

Fixity User Guide

Version 0.4

2014-07-08

Contact information

AVPreserve

<http://www.avpreserve.com/>

GitHub repository

<https://github.com/avpreserve/fixity>

Download pages for application

Windows

<http://www.avpreserve.com/wp-content/uploads/2014/07/fixity-win-0.4.zip>

Mac

<http://www.avpreserve.com/wp-content/uploads/2014/07/fixity-mac-0.4.zip>

Note

This application is in beta. Please help refine it further by reporting all bugs to

<https://github.com/avpreserve/fixity/issues>

Change log

2014-07-01 Version 0.4

- Created OSX version (64-bit systems only)
- Added MD5 checksum algorithm option
- Added ability to change checksum algorithm for a project
- Added ability to import projects between versions of Fixity
- Added checksum and filter information to manifest (.tsv files in history directory)
- Added ability to change project name
- Added ability to update the location of a scanned directory
- Added *ignore hidden files* option in *Filter Files* dialog
- Added ability to log errors and events
- Implemented SQLite database for storing projects
- Updated logic for reporting on copied and moved files

- Added ability to delete a directory from a project
- Added *About Fixity*
- Improved handling of special characters in filepaths
- Added *history* directory to store snapshots of the manifest
- Changed project file extension from .csv to .tsv to indicate that the data uses tabs as the separator
- Changed report names and the subject line of emailed reports to include the project name
- Code and interface improvements

2014-01-13 Version 0.3

- Changed *Save Email/Time* to *Save Settings* in File Menu. Selecting this saves all project settings.
- Changed *Save and Run* to *Run Now* and altered the way this invokes the scheduler so that it doesn't tie up the Fixity UI.
- Added *Preferences > Configure Sender Email* to enable ability to configure Sender Email instead of using fixityreport@avpreserve.com as the fixed address. This is a global preference for the application. The email and password are stored using a cryptographic hash to maintain security.
- Added *Preferences > Filter Files* to enable users to exclude the scanning and validation of files. This is a project level preference.
- Added *Run when on battery power* checkbox preference to choose whether the scanning and validation tasks should occur when the computer is on battery power/not plugged in. This is a Windows Task Scheduler preference that caused a lot of confusion previously with scheduled tasks 'failing' to run. This was made explicit and placed front and center to make it clearer. If unchecked the application will not run if running on a laptop that is not plugged in. This is a project level preference.
- Added *If missed, run upon restart* checkbox preference that invokes the scheduled task to run when started if it was missed for some reason (e.g., turned off or logged out). If unchecked the application missed scheduled tasks will simply be missed. This is a project level preference.
- Added *Email only upon warning or failure* checkbox preference to leave it up to the user when to receive emailed reports. If unchecked emails will be sent to the identified recipient email addresses every time a scan is performed regardless of the results. This is a project level preference.
- Compiled as 32-bit application so that it will run on 32-bit and 64-bit systems.
- Altered behavior so that saving does not wipe the project manifest
- Updated the reporting terms:

- *Created* was changed to *New*
- *Moved* was changed to *Moved or Renamed*
- *Missing* was changed to *Removed*
- *Corrupted* was changed to *Changed*
- *Confirmed* is still *Confirmed*
- Altered behavior so that changed files are updated with their new information after being reported. Therefore a changed file will be reported as changed one time, and if no further changes occur it will not continually be reported as changed.
- Fixed bug that wouldn't allow adding new directories to an existing project.
- Fixed bug that maintained directories in slots 5, 6 and 7 when existent and creating a new project.
- A display issue with name of application in Title bar of application window was corrected.

2013-11-22 Version 0.2

- Addressed bug with scheduling issue – task was not generated properly if the filepath had a directory with spaces in it.
- Addressed bug with emailing of reports – corrected SMTP configuration
- Changed the code for images so that they display properly
- Moved AutoFixity.exe into schedule folder to avoid confusion
- Other minor code refinements
- Updated User Guide according to user feedback

Known issues

- If a scan is scheduled and does not have access to the project directories (i.e., is not logged on to a server or a removable drive is unavailable) it will report the files as missing. When run again with access to the project directories it will report the files as new.
- When importing projects between operating systems the file-path syntax is different and will result in reporting as if files having been removed because the application is unable to reach the files with the incorrect syntax. If the filepath is corrected after import but before running the scan it will work correctly.
- When importing an .fxy project file the checksum algorithm is not detected. You must set this correctly manually prior to running a scan or the application will report all files as changed. This does not apply to .tsv files.

