

# Configuration Manual

MSc Research Project  
Cyber Security

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**MSc Project Submission Sheet**  
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**Programme:** MSc in Cyber Security **Year:** 2023-24  
**Module:** Practicum  
**Lecturer:** Prof. Michael Pantridge  
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**Project Title:** Password Storage protection using Audio Steganography with AES Encryption  
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# Configuration Manual

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## 1 Introduction

This manual contains a brief description of the architecture of the Flask-based audio steganography application, which includes AES encryption, hashing, and steganography. effectively encrypts and decrypt password embedded in audio streams.

## 2 Hardware Configuration

- A. Operating system: Windows >=10
- B. Processor: Intel >=i5
- C. System Compatibility: 64-bit
- D. Hard Disk: 1 TB
- E. RAM: >=4 GB

## 3 Software Configuration

### 3.1 Python 3.10

Python is one of the most popular languages to code that is quite easy for any level programmer to understand and work with. The readability of the language is high; it uses fewer lines of code to express concepts as compared to most other languages not just sparing time but also reducing the chances of making a mistake., supports multiple paradigms including procedural, object oriented, and functional programming and there are many libraries and frameworks for specific tasks ranging from web development to data analysis and artificial intelligence. This flexibility and robustness have made Python one of the most sought-after languages in various fields including software engineering.

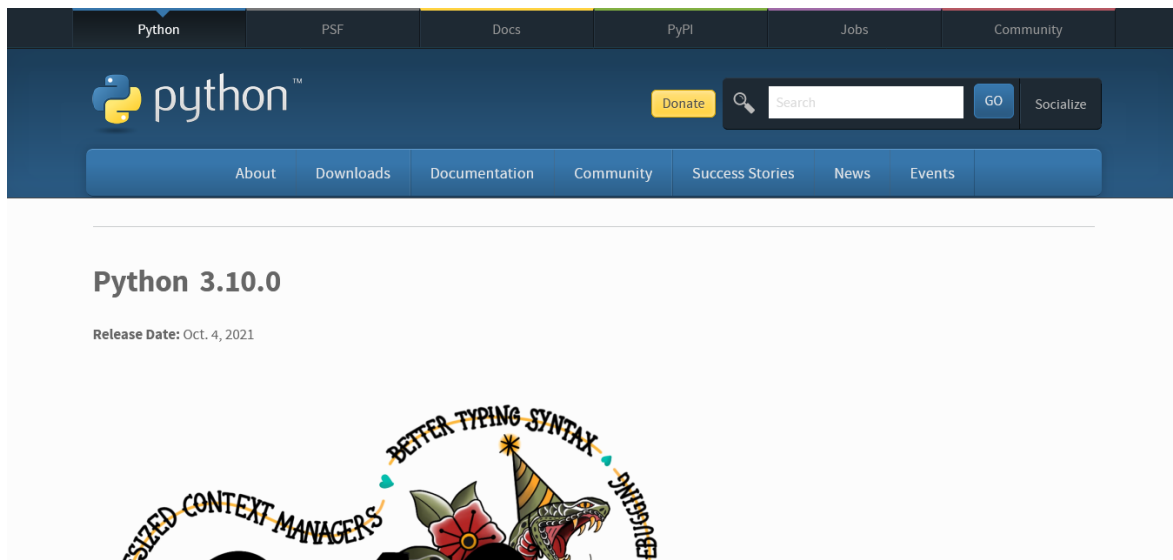


Figure 3.1: Python application

### 3.2 Visual Studio Code (VS Code)

Microsoft Visual Studio Code is a versatile yet light-weighted source code editor, which is supported cross-platform. It may be noted that it can offer sturdiness to a vast number of programming languages with the help of extensions, which it is famous for. Some of the facilities that VS Code has include code intelligence, debugging, terminal, and Git support, which enables easy development. Spread across its vast marketplace, developers can design their productivity with different extensions and themes for codes. Thanks to the very engaged community and continuous updates, VS Code continues to be the go-to solution for developers who prefer a fresh and fast working environment (Visual Studio Code, 2023).

