SUSE

Mastering System Logs: From `systemd-journald` to `journalctl`

`systemd-journald` in SUSE Linux Enterprise Server for NVIDIA is a system service responsible for collecting, indexing and storing log data across kernel and application sources. By centralizing binary event logging and enabling structured querying through **`journalctl`**, administrators can efficiently filter logs, inspect system events and troubleshoot service failures without parsing disjointed plain-text files.

Publication Date: 05 Nov 2026

Contents

1 The **`systemd-journald`** service 2

2 About the journal 4

3 The **`journalctl`** command 6

4 Filtering the journal output 8

5 Troubleshooting `systemd` errors 10

6 Legal Notice 12

A GNU Free Documentation License 13

1 The `systemd-journald` service

`journald` is a `systemd` service responsible for collecting, indexing, and storing log data. The collected events include kernel messages, initrd (initial RAM disk) messages, service startup/shutdown, application events, and authentication and session data.

On SUSE Linux Enterprise Server for NVIDIA, the `systemd-journald` service is enabled and started by default. The service logs the data into the journal described in *Section 2, "About the journal"*.

1.1 Configuring `systemd-journald`

You can configure the basic behavior of **`systemd-journald`** service by modifying `/etc/systemd/journald.conf`.

To configure **`systemd-journald`**, proceed as follows:

PROCEDURE 1: CONFIGURING `systemd-journald`

1. Open the **`systemd-journald`** configuration file:

```
> sudo  vi /etc/systemd/journald.conf
```

```
[Journal]

# Store journals on disk so logs survive reboot
Storage=persistent

# Disk space limits
SystemMaxUse=2G
SystemKeepFree=10%

# Per-file max size
SystemMaxFileSize=200M

# RAM (runtime) journal limits
RuntimeMaxUse=500M
RuntimeKeepFree=10%

# Log retention
MaxRetentionSec=4weeks

# Compression for old logs
```

```
Compress=yes

# Optional: also forward to rsyslog/syslog
ForwardToSyslog=yes
```

2. Modify the configurations:

   - To modify the storage type, modify **`Storage=auto`**.
     The available options are:

     - *volatile*: RAM only (clears on reboot).
     - *persistent*: stored in `/var/log/journal`.
     - *auto*: persistent if directory exists, otherwise volatile.
     - *none*: no logs written to disk or memory.

     If the journal log data is saved to a persistent location, it uses up to 10% of the file system the `/var/log/journal` resides on. For example, if `/var/log/journal` is located on a 30 GB /var partition, the journal may use up to 3 GB of the disk space. To change this limit, change (and uncomment) the **`SystemMaxUse`** option:

     ```
     SystemMaxUse=50M
     > sudo  systemctl restart systemd-journald
     ```

   - To limit the log rate to prevent flooding logs:

     ```
     RateLimitIntervalSec=30s
     RateLimitBurst=1000
     ```

   - To send the journal to a terminal device to inform you about system messages on a preferred terminal screen, for example `/dev/tty12`:

     ```
     ForwardToConsole=yes
     TTYPath=/dev/tty12
     ```

   - To forward logs to syslog, modify **`ForwardToSyslog=yes`**. `journald` is backward compatible with traditional syslog implementations such as rsyslog.

- Install rsyslog:

```
rpm -q rsyslog
```

- Enable rsyslog:

```
systemctl is-enabled rsyslog
```

- Enable forwarding to rsyslog in `/etc/systemd/journald.conf`:

```
ForwardToSyslog=yes
```

For more information on file descriptions, see **`man 5 journald.conf`**.

3. Save and restart **`systemd-journald`**.

```
> sudo  systemctl restart systemd-journald
```

2 About the journal

The journal is a centralized, unified storage system for log data from all sources. It stores events in a structured manner, which helps with error identification and crash recovery.

2.1 Where can I find the journal?

By default, `journald` stores the collected data in the volatile memory in `/run/log/journal`, so after reboot the data is lost.

If `systemd-journald` is configured to store the logs in a persistent manner, you can find the journal in `/var/log/journal`. See if the directory is there:

1. Check if the directory exist:

```
> sudo ls /var/log
...
journal
...
```

2. If the `/var/log/journal` directory does not exist, create it:

```
> sudo mkdir /var/log/journal
```

3. Set the correct ownership and access permissions:

```
> sudo   systemd-tmpfiles --create --prefix=/var/log/journal
```

4. *(Optional)* To flush the data from RAM to the directory:

```
> sudo   journalctl --flush
```

For details about the service configuration, refer to *Section 1.1, "Configuring* **systemd-journald***"*.