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Brief overview and background

Fixity is a utility for the documentation and regular review of stored files. Fixity scans a folder or directory, creating a manifest of the files including their filepaths and their checksums, against which a regular comparative analysis can be run. Fixity monitors **file integrity** through generation and validation of checksums, and **file attendance** through monitoring and reporting on new, missing, moved and renamed files.

AVPreserve created Fixity after coming to the realization that:

1. Checksum generation and validation are universally recognized as a primary mechanism for fulfilling the goal of fixity.
2. Generating checksums without systematically and routinely validating them is of little or no use.
3. Most organizations that “use checksums” only generate checksums but do not validate them routinely, if ever.
4. The primary reason organizations do not systematically and routinely verify checksums is that there is no tool that allows scheduling and reporting of validation.
5. Organizations that do routinely verify checksums do not typically monitor and report on information related to file attendance.
6. Overcoming the lack of resources and/or access to IT expertise is a critical factor in enabling organizations to fulfill the goal of fixity. Organizations need a simple, low cost tool.

Fixity was created with the sole focus of fulfilling the requirements of those concerned with monitoring and managing the fixity of a collection over the long term. There are many free and open source checksum utilities out on the market, but they do not offer the feature set or simplicity necessary to fulfill the needs of many organizations. It is intended for use in monitoring collections of files that are “final state”, or ready for deposit into an archive or preservation oriented repository.

The Fixity folder

When you download and unzip Fixity, the executable files, as well as the folders for your future projects, reports, and schedules, are stored within the parent directory.

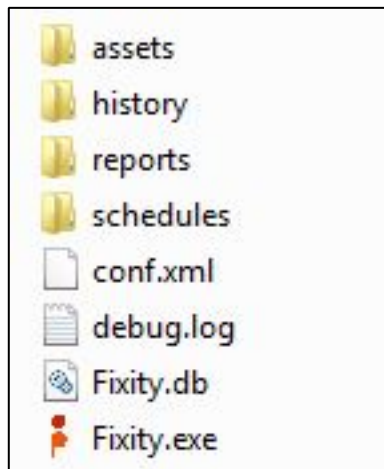


Figure 1: Fixity directory structure for Windows.

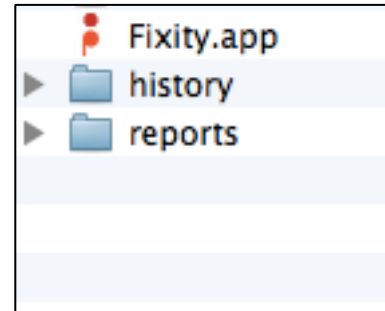


Figure 2: Fixity directory structure for Mac.

This directory can be placed anywhere on your computer but it must stay formatted as-is; if you move Fixity.exe or any of the directories from the parent folder the program will not function. On a Mac, the *history* and *reports* folders will be created in the same directory as the app the first time the application is run. Do not rename Fixity.app to any other name or the program will not function properly. If you wish, you can create shortcuts to the executable file and directories in a more convenient location. Within the parent directory you will find the following subdirectories:

bin: (Windows only) contains the database file and configuration settings for checksum and filter settings.

debug: (Windows only) contains the log reports generated when *debugging* is turned on.

history: the directory where a snapshot of the project manifest is stored each time a project is run. See section on History Snapshots for more details.

reports: the directory where reports are stored. See section on Fixity Reports for more details.

schedules: (Windows only) Stores the scheduling information necessary to update Windows Task Scheduler. Note: The AutoFixity.exe file located in the *schedules* folder is invoked during the scheduled run of Fixity, and does not need to be run manually. It should stay in place and should not be executed via double-clicking.

Fixity interface

Fixity has a graphical user interface (GUI). The following text details the behaviors of each section of the interface from left to right.

