

Report on DNA Cryptography: A Novel Approach to Data Security

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1. Introduction

DNA cryptography is a cutting-edge method of data encryption that leverages the principles of DNA computing. By mimicking biological processes such as transcription and translation, DNA cryptography introduces dynamic, robust mechanisms for encoding information. This method ensures an additional layer of security due to the inherent complexity of DNA sequences, offering a novel approach to data protection.

2. DNA Encoding Process

2.1. Generation of Dynamic Encoding Table

The DNA encoding process starts with the generation of a dynamic encoding table, responsible for converting plaintext into DNA sequences. The dynamicity of the table ensures that each encoding is unique and secure.

2.2. Unique Sequence for Each Character

The encoding table maps each character in the plaintext to a unique sequence made up of DNA's nucleotide bases (A, T, C, G), enhancing the complexity of the encoded message.

3. Robustness of Encoding and Encryption

3.1. Multiple Round Functions (Minimum 10 Rounds)

To ensure robust encryption, at least 10 rounds of transformations are performed:

- XNOR operation with introns
- Transcription (DNA \rightarrow mRNA) and translation (mRNA \rightarrow tRNA)

- Reverse transcription (tRNA → DNA)
- Sequence shifting

3.2. Biological Simulation

The encryption process simulates biological mechanisms such as transcription and translation to create a secure, complex cipher.

4. Decryption Process

The decryption process reverses the encryption operations, decoding the protein sequence (ciphertext) back into DNA and eventually reconstructing the plaintext. Biological transformations, including reverse transcription and translation, are essential to the decryption process.

5. Dynamicity and Biological Process Simulation

- **Random DNA Sequence Generation:** Two random DNA sequences are generated using the four DNA bases (A, T, C, G).
 - **Matrix Expansion:** DNA sequences are converted into mRNA and placed in a matrix, which is extended to a 16x16 configuration for increased randomness.
 - **Grouping of Amino Acids:** Amino acids are divided into four groups, forming 24 possible sequences that can be used in the encryption.
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6. Advantages of DNA Cryptography

- **Dynamic Encoding:** The constant regeneration of encoding tables ensures unpredictability in the encryption process.
 - **Biological Complexity:** Simulating biological processes adds layers of transformation, making DNA cryptography highly secure.
 - **Resistance to Attacks:** The natural randomness in DNA sequences provides resistance against brute-force and other cryptographic attacks.
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7. Conclusion

DNA cryptography represents an innovative approach to secure data encryption. By simulating biological processes and leveraging the randomness of DNA sequences, this method offers a robust, dynamic solution for protecting sensitive information. As this field evolves, it promises to become a significant advancement in the realm of cryptography and data security.