

# Sphinx showcase

Release 0.1.0

# Certora, Inc

Mar 10, 2024

# **Contents:**

Standard markup	2
<u>.</u>	2
	3
1.3 Links	5
Code blocks	7
2.1 Best practice	7
2.2 In-place code	7
2.3 From external file	10
Indexing and glossary	12
3.1 Indexing	12
3.2 Glossary	14
Comments and TODOs	15
	15
	16
•	10
Admonitions	17
Panels	19
6.1 Single card	19
6.2 Grid with two cards	20
6.3 Drop-down	21
Using Latex	22
7.1 In-line math	22
7.2 Centered math	22
7.3 Advanced use	23
Miscellaneous	24
	24
	24
8.3 Adding a video clip	25
dex	27
	1.1 Basic inline markup 1.2 Lists 1.3 Links  Code blocks 2.1 Best practice 2.2 In-place code 2.3 From external file  Indexing and glossary 3.1 Indexing 3.2 Glossary  Comments and TODOs 4.1 RestructuredText comments 4.2 Development build  Admonitions  Panels 6.1 Single card 6.2 Grid with two cards 6.3 Drop-down  Using Latex 7.1 In-line math 7.2 Centered math 7.3 Advanced use  Miscellaneous 8.1 Tables 8.2 Adding an image 8.3 Adding a video clip

This chapter describes the most useful Sphinx directives and roles.

If you're markdown files (.md) – these use the MyST package, and the MyST examples are what you need. Those using reStructuredText filed (.rst) should refer to the reStructuredText examples.

For additional information see:

- reStructuredText Primer
- Sphinx Directives
- MyST

# 1 Standard markup

## 1.1 Basic inline markup

#### **Fonts**

#### MyST (.md)

```
* We can use _italic_ and *bold*.
* We can even have a `mono font`.
```

## reStructuredText (.rst)

```
* We can use *italic* and **bold**.

* We can even have a ``mono font``.
```

## Rendered as:

- We can use italic and bold.
- We can even have a mono font.

## **Headings**

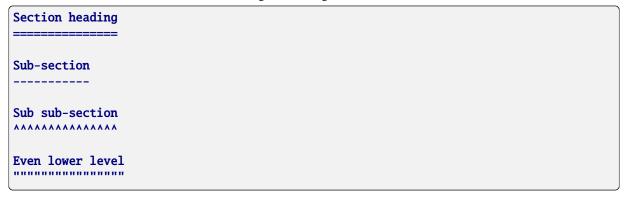
#### Listing 1: Headings conventions

```
# Top level
## Second level
### Third level
```

#### reStructuredText (.rst)

For a full list and explanation, see: reStructuredText Sections. Note there are no levels assigned to particular heading characters. Sphinx deduces the levels in each .rst file.

Listing 2: Headings conventions



#### **Horizontal rule**

Use four dashes ---- (with empty lines above and below) to get a horizontal rule like the one below.

#### 1.2 Lists

#### **Bullet lists**

- \* Bullet item
- \* Can contain nested lists
  - \* Like this
  - \* And this

### Rendered as:

- Bullet item
- Can contain nested lists
  - Like this
  - And this

#### **Numbered lists**

## MyST (.md)

- 1. Numbered list
- 2. Second item

#### reStructuredText (.rst)

- #. Numbered list
- #. Second item

#### Rendered as:

- 1. Numbered list
- 2. Second item

#### **Definition list**

#### MyST (.md)

#### Some term

: Followed by definition of the term, which must be indented.

The definition can even consist of multiple paragraphs.

#### Second term

: Description of the second term.

## reStructuredText (.rst)

#### Some term

Followed by definition of the term, which must be indented.

The definition can even consist of multiple paragraphs.

#### Second term

Description of the second term.

#### Rendered as:

#### Some term

Followed by definition of the term, which must be indented.

The definition can even consist of multiple paragraphs.

#### **Second term**

Description of the second term.

