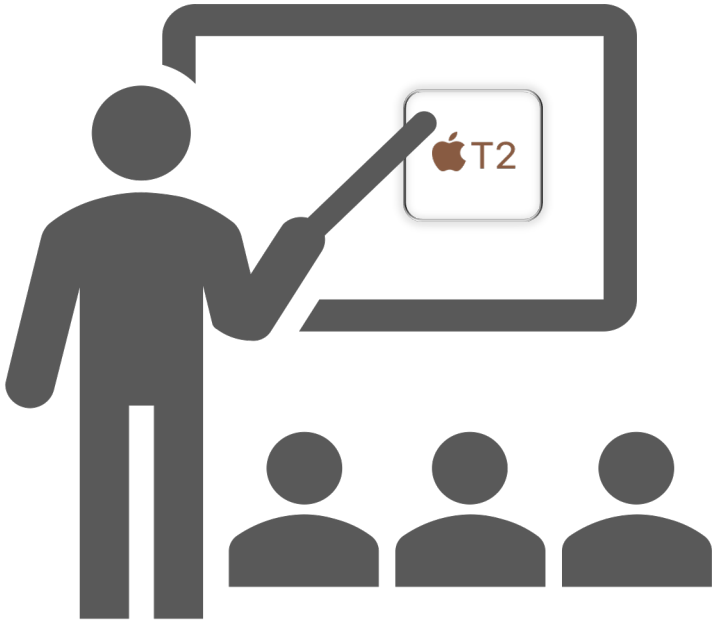
# macOS Forensics: The Next Level - Taming the T2 Chip & More

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# About us

- Yogesh Khatri
- Associate Professor
  Champlain College
- Program Director – Digital Forensics
- *15+ years doing Forensics*
- Author & Maintainer for
  *mac_apt – Artifact Parsing Tool*

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Swiftforensics.com

- Alexandra Cartwright
- Student (Junior) –
  Champlain College
- Digital Forensics Major
- Data Analytics Minor

@alex_cart27

# Agenda

- T2 chip
- Image Acquisition
- Snapshot data & Analysis
- Processing with mac_apt

## About the Apple T2 Security Chip

The Apple T2 Security Chip brings a new level of integration and security to Mac.


The Apple T2 Security Chip is Apple's second-generation, custom silicon for Mac. By redesigning and integrating several controllers found in other Mac computers—such as the System Management Controller, image signal processor, audio controller, and SSD controller—the T2 chip delivers new capabilities to your Mac.

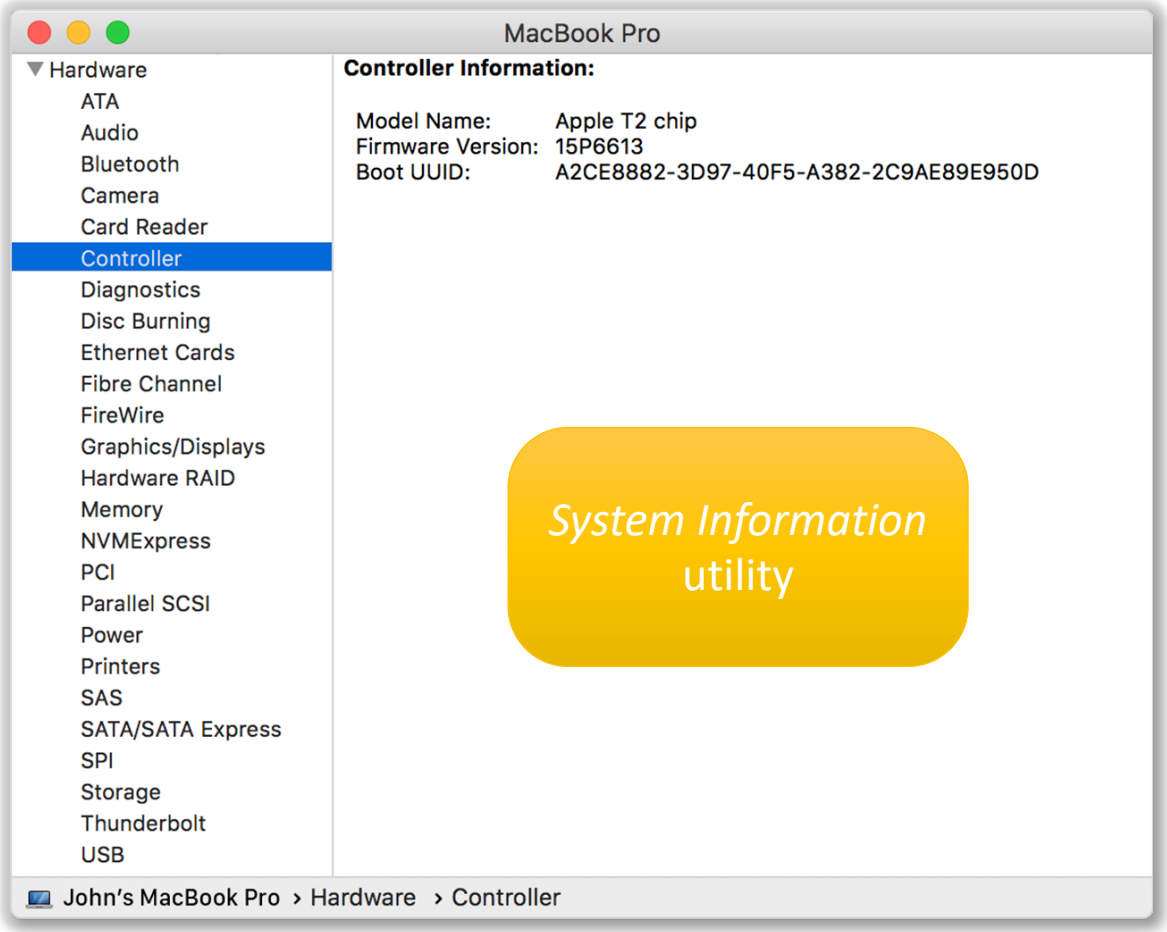
For example, the T2 chip enables a new level of security by including a secure enclave coprocessor that secures Touch ID data and provides the foundation for new encrypted storage and secure boot capabilities. And the T2 chip's image signal processor works with the FaceTime HD camera to enable enhanced tone mapping, improved exposure control, and face-detection–based autoexposure and auto white balance.

*Source: https://support.apple.com/en-us/HT208862*

# How do I know if a mac has the T2 chip?

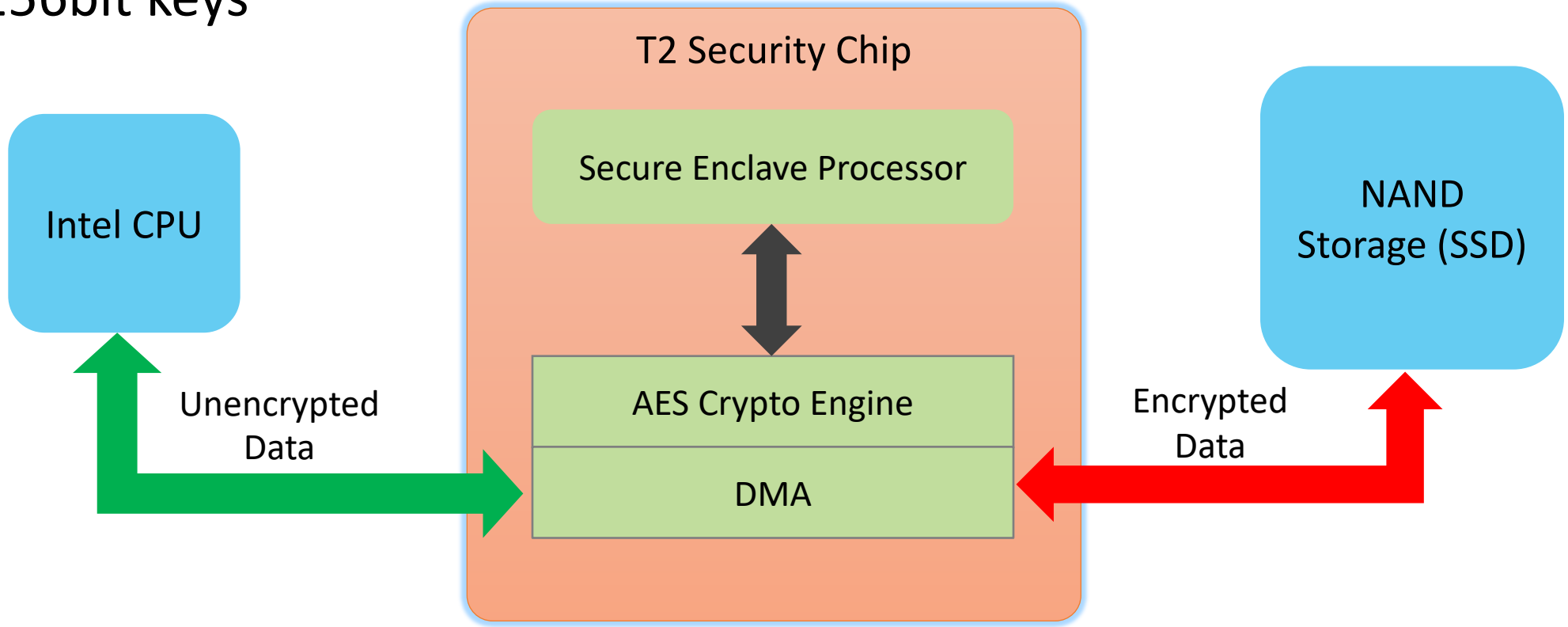
Is it one of these models?

- iMac Pro
- Mac Pro 2019 or later
- Mac mini 2018 or later
- MacBook Air 2018 or later
- MacBook Pro 2018 or later



# Encryption on T2 enabled macs

- AES-XTS
- 256bit keys



# From Apple's own documentation

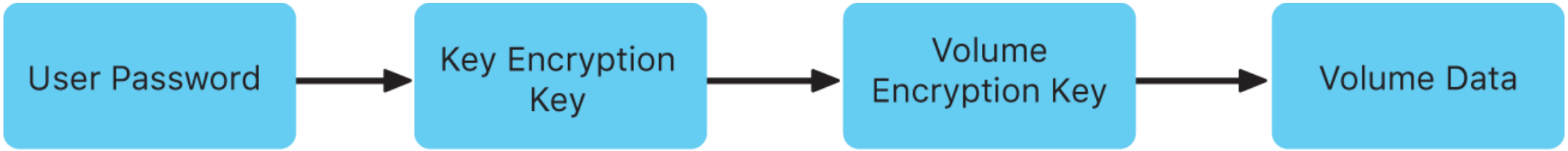
## About encrypted storage on your new Mac

Learn about encrypted storage on computers that have the Apple T2 Security Chip, and make sure that your data is fully protected.