2.2 The journal log structure

The logs are stored in binary format across several files. To view the structure of a log entry, proceed as follows:

```
> sudo  journalctl -n 1 -o verbose

    Fri 2025-12-05 10:52:53.284321 CET [s=5b7ae2e926794210bf832d014f5f560a;i=d49752>
    _UID=1000
    _AUDIT_SESSION=3
    _AUDIT_LOGINUID=1000
    _SYSTEMD_OWNER_UID=1000
    _SYSTEMD_UNIT=user@1000.service
    _SYSTEMD_SLICE=user-1000.slice
    _MACHINE_ID=d3489468c8534c5d81a2860cf9a2a20e
    _RUNTIME_SCOPE=system
    _SELINUX_CONTEXT=unconfined
    PRIORITY=6
    _TRANSPORT=syslog
    _BOOT_ID=d095069bd59b4bc4bf67c8c71999243b
   SYSLOG_IDENTIFIER=sudo
    SYSLOG_TIMESTAMP=Dec  5 10:52:53
    _PID=25806
    _COMM=sudo
    _EXE=/usr/bin/sudo
    _CMDLINE=sudo journalctl -n 1 -o verbose

    ...
```

The log entry is a data structure containing the log message and metadata fields:

Timestamp

The exact time the event occurred

Source fields

- `_PID`: process ID of the sender
- `_UID/_GID`: User/Group ID of the sender
- `_EXE`: path to the executable
- `_COMM`: name of the executable

System fields

- `_SYSTEMD_UNIT`: The systemd unit (service) that generated the log (for example, `sshd.service`)
- `_BOOT_ID`: A unique identifier for the specific system boot session

Kernel fields

`_TRANSPORT`: How the message was logged (e.g., kernel, syslog, stdout)

Priority level

A numeric value indicating the severity of the message (0=emerg, 7=debug)

3 The **`journalctl`** command

`journalctl` is a command-line utility used to query and display logs collected by the **`systemd-journald`**.

Because the logging system stores data in a binary format (for performance and security) rather than plain text, you cannot use standard tools like **`cat`** or **`less`** to open the files directly. So, the **`journalctl`** command decodes the data and displays it according to the provided parameters.

3.1 Using **`journalctl`**

This section describes the generic usage of the **`journalctl`** command.

Running **`journalctl`** without any options displays all logged messages, usually starting from the oldest, and pipes the output through a pager (like **`less`**) for easy navigation.

The general syntax of the **`journalctl`** command is as follows:

```
> sudo journalctl [OPTIONS...] [MATCHES...]
```



Tip: Messages related to a specific executable

To show all journal messages related to a specific executable, specify the full path to the executable:

```
> sudo journalctl /usr/lib/systemd/systemd
```

Listed below are the common useful options to enhance the default **`journalctl`** behavior:

-f

Shows only the most recent journal messages, and prints new log entries as they are added to the journal.

-e

Prints the messages and jumps to the end of the journal, so that the latest entries are visible within the pager.

-r

Prints the messages of the journal in reverse order, so that the latest entries are listed first.

-k

Shows only kernel messages from the current boot. This is equivalent to `-b` with the field match `_TRANSPORT=kernel`.

-u

Shows only messages for the specified `systemd` unit. Besides messages with `_SYSTEMD_UNIT=`*`UNIT`*, the output includes what `systemd` logs about the unit, such as start and stop messages and core dump reports.

```
> sudo journalctl -u apache2
```

For a complete list of options refer to man page, man 1 **`journalctl`**.

4 Filtering the journal output

This section describes how to refine searches in logs, for example, by boot number, by a specific time interval, or to view specific data fields. By default, the journal lists the oldest entries first. The output can be filtered using specific switches and fields.

You can filter journals based on boot number, time interval, and fields. For details, refer to the following sections.

4.1 Filter logs based on a specific system boot

To list logs for all the available boots, run the command as follows:

```
> sudo journalctl --list-boots
```

The first column lists the boot offset: `0` for the current boot, `-1` for the previous one, `-2` for the one before that, etc. The second column contains the boot ID followed by the limiting time stamps of the specific boot.

