

:mod:`collections.abc` --- Abstract Base Classes for Containers

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 1); [backlink](#)

Unknown interpreted text role "mod".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 4)

Unknown directive type "module".

```
.. module:: collections.abc
   :synopsis: Abstract base classes for containers
```

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 7)

Unknown directive type "moduleauthor".

```
.. moduleauthor:: Raymond Hettinger <python at rcn.com>
```

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 8)

Unknown directive type "sectionauthor".

```
.. sectionauthor:: Raymond Hettinger <python at rcn.com>
```

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 10)

Unknown directive type "versionadded".

```
.. versionadded:: 3.3
   Formerly, this module was part of the :mod:`collections` module.
```

Source code: [source:Lib/_collections_abc.py](#)

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 13); [backlink](#)

Unknown interpreted text role "source".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 15)

Unknown directive type "testsetup".

```
.. testsetup:: *
   from collections.abc import *
   import itertools
   __name__ = '<doctest>'
```

This module provides `term`abstract base classes <abstract base class>`` that can be used to test whether a class provides a particular interface; for example, whether it is hashable or whether it is a mapping.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 23); [backlink](#)

Unknown interpreted text role "term".

An `func`issubclass`` or `func`isinstance`` test for an interface works in one of three ways.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 27); [backlink](#)

Unknown interpreted text role "func".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 27); [backlink](#)

Unknown interpreted text role "func".

1) A newly written class can inherit directly from one of the abstract base classes. The class must supply the required abstract methods. The remaining mixin methods come from inheritance and can be overridden if desired. Other methods may be added as needed:

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-

main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 35)

Unknown directive type "testcode".

```
.. testcode::

class C(Sequence):
    def __init__(self): ...           # Direct inheritance
    def __getitem__(self, index): ... # Extra method not required by the ABC
    def __len__(self): ...           # Required abstract method
    def count(self, value): ...      # Required abstract method
                                     # Optionally override a mixin method
```

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 43)

Unknown directive type "doctest".

```
.. doctest::

>>> issubclass(C, Sequence)
True
>>> isinstance(C(), Sequence)
True
```

2) Existing classes and built-in classes can be registered as "virtual subclasses" of the ABCs. Those classes should define the full API including all of the abstract methods and all of the mixin methods. This lets users rely on `:func:`issubclass`` or `:func:`isinstance`` tests to determine whether the full interface is supported. The exception to this rule is for methods that are automatically inferred from the rest of the API:

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 50); [backlink](#)

Unknown interpreted text role "func".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 50); [backlink](#)

Unknown interpreted text role "func".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 58)

Unknown directive type "testcode".

```
.. testcode::

class D:
    def __init__(self): ...           # No inheritance
    def __getitem__(self, index): ...  # Extra method not required by the ABC
    def __len__(self): ...           # Abstract method
    def count(self, value): ...       # Abstract method
    def index(self, value): ...       # Mixin method
                                     # Mixin method

Sequence.register(D)                # Register instead of inherit
```

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 69)

Unknown directive type "doctest".

```
.. doctest::

>>> issubclass(D, Sequence)
True
>>> isinstance(D(), Sequence)
True
```

In this example, class `:class:`D`` does not need to define `__contains__`, `__iter__`, and `__reversed__` because the `:ref:`in-operator <comparisons>`, the `:term:`iteration <iterable>` logic, and the `:func:`reversed`` function automatically fall back to using `__getitem__` and `__len__`.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 76); [backlink](#)

Unknown interpreted text role "class".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 76); [backlink](#)

Unknown interpreted text role "ref".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 76); [backlink](#)

Unknown interpreted text role "term".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 76); [backlink](#)

Unknown interpreted text role "func".