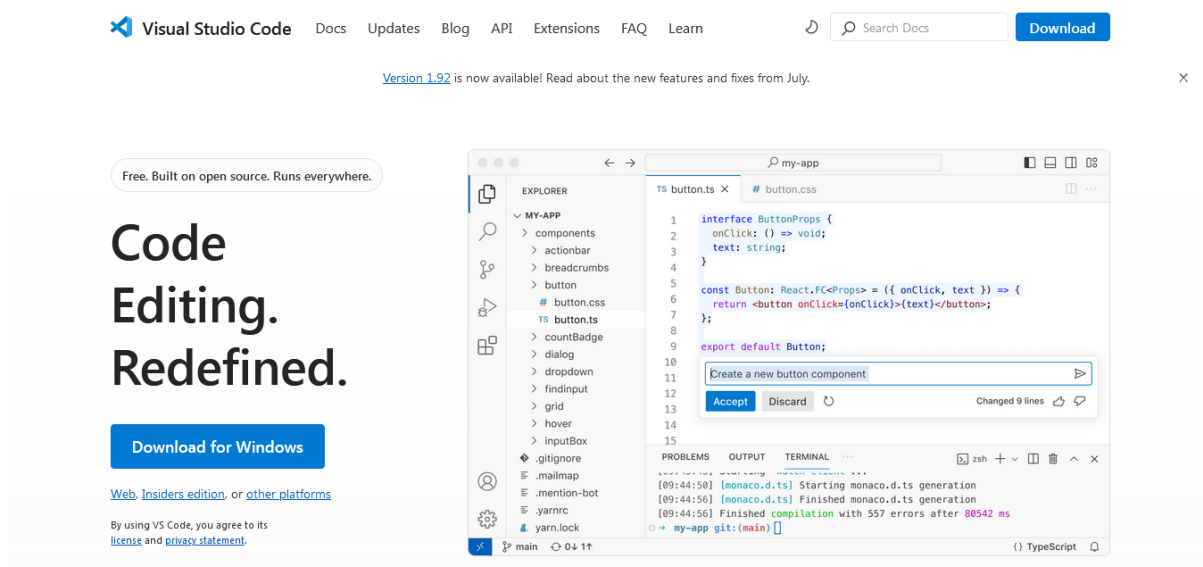


Figure 3.3: Visual Studio Code Application

## 4 LIBRARIES OVERVIEW

- **os**: Provides a way to interact with the operating system, allowing file and directory manipulation, environment variable access, and more.
- **wave**: Used for reading and writing WAV audio files, enabling audio data manipulation for steganography.
- **time**: Used for time-related functions, including measuring the duration of operations.
- **script**: Implements the scrypt password-based key derivation function to securely hash passwords with a salt.
- **random**: Provides functions for generating random numbers, useful for generating random keys or salts.
- **base64**: Used for encoding binary data into a base64 representation, often for safe transmission of binary data as text.
- **pickle**: Serializes and deserializes Python objects to and from byte streams, used for saving and loading objects.
- **smtplib**: Implements the Simple Mail Transfer Protocol (SMTP) client, allowing for sending emails.
- **numpy**: Provides support for large, multi-dimensional arrays and matrices, along with mathematical functions to operate on them.
- **pandas**: Offers data structures and data analysis tools, including DataFrames for handling and analyzing data efficiently.
- **seaborn**: Provides a high-level interface for drawing attractive and informative statistical graphics based on Matplotlib.
- **pprint**: Pretty-prints Python data structures, making them easier to read.
- **email**: Includes modules for managing email messages, including composing and sending emails.
- **datetime**: Supplies classes for manipulating dates and times, used for timestamping events and measuring durations.
- **matplotlib**: A plotting library for creating static, animated, and interactive visualizations in Python.
- **cryptodome.cipher**: Part of the PyCryptodome library, used for cryptographic operations like AES encryption and decryption.
- **cryptodome.random**: Provides secure random number generation for cryptographic purposes.
- **cryptography.hazmat**: Contains low-level cryptographic primitives and utilities, such as padding and cipher algorithms.
- **flask**: A micro web framework for building web applications, used for creating and managing routes and handling web requests.