To show all messages from the current boot:

```
> sudo journalctl -b
```

To view journal messages from the previous boot, add an offset parameter. The following example command shows the previous boot messages:

```
> sudo journalctl -b -1
```

To view boot messages based on the boot ID, `156019a44a774a0bb0148a92df4af81b`:

```
> sudo journalctl _BOOT_ID=156019a44a774a0bb0148a92df4af81b
```

4.2 Filtering logs based on time interval

You can filter the output of **`journalctl`** by specifying the starting and/or ending date. The date specification should be of the format `YYYY-MM-DD H:MM:SS`. If the time part is omitted, midnight is assumed. If seconds are omitted, `:00` is assumed. If the date part is omitted, the current day is assumed. Instead of a numeric expression, you can specify the keywords `yesterday`, `today` or `tomorrow`. They refer to midnight of the day before the current day, of the current day, or of the day after the current day. If you specify `now`, it refers to the current time. You can also specify relative times prefixed with `-` or `+`, referring to times before or after the current time.

To view only new messages since now, and update the output continuously:

```
> sudo journalctl --since "now" -f
```

To view all messages since last midnight until `3:20am`:

```
> sudo journalctl --since "today" --until "3:20"
```

4.3 Filtering logs based on fields

You can filter the output of the journal by specific fields. The syntax of a field to be matched is `FIELD_NAME=MATCHED_VALUE`, such as `_SYSTEMD_UNIT=httpd.service`. You can specify multiple matches in a single query to filter the output messages even more. See **`man 7 systemd.journal-fields`** for a list of default fields.

To view messages produced by a specific process ID: `PID_1039`:

```
> sudo journalctl _PID=1039
```

To view messages belonging to a specific user ID: `UID_1000`:

```
> sudo  journalctl _UID=1000
```

To view messages from the kernel ring buffer (the same as **`dmesg`** displays):

```
> sudo journalctl _TRANSPORT=kernel
```

To view messages from the service's standard or error output:

```
> sudo journalctl _TRANSPORT=stdout
```

To view messages produced by a specified service only:

```
> sudo journalctl _SYSTEMD_UNIT=avahi-daemon.service
```

If two different fields are specified, only entries that match both expressions at the same time are shown:

```
> sudo journalctl _SYSTEMD_UNIT=avahi-daemon.service _PID=1488
```

If two matches refer to the same field, all entries matching either expression are shown:

```
> sudo journalctl _SYSTEMD_UNIT=avahi-daemon.service _SYSTEMD_UNIT=dbus.service
```

You can use the `+` separator to combine two expressions in a logical `OR`. The following example shows all messages from the Avahi service process with the process ID 1480 together with all messages from the D-Bus service:

```
> sudo journalctl _SYSTEMD_UNIT=avahi-daemon.service _PID=1480 +
 _SYSTEMD_UNIT=dbus.service
```

5 Troubleshooting `systemd` errors

This section introduces ways to interpret and fix the log messages retrieved through **`journalctl`**.

5.1 View `systemd` errors

1. View the list of failed `systemd` units:

   ```
   systemctl --failed
   ```

   The list of all failed services appears.

2. Identify the severity and content of the error.

   ```
   journalctl -p 0..7 -b
   ```

   The list of errors with priority levels `0 to 7` appears. The errors are marked with priority level:

   - *0-2*: **`emerg, alert, crit`**: Critical issues, system collapse imminent.
   - *3*: **`err (Error)`**: A service or application failed to complete a requested operation.
   - *4*: **`warning`** : Something undesirable happened but is not an immediate failure.
   - *5-7*: **`notice, info, debug`**: Normal operational information and developer diagnostics.

3. View the error log for the failing service using the following command:

   ```
   journalctl -u <failing_service_name>
   ```

   The lines preceding the termination message include information about the error.

- *Exit Status*: If a service stops, look for a message like `Process xxx exited` with status 1/FAILURE. A status of 0 indicates success. Any nonzero status indicates an error.
- *Configuration Errors*: Messages containing phrases like `No such file or directory`, `Permission denied` or `Address already in use` usually point to a problem in the service's configuration file.
- *Out-of-Memory (OOM)*: The service was terminated because it exceeded memory limits.

4. Use detailed views of logs to get detailed information about the error.

```
journalctl -xe
```

For example, to view all messages from the Apache service during the current boot with detailed explanations, run the following command:

```
journalctl -u httpd.service -b -xe
```

5.2 Troubleshoot `systemd` error

This section introduces an example to illustrate how to find and fix the error reported by `systemd` during **`apache2`** start-up.

