Windows Foreinsics

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The **Windows Registry** is like the brain of a Windows system. It is a collection of databases that store all the important configuration details for the system. These details include information about the computer's hardware, installed software, user settings, and even recently used files or devices. From a **forensics perspective**, the registry is valuable because it provides critical insights into a computer's activity, such as which programs were run, what devices were connected, and much more.

You can view and edit the registry using a built-in tool called **regedit.exe**. This tool allows users to explore and modify the data in the registry.

Key Components of the Windows Registry:

1. Keys and Values:

- **Registry Keys**: These are like folders in a file system. When you open the registry in regedit.exe, the "folders" you see are the keys.
- **Registry Values**: These are the actual data stored inside the keys. Think of them as files stored inside folders.
- **Registry Hive**: A collection of keys, subkeys, and values grouped together in one file.

Structure of the Registry:

The registry is organized into **five root keys**, each serving a specific purpose:

1. HKEY_CURRENT_USER (HKCU):

- Stores settings and configurations for the currently logged-in user.
- Examples: Desktop background, Control Panel settings, screen colors, etc.
- This key reflects the user's profile and is specific to them.

2. HKEY_USERS (HKU):

- Contains data for all user profiles on the system.
- The **HKEY_CURRENT_USER** is a subkey of this root key.
- Think of it as a master key containing settings for every user account.

3. HKEY_LOCAL_MACHINE (HKLM):

- Stores system-wide settings for the computer, regardless of which user is logged in.
- Examples: Hardware configuration, software installed for all users, etc.
- It is vital for system stability and contains information that applies to every user.

4. HKEY_CLASSES_ROOT (HKCR):

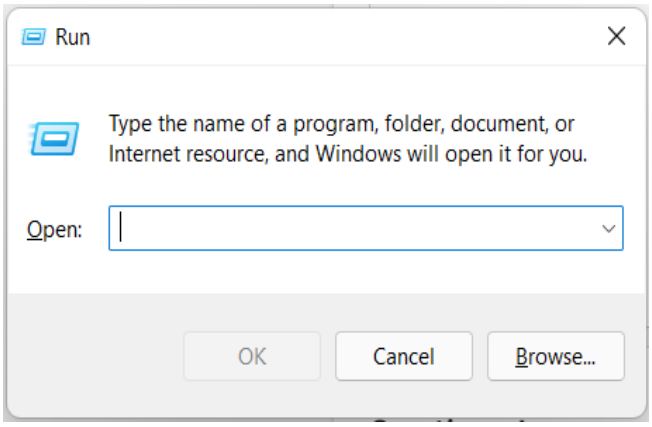
- Contains settings that determine how files and programs interact.
- Example: When you double-click a `.txt` file, this key ensures it opens with Notepad (or another default program).
- **Details on its behavior**:
    - It is a merged view of two keys:
        - **HKEY_LOCAL_MACHINE\Software\Classes**: Default settings for all users.
        - **HKEY_CURRENT_USER\Software\Classes**: Overrides default settings for the current user.
    - If you change something in HKCR:
        - If a corresponding key exists in **HKEY_CURRENT_USER\Software\Classes**, the change is saved there.
        - Otherwise, the change is saved in **HKEY_LOCAL_MACHINE\Software\Classes**.

5. HKEY_CURRENT_CONFIG (HKCC):

- Contains information about the computer's **hardware configuration** during startup.
- Example: Details about the current hardware profile being used (like which monitor or printer is connected).

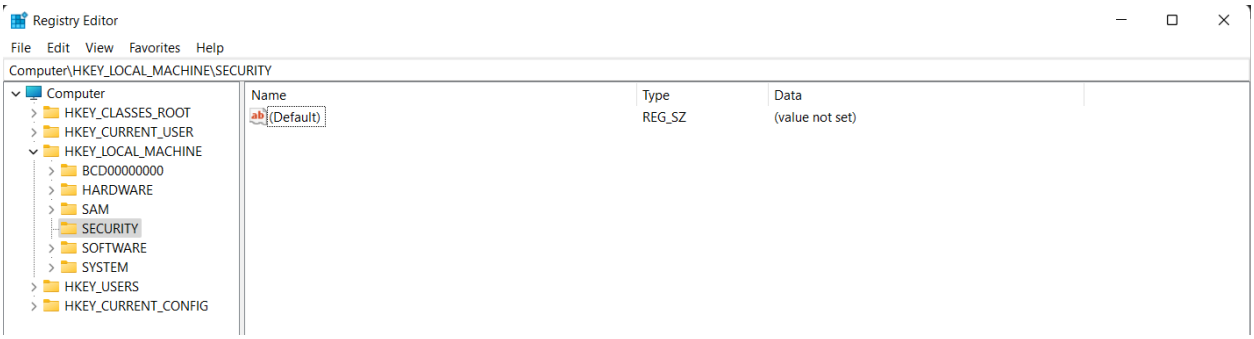
Accessing the Registry:

1. Press the **Windows Key + R** to open the Run prompt.
2. Type `regedit.exe` and hit **Enter**.
3. This will open the **Registry Editor** window.



Exploring the Registry:

- On the left side, you'll see a **tree view** with the root keys (like HKCU, HKLM, etc.).
- When you click on a key, its **values** (data) will appear on the right pane.
- You can view or edit these values by right-clicking on them and selecting **Properties**.



Why is the Registry Important?

- **System Configuration**: Stores critical information that makes your system run smoothly.
- **Forensics Use**: Helps investigators trace user activity, identify recently connected devices, or check recently used programs.
- **Customizations**: Advanced users can modify the registry to tweak system behavior.

Summary of Root Keys:

Root Key	Purpose
HKEY_CURRENT_USER	Current user's settings (desktop, Control Panel, etc.).
HKEY_USER	Settings for all user profile on the system
HEKEY_LOCAL_MACHINE	System-wide settings (hardware, software, etc)
HKEY_CLASSES_ROOT	Determines which program opens fuels and how programs interact with files.
HKEY_CURRENT_CONFIG	Current hardware profile used during system startup.

Accessing the Registry on a Live System

When working on a **live Windows system**, you can access the registry using the built-in tool called **regedit.exe**. This tool allows you to view all the standard **root keys** (like HKEY_LOCAL_MACHINE, HKEY_CURRENT_USER, etc.) that were explained earlier.

Accessing the Registry on a Disk Image

If you're analyzing a **disk image** (instead of a live system), you cannot use regedit.exe directly. Instead, you need to know where the **registry hives** (the actual registry files) are located on the disk. These hives are stored in specific locations, typically in the directory:

```
C:\Windows\System32\Config
```

The key hives in this directory are:

1. **DEFAULT**
   - This hive is mounted under: `HKEY_USERS\DEFAULT`
2. **SAM**
   - This hive is mounted under: `HKEY_LOCAL_MACHINE\SAM`
3. **SECURITY**
   - This hive is mounted under: `HKEY_LOCAL_MACHINE\SECURITY`
4. **SOFTWARE**
   - This hive is mounted under: `HKEY_LOCAL_MACHINE\SOFTWARE`
5. **SYSTEM**
   - This hive is mounted under: `HKEY_LOCAL_MACHINE\SYSTEM`

These hives contain vital information about the system, including software configurations, security settings, user accounts, and more.