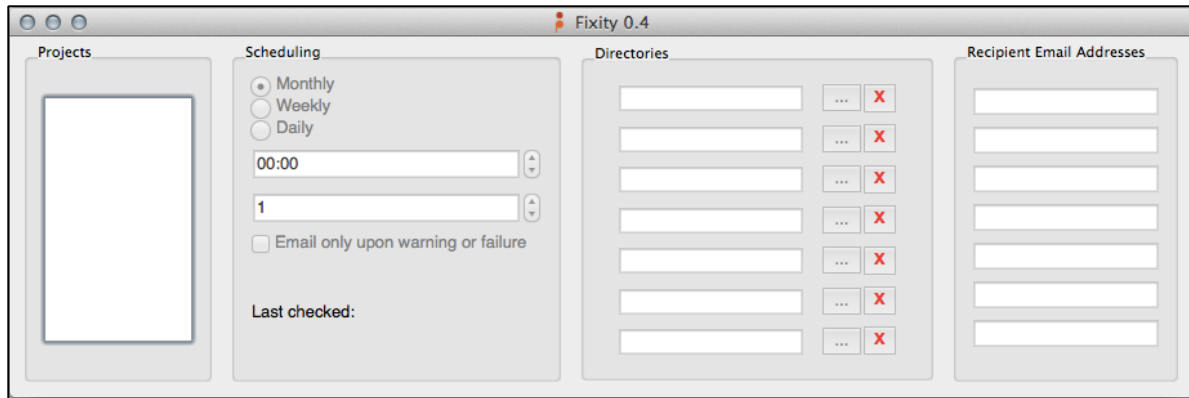


Figure 3: Screenshot of Fixity version 0.4 interface for OS X

Projects: As you create and save new projects, they will appear in this box. Click on a project name to view its settings in the rest of the window.

Scheduling: You can set the schedule for generating/validating checksums and file attendance in this section. Using the radio buttons, you can choose between a monthly, weekly, or daily scan.

- **Monthly:** If you choose this option, you will be presented with two boxes. The box containing “00:00” is where you enter the time (in military time and in reference to the date and time settings of your computer) that you want the validation to begin. The second box scrolls through numbers from 1 to 31, allowing you to choose the day of the month you wish the scan to run.
- **Weekly:** If you choose this option, you will be presented with two boxes. The box containing “00:00” is where you enter the time (in military time and in reference to the date and time settings of your computer) that you want the validation to begin. The second box allows you to choose the day of the week you wish the scan to run.
- **Daily:** If you choose this option, you will be presented with one box. This box is where you enter the time (in military time and in reference to the date and time settings of your computer) that you want the validation to begin each day.


The **Scheduling** section also contains settings for the behavior of the scheduled task.


- **Run when on battery power (Windows only):** If Fixity is being run on a laptop, check this option to allow Fixity to run when operating on battery power. Note

that this option does not affect non-battery powered systems. On OSX, Fixity will always run regardless of whether the computer is operating on battery power or not.

- *If missed, run upon restart (Windows only):* If this is selected, Fixity will run upon startup if a scheduled scan is missed (e.g., due to the system being powered off). If this is not selected, Fixity will run at the next scheduled time. On OSX, Fixity will not run a scheduled scan if it was missed. It will run at the next scheduled time. Note that Fixity will not run immediately upon startup - please wait 15-20 minutes to allow for it to run.
- *Email only upon warning or failure:* If selected, Fixity will only send email reports when a change is detected during a scan. Otherwise, it will send an email following each and every completed scan. See Fixity File Report section below for more details.

Lastly, in the *Scheduling* column, Fixity displays the date and time of your project's most recent scan.

Directories:  Click on this button next to the text field to select the specific directory that you wish to scan. You can select up to 7 directories per project.

If you need to change the location or name of one of the directories that is included in your Fixity project (for instance, you move the directory from one drive to another drive of a different name, or you need to rename the directory), you can update the Fixity project accordingly without negatively impacting your monitoring and reporting. You can do this by selecting  for the filepath that you wish to change and selecting the new location for the directory. When selecting *Save Settings* you will be prompted with the window shown in Figure 4. Selecting *Change Path* will update the Fixity project with the new path and treat all files within the selected parent directory in the same way it would have if nothing had changed.

Be careful when changing a directory to a directory containing different files than the first. As Fixity will look for the files from the first directory, it will report that all prior files were removed and all new files were added.