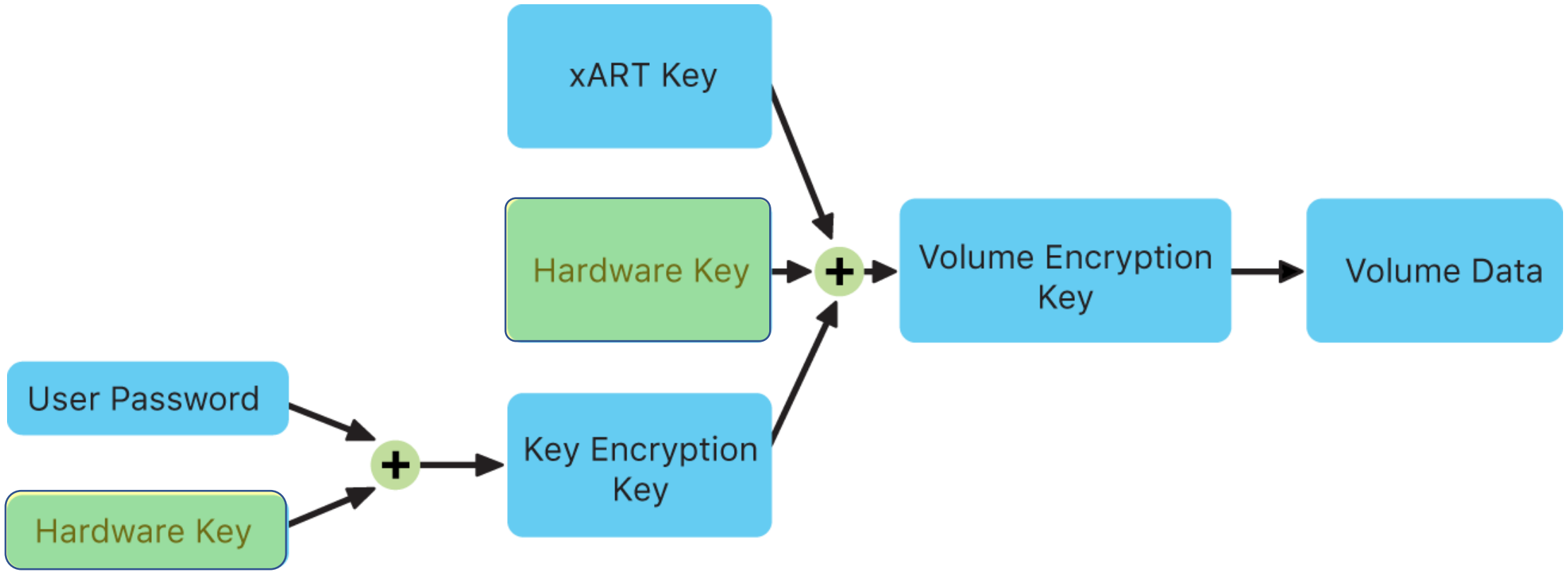
Mac computers that have the Apple T2 Security Chip integrate security into both software and hardware to provide encrypted-storage capabilities. Data on the built-in, solid-state drive (SSD) is encrypted using a hardware-accelerated AES engine built into the T2 chip. This encryption is performed with 256-bit keys tied to a unique identifier within the T2 chip.