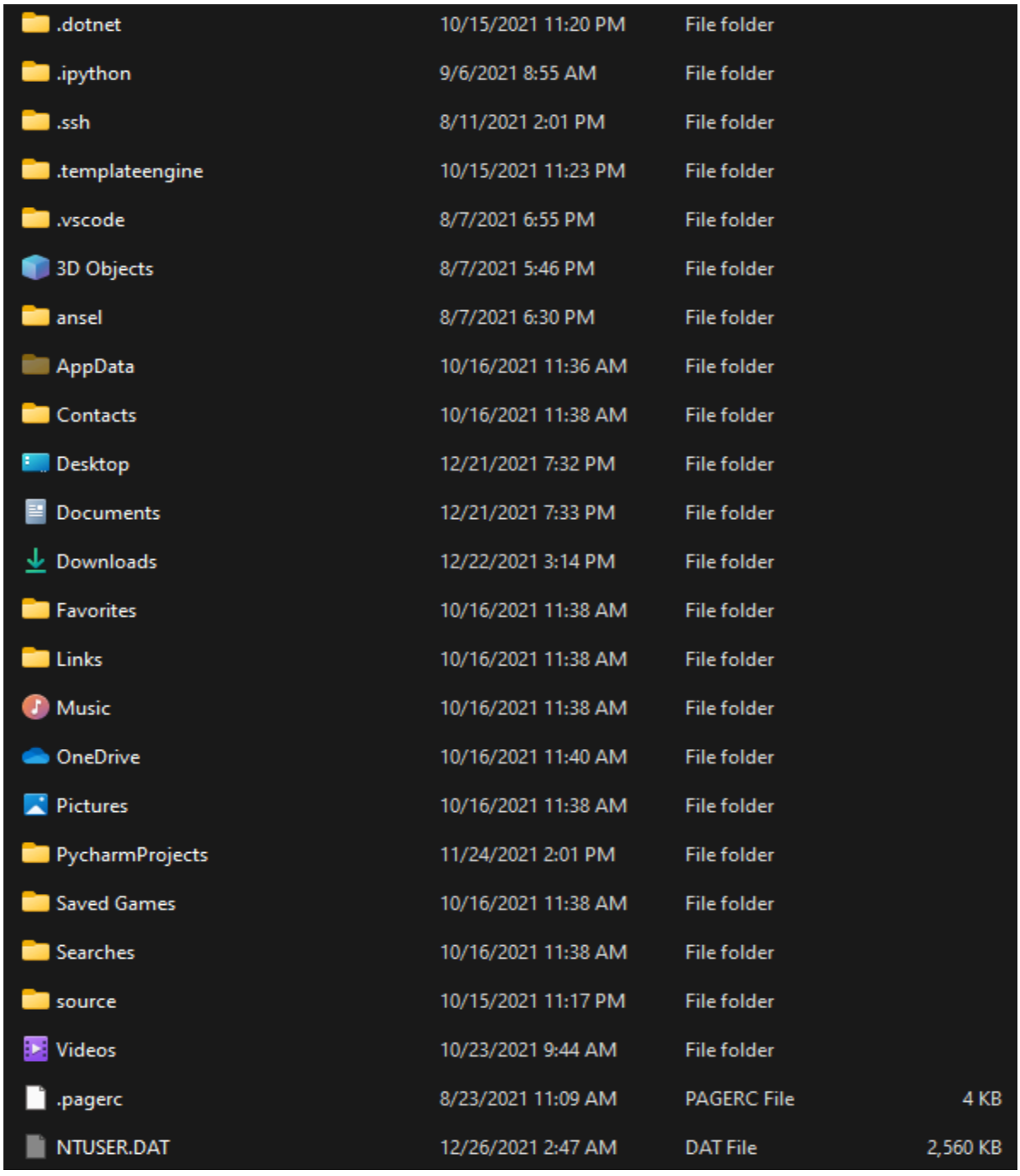
Hives Containing User Information

There are additional **hives** that contain user-specific information. These hives are located in the user's profile directory. For **Windows 7 and later versions**, a user's profile directory is typically:

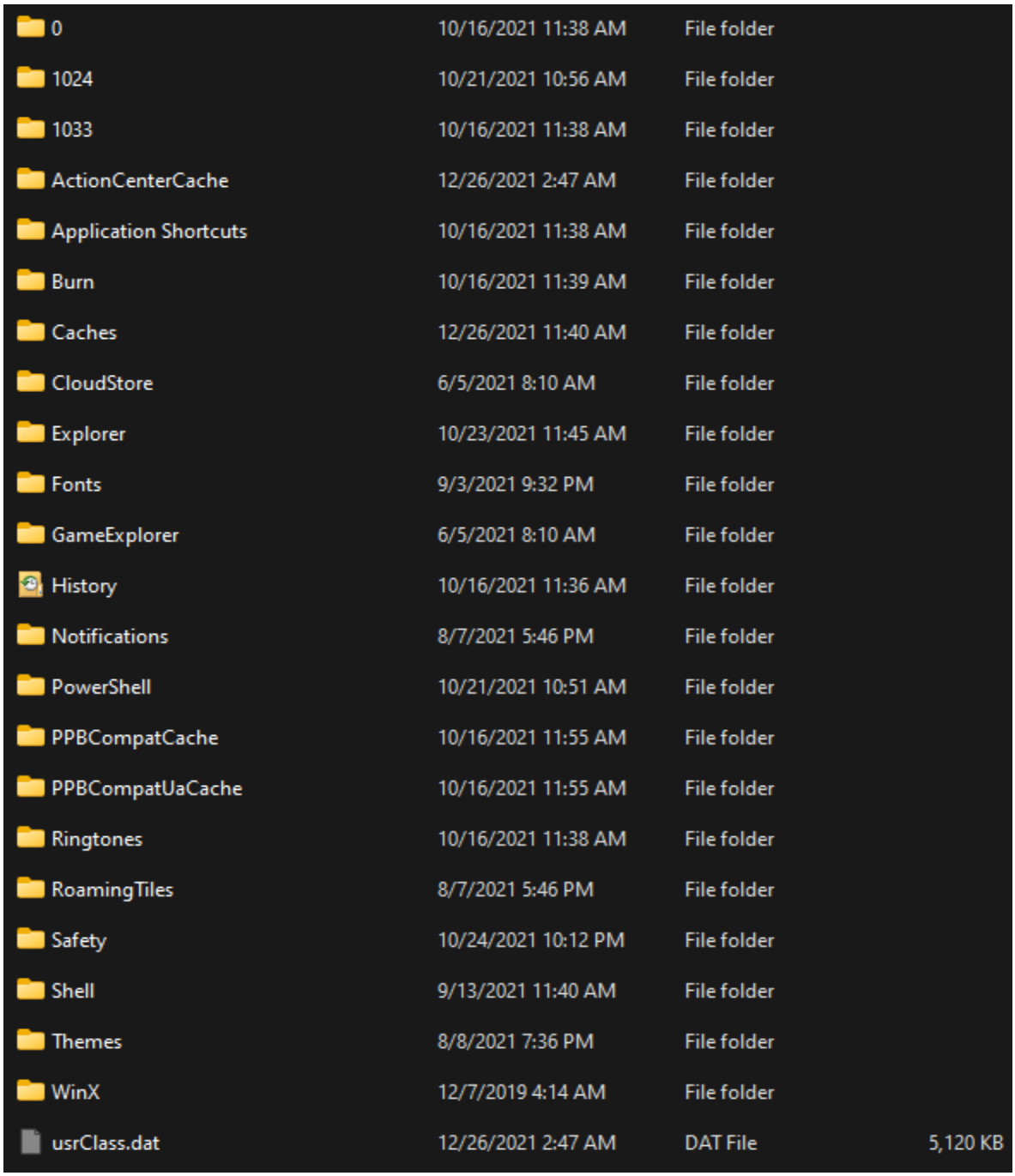
```
C:\Users\<username>\
```

The two user-specific hives are:

1. **NTUSER.DAT**
    - Location: `C:\Users\<username>\`
    - Mounted on: `HKEY_CURRENT_USER` when the user logs in.
    - This hive contains personal settings, configurations, and information specific to that user.



2. **USRCLASS.DAT**



0	10/16/2021 11:38 AM	File folder	
1024	10/21/2021 10:56 AM	File folder	
1033	10/16/2021 11:38 AM	File folder	
ActionCenterCache	12/26/2021 2:47 AM	File folder	
Application Shortcuts	10/16/2021 11:38 AM	File folder	
Burn	10/16/2021 11:39 AM	File folder	
Caches	12/26/2021 11:40 AM	File folder	
CloudStore	6/5/2021 8:10 AM	File folder	
Explorer	10/23/2021 11:45 AM	File folder	
Fonts	9/3/2021 9:32 PM	File folder	
GameExplorer	6/5/2021 8:10 AM	File folder	
History	10/16/2021 11:36 AM	File folder	
Notifications	8/7/2021 5:46 PM	File folder	
PowerShell	10/21/2021 10:51 AM	File folder	
PPBCompatCache	10/16/2021 11:55 AM	File folder	
PPBCompatUaCache	10/16/2021 11:55 AM	File folder	
Ringtones	10/16/2021 11:38 AM	File folder	
RoamingTiles	8/7/2021 5:46 PM	File folder	
Safety	10/24/2021 10:12 PM	File folder	
Shell	9/13/2021 11:40 AM	File folder	
Themes	8/8/2021 7:36 PM	File folder	
WinX	12/7/2019 4:14 AM	File folder	
usrClass.dat	12/26/2021 2:47 AM	DAT File	5,120 KB

- Location: `C:\Users\<username>\AppData\Local\Microsoft\Windows`
- Mounted on: `HKEY_CURRENT_USER\Software\CLASSES`.
- This hive stores additional user-specific settings related to software.

Both **NTUSER.DAT** and **USRCLASS.DAT** are **hidden files**, so you may need to enable the option to view hidden files in Windows to see them.

The AmCache Hive

Another important hive is the **AmCache hive**, which is located at:
`C:\Windows\AppCompat\Programs\Amcache.hve`

The **AmCache hive** is crucial because it contains information about **programs recently run** on the system. This is highly useful for forensic investigations to determine which programs were executed and when.

Transaction Logs and Backups

1. Transaction Logs

- These are **log files** that act as a **journal** for changes made to registry hives.
- When changes are made to a registry hive, they are first written to these **transaction logs** before being applied to the hive itself. This means that the transaction logs might contain the **most recent changes** that haven't yet been applied to the registry hive.
- The transaction logs for each hive are stored in the same directory as the hive and have the same name but with a **.LOG** extension.
  For example:
  - The transaction log for the SAM hive is located at:
    `C:\Windows\System32\Config\SAM.LOG`
  - If there are multiple logs, they will be named as `SAM.LOG1`, `SAM.LOG2`, etc.

Why Are Transaction Logs Important?

Transaction logs are valuable in forensic investigations as they may contain critical information about recent changes that are not visible in the main registry hives.

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2. Registry Backups

- Windows automatically creates **backups of registry hives** every ten days.
- These backups are stored in:
  `C:\Windows\System32\Config\RegBack`
- If registry keys have been **deleted** or **modified**, you can check these backups to see the earlier state of the registry.

Why Are Backups Useful?

Backups allow investigators to compare the current state of the registry with the past state to detect modifications or deletions.

Summary of Key Locations

Hive/File	Location	Mounted Under
DEFAULT	`C:\Windows\System32\Config`	`HKEY_USERS\DEFAULT`
SAM	`C:\Windows\System32\Config`	`HKEY_LOCAL_MACHINE\SAM`
SECURITY	`C:\Windows\System32\Config`	`HKEY_LOCAL_MACHINE\SECURITY`
SOFTWARE	`C:\Windows\System32\Config`	`HKEY_LOCAL_MACHINE\SOFTWARE`
SYSTEM	`C:\Windows\System32\Config`	`HKEY_LOCAL_MACHINE\SYSTEM`
NTUSER.DAT	`C:\Users\<username>\`	`HKEY_CURRENT_USER`
USRCLASS.DAT	`C:\Users\<username>\AppData\Local\Microsoft\Windows`	`HKEY_CURRENT_USER\Software\CLASSES`

AmCache.hve	`C:\Windows\AppCompat\Programs\Amcache.hve`	Not directly mounted; useful for recent program info
Transaction Logs	Same directory as registry hives, with `.LOG`	Stores recent changes
Registry Backups	`C:\Windows\System32\Config\RegBack`	Contains backups of registry hives

Final Notes

- **Live system:** Use regedit.exe to explore registry keys.
- **Disk image:** Look for hives in the specified directories.
- **Hidden files:** NTUSER.DAT and USRCLASS.DAT require enabling hidden file visibility.
- **AmCache hive:** Critical for identifying recently run programs.
- **Transaction logs and backups:** Essential for forensic investigations to track changes and restore deleted/modified registry data.