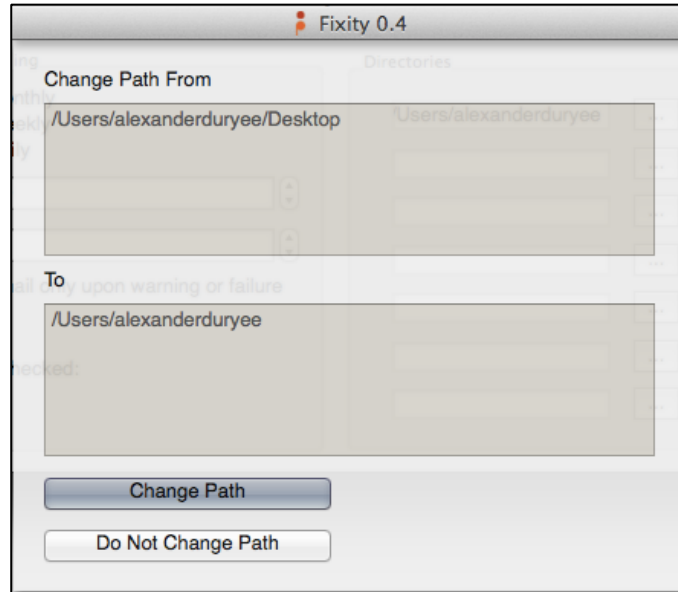



Figure 4: Dialog to update the filepath for a directory.

The  button will remove a directory from a project. Once this is done, Fixity will no longer scan it as part of a project, and its file information will be removed from the database.

Email Addresses: Every time Fixity scans a directory, a report is generated. In each of your projects, you can choose up to 7 email addresses (one per text box) to have this report sent to based on the preference *Email only upon warning or failure*. Each email address entered will receive the same report for all directories selected as part of the project. These can be freely changed at any time.

Fixity File menu

File	Preferences
New Project	⌘N
Save Settings	⌘S
Run Now	⌘R
Delete Project	⌘⌘
Change Project Name	⌘U

Figure 5: Detail of Fixity File menu (OSX).

New Project

Choose this option each time you wish to set up a new project. A project contains the settings for the scheduling, directories, and recipient email address sections. You will be prompted to name your project. Project names cannot contain spaces or characters disallowed in filenames by the operating system (such as “ and <).

Save Settings

When you are satisfied with your project's parameters, click this option to save it to the project folder. The project file contains the settings for the scheduling, directories, and recipient email address sections. Note that unlike previous versions, saving settings does not invoke a fixity check scan at the time of saving.

Run Now

Saves the current project settings and invokes a fixity scan. If it is the first time a scan is being run for a project it will perform the initial scan. If a scan has already been performed it will validate against the existing data.

Note: If Fixity is closed during a Run Now scan, it will not complete the scan. Please also note that Fixity will not allow for multiple scans to be run at the same time.

Delete Project

Choose this option if you wish to delete a project completely.

Change Project Name

Select this to rename a project.

About Fixity

Opens the About Fixity dialog window containing a description of the application, licensing information and contact information. Note: on the Mac this is under the *Fixity* menu.

Quit Fixity

Closes the application. Note: on the Mac this is under the *Fixity* menu.

Fixity Preferences menu

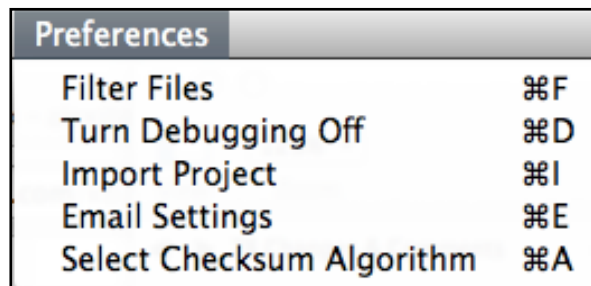


Figure 6: Detail of Fixity Preferences menu (OSX).

Filter Files

The Filter File window (Figure 7) allows the user to create pattern-matching filters to prevent Fixity from scanning certain files. For example, a repository may not want to include the *DS_Store* or *Thumbs.db* files created by default by certain operating systems. These can be blocked from scans by adding them to the filter.

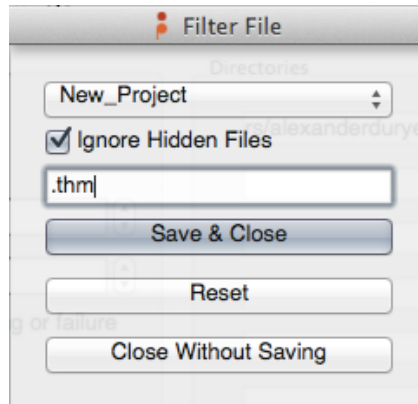


Figure 7: Fixity Filter File detail with ignore hidden files selected and sample pattern to block.

