Cybersecurity

Collision Lab

CYBER.ORG

Collision Lab

- Take a look at examples of collision and why it can be dangerous

- Materials needed
  - Kali Linux Machine

- Software Tools used
  - md5sum (Linux command to use MD5 to hash a file)
  - sha256sum (Linux command to use SHA256 to hash a file)
  - sha512sum (Linux command to use SHA512 to hash a file)

Objectives Covered

- Security+ Objectives (SY0-601)
  - Objective 1.2 - Given a scenario, analyze potential indicators to determine the type of attack.
    - Cryptographic Attacks
      - Birthday
      - Collision

What is Collision?

- Collision is when the hashes of two different hashed files match
  - Two different files
  - Same hash

ship.jpg

plane.jpg

```
┌──(kali@10.15.4.52)-[~/CourseFiles/Cybersecurity/collision-lab]
└─$ sha256sum plane.jpg ship.jpg
91e34644af1e6c36166e1a69d915d8ed5dbb43ffd62435e70059bc76a742daa6  plane.jpg
caf110e4aebe1fe7acef6da946a2bac9d51edcd47a987e311599c7c1c92e3abd  ship.jpg

┌──(kali@10.15.4.52)-[~/CourseFiles/Cybersecurity/collision-lab]
└─$ md5sum plane.jpg ship.jpg
253dd04e87492e4fc3471de5e776bc3d  plane.jpg
253dd04e87492e4fc3471de5e776bc3d  ship.jpg

┌──(kali@10.15.4.52)-[~/CourseFiles/Cybersecurity/collision-lab]
└─$ sha512sum plane.jpg ship.jpg
6451d0a8082905f5910a981e89185446c3f03912bf0f62c216e082f0f37d51f2ec6735553590a5
50520483655165b022863d7e61b54a45534f37448493908e12  plane.jpg
434425fd7ad9ef91ab9805e1a87dc35ecfc4db00b085c4cf2d5984e1c10bda5d0c3b85499b9f36
2dcd66d389ad374ca16bfc902c45fb777a80f09b3b7a773e55  ship.jpg

┌──(kali@10.15.4.52)-[~/CourseFiles/Cybersecurity/collision-lab]
└─$
```

Collision

The Collision Lab

- Setup Environment
- Get Collision Lab Files
- Collision Example
- Why Collision should not happen
- Why is Collision Bad?
- SHA256 Partial Collision
- How to Avoid Collision?

```
┌──(kali@10.15.4.52)-[~/CourseFiles/Cybersecurity/collision-lab]
└─$ md5sum plane.jpg
253dd04e87492e4fc3471de5e776bc3d  plane.jpg

┌──(kali@10.15.4.52)-[~/CourseFiles/Cybersecurity/collision-lab]
└─$ md5sum ship.jpg
253dd04e87492e4fc3471de5e776bc3d  ship.jpg
```

Setup Environment

- Log into your range
- Open the Kali Linux Environment
  - You should be on your Kali Linux Desktop