## 5 Usage

**Initialization:** Set up file paths and Flask app.

**File Handling:** Receive and save the audio file uploaded by the user.

**Encryption:** Hash the input message and encrypt it using AES.

**Steganography:** Encode the encrypted message into the WAV file.

**Timing:** Measure the time taken for encryption, encoding, decoding, and decryption.

**Decryption:** Decode the message from the audio file and decrypt it.

**Rendering:** Display results on the web interface, including timing and success messages.

## 6 Project Implementation

In this figure website interface is shown below

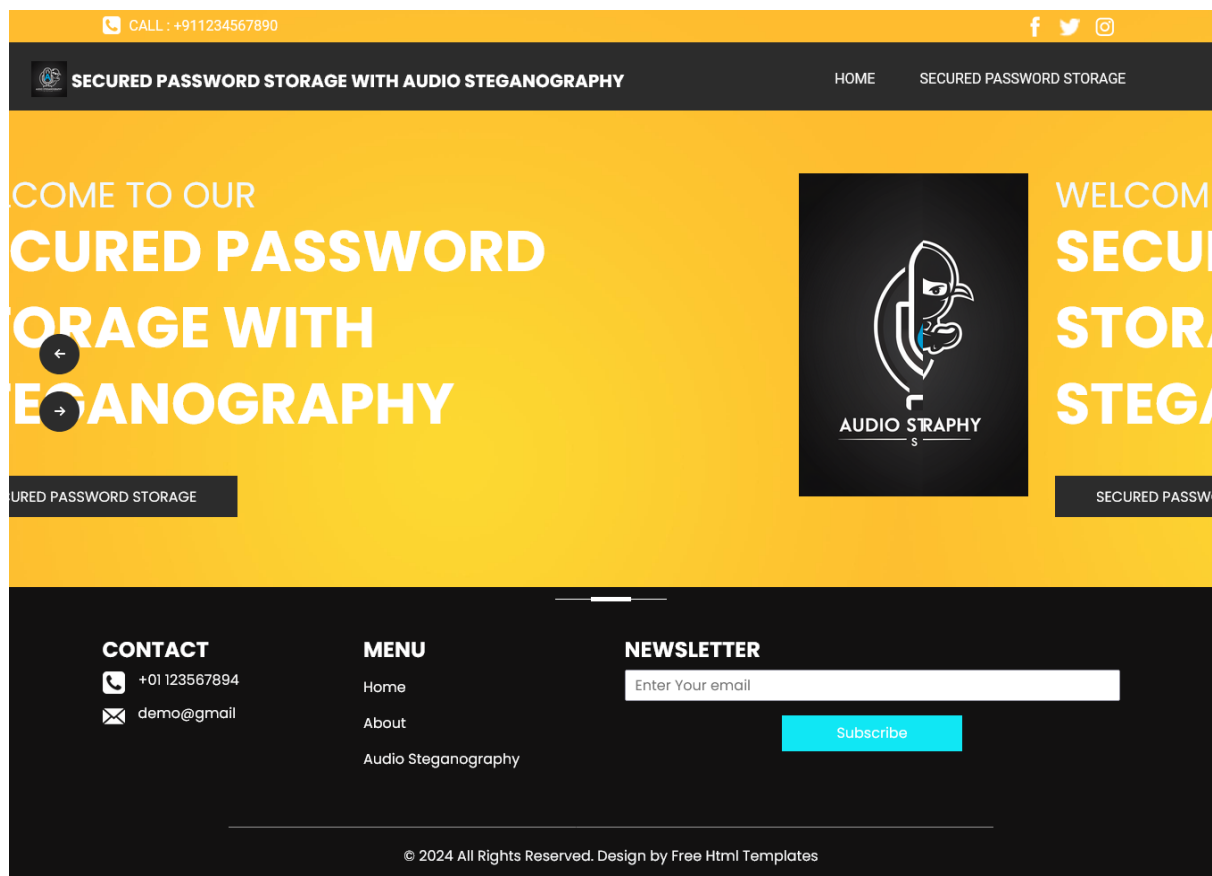


Figure 6.1: Web Application Interface

In this figure tab is shown where user can upload the audio file and the text password which will encrypt in once user will click on submit tab.

