SSD Data Evaporation

DEF CON 21

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Bio


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Data Remanence

Deleted Data

- On magnetic hard disks, data remains till it is overwritten
- Image from www.howstuffworks.com

DEMO on Windows

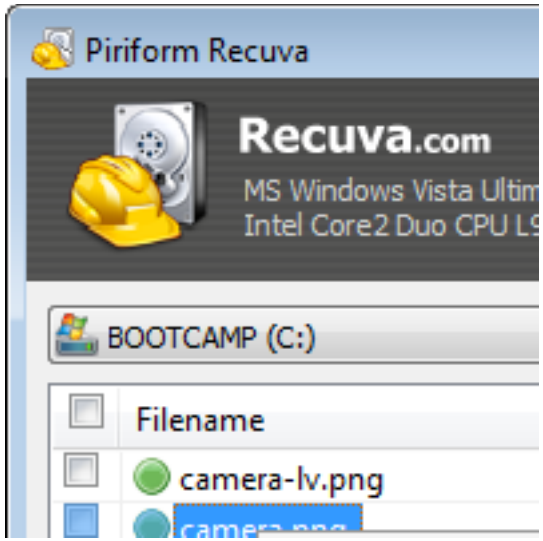
- Observing data on a magnetic hard disk after
  - Moving to Recycle Bin
  - Emptying Recycle Bin
  - Formatting Drive (Quick)
  - Formatting Drive (Slow)

Forensics & Data Recovery

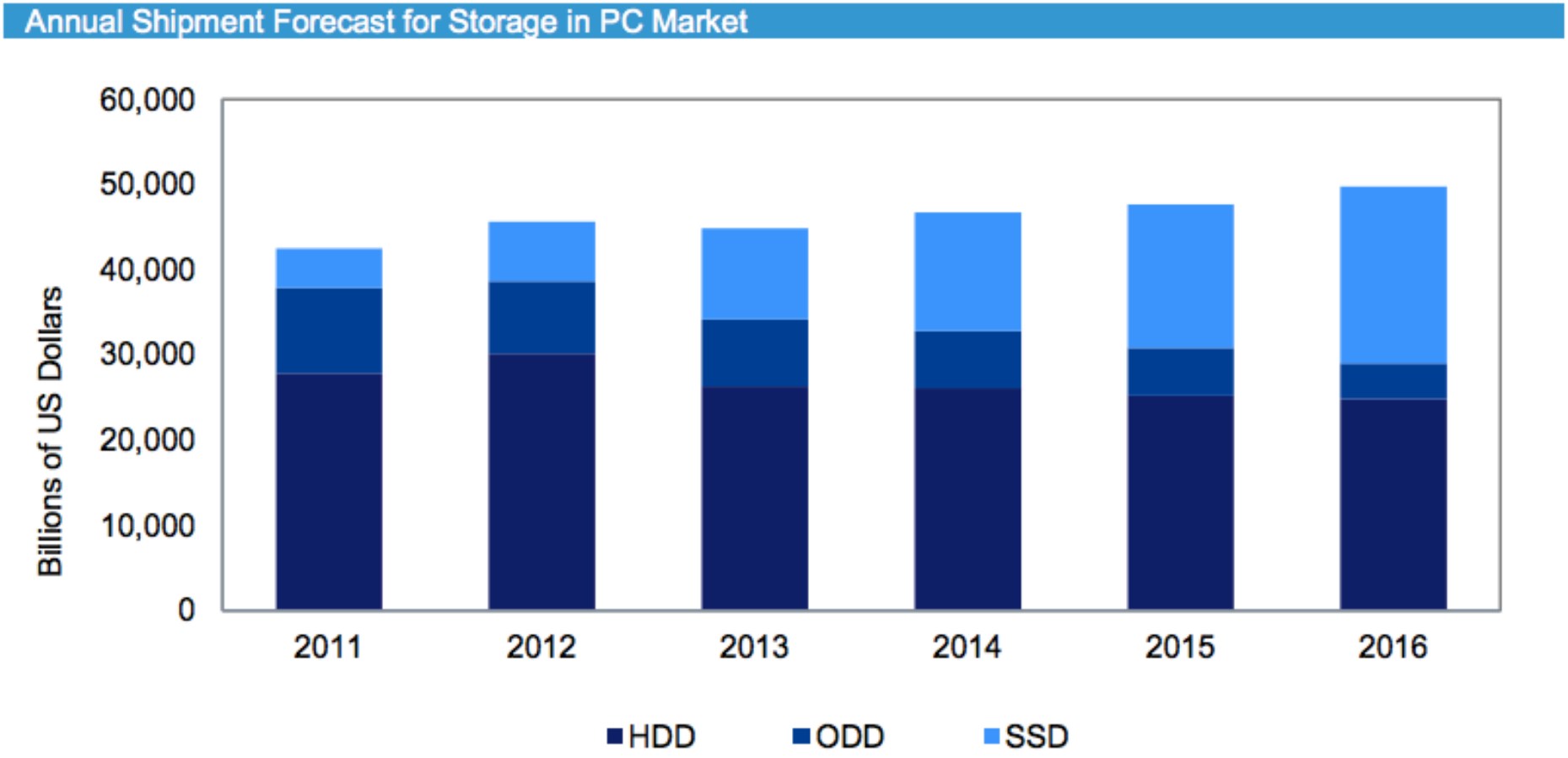
- We can recover deleted data
- Find evidence of crimes
- Even after a format
- Very few criminals know enough to use encryption or forensic erasure