3) Some simple interfaces are directly recognizable by the presence of the required methods (unless those methods have been set to `:const:None`):

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 82); [backlink](#)

Unknown interpreted text role "const".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 86)

Unknown directive type "testcode".

```
.. testcode::

    class E:
        def __iter__(self): ...
        def __next__(next): ...
```

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 92)

Unknown directive type "doctest".

```
.. doctest::

    >>> issubclass(E, Iterable)
    True
    >>> isinstance(E(), Iterable)
    True
```

Complex interfaces do not support this last technique because an interface is more than just the presence of method names. Interfaces specify semantics and relationships between methods that cannot be inferred solely from the presence of specific method names. For example, knowing that a class supplies `__getitem__`, `__len__`, and `__iter__` is insufficient for distinguishing a `:class:'Sequence'` from a `:class:'Mapping'`.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 99); [backlink](#)

Unknown interpreted text role "class".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 99); [backlink](#)

Unknown interpreted text role "class".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 107)

Unknown directive type "versionadded".

```
.. versionadded:: 3.9
    These abstract classes now support ``[]``. See :ref:`types-genericalias`
    and :pep:`585`.
```

Collections Abstract Base Classes

The collections module offers the following `:term`ABCs <abstract base class>``:

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 116); [backlink](#)

Unknown interpreted text role "term".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 118)

Unknown directive type "tabularcolums".

```
.. tabularcolums:: |l|L|L|L|
```

ABC	Inherits from	Abstract Methods	Mixin Methods
-----	---------------	------------------	---------------

ABC	Inherits from	Abstract Methods	Mixin Methods	
<p><code>:class:'Container'</code> [1]</p> <div> <p>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 124); backlink</p> <p>Unknown interpreted text role "class".</p> </div>		<code>__contains__</code>		
<p><code>:class:'Hashable'</code> [1]</p> <div> <p>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 125); backlink</p> <p>Unknown interpreted text role "class".</p> </div>		<code>__hash__</code>		
<p><code>:class:'Iterable'</code> [1] [2]</p> <div> <p>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 126); backlink</p> <p>Unknown interpreted text role "class".</p> </div>		<code>__iter__</code>		
<p><code>:class:'Iterator'</code> [1]</p> <div> <p>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 127); backlink</p> <p>Unknown interpreted text role "class".</p> </div>	<p><code>:class:'Iterable'</code></p> <div> <p>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 127); backlink</p> <p>Unknown interpreted text role "class".</p> </div>	<code>__next__</code>	<code>__iter__</code>	
<p><code>:class:'Reversible'</code> [1]</p> <div> <p>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 128); backlink</p> <p>Unknown interpreted text role "class".</p> </div>	<p><code>:class:'Iterable'</code></p> <div> <p>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 128); backlink</p> <p>Unknown interpreted text role "class".</p> </div>	<code>__reversed__</code>		
<p><code>:class:'Generator'</code> [1]</p> <div> <p>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 129); backlink</p> <p>Unknown interpreted text role "class".</p> </div>	<p><code>:class:'Iterator'</code></p> <div> <p>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 129); backlink</p> <p>Unknown interpreted text role "class".</p> </div>	<code>send, throw</code>	<code>close, __iter__, __next__</code>	

ABC	Inherits from	Abstract Methods	Mixin Methods
<code>:class: Sized</code> [1] <div><div>System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 130); backlink Unknown interpreted text role "class".</div></div>		<code>__len__</code>	
<code>:class: Callable</code> [1] <div><div>System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 131); backlink Unknown interpreted text role "class".</div></div>		<code>__call__</code>	
<code>:class: Collection</code> [1] <div><div>System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 132); backlink Unknown interpreted text role "class".</div></div>	<code>:class: Sized</code> , <code>:class: Iterable</code> , <code>:class: Container</code> <div><div>System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 132); backlink Unknown interpreted text role "class".</div></div> <div><div>System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 132); backlink Unknown interpreted text role "class".</div></div> <div><div>System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 132); backlink Unknown interpreted text role "class".</div></div>	<code>__contains__</code> , <code>__iter__</code> , <code>__len__</code>	

