CERTORA

Sphinx showcase

Release 0.1.0

Certora, Inc

Feb 07, 2024

Contents:

1 Standard markup **2**
1.1 Basic inline markup 2
1.2 Lists 3
1.3 Links 4

2 Code blocks **5**
2.1 Best practice 5
2.2 In-place code 5
2.3 From external file 7

3 Indexing and glossary **9**
3.1 Indexing 9
3.2 Glossary 10

4 Comments and TODOs **10**
4.1 RestructuredText comments 10
4.2 Development build 11

5 Admonitions **11**

6 Panels **13**
6.1 Single card 13
6.2 Grid with two cards 13
6.3 Drop-down 14

7 Using Latex **14**
7.1 In-line math 14
7.2 Centered math 14
7.3 Advanced use 15

8 Miscellaneous **15**
8.1 Tables 15
8.2 Adding an image 16
8.3 Adding a video clip 17

Index **18**

This chapter describes the most useful Sphinx directives and roles.

For additional information see:

- reStructuredText Primer
- Sphinx Directives

1 Standard markup

1.1 Basic inline markup

Fonts

Listing 1: rst

```
* We can use *italic* and **bold**.
* using ``double quotes`` provides a code style.
```

Rendered as:

- We can use *italic* and **bold**.
- using `double quotes` provides a code style.

Headings

For a full list and explanation, see: reStructuredText Primer - Sections.

Listing 2: Headings conventions

```
Section heading
===============

Sub-section
-----------

Sub sub-section
^^^^^^^^^^^^^^^

Even lower level
""""""""""""""""
```

Note there are no levels assigned to particular heading characters. Sphinx deduces the levels in each `.rst` file.

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

Listing 3: rst

```
* Bullet item
* Can contain nested lists

  * Like this
  * And this
```

Rendered as:

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

Numbered lists

Listing 4: rst

```
#. Numbered list
#. Second item
```

Rendered as:

1. Numbered list
2. Second item

Definition list

Listing 5: 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

Listing 6: rst

```
* Simple external link: `Certora <https://www.certora.com/>`_ (note underscore suffix)
* Using predefined link: `Rick Astley`_ (defined below, again note underscores)

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

Rendered as:

- Simple external link: Certora (note underscore suffix)
- Using predefined link: Rick Astley (defined below, again note underscores)

Embedding a Youtube video

Listing 7: rst

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

Rendered as:

https://youtu.be/VGSsPIsbb6U

Internal links

Link anywhere inside the documentation.

Listing 8: rst

```
.. _my-reference-label:

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`.
```

Rendered as:

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: *Cross-reference inside documentation*.

Note: This example was taken from Cross-referencing arbitrary locations.

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.

Listing 9: Syntax

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

For example:

Listing 10: rst

```
* 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*.

Using `includecvl` (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.

Listing 11: rst

```
.. code-block:: cvl

   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.

Listing 12: rst

```
.. 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 13: CVL2 code example

```
7  methods
8  {
```

(continues on next page)

(continued from previous page)

```
    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];
}
```

Inline CVL and solidity

You can add inline *CVL* code using the `:cvl:` role, and inline Solidity using the `:solidity:` role. 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
```

Rendered as:

Listing 14: 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()
```

(continues on next page)

(continued from previous page)

```
    !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.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];
```

(continues on next page)

(continued from previous page)

```
  }
}
```

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.

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

Adding single values

```
.. 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:

```
.. index:: formal
   :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:

```
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.

Listing 15: rst

```
.. glossary::

   CVL
      The Certora Veification 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 Veification 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:

Listing 16: 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:

Listing 17: 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:

Listing 18: rst

```
.. 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:

```
.. todolist::
```

5 Admonitions

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

```
.. note::

   For providing notes and information to the user.

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

   * Lists
   * Math

```

(continues on next page)

(continued from previous page)

```
.. 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

```
.. 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

```
.. 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 19: Invariant

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

Solidity

Listing 20: 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:

```
.. 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:

```
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.

```
.. math::

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

Rendered as:

$$\begin{aligned}(a+b)^2 &= (a+b)(a+b)\\ &= a^2+2ab+b^2\end{aligned}$$

7.3 Advanced use

Here is an example of showing a conditional function.

Listing 21: Conditional function in Latex

```
.. math::
   :nowrap:

   \begin{equation}
   f(x) =
   \begin{cases}
        0  & \text{if } x \leq 0 \\
        x^2 & \text{otherwise}
   \end{cases}
   \end{equation}
```

Rendered as:

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

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:

