Data and Network Security / Homework Basic Security

HomeWork 3

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Exercise 1 : UNIX Password Cracker

The goal of this exercise is to write a password cracker for the UNIX file s ystem. U NIX s tores a ll p asswords i n t he file `/etc/passwd` . Well, it doesn't store the password itself. Instead, it stores a signature of the password by using the password to encrypt a block of zero bits prepended by a salt value with a one-way function called crypt( ). The result of the crypt( ) function is stored in the `/etc/passwd` file. For example, for a password of "egg" and salt equal to `HX` , the function crypt('egg','HX') returns `HX9LLTdc/jiDE` .

When you try to log in, the program /bin/login takes the password that you typed, uses crypt( ) to encrypt a block of zero bits, and compares the result of this function with the value stored in the `/etc/passwd` file. The security of this approach rests on both the strength of the crypt( ) function and the difficulty i n g uessing a user's password. The crypt( ) algorithm has proven to be highly resistant to attacks. Conversely, the user's choices for passwords have been found to be relatively easy to guess, with many passwords being words contained in the dictionary.

TowriteourUNIXpasswordcracker,wewillneedtousethecrypt( )algorithmthathashesUNIXpasswords.Fortunately, the crypt library already exists in the Python 2.79 standard library (on UNIX-based operating systems). (Note: for Windows-based operating systems, you will need to find the correct way t o i mport t he UNIX c rypt() a lgorithm.) T o c alculate the encrypted UNIX password signature, we simply call the function crypt.cypt( ) and pass it the password and salt as parameters. This function returns the signature as a string. A simple dictionary attack involves computing the possible signatures generated for each word in the dictionary with a range of salt values.

Let's create our first password cracker using a dictionary attack.

1. Create a file called cracker.py. Start your program by reading in the HW2-passwords.txt file and, for each password found in the file, iterate through each dictionary word found in the HW2-dictionary.txt file and appropriate salt value.

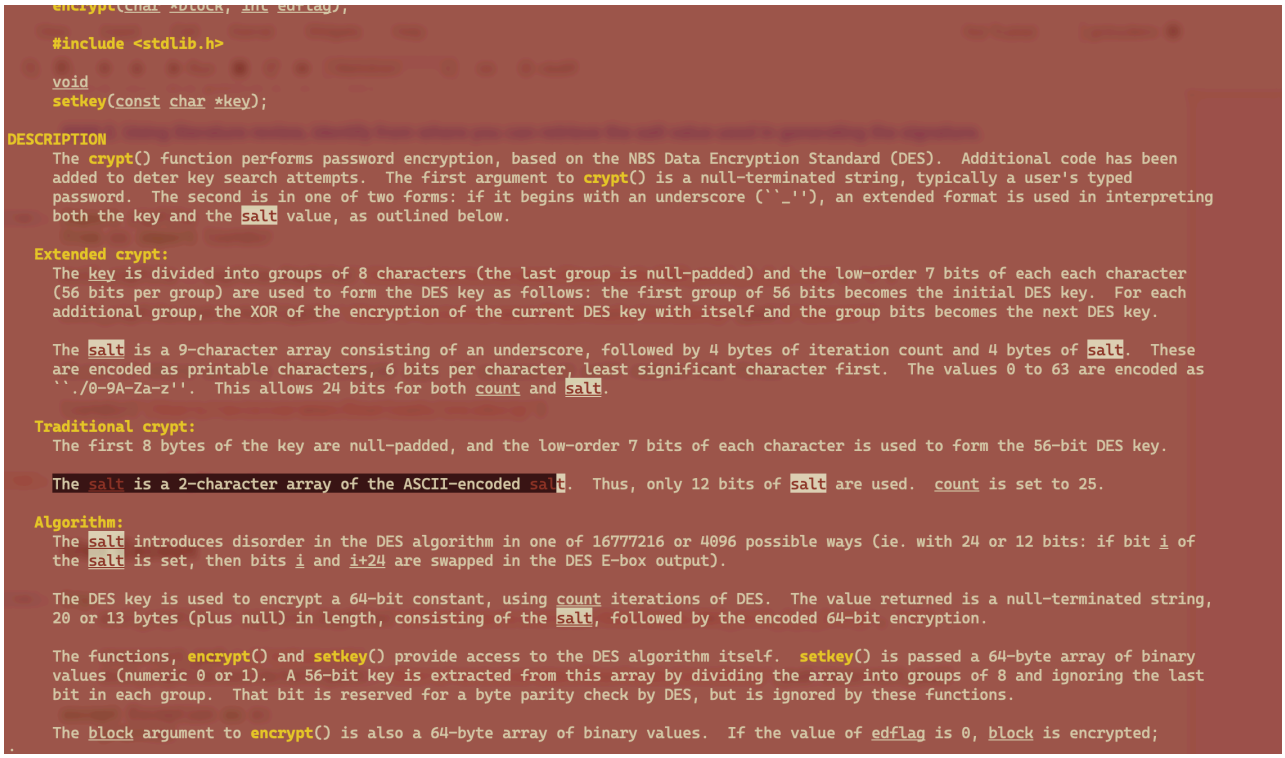
Report out the password found, if any, for each user. If no password is found, indicate that no password was found.