#### 1.3 Links

#### **External links**

#### MyST (.md)

```
* Simple external link: [Certora](https://www.certora.com/).
* Using predefined link: [Rick Astley][RickRolled] (defined below)

[RickRolled]: https://www.youtube.com/watch?v=dQw4w9WgXcQ
```

#### reStructuredText (.rst)

```
* Simple external link: `Certora <a href="https://www.certora.com/">\).
* Using predefined link: `Rick Astley`_ (defined below)

.. _Rick Astley: https://www.youtube.com/watch?v=dQw4w9WgXcQ
```

#### Rendered as:

- Simple external link: Certora.
- Using predefined link: Rick Astley (defined below)

#### **Embedding a Youtube video**

## MyST (.md)

```
```{youtube} VGSsPIsbb6U
:align: center
```

#### reStructuredText (.rst)

```
.. youtube:: VGSsPIsbb6U
:align: center
```

Rendered as:

https://youtu.be/VGSsPIsbb6U

#### Internal links

Link anywhere inside the documentation.

#### MyST (.md)

See MyST Cross-referencing.

#### reStructuredText (.rst)

```
Cross-reference inside documentation

Set up a label ``.. _my-reference-label`` as shown above.

Note underscore prefix in the label name.

To reference use the ``:ref:`` directive like so: :ref:`my-reference-label`.
```

#### Link to code file on Github

Link to a code file using the :clink: role. The link will be either to GitHub or to local file, depending on the value of link\_to\_github variable in the source/conf.py file.

Absolute paths will be considered as relative to the *absolute code path* – see code\_path\_variable. For complete documentation, see codelink\_extension.

The basic syntax is:

## MyST (.md)

#### Listing 3: Syntax

```
{clink}`Optional name <relative-path-to-code-file>`
{clink}`Optional name <absolute path relative to absolute code path>`
```

#### reStructuredText (.rst)

#### Listing 4: Syntax

```
:clink:`Optional name <relative-path-to-code-file>`
:clink:`Optional name <absolute path relative to absolute code path>`
```

For example:

```
* Reference to a folder: {clink}`Voting folder </voting>`
* Reference to a file: {clink}`Voting_solution.spec </voting/Voting_solution.spec>`
* Reference without text: {clink}`/voting/Voting_solution.spec`
```

```
* Reference to a folder: :clink:`Voting folder </voting>`
* Reference to a file: :clink:`Voting_solution.spec </voting/Voting_solution.spec>`
* Reference without text: :clink:`/voting/Voting_solution.spec`
```

#### Rendered as:

• Reference to a folder: Voting folder

• Reference to a file: Voting\_solution.spec

• Reference without text: /voting/Voting\_solution.spec

#### 2 Code blocks

## 2.1 Best practice

It is best to include a code-block from a spec or Solidity file that is part of a regtest. This will ensure that you will be alerted if there are any breaking changes. Use the directives described in *From external file*.

Including source code for CVL elements using the includecvl directive (see *Including CVL elements* below) has the added benefit that it is protected against changes to the code file itself. Added or removed lines will not affect it.

## 2.2 In-place code

#### Code-block

You can insert a *CVL* code block in-place, using the code-block directive, as shown below. The same directive can be used for other languages, such as Solidity.

```
methods {
    function balanceOf(address) external returns (uint256) envfree;
}

rule testBalance(address user) {
    assert balanceOf(user) > 0;
}
```

```
methods {
    function balanceOf(address) external returns (uint256) envfree;
}

rule testBalance(address user) {
    assert balanceOf(user) > 0;
}
```

Rendered as:

```
methods {
    function balanceOf(address) external returns (uint256) envfree;
}
rule testBalance(address user) {
    assert balanceOf(user) > 0;
}
```

Additional features, such as line numbers and emphasized lines are demonstrated below. You can find all the options available at: code-block directive.

```
```{code-block} cvl
:linenos:
:lineno-start: 7
:emphasize-lines: 10,17
:caption: CVL2 code example
methods
    function DataWarehouse.getRegisteredSlot(
        bytes32 blockHash,
        address account,
        bytes32 slot
    ) external returns (uint256) => _getRegisteredSlot(blockHash, account, slot);
}
ghost mapping(address => uint256) _exchangeRateSlotValue;
function _getRegisteredSlot(
    bytes32 blockHash,
    address account,
    bytes32 slot
) returns uint256 {
    return _exchangeRateSlotValue[account];
```

```
.. code-block:: cvl
  :linenos:
  :lineno-start: 7
  :emphasize-lines: 10,17
  :caption: CVL2 code example
  methods
  {
      function DataWarehouse.getRegisteredSlot(
          bytes32 blockHash,
          address account,
          bytes32 slot
      ) external returns (uint256) => _getRegisteredSlot(blockHash, account, slot);
  }
  ghost mapping(address => uint256) _exchangeRateSlotValue;
  function _getRegisteredSlot(
      bytes32 blockHash,
      address account,
      bytes32 slot
  ) returns uint256 {
      return _exchangeRateSlotValue[account];
```