# FileVault (APFS/HFS) without T2

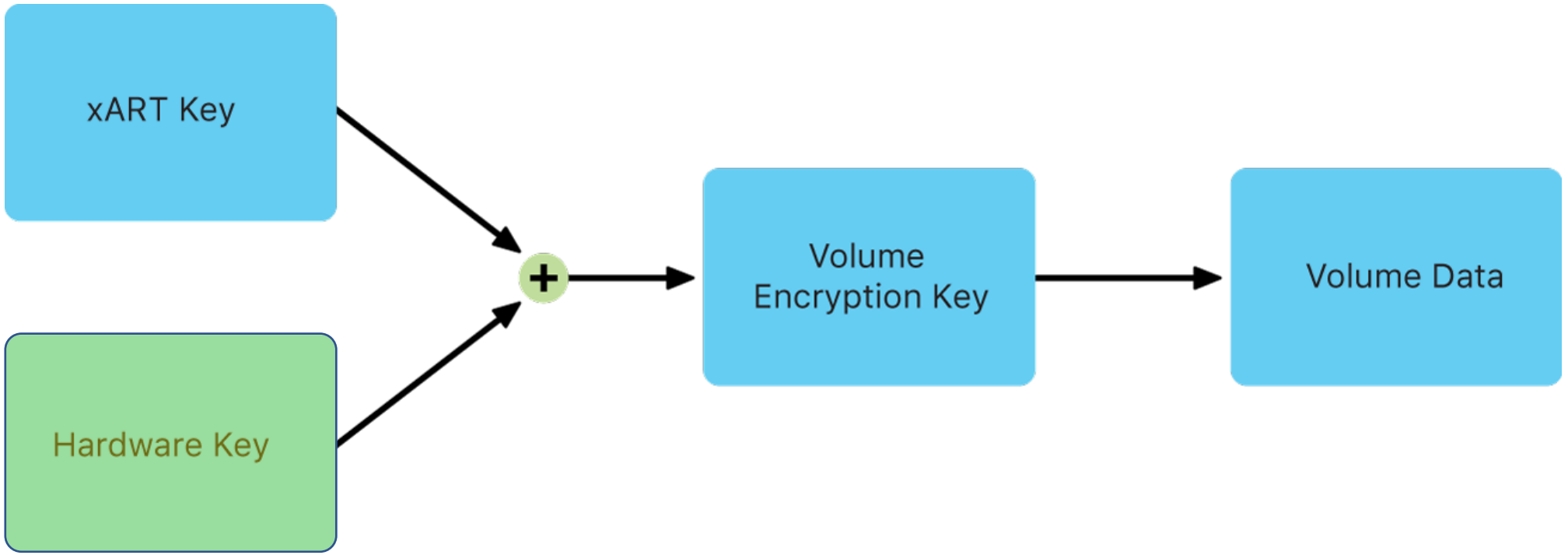
- Encryption is software based



# T2 APFS vol with FileVault ON

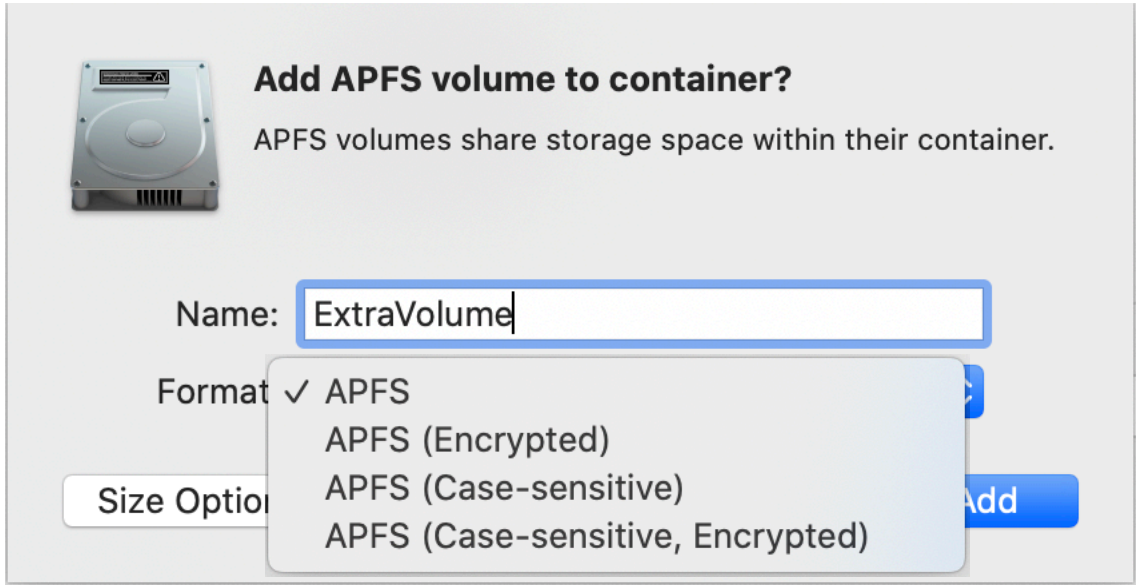


# T2 APFS vol without FileVault

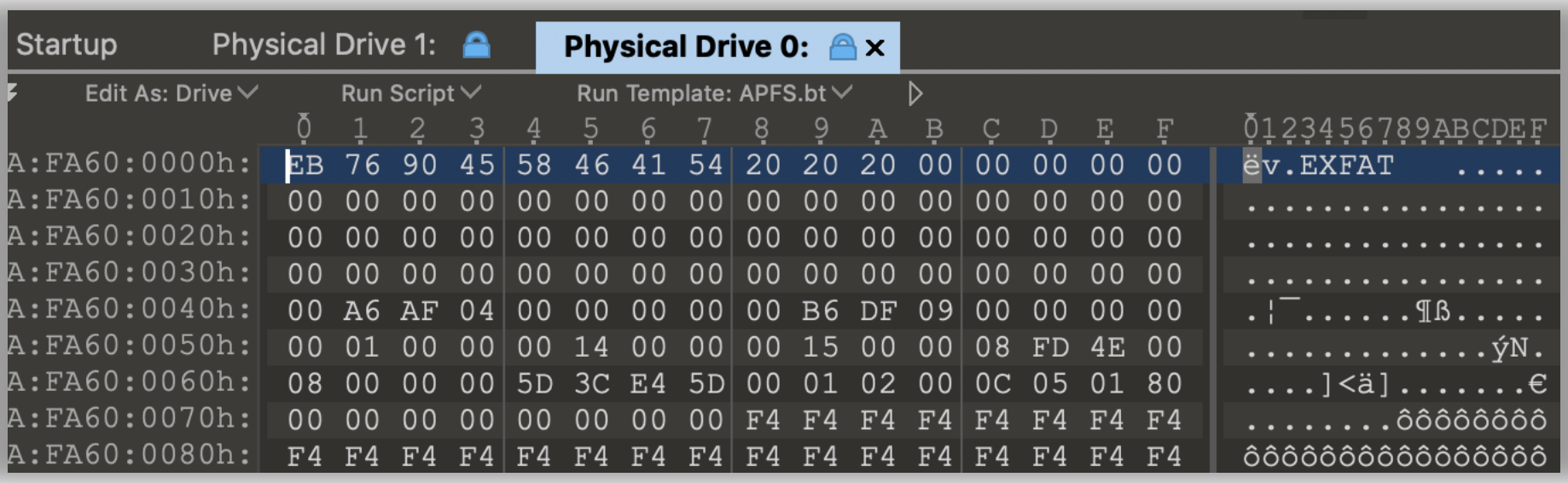


# What is really encrypted for a T2 mac?

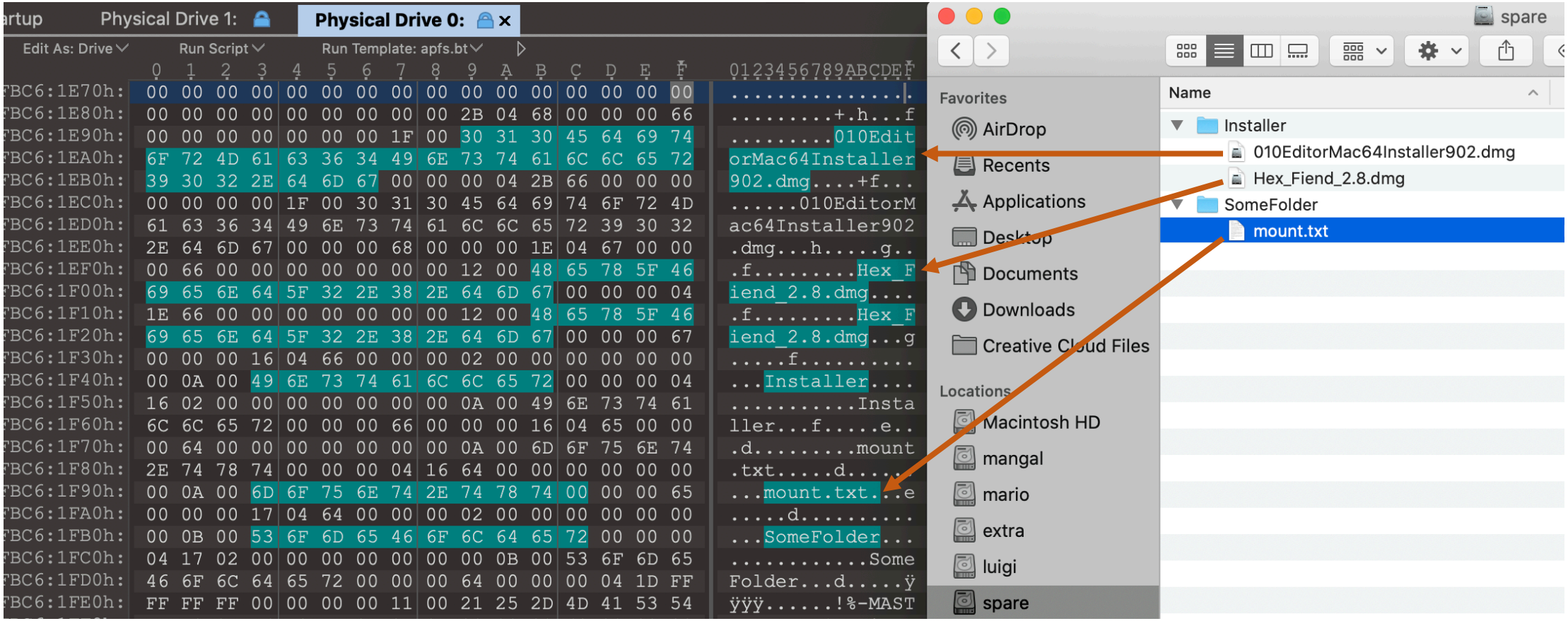
- Not everything on the SSD
- Only APFS formatted volumes are encrypted
  - Turns on encryption for all APFS volumes *(even if you choose no encryption!)*
  - This is hidden from user
- FAT, NTFS, exFAT not encrypted



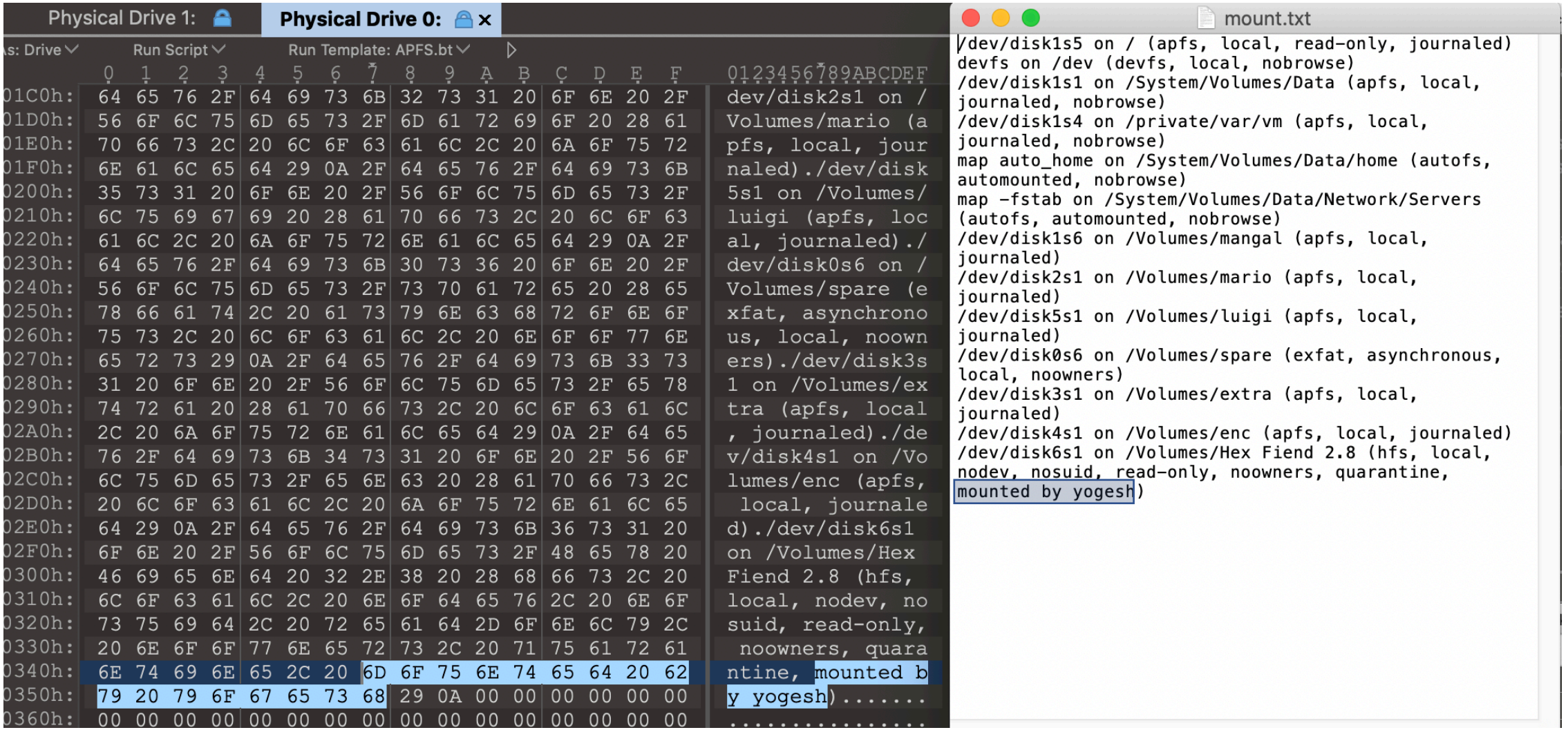
# exFAT partition on T2 mac – Raw disk view



# exFAT partition on T2 mac – Metadata



# exFAT partition on T2 mac – Data

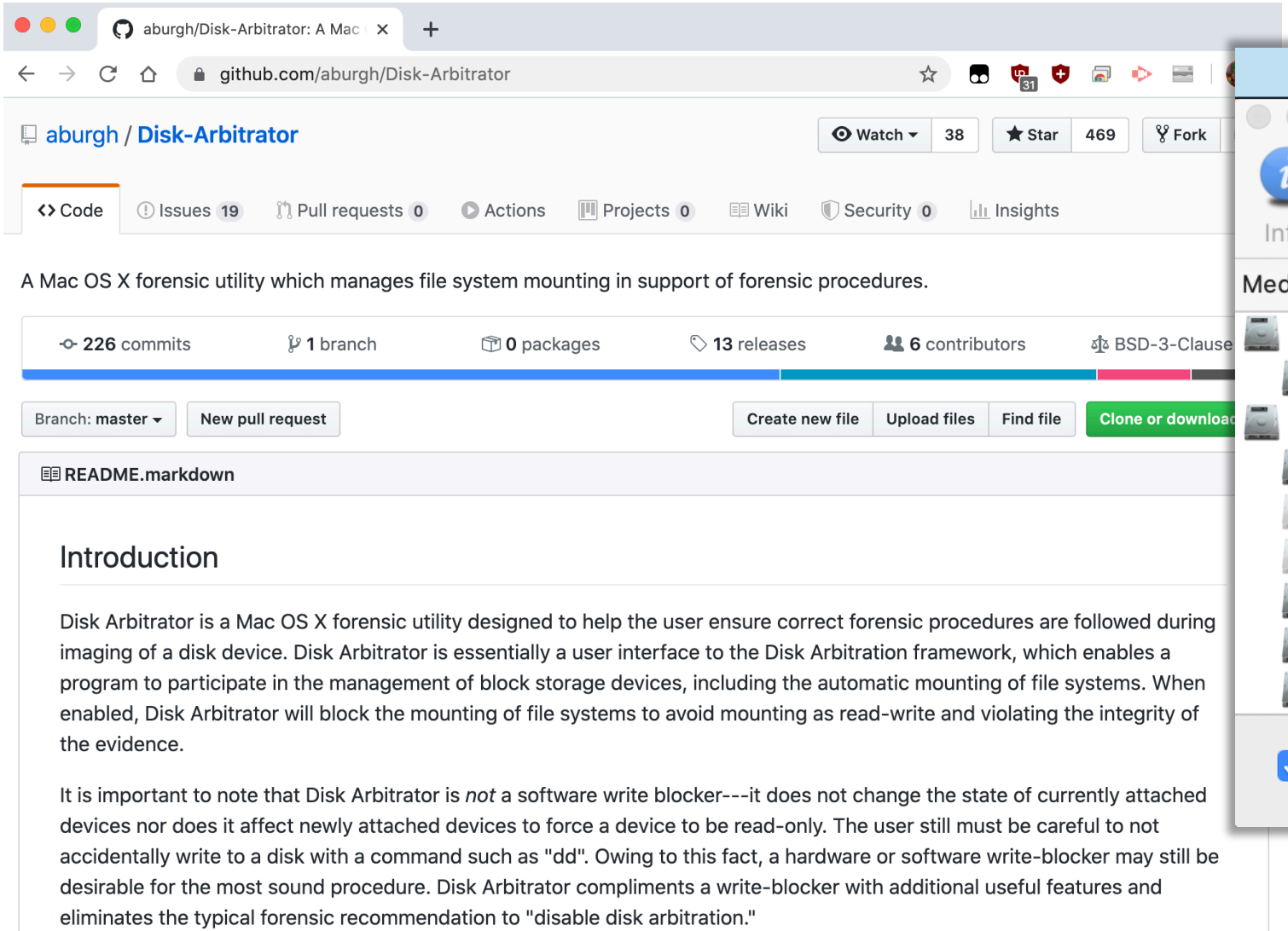


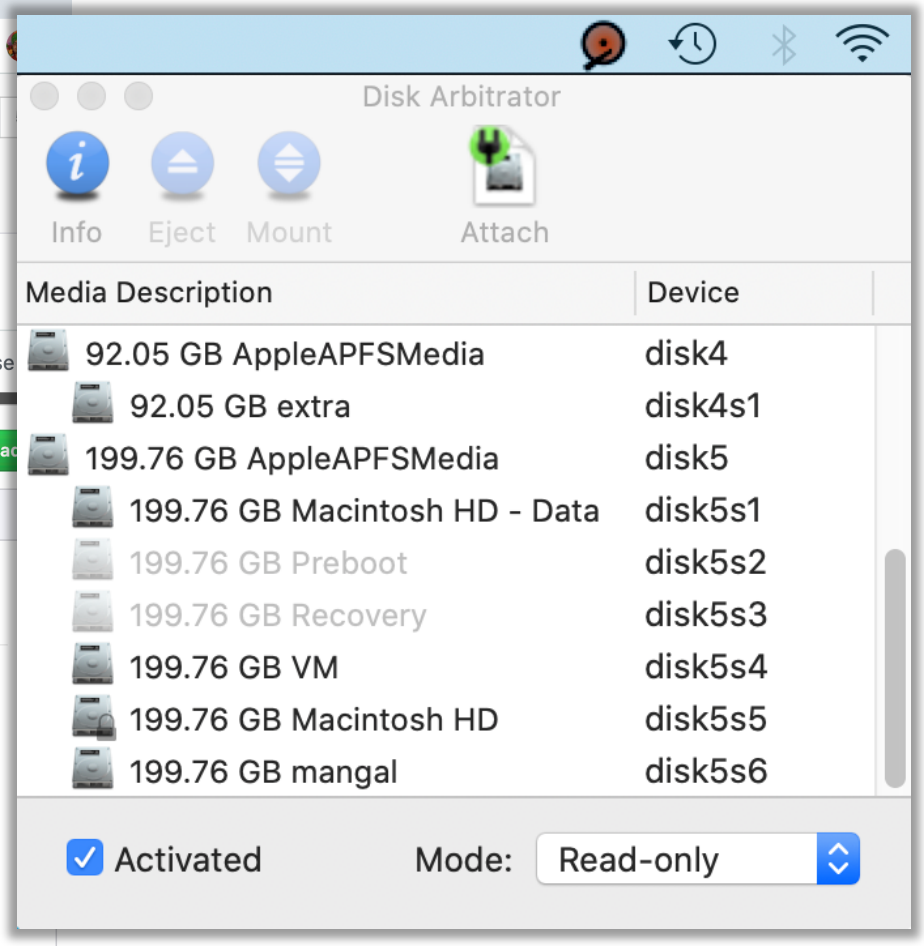
# Image a T2 mac's SSD with Target Disk Mode