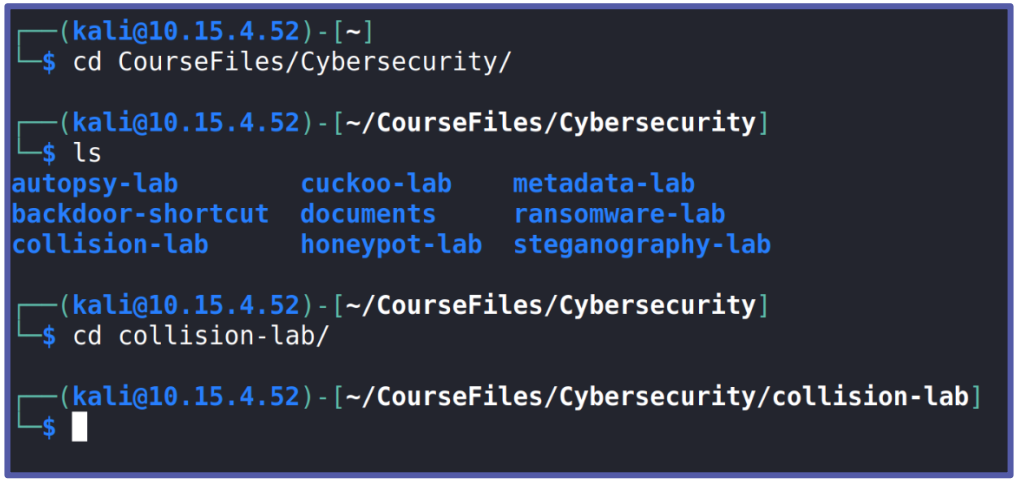
Get Collision Lab Files

- Open the terminal and navigate to the Collision Lab

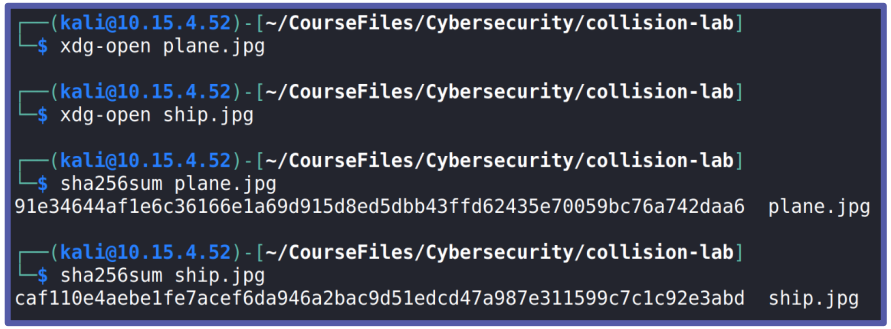
  `cd CourseFiles/Cybersecurity/`

- Navigate into this directory

  `cd collision-lab`



Collision Example



- View the plane.jpg and ship.jpg

  `xdg-open plane.jpg`

  `xdg-open ship.jpg`

  - These Terminal commands will open the images in an image viewer
- Notice how they are two different images
- Exit out of the image viewer (back to terminal) (you may need to use **`ctrl+c`** to exit the current command)
- Run a SHA-256 checksum on the images

  `sha256sum plane.jpg`

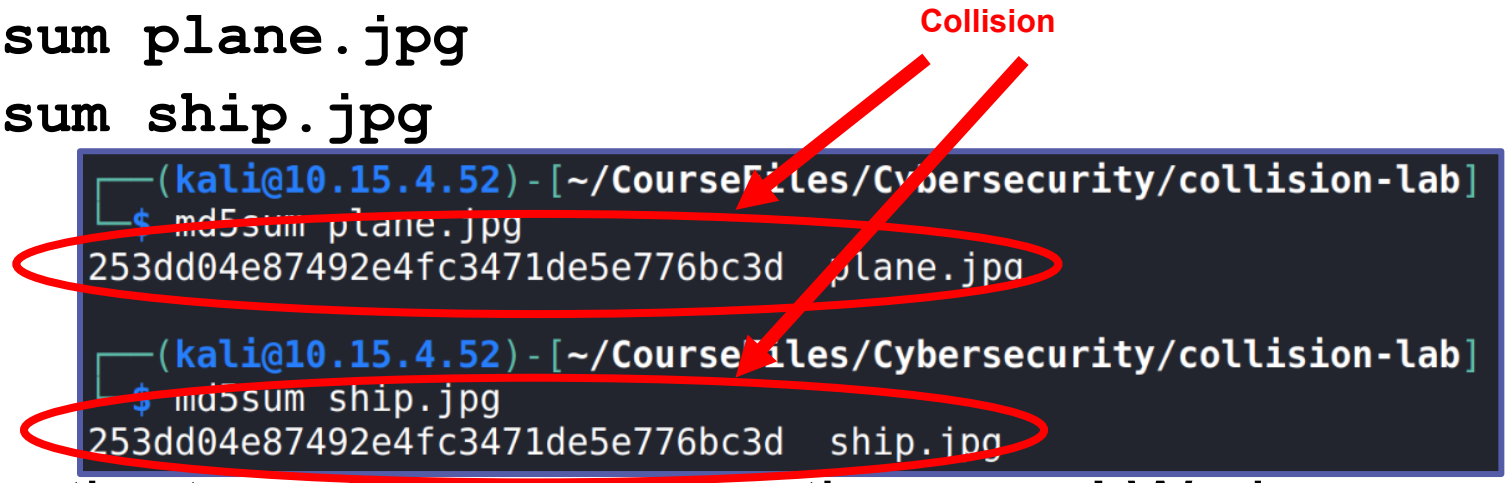
  `sha256sum ship.jpg`

  - Notice the different SHA-256 checksum for the images

Collision Example

- What happens if we run a MD5 checksum on the images?

```
md5sum plane.jpg
md5sum ship.jpg
```



- Notice the two checksums are the same! We have a collision.