The screenshot shows a web application interface with a yellow background. At the top, there is a navigation bar with a phone icon and the text 'CALL : +01 1234567890', and social media icons for Facebook, Twitter, and Instagram. Below the navigation bar, the main header reads 'SECURED PASSWORD STORAGE WITH AUDIO STEGANOGRAPHY' with links for 'HOME' and 'SECURED PASSWORD STORAGE'. The main content area has the title 'ENHANCE METHOD FOR HIDING INFORMATION WITH STEGANOGRAPHY'. It contains two sections: 'SELECT AUDIO AND HIDE INFORMATION USING AUDIO STEGANOGRAPHY ENCRYPTION' with a 'Select/Upload Audio File' button, and 'ENTER PASSWORD TO HIDE IN AUDIO STEGANOGRAPHY' with a text input field labeled 'Enter Password' and a 'SUBMIT' button. At the bottom, there is a small line of code: `{% if outputvalue != "noneoutput": %}`.

Figure 6.2: Interface for Audio Interface

In the following figure code design to check avalanche score

The screenshot shows a code editor with a dark theme. The file is named 'avalscore.py'. The code implements a function 'comp\_count(p1, p2)' that calculates the avalanche score by comparing two strings. It uses a loop to iterate through the strings and counts the number of differing bits. The score is then calculated as  $(c / \text{len}(s1)) * 100$ . The code also includes test cases for 'input1' and 'input2' and prints the result of 'avalsc'.

```

1 def comp_count (p1, p2):
2     #print(p1)
3     #print(type (p1))
4     s1=''.join(format(ord(i), 'b') for i in p1)
5     s2=''.join(format(ord(i), 'b') for i in p2)
6     #print(len(s1))
7     c=0
8     if len(s1)>len(s2):
9         diff=len(s1)-len(s2)
10        s='0'*diff
11        s2=s+s2
12    else:
13        diff=len(s2)-len(s1)
14        s='0'*diff
15        s1=s+s1
16        #print(s1)
17        #print(s2)
18        for i in range (0,len(s1)):
19            if s1[i]!=s2[i]:
20                c=c+1
21        #print(c)
22        score = (c/len(s1))*100
23        return score
24
25
26 input1 = b'\xb0\x13\x06\x1e\x09\xde\x14z\xab\xfb(\x16\x98)\x89\x99\xfb\n\xeff\xbc\xfb\x01\xdc\xfb2#\x00\xec\x01\xec\x06\xec\x03\x07\x02\xfb\x0c\x04\x05\x06\x07\x08\x09\x0a\x0b\x0c\x0d\x0e\x0f\x10\x11\x12\x13\x14\x15\x16\x17\x18\x19\x1a\x1b\x1c\x1d\x1e\x1f\x20\x21\x22\x23\x24\x25\x26\x27\x28\x29\x2a\x2b\x2c\x2d\x2e\x2f\x30\x31\x32\x33\x34\x35\x36\x37\x38\x39\x3a\x3b\x3c\x3d\x3e\x3f\x40\x41\x42\x43\x44\x45\x46\x47\x48\x49\x4a\x4b\x4c\x4d\x4e\x4f\x50\x51\x52\x53\x54\x55\x56\x57\x58\x59\x5a\x5b\x5c\x5d\x5e\x5f\x60\x61\x62\x63\x64\x65\x66\x67\x68\x69\x6a\x6b\x6c\x6d\x6e\x6f\x70\x71\x72\x73\x74\x75\x76\x77\x78\x79\x7a\x7b\x7c\x7d\x7e\x7f\x80\x81\x82\x83\x84\x85\x86\x87\x88\x89\x8a\x8b\x8c\x8d\x8e\x8f\x90\x91\x92\x93\x94\x95\x96\x97\x98\x99\x9a\x9b\x9c\x9d\x9e\x9f\xa0\xa1\xa2\xa3\xa4\xa5\xa6\xa7\xa8\xa9\xaa\xab\xac\xad\xae\xaf\b0\b1\b2\b3\b4\b5\b6\b7\b8\b9\xba\xbb\xbc\xbd\xbe\xbf\xca\xcb\xcc\xcd\xce\xcf\xda\xdb\xdc\xdd\xde\xdf\xea\xeb\xec\xed\xee\xef\xfa\xfb\xfc\xfd\xfe\xff'
27 input2 = b'\xc6\xde?kja9\x19\xac\x0d\x0f\x0c0**\xa3_\xe5\xce)y,\xa06\xfb5-\x9f\xbbfzF\xbf\x808,\xc8(\r:\xef0\x8e\xfb9(\xa9\x08da\x0e\x04w\n\xc219\xba\xadd\
28
29 p1=str(input1)
30 p2=str(input2)
31 avalsc = comp_count (p1, p2)
32 print(avalsc)
33
34

