiles

A DNA tile can be created using multiple sticky DNA segments. This method used DNA nano technology. **DNA arrays** can be constructed to implement computation.

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