Useful Free Data Recovery Tools

- Recuva for PC
- Disk Drill for Mac



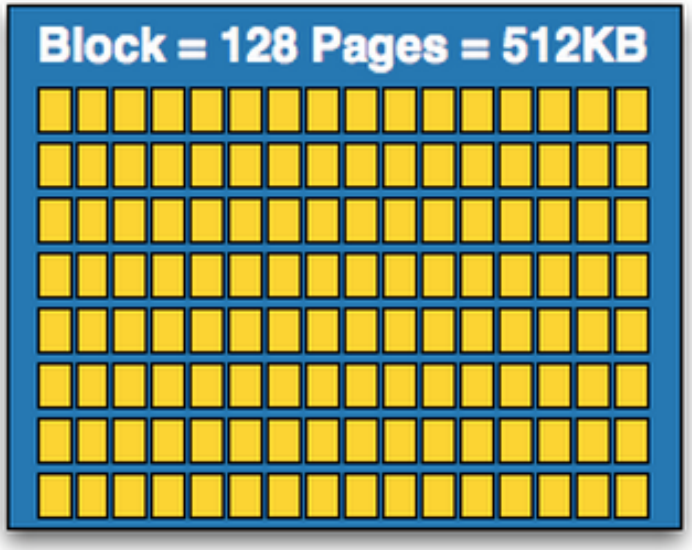
SSDs



- From http://www.isuppli.com/Abstract/P28276_20130322152341.pdf

How SSDs Work

- Data can be read and written one **page** at a time, but can only be erased a **block** at a time
- Each erasure degrades the flash—it fails around 10,000 erasures
- From http://www.anandtech.com/show/2738/5