Why Collision should not happen

- Open the copy of Tale of Two Cities with a text editor*

  `leafpad TaleofTwoCities.txt`

  - Notice, this is a copy of the novel A Tale of Two Cities
  - Exit out of Leafpad
- Create a copy of TaleofTwoCities.txt

  `cp TaleofTwoCities.txt TaleofTwoCitiesCopy.txt`

```
┌──(kali@10.15.4.52)-[~/CourseFiles/Cybersecurity/collision-lab]
└─$ leafpad TaleofTwoCities.txt
/usr/share/themes/Kali-Dark/gtk-2.0/gtkrc:39: Unable to find include file: "ap
ps.rc"
/usr/share/themes/Kali-Dark/gtk-2.0/gtkrc:40: Unable to find include file: "ha
cks.rc"
/usr/share/themes/Kali-Dark/gtk-2.0/gtkrc:41: Unable to find include file: "ha
cks-dark.rc"

┌──(kali@10.15.4.52)-[~/CourseFiles/Cybersecurity/collision-lab]
└─$ cp TaleofTwoCities.txt TaleofTwoCitiesCopy.txt

┌──(kali@10.15.4.52)-[~/CourseFiles/Cybersecurity/collision-lab]
└─$
```

Why Collision should not happen

- Check to make sure the MD5 checksums are the same

  `md5sum TaleofTwoCities.txt`

  `md5sum TaleofTwoCitiesCopy.txt`

- You should notice they have the same checksum
  - This is because they are the same file

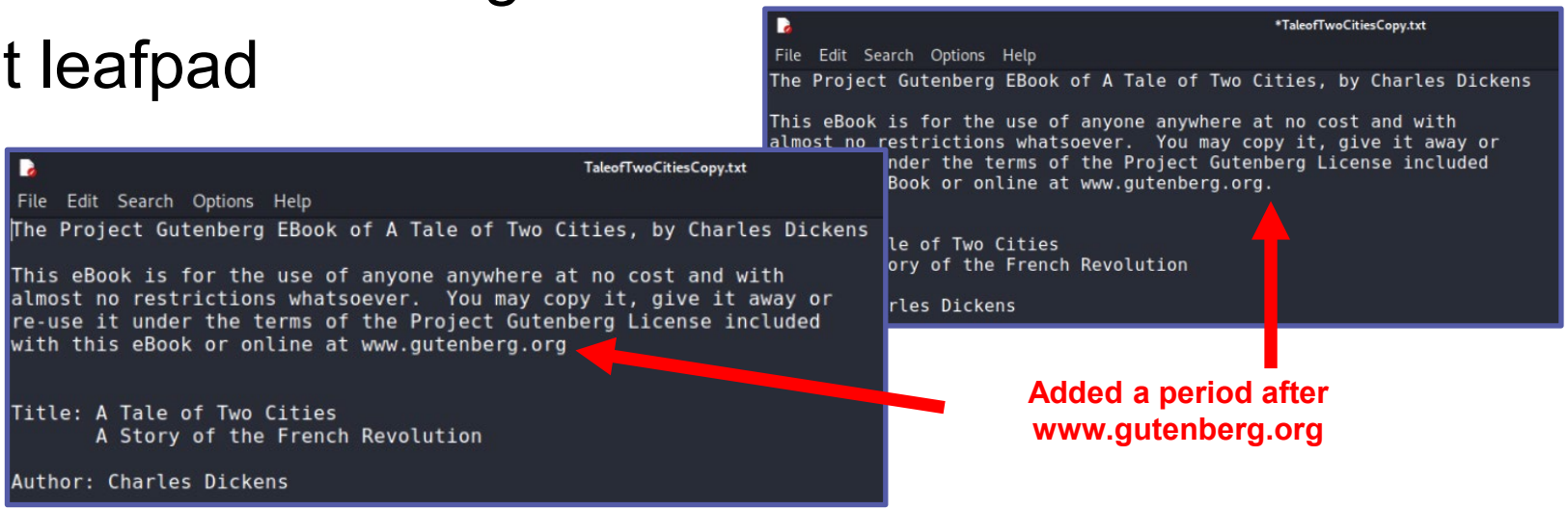
```
┌──(kali@10.15.4.52)-[~/CourseFiles/Cybersecurity/collision-lab]
└─$ md5sum TaleofTwoCities.txt
6373ee9db053f480be62803c9ff4d561  TaleofTwoCities.txt

┌──(kali@10.15.4.52)-[~/CourseFiles/Cybersecurity/collision-lab]
└─$ md5sum TaleofTwoCitiesCopy.txt
6373ee9db053f480be62803c9ff4d561  TaleofTwoCitiesCopy.txt
```

Why Collision should not happen

- Make a tiny change in the copy
- Open the copy in a text editor

  `leafpad TaleofTwoCitiesCopy.txt`
- Make a minor change and save
- Exit leafpad



Why Collision should not happen

- Check the MD5 hashes again

  `md5sum TaleofTwoCities.txt`

  `md5sum TaleofTwoCitiesCopy.txt`

- Are the hashes the same? How different are they?
  - Notice one minor change should completely change the hash

```
┌──(kali@10.15.4.52)-[~/CourseFiles/Cybersecurity/collision-lab]
└─$ md5sum TaleofTwoCities.txt
6373ee9db053f480be62803c9ff4d561  TaleofTwoCities.txt

┌──(kali@10.15.4.52)-[~/CourseFiles/Cybersecurity/collision-lab]
└─$ md5sum TaleofTwoCitiesCopy.txt
be6beb9d9c3bf495796d5302a5c3fed9  TaleofTwoCitiesCopy.txt
```

Why is Collision Bad?