In [1]:

```
import crypt
passwd_file = open('/Users/ravisivaraman/Downloads/HW3passwords.txt', 'r')
passwd_lines = passwd_file.readlines()

for passwd_line in passwd_lines:
    user_props = passwd_line.split(":")
    user_id = user_props[0]
    user_passwd_hash = user_props[1]
    user_salt = user_passwd_hash[1:3]
    user_passwd_hash = user_passwd_hash.strip()
    #Iterate dictionary and find a match
    dict_file = open('/Users/ravisivaraman/Downloads/HW3dictionary.txt', 'r')
    dict_words = dict_file.readlines()
    found = False
    for dict_word in dict_words:
        dict_word = dict_word.strip()
        hash_dict_word = crypt.crypt(dict_word,user_salt)
        if hash_dict_word == user_passwd_hash:
            print("Cracked password for:", user_id, "; password is:", dict_wo
            found=True
    if found == False:
        print("Cound not find password for ", user_id)
```

```
Cracked password for: victim ; password is: egg
Cound not find password for  root
```

2. Using literature review, identify from where you can retrieve the salt value used in generating the signature.



```
#include <stdlib.h>

void
setkey(const char *key);

DESCRIPTION
     The crypt() function performs password encryption, based on the NBS Data Encryption Standard (DES).  Additional code has been
     added to deter key search attempts.  The first argument to crypt() is a null-terminated string, typically a user's typed
     password.  The second is in one of two forms: if it begins with an underscore (``_'') an extended format is used in interpreting
     both the key and the salt value, as outlined below.

   Extended crypt:
     The key is divided into groups of 8 characters (the last group is null-padded) and the low-order 7 bits of each each character
     (56 bits per group) are used to form the DES key as follows: the first group of 56 bits becomes the initial DES key.  For each
     additional group, the XOR of the encryption of the current DES key with itself and the group bits becomes the next DES key.

     The salt is a 9-character array consisting of an underscore, followed by 4 bytes of iteration count and 4 bytes of salt.  These
     are encoded as printable characters, 6 bits per character, least significant character first.  The values 0 to 63 are encoded as
     ``./0-9A-Za-z''.  This allows 24 bits for both count and salt.

   Traditional crypt:
     The first 8 bytes of the key are null-padded, and the low-order 7 bits of each character is used to form the 56-bit DES key.

     The salt is a 2-character array of the ASCII-encoded salt.  Thus, only 12 bits of salt are used.  count is set to 25.

   Algorithm:
     The salt introduces disorder in the DES algorithm in one of 16777216 or 4096 possible ways (ie. with 24 or 12 bits: if bit i of
     the salt is set, then bits i and i+24 are swapped in the DES E-box output).

     The DES key is used to encrypt a 64-bit constant, using count iterations of DES.  The value returned is a null-terminated string,
     20 or 13 bytes (plus null) in length, consisting of the salt, followed by the encoded 64-bit encryption.

     The functions, encrypt() and setkey() provide access to the DES algorithm itself.  setkey() is passed a 64-byte array of binary
     values (numeric 0 or 1).  A 56-bit key is extracted from this array by dividing the array into groups of 8 and ignoring the last
     bit in each group.  That bit is reserved for a byte parity check by DES, but is ignored by these functions.

     The block argument to encrypt() is also a 64-byte array of binary values.  If the value of edflag is 0, block is encrypted;
```

Exercise 2 : Zip File Password Cracker

The goal of this exercise is to write a zip file extractor and password cracker. For this exercise, we will use the zipfile library. You may view information about the zipfile library in Python 2.79 by issuing the command help('zipfile') to learn more about the library. Pay close attention to the extractall( ) method. You may use this method to extract the contents from a zip file.

1. Write a quick script to test the use of the zipfile library. After importing the library, instantiate a new ZipFile class by specifying the filename of the password-protected zip file (evil.zip). utilize the extractall( ) method and specify the optional parameter for the password (secret). Execute your script and turn in the code and output.