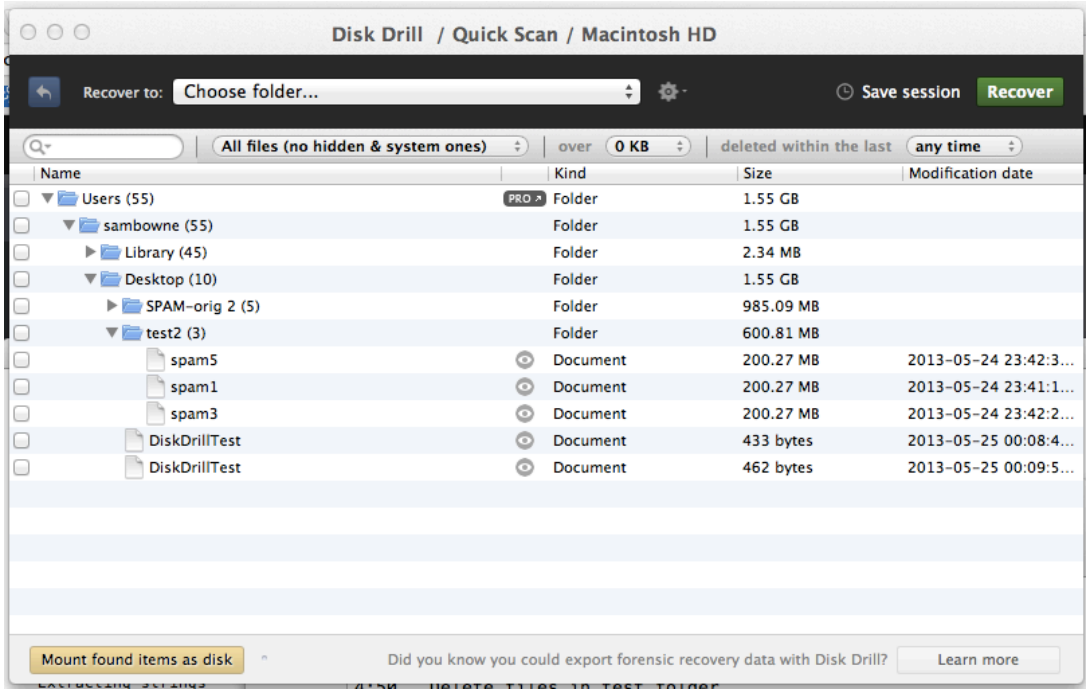


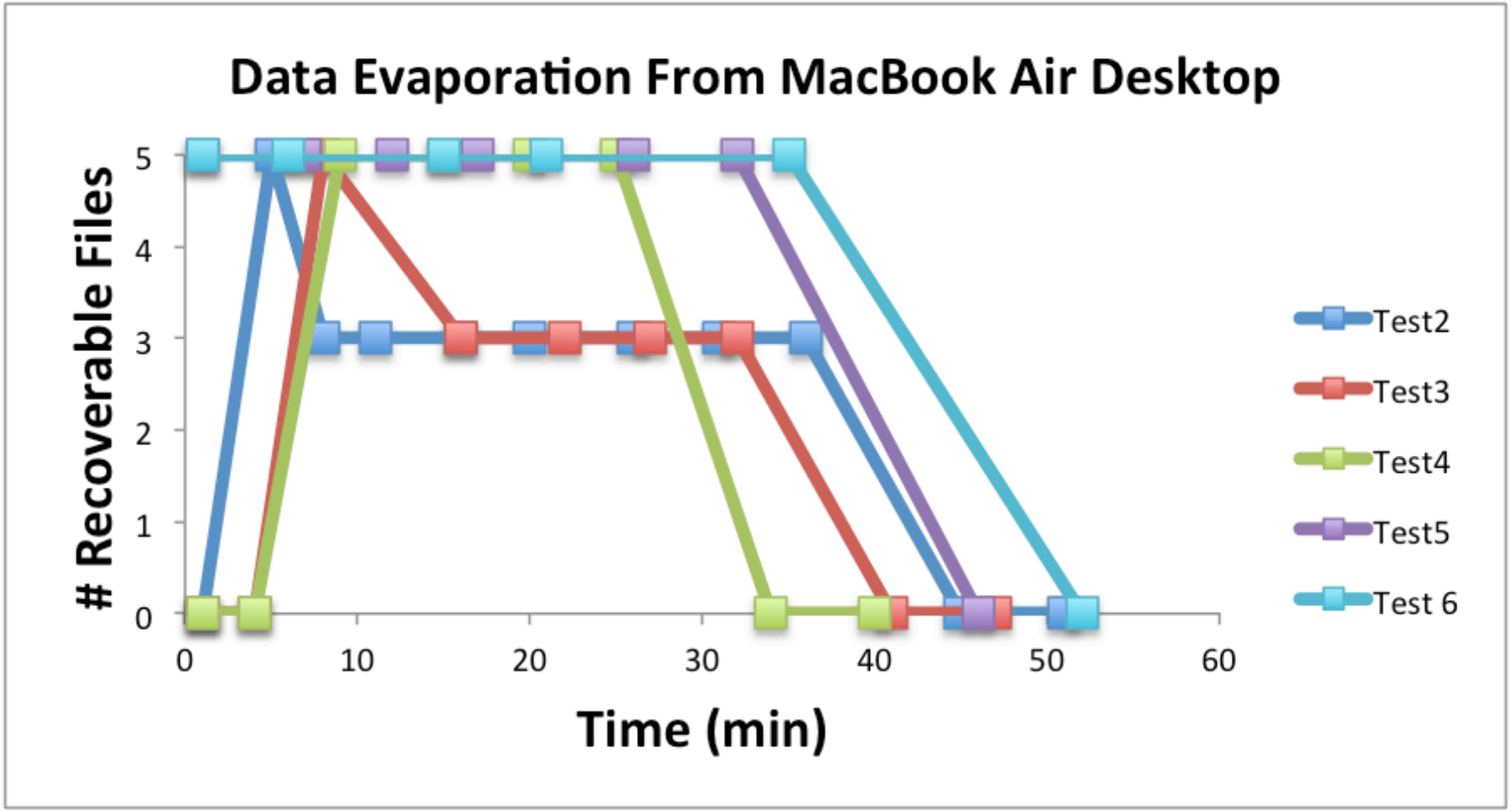
Garbage Collection

- SSD controller erases pages all by itself, **when it knows they are empty**
- The **TRIM** command is sent to the SSD when a file is deleted
  - But only if you use a the correct OS, Partition type, and BIOS settings
- Yuri Gubanov calls this “Self-Corrosion” – I call it **Data Evaporation**

Demo on Mac: Disk Drill

- Deleted files from desktop evaporate in 30-60 min




Data Evaporation From MacBook Air Desktop
Recoverable Files
0
1
2
3
4
5
0
10
20
30
40
50
60
Time (min)
Test2
Test3
Test4
Test5
Test 6

Demo on PC

- Save data on an SSD
- Watch it evaporate!
- How to test TRIM
  - **fsutil behavior query DisableDeleteNotify**
  - Zero = TRIM enabled

When Does TRIM Work?

- **BIOS**: Drive must be SATA in AHCI mode, not in IDE emulation mode
- **SSD** must be new (Intel: 34 nm only)
- **Windows 7** or later
  - **NTFS** volumes, not **FAT**
- **Mac OS X 10.6.8** or later
  - Must be Apple-branded SSD

When Does TRIM Work?

- **External Drives** must use SATA or SCSI, not USB
- **PCI-Express** & **RAID** does not support TRIM
- From http://forensic.belkasoft.com/en/why-ssd-destroy-court-evidence

Expert Witness Testimony

Experience

- In court, an expert witness can state an opinion
- Must be based on **personal experience**
  - "I read it in a book" ***NO***
  - "A teacher said it in a class" ***NO***
  - "I know this because **I tested it**" ***YES***
- So forensic examiners do a lot of testing

