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Decryption of genome-encoded cryptographic keys using DNAcrypt-AI

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We use this protocol and it's working

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Disclaimer

This protocol is licensed under CC-BY. DNAcrypt-AI software referenced here is subject to its own separate license terms. Please refer to the license notice at <https://github.com/mahvin92/DNAcrypt-AI> for your review. Note that this protocol was tested using the Colab implementation of a Jupyter notebook of DNAcrypt-AI. Additional validation may be required when applying this workflow to a different computing infrastructure. DNAcrypt-AI is provided for research use only and has not been validated for personal, clinical, diagnostic, and enterprise use. The software is provided "as is", without warranty of any kind, express or implied. For more information, please visit <https://dnacryptai.chordexbio.com/>.

Abstract

DNAcrypt-AI is a human genome-based cryptographic framework that leverages k-mer-based alphanumeric encoding, genome vocabulary, sequence reconstruction, and sequence-informed machine learning to enable controlled decryption of encrypted digital credentials. This protocol describes the procedure for decrypting an encrypted secret key generated using DNAcrypt-AI, restoring the original fixed-length plaintext key from its genome metadata representation. The decryption workflow is implemented on Google Colab and integrates a high-throughput DNA sequence reconstitution pipeline (FAS2rDNA) with a sequence intelligence model (Covary) to reconstruct the encrypted genome coordinates into a human-readable secret key. The protocol successfully recovered the expected 16-character secret key, demonstrating reproducible reversibility of the DNAcrypt-AI encryption-decryption cycle for research and educational use.



Before start

For this protocol to work, users must generate and encrypt a 16-character secret key using DNAcrypt-AI (see protocol here: [10.17504/protocols.io.14egn12k6v5d/v1](https://doi.org/10.17504/protocols.io.14egn12k6v5d/v1)). Save and store the DNAcrypt_metadata.json file, which is the genome-encrypted data, and will be used for the decryption exercise. DNAcrypt-AI is implemented as a Jupyter notebook that is hosted on Google Colab. DNAcrypt-AI is dependent on a high-throughput DNA sequence reconstitution pipeline ([FAS2rDNA](#)) and sequence-informed machine learning model ([Covary](#)).

Protocol procedure

- 1 Launch DNAcrypt-AI from <https://dnacryptai.chordexbio.com/>. Alternatively, you can run DNAcrypt-AI using the recommended methods described in <https://github.com/mahvin92/DNAcrypt-AI>.
- 2 Select 'Decryption' under the *Use cases* section in the user configuration interface, as shown in Figure 1 below.



Figure 1. The interface of user configuration on DNAcrypt-AI, where users can specify the behavior of the cipher.

- 3 Run DNAcrypt-AI by initiating a runtime, ensuring a GPU (T4 as default) support, if available. Note that DNAcrypt-AI will still work in a non-GPU hosted runtime.

Click "Runtime" -> Select "Run all"

- 4 Upload the previously generated genome-encrypted data (see *Before starting*), using the upload feature as shown in Figure 2 below.

Figure 2. The upload functionality on DNACrypt-AI Jupyter notebook, executed in Google Colab environment.

- 5 Wait for DNACrypt-AI to finish the decryption process. The status and any error will be displayed below the code cell.
- 6 The decrypted 16-character key will be displayed below the code cell. Note that if you generated and encrypted a key with length from 6 to 90 characters, DNACrypt-AI will yield a key with the same character length.

Application note

- 7 This protocol is designed for decrypting passwords or encrypted keys, which are originally encoded into genome coordinated (encrypted data) by DNACrypt-AI. Decryption relies on correct metadata and compatible k-mer encoding logic, ensuring controlled reversibility of the cipher. This workflow is intended for research, validation, and educational use cases involving DNA-based cryptographic systems.