- Restart the computer you want to image in Target Disk Mode by holding T during boot
- Connect examiner mac to the target mac using Thunderbolt USB-C cable
- All disks on the target should now be accessible on examiner's mac

Caveat – Use a disk arbitration program to turn off automatic mounting as RW

# Disk-Arbitrator tool



# Can we boot into Linux Forensic Boot distro?

- Pre-T2 no issues
  - CAINE, DEFT ZERO, KALI, PALADIN, ..
- With T2 and NVMe SSD
  - *Secure Boot* needs to be disabled
  - NVMe kernel driver that works with T2 macs is now available
    - But no known (forensics) distros have this implemented yet!
  - Fusion disks can't be read!
  - **Won't be able to decrypt encrypted disks!**

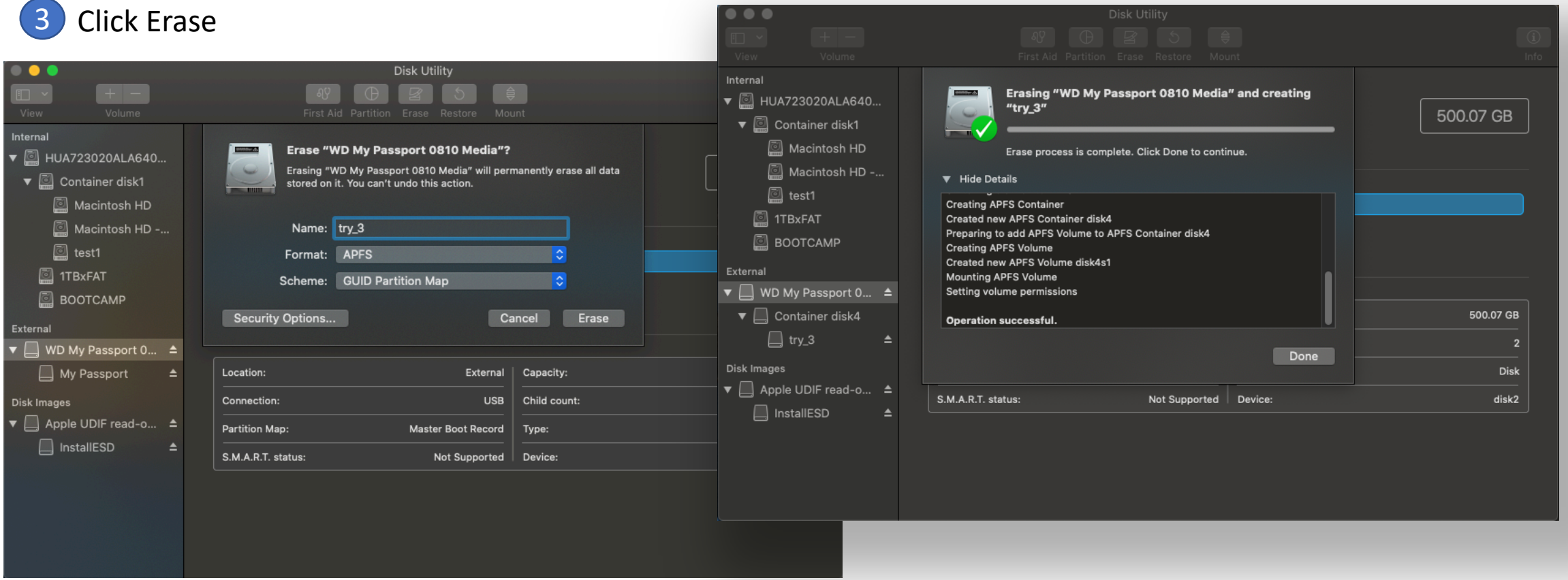
This approach won't work ☹

# Creating your own macOS forensic boot disk

- Requirements
  - macOS Installer for 10.15
  - For Catalina (10.15) - Min 32GB external disk (SSD preferred)
  - Disk Arbitration program to prevent automating RW mounting of disks