ABC	Inherits from	Abstract Methods	Mixin Methods
<p><code>:class:'Sequence'</code></p> <div> System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library] collections.abc.rst, line 136); backlink Unknown interpreted text role "class". </div>	<p><code>:class:'Reversible', :class:'Collection'</code></p> <div> System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library] collections.abc.rst, line 136); backlink Unknown interpreted text role "class". </div> <div> System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library] collections.abc.rst, line 136); backlink Unknown interpreted text role "class". </div>	<p><code>__getitem__, __len__</code></p>	<p><code>__contains__, __iter__, __reversed__, __len__</code> and <code>count</code></p>
<p><code>:class:'MutableSequence'</code></p> <div> System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library] collections.abc.rst, line 139); backlink Unknown interpreted text role "class". </div>	<p><code>:class:'Sequence'</code></p> <div> System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library] collections.abc.rst, line 139); backlink Unknown interpreted text role "class". </div>	<p><code>__getitem__, __setitem__, __delitem__, __len__, insert</code></p>	<p>Inherited <code>:class:'Sequence'</code> methods <code>reverse</code>, <code>extend</code>, <code>pop</code>, <code>remove</code></p> <div> System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library] collections.abc.rst, line 139); backlink Unknown interpreted text role "class". </div>
<p><code>:class:'ByteString'</code></p> <div> System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library] collections.abc.rst, line 145); backlink Unknown interpreted text role "class". </div>	<p><code>:class:'Sequence'</code></p> <div> System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library] collections.abc.rst, line 145); backlink Unknown interpreted text role "class". </div>	<p><code>__getitem__, __len__</code></p>	<p>Inherited <code>:class:'Sequence'</code> methods</p> <div> System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library] collections.abc.rst, line 145); backlink Unknown interpreted text role "class". </div>
<p><code>:class:'Set'</code></p> <div> System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library] collections.abc.rst, line 148); backlink Unknown interpreted text role "class". </div>	<p><code>:class:'Collection'</code></p> <div> System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library] collections.abc.rst, line 148); backlink Unknown interpreted text role "class". </div>	<p><code>__contains__, __iter__, __len__</code></p>	<p><code>__le__, __lt__, __eq__, __ne__, __ge__, __and__, __or__, __xor__, __isdisjoint</code></p>
<p><code>:class:'MutableSet'</code></p> <div> System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library] collections.abc.rst, line 152); backlink Unknown interpreted text role "class". </div>	<p><code>:class:'Set'</code></p> <div> System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library] collections.abc.rst, line 152); backlink Unknown interpreted text role "class". </div>	<p><code>__contains__, __iter__, __len__, add, discard</code></p>	<p>Inherited <code>:class:'Set'</code> methods and <code>remove</code>, <code>__ior__</code>, <code>__iand__</code>, <code>__isub__</code></p> <div> System Message: ERROR/3 (D: \onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library] collections.abc.rst, line 152); backlink Unknown interpreted text role "class". </div>

ABC	Inherits from	Abstract Methods	Mixin Methods
<div>:class: 'Mapping'</div> <div><div><div>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 158); backlink</div><div>Unknown interpreted text role "class".</div></div></div>	<div>:class: 'Collection'</div> <div><div><div>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 158); backlink</div><div>Unknown interpreted text role "class".</div></div></div>	<div><div><div>__getitem__</div><div>__iter__</div><div>__len__</div></div></div>	<div><div><div>__contains__</div><div>keys</div><div>items</div><div>values</div><div>__eq__</div><div>and</div><div>__ne__</div></div></div>
<div>:class: 'MutableMapping'</div> <div><div><div>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 162); backlink</div><div>Unknown interpreted text role "class".</div></div></div>	<div>:class: 'Mapping'</div> <div><div><div>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 162); backlink</div><div>Unknown interpreted text role "class".</div></div></div>	<div><div><div>__getitem__</div><div>__setitem__</div><div>__delitem__</div><div>__iter__</div><div>__len__</div></div></div>	<div>Inherited :class: 'Mapping' methods: popitem, clear, update, and setdefault</div> <div><div><div>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 162); backlink</div><div>Unknown interpreted text role "class".</div></div></div>
<div>:class: 'MappingView'</div> <div><div><div>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 169); backlink</div><div>Unknown interpreted text role "class".</div></div></div>	<div>:class: 'Sized'</div> <div><div><div>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 169); backlink</div><div>Unknown interpreted text role "class".</div></div></div>		<div><div><div>__len__</div></div></div>
<div>:class: 'ItemsView'</div> <div><div><div>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 170); backlink</div><div>Unknown interpreted text role "class".</div></div></div>	<div>:class: 'MappingView', :class: 'Set'</div> <div><div><div>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 170); backlink</div><div>Unknown interpreted text role "class".</div></div><div><div><div>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 170); backlink</div><div>Unknown interpreted text role "class".</div></div></div></div>		<div><div><div>__contains__</div><div>__iter__</div></div></div>