Simplified Explanation for Forensic Analysis Using the Windows Registry

When investigating a Windows system for forensic purposes, we can use the **Windows Registry** to gather important information about the system. Below are the key steps and what each part of the registry tells us:

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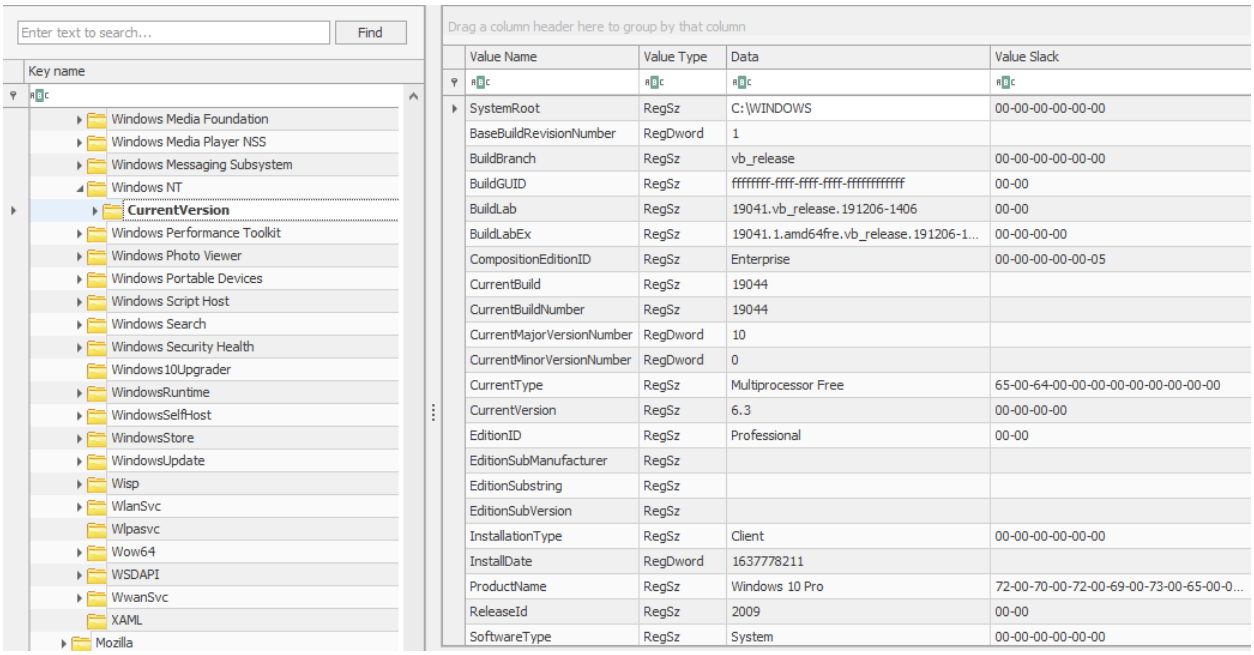
1. Finding the OS Version

- To determine the **Operating System version** (e.g., Windows 10, Windows 11), we check the registry key:
  `SOFTWARE\Microsoft\Windows NT\CurrentVersion`
- This key tells us the OS version from which the forensic data was collected.



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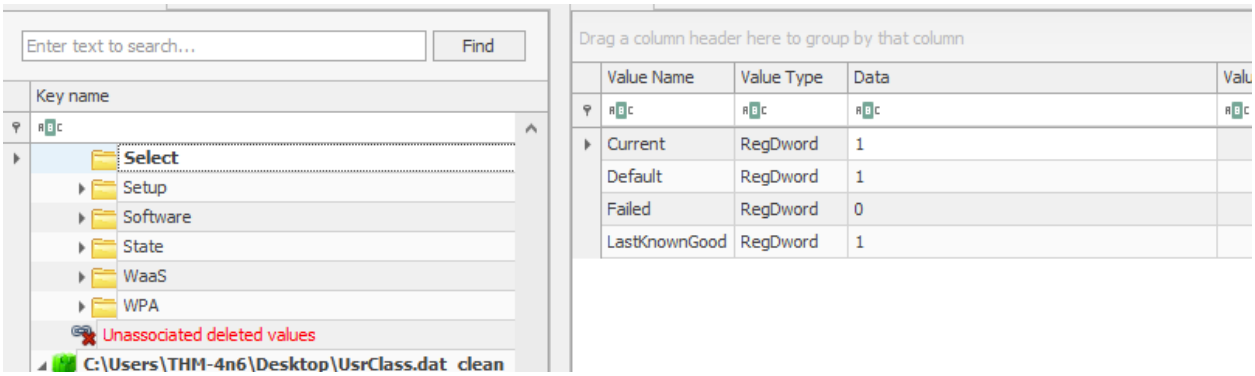
2. Finding the Current Control Set

- **Control Sets** store the system's configuration for startup. Commonly, there are two:
  - **ControlSet001**: Represents the current configuration used during startup.
  - **ControlSet002**: Stores the last known good configuration.
- To find the **CurrentControlSet** (the active one), look at: `SYSTEM\Select\Current`

- The **last known good configuration** is located at:
  `SYSTEM\Select\LastKnownGood`



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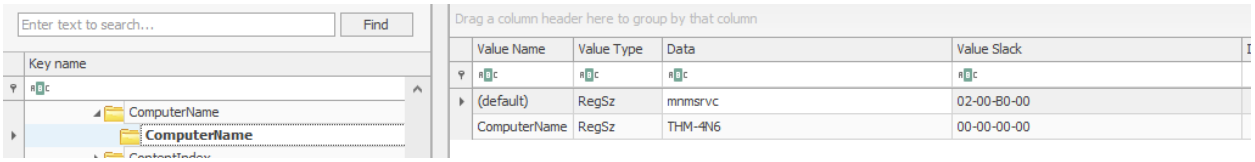
3. Finding the Computer Name

- The **computer's name** helps confirm that we're investigating the right machine.
- The registry key to find the computer name is:
  `SYSTEM\CurrentControlSet\Control\ComputerName\ComputerName`



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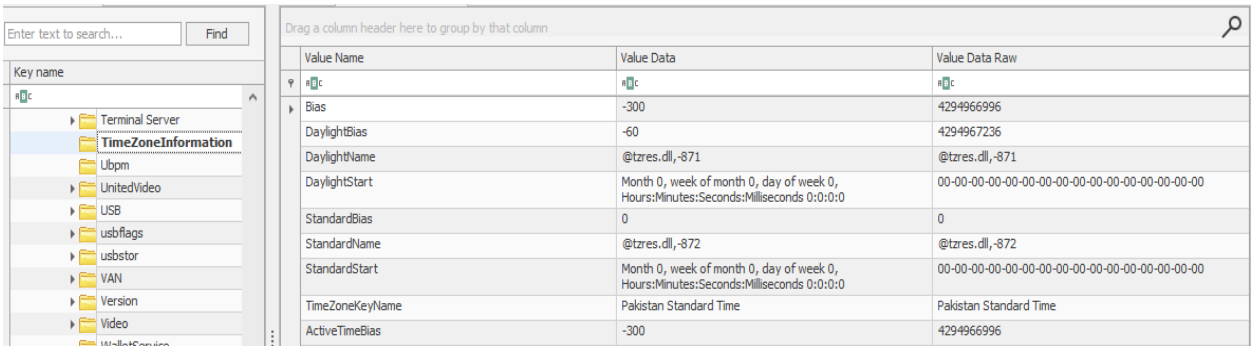
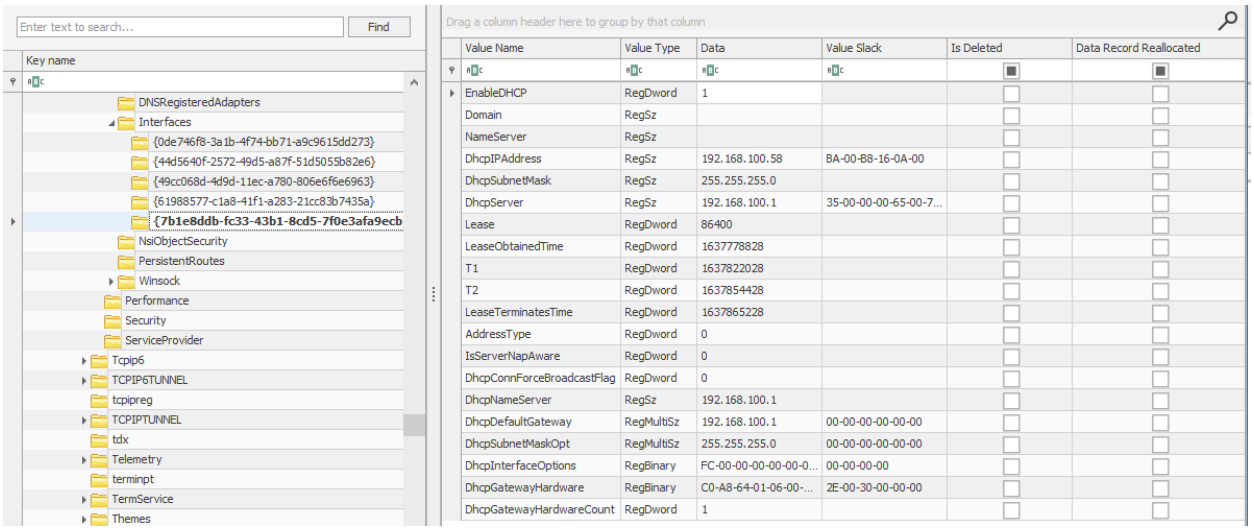
4. Finding Time Zone Information