In [2]:

```
import zipfile
from os import listdir

evil_zipfile = zipfile.ZipFile('/Users/ravisivaraman/Downloads/HW3_evil_2_2_2

evil_zipfile.extractall(path='/Users/ravisivaraman/Downloads/insidezip',pwd=b


#List if there are any files inside zip. If success it will return the files

listdir('/Users/ravisivaraman/Downloads/insidezip')
```

Out[2]: ['evil', '.DS_Store']

In [ ]:

2. Use the except Exception exception handler to catch exceptions and print them out when an incorrect password is used. Execute your script with an incorrect password and exception handler and turn in the code and output.

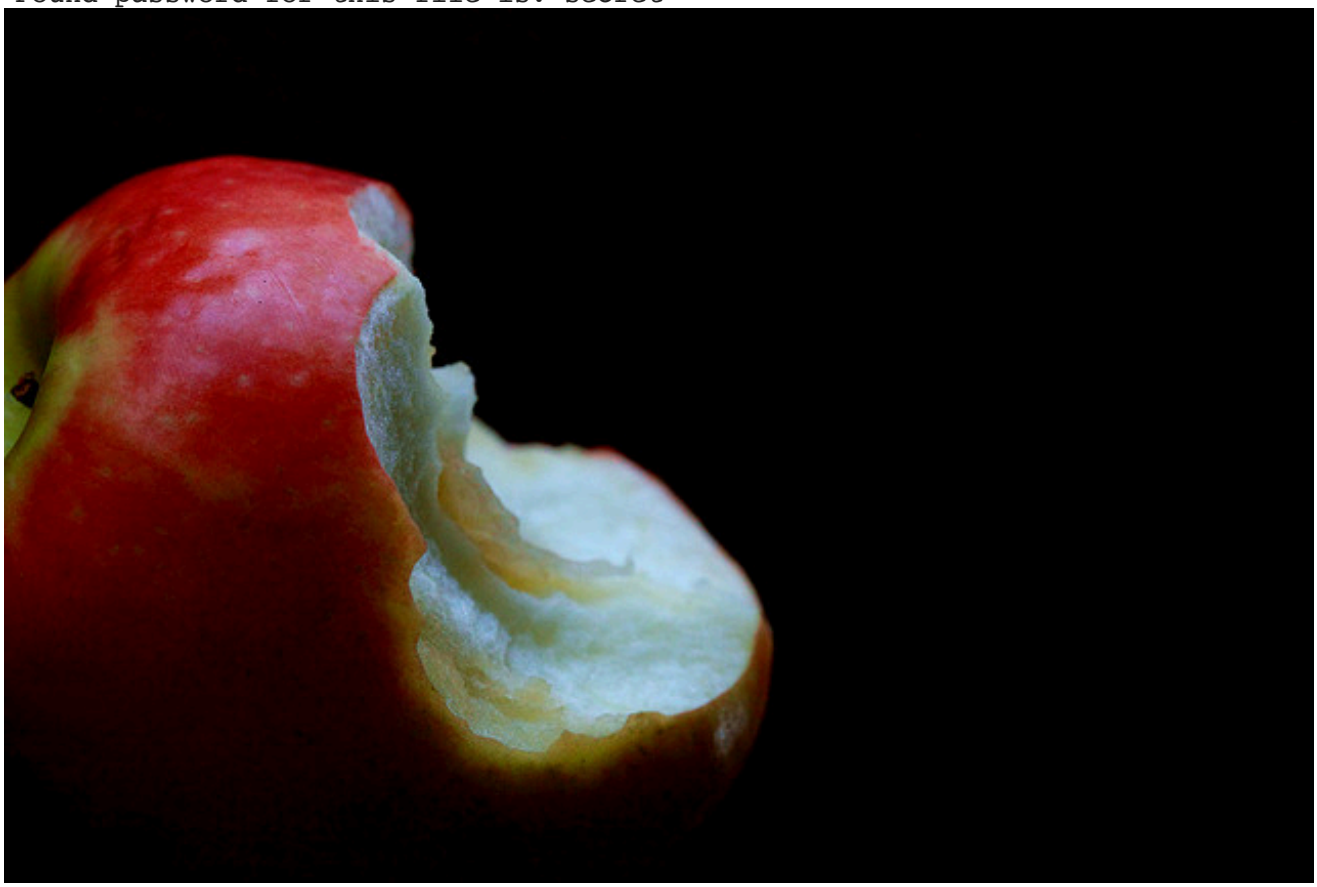
In [3]:
```
try:
    evil_zipfile = zipfile.ZipFile('/Users/ravisivaraman/Downloads/HW3_evil_2

    incorrect_pwd = b'notsecret'
    evil_zipfile.extractall(path='/Users/ravisivaraman/Downloads/insidezip',p

except Exception as e:
    print(e)
```

```
Bad password for file <ZipInfo filename='evil/note_to_adam.txt' compress_type=
deflate filemode='-rw-r--r--' file_size=171 compress_size=156>
```

3. Write a script that performs a dictionary attack on the password protected zip file. Execute your script and turn in the code and output. Be sure to provide user feedback on exceptions thrown.