```
\begin{split}
    (a + b)^2  &=  (a + b)(a + b) \\
               &=  a^2 + 2ab + b^2
\end{split}
```

8 Miscellaneous

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

```

(continues on next page)

(continued from previous page)

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

Rendered as:

Table 1: Table title

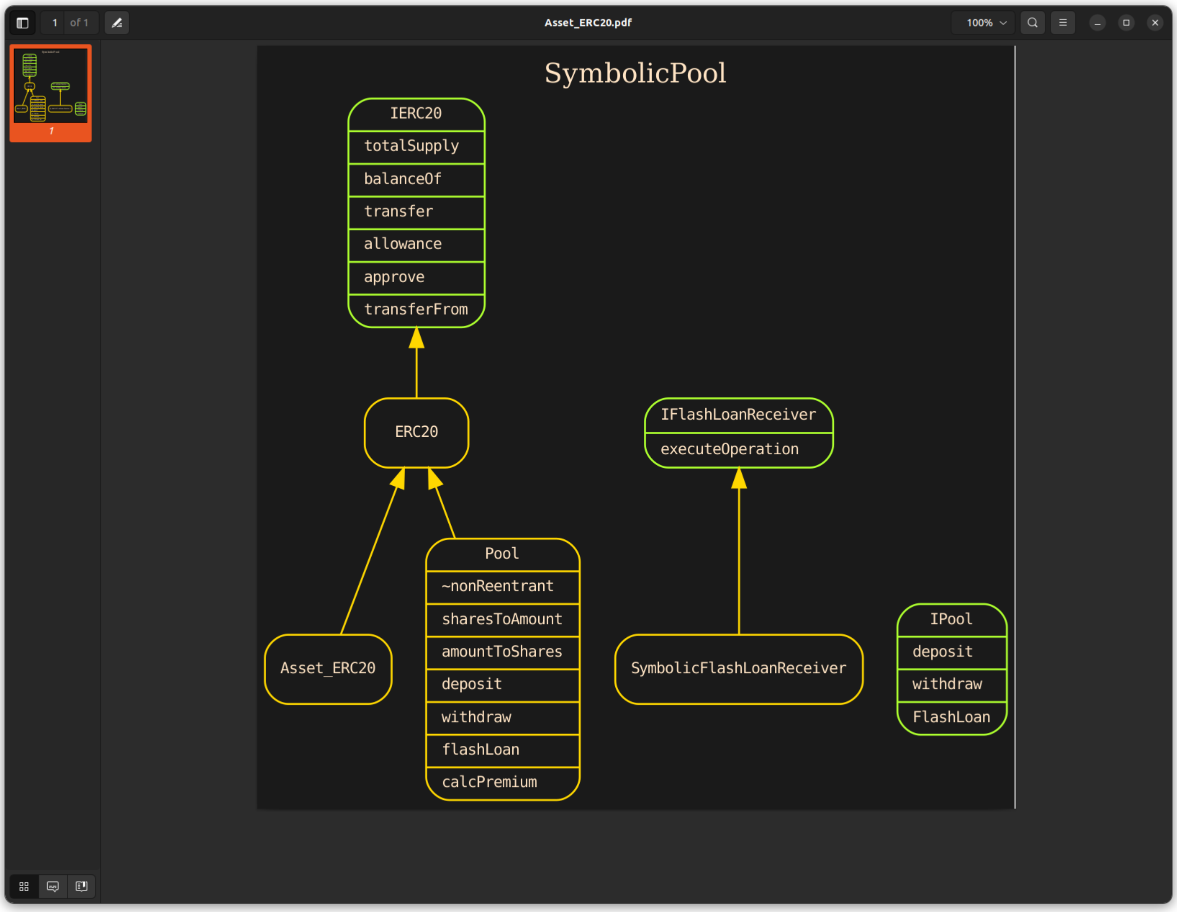
Column Header	2nd Column Header	3rd Column Header
Row 1 Column 1 item	Row 1 Column 2 item	An item
An item	Row 2 Column 2 item	Row 2 Column 3 item

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)
- tabs (from sphinx-design)
- footnotes
- `.. rubric`, `.. centered` and `.. hlist`

Index

C

`Certora Prover`, **10**
`closed captions`, 17
`CVL`, **10**

D

`dev-build`, 10

I

`image`, 16

P

`picture`, 16
`Prover`, **10**

S

`subtitles`, 17

T

`table`, 15
`todo`, 11

V

`video`, 17
    `youtube`, 4

Y

`youtube`, 4