- Knowing the **time zone** helps us interpret timestamps (some are in UTC, others in local time).
- Time zone information is found at:
  `SYSTEM\CurrentControlSet\Control\TimeZoneInformation`



5. Finding Network Interfaces

- To see the **network interfaces** (like Wi-Fi or Ethernet adapters) on the machine, look at:
  `SYSTEM\CurrentControlSet\Services\Tcpip\Parameters\Interfaces`
- Each interface has a unique ID (GUID) with details like:
  - IP addresses
  - Subnet Mask
  - DNS Servers
  - DHCP details



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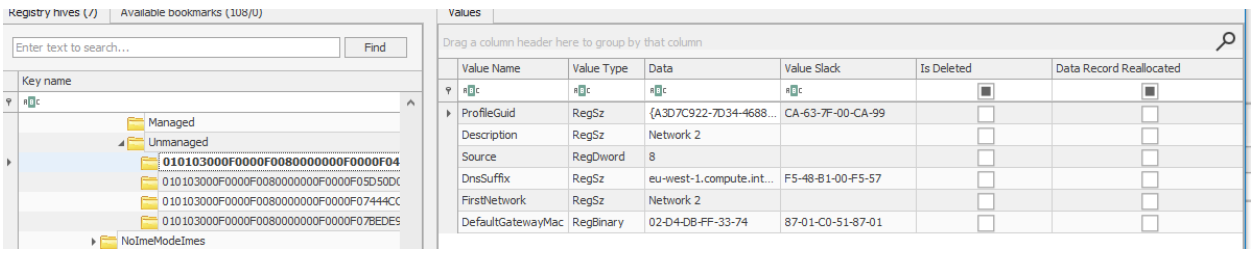
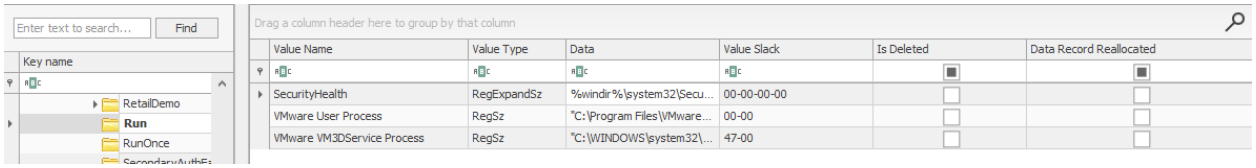
6. Finding Past Networks

- To find **networks the machine was connected to previously**, use:
  - **Unmanaged Networks**:
    `SOFTWARE\Microsoft\Windows NT\CurrentVersion\NetworkList\Signatures\Unmanaged`
  - **Managed Networks**:
    `SOFTWARE\Microsoft\Windows NT\CurrentVersion\NetworkList\Signatures\Managed`
- The **last write time** shows when the machine last connected to these networks.



7. Finding Programs that Start Automatically (Autoruns)

- Programs or commands that run automatically during login can be found at:
  - **`NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Run`**
  - **`SOFTWARE\Microsoft\Windows\CurrentVersion\Run`**
  - **`SOFTWARE\Microsoft\Windows\CurrentVersion\RunOnce`**
- To check for **services that start at boot**, look at:
  `SYSTEM\CurrentControlSet\Services`
  - If the **Start key** is set to `0x02`, it means the service starts at boot.



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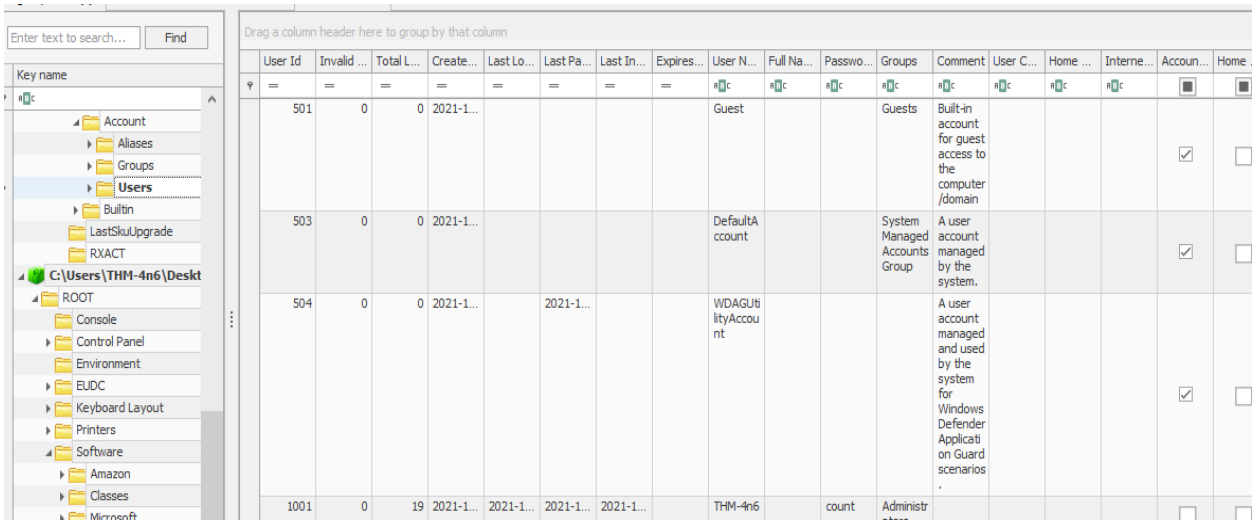
8. Finding User Information (SAM Hive)