```

Figure 6.3: Avalanche Score Code

For testing purpose in the following figure audio file is selected names Audio 1 (file\_example\_WAV\_1MB.wav) and as password 'Test@12345\$' is given and this is the first example

CALL : +01 1234567890

f t i

**SECURED PASSWORD STORAGE WITH AUDIO STEGANOGRAPHY** HOME SECURED PASSWORD STORAGE

ENHANCE METHOD FOR HIDING INFORMATION WITH STEGANOGRAPHY

**SELECT AUDIO AND HIDE INFORMATION USING AUDIO STEGANOGRAPHY ENCRYPTION**

Select/Upload Audio File

**ENTER MESSAGE TO HIDE IN AUDIO STEGANOGRAPHY**

Test@12345\$

SUBMIT

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Figure 6.4: User Interface while giving inputs.



In this figure we get encrypted hash value cypher text & decrypted as well with their timing.

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f

t

i

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HOME

SECURED PASSWORD STORAGE

ENHANCE METHOD FOR HIDING INFORMATION WITH STEGANOGRAPHY

SELECT AUDIO AND HIDE INFORMATION USING AUDIO STEGANOGRAPHY ENCRYPTION

Select/Upload Audio File

ENTER MESSAGE TO HIDE IN AUDIO STEGANOGRAPHY

Enter Message

SUBMIT

SECURED PASSWORD STORAGE WITH AUDIO STEGANOGRAPHY ENCRYPTION

0:00 / 0:06

Password Hashing by SCrypt

b\*\xde6\$\xf2\x8225\xabE\xad\xe5c=t\x4K \x1l\ty\xc8?w\xdc\xdf\xa4\x8fk'o\xe5c;\x14\xb9\x1d\x8eC\x99l=\xaes\xdd\x96T\x983l=\xd2U\x14\xb5O5\x95\xb6rs\xac\xa7\x15"

AES Encryption on Hash Password

b'b\x98\xb0\x13\x06\x1eH\xd9\xde\x14z\xab\x19(\x16\x98}\x89\x99\xfbal\n\xefF\xbcY\x17\xej\xdc\x12#\x00\xec}\{-\{\xfi\xec\xa6\xec\xe3\xe7\xd2\xfb\x13l=\x90\xba\xbf\x17Y\xbbMa\xcd\xdb\x86Pn

Hiding Encrypted Data in Audio - Steganography

0:00 / 0:06

Encryption Process Time : 109.01 ms

SECURED PASSWORD STORAGE WITH AUDIO STEGANOGRAPHY DECRYPTION

Retrieve Encrypted CiperText from Stegano Audio

b'b\x98\xb0\x13\x06\x1eH\xd9\xde\x14z\xab\x19(\x16\x98}\x89\x99\xfbal\n\xefF\xbcY\x17\xej\xdc\x12#\x00\xec}\{-\{\xfi\xec\xa6\xec\xe3\xe7\xd2\xfb\x13l=\x90\xba\xbf\x17Y\xbbMa\xcd\xdb\x86Pn