# Step 1 - Setting up your external disk

1. Start Disk Utility
2. Select Disk on left
3. Click Erase



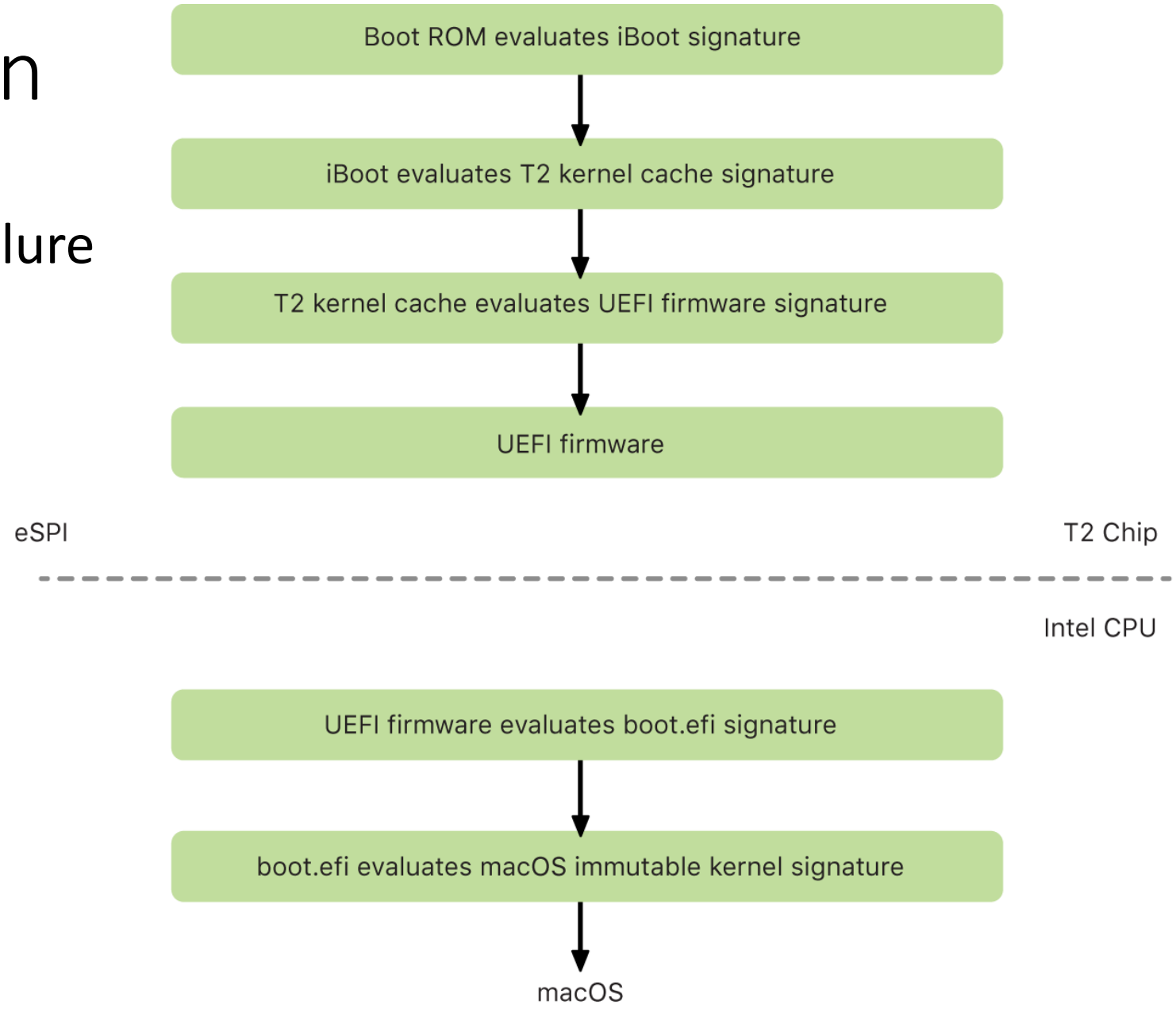

4. Set Scheme to GUID Partition Map and Format to APFS

# Step 2 - Installing macOS on external disk


# Secure Boot chain

On error or Verification failure this will boot into

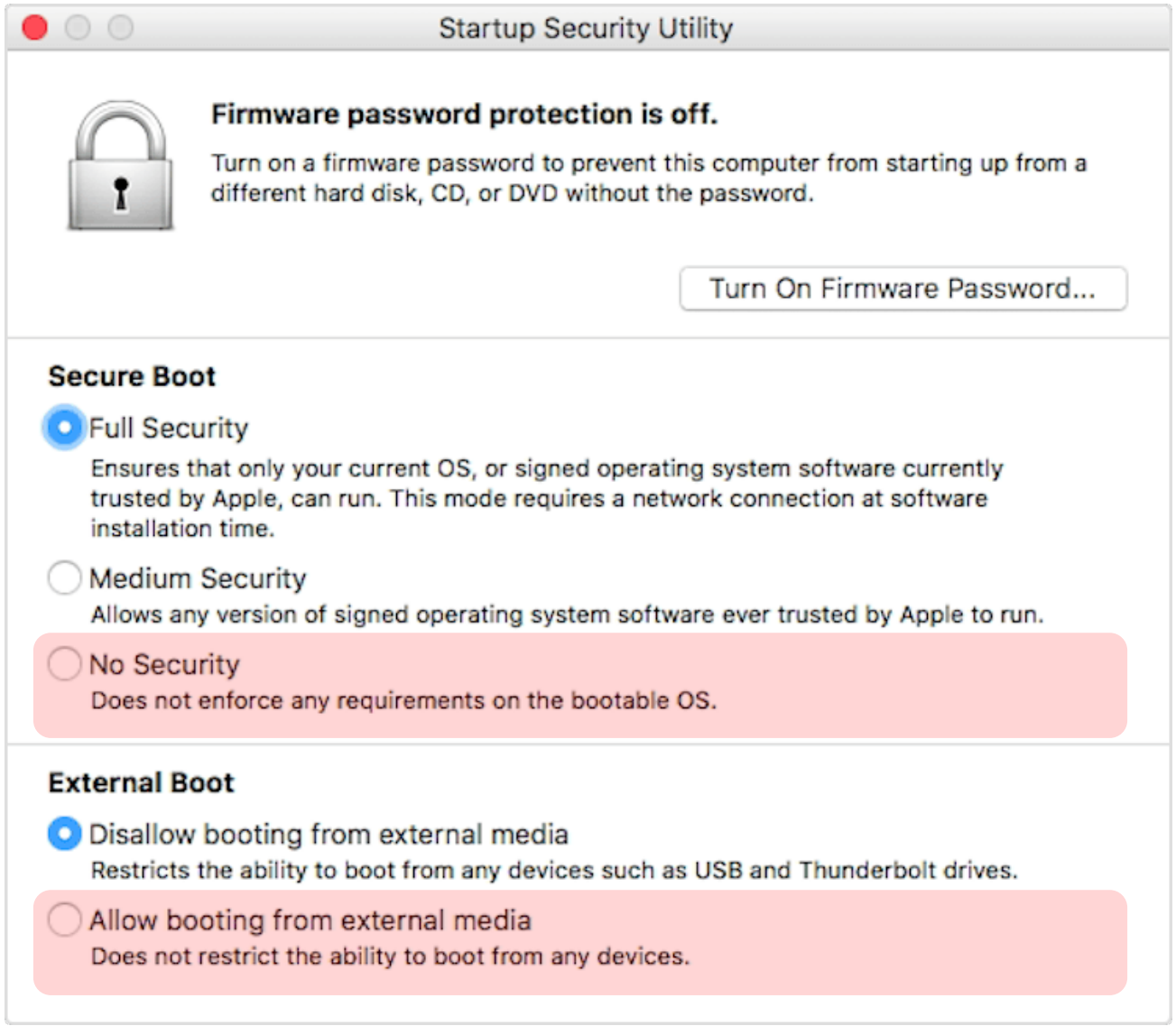
macOS Recovery Mode



# Go to Recovery Mode

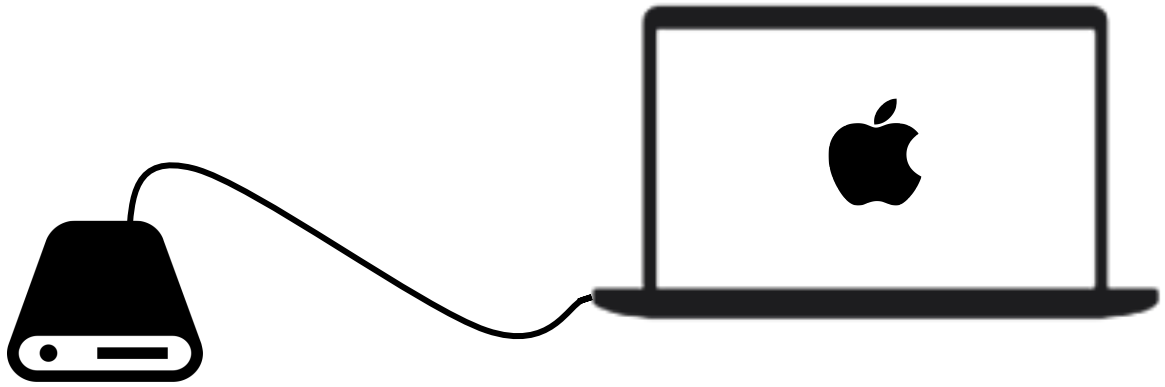
- To access this menu, boot the computer holding keys Command (⌘) and R together
- Then choose from menu

  Utilities → Startup Security Utility

# Booting into your external disk

1. Connect the disk



2. Boot the computer holding down the Option key


3. Select the external disk when asked

# Blocking disk mounts for Internal disks

- Disk-Arbitrator does not block internal disks at boot

- So.. we wrote our own *disk_block_daemon*
  - Uses Disk Arbitration Framework
  - Runs as root
  - Blocks all internal disk from mounting
    - *Explicit mounts using 'sudo mount' are still allowed*
  - https://github.com/ydkhatri/macOS_FE/NoMountDaemon

Caveat – This is *NOT* a full proof method of preventing disks from mounting at boot! There are conditions under which this may fail.

# disk_block_daemon – compile

**To compile and set as service**

clang -Wall -Werror -g -v stop_mounts.m -lobjc -framework DiskArbitration -framework Foundation -o stop_mount


**Change permissions so anyone can execute**

chmod +x stop_mount

**Rename and copy to /usr/local/bin**

cp stop_mount /usr/local/bin/disk_block_daemon

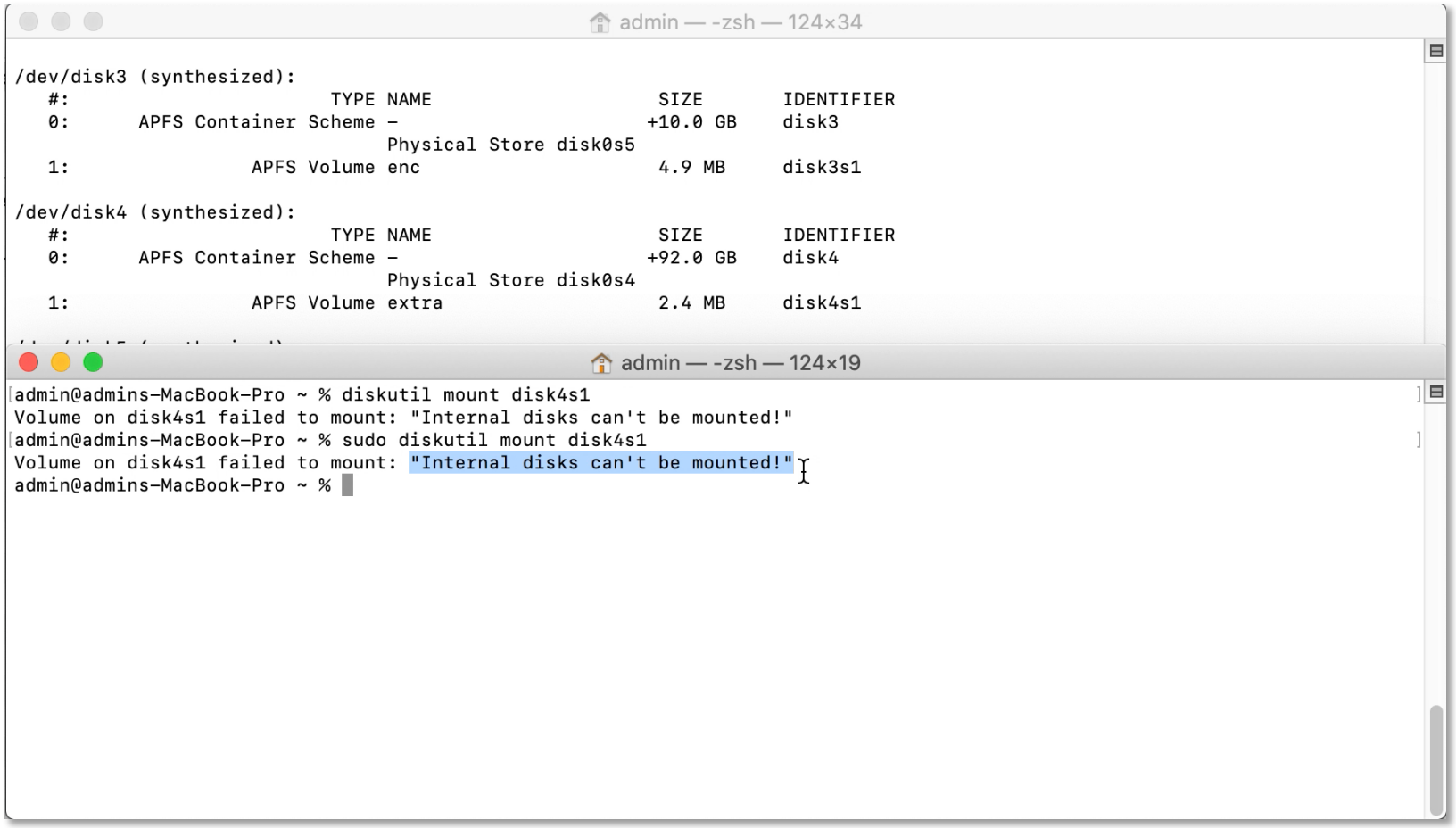
**Copy the plist to /Library/LaunchDaemons/**

cp com.swiftforensics.diskblock.plist  /Library/LaunchDaemons/

# LaunchDaemon configuration

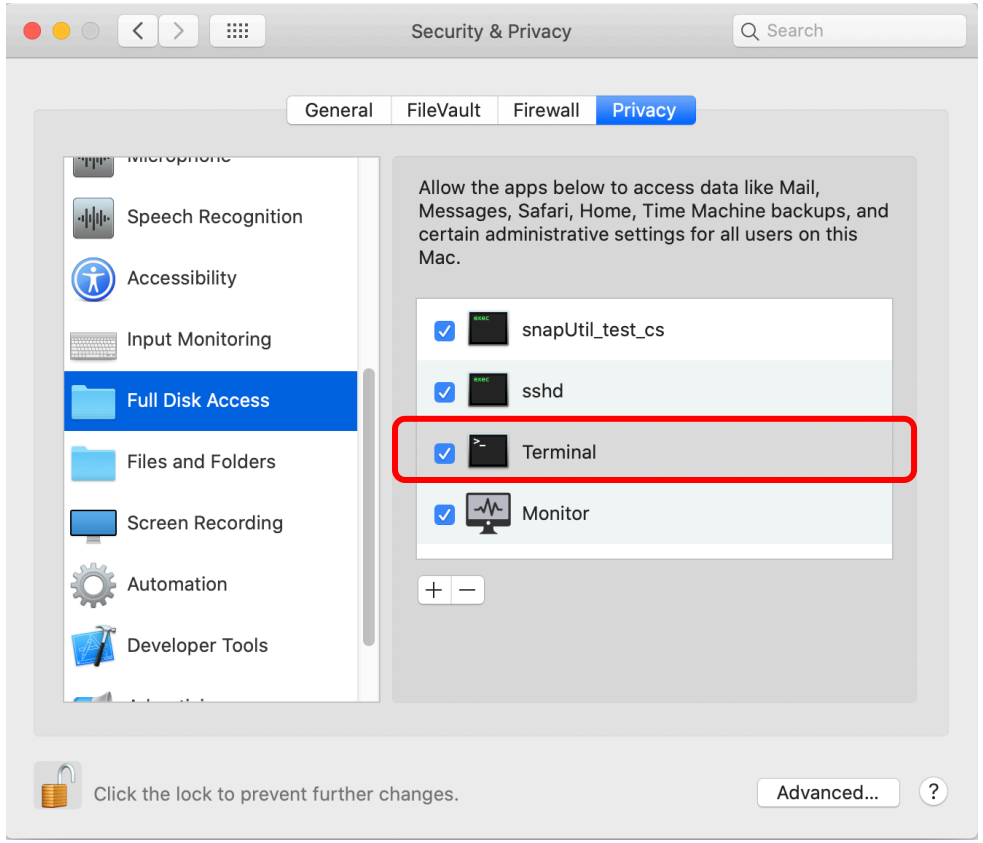
```
$ plutil -p com.swiftforensics.diskblock.plist
{
  "Label" => "com.swiftforensics.diskblock"
  "ProgramArguments" => [
    0 => "/usr/local/bin/disk_block_daemon"
  ]
  "RunAtLoad" => 1
  "StandardErrorPath" => "/tmp/diskblock.err.log"
  "StandardOutPath" => "/tmp/diskblock.out.log"
  "UserName" => "root"
}
```

# disk_block_daemon *in action*



# Allow Terminal full disk access

System Preferences → Security & Privacy




# Other tools

- https://naarakstudio.com/direqual/
- https://apps.apple.com/us/app/direqual/id1435575700?mt=12