1. Start the apache2 service:

```
systemctl start apache2
Job for apache2.service failed. See 'systemctl status apache2' and 'journalctl -xn'
 for details.
```

2. View the service status:

```
> sudo systemctl status apache2
apache2.service - The Apache Webserver
   Loaded: loaded (/usr/lib/systemd/system/apache2.service; disabled)
   Active: failed (Result: exit-code) since Tue 2025-09-03 11:08:13 EDT; 7min ago
  Process: 11026 ExecStop=/usr/sbin/start_apache2 -D SYSTEMD -DFOREGROUND \
           -k graceful-stop (code=exited, status=1/FAILURE)
```

The ID of the process causing the failure is 11026.

3. View the verbose version of messages related to process ID 11026:

```
> sudo journalctl -o verbose _PID=11026
```

```
[...]
MESSAGE=AH00526: Syntax error on line 6 of /etc/apache2/default-server.conf:
[...]
MESSAGE=Invalid command 'DocumenttRoot', perhaps misspelled or defined by a module
[...]
```

4. Fix the typo inside `/etc/apache2/default-server.conf`, start the apache2 service, and print its status:

```
> sudo systemctl start apache2 && systemctl status apache2
apache2.service - The Apache Webserver
   Loaded: loaded (/usr/lib/systemd/system/apache2.service; disabled)
   Active: active (running) since Tue 2025-09-03 11:26:24 EDT; 4ms ago
  Process: 11026 ExecStop=/usr/sbin/start_apache2 -D SYSTEMD -DFOREGROUND
           -k graceful-stop (code=exited, status=1/FAILURE)
 Main PID: 11263 (httpd2-prefork)
   Status: "Processing requests..."
   CGroup: /system.slice/apache2.service
           ├─11263 /usr/sbin/httpd2-prefork -f /etc/apache2/httpd.conf -D [...]
           ├─11280 /usr/sbin/httpd2-prefork -f /etc/apache2/httpd.conf -D [...]
           ├─11281 /usr/sbin/httpd2-prefork -f /etc/apache2/httpd.conf -D [...]
           ├─11282 /usr/sbin/httpd2-prefork -f /etc/apache2/httpd.conf -D [...]
           ├─11283 /usr/sbin/httpd2-prefork -f /etc/apache2/httpd.conf -D [...]
           └─11285 /usr/sbin/httpd2-prefork -f /etc/apache2/httpd.conf -D [...]
```

6 Legal Notice

Copyright© 2006– 2026 SUSE LLC and contributors. All rights reserved.

Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.2 or (at your option) version 1.3; with the Invariant Section being this copyright notice and license. A copy of the license version 1.2 is included in the section entitled “GNU Free Documentation License”.

For SUSE trademarks, see https://www.suse.com/company/legal/. All other third-party trademarks are the property of their respective owners. Trademark symbols (®, ™ etc.) denote trademarks of SUSE and its affiliates. Asterisks (*) denote third-party trademarks.

All information found in this book has been compiled with utmost attention to detail. However, this does not guarantee complete accuracy. Neither SUSE LLC, its affiliates, the authors, nor the translators shall be held liable for possible errors or the consequences thereof.

A GNU Free Documentation License

Copyright (C) 2000, 2001, 2002 Free Software Foundation, Inc. 51 Franklin St, Fifth Floor, Boston, MA 02110-1301 USA. Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

0. PREAMBLE

The purpose of this License is to make a manual, textbook, or other functional and useful document "free" in the sense of freedom: to assure everyone the effective freedom to copy and redistribute it, with or without modifying it, either commercially or non-commercially. Secondarily, this License preserves for the author and publisher a way to get credit for their work, while not being considered responsible for modifications made by others.

This License is a kind of "copyleft", which means that derivative works of the document must themselves be free in the same sense. It complements the GNU General Public License, which is a copyleft license designed for free software.

We have designed this License to use it for manuals for free software, because free software needs free documentation: a free program should come with manuals providing the same freedoms that the software does. But this License is not limited to software manuals; it can be used for any textual work, regardless of subject matter or whether it is published as a printed book. We recommend this License principally for works whose purpose is instruction or reference.

1. APPLICABILITY AND DEFINITIONS

This License applies to any manual or other work, in any medium, that contains a notice placed by the copyright holder saying it can be distributed under the terms of this License. Such a notice grants a world-wide, royalty-free license, unlimited in duration, to use that work under the conditions stated herein. The "Document", below, refers to any such manual or work. Any member of the public is a licensee, and is addressed as "you". You accept the license if you copy, modify or distribute the work in a way requiring permission under copyright law.