The filter interface contains a drop-down menu of projects, from which the user can select a project before setting filters. A project must be saved before it will appear in the dropdown list. In the text box, a comma-separated list of case-sensitive patterns to block can be set. For example, the settings in the screenshot below will not scan files containing .thm or hidden files. Once the filters are created, *Set Information* will save the settings.

Turn Debugging On/Off

With debugging on Fixity generates log files in order to assist in troubleshooting issues. Turning debugging off disables logging.

Select Checksum Algorithm

Fixity defaults to using the SHA256 algorithm to generate its checksums. This setting allows the user to select either SHA256 or MD5 algorithms to calculate checksums for a given project.

If the algorithm is changed after checksums have already been generated for a project, Fixity will do the following:

1. Perform a Fixity scan and generate a report using the original algorithm.

2. Confirmation

- a. If all files are confirmed, another scan will be performed immediately generating checksums using the new algorithm, and generating a report. Future scans will use the new algorithm.
- b. If all files are not confirmed, a report will be generated and the process will be halted after the initial scan. A prompt will be generated in the application and an email will be sent to recipient email addresses with notification of the failure and a full report. The checksum algorithm for the project will not be changed if all files are not confirmed. The user can perform the operation again to complete the process, assuming that all files are confirmed on the initial scan.

Import Project

This option allows for the importing of project information. Import will accept .fxy files from older versions of Fixity and .tsv files generated by newer versions of Fixity in the *history* directory. Importing a .fxy or .tsv file into Fixity imports the following information:

- Directories
- Recipient email addresses
- Filepaths
- Checksum values
- Filesystem index location
- Scheduling information
- Checksum algorithm type (.tsv files only)
 - For .fxy files, this must be manually configured. If the wrong algorithm is used, Fixity will not be able to confirm any files.
- Filter file information (.tsv files only)
 - For .fxy files, this must be manually configured for each project.

Importing a project will not import:

- Sender Email Configuration: This is a preference that is set at the global level and is not part of the project import information.

Importing projects can also be used for reverting back to a previous snapshot by importing an older .tsv file from the *history* folder.

NOTE: Due to how the filesystem structures of different operating systems track files, the index location and file path for each file will change when importing projects between OSX and Windows. Filepaths will need to be updated when moving between

operating systems, and all files will be reported as being New Files during the first scan.

Configure Sender Email

Figure 8 demonstrates how Fixity allows you to configure the email settings associated with the account used for emailing reports. Without setting this preference, Fixity will not be able to send report emails. Note that Fixity will encrypt the credentials before storing them in order to provide account security.

By default, Fixity populates the server, port, and security fields with Gmail default settings. If these values are different for your email account (for example, if your email account is provided through your organization), you will need to provide the appropriate information. This is the same information you would find in your email application configuration settings, so you may be able to obtain the information by looking at your email application account settings. If not, the information needed can be obtained from your email provider or by contacting your IT administrator.

Figure 8: Email Settings window

The email account can be tested with *Check Credentials*, which will send an email to the account provided. If the email is received, then Fixity is able to successfully use the email address. Note: be sure to check your spam folder if the email is not received in your inbox before performing troubleshooting. Select *Set Information* to save changes. Simply selecting *Close* will not save changes.

NOTE: The sender email settings are global for all projects in Fixity. It only needs to be set once and will notify all projects with recipient email addresses.

Fixity analysis and reporting

Fixity report

A Fixity report is saved to the *reports* folder and emailed to the recipient email addresses identified in the project according to the *Email only upon warning or failure* preference. The Fixity report is named *fixity_yyyy-mm-dd-hhmmss_projectname.tsv* where *hhmmss* is in military time.

Fixity report	
Project name	New_Project
Algorithm used	sha256
Date	2014-05-13
Total Files	987
Confirmed Files	987
Moved or Renamed Files	0
New Files	0
Changed Files	0
Removed Files	0
Confirmed File :	/Users/alexanderdu
Confirmed File :	/Users/alexanderdu

Figure 9: Detail of a sample Fixity report.

When opening Fixity reports in spreadsheet applications it is important to open them by importing the .tsv file, identifying the delimiter as a Tab and treating all data as text (see FAQ for details). This will ensure maximum functionality and keep spreadsheet applications from altering the data in unintended ways. Fixity reports contain the following information:

Fixity report: Identifies the report as a Fixity report

Project name: Provides the name of the project for which the report was generated

Algorithm used: Identifies the hash algorithm used to compute the checksums for the files scanned.