- If you've run through the File Hashing Lab, you should know that checksums is a way to verify that a file has not been changed or tampered with
- What if a malicious program can have the same checksum of a program that the user wanted to download?
- Take a look at an example of a good program and a malicious program that was made by Peter Selinger*

*Read more about these programs at the following website:

https://www.mscs.dal.ca/~selinger/md5collision/

Why is Collision Bad?

- Check the MD5 hashes of the two programs

  `md5sum hello`

  `md5sum erase`

  - You should notice these two programs have the same MD5 checksums

```
┌──(kali@10.15.4.52)-[~/CourseFiles/Cybersecurity/collision-lab]
└─$ md5sum hello
da5c61e1edc0f18337e46418e48c1290  hello

┌──(kali@10.15.4.52)-[~/CourseFiles/Cybersecurity/collision-lab]
└─$ md5sum erase
da5c61e1edc0f18337e46418e48c1290  erase
```

- This is another example of a collision!

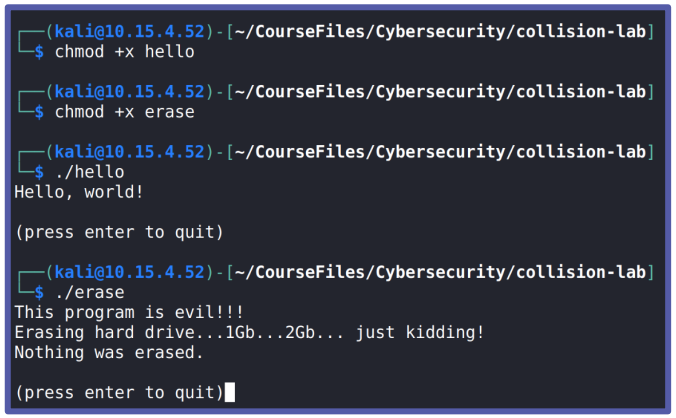
Why is Collision Bad?

- Try to run the two programs
- Make the programs executable

```
chmod +x hello
chmod +x erase
```

- Run the programs

```
./hello
./erase
```



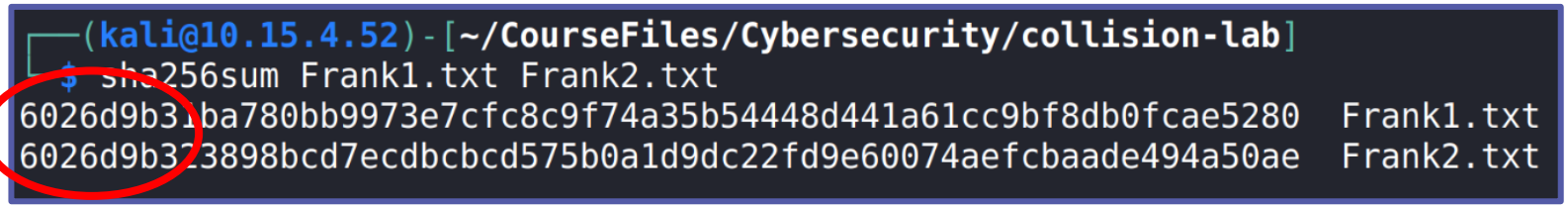
- What if a user was trying to download the hello program, verified it with the MD5 checksum, but it was actually the erase program?

SHA256 Partial Collision

- While there are still no known SHA256 collisions, there are examples of partial collisions
- Check the SHA256 checksums of the Frank text files

```
sha256sum Frank1.txt Frank2.txt
```

Partial Collision



Why are partial collisions still dangerous?

Sometimes a script will only check the first few characters in the checksum, this is to save time and not have to check all of the characters. Also, a human might only glance at the first couple of characters and not the entire checksum.

How to Avoid Collision?

- Avoid using MD5 hashes! (and other weak encryptions)
  - MD5 checksum have been proven to have collisions
- Use stronger encryption methods
  - Check using SHA-256
  - Check using SHA-512
- How else can you avoid collisions?