- The **SAM hive** (Security Accounts Manager) contains user account details such as:
  - **Usernames and IDs (RIDs)**
  - Number of logins
  - Last login and failed login times
  - Password policy (e.g., expiry, hints, etc.)
  - Groups the user belongs to
- This information is located at:
  `SAM\Domains\Account\Users`



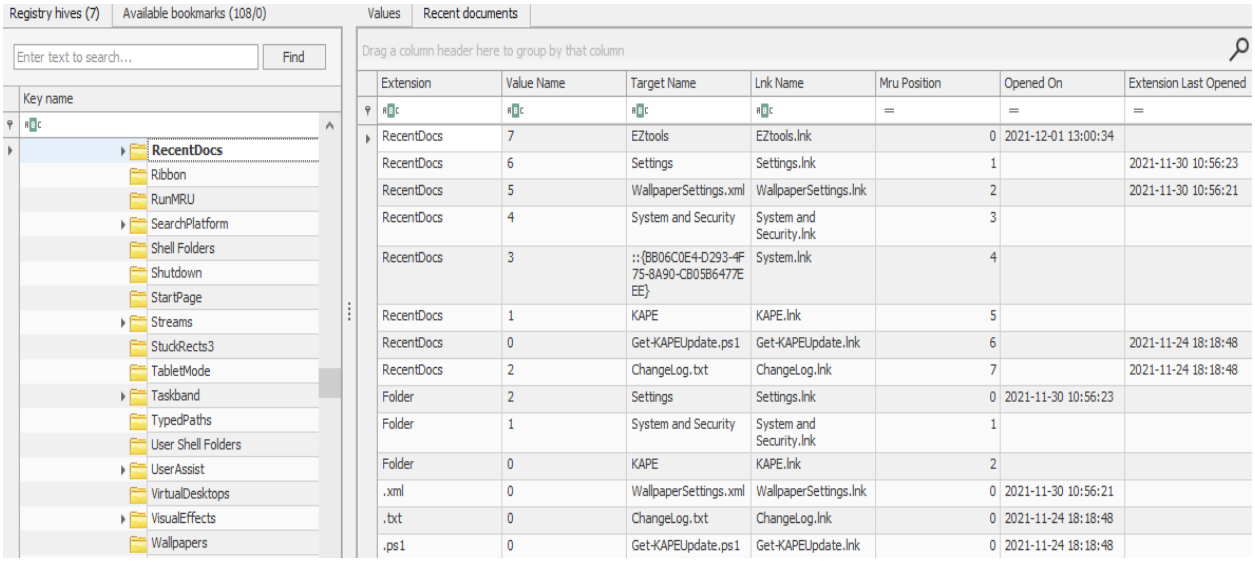
Why Is This Information Important?

- **OS Version**: Helps identify the type of system you're analyzing.
- **Control Sets**: Determines system configurations during startup.
- **Computer Name**: Confirms the machine's identity.
- **Time Zone**: Helps create a timeline of events.
- **Network Interfaces and Past Networks**: Tracks network connections and IP addresses.
- **Autoruns**: Finds programs/services that run on startup (potentially malicious ones).
- **SAM Hive**: Provides detailed user account and login activity information.

This data is critical for piecing together evidence during a forensic investigation

Recent Files

- **What is it?**
  Windows keeps a record of files that a user recently opened. This is visible in "Recent Files" in Windows Explorer.
- **Where is it stored?**
  This information is stored in the **NTUSER.DAT** file under the registry path: `NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\RecentDocs`



- **How does it work?**
  Registry Explorer organizes these files, showing the **Most Recently Used (MRU)** file at the top. You can also check specific file types, such as PDFs or Word documents.

For example:
`NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\RecentDocs\.pdf`
This shows a list of recently opened PDF files.

- **What else can we find?**
  It even includes the **last opened time** for each file.

Office Recent Files

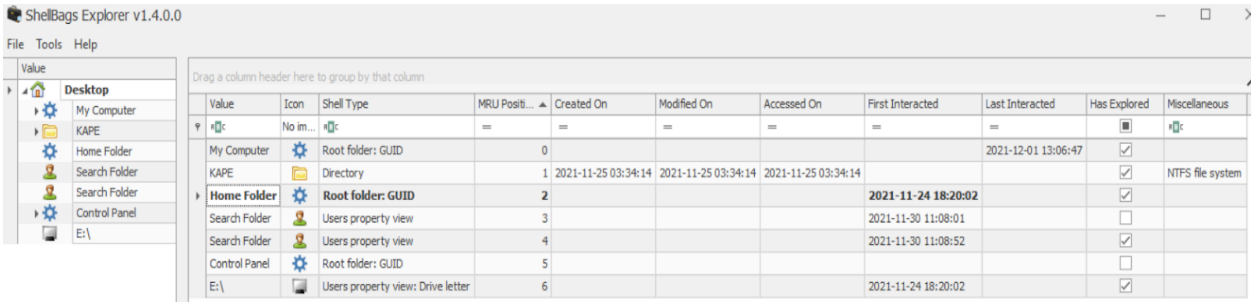
- **What is it?**
  Microsoft Office also keeps a list of recently opened files (like Word documents, Excel sheets, etc.).
- **Where is it stored?**
  This information is stored in the **NTUSER.DAT** file under paths like:
  `NTUSER.DAT\Software\Microsoft\Office\VERSION`
  Here, "VERSION" depends on the Office version. For example:
- Office 2013 = `15.0`
- Office 2016 = `16.0`
- Office 365 uses the user's **Live ID** for storing recent files.
- **What does it include?**
  The registry stores the **complete path** of recently opened files.

ShellBags

- **What is it?**
  Windows remembers the layout and view settings (e.g., list, details, icons) for folders that users open.
- **Why is it important?**
  This data can show **folders recently accessed** by a user, which is useful in forensic analysis.
- **Where is it stored?**
  The information is in the following registry keys:

1. `USRCLASS.DAT\Local Settings\Software\Microsoft\Windows\Shell\Bags`
2. `USRCLASS.DAT\Local Settings\Software\Microsoft\Windows\Shell\BagMRU`
3. `NTUSER.DAT\Software\Microsoft\Windows\Shell\BagMRU`
4. `NTUSER.DAT\Software\Microsoft\Windows\Shell\Bags`

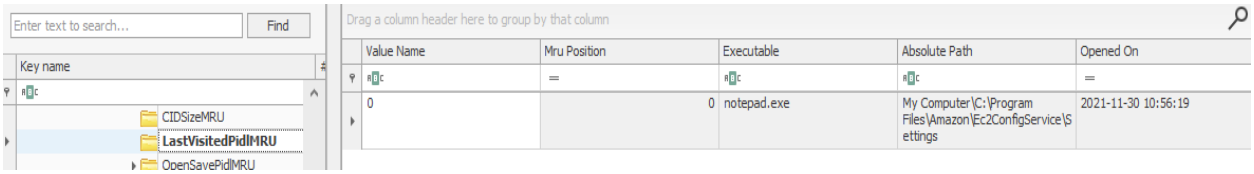
- **How do we analyze it?**
  Tools like **ShellBag Explorer** (by Eric Zimmerman) make it easy to interpret this data.