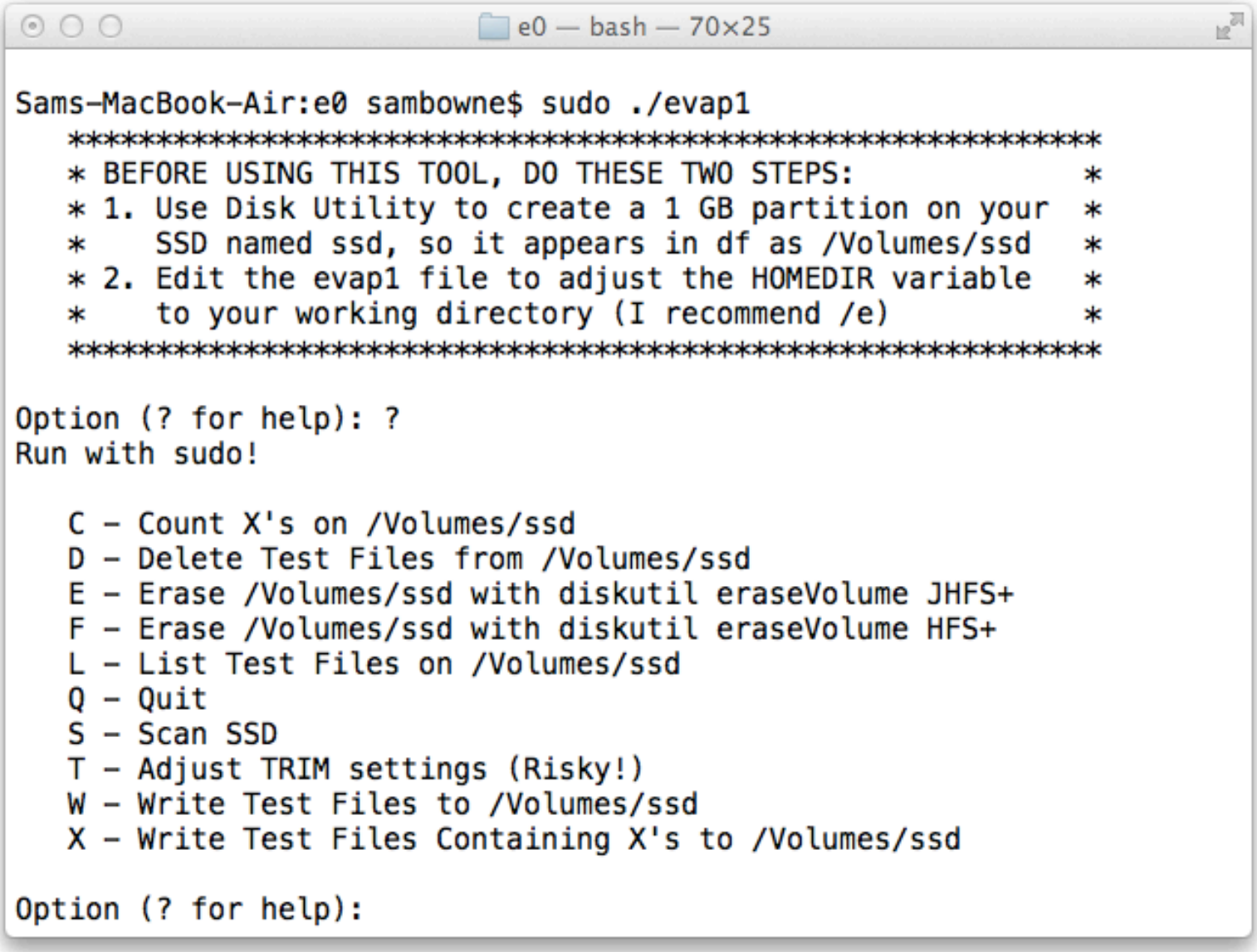
Summary

- SSDs retain deleted data sometimes
- Other times they don't
- It depends on
  - Manufacturer
  - OS
  - BIOS
  - Interface
  - Who knows what else