ABC	Inherits from	Abstract Methods	Mixin Methods
<code>:class: 'AsyncIterable'</code> [1] <div><div>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 178); backlink</div><div>Unknown interpreted text role "class".</div></div>		<code>__aiter__</code>	
<code>:class: 'AsyncIterator'</code> [1] <div><div>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 179); backlink</div><div>Unknown interpreted text role "class".</div></div>	<code>:class: 'AsyncIterable'</code> <div><div>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 179); backlink</div><div>Unknown interpreted text role "class".</div></div>	<code>__anext__</code>	<code>__aiter__</code>
<code>:class: 'AsyncGenerator'</code> [1] <div><div>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 180); backlink</div><div>Unknown interpreted text role "class".</div></div>	<code>:class: 'AsyncIterator'</code> <div><div>System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 180); backlink</div><div>Unknown interpreted text role "class".</div></div>	<code>asend, athrow</code>	<code>aclose, __aiter__, __anext__</code>

Footnotes

[1](1,2,3,4,5,6,7,8,9,10,11,12,13,14) These ABCs override `:meth: object.__subclasshook__` to support testing an interface by verifying the required methods are present and have not been set to `:const: 'None'`. This only works for simple interfaces. More complex interfaces require registration or direct subclassing.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 185); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 185); [backlink](#)

Unknown interpreted text role "const".

[2] Checking `isinstance(obj, Iterable)` detects classes that are registered as `:class: 'Iterable'` or that have an `:meth: __iter__` method, but it does not detect classes that iterate with the `:meth: __getitem__` method. The only reliable way to determine whether an object is `:term: 'iterable'` is to call `iter(obj)`.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 191); [backlink](#)

Unknown interpreted text role "class".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 191); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 191); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\ [cpython-main] [Doc] [library]collections.abc.rst, line 191); [backlink](#)

Collections Abstract Base Classes -- Detailed Descriptions

ABC for classes that provide the `meth: '__contains__'` method.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 204); [backlink](#)

Unknown interpreted text role "meth".

ABC for classes that provide the `meth: '__hash__'` method.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 208); [backlink](#)

Unknown interpreted text role "meth".

ABC for classes that provide the `meth: '__len__'` method.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 212); [backlink](#)

Unknown interpreted text role "meth".

ABC for classes that provide the `meth: '__call__'` method.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 216); [backlink](#)

Unknown interpreted text role "meth".

ABC for classes that provide the `meth: '__iter__'` method.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 220); [backlink](#)

Unknown interpreted text role "meth".

Checking `isinstance(obj, Iterable)` detects classes that are registered as `:class:Iterable` or that have an `meth: '__iter__'` method, but it does not detect classes that iterate with the `meth: '__getitem__'` method. The only reliable way to determine whether an object is `term: iterable` is to call `iter(obj)`.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 222); [backlink](#)

Unknown interpreted text role "class".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 222); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 222); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 222); [backlink](#)

Unknown interpreted text role "term".

ABC for sized iterable container classes.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 232)

Unknown directive type "versionadded".

```
.. versionadded:: 3.6
```

ABC for classes that provide the `meth: '~iterator.__iter__'` and `meth: '~iterator.__next__'` methods. See also the definition of `term: iterator`.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 236); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 236); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 236); [backlink](#)
Unknown interpreted text role "term".