Retrieve Hash Data from CiperText

b\*\xde6\$\xf2\x8225\xabE\xad\xe5c=t\x4K \x1l\ty\xc8?w\xdc\xdf\xa4\x8fk'o\xe5c;\x14\xb9\x1d\x8eC\x99l=\xaes\xdd\x96T\x983l=\xd2U\x14\xb5O5\x95\xb6rs\xac\xa7\x15"

Matching Original Hash Password with Retrieved Hash Password (True/False)

True

Decryption Process Time : 47.0 ms

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Fig 6.5: Interface after getting all results.

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In this second example we change the password slightly to check performance as well as accuracy of our model. Here is changed password - Teap@12345%

CALL : +01 1234567890

[f](#) [t](#) [i](#)

 SECURED PASSWORD STORAGE WITH AUDIO STEGANOGRAPHY

HOME

SECURED PASSWORD STORAGE

ENHANCE METHOD FOR HIDING INFORMATION WITH STEGANOGRAPHY

SELECT AUDIO AND HIDE INFORMATION USING AUDIO STEGANOGRAPHY ENCRYPTION

Select/Upload Audio File

ENTER MESSAGE TO HIDE IN AUDIO STEGANOGRAPHY

Teap@12345%

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Fig 6.6: Interface while giving second inputs

In this following figure we get result of second example.

CALL : +01 1234567890

SECURED PASSWORD STORAGE WITH AUDIO STEGANOGRAPHY

HOMESECURED PASSWORD STORAGE

ENHANCE METHOD FOR HIDING INFORMATION WITH STEGANOGRAPHY

SELECT AUDIO AND HIDE INFORMATION USING AUDIO STEGANOGRAPHY ENCRYPTION

Select/Upload Audio File

ENTER MESSAGE TO HIDE IN AUDIO STEGANOGRAPHY

Enter Message

SUBMIT

SECURED PASSWORD STORAGE WITH AUDIO STEGANOGRAPHY ENCRYPTION

0:00 / 0:06

Password Hashing by SCrypt

b\*\xa5\x1c\xd1\xc3y\x80\x925e\xflE\xfdchYx>\x80\xe7c\xb7\xa2||\xcf\xc5\xc2D\x07\x86W\x19\x82\$\xc8\xed\x1b\xc2\xf6i\xb5\xc2\x9d\xbf\x05\xe6\xdb\x84\x1c\xdb\xddG\xae\xde\x16\xd2||\xdf\x81\xcd\xae\xa3B\x86"

AES Encryption on Hash Password

b'\xc6\xde?kj\xa9\x19\xac\xd0\xf0\xc0\*\*\xa3\_\xe5\xce}Y,\xa06\xf5-\x9f\xbbfzF\xbf\x808,\xc8{\r\xefQ\x8e\xf9{\xa9\xd8dA\x0e\x04W\n\x219\xba\xadd\x17\xa2\x86\xab\xdl\x84\xc9'

Hiding Encrypted Data in Audio - Steganography

0:00 / 0:06

Encryption Process Time : 102.95 ms

SECURED PASSWORD STORAGE WITH AUDIO STEGANOGRAPHY DECRYPTION

Retrieve Encrypted CiperText from Stegano Audio

b'\xc6\xde?kj\xa9\x19\xac\xd0\xf0\xc0\*\*\xa3\_\xe5\xce}Y,\xa06\xf5-\x9f\xbbfzF\xbf\x808,\xc8{\r\xefQ\x8e\xf9{\xa9\xd8dA\x0e\x04W\n\x219\xba\xadd\x17\xa2\x86\xab\xdl\x84\xc9'

Retrieve Hash Data from CiperText

b\*\xa5\x1c\xd1\xc3y\x80\x925e\xflE\xfdchYx>\x80\xe7c\xb7\xa2||\xcf\xc5\xc2D\x07\x86W\x19\x82\$\xc8\xed\x1b\xc2\xf6i\xb5\xc2\x9d\xbf\x05\xe6\xdb\x84\x1c\xdb\xddG\xae\xde\x16\xd2||\xdf\x81\xcd\xae\xa3B\x86"