In [6]:
```
from IPython.display import display, Image

## Dictionary Attack on Zip File

evil_zipfile = zipfile.ZipFile('/Users/ravisivaraman/Downloads/HW3_evil_2_2_2

#Read dictionary and check if any password matches
dict_file = open('/Users/ravisivaraman/Downloads/HW3dictionary.txt', 'r')
dict_words = dict_file.readlines()

for dict_word in dict_words:
    try:
        dict_word = dict_word.rstrip()
        evil_zipfile.extractall(path='/Users/ravisivaraman/Downloads/insidezi
        print("Found password for this file is:", dict_word)
        #display the image
        display(Image(filename='/Users/ravisivaraman/Downloads/insidezip/evil

    except Exception as e:
        #This is not the password
        continue
```

```
Found password for this file is: secret
```



Exercise 3 : Port Scanner

The goal of this exercise is to learn about port scanners for networked systems. First, create a simple Python-based port scanner.

Using the socket library, you will create a script that iterates through a range of IP addresses, and, for each IP address, will identify the active ports available for that IP address. At least ports corresponding to telnet, ftp SSH, smtp, http, imap, and https services should be scanned and identified.

In [ ]:

```
import socket
import ipaddress
sock = socket.socket(socket.AF_INET,socket.SOCK_STREAM )

myip_range = "127.0.0.0/24"

for ip in ipaddress.IPv4Network(myip_range):
    for port in range(1,9999):
        try:
            #addr = (ip, port)
            ipaddr = format(ipaddress.IPv4Address(ip))
            addr = (ipaddr, port)
            conn = socket.create_connection(addr, timeout=1)
            print("Open port-->", ip, port)
        except:
            continue
```

```
Open port--> 127.0.0.1 88
Open port--> 127.0.0.1 445
Open port--> 127.0.0.1 3306
Open port--> 127.0.0.1 5055
Open port--> 127.0.0.1 7778
Open port--> 127.0.0.1 8888
```

Second, download and install the nmap port scanning software from nmap.org. Utilize nmap to identify the operating system and the open ports of devices on a range of IP addresses.

```
(base) ravisivaraman@aaradhanas-mbp ~ % nmap -p0-9999 -v -A -T4  127.0.0.0/30
Starting Nmap 7.92 ( https://nmap.org ) at 2021-11-18 15:43 PST
NSE: Loaded 155 scripts for scanning.
NSE: Script Pre-scanning.
Initiating NSE at 15:43
Completed NSE at 15:43, 0.00s elapsed
Initiating NSE at 15:43
Completed NSE at 15:43, 0.00s elapsed
Initiating NSE at 15:43
Completed NSE at 15:43, 0.00s elapsed
Initiating Ping Scan at 15:43
Scanning 4 hosts [2 ports/host]
Completed Ping Scan at 15:43, 1.30s elapsed (4 total hosts)
Nmap scan report for 127.0.0.0 [host down]
Nmap scan report for 127.0.0.2 [host down]
Nmap scan report for 127.0.0.3 [host down]
Initiating Connect Scan at 15:43
Scanning localhost (127.0.0.1) [10000 ports]
Discovered open port 445/tcp on 127.0.0.1
Discovered open port 3306/tcp on 127.0.0.1
Discovered open port 8888/tcp on 127.0.0.1
Discovered open port 7778/tcp on 127.0.0.1
Discovered open port 5055/tcp on 127.0.0.1
Strange read error from 127.0.0.1 (49 - 'Can't assign requested address')
Completed Connect Scan at 15:43, 0.36s elapsed (10000 total ports)
Initiating Service scan at 15:43
Scanning 5 services on localhost (127.0.0.1)
Stats: 0:00:28 elapsed; 3 hosts completed (1 up), 1 undergoing Service Scan
Service scan Timing: About 60.00% done; ETC: 15:44 (0:00:17 remaining)
Completed Service scan at 15:44, 73.54s elapsed (5 services on 1 host)
NSE: Script scanning 127.0.0.1.
```

The python script above and the nmap scanned the same ports and ip for the range 127.0.0.1/30

In [ ]: