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Evidence per

Operating System & Device In-Depth



Battlefield Forensics



Analysis



Mac and iOS

Forensic Analysis and Incident Response



Incident Response

& Threat Hunting



GCTI











FOR526



Analysis In-Depth





Smartphone Forensic Analysis In-Depth

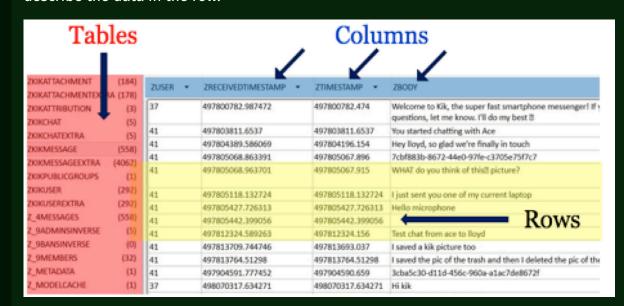
for585.com/course

FOR585:

SQLite Database Basics

SQLite databases are a self-contained database stored as a file system file (but may have a few supporting files that will also be needed for analysis!) Files have the magic number "SQLite format 3." SQLite files correspond to a database that contains tables. Tables contain rows of data with corresponding columns that describe the data in the row.

The Most Relevant



Some temporary files may also be created, including Journal files and Write Ahead Logs. Journal files store original data before a transaction change so the database can be restored to a known state if an error occurs. They are created by default.

Write Ahead Logs (WAL) contain new data changes, leaving original database untouched. After a set number of page changes, the WAL is used to update the actual database. Write ahead logs are optional. Journal files – stores original data before a transaction change so the database can be restored to a known state if an error occurs (created by default).

SQLite

Timestamp Conversion

Timestamps are stored in the databases as one of several numerical representations. (Timestamps are assumed to be stored in UTC, you may need to verify this.)

UNIX Epoch (10 digit number - number of seconds since 01/01/1970 00:00:00):

• SELECT datetime (TS COLUMN, 'unixepoch') Or in **local time** as suggested by the device settings (this can be done for all the following timestamps):

• SELECT datetime(TS COLUMN, 'unixepoch', 'localtime')

UNIX Epoch MILLISECONDS (13 digit number – number of milliseconds since 01/01/1970 00:00:00):

• SELECT datetime(TS_COLUMN/1000, 'unixepoch');

Mac Absolute time, number of seconds since 01/01/2001 00:00:00. In order to correctly convert this timestamp, first, add the number of seconds since UNIXEPOCH time to Mac Absolute Time (978307200), then convert.

• SELECT datetime (TS COLUMN + 978307200, 'unixepoch');

Chrome time accounts for time accurate to the MICROSECOND, which requires dividing

• SELECT datetime(TS COLUMN/1000000 + (strftime('%s','1601-01-01')),'UNIXEPOCH');

Basic Analysis Query Structure

Get everything from a single table: SELECT * FROM A TABLE;

Get two columns from a single table: SELECT COLUMN A, COLUMN B FROM A TABLE;

Table Joins

Taking data from two (or more!) tables that have a column in common and joining them into one table. Identify tables of interest that contain unique values. **LEFT JOIN** – Resulting rows are returned from the **LEFT** table even if there are no matches in the right. Using the **LEFT JOIN** returns all the text messages, including

SELECT ZVIBERMESSAGE.ZTEXT AS "Message Text", ZATTACHMENT.ZNAME AS "Attachment Filename", datetime(ZVIBERMESSAGE.ZDATE+978307200, 'unixepoch', 'localtime') AS "Message Date", ZVIBERMESSAGE. ZSTATE AS "Message Direction/State" FROM ZVIBERMESSAGE LEFT JOIN ZATTACHMENT on ZATTACHMENT.Z PK=ZVIBERMESSAGE.ZATTACHMENT

INNER JOIN – Resulting rows are returned when both items are a match. Using the **INNER JOIN** (also achieved by typing "**JOIN**" in the query) returned just the messages that included attachments.