Open/Save and LastVisited Dialog MRUs

- **What is it?**
  When you open or save a file in Windows, a dialog box appears. Windows **remembers the last location** where you opened/saved files.
- **Where is it stored?**
  This data is saved in the following registry keys:

1. `NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\OpenSavePIDlMRU`
2. `NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\LastVisitedPidlMRU`



- **Why is it important?**
  It helps forensic analysts find **recently opened/saved files** and their locations.

Windows Explorer Address/Search Bars

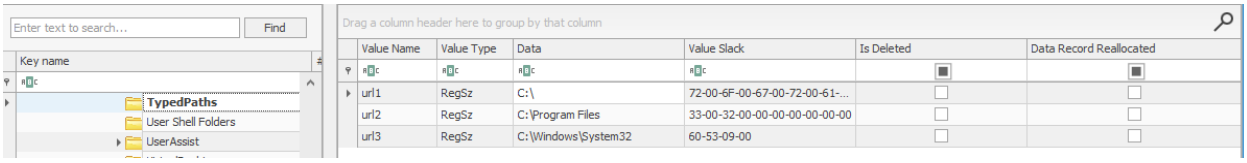
- **What is it?**
  Windows Explorer keeps a record of:

1. Paths typed in the address bar (e.g., "C:\Users\Documents").
2. Searches made in the search bar.

- **Where is it stored?**

1. Address bar paths:
   `NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\TypedPaths`
2. Search bar queries:
   `NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\WordWheelQuery`

- **Why is it useful?**
  This data provides insights into user activity, such as **locations accessed** and **queries searched**.



Key Takeaways

1. **Recent Files**: Tracks files opened recently by type and time.
2. **Office Recent Files**: Tracks recent Microsoft Office documents.
3. **ShellBags**: Records folder layouts and access history.
4. **Open/Save Dialogs**: Shows recently accessed file locations.
5. **Explorer Activity**: Tracks typed paths and search queries.

Each of these can provide critical information about a user's activities on a system during forensic analysis.

Here’s a simplified explanation of these Windows artifacts and their purposes, written in easy-to-understand language:

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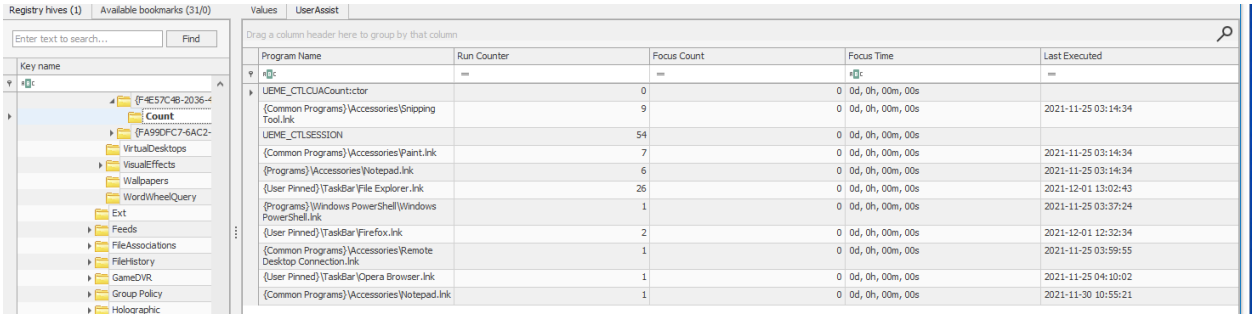
1. UserAssist

- **What it is:** Windows keeps track of programs you open using Windows Explorer. This is saved in the **UserAssist** registry key for each user. It helps Windows know which programs you use most often.

Location in Registry:
`NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\UserAssist\{GUID}\Count`



- **What it stores:**
  - The name of the program.
  - The number of times the program was opened.
  - The last time the program was launched.
- **Limitations:** Programs launched from the command line are **not** recorded here.
- **Tools to View:** Use **Registry Explorer** to view this data.

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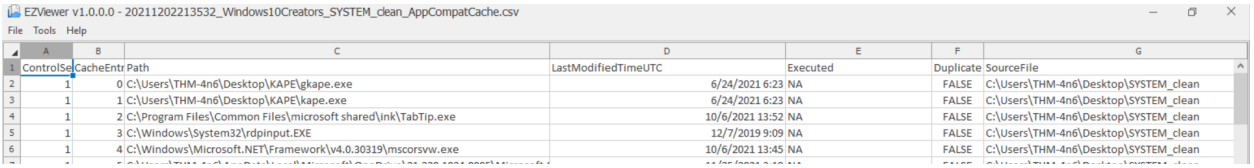
2. ShimCache (Application Compatibility Cache)

- **What it is:** ShimCache tracks all programs launched on your system. It was designed to help old programs work with newer versions of Windows (backward compatibility).

Location in Registry:
`SYSTEM\CurrentControlSet\Control\Session Manager\AppCompatCache`

- **What it stores:**
  - File names of the programs.
  - File size.
  - Last modified time (not the execution time).

- **How to Read:** ShimCache data is not easy to read directly in Registry Explorer. Instead, use the **AppCompatCache Parser** tool. It can convert the data into a CSV (spreadsheet) file that shows the information clearly.


EZViewer v1.0.0.0 - 20211202213532_Windows10Creators_SYSTEM_clean_AppCompatCache.csv

File Tools Help

	A	B	C	D	E	F	G
1	ControlSe	CacheEntr	Path	LastModifiedTimeUTC	Executed	Duplicate	SourceFile
2	1	0	C:\Users\THM-4n6\Desktop\KAPE\gkape.exe	6/24/2021 6:23	NA	FALSE	C:\Users\THM-4n6\Desktop\SYSTEM_clean
3	1	1	C:\Users\THM-4n6\Desktop\KAPE\kape.exe	6/24/2021 6:23	NA	FALSE	C:\Users\THM-4n6\Desktop\SYSTEM_clean
4	1	2	C:\Program Files\Common Files\microsoft shared\ink\TabTip.exe	10/6/2021 13:52	NA	FALSE	C:\Users\THM-4n6\Desktop\SYSTEM_clean
5	1	3	C:\Windows\System32\rdpinput.EXE	12/7/2019 9:09	NA	FALSE	C:\Users\THM-4n6\Desktop\SYSTEM_clean
6	1	4	C:\Windows\Microsoft.NET\Framework\v4.0.30319\mscorsvw.exe	10/6/2021 13:45	NA	FALSE	C:\Users\THM-4n6\Desktop\SYSTEM_clean

Command to Use Parser:

```
AppCompatCacheParser.exe --csv <output file path> -f <SYSTEM hive file path> -c <control set>
```

3. AmCache

- **What it is:** AmCache is similar to ShimCache but provides more detailed information about programs that were run on the system.

