rmlint documentation

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Contents

`rmlint` finds space waste and other broken things on your filesystem and offers to remove it. It is able to find:

- Duplicate files & directories.
- Nonstripped Binaries
- Broken symlinks.
- Empty files.
- Recursive empty directories.
- Files with broken user or group id.

Key Features:

- Extremely fast.
- Flexible and easy commandline options.
- Choice of several hashes for hash-based duplicate detection
- Option for exact byte-by-byte comparison (only slightly slower).
- Numerous output options.
- Option to store time of last run; next time will only scan new files.
- Many options for original selection / prioritisation.
- Can handle very large file sets (millions of files).
- Colorful progressbar. ()

Although `rmlint` is easy to use, you might want to read these chapters first. They show you the basic principles and most of the advanced options:

CHAPTER 1

Installation

Many major Linux distribution might already package `rmlint` – but watch out for the version. If possible, we recommend using the newest version available.

If there is no package yet or you want to try a development version, you gonna need to compile `rmlint` from source.

1.1 Dependencies

1.1.1 Hard dependencies:

- **glib** $\geq$ 2.32 (general C Utility Library)

1.1.2 Soft dependencies:

- **libblkid** (detecting mountpoints)
- **libelf** (nonstripped binary detection)
- **libjson-glib** (parsing rmlint's own json as caching layer)

1.1.3 Build dependencies:

- **git** (version control)
- **scons** (build system)
- **sphinx** (manpage/documentation generation)
- **gettext** (support for localization)

Here's a list of readily prepared commands for known operating systems:

- **Fedora** $\geq$ 21:

```
$ yum -y install pkgconf git scons python3-sphinx gettext json-glib-devel
$ yum -y install glib2-devel libblkid-devel elfutils-libelf-devel
# Optional dependencies for the GUI:
$ yum -y install pygobject3 gtk3 librsvg2
```

There are also pre-built packages on Fedora Copr:

```
$ dnf copr enable eclipseo/rmlint
$ dnf install rmlint
```

Since **Fedora 29** we also have an official package.

- **ArchLinux:**

  There is an official package in `[community]` here:

  ```
  $ pacman -S rmlint
  ```

  Alternatively you can use `rmlint-git` in the AUR:

  ```
  $ pacman -S pkgconf git scons python-sphinx
  $ pacman -S glib2 libutil-linux elfutils json-glib
  # Optional dependencies for the GUI:
  $ pacman -S gtk3 python-gobject librsvg
  ```

  There is also a PKGBUILD on the ArchLinux AUR:

  ```
  $ # Use your favourite AUR Helper.
  $ yaourt -S rmlint-git
  ```

  It is built from git `master`, not from the `develop` branch.

- **Debian / Ubuntu** $\geq$ 12.04:

  Note: Debian also ships an official package. Use the below instructions if you need a more recent version.

  This most likely applies to most distributions that are derived from Ubuntu. Note that the `GUI` depends on `GTK+ >= 3.12`! Ubuntu 14.04 LTS and earlier still ships with `3.10`.

  ```
  $ apt-get install pkg-config git scons python3-sphinx python3-nose gettext build-
  ↪essential
  # Optional dependencies for more features:
  $ apt-get install libelf-dev libglib2.0-dev libblkid-dev libjson-glib-1.0 libjson-
  ↪glib-dev
  # Optional dependencies for the GUI:
  $ apt-get install python3-gi gir1.2-rsvg gir1.2-gtk-3.0 python-cairo gir1.2-
  ↪polkit-1.0 gir1.2-gtksource-3.0
  ```

- **macOS**

  `rmlint` can be installed via homebrew:

  Prerequisite: If homebrew has not already been installed on the system, execute:

  ```
  $ /usr/bin/ruby -e "$(curl -fsSL https://raw.githubusercontent.com/Homebrew/
  ↪install/master/install)".
  ```

  With homebrew installed, execute:

```
$ brew install rmlint
```

See also this issue for more information on the homebrew formula.

- **FreeBSD** $\geq$ 10.1:

```
$ pkg install git scons py27-sphinx pkgconf
$ pkg install glib gettext libelf json-glib
```

Send us a note if you want to see your distribution here or the instructions need an update. The commands above install the full dependencies, therefore some packages might be stripped if you do not need the feature they enable. Only hard requirement for the commandline is `glib`.

Also be aware that the GUI needs at least $gtk \geq 3.12$ to work!

1.2 Compilation

Compilation consists of getting the source and translating it into a usable binary. We use the build system `scons`. Note that the following instructions build the software from the potentially unstable `develop` branch:

```
$ # Omit -b develop if you want to build from the stable master
$ git clone -b develop https://github.com/sahib/rmlint.git
$ cd rmlint/
$ scons config       # Look what features scons would compile
$ scons DEBUG=1      # Optional, build locally.
# Install (and build if necessary). For releases you can omit DEBUG=1
$ sudo scons DEBUG=1 --prefix=/usr install
```

Done!

You should be now able to see the manpage with `rmlint --help` or `man 1 rmlint`.

Uninstall with `sudo scons uninstall` and clean with `scons -c`.

You can also only type the `install` command above. The buildsystem is clever enough to figure out which targets need to be built beforehand.

1.3 Troubleshooting

On some distributions (especially Debian derived) `rmlint --gui` might fail with `/usr/bin/python3: No module named shredder` (or similar). This is due some incompatible changes on Debian's side.

See this thread for a workaround using `PYTHONPATH`.

CHAPTER 2

Gentle Guide to `rmlint`

Welcome to the Tutorial of `rmlint`.

We use a few terms that might not be obvious to you at first, so we gonna explain them to you here.

Original In a group of *duplicate* files, one file is said to be the original file. It might not, strictly speaking, be the original from which the copies where created, but is a convenient terminology for selecting which files to keep and which to delete.

Duplicate A file that matches the original. Note that depending on rmlint settings, "match" may mean an exact match or just that the files have matching hash values.

2.1 Beginner Examples

Let's just dive in into some examples:

```
$ rmlint
```

This simply scans your current working directory for lint and reports them in your terminal. Note that **nothing will be removed** (even if it prints `rm`).

Despite its name, `rmlint` just finds suspicious files, but never modifies the filesystem itself*[0]. Instead it gives you detailed reports in different formats to get rid of them yourself. These reports are called *outputs*. By default a shellscript will be written to `rmlint.sh` that contains readily prepared shell commands to remove duplicates and other finds,

So for the above example the full process, if you want to actually delete the lint that was found, would be:

```
$ rmlint some/path
# (wait for rmlint to finish running)
$ gedit rmlint.sh
```

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[0] You could say it should be named `findlint`.

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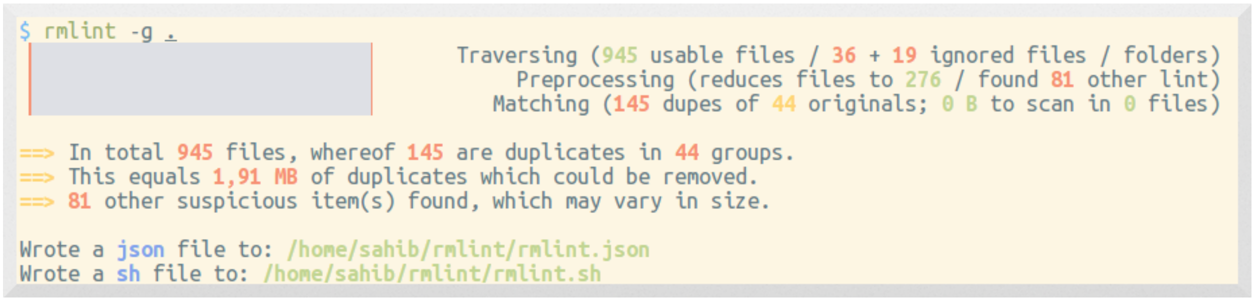
```
# (or any editor you prefer... review the content of rmlint.sh to
#  check what it plans to delete; make any edits as necessary)
$ ./rmlint.sh
# (the rmlint.sh script will ask for confirmation, then delete the
#  appropriate lint, then delete itself)
```

On larger runs, it might be more preferable to show a progressbar instead of a long list of files. You can do this easily with the `-g` switch:

```
$ rmlint -g
```

It will look like this:



```
$ rmlint -g .
                              Traversing (945 usable files / 36 + 19 ignored files / folders)
                                  Preprocessing (reduces files to 276 / found 81 other lint)
                                    Matching (145 dupes of 44 originals; 0 B to scan in 0 files)

==> In total 945 files, whereof 145 are duplicates in 44 groups.
==> This equals 1,91 MB of duplicates which could be removed.
==> 81 other suspicious item(s) found, which may vary in size.

Wrote a json file to: /home/sahib/rmlint/rmlint.json
Wrote a sh file to: /home/sahib/rmlint/rmlint.sh
```

2.2 Filtering input files

What if we do not want to check all files as dupes? `rmlint` has a good repertoire of options to select only certain files. We won't cover all options, but will get you started with a few useful ones. Note if you want a more do-it-yourself approach to file filtering, you can also use external tools to feed `rmlint's stdin`:

```
$ find pics/ -iname '*.png' | rmlint -
$ find pics/ -iname '*.png' -print0 | rmlint -0 # (also handles filenames with␣
↪newline characters)
```

2.2.1 Limit files by size using `--size`

```
# only check files between 20 MB and 1 Gigabyte:
$ rmlint --size 20M-1G
# short form (-s) works just as well:
$ rmlint -s 20M-1G
# only check files bigger than 4 kB:
$ rmlint -s 4K
# only check files smaller than 1234 bytes:
$ rmlint -s 0-1234
# Find empty files and handle them as duplicates:
$ rmlint -T df --size 0-1
```

Valid units include:

K,M,G,T,P for powers of 1000
KB, MB, GB etc for powers of 1024

If no units are given, `rmlint` will assume bytes.

2.2.2 Limit duplicate matching according to basename

By default, `rmlint` compares file contents, regardless of file name. So if *afile.jpg* has the same content as *bfile.txt* (which is unlikely!), then `rmlint` will find and report this as a duplicate. You can speed things up a little bit by telling rmlint not to try to match files unless they have the same or similar file names. The three options here are:

`-b` (`--match-basename`)
`-e` (`--match-extension`)
`-i` (`--match-without-extension`).

Examples:

```
# Find all duplicate files with the same basename:
$ rmlint -b some_dir/
ls some_dir/one/hello.c
rm some_dir/two/hello.c
# Find all duplicate files that have the same extension:
$ rmlint -e some_dir/
ls some_dir/hello.c
rm some_dir/hello_copy.c
# Find all duplicate files that have the same basename:
# minus the extension
$ rmlint -i some_dir/
ls some_dir/hello.c
rm some_dir/hello.bak
```

2.2.3 Limit files by their modification time

This is a useful feature if you want to investigate only files newer than a certain date or if you want to progressively update the results, i.e. when you run `rmlint` in a script that watches a directory for duplicates.

The manual way is using `-N` (`--newer-than=<timestamp>`):

```
# Use a Unix-UTC Timestamp (seconds since epoch)
$ rmlint -N 1414755960

# Find all files newer than file.png
$ rmlint -N $(stat --print %Y file.png)

# Alternatively use an ISO8601 formatted Timestamp
$ rmlint -N 2014-09-08T00:12:32+0200
```

If you are periodically checking the same directory tree for duplicates, you can get a substantial speedup by creating an automatic timestamp file each time you run rmlint. To do this, use command line options: `-n` (`--newer-than-stamp`) and `-O stamp:stamp.file` (we'll come to outputs in a minute): Here's an example for incrementally scanning your home folder:

```
# First run of rmlint:
$ rmlint /home/foobar -O stamp:/home/foobar/.rmlint.stamp
ls /home/foobar/a.file
```

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```
rm /home/foobar/b.file

# Second run, no changes:
$ rmlint /home/foobar -n /home/foobar/.rmlint.stamp
<nothing>

# Second run, new file copied:
$ cp /home/foobar/a.file /home/foobar/c.file
$ rmlint /home/foobar -n /home/foobar/.rmlint.stamp
ls /home/foobar/a.file
rm /home/foobar/b.file
rm /home/foobar/c.file
```

Note that `-n` updates the timestamp file each time it is run.

2.3 Outputs & Formatters

`rmlint` is capable of creating reports in several output formats, to either your screen or to a file. If you run it with the default options you already see two of those output formatters on your screen, namely `pretty` and `summary`.

Extra output formats can be added via either the `-O` (`--add-output`) or `-o` (`--output`) switch. The only difference is the `-o` clears all the default outputs while `-O` just adds to the defaults.

Note: If you just came here to learn how to print a nice progressbar: Just use the `-g` (`--progress`) option:

```
$ rmlint -g /usr
```

Here's an example:

```
$ rmlint -o json:stderr
```

Here you would get this output printed on `stderr`:

```
[{
  "description": "rmlint json-dump of lint files",
  "cwd": "/home/user/",
  "args": "rmlint -o json:stderr"
},
{
  "type": "duplicate_file",
  "path": "/home/user/test/b/one",
  "size": 2,
  "inode": 2492950,
  "disk_id": 64771,
  "progress": 100,
  "is_original": true,
  "mtime": 1414587002
},
... snip ...
{
  "aborted": false,
  "total_files": 145,
  "ignored_files": 9,
```

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```
  "ignored_folders": 4,
  "duplicates": 11,
  "duplicate_sets": 2,
  "total_lint_size": 38
}]
```

You probably noticed the colon in the commandline above. Everything before it is the name of the output-format, everything behind is the path where the output should land. Instead of a path you can also use `stdout` and `stderr`, as we did above or just omit the colon which will print everything to `stdout`.

Some formatters can be customised using the `-c` (`--config`) command. Here's the list of currently available formatters and their config options:

json Outputs all finds as a json document. The document is a list of dictionaries, where the first and last element is the header and the footer respectively, everything between are data-dictionaries. This format was chosen to allow application to parse the output in realtime while `rmlint` is still running.

The header contains information about the program invocation, while the footer contains statistics about the program-run. Every data element has a type which identifies its lint type (you can lookup all types **here_**).

Config values:

- *use_header=[true|false]:* Print the header with metadata.
- *use_footer=[true|false]:* Print the footer with statistics.
- *oneline=[true|false]:* Print one json document per line.

sh Outputs a shell script defines a command function for each lint type, which it then calls for each file of each type. The script can be executed (it is already `chmod +x`'d by `rmlint`). By default it will ask you if you really want to proceed. If you do not want that confirmation prompt you can pass the `-d`. Additionally it will delete itself after running, unless you pass the `-x` switch to the `sh` script.

It is enabled by default and writes to `rmlint.sh`.

Example output:

```
$ rmlint -o sh:stdout
#!/bin/sh
# This file was autowritten by rmlint
# rmlint was executed from: /home/user/
# You command line was: ./rmlint -o sh:rmlint.sh

# ... snip ...

echo  '/home/user/test/b/one' # original
remove_cmd '/home/user/test/b/file' # duplicate
remove_cmd '/home/user/test/a/two' # duplicate
remove_cmd '/home/user/test/a/file' # duplicate

if [ -z $DO_REMOVE ]
then
  rm -f 'rmlint.sh';
fi
```

Config values:

- *clone*: reflink-capable filesystems only. Try to clone both files with the FIDEDUPERANGE `ioctl(3p)` (or BTRFS_IOC_FILE_EXTENT_SAME on older kernels). This will free up duplicate extents while preserving the metadata of both. Needs at least kernel 4.2.

- *reflink*: Try to replace the duplicate file with a reflink to the original. See also `--reflink` in `man 1 cp`. Fails if the filesystem does not support it.
- *hardlink*: Replace the duplicate file with a hardlink to the original file. Fails if both files are not on the same partition.
- *symlink*: Tries to replace the duplicate file with a symbolic link to the original. Never fails.
- *remove*: Remove the file using `rm -rf`. (`-r` for duplicate dirs). Never fails.
- *usercmd*: Use the provided user defined command (`-c sh:cmd='*user command*'`). Use "$1" within '*user command*' to refer to the duplicate file and (optionally) "$2" to refer to the original.

Example (predefined config):

```
$ rmlint -o sh:stdout -o sh:rmlint.sh -c sh:symlink
...
echo  '/home/user/test/b/one' # original
cp_symlink '/home/user/test/b/file' '/home/user/test/b/one' # duplicate
$ ./rmlint.sh -d
Keeping: /home/user/test/b/one
Symlinking to original: /home/user/test/b/file
```

Example (custom command):

The following example uses the trash-put command from the trash-cli utility to move duplicate files to trash:

```
$ rmlint -o sh -c sh:cmd='echo "Trashing $1" && trash-put "$1"'
```

py Outputs a python script and a JSON file. The json file is the same as that produced by the **json** formatter. The JSON file is written to `.rmlint.json`, executing the python script will find it there. The default python script produced by rmlint does pretty much the same thing as the shell script described above (although not reflinking or hardlinking or symlinking at the moment). You can customise the python script for just about any use case (Python is a simple and extremely powerful programming language).

Example:

```
$ rmlint -o py:remover.py
$ ./remover.py --dry-run    # Needs Python3
Deleting twins of /home/user/sub2/a
Handling (duplicate_file): /home/user/sub1/a
Handling (duplicate_file): /home/user/a

Deleting twins of /home/user/sub2/b
Handling (duplicate_file): /home/user/sub1/b
```

csv Outputs a csv formatted dump of all lint files. Handy for all the spreadsheet-jockeys out there! It looks like this:

```
$ rmlint -o csv -D
type,path,size,checksum
emptydir,"/home/user/tree2/b",0,00000000000000000000000000000000
duplicate_dir,"/home/user/test/b",4,f8772f6fda08bbc826543334663d6f13
duplicate_dir,"/home/user/test/a",4,f8772f6fda08bbc826543334663d6f13
duplicate_dir,"/home/user/tree/b",8,62202a79add28a72209b41b6c8f43400
```

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```
duplicate_dir,"/home/user/tree/a",8,62202a79add28a72209b41b6c8f43400
duplicate_dir,"/home/user/tree2/a",4,311095bc5669453990cd205b647a1a00
```

Config values:

- *use_header=[true|false]:* Print the column name headers.

stamp Outputs a timestamp of the time `rmlint` was run.

Config values:

- *iso8601=[true|false]:* Write an ISO8601 formatted timestamps or seconds since epoch?

pretty Pretty-prints the found files in a colorful output (intended to be printed on *stdout* or *stderr*). This is enabled by default.

summary Sums up the run in a few lines with some statistics. This enabled by default too.

progressbar Prints a progressbar during the run of `rmlint`. This is recommended for large runs where the `pretty` formatter would print thousands of lines. Not recommended in combination with `pretty`

Config values:

- *update_interval=number:* Number of milliseconds to wait between updates. Higher values use less resources.

fdupes A formatter that behaves similar to **fdupes(1)** - another duplicate finder. This is mostly indented for compatibility (e.g. scripts that relied on that format). Duplicate set of files are printed as block, each separated by a newline. Original files are highlighted in green (this is an addition). During scanning a progressbar and summary are printed, followed by the fdupes output. The first two are printed to `stderr`, while the parseable lines will be printed to `stdout`.

Consider using the far more powerful `json` output for scripting purposes, unless you already have a script that expects fdupes output.

2.4 Paranoia mode

Let's face it, why should you trust `rmlint`?

Technically it only computes a hash of your file which might, by its nature, collide with the hash of a totally different file. If we assume a *perfect* hash function (i.e. one that distributes its hash values perfectly even over all possible values), the probability of having a hash-collision is $\frac{1}{2^{512}}$ for the default `blake2b` 512-bit hash. Of course hash functions are not totally random, so the collision probability is slightly higher. Due to the "birthday paradox", collision starts to become a real risk if you have more than about 2^{256} files of the same size.

If you're wary, you might want to make a bit more paranoid than the default. By default the `blake2b` (previously `sha1` was the default) hash algorithm is used, which we consider a good trade-off of speed and accuracy. `rmlint`'s paranoia level can be adjusted using the `-p` (`--paranoid`) switch.

Here's what they do in detail:

- `-p` is equivalent to `--algorithm=paranoid`
- `-P` is equivalent to `--algorithm=highway256`
- `-PP` is equivalent to `--algorithm=metro256`
- `-PPP` is equivalent to `--algorithm=metro`

As you see, it just enables a certain duplicate detection algorithm to either use a stronger hash function or to do a byte-by-byte comparison. While this might sound slow it's often only a few seconds slower than the default behaviour.

There is a bunch of other hash functions you can lookup in the manpage. We recommend never to use anything worse than the default.

Note: Even with the default options, the probability of a false positive doesn't really start to get significant until you have around 1,000,000,000,000,000,000,000,000 different files all of the same file size. Bugs in `rmlint` are sadly (or happily?) more likely than hash collisions. See http://preshing.com/20110504/hash-collision-probabilities/ for discussion.

2.5 Original detection / selection

As mentioned before, `rmlint` divides a group of dupes in one original and one or more duplicates of that one. While the chosen original might not be the one that was there first, you generally want to select one file to keep from each duplicate set.

By default, if you specify multiple paths in the rmlint command, the files in the first-named paths are treated as more "original" than the later named paths. If there are two files in the same path, then the older one will be treated as the original. If they have the same modification time then it's just a matter of chance which one is selected as the original.

The way `rmlint` chooses the original can be customised by the `-S` (`--rank-by`) option.

Here's an example:

```
# Normal run:
$ rmlint
ls c
rm a
rm b

# Use alphabetically first one as original
$ rmlint -S a
ls a
rm b
rm c
```

Alphabetically first makes sense in the case of backup files, ie **a.txt.bak** comes after **a.txt**.

Here's a table of letters you can supply to the `-S` option:

m	keep lowest mtime (oldest)	**M**	keep highest mtime (newest)
a	keep first alphabetically	**A**	keep last alphabetically
p	keep first named path	**P**	keep last named path
d	keep path with lowest depth	**D**	keep path with highest depth
l	keep path with shortest basename	**L**	keep path with longest basename
r	keep paths matching regex	**R**	keep path not matching regex
x	keep basenames matching regex	**X**	keep basenames not matching regex
h	keep file with lowest hardlink count	**H**	keep file with highest hardlink count
o	keep file with lowest number of hardlinks outside of the paths traversed by `rmlint`.	**O**	keep file with highest number of hardlinks outside of the paths traversed by `rmlint`.

The default setting is `-S pOma`. Multiple sort criteria can be specified, eg `-S mpa` will sort first by mtime, then (if tied), based on which path you specified first in the rmlint command, then finally based on alphabetical order of file name. Note that "original directory" criteria (see below) take precedence over any `-S` options.

Alphabetical sort will only use the basename of the file and ignore its case. One can have multiple criteria, e.g.: `-S am` will choose first alphabetically; if tied then by mtime. **Note:** original path criteria (specified using *//*) will always take first priority over *-S* options.

For more fine grained control, it is possible to give a regular expression to sort by. This can be useful when you know a common fact that identifies original paths (like a path component being `src` or a certain file ending).

To use the regular expression you simply enclose it in the criteria string by adding *<REGULAR_EXPRESSION>* after specifying *r* or *x*. Example: `-S 'r<.*\.bak$>'` makes all files that have a `.bak` suffix original files.

Warning: When using **r** or **x**, try to make your regex to be as specific as possible! Good practice includes adding a `$` anchor at the end of the regex.

Tips:

- **l** is useful for files like *file.mp3 vs file.1.mp3 or file.mp3.bak*.
- **a** can be used as last criteria to assert a defined order.
- **o/O** and **h/H** are only useful if there any hardlinks in the traversed path.
- **o/O** takes the number of hardlinks outside the traversed paths (and thereby minimizes/maximizes the overall number of hardlinks). **h/H** in contrast only takes the number of hardlinks *inside* of the traversed paths. When hardlinking files, one would like to link to the original file with the highest outer link count (**O**) in order to maximise the space cleanup. **H** does not maximise the space cleanup, it just selects the file with the highest total hardlink count. You usually want to specify **O**.
- **pOma** is the default since **p** ensures that first given paths rank as originals, **O** ensures that hardlinks are handled well, **m** ensures that the oldest file is the original and **a** simply ensures a defined ordering if no other criteria applies.
- If you something very specific about the paths you're searching, then the `r/R` or `x/X` options are your friend. You can also specify those options multiple times. Have an example here:

```
# Sort paths with ABC in them first, then DEF, then GHI.
# Everything with »temp«, »tmp« or »cache« in it comes last,
# the rest is sandwhiched in between and sorted by their modification time (m).
# If something is tied, the modification time is also used a sorting criteria.
$ rmlint -S 'r<.*ABC.*>r<.*DEF.*>r<.*GHI.*>R<.*(tmp|temp|cache).*>m' /tmp/t

# Duplicate(s):
   ls '/tmp/t/ABC'
   rm '/tmp/t/DEF'
   rm '/tmp/t/GHI'
   rm '/tmp/t/another'
   rm '/tmp/t/other'
   rm '/tmp/t/xxx-cache-yyy'
   rm '/tmp/t/xxx-tmp-yyy'
   rm '/tmp/t/xxx-tempt-yyy'
```

For more information you can also follow this link

2.5.1 Flagging original directories

Sometimes you have a specific path that **only** contains originals, or **only** contains backups. In this case you can flag directories on the commandline by using a special separator (//) between the duplicate and original paths. Every path after the // separator is considered to be "tagged" and will be treated as an original where possible. Tagging always takes precedence over the `-S` options above.

```
$ rmlint a // b
ls b/file
rm a/file
```

If there are more than one tagged files in a duplicate group then the highest ranked (per `-S` options) will be kept. In order to never delete any tagged files, there is the `-k` (`--keep-all-tagged`) option. A slightly more esoteric option is `-m` (`--must-match-tagged`), which only looks for duplicates where there is an original in a tagged path.

Here's a real world example using these features: You have a portable backup drive with some old backups on it. You have just backed up your home folder to a new backup drive. You want to reformat the old backup drive and use it for something else. But first you want to check that there is nothing on the old drive that you don't have somewhere else. The old drive is mounted at /media/portable.

```
# Find all files on /media/portable that can be safely deleted:
$ rmlint --keep-all-tagged --must-match-tagged /media/portable // ~
# check the shellscript looks ok:
$ less ./rmlint.sh # or use gedit or any other viewer/editor
# run the shellscript to delete the redundant backups
$ ./rmlint.sh
# run again (to delete empty dirs)
$ rmlint -km /media/portable // ~
$ ./rmlint.sh
# see what files are left:
$ tree /media/portable
# recover any files that you want to save, then you can safely reformat the drive
```

In the case of nested mountpoints, it may sometimes makes sense to use the opposite variations, `-K` (`--keep-all-untagged`) and `-M` (`--must-match-untagged`).

2.6 Finding duplicate directories

Note: `--merge-directories` is still an experimental option that is non-trivial to implement. Please double check the output and report any possible bugs.

As far as we know, `rmlint` is the only duplicate finder that can do this. Basically, all you have to do is to specify the `-D` (`--merge-directories`) option and `rmlint` will cache all duplicates until everything is found and then merge them into full duplicate directories (if any). All other files are printed normally.

This may sound simple after all, but there are some caveats you should know of.

Let's create a tricky folder structure to demonstrate the feature:

```
$ mkdir -p fake/one/two/ fake/one/two_copy fake/one_copy/two fake/one_copy/two_copy
$ echo xxx > fake/one/two/file
$ echo xxx > fake/one/two_copy/file
$ echo xxx > fake/one_copy/two/file
$ echo xxx > fake/one_copy/two_copy/file
$ echo xxx > fake/file
$ echo xxx > fake/another_file
```

Now go run `rmlint` on it like that:

```
$ rmlint fake -D -S a
# Duplicate Directorie(s):
```

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```
    ls -la /home/sahib/rmlint/fake/one
    rm -rf /home/sahib/rmlint/fake/one_copy
    ls -la /home/sahib/rmlint/fake/one/two
    rm -rf /home/sahib/rmlint/fake/one/two_copy

# Duplicate(s):
    ls /home/sahib/rmlint/fake/another_file
    rm /home/sahib/rmlint/fake/one/two/file
    rm /home/sahib/rmlint/fake/file

==> In total 6 files, whereof 5 are duplicates in 1 groups.
==> This equals 20 B of duplicates which could be removed.
```

As you can see it correctly recognized the copies as duplicate directories. Also, it did not stop at `fake/one` but also looked at what parts of this original directory could be possibly removed too.

Files that could not be merged into directories are printed separately. Note here, that the original is taken from a directory that was preserved. So exactly one copy of the `xxx`-content file stays on the filesystem in the end.

`rmlint` finds duplicate directories by counting all files in the directory tree and looking up if there's an equal amount of duplicate and empty files. If yes, it checks if the hashes are equal using a Merkle Tree. If it matches, it continues on the parent directory.

Some file like hidden files will not be recognized as duplicates, but still added to the count. This will of course lead to unmerged directories. That's why the `-D` option implies the `-r` (`--hidden`) and `-l` (`--hardlinked`) option in order to make this convenient.

A note to symbolic links: The default behaviour with –merge-directories is to not follow symbolic links, but to compare the link targets. If the target is the same, the link will be the same. This is a sane default for duplicate directories, since twin copies often are created by doing a backup of some files. In this case any symlinks in the backed-up data will still point to the same target. If you have symlinks that reference a file in each respective directory tree, consider using `-f`.

Warning: Do *never ever* modify the filesystem (especially deleting files) while running with the `-D` option. This can lead to mismatches in the file count of a directory, possibly causing dataloss. **You have been warned!**

Sometimes it might be nice to only search for duplicate directories, banning all the sole files from littering the screen. While this will not delete all files, it will give you a nice overview of what you copied where.

Since duplicate directories are just a lint type as every other, you can just pass it to `-T`: `-T "none +dd"` (or `-T "none +duplicatedirs"`). There's also a preset of it to save you some typing: `-T minimaldirs`.

Warning: Also take note that `-D` will cause a higher memory footprint and might add a bit of processing time. This is due to the fact that all files need to be cached till the end and some other internal data structures need to be created.

2.7 Replaying results

Often it is useful to just re-output the results you got from `rmlint`. That's kind of annoying for large datasets, especially when you have big files. For this, `rmlint` features a special mode, where it re-outputs the result of previous runs. By default, `rmlint` will spit out a `.json` file (usually called `rmlint.json`). When `--replay` is given, you can pass one or more of those `.json` files to the commandline as they would be normal directories. `rmlint` will then merge and re-output then. Note however, that no filesystem input/output is done.

The usage of the `--replay` feature is best understood by example:

```
$ rmlint real-large-dir --progress
# ... lots of output ...
$ cp rmlint.json large.json  # Save json, so we don't overwrite it.
$ rmlint --replay large.json real-large-dir
# ... same output, just faster ...
$ rmlint --replay large.json --size 2M-512M --sort-by sn real-large-dir
# ... filter stuff; and rank by size and by size and groupsize ....
$ rmlint --replay large.json real-large-dir/subdir
# ... only show stuff in /subdir ...
```

Warning: Details may differ

The generated output might differ slightly in order and details. For example the total number of files in the replayed runs will be the total of entries in the json document, not the total number of traversed files.

Also be careful when replaying on a modified filesystem. `rmlint` will ignore files with newer mtime than in the `.json` file for safety reason.

Warning: Not all options might work

Options that are related to traversing and hashing/reading have no effect. Those are:

- *–followlinks*
- *–algorithm and –paranoid*
- *–clamp-low*
- *–hardlinked*
- *–write-unfinished*
- all other caching options.

2.8 Miscellaneous options

If you read so far, you know `rmlint` pretty well by now. Here's just a list of options that are nice to know, but are not essential:

- Consecutive runs of `rmlint` can be speed up by using `--xattr`.

  ```
  $ rmlint large_dataset/ --xattr
  $ rmlint large_dataset/ --xattr
  ```

  Here, the second run should (or *might*) run a lot faster, since the first run saved all calculated checksums to the extended attributes of each processed file. But be sure to read the caveats stated in the manpage! Especially keep in mind that you need to have write access to the files for this to work.

- `-r` (`--hidden`): Include hidden files and directories. The default is to ignore these, to save you from destroying git repositories (or similar programs) that save their information in a `.git` directory where `rmlint` often finds duplicates.

  If you want to be safe you can do something like this:

```
$ # find all files except everything under .git or .svn folders
$ find . -type d | grep -v '\(.git\|.svn\)' -print0 | rmlint -0 --hidden
```

But you would have checked the output anyways, wouldn't you?

- If something ever goes wrong, it might help to increase the verbosity with `-v` (up to `-vvv`).
- Usually the commandline output is colored, but you can disable it explicitly with `-w` (`--with-color`). If *stdout* or *stderr* is not a terminal anyways, `rmlint` will disable colors itself.
- You can limit the traversal depth with `-d` (`--max-depth`):

```
$ rmlint -d 0
<finds everything in the same working directory>
```

- If you want to prevent `rmlint` from crossing mountpoints (e.g. scan a home directory, but no the HD mounted in there), you can use the `-x` (`--no-crossdev`) option.
- It is possible to tell `rmlint` that it should not scan the whole file. With `-q` (`--clamp-low`) / `-Q` (`--clamp-top`) it is possible to limit the range to a starting point (`-q`) and end point (`-Q`). The point where to start might be either given as percent value, factor (percent / 100) or as an absolute offset.

  If the file size is lower than the absolute offset, the file is simply ignored.

  This feature might prove useful if you want to examine files with a constant header. The constant header might be different, i.e. by a different ID, but the content might be still the same. In any case it is advisable to use this option with care.

  Example:

```
# Start hashing at byte 100, but not more than 90% of the filesize.
$ rmlint -q 100 -Q .9
```

2.9 Scripting

Sometimes `rmlint` can't help you with everything. While we get a lot of feature request to have some more comfort-options built-in, we have to decline most of them to make sure that `rmlint` does not become too bloated. But fret not, we have lots of possibilities to do some scripting. Let's look at some common problem that can be easily solved with some other tools.

2.9.1 Copying unique files

Imagine you have a folder from which you want to extract one copy of each file by content. This does not only mean unique files, but also original files - but not their duplicates. This sounds like a job for the `uniques` formatter (which outputs all unique paths, one by line) and `jq`. `jq` is a great little tool which makes it really easy to extract data from a `json` file:

```
# This command produces two files:
# - unique_files: Files that have a unique checksum in the directory.
# - original_files: Files that have the "is_original" field set to true in the json␣
↪output.
# The '.[1:-1]' part is for filtering the header and footer part of the json response.
$ rmlint t -o json -o uniques:unique_files |  jq -r '.[1:-1][] | select(.is_original)␣
↪| .path' | sort > original_files
```

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```
# Now we only need to combine both files:
$ cat unique_files original_files
```

2.9.2 Filter by regular expressions

A very often requested feature is to provide something like `--include` or `--exclude` where you could pass a regular expression to include or exclude some files from traversing. But `rmlint` is not a clone of `find`. Instead you can use `find` just fine to pipe output into `rmlint`:

```
# Deduplicate all png pictures that were not modified in the last 24 hours:
$ find ~ -iname '*.png' ! -mtime 0 | rmlint -
```

CHAPTER 3

Graphical user interface

As of `rmlint` $\geq$ 2.4.0 a GUI frontend called `Shredder` is shipped alongside of `rmlint`. It is written in Python and uses no external dependencies beside `gtk+` $\geq$ 3.14 and `PyGObject`.

Warning: The user interface is still in development. Use at your own risk! There is a safety net though: Every file will be re-checked before its deletion.

3.1 Installation

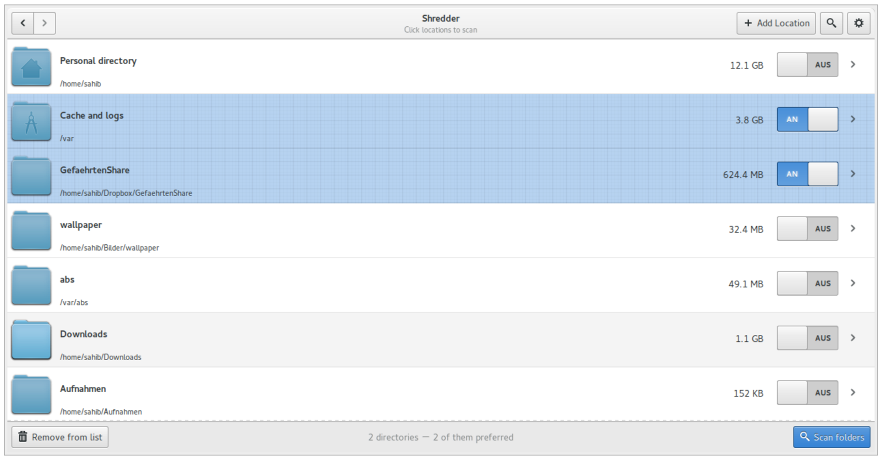
If you compiled `rmlint` from source, `scons` will try to build and install the GUI, except you pass `--without-gui` to it.

3.2 Usage

The GUI can be started via `rmlint --gui`.The application is divided into several views that guide you through the duplicate finding process.

3.3 Developers

3.3.1 Location view

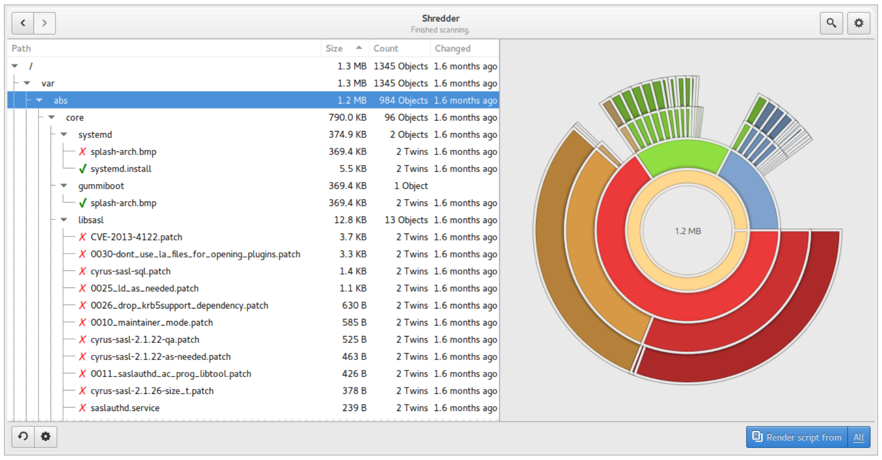


Personal directory /home/sahib	12.1 GB	AUS
Cache and logs /var	3.8 GB	AN
GefaehrtenShare /home/sahib/Dropbox/GefaehrtenShare	624.4 MB	AN
wallpaper /home/sahib/Bilder/wallpaper	32.4 MB	AUS
abs /var/abs	49.1 MB	AUS
Downloads /home/sahib/Downloads	1.1 GB	AUS
Aufnahmen /home/sahib/Aufnahmen	152 KB	AUS

Shows a list of locations the user might want to scan. A number of locations is guessed from the list of mounted volumes, recently used files and a static set of paths. The user can of course add a new location via a filebrowser.

The user can select one or multiple paths and hit *Scan*. In prior he might choose to prefer certain paths, so only files in non-preferred paths are deleted if they have a twin in a preferred path.

3.3.2 Runner view



Path	Size	Count	Changed
/	1.3 MB	1345 Objects	1.6 months ago
var	1.3 MB	1345 Objects	1.6 months ago
abs	1.2 MB	984 Objects	1.6 months ago
core	790.0 KB	96 Objects	1.6 months ago
systemd	374.9 KB	2 Objects	1.6 months ago
✗ splash-arch.bmp	369.4 KB	2 Twins	1.6 months ago
✓ systemd.install	5.5 KB	2 Twins	1.6 months ago
gummiboot	369.4 KB	1 Object	
✓ splash-arch.bmp	369.4 KB	2 Twins	1.6 months ago
libsasl	12.8 KB	13 Objects	1.6 months ago
✗ CVE-2013-4122.patch	3.7 KB	2 Twins	1.6 months ago
✗ 0030-dont_use_la_files_for_opening_plugins.patch	3.3 KB	2 Twins	1.6 months ago
✗ cyrus-sasl-sql.patch	1.4 KB	2 Twins	1.6 months ago
✗ 0025_ld_as_needed.patch	1.1 KB	2 Twins	1.6 months ago
✗ 0026_drop_krb5support_dependency.patch	630 B	2 Twins	1.6 months ago
✗ 0010_maintainer_mode.patch	585 B	2 Twins	1.6 months ago
✗ cyrus-sasl-2.1.22-qa.patch	525 B	2 Twins	1.6 months ago
✗ cyrus-sasl-2.1.22-as-needed.patch	463 B	2 Twins	1.6 months ago
✗ 0011_saslauthd_ac_prog_libtool.patch	426 B	2 Twins	1.6 months ago
✗ cyrus-sasl-2.1.26-size_t.patch	378 B	2 Twins	1.6 months ago
✗ saslauthd.service	239 B	2 Twins	1.6 months ago

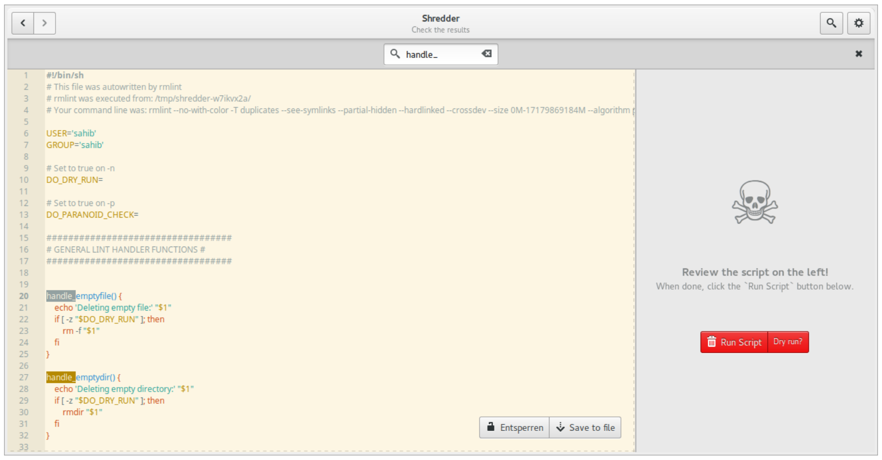
After hitting scan in the locations view, the application will start `rmlint` in the background. The output will be shown live in the treeview on the left.

Once finished, a chart will be shown on the right that shows how the duplicates are distributed over the scanned directories. The treeview will show the detailed list of found files. A red cross will indicate that `Shredder` wants to delete this file, a green checkmark will make it keep it. The user can edit those to his liking.

Additionally, the view can be filtered after a search query. In the simplest case this filters by a path element, in more complex use cases you can also filter by size, mtime and twincount. The latter can be done by adding `size:10K` or `size:1M-2M,3M-4M` to the query (similar with `mtime:` and `count:`)

Once happy with the results, the user can generate a script out of the results (all or just those that are visible).

3.3.3 Editor view

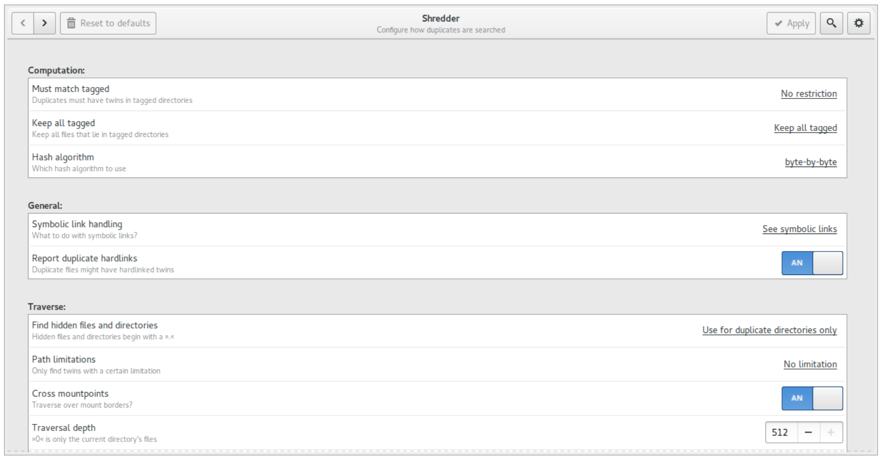

Shredder
Check the results
handle_
Review the script on the left!
When done, click the `Run Script` button below.
Run Script
Dry run?
Entsperren
Save to file

```
#!/bin/sh
# This file was autowritten by rmlint
# rmlint was executed from: /tmp/shredder-w7ikvx2a/
# Your command line was: rmlint --no-with-color -T duplicates --see-symlinks --partial-hidden --hardlinked --crossdev --size 0M-17179869184M --algorithm

USER='sahib'
GROUP='sahib'

# Set to true on -n
DO_DRY_RUN=

# Set to true on -p
DO_PARANOID_CHECK=

##################################
# GENERAL LINT HANDLER FUNCTIONS #
##################################


handle_emptyfile() {
  echo 'Deleting empty file:' "$1"
  if [ -z "$DO_DRY_RUN" ]; then
    rm -f "$1"
  fi
}

handle_emptydir() {
  echo 'Deleting empty directory:' "$1"
  if [ -z "$DO_DRY_RUN" ]; then
    rmdir "$1"
  fi
}
```

A source editor will show the generated script. It can be edited and searched through. Apart from that, the file can be saved not only a `.sh` file, but also as `.csv` and `.json` file.

The user can now choose to save the script and execute it himself, or to click the `Run Script` button. If this button is blue, it indicates a dry run, where nothing will be deleted. A red button however will kill your files. In any way, a running counter of deleted bytes will be shown.

3.3.4 Settings view



Computation:

Must match tagged Duplicates must have twins in tagged directories	No restriction
Keep all tagged Keep all files that lie in tagged directories	Keep all tagged
Hash algorithm Which hash algorithm to use	byte-by-byte

General:

Symbolic link handling What to do with symbolic links?	See symbolic links
Report duplicate hardlinks Duplicate files might have hardlinked twins	AN

Traverse:

Find hidden files and directories Hidden files and directories begin with a ».«	Use for duplicate directories only
Path limitations Only find twins with a certain limitation	No limitation
Cross mountpoints Traverse over mount borders?	AN
Traversal depth »0« is only the current directory's files	512

The settings view is the leftmost view and will not be shown by default in the process. It can always be accessed by:

- Going to the leftmost view.
- Hitting the `Settings` menu entry.
- Hit the gear button in the runner view.

Normal user probably do not need to adjust anything. The options shown here, resemble the option that may be given to the commandline of `rmlint`.

3.3.5 Design

The design loosely follows the Gnome Human Interface Guidelines.*[0] Beside the appearance, this means that the program should be easy and intuitive to use. Suggested actions should be clear to recognize and the application should always be responsive and never just *do work in the background*.

3.3.6 Internal

`Shredder` works by forking off `rmlint` and reading its json output in parallel. The script generation works by calling `rmlint --replay` on the generated `json` file, since this is the only sane way to filter the results of all formats properly.

[0] https://developer.gnome.org/hig/stable/

CHAPTER 4

Cautions (or *why it's hard to write a dupefinder*)

This section covers good practice for safe duplicate removal. It is not intended to be specifically related to `rmlint`. It includes general discussion on duplicate detection and shows, by example, some of the traps that duplicate finders can fall into. This section might not only be useful for developers of dupe finders, but also educational for users that strive for best practices regarding deduplication.

4.1 Good Practice when Deleting Duplicates

4.1.1 Backup your data

There is a wise adage, *"if it's not backed up, it's not important"*. It's just good practice to keep your important data backed up. In particular, any time you are contemplating doing major file reorganisations or deletions, that's a good time to make sure that your backups are up to date.

What about when you want to clean up your backups by deleting duplicate files from your backup drive? Well as long as your duplicate file finder is reliable, you shouldn't have any problems. Consider replacing the duplicate with a link (hardlink, symlink or reflink) to the original data. This still frees up the space, but makes it easier to find the file if and when it comes time to restore files from backup.

4.1.2 Measure twice, cut once

This is a popular saying amongst builders; the same goes for your files. Do at least some sort of sanity check on which files are going to be deleted. All duplicate file finders (including `rmlint`) are capable of identifying false positives or more serious bugs.

4.1.3 Beware of unusual filename characters

Even a space in a filename is capable of causing grief. Make sure your file deletion command (or the one used by your duplicate finder) has the filename properly escaped.

4.1.4 Consider safe removal options

Rather than deleting duplicates, consider moving them to a holding area or trash folder. The trash-cli utility is one option for this. Alternatively if using the `rmlint` shell script you can replace the `remove_cmd` section as follows to move the files to */tmp*:

```
remove_cmd() {
    echo 'Deleting:' "$1"
    if original_check "$1" "$2"; then
        if [ -z "$DO_DRY_RUN" ]; then
            # was: rm -rf "$1"
            mv -p "$1" "/tmp$1"
        fi
    fi
}
```

Another safe alternative, if your files are on a copy-on-write filesystem such as `btrfs`, and you have linux kernel 4.2 or higher, is to use a deduplication utility such as `duperemove` or `rmlint --dedupe`:

```
$ duperemove -dh original duplicate
$ rmlint --dedupe original duplicate
```

Both of the above first verify (via the kernel) that `original` and `duplicate` are identical, then modifies `duplicate` to reference `original`'s data extents. Note they do not change the mtime or other metadata of the duplicate (unlike hardlinks).

If you pass `-c sh:link` to `rmlint`, it will even check for you if your filesystem is capable of reflinks and emit the correct command conveniently.

You might think hardlinking as a safe alternative to deletion, but in fact hardlinking first deletes the duplicate and then creates a hardlink to the original in its place. If your duplicate finder has found a false positive, it is possible that you may lose your data.

4.2 Attributes of a Robust Duplicate Finder

(also known as *"Traps for young dupe finders"*)

4.2.1 Traversal Robustness

Path Doubles

One simple trap for a dupe finder is to not realise that it has reached the same file via two different paths. This can happen due to user inputting overlapping paths to traverse, or due to symlinks or other filesystem loops such as bind mounts. Here's a simple "path double" example trying to trick a duplicate file finder by "accidentally" feeding it the same path twice. We'll use fdupes for this example:

```
$ mkdir dir
$ echo "important" > dir/file
$ fdupes -r --delete --noprompt dir dir
[no output]
$ ls dir
file
```

So far so good, `fdupes` didn't fall for the trick. It has a check built-in which looks at the files' device and inode numbers, which automatically filters out path doubles.

Let’s try again using the -H option to find hardlinked duplicates:

```
$ fdupes -r -H --delete --noprompt dir dir
   [+] dir/file
   [-] dir/file
$ ls -l dir/
total 0
```

Oh dear, our file is gone! The problem is that hardlinks share the same device and inode numbers, so the inode check is turned off for this option.

Dupe finders `rdfind` and `dupd` can also be tricked with the right combination of settings:

```
$ rdfind -removeidentinode false -deleteduplicates true a a
[snip]
Now deleting duplicates:
Deleted 1 files.
$ ls -l dir/
total 0

$ dupd scan --path /home/foo/a --path /home/foo/a
Files scanned: 2
Total duplicates: 2
Run 'dupd report' to list duplicates.
$ dupd report
Duplicate report from database /home/foo/.dupd_sqlite:
20 total bytes used by duplicates:
  /home/foo/a/data
  /home/foo/a/data
```

Solution:

For a duplicate finder to be able to find hardlinked duplicates, without also inadvertently identifying a file as a duplicate or itself, a more sophisticated test is required. Path doubles will always have:

- matching device and inode.
- matching basename.
- parent directories also have matching device and inode.

That **seems** pretty fool-proof (see `rmlint` example below) but please file an issue on our Issue Tracker if you find an exception.

```
$ echo "data" > dir/file
$ # rmlint with default settings:
$  rmlint dir dir
==> In total 2 files, whereof 0 are duplicates in 0 groups.
==> This equals 0 B of duplicates which could be removed.
$
$ # rmlint with hardlink duplicate detection enabled:
$  rmlint --hardlinked dir dir
==> In total 2 files, whereof 0 are duplicates in 0 groups.
==> This equals 0 B of duplicates which could be removed.
$ ls dir
file
```

Symlinks:

“Ah but I’m not silly enough to enter the same path twice” you say. Well maybe so, but there are other ways that folder traversal can reach the same path twice, for example via symbolic links:

```
$ mkdir dir
$ echo "important" > dir/file
$ ln -s dir link
$ fdupes -r --delete --noprompt .
$ ls -l dir/
total 0
```

Symlinks can make a real mess out of filesystem traversal:

```
$ mkdir dir
$ cd dir
$ ln -s . link
$ cd ..
$ echo "data" > dir/file
$ fdupes -rHs dir
dir/file
dir/link/file
dir/link/link/file
[snip]
dir/link/link/link/link/link/link/link/link/link/link/link/link/link/link/link/link/
↪link/link/link/link/link/link/link/link/link/link/link/link/link/link/link/link/
↪link/link/link/link/link/link/link/link/file

Set 1 of 1, preserve files [1 - 41, all]:
```

Solution:

During traversal, the duplicate finder should keep track of all folders visited (by device and inode number). Don't re-traverse folders that were already traversed.

Hardlinks:

Also as noted above, replacing duplicates with hardlinks can still end badly if there are false positives. For example, using `rdfind`'s the `-makehardlinks` option:

```
$ echo "data" > dir/file
$ rdfind -removeidentinode false -makehardlinks true dir dir
[snip]
It seems like you have 2 files that are not unique
Totally, 5 b can be reduced.
Now making results file results.txt
Now making hard links.
failed to make hardlink dir/file to dir/file
$ ls -l dir
total 0
```

Solution:

Don't find false positives. Check files are on same filesystem before trying to create hardlink. Temporarily rename the duplicate before creating the hardlink and then deleting the renamed file.

4.2.2 Collision Robustness

Duplicate detection by file hash

If a duplicate finder uses file hashes to identify duplicates, there is a very small risk that two different files have the same hash value. This is called a *hash collision* and can result in the two files being falsely flagged as duplicates.

Several duplicate finders use the popular MD5 Hash, which is 128 bits long. With a 128-bit hash, if you have a million sets of same-size files, each set containing a million different files, the chance of a hash collision is about `0.000 000 000 000 000 000 147%`. To get a `0.1%` chance of a hash collision you would need nine hundred thousand million (9×10^{11}) groups of (9×10^{11}) files each, or one group of eight hundred thousand million million (8×10^{17}) files.

If someone had access to your files, and *wanted* to create a malicious duplicate, they could potentially do something like this (based on http://web.archive.org/web/20071226014140/http://www.cits.rub.de/MD5Collisions/):

```
$ mkdir test && cd test
$ # get two different files with same md5 hash:
$ wget http://web.archive.org/web/20071226014140/http://www.cits.rub.de/imperia/md/
↪content/magnus/order.ps
$ wget http://web.archive.org/web/20071226014140/http://www.cits.rub.de/imperia/md/
↪content/magnus/letter_of_rec.ps
$ md5sum *  # verify that they have the same md5sum
a25f7f0b29ee0b3968c860738533a4b9  letter_of_rec.ps
a25f7f0b29ee0b3968c860738533a4b9  order.ps
$ sha1sum * # verify that they are not actually the same
07835fdd04c9afd283046bd30a362a6516b7e216  letter_of_rec.ps
3548db4d0af8fd2f1dbe02288575e8f9f539bfa6  order.ps
$ rmlint -a md5 . -o pretty  # run rmlint using md5 hash for duplicate file detection
# Duplicate(s):
    ls '/home/foo/test/order.ps'
    rm '/home/foo/test/letter_of_rec.ps'
$ rmlint test -a sha1 -o summary   # run using sha1 hash
==> In total 2 files, whereof 0 are duplicates in 0 groups.
```

If your intention was to free up space by hardlinking the duplicate to the original, you would end up with two hardlinked files, one called `order.ps` and the other called `letter_of_rec.ps`, both containing the contents of `order.ps`.

Solution:

`fdupes` detects duplicates using MD5 Hashes, but eliminates the collision risk by doing a byte-wise comparison of the duplicates detected. This means each file is read twice, which can tend to slow things down.

`dupd` uses direct file comparison, unless there are more than 3 files in a set of duplicates, in which case it uses MD5 only.

If you use `rmlint`'s `sha1` hash features, which features 160 bit output, you need at least 5.4×10^{22} files before you get a 0.1% probability of collision. `rmlint`'s `-p` option uses `SHA512` (5.2×10^{75} files for 0.1% risk), while `rmlint`'s `-pp` option uses direct file comparison to eliminate the risk altogether. Refer to the *Benchmarks* chapter for speed and memory overhead implications.

4.2.3 Unusual Characters Robustness

Spaces, commas, nonprinting characters etc can all potentially trip up a duplicate finder or the subsequent file deletion command. For example:

```
$ mkdir test
$ echo "data" > 'test/\t\r\"\b\f\\,.'
$ cp test/\\t\\r\\\"\\b\\f\\\\,. test/copy  # even just copying filenames like this␣
↪is ugly!
$ ls -1 test/
copy
\t\r\"\b\f\\,.
```

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```
$ md5sum test/*  # md5's output gets a little bit mangled by the odd characters
6137cde4893c59f76f005a8123d8e8e6  test/copy
\6137cde4893c59f76f005a8123d8e8e6  test/\\t\\r\\"\\b\\f\\\\,.
$ dupd scan --path /home/foo/test
SKIP (comma) [/home/foo/test/\t\r\"\b\f\\,.]
Files scanned: 1
Total duplicates: 0
```

Solution: Be careful!

4.2.4 *"Seek Thrash"* Robustness

Duplicate finders use a range of strategies to find duplicates. It is common to reading and compare small increments of potential duplicates. This avoids the need to read the whole file if the files differ in the first few megabytes, so this can give a major speedup in some cases. However, in the case of hard disk drives, constantly reading small increments from several files at the same time causes the hard drive head to have to jump around ("seek thrash").

Here are some speed test results showing relative speed for scanning my `/usr` folder (on SSD) and an HDD copy of same. The speed ratio gives an indication of how effectively the search algorithm manages disk seek overheads:

Program	`/usr` (SSD)	`/mnt/usr` (HDD)	*Ratio*
`dupd`	48s	1769s	36.9
`fdupes`	65s	486s	7.5
`rmlint`	38s	106s	2.8
`rmlint -pp`	40s	139s	3.5

Note: Before each run, disk caches were cleared:

```
$ sync && echo 3 | sudo tee /proc/sys/vm/drop_caches
```

Solution:

Achieving good speeds on HDD's requires a balance between small file increments early on, then switching to bigger file increments. Fiemap information (physical location of files on the disk) can be used to sort the files into an order that reduces disk seek times.

4.2.5 Memory Usage Robustness

When scanning very large filesystems, duplicate finders may have to hold a large amount of information in memory at the same time. Once this information exceeds the computers' RAM, performance will suffer significantly. `dupd` handles this quite nicely by storing a lot of the data in a sqlite database file, although this may have a slight performance penalty due to disk read/write time to the database file. `rmlint` uses a path tree structure to reduce the memory required to store all traversed paths.

CHAPTER 5

Frequently Asked Questions

5.1 `rmlint` finds more/less dupes than tool `X`!

Make sure that *none* of the following applies to you:

Both tools might investigate a different number of files. `rmlint` e.g. does not look through hidden files by default, while other tools might follow symlinks by default. Suspicious options you should look into are:

- `--hidden`: Disabled by default, since it might screw up `.git/` and similar directories.
- `--hardlinked`: Might find larger amount files, but not more lint itself.
- `--followlinks`: Might lead `rmlint` to different places on the filesystem.
- `--merge-directories`: pulls in both `--hidden` and `--hardlinked`.

If there's still a difference, check with another algorithm. In particular use `-pp` to enable paranoid mode. Also make sure to have `-D` (`--merge-directories`) disabled to see the raw number of duplicate files.

Still here? Maybe talk to us on the issue tracker.

5.2 Can you implement feature `X`?

Depends. Go to to the issue tracker and open a feature request.

Here is a list of features where you probably have no chance:

- Port it to Windows.
- Find similar files like `ssdeep` does.

5.3 I forgot to add some options before running on a large dataset. Do I need to re-run it?

Probably not. Since `rmlint 2.3.0` there is `--replay` which can be used to to re-output a json file of a prior run.

If you have changed the filesystem that might not be a good idea of course. In this case you'll have to re-run, but it's not as bad as it sounds though. Your filesystem is probably very good at caching.

If you only want to see the difference to what changed since last time you can look into `-n --newer-than-stamp / -N --newer-than`.

In some cases you might really need to re-run, but if that happens often, you might look into `--xattr-write` and `--xattr-read` which is capable of writing finished checksums to extended attributes of each processed file.

5.4 I have a very large number of files and I run out of memory and patience.

As a rule of thumb, `rmlint` will allocate *~150 bytes* for every file it will investigate. Additionally paths are stored in a patricia trie, which will compress paths and save memory therefore.

The memory peak is usually shortly after it finished traversing all files. For example, 5 million files will result in a memory footprint of roughly 1.0GB of memory in average.

Some things to consider:

- Enable the progress bar with `-g` to keep track of how much data is left to scan.

Also:

`rmlint` have been successfully used on datasets of 5 million files. See this bug report for more information: #109.

If you have usage questions or find weird behaviour, you can also try to reach us via *IRC* in `#rmlint` on `irc.freenode.net`.

Since version `2.4.0` we also feature an optional graphical user interface:

CHAPTER 6

Informative reference

These chapters are informative and are not essential for the average user. People that want to extend `rmlint` might want to read this though:

6.1 Developer's Guide

This guide is targeted to people that want to write new features or fix bugs in rmlint.

6.1.1 Bugs

Please use the issue tracker to post and discuss bugs and features:

https://github.com/sahib/rmlint/issues

6.1.2 Philosophy

We try to adhere to some principles when adding features:

- Try to stay compatible to standard unix' tools and ideas.
- Try to stay out of the users way and never be interactive.
- Try to make scripting as easy as possible.
- **Never** make `rmlint` modify the filesystem itself, only produce output to let the user easily do it.

Also keep this in mind, if you want to make a feature request.

6.1.3 Making contributions

The code is hosted on GitHub, therefore our preferred way of receiving patches is using GitHub's pull requests (normal git pull requests are okay too of course).

Note: `origin/master` should always contain working software. Base your patches and pull requests always on `origin/develop`.

Here's a short step-by-step:

1. Fork it.
2. Create a branch from develop. (`git checkout develop && git checkout -b my_feature`)
3. Commit your changes. (`git commit -am "Fixed it all."`)
4. Check if your commit message is good. (If not: `git commit --amend`)
5. Push to the branch (`git push origin my_feature`)
6. Open a Pull Request against the develop branch.
7. Enjoy a refreshing Tea and wait until we get back to you.

Here are some other things to check before submitting your contribution:

- Does your code look alien to the other code? Is the style the same? You can run this command to make sure it is the same:

  ```
  $ clang-format -style=file -i $(find lib src -iname '*.[ch]')
  ```

- Do all tests run? Go to the test documentation for more info. Also after opening the pull request, your code will be checked via TravisCI.
- Is your commit message descriptive? whatthecommit.com has some good examples how they should **not** look like.
- Is `rmlint` running okay inside of `valgrind` (i.e. no leaks and no memory violations)?

For language-translations/updates it is also okay to send the `.po` files via mail at sahib@online.de, since not every translator is necessarily a software developer.

6.1.4 Testsuite

`rmlint` has a not yet complete but quite powerful testsuite. It is not complete yet (and probably never will), but it's already a valuable boost of confidence in `rmlint's` correctness.

The tests are based on `nosetest` and are written in `python>=3.0`. Every testcase just runs the (previously built) `rmlint` binary a and parses its json output. So they are technically blackbox-tests.

On every commit, those tests are additionally run on TravisCI.

Control Variables

The behaviour of the testsuite can be controlled by certain environment variables which are:

- `RM_TS_DIR`: Testdir to create files in. Can be very large with some tests, sometimes `tmpfs` might therefore slow down your computer. By default `/tmp` will be used.
- `RM_TS_USE_VALGRIND`: Run each test inside of valgrind's memcheck. *(slow)*
- `RM_TS_CHECK_LEAKS`: Fail test if valgrind indicates (definite) memory leak.
- `RM_TS_USE_GDB`: Run tests inside of `gdb`. Fatal signals will trigger a backtrace.

- RM_TS_PEDANTIC: Run each test several times with different optimization options and check for errors between the runs. *(slow)*.
- RM_TS_SLEEP: Waits a long time before executing a command. Useful for starting the testcase and manually running *rmlint* on the priorly generated testdir.
- RM_TS_PRINT_CMD: Print the command that is currently run.
- RM_TS_KEEP_TESTDIR: If a test failed, keep the test files.

Additionally slow tests can be omitted with by appending `-a '!slow'` to the commandline. More information on this syntax can be found on the nosetest documentation.

Before each release we call the testsuite (at least) like this:

```
$ sudo RM_TS_USE_VALGRIND=1 RM_TS_PRINT_CMD=1 RM_TS_PEDANTIC=1 nosetests-3.4 -s -a '!
↪slow !known_issue'
```

The `sudo` here is there for executing some tests that need root access (like the creating of bad user and group ids). Most tests will work without.

Coverage

To see which functions need more testcases we use `gcov` to detect which lines were executed (and how often) by the testsuite. Here's a short quickstart using `lcov`:

```
$ CFLAGS="-fprofile-arcs -ftest-coverage" LDFLAGS="-fprofile-arcs -ftest-coverage"␣
↪scons -j4 DEBUG=1
$ sudo RM_TS_USE_VALGRIND=1 RM_TS_PRINT_CMD=1 RM_TS_PEDANTIC=1 nosetests-3.4 -s -a '!
↪slow !known_issue'
$ lcov --capture --directory . --output-file coverage.info
$ genhtml coverage.info --output-directory out
```

The coverage results are updated from time to time here:

> http://sahib.github.io/rmlint/gcov/index.html

Structure

```
tests
├── test_formatters   # Tests for output formatters (like sh or json)
├── test_options      # Tests for normal options like --merge-directories etc.
├── test_types        # Tests for all lint types rmlint can find
└── utils.py          # Common utilities shared among tests.
```

Templates

A template for a testcase looks like this:

```
from nose import with_setup
from tests.utils import *

@with_setup(usual_setup_func, usual_teardown_func)
def test_basic():
    create_file('xxx', 'a')
```

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```
    create_file('xxx', 'b')

    head, *data, footer = run_rmlint('-a city -S a')

    assert footer['duplicate_sets'] == 1
    assert footer['total_lint_size'] == 3
    assert footer['total_files'] == 2
    assert footer['duplicates'] == 1
```

Rules

- Test should be able to run as normal user.
- If that's not possible, check at the beginning of the testcase with this:

```
if not runs_as_root():
    return
```

- Regressions in `rmlint` should get their own testcase so they do not appear again.
- Slow tests can be marked with a slow attribute:

```
from nose.plugins.attrib import attr

@attr('slow')
@with_setup(usual_setup_func, usual_teardown_func)
def test_debian_support():
    assert random.choice([True, False]):
```

- Unresolved issues can be marked with *known_issue* attribute to avoid failing automated travis testing

6.1.5 Buildsystem Helpers

Environment Variables

CFLAGS Extra flags passed to the compiler.

LDFLAGS Extra flags passed to the linker.

CC Which compiler to use?

```
# Use clang and enable profiling, verbose build and enable debugging
CC=clang CFLAGS='-pg' LDFLAGS='-pg' scons VERBOSE=1 DEBUG=1
```

Variables

O=<level> Set the optimization level.

Valid levels are currently those that may be passed with the GCC/Clang option `-O`; these include `0`, `1`, `2`, `3`, `s`, `fast`, `g`, etc., depending on the compiler version.

In addition, the level may be `debug` or `release`, which indicates that the optimization level should be whatever the build system currently defines to be the default for the associated build mode.

DEBUG=1 Enable a debugging build.

This turns on extra tests; in particular, it turns on run-time assertions. By default, a debug build excludes optimizations that may hinder debugging, but this may be overridden with the `O` variable, as usual.

Note that setting `DEBUG=1` does not enable the production of debugger symbols; to enable those, use `SYMBOLS=1` or `GDB=1`.

This should always be enabled during development.

SYMBOLS=1 Enable debugger symbols.

This option instructs the compiler to collect information that will help tools such as `gdb` present human-readable identifiers for a program's functions and variables, etc. Note, though, that this information becomes obscured by optimizations, so make sure to set the optimization level appropriately.

GDB=1 Enable options that help a debugger (such as `gdb`).

This option is equivalent to `DEBUG=1 SYMBOLS=1`.

VERBOSE=1 Print the exact compiler and linker commands. Useful for troubleshooting build errors.

CCFLAGS=<command line options> Set the last compiler options.

Internally, the build system maintains in `CCFLAGS` the list of options that are supplied to the compiler; this list is composed by combining the relevant environment variables (such as `CFLAGS`) along with the choices made by other build-time configurations.

This command-line variable makes it possible to override an option in this list by supplying customized command-line options to be appended. For example: `GDB=1 CCFLAGS=-g1`.

The string that is supplied as the value for this variable is parsed as per a POSIX shell command line, and so it may include shell quoting if necessary.

Arguments

–prefix Change the installation prefix. By default this is `/usr`, but some users might prefer `/usr/local` or `/opt`.

–actual-prefix This is mainly useful for packagers. The `rmlint` binary knows where it is installed (which is needed to set e.g. the path to the gettext files). When installing a package, most of the time the build is installed to a local test environment first before being packed to `/usr`. In this case the `--prefix` would be set to the path of the temporary build env, while `--actual-prefix` would be set to `/usr`.

–libdir Some distributions like Fedora use separate libdirectories for 64/32 bit. If this happens, you should set the correct one for 64 bit with `--libdir=lib64`.

–without-libelf Do not link with `libelf`, which is needed for nonstripped binary detection.

–without-blkid Do not link with `libblkid`, which is needed to differentiate between normal rotational harddisks and non-rotational disks.

–without-json-glib Do not link with `libjson-glib`, which is needed to load json-cache files. Without this library a warning is printed when using `--replay`.

–without-fiemap Do not attempt to use the `FIEMAP ioctl(2)`.

–without-gettext Do not link with `libintl` and do not compile any message catalogs.

All `--without-*` options come with a `--with-*` option that inverses its effect. By default `rmlint` is built with all features available on the system, so you do not need to specify any `--with-*` option normally.

Notable targets

install Install all program parts system-wide.

config Print a summary of all features that will be compiled and what the environment looks like.

man Build the manpage.

docs Build the online html docs (which you are reading now).

test Build the tests (requires `python` and `nosetest` installed). Optionally `valgrind` can be installed to run the tests through valgrind:

```
$ USE_VALGRIND=1 nosetests  # or nosetests-3.3, python3 needed.
```

xgettext Extract a gettext `.pot` template from the source.

dist Build a tarball suitable for release. Save it under `rmlint-$major-$minor-$patch.tar.gz`.

release Same as `dist`, but reads the `.version` file and replaces the current version in the files that are not built by *scons*.

6.1.6 Sourcecode layout

- All C-source lives in `lib`, the file names should be self explanatory.
- As an exception, the main lives in `src/rmlint.c`.
- All documentation is inside `docs`.
- All translation stuff should go to `po`.
- All packaging should be done in `pkg/<distribution>`.
- Tests are written in Python and live in `tests`.

6.1.7 Hashfunctions

Here is a short comparison of the existing hashfunctions in `rmlint` (linear scale). For reference: Those plots were rendered with these sources - which are very ugly, sorry.

If you want to add new hashfunctions, you should have some arguments why it is valuable and possibly even benchmark it with the above scripts to see if it's really that much faster.

Also keep in mind that most of the time the hashfunction is not the bottleneck.

6.1.8 Optimizations

For sake of overview, here is a short list of optimizations implemented in `rmlint`:

Obvious ones

- Do not compare each file with each other by content, use a hashfunction to reduce comparison overhead drastically (introduces possibility of collisions though).
- Only compare files of same size with each other.
- Use incremental hashing, i.e. hash block-wise each size group and stop as soon a difference occurs or the file is read fully.
- Create one reading thread for each physical disk. This gives a big speedup if files are roughly evenly spread over multiple physical disks [note: currently using 2 reading threads per disk as a workaround for a speed regression but hoping to fix this for rmlint 2.5].
- Disk traversal is similarly multi-threaded, one thread per disk.
- Create separate hashing threads (one for each file) so that the reader threads don't have to wait for hashing to catch up.

Subtle ones

- Check only executable files to be non-stripped binaries.
- Use `preadv(2)` based reading for small speeedups.
- Every thread in rmlint is shared, so only few calls to `pthread_create` are made.

Insane ones

- Use `fiemap ioctl(2)` to analyze the harddisk layout of each file, so each block can read it in *perfect* order on a rotational device.
- Check the device ID of each file to see if it on a rotational (normal hard disks) or on a non-rotational device (like an SSD). On the latter the fiemap optimisation is bypassed.
- Use a common buffer pool for IO buffers and recycle used buffers to reduce memory allocation overheads.
- Use only one hashsum per group of same-sized files.
- Implement paranoia check using the same algorithm as the incremental hash. The difference is that large chunks of the file are read and kept in memory instead of just keeping the hash in memory. This avoids the need for a two-pass algorithm (find matches using hashes then confirm via bytewise comparison). Each file is read once only. This achieves bytewise comparison in O(N) time, even if there are large clusters of same-size files. The downside is that it is somewhat memory-intensive (can be configured by `--limit-mem` option).

6.2 Translating `rmlint`

Rudimentary support for internationalization is provided via `gettext`. Also see this Issue for a list of translators, current translations and a wish-list of new translations.

6.2.1 Adding new languages

```
# Fork a new .po file from the po-template (here swedish):
$ msginit -i po/rmlint.pot -o po/se.po --locale se --no-translator

# Edit the po/se.po file, the format is self describing
$ vim po/se.po

# .po files need to be compiled, but that's handled by scons already.
$ scons
$ scons install

# You should see your changes now:
$ LANG=se ./rmlint
```

If you'd like to contribute your new translation you want to do a pull request (if you really dislike that, you may also send the translation to us via mail). Here is a small introduction on Pull Requests.

6.2.2 Updating existing languages

```
# Edit the file to your needs:
$ vim po/xy.po

# Install:
$ scons install

# Done
$ LANG=xy ./rmlint
```

6.2.3 Marking new strings for translations

If you want to mark strings in the C-code to be translated, you gonna need to mark them so the `xgettext` can find it. The latter tool goes through the source and creates a template file with all translations left out.

```
/* Mark the string with the _() macro */
fprintf(out, _("Stuff is alright: %s\n"), (alright) ? "yes" : "no");
```

It gets a little harder when static strings need to be marked, since they cannot be translated during compile time. You have to mark them first and translate them at a later point:

```
static const char * stuff = _N("Hello World");

void print_world(void) {
    printf("World is %s\n", _(stuff));
}
```

After you're done with marking the new strings, you have to update the gettext files:

```
$ scons gettext
```

Then, proceed to work with the relevant **.po* file as described above.

6.3 Benchmarks

This page contains the images that our benchmark suite renders for the current release. Inside the benchmark suite, `rmlint` is *challenged* against other popular and some less known duplicate finders. Apart from that a very dumb duplicate finder called `baseline.py` is used to see how slow a program would be that would blindly hash all files it finds. Luckily none of the programs is *that* slow. We'll allow us a few remarks on the plots, although we focus a bit on `rmlint`. You're of course free to interpret something different or re-run the benchmarks on your own machine. The exact version of each program is given in the plots.

Warning: This page is a little out of date. Help in updating it would be appreciated. The performance characteristics of rmlint have improved overall, but so might have other tools.

It should be noted that it is very hard to compare these tools, since *each* tool investigated a slightly different amount of data and produces different results on the dataset below. This is partly due to the fact that some tools count empty files and hardlinks as duplicates, while `rmlint` does not. Partly it might also be false positives, missed files or, in some tools, paths that contain a ','. For `rmlint` we verified that no false positives are in the set.

Here are some statistics on the datasets `/usr` and `/mnt/music`. `/usr` is on a `btrfs` filesystem that is located on an SSD with many small files, while `/mnt/music` is located on a rotational disk with `ext4` as filesystem. The amount of available memory was *8GB*.

```
$ du -hs /usr
7,8G        /usr
$ du -hs /mnt/music
213G    /mnt/music
$ find /usr -type f ! -empty | wc -l
284075
$ find /mnt/music -type f ! -empty | wc -l
37370
$ uname -a
Linux werkstatt 3.14.51-1-lts #1 SMP Mon Aug 17 19:21:08 CEST 2015 x86_64 GNU/Linux
```

Note: This plot uses logarithmic scaling for the time.

It should be noted that the first run is the most important run. At least for a rather large amount of data (here 211 GB), it is unlikely that the file system has all relevant files in its cache. You can see this with the second run of `baseline.py` - when reading all files the cache won't be useful at such large file quantities. The other tools read only a partial set of files and can thus benefit from caching on the second run. However `rmlint` (and also `dupd`) support fast re-running (see `rmlint-replay`) which makes repeated runs very fast. It is interesting to see `rmlint-paranoid` (no hash, incremental byte-by-byte comparison) to be mostly equally fast as the vanilla `rmlint`.

`rmlint` has the highest CPU footprint here, mostly due to its multithreaded nature. Higher CPU usage is not a bad thing since it might indicate that the program spends more time hashing files instead of switching between hashing and reading. `dupd` seems to be pretty efficient here, especially on re-runs. `rmlint-replay` has a high CPU usage here, but keep in mind that it does (almost) no IO and only has to repeat previous outputs.

The most memory efficient program here seems to be `rdfind` which uses even less than the bare bone `baseline.py` (which does not much more than holding a hashtable). The well known `fdupes` is also low on memory footprint.

Before saying that the paranoid mode of `rmlint` is a memory hog, it should be noted (since this can't be seen on those plots) that the memory consumption scales very well. Partly because `rmlint` saves all paths in a Trie, making it usable for ≥ 5M files. Also it is able to control the amount of memory it uses (`--limit-mem`). Due to the high amount of internal data structures it however has a rather large base memory footprint.

`dupd` uses direct file comparison for groups of two and three files and hash functions for the rest. It seems to have a rather high memory footprint in any case.

Surprisingly each tool found a different set of files. As stated above, direct comparison may not be possible here. For most tools except `rdfind` and `baseline.py` it's about in the same magnitude of files. `fdupes` seems to find about the same amount as `rmlint` (with small differences). The reasons for this are not clear yet, but we're looking at it currently.

6.3.1 User benchmarks

If you like, you can add your own benchmarks below. Maybe include the following information:

- `rmlint --version`
- `uname -a` or similar.
- Hardware setup, in particular the filesystem.
- The summary printed by `rmlint` in the end.
- Did it match your expectations?

If you have longer output you might want to use a pastebin like gist.

6.4 rmlint

6.4.1 find duplicate files and other space waste efficiently

SYNOPSIS

rmlint [TARGET_DIR_OR_FILES …] [//] [TAGGED_TARGET_DIR_OR_FILES …] [-] [OPTIONS]

DESCRIPTION

`rmlint` finds space waste and other broken things on your filesystem. Its main focus lies on finding duplicate files and directories.

It is able to find the following types of lint:

- Duplicate files and directories (and as a by-product unique files).
- Nonstripped Binaries (Binaries with debug symbols; needs to be explicitly enabled).
- Broken symbolic links.
- Empty files and directories (also nested empty directories).
- Files with broken user or group id.

`rmlint` itself WILL NOT DELETE ANY FILES. It does however produce executable output (for example a shell script) to help you delete the files if you want to. Another design principle is that it should work well together with other tools like `find`. Therefore we do not replicate features of other well know programs, as for example pattern matching and finding duplicate filenames. However we provide many convenience options for common use cases that are hard to build from scratch with standard tools.

In order to find the lint, `rmlint` is given one or more directories to traverse. If no directories or files were given, the current working directory is assumed. By default, `rmlint` will ignore hidden files and will not follow symlinks (see *Traversal Options*). `rmlint` will first find "other lint" and then search the remaining files for duplicates.

`rmlint` tries to be helpful by guessing what file of a group of duplicates is the **original** (i.e. the file that should not be deleted). It does this by using different sorting strategies that can be controlled via the `-S` option. By default it chooses the first-named path on the commandline. If two duplicates come from the same path, it will also apply different fallback sort strategies (See the documentation of the `-S` strategy).

This behaviour can be also overwritten if you know that a certain directory contains duplicates and another one originals. In this case you write the original directory after specifying a single `//` on the commandline. Everything that comes after is a preferred (or a "tagged") directory. If there are duplicates from an unpreferred and from a preferred directory, the preferred one will always count as original. Special options can also be used to always keep files in preferred directories (`-k`) and to only find duplicates that are present in both given directories (`-m`).

We advise new users to have a short look at all options `rmlint` has to offer, and maybe test some examples before letting it run on productive data. WRONG ASSUMPTIONS ARE THE BIGGEST ENEMY OF YOUR DATA. There are some extended example at the end of this manual, but each option that is not self-explanatory will also try to give examples.

OPTIONS

General Options

`-T --types="list"` (default: *defaults*) Configure the types of lint rmlint will look for. The *list* string is a comma-separated list of lint types or lint groups (other separators like semicolon or space also work though).

One of the following groups can be specified at the beginning of the list:

- `all`: Enables all lint types.
- `defaults`: Enables all lint types, but `nonstripped`.
- `minimal`: `defaults` minus `emptyfiles` and `emptydirs`.
- `minimaldirs`: `defaults` minus `emptyfiles`, `emptydirs` and `duplicates`, but with `duplicatedirs`.
- `none`: Disable all lint types [default].

Any of the following lint types can be added individually, or deselected by prefixing with a **-**:

- `badids`, `bi`: Find files with bad UID, GID or both.
- `badlinks`, `bl`: Find bad symlinks pointing nowhere valid.
- `emptydirs`, `ed`: Find empty directories.
- `emptyfiles`, `ef`: Find empty files.
- `nonstripped`, `ns`: Find nonstripped binaries.
- `duplicates`, `df`: Find duplicate files.
- `duplicatedirs`, `dd`: Find duplicate directories (This is the same `-D`!)

WARNING: It is good practice to enclose the description in single or double quotes. In obscure cases argument parsing might fail in weird ways, especially when using spaces as separator.

Example:

```
$ rmlint -T "df,dd"        # Only search for duplicate files and␣
↪directories
$ rmlint -T "all -df -dd"  # Search for all lint except duplicate files␣
↪and dirs.
```

`-o --output=spec` / `-O --add-output=spec` (default: *-o sh:rmlint.sh -o pretty:stdout -o summary:stdout -o json:rm*
Configure the way `rmlint` outputs its results. A `spec` is in the form `format:file` or just `format`. A `file` might either be an arbitrary path or `stdout` or `stderr`. If file is omitted, `stdout` is assumed. `format` is the name of a formatter supported by this program. For a list of formatters and their options, refer to the **Formatters** section below.

If `-o` is specified, rmlint's default outputs are overwritten. With `--O` the defaults are preserved. Either `-o` or `-O` may be specified multiple times to get multiple outputs, including multiple outputs of the same format.

Examples:

```
$ rmlint -o json                 # Stream the json output to stdout
$ rmlint -O csv:/tmp/rmlint.csv  # Output an extra csv file to /tmp
```

`-c --config=spec[=value]` (default: *none*) Configure a format. This option can be used to fine-tune the behaviour of the existing formatters. See the **Formatters** section for details on the available keys.

If the value is omitted it is set to a value meaning "enabled".

Examples:

```
$ rmlint -c sh:link             # Smartly link duplicates instead of␣
↪removing
$ rmlint -c progressbar:fancy  # Use a different theme for the␣
↪progressbar
```

`-z --perms[=[rwx]]` (default: *no check*) Only look into file if it is readable, writable or executable by the current user. Which one of the can be given as argument as one of *"rwx"*.

If no argument is given, *"rw"* is assumed. Note that *r* does basically nothing user-visible since `rmlint` will ignore unreadable files anyways. It's just there for the sake of completeness.

By default this check is not done.

```
$ rmlint -z rx $(echo $PATH | tr ":" " ") # Look at all executable
files in $PATH
```

`-a --algorithm=name` (default: *blake2b*) Choose the algorithm to use for finding duplicate files. The algorithm can be either **paranoid** (byte-by-byte file comparison) or use one of several file hash algorithms to identify duplicates. The following hash families are available (in approximate descending order of cryptographic strength):

sha3, **blake**,

sha,

highway, **md**

metro, **murmur**, **xxhash**

The weaker hash functions still offer excellent distribution properties, but are potentially more vulnerable to *malicious* crafting of duplicate files.

The full list of hash functions (in decreasing order of checksum length) is:

512-bit: **blake2b**, **blake2bp**, **sha3-512**, **sha512**

384-bit: **sha3-384**,

256-bit: **blake2s**, **blake2sp**, **sha3-256**, **sha256**, **highway256**, **metro256**, **metrocrc256**

160-bit: **sha1**

128-bit: **md5**, **murmur**, **metro**, **metrocrc**

64-bit: **highway64**, **xxhash**.

The use of 64-bit hash length for detecting duplicate files is not recommended, due to the probability of a random hash collision.

`-p --paranoid` / **`-P --less-paranoid`** **(default)** Increase or decrease the paranoia of `rmlint`'s duplicate algorithm. Use `-p` if you want byte-by-byte comparison without any hashing.

- `-p` is equivalent to `--algorithm=paranoid`
- `-P` is equivalent to `--algorithm=highway256`
- `-PP` is equivalent to `--algorithm=metro256`
- `-PPP` is equivalent to `--algorithm=metro`

`-v --loud` / **`-V --quiet`** Increase or decrease the verbosity. You can pass these options several times. This only affects `rmlint`'s logging on *stderr*, but not the outputs defined with **-o**. Passing either option more than three times has no further effect.

`-g --progress` / **`-G --no-progress`** **(default)** Show a progressbar with sane defaults.

Convenience shortcut for `-o progressbar -o summary -o sh:rmlint.sh -o json:rmlint.json -VVV`.

NOTE: This flag clears all previous outputs. If you want additional outputs, specify them after this flag using `-O`.

`-D --merge-directories` **(default: *disabled*)** Makes rmlint use a special mode where all found duplicates are collected and checked if whole directory trees are duplicates. Use with caution: You always should make sure that the investigated directory is not modified during `rmlint`'s or its removal scripts run.

IMPORTANT: Definition of equal: Two directories are considered equal by `rmlint` if they contain the exact same data, no matter how the files containing the data are named. Imagine that `rmlint` creates a long, sorted stream out of the data found in the directory and compares this in a magic way to another directory. This means that the layout of the directory is not considered to be important by default. Also empty files will not count as content. This might be surprising to some users, but remember that `rmlint` generally cares only about content, not about any other metadata or layout. If you want to only find trees with the same hierarchy you should use `--honour-dir-layout / -j`.

Output is deferred until all duplicates were found. Duplicate directories are printed first, followed by any remaining duplicate files that are isolated or inside of any original directories.

–rank-by applies for directories too, but 'p' or 'P' (path index) has no defined (i.e. useful) meaning. Sorting takes only place when the number of preferred files in the directory differs.

NOTES:

- This option enables `--partial-hidden` and `-@` (`--see-symlinks`) for convenience. If this is not desired, you should change this after specifying `-D`.
- This feature might add some runtime for large datasets.

- When using this option, you will not be able to use the `-c sh:clone` option. Use `-c sh:link` as a good alternative.

`-j --honour-dir-layout` **(default: *disabled*)** Only recognize directories as duplicates that have the same path layout. In other words: All duplicates that build the duplicate directory must have the same path from the root of each respective directory. This flag makes no sense without `--merge-directories`.

`-y --sort-by=order` **(default: *none*)** During output, sort the found duplicate groups by criteria described by *order*. *order* is a string that may consist of one or more of the following letters:

- *s*: Sort by size of group.
- *a*: Sort alphabetically by the basename of the original.
- *m*: Sort by mtime of the original.
- *p*: Sort by path-index of the original.
- *o*: Sort by natural found order (might be different on each run).
- *n*: Sort by number of files in the group.

The letter may also be written uppercase (similar to `-S / --rank-by`) to reverse the sorting. Note that `rmlint` has to hold back all results to the end of the run before sorting and printing.

`-w --with-color` **(default) /** **`-W --no-with-color`** Use color escapes for pretty output or disable them. If you pipe *rmlints* output to a file `-W` is assumed automatically.

`-h --help` **/** **`-H --show-man`** Show a shorter reference help text (`-h`) or the full man page (`-H`).

`--version` Print the version of rmlint. Includes git revision and compile time features. Please include this when giving feedback to us.

Traversal Options

`-s --size=range` **(default: "1")** Only consider files as duplicates in a certain size range. The format of *range* is *min-max*, where both ends can be specified as a number with an optional multiplier. The available multipliers are:

- *C* (1^1), *W* (2^1), B (512^1), *K* (1000^1), KB (1024^1), *M* (1000^2), *MB* (1024^2), *G* (1000^3), *GB* (1024^3),
- *T* (1000^4), *TB* (1024^4), *P* (1000^5), *PB* (1024^5), *E* (1000^6), *EB* (1024^6)

The size format is about the same as *dd(1)* uses. A valid example would be: **"100KB-2M"**. This limits duplicates to a range from 100 Kilobyte to 2 Megabyte.

It's also possible to specify only one size. In this case the size is interpreted as *"bigger or equal"*. If you want to filter for files *up to this size* you can add a - in front (`-s -1M` == `-s 0-1M`).

Edge case: The default excludes empty files from the duplicate search. Normally these are treated specially by `rmlint` by handling them as *other lint*. If you want to include empty files as duplicates you should lower the limit to zero:

```
$ rmlint -T df --size 0
```

`-d --max-depth=depth` **(default: *INF*)** Only recurse up to this depth. A depth of 1 would disable recursion and is equivalent to a directory listing. A depth of 2 would also consider all children directories and so on.

-l --hardlinked (default) / --keep-hardlinked / -L --no-hardlinked Hardlinked files are treated as duplicates by default (`--hardlinked`). If `--keep-hardlinked` is given, *rmlint* will not delete any files that are hardlinked to an original in their respective group. Such files will be displayed like originals, i.e. for the default output with a "ls" in front. The reasoning here is to maximize the number of kept files, while maximizing the number of freed space: Removing hardlinks to originals will not allocate any free space.

If *–no-hardlinked* is given, only one file (of a set of hardlinked files) is considered, all the others are ignored; this means, they are not deleted and also not even shown in the output. The "highest ranked" of the set is the one that is considered.

-f --followlinks / -F --no-followlinks / -@ --see-symlinks (default) `-f` will always follow symbolic links. If file system loops occurs `rmlint` will detect this. If *-F* is specified, symbolic links will be ignored completely, if `-@` is specified, `rmlint` will see symlinks and treats them like small files with the path to their target in them. The latter is the default behaviour, since it is a sensible default for `--merge-directories`.

-x --no-crossdev / -X --crossdev (default) Stay always on the same device (`-x`), or allow crossing mountpoints (`-X`). The latter is the default.

-r --hidden / -R --no-hidden (default) / --partial-hidden Also traverse hidden directories? This is often not a good idea, since directories like `.git/` would be investigated, possibly leading to the deletion of internal `git` files which in turn break a repository. With `--partial-hidden` hidden files and folders are only considered if they're inside duplicate directories (see `--merge-directories`) and will be deleted as part of it.

-b --match-basename Only consider those files as dupes that have the same basename. See also `man 1 basename`. The comparison of the basenames is case-insensitive.

-B --unmatched-basename Only consider those files as dupes that do not share the same basename. See also `man 1 basename`. The comparison of the basenames is case-insensitive.

-e --match-with-extension / -E --no-match-with-extension (default) Only consider those files as dupes that have the same file extension. For example two photos would only match if they are a `.png`. The extension is compared case-insensitive, so `.PNG` is the same as `.png`.

-i --match-without-extension / -I --no-match-without-extension (default) Only consider those files as dupes that have the same basename minus the file extension. For example: `banana.png` and `Banana.jpeg` would be considered, while `apple.png` and `peach.png` won't. The comparison is case-insensitive.

-n --newer-than-stamp=<timestamp_filename> / -N --newer-than=<iso8601_timestamp_or_unix_
Only consider files (and their size siblings for duplicates) newer than a certain modification time (*mtime*). The age barrier may be given as seconds since the epoch or as ISO8601-Timestamp like *2014-09-08T00:12:32+0200*.

`-n` expects a file from which it can read the timestamp. After rmlint run, the file will be updated with the current timestamp. If the file does not initially exist, no filtering is done but the stampfile is still written.

`-N`, in contrast, takes the timestamp directly and will not write anything.

Note that `rmlint` will find duplicates newer than `timestamp`, even if the original is older. If you want only find duplicates where both original and duplicate are newer than `timestamp` you can use `find(1)`:

- `find -mtime -1 -print0 | rmlint -0 # pass all files younger than a day to rmlint`

Note: you can make rmlint write out a compatible timestamp with:

- `-O stamp:stdout # Write a seconds-since-epoch timestamp to stdout on finish.`
- `-O stamp:stdout -c stamp:iso8601 # Same, but write as ISO8601.`

Original Detection Options

`-k --keep-all-tagged` / **`-K --keep-all-untagged`** Don't delete any duplicates that are in tagged paths (`-k`) or that are in non-tagged paths (`-K`). (Tagged paths are those that were named after *//*).

`-m --must-match-tagged` / **`-M --must-match-untagged`** Only look for duplicates of which at least one is in one of the tagged paths. (Paths that were named after *//*).

Note that the combinations of `-kM` and `-Km` are prohibited by `rmlint`. See https://github.com/sahib/rmlint/issues/244 for more information.

`-S --rank-by=criteria` (default: *pOma*) Sort the files in a group of duplicates into originals and duplicates by one or more criteria. Each criteria is defined by a single letter (except **r** and **x** which expect a regex pattern after the letter). Multiple criteria may be given as string, where the first criteria is the most important. If one criteria cannot decide between original and duplicate the next one is tried.

- **m**: keep lowest mtime (oldest) **M**: keep highest mtime (newest)
- **a**: keep first alphabetically **A**: keep last alphabetically
- **p**: keep first named path **P**: keep last named path
- **d**: keep path with lowest depth **D**: keep path with highest depth
- **l**: keep path with shortest basename **L**: keep path with longest basename
- **r**: keep paths matching regex **R**: keep path not matching regex
- **x**: keep basenames matching regex **X**: keep basenames not matching regex
- **h**: keep file with lowest hardlink count **H**: keep file with highest hardlink count
- **o**: keep file with lowest number of hardlinks outside of the paths traversed by `rmlint`.
- **O**: keep file with highest number of hardlinks outside of the paths traversed by `rmlint`.

Alphabetical sort will only use the basename of the file and ignore its case. One can have multiple criteria, e.g.: `-S am` will choose first alphabetically; if tied then by mtime. **Note:** original path criteria (specified using *//*) will always take first priority over *-S* options.

For more fine grained control, it is possible to give a regular expression to sort by. This can be useful when you know a common fact that identifies original paths (like a path component being `src` or a certain file ending).

To use the regular expression you simply enclose it in the criteria string by adding *<REGULAR_EXPRESSION>* after specifying *r* or *x*. Example: `-S 'r<.*\.bak$>'` makes all files that have a `.bak` suffix original files.

Warning: When using **r** or **x**, try to make your regex to be as specific as possible! Good practice includes adding a `$` anchor at the end of the regex.

Tips:

- **l** is useful for files like *file.mp3 vs file.1.mp3 or file.mp3.bak*.
- **a** can be used as last criteria to assert a defined order.

- **o/O** and **h/H** are only useful if there any hardlinks in the traversed path.
- **o/O** takes the number of hardlinks outside the traversed paths (and thereby minimizes/maximizes the overall number of hardlinks). **h/H** in contrast only takes the number of hardlinks *inside* of the traversed paths. When hardlinking files, one would like to link to the original file with the highest outer link count (**O**) in order to maximise the space cleanup. **H** does not maximise the space cleanup, it just selects the file with the highest total hardlink count. You usually want to specify **O**.
- **pOma** is the default since **p** ensures that first given paths rank as originals, **O** ensures that hardlinks are handled well, **m** ensures that the oldest file is the original and **a** simply ensures a defined ordering if no other criteria applies.

Caching

`--replay` Read an existing json file and re-output it. When `--replay` is given, `rmlint` does **no input/output on the filesystem**, even if you pass additional paths. The paths you pass will be used for filtering the `--replay` output.

This is very useful if you want to reformat, refilter or resort the output you got from a previous run. Usage is simple: Just pass `--replay` on the second run, with other changed to the new formatters or filters. Pass the `.json` files of the previous runs additionally to the paths you ran `rmlint` on. You can also merge several previous runs by specifying more than one `.json` file, in this case it will merge all files given and output them as one big run.

If you want to view only the duplicates of certain subdirectories, just pass them on the commandline as usual.

The usage of `//` has the same effect as in a normal run. It can be used to prefer one `.json` file over another. However note that running `rmlint` in `--replay` mode includes no real disk traversal, i.e. only duplicates from previous runs are printed. Therefore specifying new paths will simply have no effect. As a security measure, `--replay` will ignore files whose mtime changed in the meantime (i.e. mtime in the `.json` file differs from the current one). These files might have been modified and are silently ignored.

By design, some options will not have any effect. Those are:

- `--followlinks`
- `--algorithm`
- `--paranoid`
- `--clamp-low`
- `--hardlinked`
- `--write-unfinished`
- `...` and all other caching options below.

NOTE: In `--replay` mode, a new `.json` file will be written to `rmlint.replay.json` in order to avoid overwriting `rmlint.json`.

`-C --xattr` Shortcut for `--xattr-read`, `--xattr-write`, `--write-unfinished`. This will write a checksum and a timestamp to the extended attributes of each file that rmlint hashed. This speeds up subsequent runs on the same data set. Please note that not all filesystems may support extended attributes and you need write support to use this feature.

See the individual options below for more details and some examples.

`--xattr-read` / `--xattr-write` / `--xattr-clear` Read or write cached checksums from the extended file attributes. This feature can be used to speed up consecutive runs.

CAUTION: This could potentially lead to false positives if file contents are somehow modified without changing the file modification time. rmlint uses the mtime to determine the modification timestamp if a checksum is outdated. This is not a problem if you use the clone or reflink operation on a filesystem like btrfs. There an outdated checksum entry would simply lead to some duplicate work done in the kernel but would do no harm otherwise.

NOTE: Many tools do not support extended file attributes properly, resulting in a loss of the information when copying the file or editing it.

NOTE: You can specify `--xattr-write` and `--xattr-read` at the same time. This will read from existing checksums at the start of the run and update all hashed files at the end.

Usage example:

```
$ rmlint large_file_cluster/ -U --xattr-write   # first run should be␣
↪slow.
$ rmlint large_file_cluster/ --xattr-read       # second run should be␣
↪faster.

# Or do the same in just one run:
$ rmlint large_file_cluster/ --xattr
```

`-U --write-unfinished` Include files in output that have not been hashed fully, i.e. files that do not appear to have a duplicate. Note that this will not include all files that `rmlint` traversed, but only the files that were chosen to be hashed.

This is mainly useful in conjunction with `--xattr-write/read`. When re-running rmlint on a large dataset this can greatly speed up a re-run in some cases. Please refer to `--xattr-read` for an example.

If you want to output unique files, please look into the `uniques` output formatter.

Rarely used, miscellaneous options

`-t --threads=N` (*default:* 16) The number of threads to use during file tree traversal and hashing. `rmlint` probably knows better than you how to set this value, so just leave it as it is. Setting it to `1` will also not make `rmlint` a single threaded program.

`-u --limit-mem=size` Apply a maximum number of memory to use for hashing and **–paranoid**. The total number of memory might still exceed this limit though, especially when setting it very low. In general `rmlint` will however consume about this amount of memory plus a more or less constant extra amount that depends on the data you are scanning.

The `size`-description has the same format as for **–size**, therefore you can do something like this (use this if you have 1GB of memory available):

```
$ rmlint -u 512M # Limit paranoid mem usage to 512 MB
```

`-q --clamp-low=[fac.tor|percent%|offset]` (default: *0*) / `-Q --clamp-top=[fac.tor|percent%|offs`
The argument can be either passed as factor (a number with a `.` in it), a percent value (suffixed by `%`) or as absolute number or size spec, like in `--size`.

Only look at the content of files in the range of from `low` to (including) `high`. This means, if the range is less than `-q 0%` to `-Q 100%`, than only partial duplicates are searched. If the file size is less than the clamp limits, the file is ignored during traversing. Be careful when using this function, you can easily get dangerous results for small files.

This is useful in a few cases where a file consists of a constant sized header or footer. With this option you can just compare the data in between. Also it might be useful for approximate comparison where it suffices when the file is the same in the middle part.

Example:

```
$ rmlint -q 10% -Q 512M # Only read the last 90% of a file, but
read at max. 512MB
```

`-Z --mtime-window=T` (default: *-1*) Only consider those files as duplicates that have the same content and the same modification time (mtime) within a certain window of *T* seconds. If *T* is 0, both files need to have the same mtime. For *T=1* they may differ one second and so on. If the window size is negative, the mtime of duplicates will not be considered. *T* may be a floating point number.

However, with three (or more) files, the mtime difference between two duplicates can be bigger than the mtime window *T*, i.e. several files may be chained together by the window. Example: If *T* is 1, the four files fooA (mtime: 00:00:00), fooB (00:00:01), fooC (00:00:02), fooD (00:00:03) would all belong to the same duplicate group, although the mtime of fooA and fooD differs by 3 seconds.

`--with-fiemap` (default) / `--without-fiemap` Enable or disable reading the file extents on rotational disk in order to optimize disk access patterns. If this feature is not available, it is disabled automatically.

FORMATTERS

- `csv`: Output all found lint as comma-separated-value list.

  Available options:

  – *no_header*: Do not write a first line describing the column headers.

  – *unique*: Include unique files in the output.

- **`sh`: Output all found lint as shell script This formatter is activated** as default.

  available options:

  – *cmd*: Specify a user defined command to run on duplicates. The command can be any valid `/bin/sh`-expression. The duplicate path and original path can be accessed via `"$1"` and `"$2"`. The command will be written to the `user_command` function in the `sh`-file produced by rmlint.

  – *handler* Define a comma separated list of handlers to try on duplicate files in that given order until one handler succeeds. Handlers are just the name of a way of getting rid of the file and can be any of the following:

    * `clone`: For reflink-capable filesystems only. Try to clone both files with the FIDEDUPERANGE `ioctl(3p)` (or BTRFS_IOC_FILE_EXTENT_SAME on older kernels). This will free up duplicate extents. Needs at least kernel 4.2. Use this option when you only have read-only access to a btrfs filesystem but still want to deduplicate it. This is usually the case for snapshots.

    * `reflink`: Try to reflink the duplicate file to the original. See also `--reflink` in `man 1 cp`. Fails if the filesystem does not support it.

    * `hardlink`: Replace the duplicate file with a hardlink to the original file. The resulting files will have the same inode number. Fails if both files are not on the same partition. You can use `ls -i` to show the inode number of a file and `find -samefile <path>` to find all hardlinks for a certain file.

    * `symlink`: Tries to replace the duplicate file with a symbolic link to the original. This handler never fails.

    * `remove`: Remove the file using `rm -rf`. (`-r` for duplicate dirs). This handler never fails.

    * `usercmd`: Use the provided user defined command (`-c sh:cmd=something`). This handler never fails.

  Default is `remove`.

  – *link*: Shortcut for `-c sh:handler=clone,reflink,hardlink,symlink`. Use this if you are on a reflink-capable system.

  – *hardlink*: Shortcut for `-c sh:handler=hardlink,symlink`. Use this if you want to hardlink files, but want to fallback for duplicates that lie on different devices.

  – *symlink*: Shortcut for `-c sh:handler=symlink`. Use this as last straw.

• `json`: Print a JSON-formatted dump of all found reports. Outputs all lint as a json document. The document is a list of dictionaries, where the first and last element is the header and the footer. Everything between are data-dictionaries.

  Available options:

  – *unique*: Include unique files in the output.

  – *no_header=[true|false]:* Print the header with metadata (default: true)

  – *no_footer=[true|false]:* Print the footer with statistics (default: true)

  – *oneline=[true|false]:* Print one json document per line (default: false) This is useful if you plan to parse the output line-by-line, e.g. while `rmlint` is sill running.

  This formatter is extremely useful if you're in need of scripting more complex behaviour, that is not directly possible with rmlint's built-in options. A very handy tool here is `jq`. Here is an example to output all original files directly from a `rmlint` run:

  ```
  $ rmlint -o | json jq -r '.[1:-1][] | select(.is_original) | .path'
  ```

• `py`: Outputs a python script and a JSON document, just like the **json** formatter. The JSON document is written to `.rmlint.json`, executing the script will make it read from there. This formatter is mostly intended for complex use-cases where the lint needs special handling that you define in the python script. Therefore the python script can be modified to do things standard `rmlint` is not able to do easily.

• `uniques`: Outputs all unique paths found during the run, one path per line. This is often useful for scripting purposes.

  Available options:

  – *print0*: Do not put newlines between paths but zero bytes.

• `stamp`:

  Outputs a timestamp of the time `rmlint` was run. See also the `--newer-than` and `--newer-than-stamp` file option.

  Available options:

  – *iso8601=[true|false]:* Write an ISO8601 formatted timestamps or seconds since epoch?

• `progressbar`: Shows a progressbar. This is meant for use with **stdout** or **stderr** [default].

  See also: `-g` (`--progress`) for a convenience shortcut option.

  Available options:

  – *update_interval=number:* Number of milliseconds to wait between updates. Higher values use less resources (default 50).

  – *ascii:* Do not attempt to use unicode characters, which might not be supported by some terminals.

  – *fancy:* Use a more fancy style for the progressbar.

- `pretty`: Shows all found items in realtime nicely colored. This formatter is activated as default.
- `summary`: Shows counts of files and their respective size after the run. Also list all written output files.
- `fdupes`: Prints an output similar to the popular duplicate finder **fdupes(1)**. At first a progressbar is printed on **stderr.** Afterwards the found files are printed on **stdout;** each set of duplicates gets printed as a block separated by newlines. Originals are highlighted in green. At the bottom a summary is printed on **stderr**. This is mostly useful for scripts that were set up for parsing fdupes output. We recommend the `json` formatter for every other scripting purpose.

  Available options:

  – *omitfirst:* Same as the `-f / --omitfirst` option in `fdupes(1)`. Omits the first line of each set of duplicates (i.e. the original file.

  – *sameline:* Same as the `-1 / --sameline` option in `fdupes(1)`. Does not print newlines between files, only a space. Newlines are printed only between sets of duplicates.

OTHER STAND-ALONE COMMANDS

`rmlint --gui` Start the optional graphical frontend to `rmlint` called `Shredder`.

  This will only work when `Shredder` and its dependencies were installed. See also: http://rmlint.readthedocs.org/en/latest/gui.html

  The gui has its own set of options, see `--gui --help` for a list. These should be placed at the end, ie `rmlint --gui [options]` when calling it from commandline.

`rmlint --hash [paths...]` Make `rmlint` work as a multi-threaded file hash utility, similar to the popular `md5sum` or `sha1sum` utilities, but faster and with more algorithms. A set of paths given on the commandline or from *stdin* is hashed using one of the available hash algorithms. Use `rmlint --hash -h` to see options.

`rmlint --equal [paths...]` Check if the paths given on the commandline all have equal content. If all paths are equal and no other error happened, rmlint will exit with an exit code 0. Otherwise it will exit with a nonzero exit code. All other options can be used as normal, but note that no other formatters (`sh`, `csv` etc.) will be executed by default. At least two paths need to be passed.

  Note: This even works for directories and also in combination with paranoid mode (pass `-pp` for byte comparison); remember that rmlint does not care about the layout of the directory, but only about the content of the files in it. At least two paths need to be given to the commandline.

  By default this will use hashing to compare the files and/or directories.

`rmlint --dedupe [-r] [-v|-V] <src> <dest>` If the filesystem supports files sharing physical storage between multiple files, and if `src` and `dest` have same content, this command makes the data in the `src` file appear the `dest` file by sharing the underlying storage.

  This command is similar to `cp --reflink=always <src> <dest>` except that it (a) checks that `src` and `dest` have identical data, and it makes no changes to `dest`'s metadata.

  Running with `-r` option will enable deduplication of read-only [btrfs] snapshots (requires root).

`rmlint --is-reflink [-v|-V] <file1> <file2>` Tests whether `file1` and `file2` are reflinks (reference same data). This command makes `rmlint` exit with one of the following exit codes:

  - 0: files are reflinks
  - 1: files are not reflinks
  - 3: not a regular file

- 4: file sizes differ
- 5: fiemaps can't be read
- 6: file1 and file2 are the same path
- 7: file1 and file2 are the same file under different mountpoints
- 8: files are hardlinks
- 9: files are symlinks
- 10: files are not on same device
- 11: other error encountered

EXAMPLES

This is a collection of common use cases and other tricks:

- Check the current working directory for duplicates.

  ```
  $ rmlint
  ```

- Show a progressbar:

  ```
  $ rmlint -g
  ```

- Quick re-run on large datasets using different ranking criteria on second run:

  ```
  $ rmlint large_dir/ # First run; writes rmlint.json
  $ rmlint --replay rmlint.json large_dir -S MaD
  ```

- Merge together previous runs, but prefer the originals to be from `b.json` and make sure that no files are deleted from `b.json`:

  ```
  $ rmlint --replay a.json // b.json -k
  ```

- Search only for duplicates and duplicate directories

  ```
  $ rmlint -T "df,dd" .
  ```

- Compare files byte-by-byte in current directory:

  ```
  $ rmlint -pp .
  ```

- Find duplicates with same basename (excluding extension):

  ```
  $ rmlint -e
  ```

- Do more complex traversal using `find(1)`.

  ```
  $ find /usr/lib -iname '*.so' -type f | rmlint - # find all duplicate .so files
  $ find /usr/lib -iname '*.so' -type f -print0 | rmlint -0 # as above but handles filenames with newline character in them
  $ find ~/pics -iname '*.png' | ./rmlint - # compare png files only
  ```

- Limit file size range to investigate:

  ```
  $ rmlint -s 2GB # Find everything >= 2GB
  $ rmlint -s 0-2GB # Find everything < 2GB
  ```

- Only find writable and executable files:

  `$ rmlint --perms wx`

- Reflink if possible, else hardlink duplicates to original if possible, else replace duplicate with a symbolic link:

  `$ rmlint -c sh:link`

- Inject user-defined command into shell script output:

  `$ rmlint -o sh -c sh:cmd='echo "original:" "$2" "is the same as" "$1"'`

- Use `shred` to overwrite the contents of a file fully:

  `$ rmlint -c 'sh:cmd=shred -un 10 "$1"'`

- Use *data* as master directory. Find **only** duplicates in *backup* that are also in *data*. Do not delete any files in *data*:

  `$ rmlint backup // data --keep-all-tagged --must-match-tagged`

- Compare if the directories a b c and are equal

  `$ rmlint --equal a b c && echo "Files are equal" || echo "Files are not equal"`

- Test if two files are reflinks

  `$ rmlint --is-reflink a b && echo "Files are reflinks" || echo "Files are not reflinks".`

- Cache calculated checksums for next run. The checksums will be written to the extended file attributes:

  `$ rmlint --xattr`

- Produce a list of unique files in a folder:

  `$ rmlint -o uniques`

- Produce a list of files that are unique, including original files ("one of each"):

  `$ rmlint t -o json -o uniques:unique_files | jq -r '.[1:-1][] | select(.is_original) | .path' | sort > original_files        $ cat unique_files original_files`

- Sort files by a user-defined regular expression

  ```
  # Always keep files with ABC or DEF in their basename,
  # dismiss all duplicates with tmp, temp or cache in their names
  # and if none of those are applicable, keep the oldest files instead.
  $ ./rmlint -S 'x<.*(ABC|DEF).*>X<.*(tmp|temp|cache).*>m' /some/path
  ```

- Sort files by adding priorities to several user-defined regular expressions:

  ```
  # Unlike the previous snippet, this one uses priorities:
  # Always keep files in ABC, DEF, GHI by following that particular order of
  # importance (ABC has a top priority), dismiss all duplicates with
  # tmp, temp, cache in their paths and if none of those are applicable,
  # keep the oldest files instead.
  $ rmlint -S 'r<.*ABC.*>r<.*DEF.*>r<.*GHI.*>R<.*(tmp|temp|cache).*>m' /
  ↪some/path
  ```

PROBLEMS

1. **False Positives:** Depending on the options you use, there is a very slight risk of false positives (files that are erroneously detected as duplicate). The default hash function (blake2b) is very safe but in theory it is possible for two files to have then same hash. If you had 10^73 different files, all the same size, then the chance of a false positive is still less than 1 in a billion. If you're concerned just use the `--paranoid` (`-pp`) option. This will compare all the files byte-by-byte and is not much slower than blake2b (it may even be faster), although it is a lot more memory-hungry.
2. **File modification during or after rmlint run:** It is possible that a file that `rmlint` recognized as duplicate is modified afterwards, resulting in a different file. If you use the rmlint-generated shell script to delete the duplicates, you can run it with the `-p` option to do a full re-check of the duplicate against the original before it deletes the file. When using `-c sh:hardlink` or `-c sh:symlink` care should be taken that a modification of one file will now result in a modification of all files. This is not the case for `-c sh:reflink` or `-c sh:clone`. Use `-c sh:link` to minimise this risk.

SEE ALSO

Reading the manpages of these tools might help working with `rmlint`:

- *find(1)*
- *rm(1)*
- *cp(1)*

Extended documentation and an in-depth tutorial can be found at:

- http://rmlint.rtfd.org

BUGS

If you found a bug, have a feature requests or want to say something nice, please visit https://github.com/sahib/rmlint/issues.

Please make sure to describe your problem in detail. Always include the version of `rmlint` (`--version`). If you experienced a crash, please include at least one of the following information with a debug build of `rmlint`:

- `gdb --ex run -ex bt --args rmlint -vvv [your_options]`
- `valgrind --leak-check=no rmlint -vvv [your_options]`

You can build a debug build of `rmlint` like this:

- `git clone git@github.com:sahib/rmlint.git`
- `cd rmlint`
- `scons GDB=1 DEBUG=1`
- `sudo scons install # Optional`

LICENSE

`rmlint` is licensed under the terms of the GPLv3.

See the COPYRIGHT file that came with the source for more information.

PROGRAM AUTHORS

`rmlint` was written by:

- Christopher <sahib> Pahl 2010-2017 (https://github.com/sahib)
- Daniel <SeeSpotRun> T. 2014-2017 (https://github.com/SeeSpotRun)

Also see the http://rmlint.rtfd.org for other people that helped us.

The Changelog is also updated with new and futures features, fixes and overall changes.

CHAPTER 7

Authors

`rmlint` was and is written by:

Christopher Pahl	https://github.com/sahib	2010-2019
Daniel Thomas	https://github.com/SeeSpotRun	2014-2019

Additional thanks to:

- vvs- (Scalability testing)
- *Attila* Toth
- All sane bugreporters (there are not many)
- All packagers, porters and patchers.

CHAPTER 8

License

`rmlint` is licensed under the terms of GPLv3.