Useful Stuff

Column Renaming: A_TABLE.ZAWKWARDCOLUMNNAME AS "Chat Messages"

SELECT COUNT(*) FROM A TABLE;

those with and without attachments.

Aggregating with GROUP BY and COUNT (Count chat messages per contact): SELECT MESSAGES, COUNT(*) FROM CHAT GROUP BY CONTACT;

Sorting with ORDER BY:

SELECT * FROM CHAT ORDER BY A TIMESTAMP ASC

ASC = Ascending DESC = Descending

Searching with WHERE and LIKE:

SELECT CONTACT, MESSAGE FROM CHAT WHERE CONTACT LIKE '%Hank%'

Our Favorite Mobile Forensic Resources

Practitioners/Researchers Sarah Edwards https://www.mac4n6.com Mattia Epifani Adrian Leong Alexis Brignoni Jon B Mari DeGrazia Andrew Hoog

Ian Whiffin

Josh Hickman

Heather Mahalik https://smarterforensics.com http://mattiaep.blogspot.com http://cheeky4n6monkey.blogspot.com https://abrignoni.blogspot.com https://www.ciofecaforensics.com http://az4n6.blogspot.com https://www.hack42labs.com http://doubleblak.com/blogs.php

https://thebinaryhick.blog

Vendors

Cellebrite BlackBag Technologies Sanderson Forensics

Elcomsoft

Oxygen Forensics https://blog.oxygen-forensic.com

Magnet Forensics https://www.magnetforensics.com/blog https://www.cellebrite.com/en/blog https://www.blackbagtech.com/blog https://sqliteforensictoolkit.com/ support-articles

Additional Resources

DFRWS https://dfrws.org/

iOS Jailbreaks https://www.theiphonewiki.com/wiki/Jailbreak FOR585 Google *access granted to all 585 Alumni

DFIR mailing list DFIR@lists.sans.org

Mobile Malware and Spyware

https://blog.elcomsoft.com

Key Artifacts: Static Analysis

Requested Permissions: Granted to an application by the user (1) during installation or (2) upon execution/runtime. Found in the AndroidManifest.xml file.

through the User Interface (UI). **Services:** Tasks often running in the background and integrated

Activities: One or more activities comprise each application.

into the application. User doesn't (normally) interact with Services. Examples: music playing during a gaming application, or calculations performed in the background. **Broadcast Receivers:** Facilitates the exchange of information

for applications, which can be delivered between app components or between entirely different applications. Applications can be programmed to "listen" for events that are then delivered to the broadcast receivers using Intents. **Content Providers:** Refers to how information is stored

within an application and shared between multiple applications. Example: a contact database often used by many native and third-party applications. The code would call the ContentResolver (the global instance that provides access to the content) that passes on the request to the proper Content Provider.