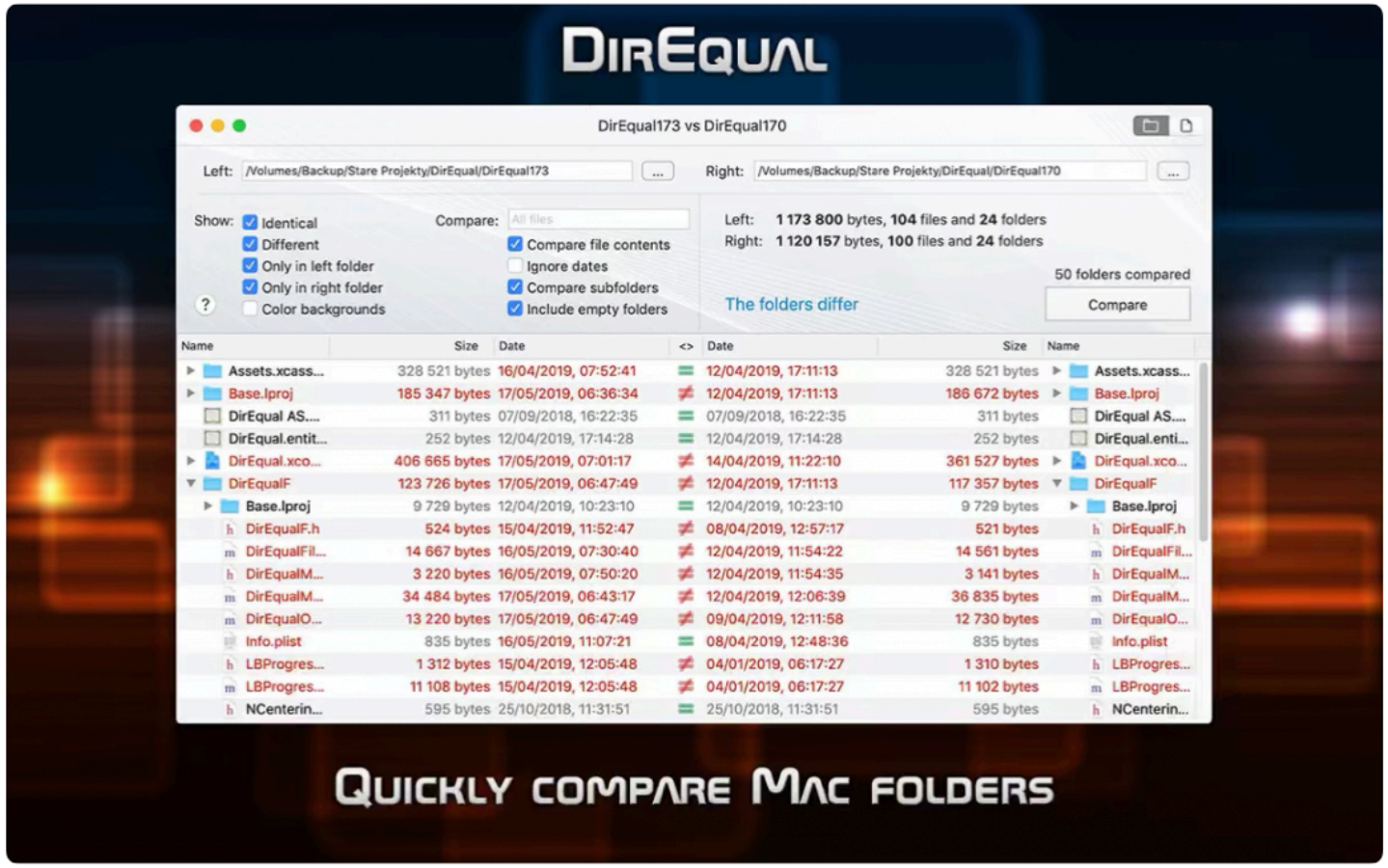
**DirEqual**

Compare Folders

Grzegorz Staszczyk

4.8 ★★★★★

13 Ratings



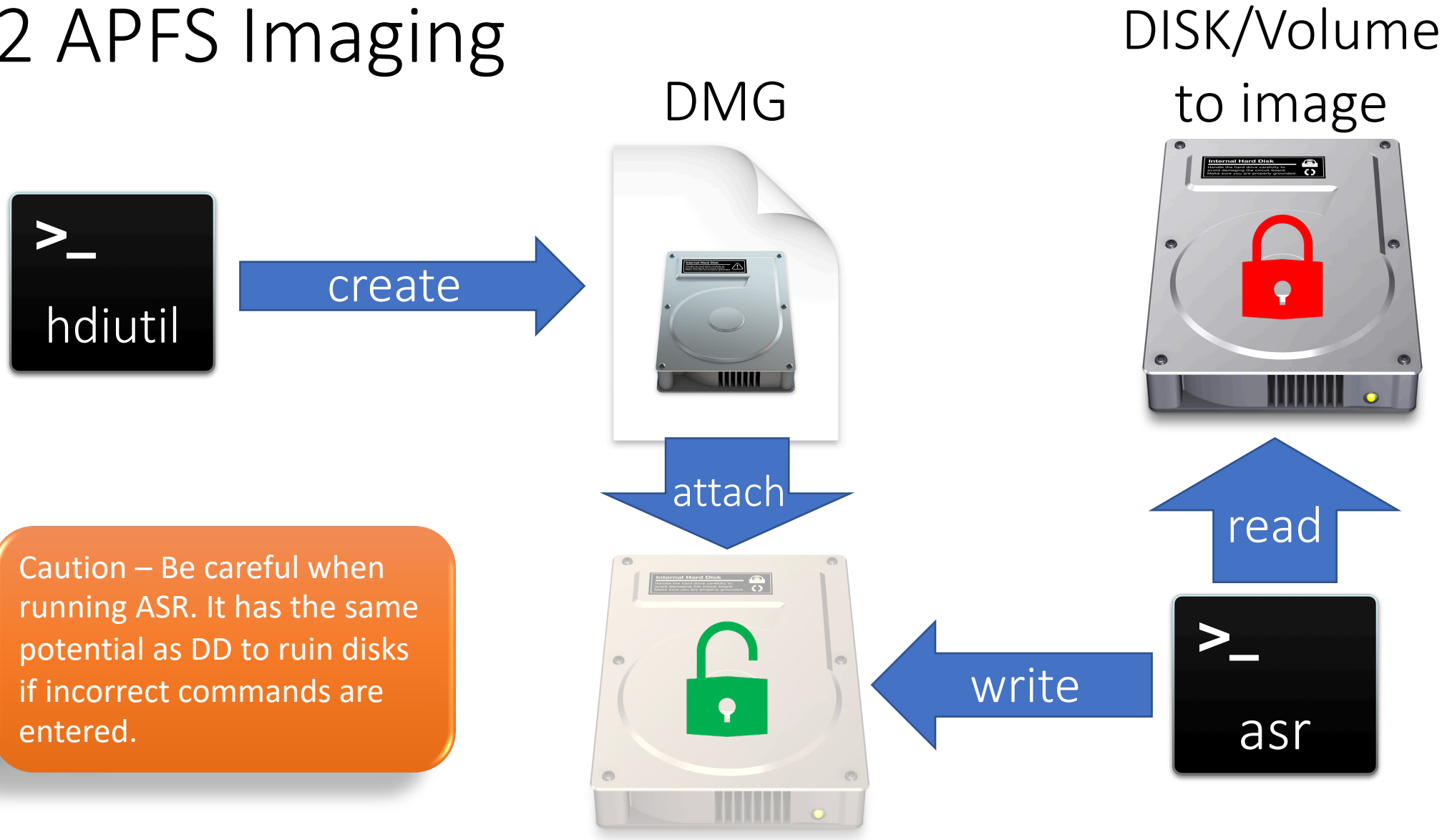
# macOS tools for imaging and analysis

- asr
- diskutil
- hdiutil
- mount & umount
- tmutil


✓ Our macOS Forensic Boot Disk is ready to use!

# Listing Disks & unlocking encrypted volumes – demo

# T2 APFS Imaging



# Final disk image (DMG)

**Included**

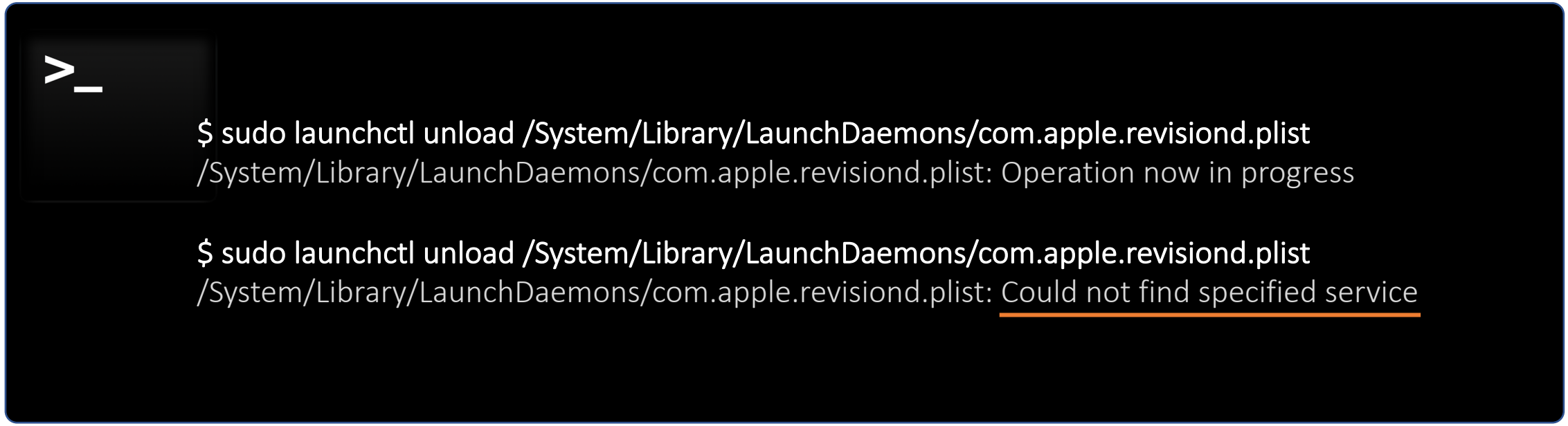
- All logical disk content
  - All XATTR
- All timestamps as original
- Same inode numbers (File Id) as source disk

**Excluded**

- Unallocated space
- Snapshots
  - However, snapshots can be imaged as entire new disk images

# Demo!

- Imaging
- Snapshot analysis




*Do this on every boot*

# Imaging a disk/volume - demo

# Imaging the container with macOS

1. Mount external disk/volume (that's where image will be written)
2. Creating DMG and attaching it..

admin — -zsh — 124×34

```
admin@admins-MacBook-Pro test_imaging % hdiutil create -fs apfs -size 120GB ssd.dmg
.....................................................................
.....................................
created: /Users/admin/Desktop/tempMount/test_imaging/ssd.dmg
admin@admins-MacBook-Pro test_imaging % sudo hdiutil attach -nomount ssd.dmg
Password:
/dev/disk8              GUID_partition_scheme
/dev/disk8s1            EFI
/dev/disk8s2            Apple_APFS
/dev/disk9              EF57347C-0000-11AA-AA11-0030654
/dev/disk9s1            41504653-0000-11AA-AA11-0030654
```

# Imaging the container with macOS

## 3. Create image with **asr**

admin — -zsh — 124×34

```
admin@admins-MacBook-Pro test_imaging % sudo asr restore --source /dev/disk5 --target
/dev/disk9 --debug --erase --verbose
Validating target...done
Validating source...
Source "/dev/disk5" contains multiple system/data volumes.
You must pass --sourcevolumename or --sourcevolumeUUID to specify which volume to restore.
Could not validate source - Invalid argument

admin@admins-MacBook-Pro test_imaging % sudo asr restore --source /dev/disk5 --target
/dev/disk9 --debug --erase --verbose --sourcevolumename="Macintosh HD"
Validating target...done
Validating source...done
Erase contents of /dev/disk9 ()? [ny]: y
Replicating ....10....20....30....40....50....60....70....80....90....100
Replicating ....10....20....30....40....50....60....70....80....90....100
Restored target device is /dev/disk9s1.
```