A "Modified Version" of the Document means any work containing the Document or a portion of it, either copied verbatim, or with modifications and/or translated into another language.

A "Secondary Section" is a named appendix or a front-matter section of the Document that deals exclusively with the relationship of the publishers or authors of the Document to the Document's overall subject (or to related matters) and contains nothing that could fall directly within that overall subject. (Thus, if the

Document is in part a textbook of mathematics, a Secondary Section may not explain any mathematics.) The relationship could be a matter of historical connection with the subject or with related matters, or of legal, commercial, philosophical, ethical or political position regarding them.

The "Invariant Sections" are certain Secondary Sections whose titles are designated, as being those of Invariant Sections, in the notice that says that the Document is released under this License. If a section does not fit the above definition of Secondary then it is not allowed to be designated as Invariant. The Document may contain zero Invariant Sections. If the Document does not identify any Invariant Sections then there are none.

The "Cover Texts" are certain short passages of text that are listed, as Front-Cover Texts or Back-Cover Texts, in the notice that says that the Document is released under this License. A Front-Cover Text may be at most 5 words, and a Back-Cover Text may be at most 25 words.

A "Transparent" copy of the Document means a machine-readable copy, represented in a format whose specification is available to the general public, that is suitable for revising the document straightforwardly with generic text editors or (for images composed of pixels) generic paint programs or (for drawings) some widely available drawing editor, and that is suitable for input to text formatters or for automatic translation to a variety of formats suitable for input to text formatters. A copy made in an otherwise Transparent file format whose markup, or absence of markup, has been arranged to thwart or discourage subsequent modification by readers is not Transparent. An image format is not Transparent if used for any substantial amount of text. A copy that is not "Transparent" is called "Opaque".

Examples of suitable formats for Transparent copies include plain ASCII without markup, Texinfo input format, LaTeX input format, SGML or XML using a publicly available DTD, and standard-conforming simple HTML, PostScript or PDF designed for human modification. Examples of transparent image formats include PNG, XCF and JPG. Opaque formats include proprietary formats that can be read and edited only by proprietary word processors, SGML or XML for which the DTD and/or processing tools are not generally available, and the machine-generated HTML, PostScript or PDF produced by some word processors for output purposes only.

The "Title Page" means, for a printed book, the title page itself, plus such following pages as are needed to hold, legibly, the material this License requires to appear in the title page. For works in formats which do not have any title page as such, "Title Page" means the text near the most prominent appearance of the work's title, preceding the beginning of the body of the text.

A section "Entitled XYZ" means a named subunit of the Document whose title either is precisely XYZ or contains XYZ in parentheses following text that translates XYZ in another language. (Here XYZ stands for a specific section name mentioned below, such as "Acknowledgements", "Dedications", "Endorsements", or "History".) To "Preserve the Title" of such a section when you modify the Document means that it remains a section "Entitled XYZ" according to this definition.

The Document may include Warranty Disclaimers next to the notice which states that this License applies to the Document. These Warranty Disclaimers are considered to be included by reference in this License, but only as regards disclaiming warranties: any other implication that these Warranty Disclaimers may have is void and has no effect on the meaning of this License.

2. VERBATIM COPYING

You may copy and distribute the Document in any medium, either commercially or non-commercially, provided that this License, the copyright notices, and the license notice saying this License applies to the Document are reproduced in all copies, and that you add no other conditions whatsoever to those of this License. You may not use technical measures to obstruct or control the reading or further copying of the copies you make or distribute. However, you may accept compensation in exchange for copies. If you distribute a large enough number of copies you must also follow the conditions in section 3.

You may also lend copies, under the same conditions stated above, and you may publicly display copies.

3. COPYING IN QUANTITY

If you publish printed copies (or copies in media that commonly have printed covers) of the Document, numbering more than 100, and the Document's license notice requires Cover Texts, you must enclose the copies in covers that carry, clearly and legibly, all these Cover Texts: Front-Cover Texts on the front cover, and Back-Cover Texts on the back cover. Both covers must also clearly and legibly identify you as the publisher of these copies. The front cover must present the full title with all words of the title equally prominent and visible. You may add other material on the covers in addition. Copying with changes limited to the covers, as long as they preserve the title of the Document and satisfy these conditions, can be treated as verbatim copying in other respects.

If the required texts for either cover are too voluminous to fit legibly, you should put the first ones listed (as many as fit reasonably) on the actual cover, and continue the rest onto adjacent pages.

If you publish or distribute Opaque copies of the Document numbering more than 100, you must either include a machine-readable Transparent copy along with each Opaque copy, or state in or with each Opaque copy a computer-network location from which the general network-using public has access to download using public-standard network protocols a complete Transparent copy of the Document, free of added material. If you use the latter option, you must take reasonably prudent steps, when you begin distribution of Opaque copies in quantity, to ensure that this Transparent copy will remain thus accessible at the stated location until at least one year after the last time you distribute an Opaque copy (directly or through your agents or retailers) of that edition to the public.

It is requested, but not required, that you contact the authors of the Document well before redistributing any large number of copies, to give them a chance to provide you with an updated version of the Document.

4. MODIFICATIONS

You may copy and distribute a Modified Version of the Document under the conditions of sections 2 and 3 above, provided that you release the Modified Version under precisely this License, with the Modified Version filling the role of the Document, thus licensing distribution and modification of the Modified Version to whoever possesses a copy of it. In addition, you must do these things in the Modified Version:

A. Use in the Title Page (and on the covers, if any) a title distinct from that of the Document, and from those of previous versions (which should, if there were any, be listed in the History section of the Document). You may use the same title as a previous version if the original publisher of that version gives permission.

B. List on the Title Page, as authors, one or more persons or entities responsible for authorship of the modifications in the Modified Version, together with at least five of the principal authors of the Document (all of its principal authors, if it has fewer than five), unless they release you from this requirement.

C. State on the Title page the name of the publisher of the Modified Version, as the publisher.

D. Preserve all the copyright notices of the Document.

E. Add an appropriate copyright notice for your modifications adjacent to the other copyright notices.

F. Include, immediately after the copyright notices, a license notice giving the public permission to use the Modified Version under the terms of this License, in the form shown in the Addendum below.

G. Preserve in that license notice the full lists of Invariant Sections and required Cover Texts given in the Document's license notice.

H. Include an unaltered copy of this License.

I. Preserve the section Entitled "History", Preserve its Title, and add to it an item stating at least the title, year, new authors, and publisher of the Modified Version as given on the Title Page. If there is no section Entitled "History" in the Document, create one stating the title, year, authors, and publisher of the Document as given on its Title Page, then add an item describing the Modified Version as stated in the previous sentence.

J. Preserve the network location, if any, given in the Document for public access to a Transparent copy of the Document, and likewise the network locations given in the Document for previous versions it was based on. These may be placed in the "History" section. You may omit a network location for a work that was published at least four years before the Document itself, or if the original publisher of the version it refers to gives permission.

K. For any section Entitled "Acknowledgements" or "Dedications", Preserve the Title of the section, and preserve in the section all the substance and tone of each of the contributor acknowledgements and/or dedications given therein.

L. Preserve all the Invariant Sections of the Document, unaltered in their text and in their titles. Section numbers or the equivalent are not considered part of the section titles.

M. Delete any section Entitled "Endorsements". Such a section may not be included in the Modified Version.

N. Do not retitle any existing section to be Entitled "Endorsements" or to conflict in title with any Invariant Section.

O. Preserve any Warranty Disclaimers.

If the Modified Version includes new front-matter sections or appendices that qualify as Secondary Sections and contain no material copied from the Document, you may at your option designate some or all of these sections as invariant. To do this, add their titles to the list of Invariant Sections in the Modified Version's license notice. These titles must be distinct from any other section titles.

You may add a section Entitled "Endorsements", provided it contains nothing but endorsements of your Modified Version by various parties--for example, statements of peer review or that the text has been approved by an organization as the authoritative definition of a standard.

You may add a passage of up to five words as a Front-Cover Text, and a passage of up to 25 words as a Back-Cover Text, to the end of the list of Cover Texts in the Modified Version. Only one passage of Front-Cover Text and one of Back-Cover Text may be added by (or through arrangements made by) any one entity. If the Document already includes a cover text for the same cover, previously added by you or by arrangement made by the same entity you are acting on behalf of, you may not add another; but you may replace the old one, on explicit permission from the previous publisher that added the old one.

The author(s) and publisher(s) of the Document do not by this License give permission to use their names for publicity for or to assert or imply endorsement of any Modified Version.

5. COMBINING DOCUMENTS

You may combine the Document with other documents released under this License, under the terms defined in section 4 above for modified versions, provided that you include in the combination all of the Invariant Sections of all of the original documents, unmodified, and list them all as Invariant Sections of your combined work in its license notice, and that you preserve all their Warranty Disclaimers.

The combined work need only contain one copy of this License, and multiple identical Invariant Sections may be replaced with a single copy. If there are multiple Invariant Sections with the same name but different contents, make the title of each such section unique by adding at the end of it, in parentheses, the name of the original author or publisher of that section if known, or else a unique number. Make the same adjustment to the section titles in the list of Invariant Sections in the license notice of the combined work.

In the combination, you must combine any sections Entitled "History" in the various original documents, forming one section Entitled "History"; likewise combine any sections Entitled "Acknowledgements", and any sections Entitled "Dedications". You must delete all sections Entitled "Endorsements".

6. COLLECTIONS OF DOCUMENTS

You may make a collection consisting of the Document and other documents released under this License, and replace the individual copies of this License in the various documents with a single copy that is included in the collection, provided that you follow the rules of this License for verbatim copying of each of the documents in all other respects.

You may extract a single document from such a collection, and distribute it individually under this License, provided you insert a copy of this License into the extracted document, and follow this License in all other respects regarding verbatim copying of that document.

7. AGGREGATION WITH INDEPENDENT WORKS

A compilation of the Document or its derivatives with other separate and independent documents or works, in or on a volume of a storage or distribution medium, is called an "aggregate" if the copyright resulting from the compilation is not used to limit the legal rights of the compilation's users beyond what the individual works permit. When the Document is included in an aggregate, this License does not apply to the other works in the aggregate which are not themselves derivative works of the Document.

If the Cover Text requirement of section 3 is applicable to these copies of the Document, then if the Document is less than one half of the entire aggregate, the Document's Cover Texts may be placed on covers that bracket the Document within the aggregate, or the electronic equivalent of covers if the Document is in electronic form. Otherwise they must appear on printed covers that bracket the whole aggregate.

8. TRANSLATION

Translation is considered a kind of modification, so you may distribute translations of the Document under the terms of section 4. Replacing Invariant Sections with translations requires special permission from their copyright holders, but you may include translations of some or all Invariant Sections in addition to the original versions of these Invariant Sections. You may include a translation of this License, and all the license notices in the Document, and any Warranty Disclaimers, provided that you also include the original English version of this License and the original versions of those notices and disclaimers. In case of a disagreement between the translation and the original version of this License or a notice or disclaimer, the original version will prevail.

If a section in the Document is Entitled "Acknowledgements", "Dedications", or "History", the requirement (section 4) to Preserve its Title (section 1) will typically require changing the actual title.

9. TERMINATION

You may not copy, modify, sublicense, or distribute the Document except as expressly provided for under this License. Any other attempt to copy, modify, sublicense or distribute the Document is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

10. FUTURE REVISIONS OF THIS LICENSE

The Free Software Foundation may publish new, revised versions of the GNU Free Documentation License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns. See https://www.gnu.org/copyleft/.

Each version of the License is given a distinguishing version number. If the Document specifies that a particular numbered version of this License "or any later version" applies to it, you have the option of following the terms and conditions either of that specified version or of any later version that has been published (not as a draft) by the Free Software Foundation. If the Document does not specify a version number of this License, you may choose any version ever published (not as a draft) by the Free Software Foundation.

ADDENDUM: How to use this License for your documents

```
Copyright (c) YEAR YOUR NAME.
```

```
Permission is granted to copy, distribute and/or modify this document
under the terms of the GNU Free Documentation License, Version 1.2
or any later version published by the Free Software Foundation;
with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts.
A copy of the license is included in the section entitled “GNU
Free Documentation License”.
```

If you have Invariant Sections, Front-Cover Texts and Back-Cover Texts, replace the “with...Texts.” line with this:

```
with the Invariant Sections being LIST THEIR TITLES, with the
Front-Cover Texts being LIST, and with the Back-Cover Texts being LIST.
```

If you have Invariant Sections without Cover Texts, or some other combination of the three, merge those two alternatives to suit the situation.

If your document contains nontrivial examples of program code, we recommend releasing these examples in parallel under your choice of free software license, such as the GNU General Public License, to permit their use in free software.