📤 jadx-gui - evernote.apk File View Navigation Tools Help Resources ↑ AndroidManifest.xml 🗶 ⊞ 🏣 META-INF xml version="1.0" encoding="utf-8"?> ii assets manifest xmlns:android="http://schemas.android.com/apk/res/android" xmlns:app="http://schem Users can navigate to/from and interact with activities directly classes.dex <uses-sdk android:minSdkVersion="23" android:targetSdkVersion="28"/> classes2.dex <uses-permission android:name="android.permission.ACCESS_NETWORK_STATE"/> <uses-permission android:name="android.permission.ACCESS_WIFI_STATE"/> firebase-abt.properties <uses-permission android:name="android.permission.FOREGROUND_SERVICE"/> firebase-analytics-impl.properties <uses-permission android:name="android.permission.GET_ACCOUNTS"/> firebase-analytics.properties <uses-permission android:name="android.permission.INTERNET"/> firebase-appindexing.properties <uses-permission android:name="android.permission.READ_SYNC_SETTINGS"/> firebase-common.properties <uses-permission android:name="android.permission.READ_SYNC_STATS"/> <uses-permission android:name="android.permission.RECEIVE_BOOT_COMPLETED"/> firebase-config.properties <uses-permission android:name="android.permission.USE_BIOMETRIC"/> firebase-core.properties firebase-iid-interop.properties <uses-permission android:name="android.permission.VIBRATE"/> <uses-permission android:name="android.permission.WAKE_LOCK"/> firebase-iid.properties firebase-measurement-connector-impl.properties <uses-permission android:name="android.permission.WRITE_SYNC_SETTINGS"/> firebase-measurement-connector.properties <uses-permission android:name="com.android.launcher.permission.INSTALL_SHORTCUT"/> <uses-permission android:name="android.permission.USE_FINGERPRINT"/p</p> okhttp3 <uses-permission android:name="android.permission.READ_CALENDAR"/> play-services-ads-identifier.properties <uses-permission android:name="android.permission.CAMERA"/> <uses-permission android:name="android.permission.READ_CONTACTS"/> play-services-analytics-impl.properties play-services-analytics.properties <uses-permission android:name="android.permission.MANAGE_ACCOUNTS"/> play-services-audience.properties <uses-permission android:name="android.permission.ACCESS_COARSE_LOCATION"/> play-services-auth-api-phone.properties <uses-permission android:name="android.permission.ACCESS_FINE_LOCATION"/> play-services-auth-base.properties <uses-permission android:name="android.permission.RECORD_AUDIO"/> <uses-permission android:name="android.permission.READ_PHONE_STATE"/> play-services-auth.properties play-services-base.properties <uses-permission android:name="android.permission.WRITE_EXTERNAL_STORAGE"/> <uses-permission android:name="com android vending BILLING"/> play-services-basement.properties <uses-permission android:name="android.permission.USE_CREDENTIALS"/> play-services-drive.properties <uses-permission android:name="android.permission.AUTHENTICATE_ACCOUNTS"/> play-services-gcm.properties play-services-iid.properties <uses-permission android:name="com.sonvmobile.permission.CAMERA_ADDON"/

Common Signs and Symptoms

- Android devices are most at risk
 Unexpected device behaviors for mobile malware infection
- Poor battery life
- Dropped calls and call disruptions • Unusually large phone bills
- Data plan spikes Device performance problems Unexplained application errors
- Unplanned reboots - Apps that close or open on their own - Unexplained settings changes
 - High-risk user behavior
 - Risky downloads, browsing or link-clicking
 - Spyware: Device was out of owner's control - Spyware installation requires possession of the device

Online Mobile Malware Sandboxes

Upload suspicious .apk files to the Internet for online sandbox analysis:

- https://www.joesandbox.com/
- https://amaaas.com/ https://github.com/pjlantz/droidbox

Tools installed on the local machine for

- Android SDK Dex2Jar
- Dexter

Local Static Malware Analysis

mobile malware analysis:

- JD-GUI
- *Virtual machine environments for mobile malware analysis: Santoku

Signature-Based **Specification-Based** Behavioral-Based **Data Mining Cloud-Based** Malware action— do families behave **Bit Defender/** What activity is App store approach, dynamic analysis arching for patterns considered normal **Check installed Check downloads** Establish a folder(s) for applications for suspicious timeline application files suspicious files **Beyond Scanning for Check browser** Research error **Malware with Forensic** messages/notifications history for visits to for clues about infection suspicious sites and AV Tools **Examine other activity on** Check for links from phone around the SMS. MMS. and email suspected time of infection

Mobile Malware Detection

Mobile Malware



APOLLO Apple Pattern of Life Lazy Output'er https://github.com/mac4n6/APOLLO **ILEAPP** iOS Logs, Events, And Properties Parser https://github.com/abrignoni/iLEAPP iOS-MobileiOS installation and uninstallation https://github.com/abrignoni/iOS-Mobile-Installation- Logs-Parser Installationlog parser Logs-Parser iOS Triage https://github.com/ahoog42/ios-triage Incident response tool for iOS devices Converts plist files to json, https://www.hack42labs.com/tools/fplist/details/ fplist dot notation or csv iOS_sysdiagnose_ Scripts for parsing various iOS https://github.com/cheeky4n6monkey/iOS_ forensic_scripts sysdiagnose logs sysdiagnose_forensic_scripts