# Imaging the container with macOS

## 4. Add the other volumes to this container – ‘mangal’

admin — -zsh — 124×34

```
admin@admins-MacBook-Pro test_imaging % sudo asr restore --source /dev/disk5 --target
/dev/disk9 --debug --verbose --sourcevolumename="mangal"
Password:
Validating target...done
Validating source...done
Replicating ....10....20....30....40....50....60....70....80....90....100
Restored target device is /dev/disk9s5.
```

No --erase

# Verifying image contents - demo

# Accessing snapshots

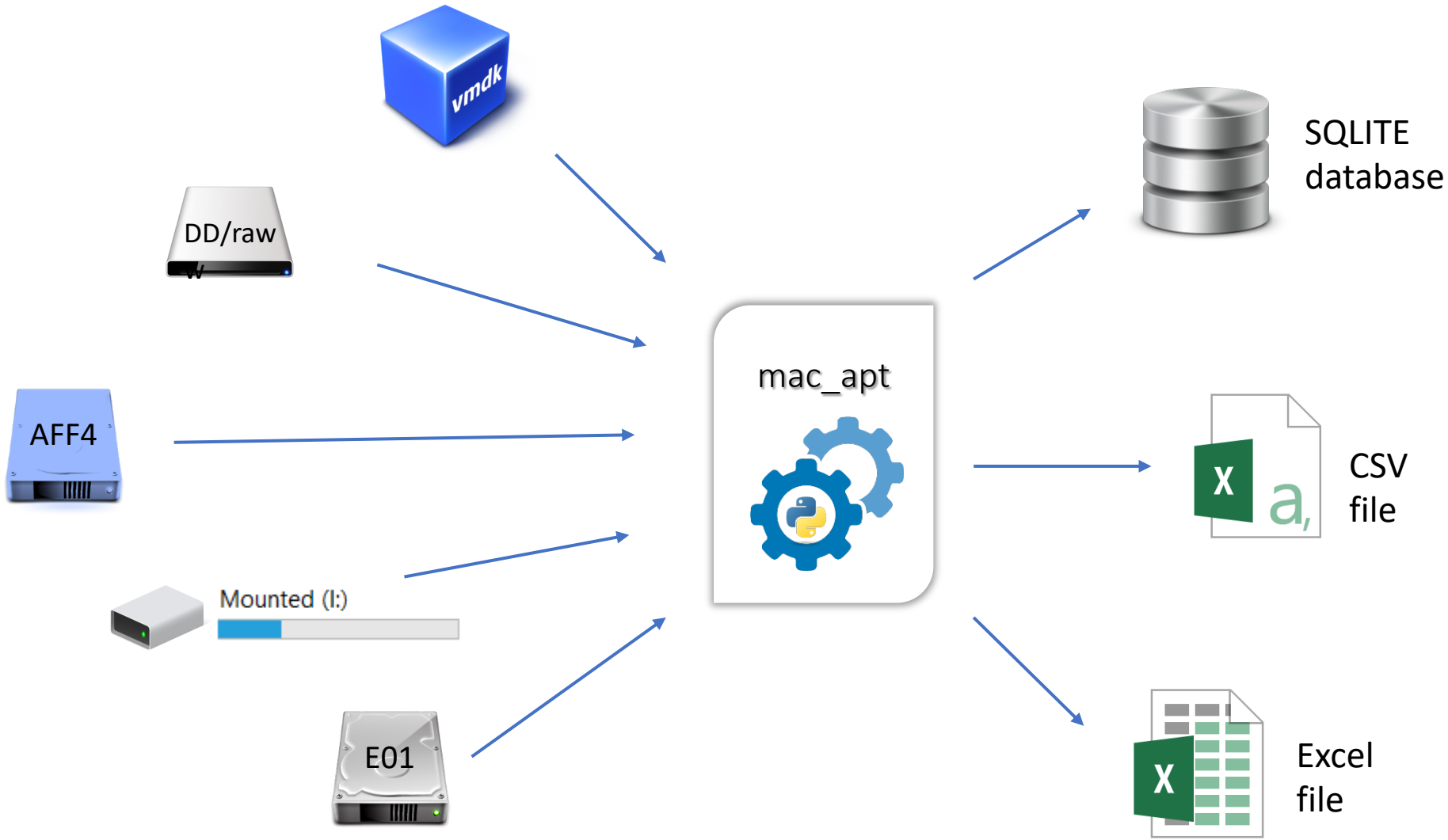
- Volume must be mounted (can be read-only)
- Listing them out
  - **tmutil** listlocalsnapshots <mountpoint>
  - **diskutil** apfs list snapshots
- Mounting snapshots
  - **mount_apfs** -s <snapshot> <volume | device> <directory>

Currently mounted volume (/dev/disk2s1) or it's mountpoint (/Volumes/Bob)

Folder to mount snapshot

# Snapshots - demo

# mac_apt - Input & output types




https://github.com/ydkhatri/mac_apt/

# Scenario

- Investigators have been on a case of passport theft or forgery across New England
- Investigators intercept a suspicious transaction and confiscate a live Macintosh computer

- Traces of the passport information in the computer.
- Contact between the suspect and other individuals; sharing the information.
- Relevant locations, meeting points, or contact information.

# Running mac_apt (video)

# Plugins

FAST:

- APPS
- AUTOSTART
- **BASH_SESSIONS**
- **BASIC_INFO**
- COOKIES
- DOCK_ITEMS
- FS_EVENTS
- **IMESSAGE**
- INTERNET_ACCOUNTS
- **INSTALLHISTORY**
- NETUSAGE
- NETWORKING/WIFI
- **NOTES**
- QUARANTINE
- QUICKLOOK
- **RECENT_ITEMS**
- **SAFARI**
- SCREENTIME
- SPOTLIGHTSHORTCUTS
- **TERMINALSTATE**
- **USERS**

# Reading the Output (live)

# Basic Info Output

Table: Basic_Info

| | INFO_TYPE | Name | Data | Description |
|---|---|---|---|---|
| | Filter | Filter | Filter | Filter |
| 1 | SYSTEM | macOS Version | 10.15.1 | Catalina |
| 2 | SYSTEM | macOS Build Version | 19B88 | Catalina |
| 3 | HARDWARE | Mac Serial Number | VMEBHcciB7Au | Hardware Serial Number |
| 4 | HARDWARE | Model | VMware7,1 | Mac Hardware Model |
| 5 | SYSTEM | ComputerName | experimental's Mac | |
| 6 | SYSTEM | LocalHostName | experimentals-Mac | |
| 7 | TIMEZONE | TimeZone Set | America/New_York | Timezone on machine |
| 8 | USER-LOGIN | lastUser | Restart | Last user (Login) Action |
| 9 | USER-LOGIN | lastUserName | experimental | |
| 10 | USER-LOGIN | UseVoiceOverLegacyMigrated | True | unknown |
| 11 | USER-LOGIN | lastLoginPanic | 2020-05-10 10:50:02.755967 | |
| 12 | APFS | Information | | Data below represents a combined SYSTE... |
| 13 | APFS | Block Size (bytes) | 4096 | Container Block size |
| 14 | APFS | Container Size (GB) | 39.68 | Container size (SYSTEM + DATA) |
| 15 | APFS | Volume Name | Macintosh HD,Macintosh HD - Data | Volume names (SYSTEM, DATA) |
| 16 | APFS | Volume UUID | CE465AAC-A681-4DD3-A0D7-6D3C... | Volume Unique Identifiers (SYSTEM, DATA) |
| 17 | APFS | Size Used (GB) | 26.58 | Space allocated (SYSTEM + DATA) |

## Recent Items

Table: RecentItems

| | Type | Name | URL |
|---|---|---|---|
| | Filter | Filter | Filter |
| 22 | SSH_KNOWN... | 216.93.152.89 | |

## Net Usage

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Type | Name | FirstSeenDate | LastSeenDate |
| 79 | Process | sharingd | 2/19/2020 11:54 | 5/9/2020 7:08 |
| 80 | Process | softwareupdated | 11/15/2019 19:17 | 5/9/2020 7:16 |
| 81 | Process | ssh | 5/7/2020 6:20 | 5/7/2020 17:26 |
| 82 | Process | studentd | 2/19/2020 10:44 | 5/6/2020 3:00 |
| 83 | Process | swcd | 11/15/2019 19:21 | 5/5/2020 17:35 |
| 84 | Process | syncdefaultsd | 2/19/2020 11:54 | 5/9/2020 15:59 |
| 85 | Process | syspolicyd | 11/15/2019 19:17 | 5/9/2020 15:51 |

# TerminalState

- Reads Terminal saved state files which includes full text content of terminal window(s)
- Shows SCP file transferring and file-reading

```
experimental@experimentals-Mac ~ % history
   97  vim startupscript.sh
   98  cp startupscript.sh setupKali.sh
   99  rm startupscript.sh
  100  cat setupKali.sh
  101  cp setupKali.sh setupKali.app
  102  echo "Hello"
  103  pwd
  104  ls -la
  105  pwd
  106  ifconfig
  107  scp root@216.93.152.89:/home/temporary/passds.txt /Users/experimental/Desktop
  108  cat /Users/experimental/Desktop/passds.txt
  109  cd ~/Downloads
  110  ls -la
  111  scp untitled\ \(1\).csv root@216.93.152.89:/home/temporary/
  112  ssh root@216.93.152.89
```

OK, we got lucky here, (user had printed out his own history!) This happens sometimes!

```
experimental@experimentals-Mac Downloads % cat ../Desktop/passds.txt
root:x:0:0:root:/root:/bin/bash
bin:x:1:1:bin:/bin:/sbin/nologin
daemon:x:2:2:daemon:/sbin:/sbin/nologin
adm:x:3:4:adm:/var/adm:/sbin/nologin
lp:x:4:7:lp:/var/spool/lpd:/sbin/nologin
sync:x:5:0:sync:/sbin:/bin/sync
shutdown:x:6:0:shutdown:/sbin:/sbin/shutdown
halt:x:7:0:halt:/sbin:/sbin/halt
mail:x:8:12:mail:/var/spool/mail:/sbin/nologin
operator:x:11:0:operator:/root:/sbin/nologin
games:x:12:100:games:/usr/games:/sbin/nologin
```

```
experimental@experimentals-Mac Downloads % scp untitled\ \(1\).csv root@216.93.152.89:/home/temporary/
root@216.93.152.89's password:
untitled (1).csv                              100%  699   844.8KB/s   00:00
experimental@experimentals-Mac Downloads % scp untitled\ \(2\).csv root@216.93.152.89:/home/temporary/
root@216.93.152.89's password:
untitled (2).csv                              100%  566    38.2KB/s   00:00
```

```
experimental@experimentals-Mac Downloads % cat "untitled (1).csv"
QW5ndXMgUG93ZXI=,MTAyOThSRkU0,20-Apr-69,TQ==69,Rg==
```

# TerminalState

- SSH activity

```
experimental@experimentals-Mac Downloads % ssh root@216.93.152.89
root@216.93.152.89's password:
Last login: Fri May  8 15:44:25 2020 from 134-152.champlain.edu
[root@62-152 ~]# rm /home/temporary/untitled\ \(1\).csv
rm: remove regular file '/home/temporary/untitled (1).csv'? yes
[root@62-152 ~]# exit
logout
Connection to 216.93.152.89 closed.
experimental@experimentals-Mac Downloads % ssh root@216.93.152.89 mysqldump -u root -p secrets
> data-dump.sql ; cat data-dump.sql | tail -n 20
root@216.93.152.89's password:
Enter password: 2616
--
-- Dumping data for table `passpts`
--

LOCK TABLES `passpts` WRITE;
/*!40000 ALTER TABLE `passpts` DISABLE KEYS */;
INSERT INTO `passpts` VALUES (1,'Sameeha Cullen','J83421ef8','2000-01-02'),(2,'Omar
Pearce','N88890D8I','1992-04-03'),(3,'Jamie Carty','DF282BC9e','1961-03-05'),(4,'Sofie
Forster','N78Vf6789','1968-02-18'),(5,'Hallie Colley','J823F5G78','1982-03-25'),(6,'Kyra
Ross','K177M3P72','1988-08-17'),(7,'Amelia-Rose Petty','C0K4ND847','1993-09-12'),(8,'Rico
Squansonson','9USS8A772','1989-10-10'),(9,'Shivani Steele','M07H3RC47','1955-11-12');
/*!40000 ALTER TABLE `passpts` ENABLE KEYS */;
UNLOCK TABLES;
/*!40103 SET TIME_ZONE=@OLD_TIME_ZONE */;
```

# iMessage Data

| MsgID | Text | versa | Contact | irectic | Account | Date | AttachmentPath |
|---|---|---|---|---|---|---|---|
| | Filter | | Filter | | Filter | Filter | Filter |
| 9 | Are you receiving my the file? | 1 | chrisaustin3c@gmail.com | ⟵ | E:janesmithmacfor@icloud.com | 2020-05-07 01:51:46.434342 | /Volumes/TEST/untitled (1).csv |
| 10 | | 1 | chrisaustin3c@gmail.com | ⟵ | e:janesmithmacfor@icloud.com | 2020-05-07 01:51:34.321000 | NULL |
| 11 | | 1 | chrisaustin3c@gmail.com | ⟵ | E:janesmithmacfor@icloud.com | 2020-05-07 02:14:33.042905 | /Volumes/TEST/untitled (1).csv |
| 12 | Hey Jane, this is Hazel | 2 | hazelhill010@icloud.com | ⟶ | e:janesmithmacfor@icloud.com | 2020-05-08 16:36:44.388566 | NULL |
| 13 | Hello hazel, I'm having trouble reaching Chris, can I forward you the file to decode for me? | 2 | hazelhill010@icloud.com | ⟵ | e:janesmithmacfor@icloud.com | 2020-05-08 16:37:41.518922 | NULL |
| 14 | Surely | 2 | hazelhill010@icloud.com | ⟶ | e:janesmithmacfor@icloud.com | 2020-05-08 16:37:50.304400 | NULL |
| 15 | | 2 | hazelhill010@icloud.com | ⟵ | E:janesmithmacfor@icloud.com | 2020-05-07 03:47:20.958276 | /Volumes/TEST/untitled (1).csv |
| 16 | It doesn't seem to be going through, ill try to email it | 2 | hazelhill010@icloud.com | ⟵ | e:janesmithmacfor@icloud.com | 2020-05-08 16:43:21.581000 | NULL |
| 17 | K | 2 | hazelhill010@icloud.com | ⟶ | e:janesmithmacfor@icloud.com | 2020-05-08 16:44:44.561443 | NULL |
| 18 | | 2 | hazelhill010@icloud.com | ⟶ | e:janesmithmacfor@icloud.com | 2020-05-08 16:55:24.731872 | ~/Library/Messages/Attachments/... |
| 19 | This one? | 2 | hazelhill010@icloud.com | ⟶ | e:janesmithmacfor@icloud.com | 2020-05-08 16:55:41.682888 | NULL |
| 20 | Yes | 2 | hazelhill010@icloud.com | ⟵ | e:janesmithmacfor@icloud.com | 2020-05-08 16:55:44.897000 | NULL |
| 21 | I can't send files, I will attach text of it here and email you the file | 2 | hazelhill010@icloud.com | ⟶ | e:janesmithmacfor@icloud.com | 2020-05-08 16:56:10.236733 | NULL |
| 28 | I found more data! | 2 | hazelhill010@icloud.com | ⟵ | e:janesmithmacfor@icloud.com | 2020-05-09 07:00:17.513000 | ~/Library/Messages/Attachments/... |
| 29 | Are you ready for tomorrow? | 2 | hazelhill010@icloud.com | ⟶ | e:janesmithmacfor@icloud.com | 2020-05-10 06:15:51.013955 | NULL |
| 30 | Yeah, same place as last time? | 2 | hazelhill010@icloud.com | ⟵ | e:janesmithmacfor@icloud.com | 2020-05-10 06:16:42.569000 | NULL |
| 31 | Centennial — yes | 2 | hazelhill010@icloud.com | ⟶ | e:janesmithmacfor@icloud.com | 2020-05-10 06:16:57.837042 | NULL |
| 32 | 12pm | 2 | hazelhill010@icloud.com | ⟶ | e:janesmithmacfor@icloud.com | 2020-05-10 06:23:35.160071 | NULL |
| 33 | The best I can do is 1:30, its a long drive from boston and I don't want to wake up any earlier than 10 | 2 | hazelhill010@icloud.com | ⟵ | e:janesmithmacfor@icloud.com | 2020-05-10 06:24:44.101000 | NULL |

# Notes

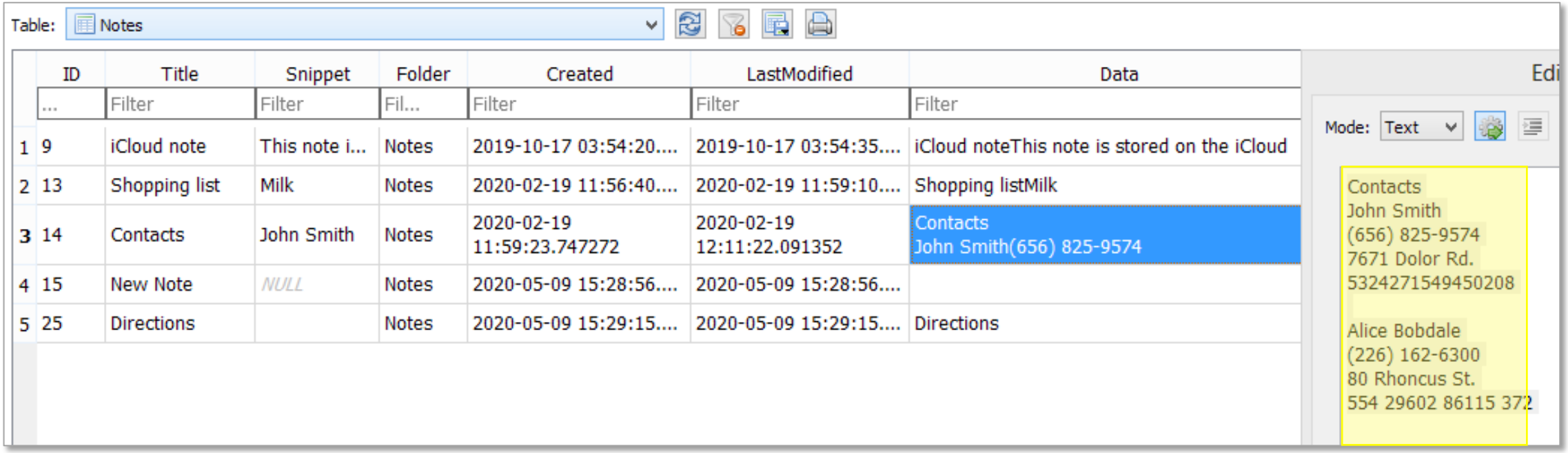


Table: Notes
ID
Title
Snippet
Folder
Created
LastModified
Data
Filter
1 9 iCloud note This note i... Notes 2019-10-17 03:54:20.... 2019-10-17 03:54:35.... iCloud noteThis note is stored on the iCloud
2 13 Shopping list Milk Notes 2020-02-19 11:56:40.... 2020-02-19 11:59:10.... Shopping listMilk
3 14 Contacts John Smith Notes 2020-02-19 11:59:23.747272 2020-02-19 12:11:22.091352 Contacts John Smith(656) 825-9574
4 15 New Note NULL Notes 2020-05-09 15:28:56.... 2020-05-09 15:28:56....
5 25 Directions Notes 2020-05-09 15:29:15.... 2020-05-09 15:29:15.... Directions
Mode: Text
Contacts
John Smith
(656) 825-9574
7671 Dolor Rd.
5324271549450208
Alice Bobdale
(226) 162-6300
80 Rhoncus St.
554 29602 86115 372

# Safari

| | Type | Name_or_Title | URL | Date |
|---|---|---|---|---|
| | Filter | Filter | Filter | Filter |
| 335 | HISTORY | Google Maps | https://www.googl... | 2020-05-09 15:37:50.... |
| 336 | HISTORY | The Andi Apartments to Centennial Woods Natural Area - Googl... | https://www.googl... | 2020-05-09 15:37:50.... |
| 337 | HISTORY | The Andi Apartments to Centennial Woods Natural Area - Googl... | https://www.googl... | 2020-05-09 15:37:53.... |
| 338 | HISTORY | The Andi Apartments to Centennial Woods Natural Area - Googl... | https://www.googl... | 2020-05-09 15:38:01.... |
| 339 | HISTORY | Amazon.com: Online Shopping for Electronics, Apparel, Comput... | https://www.amaz... | 2020-05-09 15:38:45.... |

| | | | | |
|---|---|---|---|---|
| 350 | HISTORY | Amazon.com: Deftun Mag Card Reader Writer Compare with MSR605X For Windows and Mac OS: Computers & Accessories | https://www.amazon.com... | 2020-05-09 15:40:47.604028 |
| 351 | HISTORY | Amazon.com: passport scanner: Electronics | https://www.amaz... | 2020-05-09 15:41:28.... |
| 352 | HISTORY | Amazon.com: passport scanner: Electronics | https://www.amaz... | 2020-05-09 15:41:28.... |
| 353 | HISTORY | | https://www.amaz... | 2020-05-09 15:41:45.... |
| 354 | HISTORY | Amazon.com: Gemalto CR100M Document Passport Reader Scanner MRZ MRTDS USB: Electronics | https://www.amazon.com... | 2020-05-09 15:41:45.371295 |
| 355 | HISTORY | Amazon.com Shopping Cart | https://www.amaz... | 2020-05-09 15:42:08.... |

# Thanks for watching!

# Any Questions?


Tools @ https://github.com/ydkhatri/mac_apt
https://github.com/ydkhatri/macOS_FE

*@swiftforensics*
*@alex_cart27*

Yogesh@swiftforensics.com
Alexandra.cartwright@mymail.champlain.edu

# References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- About encrypted storage on your new Mac - https://support.apple.com/en-us/HT208344
- Apple Platform Security  Spring 2020 - https://support.apple.com/guide/security/welcome/web
- Apple T2 Security Chip - Security Overview - https://www.apple.com/euro/mac/shared/docs/Apple_T2_Security_Chip_Overview.pdf
- Disk Arbitrator - https://github.com/aburgh/Disk-Arbitrator
- disk_block_daemon - https://github.com/ydkhatri/macOS_FE/NoMountDaemon
- Mounting timemachine local Snapshots - https://derflounder.wordpress.com/2019/02/23/mounting-time-machine-local-snapshots-as-read-only-volumes/