Matching Original Hash Password with Retrieved Hash Password (True/False)

True

Decryption Process Time : 39.0 ms

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Fig 6.7 Interface after getting second result

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```

File Edit Selection View Go Run ...
Search
avalscore.py
Project_2022_2023 > Ashish > Project_2022_2023 > audio_steganography_system > avalscore.py > ...
8  if len(s1)>len(s2):
9      diff=len(s1)-len(s2)
10     s='0'*diff
11     s2=s+s2
12 else:
13     diff=len(s2)-len(s1)
14     s='0'*diff
15     s1=s+s1
16     #print(s1)
17     #print(s2)
18     for i in range(0,len(s1)):
19         if s1[i]!=s2[i]:
20             c=c+1
21         #print(c)
22     score = (c/len(s1))*100
23     return score
24
25
26 input1 = b'\x98\xb0\x13\x06\x1eH\xd9\xde\x14z\xab\xfb9(\x16\x98}\x89\xc9\xfb\n\xeff\xbcY\xf7\xe1\xdc\xf2#\x00\heck\-\{ \xf1\xec\xa6\xec\xe3\xe7\xd2\xfb\x
27 input2 = b'\xc6\xde?kj\xa9\x19\xac\xd0\xf0\x00**\xa3_\xe5\xce}Y,\xa06\xf5-\x9f\xbbfzF\xbf\x008,\xc8{\r:\xefQ\x8e\x9f(\xa9\xd8dA\x0e\x04w\n\xc2i9\xba\xadd\
28
29 p1=str(input1)
30 p2=str(input2)
31 avals = comp_count(p1, p2)
32 print(avals)
33
34

```

This is the snapshot of overall comparison of avalanche score with various passwords as well as with different sizes of audio files.

A	B	C	D	E	F	G	H	I	J
Audio File Name	Original Password	Ciphertext	Enc Process Time(ms)	Dec Process Time(ms)	Changed Password	Ciphertext	Enc Process Time(ms)	Dec Process Time(ms)	Avalanche Score
file_example_WAV_1MG.wav	Test@12345\$	b"b\98\xb0\13\	109.01	47	Teap@12345\$	b"xc6\xde2\k\9a9\	102.95	39	51.4084507
file_example_WAV_1MG.wav	tangoCharlie1121	b"95\9\de\94\	98.01	46.99	teng0Charlie1213	b"959\9b7\02\	113	44	65.269461
file_example_WAV_1MG.wav	dummy@abc	b"9aJh\85\9a4\	116.01	48.01	tummp@bcd123	b"9a3Q\9d3\9c85\	95.01	46	51.41122214
file_example_WAV_2MG.wav	Test@12345\$	b"x\9d4\9a6U\9c8	134.01	73.01	Teap@12345\$	b"F9a0\9c8\9bf\9b8	125.97	72	50.23359769
file_example_WAV_2MG.wav	tangoCharlie1121	b"1o\9ea\9a0\9d\	132.01	71.01	teng0Charlie1213	b"9cf\9cb\990\91	141.01	92.01	49.43014129
file_example_WAV_2MG.wav	passw0rd111\$	b"9c3F\9x82\9d~+	133.01	76.01	pasaw0rd121\$	b"9e9\998\901\915	157.01	82.01	48.23172628
file_example_WAV_10MG.wav	Test@12345\$	b"9c2b\981c\981*	419.03	292.02	Teap@12345\$	b"1\97\9a7fA\9dc\90	428.04	271.02	51.62002946
file_example_WAV_10MG.wav	tangoCharlie1121	b"9d7\999\9f9\9e	387.03	280.02	teng0Charlie1213	b"8\9a3\913\9be\9	465.08	314.02	50.36603221
file_example_WAV_10MG.wav	passw0rd111\$	b"985\988\9cd\90	433.03	309.02	pasaw0rd121\$	b"9\9c\990\9db\9a	405.48	297.03	49.80930587

## References

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