Android Logs Events & Protobuf Parser

Collection of SQL query templates

for digital forensics use by

Parser for Android Usagestats files in Android Usagestats XML + xml or protobuf format Protobuf Parser Identifies, hashes and destructures all files recursively from any file system Extracts apk files from an **FAPK** Android device

Android-Usagestats-XML-Protobuf https://www.hack42labs.com/tools/ftree/details/ https://www.hack42labs.com/tools/fapk/

DFIR-SQL-SQLite-Deleted-Records-Parser SQLECmd

4n6-scripts

ALEAPP

sqlite_miner

platform and application Recovers deleted entries from Automates the identification and processing of sqlite database files Mines SQLite databases for BLOBs and potential unparsed content of interest

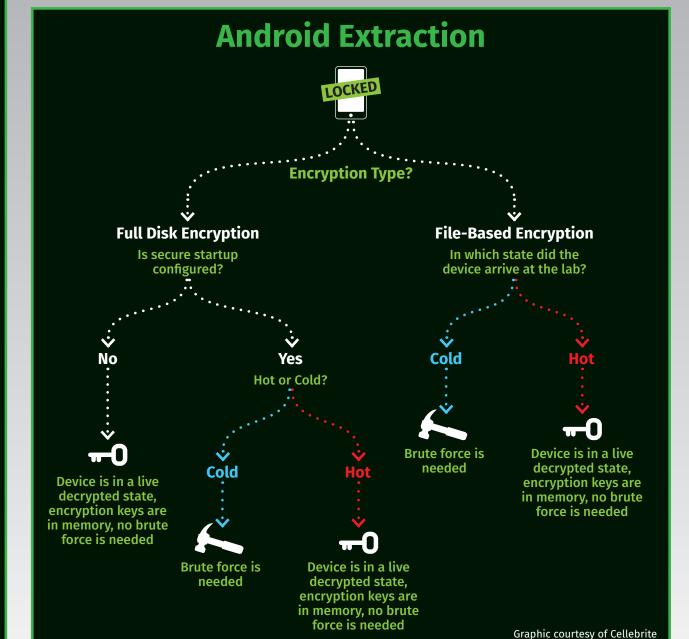
https://github.com/mdegrazia/SQLite-Deletedhttps://github.com/EricZimmerman/SQLECmd

https://github.com/abrignoni/DFIR-SQL-Query-Repo

https://github.com/abrignoni/ALEAPP

https://github.com/abrignoni/

https://github.com/threeplanetssoftware/ Collection of forensic and third-party scripts https://github.com/cheeky4n6monkey/4n6-scripts



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iOS Cheatsheet

Path DEVICE INFORMATION	Description	BFU Backup Sysdiagnose	Path ADDITION LISAGE	Description BFU Backup Sysdiagnos
DEVICE INFORMATION /private/var/installd/Library/MobileInstallation/LastBuildInfo.plist /private/var/mobile/Library/CoreDuet/coreduetd.db	Operating system version Lock/Device Passcode Info (0=unlocked, 1=locked) (Up to iOS 9)	Y Y N N N N	APPLICATION USAGE /private/var/installd/Library/Logs/MobileInstallation/mobile_installation.log.* /private/var/containers/Shared/SystemGroup/sGIJID>/Library/RatteryLife/CurrentPowerLog PL	Mobile Applications Installation Logs Y N Y SQL Battery life tracker N N Y
/private/var/mobile/Library/Logs/mobileactivationd/ /private/var/mobile/Library/Preferences/com.apple.AdLib.plist	MobileActivation Logs May show older iOS versions used Last BootTime	Y N Y Y Y N	/private/var/installd/Library/Logs/MobileInstallation/mobile_installation.log.* /private/var/containers/Shared/SystemGroup/ <guid>/Library/BatteryLife/CurrentPowerLog.PL/private/var/mobile/Library/AggregatedDictionary/ADDataStore.sqlitedb/private/var/mobile/Library/AppConduit/AvailableApps.plist</guid>	Application tracker N N Y Application traces Y N N Installed Apps and Apps Path Y N N
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