Location in File System:

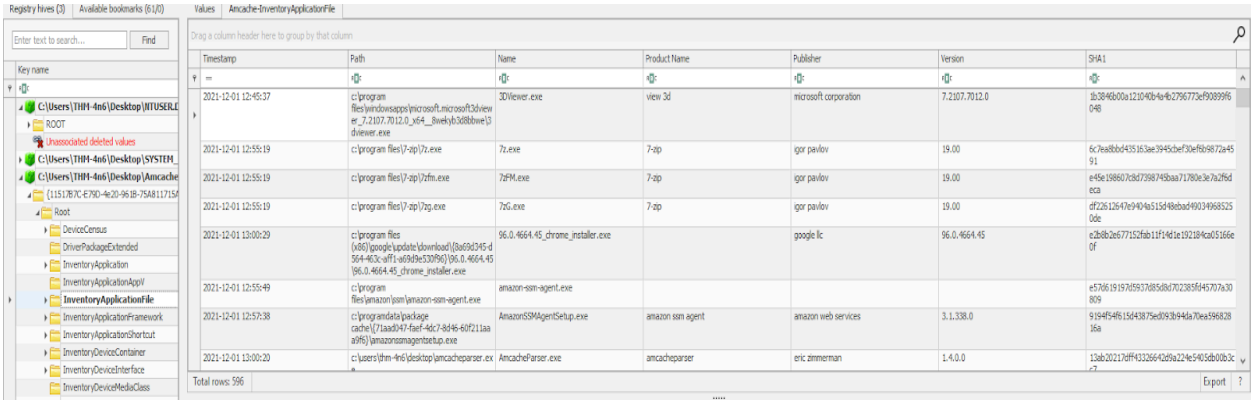
```
C:\Windows\appcompat\Programs\Amcache.hve
```

-
- **What it stores:**
  - Execution path (where the program was launched from).
  - Installation, execution, and deletion times of the program.
  - The SHA-1 hash of the program (used for security checks).

Registry Key for Last Run Programs:

```
Amcache.hve\Root\File\{Volume GUID}\
```

- **Tools to Use:** Use **Registry Explorer** to view AmCache data.



4. BAM/DAM

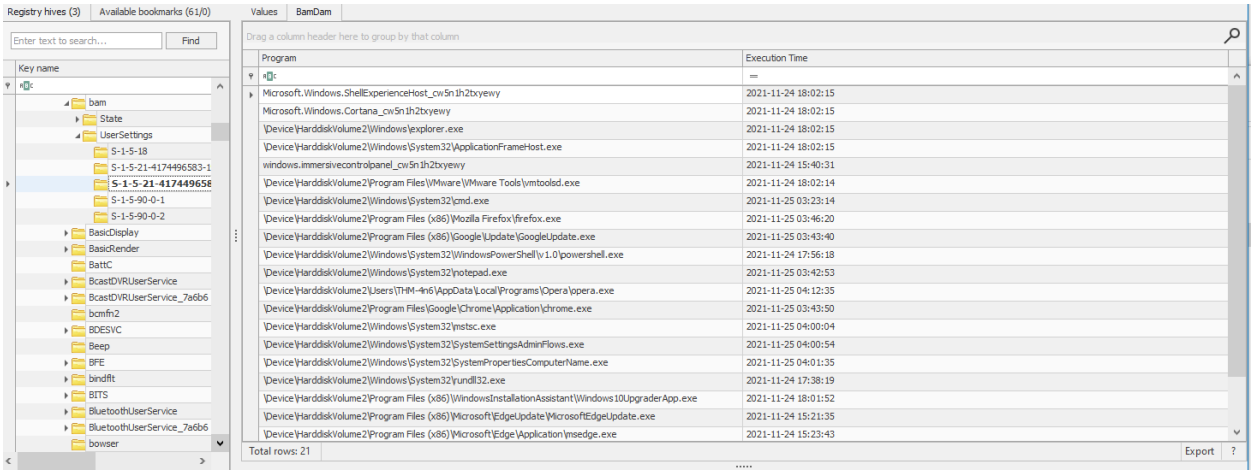
- **What it is:**
    - **BAM (Background Activity Monitor):** Keeps track of programs running in the background.
    - **DAM (Desktop Activity Moderator):** Manages power consumption by controlling app activities.

Location in Registry:
sql
Copy code

```
SYSTEM\CurrentControlSet\Services\bam\UserSettings\{SID}

SYSTEM\CurrentControlSet\Services\dam\UserSettings\{SID}
```

- Here, **SID** refers to the unique user ID on the computer.
- **What it stores:**
    - Program names and their full paths.
    - The last time the program was executed.
- **Tools to Use:** Use **Registry Explorer** to view this data.



Summary:

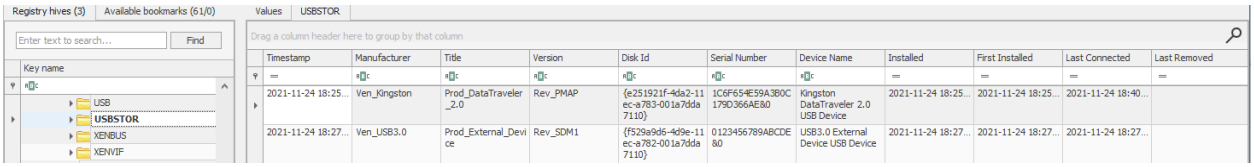
- **UserAssist:** Tracks programs opened using Windows Explorer.
- **ShimCache:** Tracks all launched programs for compatibility purposes.
- **AmCache:** Stores more detailed data about executed programs, including their installation times and security hashes.
- **BAM/DAM:** Monitors background apps and optimizes power usage.

1. Device Identification

- **Purpose:** Tracks USB devices connected to the system, including their **Vendor ID**, **Product ID**, and **Version**.

Registry Keys:
`SYSTEM\CurrentControlSet\Enum\USBSTOR`

`SYSTEM\CurrentControlSet\Enum\USB`



- **What it shows:**
  - Unique device details (e.g., vendor, product).
  - Connection timestamps.
- **Tool:** Use **Registry Explorer** to view this information in a readable format.

---

2. First/Last Connection and Removal Times

- **Purpose:** Tracks the first connection, last connection, and last removal times of USB devices.

Registry Key:

`SYSTEM\CurrentControlSet\Enum\USBSTOR\Ven_Prod_Version\USBSerial#\Properties\{83da6326-97a6-4088-9453-a19231573b29}\####`

- Replace `####` with:
  - **0064** → First connection time.
  - **0066** → Last connection time.
  - **0067** → Last removal time.
- **Tool: Registry Explorer** automatically shows this data under the **USBSTOR** key.

---

3. USB Device Volume Name

- **Purpose:** Identifies the **volume name** of the connected USB device.

Registry Key:
`SOFTWARE\Microsoft\Windows Portable Devices\Devices`

- **What to do:** Match the **GUID** here with the **Disk ID** from the **USBSTOR** key to link the volume name with the specific USB device.