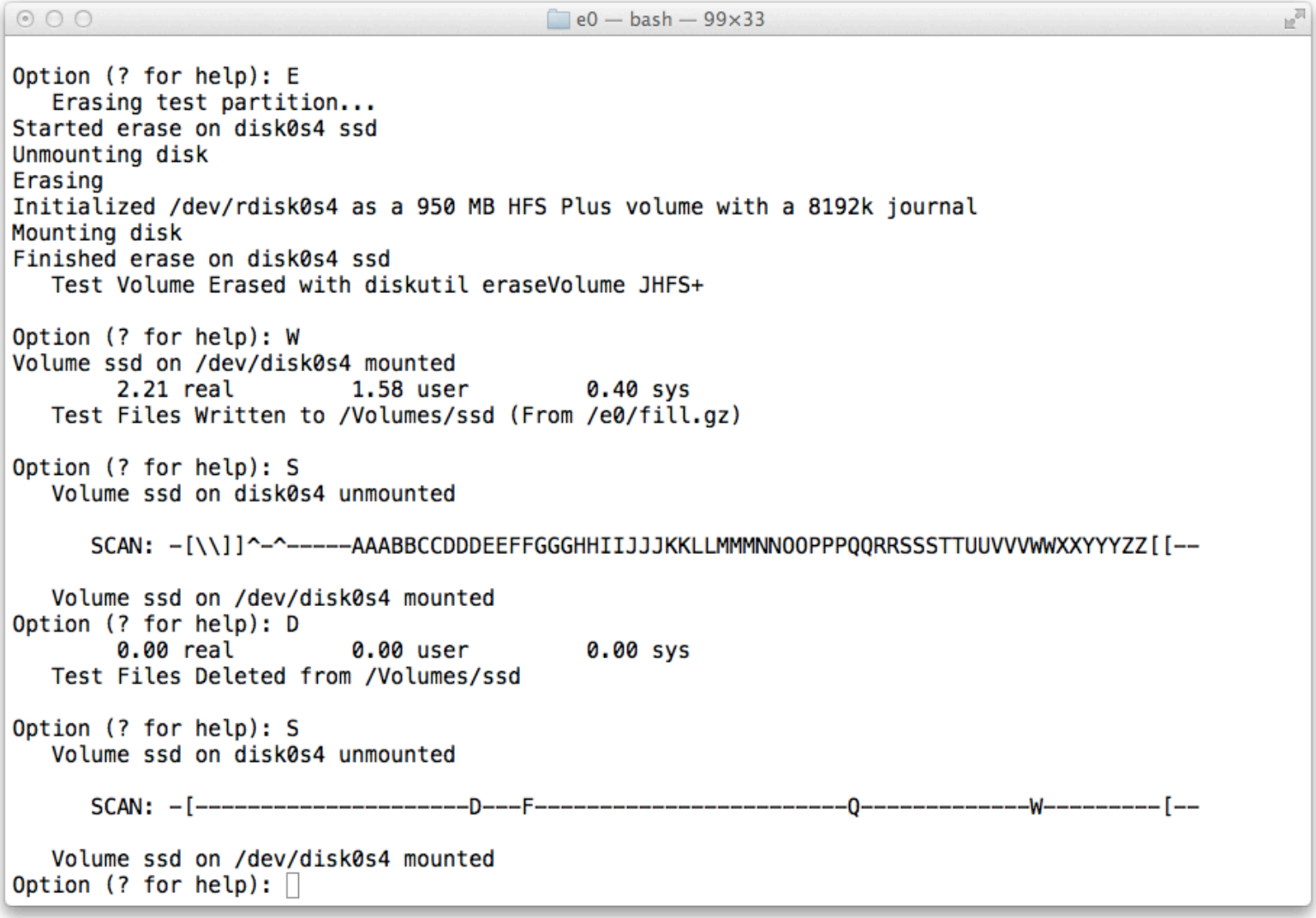
The evap Tool

For Mac OS X Only

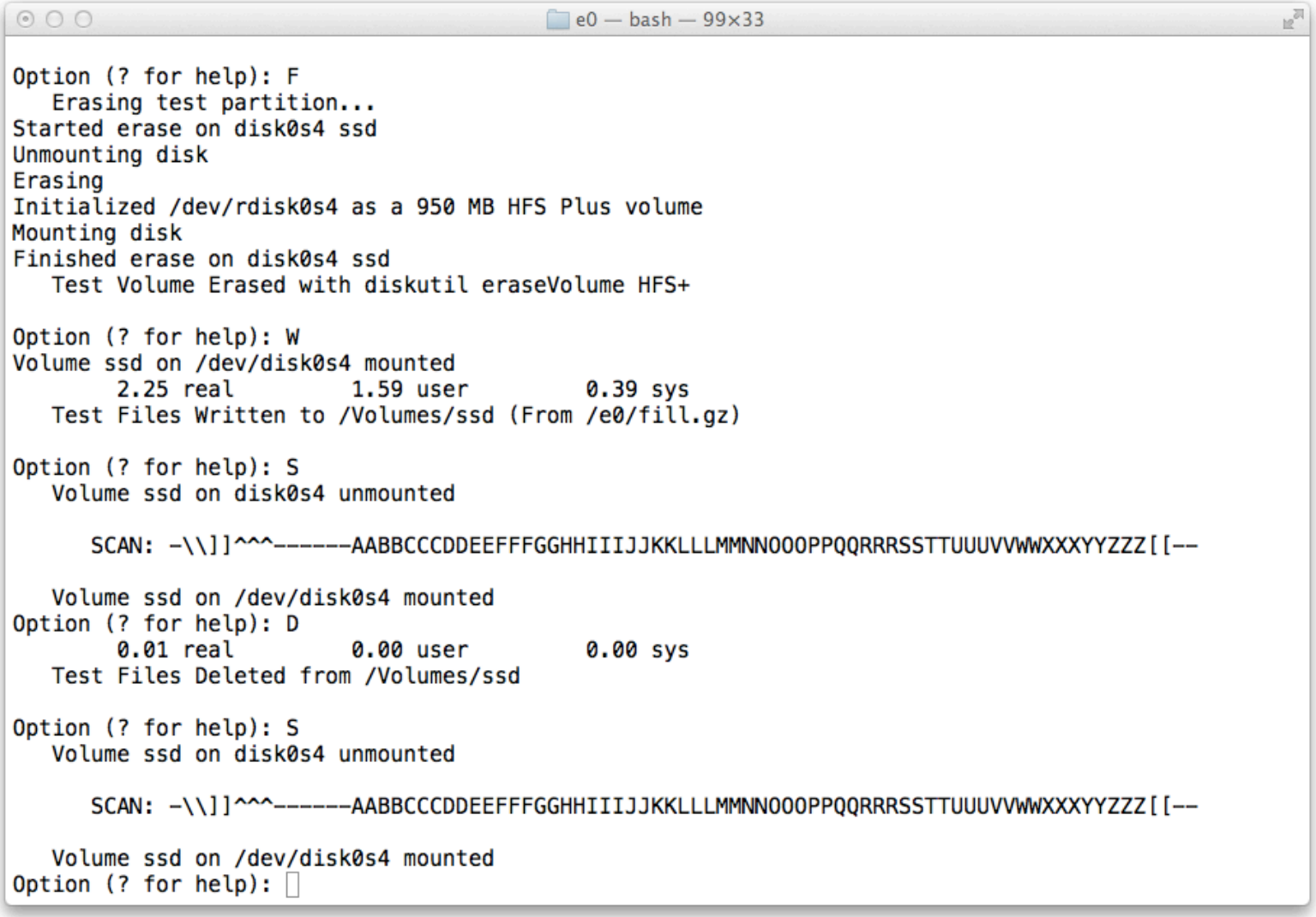
Intro


e0 — bash — 70×25
Sams-MacBook-Air:e0 sambowne$ sudo ./evap1
* BEFORE USING THIS TOOL, DO THESE TWO STEPS:
* 1. Use Disk Utility to create a 1 GB partition on your
* SSD named ssd, so it appears in df as /Volumes/ssd
* 2. Edit the evap1 file to adjust the HOMEDIR variable
* to your working directory (I recommend /e)
Option (? for help): ?
Run with sudo!
C - Count X's on /Volumes/ssd
D - Delete Test Files from /Volumes/ssd
E - Erase /Volumes/ssd with diskutil eraseVolume JHFS+
F - Erase /Volumes/ssd with diskutil eraseVolume HFS+
L - List Test Files on /Volumes/ssd
Q - Quit
S - Scan SSD
T - Adjust TRIM settings (Risky!)
W - Write Test Files to /Volumes/ssd
X - Write Test Files Containing X's to /Volumes/ssd
Option (? for help):

Evaporation on JHFS+



No Evaporation on HFS+



More Info

- Slides, instructions for the attacks, & more at
- Samsclass.info