Date: The date that the report was generated.

Total Files: Total files scanned and/or removed. It is the sum of all of the below categories in any single scan.

Confirmed Files: A file is confirmed if nothing has changed since the last scan. In

this case the number of files scanned that exist in the manifest where the filepath, hash value, and filesystem index location are the same as they were in the last scan.

Moved or Renamed Files: A file has been renamed and/or moved to another location being scanned within the same Fixity project. When files are moved or renamed they will usually have a different filepath but retain the same hash value and index location. If a file is copied and pasted to a new location and the original one is deleted this will result in the hash value remaining the same but the filesystem index location and filepath changing, resulting in a report of one new file and one removed file.

New Files: The number of files detected by Fixity that do not currently exist in its manifest. If a file is found that does not have a matching hash, filesystem index location, or filepath, it is listed as a new file. Files are also listed as new if they share a hash value with a previously scanned file, but have a new filesystem index location and filepath.

Changed Files: The number of files that have a different hash value since the last scan.

Removed Files: The number of files that existed in the manifest previously which are no longer present.

Each row beneath *Removed Files* provides a filepath and the associated status of the identified file for all files scanned and/or removed in a project. Files that have been filtered out using the *Filter File* preference will not appear because they will not have been scanned.

Analysis and reporting logic

Figure 10 aims to support users in interpreting reporting by presenting various scenarios and results in an easy-to-read table with Y[es] or N[o] indicators and the outcomes.

The chart denotes:

- If a file that is present in the manifest is present in a target directory,
- If a file has the same hash value, filepath, and filesystem index location upon comparison, and
- How Fixity reports each scenario.

File present?	Same hash?	Same filepath?	Same index location?	Result
Y	N	Y	Y	Changed File
Y	N	N	Y	Changed File
Y	N	Y	N	Changed File
Y	Y	Y	Y	Confirmed File
Y	Y	Y	N	Confirmed File
Y	Y	N	Y	Moved or Renamed File
Y	None	None	None	New File
Y	Y	N/None	N/None	New File
N	Existing	Existing	Existing	Removed File

Figure 10: Fixity reporting chart.

Notes on analysis and reporting:

- If a file is moved to a new directory it will have the same index location value and same hash value, but a new path. This will result in reporting that the file has been *Moved or Renamed*. Some versions of some operating systems will perform a copy operation even when moving files, producing the same results as if a file was copied and pasted (described below).
- Due to how Fixity tracks files, there are no conflicts or confusion when two files share a checksum value. It will properly track them as two distinct objects.
- If a file is copied to a new location and the original file is deleted (effectively moving a file but using different operations) this will result in the “moved” file having a different index location value but the same hash value. This will result in reporting that there is one new file and one removed file (the original file).
- If a file is renamed, it will have the same index location and hash value, and a new path. As such, Fixity will report that it was *Moved or Renamed*.
- If a file is copied to a new location it will have a different index location value and path but the same hash value. This will result in reporting that there is one *New File* and one *Confirmed File* (the original file).
- Most files maintain their index location value when they are edited. Certain applications (such as many text editors) will instead edit a temporary version of a file and copy that over the original upon saving. This will change the checksum and the index location, which will report correctly as a changed file. However, if this were coupled with a rename or move it would result in a report of 1 removed file and 1 new file.

Fixity reporting and manifest updating behavior

When changes are identified, Fixity behaves in the following ways upon finding changes and after reporting them:

- New files are added to the manifest and checksums are generated for them
- Removed files are removed from the manifest
- Moved files are updated with their new location in the manifest
- Renamed files are updated with their new name in the manifest
- Changed files are updated with new hashes in the manifest

History snapshots

Each time a project is run a snapshot of the manifest data is saved to the *history* folder. This contains the hash value, filepath, and index location value for every file scanned. The snapshot is created after the project is run. This provides an audit trail over time and the ability to revert to a previous snapshot using the *import project* function. A Fixity report represents the differences/similarities between two history snapshots. The file is named *projectname_yyyy-mm-dd-hhmmss.tsv* where *hhmmss* is in military time.

When opening history snapshots in spreadsheet applications it is important to open them by importing the .tsv file and identifying the delimiter as a Tab and treating all data as text (see FAQ for details). This will ensure maximum functionality and keep spreadsheet applications from altering the data in unintended ways.

/Users/alexanderduryee/img;		
alex@avpreserve.com,		
99 00:00:00 99 1		
2014-05-13 11:58:51		
None - None		
sha256		
53a320d16e4dce46b482158b69036	/Users/alexanderduryee/in	3589646
5212803780e34b84f92a06c3ac751	/Users/alexanderduryee/in	3586478
133dce1caef7fc5544d81579126556	/Users/alexanderduryee/in	3586476
882eb302851ef414f60fb0838d84cc	/Users/alexanderduryee/in	3586479
f2ca1bb6c7e907d06dfe4687e579f	/Users/alexanderduryee/in	3591731
3d620e9e4ad7b19298051e57d4b5	/Users/alexanderduryee/in	3586477
428ac179cb841b7eb8f972eeb4891	/Users/alexanderduryee/in	3601091
774597456f0886c4346e2ce0052df	/Users/alexanderduryee/in	2995558
0d02c21ef86a31e90cf430ba700f04	/Users/alexanderduryee/in	2995606

Figure 11: Detail of a sample history snapshot

History snapshots contain the following information:

Directories scanned: The directories selected for scanning for a given project.

Email addresses: The recipient email addresses for a given project (not shown in the figure).

Schedule information: codes identifying project schedule settings.

Date and time of run: The date that the project was run and the file was created.

Filter Files Preference: Any preferences that have been saved for the project regarding filtering of files.

Checksum Algorithm Preference: The checksum algorithm preference last saved for the project.

Each line following the checksum algorithm contains the following columns:

Hash Value : The checksum value for each file scanned.

Filepath : The filepath for each file scanned.

Filesystem Index Location : The location in the filesystem index for each file scanned.

Frequently Asked Questions (FAQs)

Note: This application is in beta. Please help refine it further by reporting all bugs to <https://github.com/avpreserve/fixity/issues>

Q: Can I commission AVPreserve to develop additional functionality or extended implementations for Fixity if it doesn't do exactly what I want it to do?

A: Yes, just contact us at info@avpreserve.com and let us know what you'd like to do.

Q: Will Fixity perform a scheduled scan if the application is not open?

A: Yes.

Q: Will Fixity perform a scheduled scan if the computer is turned off?

A: No. On Windows, if the project is set to scan on restart it will attempt to perform the scan 15-20 minutes after restarting. On OSX, and if *Run Upon Restart* is not selected on Windows, an automated scan will not occur until the next scheduled time.

Q: What is a .tsv file?

A: The .tsv file found in the *reports* and *history* directories are text files that use *tab* as a delimiter for structured data.

Q: What is the best way to open a .tsv file for manual review?

A: The .tsv file can be opened with any text editor. However, for simple viewing of the data in the .tsv files using a spreadsheet application will be the easiest. The best way to open a .tsv (or .csv file for that matter) is by importing, instead of opening.

Instructions on how to do this can be found here: http://www.avpreserve.com/wp-content/uploads/2013/10/Spreadsheet_Workshop_Materials.zip

Q: How is scheduling performed within Windows?

A: Fixity uses Windows' SCHEDULE_TASKS tasks with AutoFixity to set/update/delete scheduled tasks. As such, its behavior is best explored via the SCHEDULE_TASKS documentation.

Q: How is scheduling performed within OSX?

A: Fixity uses OSX's launchd to run Fixity at scheduled intervals. As such, its behavior is best explored via the launchd documentation.

Q: Will Fixity for Mac run on a 32-bit system?

A: No, only 64-bit systems. Fixity will run on 32-bit Windows.

Q: What happened to the .fxy files in previous versions of Fixity?

A: In version 0.4 Fixity was updated to using a SQLite database instead of using the .fxy file in combination with other files to serve the role of a database. However, users of Fixity were interested in accessing the data in the .fxy files. For this reason we created the *history* directory, where we output .tsv files that contain the same data that was in the .fxy files. In addition to making this data accessible, we decided to have this data output each time a project scan is run so that a history of snapshots is maintained for auditing and reversion purposes.

Q: Where can I find out more about filesystem index locations?

A: A free technical white paper on filesystem index locations, Fixity and Filesystems: Enhanced System Monitoring via inodes, is available at <http://www.avpreserve.com/wp-content/uploads/2014/07/FixityAndFilesystems.pdf>