Rendered as:

Listing 5: CVL2 code example

```
methods
   {
        function DataWarehouse.getRegisteredSlot(
            bytes32 blockHash,
            address account,
11
            bytes32 slot
12
       ) external returns (uint256) => _getRegisteredSlot(blockHash, account, slot);
13
14
15
   ghost mapping(address => uint256) _exchangeRateSlotValue;
16
17
   function _getRegisteredSlot(
18
       bytes32 blockHash,
19
       address account,
20
       bytes32 slot
21
   ) returns uint256 {
22
       return _exchangeRateSlotValue[account];
23
   }
24
```

#### Inline CVL and solidity

#### MyST (.md)

You can add inline *CVL* code using the :cvl: role, and inline Solidity using the :solidity: role. To do so you must first define these roles at the top of your .md file, like so:

```
'``{role} cvl(code)
:language: cvl
'``
{role} solidity(code)
:language: solidity
```

Now we can use them, as in the following example:

```
Type casting between integers in *CVL* has two different forms, {cvl}`assert_uint256` and {cvl}`require_uint256`.
In the {solidity}`constructor(uin256 x)` ...
```

#### reStructuredText (.rst)

You can add inline *CVL* code using the :cvl: role, and inline Solidity using the :solidity: role. These roles are defined in the conf.py file. For example, the following paragraph:

```
Type casting between integers in *CVL* has two different forms, :cvl:`assert_uint256` and :cvl:`require_uint256`. In the :solidity:`constructor(uin256 x)` ...
```

#### Rendered as:

Type casting between integers in CVL has two different forms, assert\_uint256 and require\_uint256. In the constructor(uin256 x) ...

## 2.3 From external file

#### **Including CVL elements**

Use the cvlinclude directive to include CVL elements *by name*. This is the preferred way to include rules, invariants, ghosts and the methods block. Complete documentation is available at includecvl\_extension.

## **Example**

```
```{cvlinclude} ../../../code/voting/Voting_solution.spec
:cvlobject: numVoted onlyLegalVotedChanges sumResultsEqualsTotalVotes
:caption: Voting rules
```

```
.. cvlinclude:: ../../../code/voting/Voting_solution.spec
:cvlobject: numVoted onlyLegalVotedChanges sumResultsEqualsTotalVotes
:caption: Voting rules
```

Rendered as:

Listing 6: Voting rules

```
/// @title Count the number of times `_hasVoted` been written to
ghost mathint numVoted {
    init_state axiom numVoted == 0;
}

/// @title No illegal changes to `_hasVoted`
invariant onlyLegalVotedChanges()
    !illegalStore;

/// @title Sum of voter in favor and against equals total number of voted
invariant sumResultsEqualsTotalVotes()
    votesInFavor() + votesAgainst() == to_mathint(totalVotes());
```

- If the path to the spec file is absolute, it is considered as relative to the /source/ directory.
- The :cvlobject: option accepts names of CVL elements (rule, invariant and ghosts). To include the methods block, add methods to these names. The elements will be shown in the order they are given.

**Note:** Hooks are not supported (since they are not supported by the CVLDoc package). Use literalinclude below.

#### Including any code

Use the literalinclude directive to include code from an external file. As above, providing an absolute path is taken as relative to the /source/ directory. For all possible options of literalinclude, see the literalinclude directive.

**Important:** An alternative to using line numbers when including code are the :start-after:, :start-at:, :end-before:, and :end-at: options. These accept string, which they match to find the desired lines.

For example:

```
```{literalinclude} ../../../code/voting/Voting_solution.spec
:language: solidity
:lines: 4-
:emphasize-lines: 4-6
```

```
.. literalinclude:: ../../../code/voting/Voting.sol
   :language: solidity
   :lines: 4-
   :emphasize-lines: 4-6
```

Rendered as:

```
contract Voting {
  mapping(address => bool) internal _hasVoted;
  uint256 public votesInFavor;
  uint256 public votesAgainst;
  uint256 public totalVotes;
  function vote(bool isInFavor) public {
    require(!_hasVoted[msg.sender]);
    _hasVoted[msg.sender] = true;
    totalVotes += 1;
    if (isInFavor) {
      votesInFavor += 1;
    } else {
      votesAgainst += 1;
  }
  function hasVoted(address voter) public view returns (bool) {
    return _hasVoted[voter];
  }
}
```

# 3 Indexing and glossary

## 3.1 Indexing

To add terms to the genindex, place an appropriate index directive before the part you wish to index. See Sphinx - index directive for a comprehensive description of this directive, here are some simple examples.

## Simple indexing

The following will create three index entries.

#### MyST (.md)

```
Todo: Test this one!
```

```
```{index} municipality, town, city
```

## reStructuredText (.rst)

```
.. index:: municipality, town, city
```

## Adding single values

## MyST (.md)

```
```{eval-rst}
.. index::
    single: propositional logic
    single: logic; propositional
```
```

## reStructuredText (.rst)

```
.. index::
single: propositional logic
single: logic; propositional
```

This will create two index entries, the first as "propositional logic" and the second will be a sub-index under "logic".

#### Adding reference labels to indexes

Use the :name: option for adding a label that can be used with :ref:. For example:

```
```{eval-rst}
.. index::
    :name: intro_to_formal

## Introduction to formal verification
See {ref}`intro_to_formal` ...
```

#### Inline indexing

You can add index entries inline. Here is an example from Sphinx - index directive:

#### MyST (.md)

```
This is a normal MyST {index}`paragraph` that contains several {index}`index entries <pair: index; entry>`.
```

#### reStructuredText (.rst)

```
This is a normal reST :index:`paragraph` that contains several :index:`index entries <pair: index; entry>`.
```

## 3.2 Glossary

For complete documentation on the glossary directive see Sphinx - Glossary.

## **Creating a glossary**

Create a glossary using the glossary directive, followed by a *Definition list* of the desired terms. A term can have several names, as shown in the following example.

```
{.glossary}
CVL
: The Certora Verification Language, used for writing specs for Solidity contracts.
   ```{glossary}
Prover
Certora Prover
: The tool used for verifying specs written in {term}`CVL`.
   ```
```

```
.. glossary::
    CVL
        The Certora Verification Language, used for writing specs for Solidity
        contracts.
    Prover
        Certora Prover
        The tool used for verifying specs written in :term:`CVL`.
```

#### Rendered as:

#### **CVL**

The Certora Verification Language, used for writing specs for Solidity contracts.

#### **Prover**

#### **Certora Prover**

The tool used for verifying specs written in CVL.

#### Referencing a glossary term

Use the term role to refer to a glossary term, for example:

#### MyST (.md)

```
* Simple reference such as {term}`CVL`
* Showing alternative text like {term}`The Prover <Prover>`
```

#### reStructuredText (.rst)

```
* Simple reference such as :term:`CVL`
* Showing alternative text like :term:`The Prover <Prover>`
```

#### Rendered as:

- Simple reference such as CVL
- Showing alternative text like *The Prover*

## 4 Comments and TODOs

#### 4.1 RestructuredText comments

.. This is a comment in RestructuredText, the entire paragraph will be ignored by sphinx. Just note the indentation.

## 4.2 Development build

We can have content that is visible only in *dev-build* mode. To enable dev-build mode, add -t is\_dev\_build to the sphinx-build command (see build\_html and generating\_pdf). For example:

```
sphinx-build -b html docs/source/ docs/build/html -t is_dev_build
```

**Note:** In dev-build the html title (on the side bar) will have "- Development" added to it. This behavior can be modified in the /source/conf.py file.

## Contents for dev-build only

To produce contents that will appear only in dev-build, use the .. only directive, like this:

#### MyST (.md)

```
```{only} is_dev_build
The following will only be included in dev builds.
```
```

#### reStructuredText (.rst)

```
.. only:: is_dev_build
The following will only be included in dev builds.
```

Rendered as:

The following will only be included in dev builds.

#### **TODOs**

TODO comments will only appear in dev-build. To add a TODO comment:

```
```{todo}
This is an example of a TODO comment, it can also have several paragraphs.
```
```

```
.. todo:: This is an example of a TODO comment, it can also have several paragraphs.
```

Rendered as:

**Todo:** This is an example of a TODO comment, it can also have several paragraphs.

To create a list containing all the TODO comments:

#### MyST (.md)

```
[```{todolist}
...
```

#### reStructuredText (.rst)

```
.. todolist::
```

## **5 Admonitions**

Admonitions are used for warnings, info and so on. Here is a collection of admonitions examples.

## MyST (.md)

```
For providing notes and information to the user.
The admonition can contain several paragraphs and also other elements, like:
* Lists
* Math
...
'``{attention}
Pay attention.
'```{important}
For marking very important things.
...
'``{tip}
Tips for the reader.
...
'``{hint}
Provide hints.
```

(continues on next page)

(continued from previous page)

```
```{warning}
Warn about dangerous things.

```{seealso}
For providing more references.

```{admonition} General admonition - any title you want
The freedom to admonish.

```
```

#### reStructuredText (.rst)

```
.. note::
  For providing notes and information to the user.
  The admonition can contain several paragraphs and also other elements, like:
  * Lists
  * Math
.. attention::
  Pay attention,
.. important::
  For marking very important things.
.. tip::
  Tips for the reader.
.. hint::
  Provide hints.
.. warning::
  Warn about dangerous things.
.. seealso::
  For providing more references.
.. admonition:: General admonition - any title you want
  The freedom to admonish.
```

Rendered as:

**Note:** For providing notes and information to the user.

The admonition can contain several paragraphs and also other elements, like:

- Lists
- Math

Attention: Pay attention,

**Important:** For marking very important things.

**Tip:** Tips for the reader.

Hint: Provide hints.

Warning: Warn about dangerous things.

#### See also:

For providing more references.

## General admonition - any title you want

The freedom to admonish.

## 6 Panels

The panels use the sphinx-design extension. Follow the link for more details.

## 6.1 Single card

```
Content of the card. See
    `sphinx-design <https://sphinx-design.readthedocs.io/en/rtd-theme/index.html>`_
for more details.
    ```
```

```
.. card:: Card Title

Content of the card. See
  `sphinx-design <https://sphinx-design.readthedocs.io/en/rtd-theme/index.html>`_
  for more details.
```

Rendered as:

Card Title Content of the card. See sphinx-design for more details.

## 6.2 Grid with two cards

## MyST (.md)

```
````{grid} 2

```{grid-item-card} Title 1

Left card

```
```{grid-item-card} Title 2

Right card

....
```

#### reStructuredText (.rst)

```
.. grid:: 2
    .. grid-item-card:: Title 1
        Left card
    .. grid-item-card:: Title 2
        Right card
```

Rendered as:

Title 1 Left card

Title 2 Right card

#### Placing code side by side

Note the limited width of the columns!

Spec

Listing 7: Invariant

```
invariant totalIsBiggest(address user)
balanceOf(user) <= totalBalance();</pre>
```

Solidity

Listing 8: Solidity

```
function balanceOf(
  address user
) external view returns (bool) {
  return _balances[user];
}
```

## 6.3 Drop-down

Drop-down content is useful for providing hidden hints. Here is a simple drop-down:

#### MyST (.md)

```
```{dropdown} Dropdown title
:animate: fade-in-slide-down

Dropdown content, for example an important hint.

See `sphinx-design - dropdowns
<https://sphinx-design.readthedocs.io/en/rtd-theme/dropdowns.html>`_ for more options.
```
```

#### reStructuredText (.rst)

```
.. dropdown:: Dropdown title
   :animate: fade-in-slide-down

Dropdown content, for example an important hint.

See `sphinx-design - dropdowns
   <https://sphinx-design.readthedocs.io/en/rtd-theme/dropdowns.html>`_ for more_
   →options.
```

Rendered as:

#### **Dropdown title**

Dropdown content, for example an important hint.

See sphinx-design - dropdowns for more options.

## 7 Using Latex

#### 7.1 In-line math

For inline math use the :math: role. For example:

#### MyST (.md)

```
Let {math}^{\ } be the category of groups and {math}^{\ }: G \to H \text{ be a morphism in {math}^{\ } mathcal{C}\text{.}
```

#### reStructuredText (.rst)

```
Let :math:`\mathcal{C}` be the category of groups and :math:`f: G \to H` be a morphism in :math:`\mathcal{C}`.
```

Rendered as:

Let  $\mathcal{C}$  be the category of groups and  $f:G\to H$  be a morphism in  $\mathcal{C}$ .

#### 7.2 Centered math

Use the math directive, as shown below. See Directives - math for additional options and examples.

## MyST (.md)

#### reStructuredText (.rst)

```
.. math::

(a + b)^2 &= (a + b)(a + b) \\
&= a^2 + 2ab + b^2
```

Rendered as:

$$(a + b)^2 = (a + b)(a + b)$$
  
=  $a^2 + 2ab + b^2$ 

#### 7.3 Advanced use

Here is an example of showing a conditional function.

## MyST (.md)

Listing 9: Conditional function in Latex

#### reStructuredText (.rst)

Listing 10: Conditional function in Latex

Rendered as:

$$f(x) = \begin{cases} 0 & \text{if } x \le 0\\ x^2 & \text{otherwise} \end{cases}$$
 (1)

**Note:** When using the .. math:: directive, Sphinx will wrap the latex code inside the Latex split environment before rendering it. Using the :nowrap: option disables this behavior.

For example, the code from *Centered math* is rendered as the following Latex code:

## 8 Miscellaneous

**Attention:** This section is currently only available for reStructuredText. See MyST Roles and Directives for how to use these directives in MyST.

#### 8.1 Tables

There are several ways to add tables in reStructuredText, there are described in

- reStructuredText Primer Tables
- CSV Tables
- List Tables

Here is an example of a list table.

```
.. list-table:: Table title
:header-rows: 1

* - Column Header
- 2nd Column Header
- 3rd Column Header

* - Row 1 Column 1 item
- Row 1 Column 2 item
- An item

* - An item
- Row 2 Column 2 item
- Row 2 Column 3 item
```

Rendered as:

Table 1: Table title

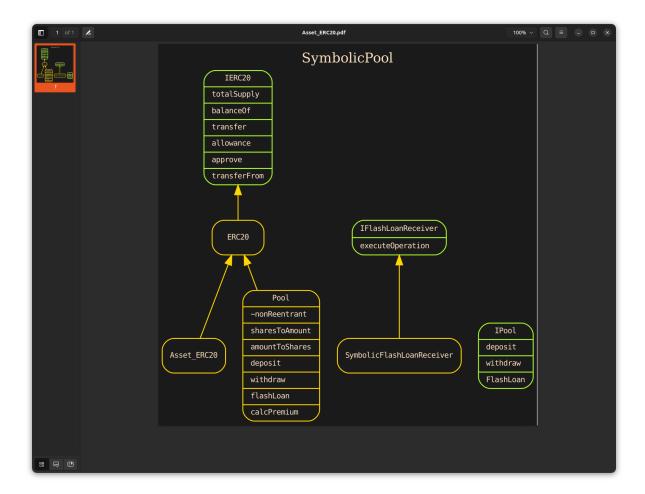
| Column Header       | 2nd Column Header   | 3rd Column Header   |
|---------------------|---------------------|---------------------|
| Row 1 Column 1 item | Row 1 Column 2 item | An item             |
| An item             | Row 2 Column 2 item | Row 2 Column 3 item |

## 8.2 Adding an image

To insert an image or picture use the .. image directive, as shown below. The specified path to the image  $images/symbolic\_pool\_diagram.png$  is relative to the file containing the directive.

```
.. image:: images/symbolic_pool_diagram.png
:alt: This text will be displayed if the image is broken
```

Rendered as:



## Notes

## The image path

A relative path should be relative to the .rst file. An absolute path is treated as relative to the top source/directory. See Sphinx Image Directive for more on this.

#### **Additional options**

Options, such as alternative text for missing images and scaling, are described in Docutils Image Directive.

## 8.3 Adding a video clip

To add a video clip file we use the sphinxcontrib-video extension. Note that the preferred folder to place the video file is the source/\_static/ folder. For example:

```
.. video:: ../_static/lesson4_invariants/ball_game/InvariantsClip_subtitles.mp4
:alt: The text shown when the video cannot be displayed
:height: 250
```

Rendered as:

#### See also:

See sphinxcontrib-video Quickstart for additional options.

#### **Combining closed captions**

You cannot use a separate file for the closed captions (subtitles). Instead you must embed the closed captions inside the video itself.

Here is one recipe to include a closed captions file in your video. Suppose you have an mp4 video InvariantsClip.mp4 and a closed captions file named InvariantsClip.srt, you can combine them using the FFmpeg package with the following command:

```
ffmpeg -i InvariantsClip.mp4 -vf subtitles=InvariantsClip.srt InvariantsClip_

→subtitles.mp4
```

**Todo:** Missing topics to add:

- table ot contents (mainly the hidden option)
- adding images and using the only-light and only-dark classes in furo
- tabs (from sphinx-design)
- footnotes
- .. rubric, .. centered and .. hlist

# Index

```
C
Certora Prover, 15
closed captions, 25
CVL, 15
D
dev-build, 15
image, 24
Р
picture, 24
Prover, 15
subtitles, 25
Т
table, 24
todo, 16
٧
video, 25
   youtube, 5
Υ
youtube, 5
```