ABC for iterable classes that also provide the `meth:~__reversed__` method.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 242); [backlink](#)
Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 245)
Unknown directive type "versionadded".

.. versionadded:: 3.6

ABC for generator classes that implement the protocol defined in [PEP 342](#) that extends iterators with the `meth:~generator.send`, `meth:~generator.throw` and `meth:~generator.close` methods. See also the definition of `term:generator`.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 249); [backlink](#)
Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 249); [backlink](#)
Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 249); [backlink](#)
Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 249); [backlink](#)
Unknown interpreted text role "term".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 254)
Unknown directive type "versionadded".

.. versionadded:: 3.5

ABCs for read-only and mutable `term:sequences <sequence>`.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 260); [backlink](#)
Unknown interpreted text role "term".

Implementation note: Some of the mixin methods, such as `meth:~__iter__`, `meth:~__reversed__` and `meth:index`, make repeated calls to the underlying `meth:~__getitem__` method. Consequently, if `meth:~__getitem__` is implemented with constant access speed, the mixin methods will have linear performance; however, if the underlying method is linear (as it would be with a linked list), the mixins will have quadratic performance and will likely need to be overridden.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 262); [backlink](#)
Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 262); [backlink](#)
Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 262); [backlink](#)
Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 262); [backlink](#)
Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 262); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 271)

Unknown directive type "versionchanged".

```
.. versionchanged:: 3.5
   The index() method added support for *stop* and *start*
   arguments.
```

ABCs for read-only and mutable sets.

ABCs for read-only and mutable `term`mappings`<mapping>``.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 283); [backlink](#)

Unknown interpreted text role "term".

ABCs for mapping, items, keys, and values `term`views`<dictionary view>``.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 290); [backlink](#)

Unknown interpreted text role "term".

ABC for `term`awaitable`` objects, which can be used in `keyword:`await`` expressions. Custom implementations must provide the `meth:`__await__`` method.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 294); [backlink](#)

Unknown interpreted text role "term".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 294); [backlink](#)

Unknown interpreted text role "keyword".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 294); [backlink](#)

Unknown interpreted text role "meth".

`term`Coroutine`<coroutine>`` objects and instances of the `class:`~collections.abc.Coroutine`` ABC are all instances of this ABC.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 298); [backlink](#)

Unknown interpreted text role "term".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 298); [backlink](#)

Unknown interpreted text role "class".

Note

In CPython, generator-based coroutines (generators decorated with `func:`types.coroutine``) are *awaitables*, even though they do not have an `meth:`__await__`` method. Using `isinstance(gencoro, Awaitable)` for them will return `False`. Use `func:`inspect.isawaitable`` to detect them.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 302); [backlink](#)

Unknown interpreted text role "func".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 302); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 302); [backlink](#)

Unknown interpreted text role "func".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 308)

Unknown directive type "versionadded".

```
.. versionadded:: 3.5
```

ABC for coroutine compatible classes. These implement the following methods, defined in `ref:coroutine-objects`: `meth:~coroutine.send`, `meth:~coroutine.throw`, and `meth:~coroutine.close`. Custom implementations must also implement `meth:~__await__`. All `class:Coroutine` instances are also instances of `class:Awaitable`. See also the definition of `term:coroutine`.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 312); [backlink](#)

Unknown interpreted text role "ref".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 312); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 312); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 312); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 312); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 312); [backlink](#)

Unknown interpreted text role "class".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 312); [backlink](#)

Unknown interpreted text role "class".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 312); [backlink](#)

Unknown interpreted text role "term".

Note

In CPython, generator-based coroutines (generators decorated with `func:types.coroutine`) are *awaitables*, even though they do not have an `meth:~__await__` method. Using `isinstance(gencoro, Coroutine)` for them will return `False`. Use `func:inspect.isawaitable` to detect them.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 320); [backlink](#)

Unknown interpreted text role "func".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 320); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 320); [backlink](#)

Unknown interpreted text role "func".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main [Doc] [library]collections.abc.rst, line 326)

Unknown directive type "versionadded".

```
.. versionadded:: 3.5
```

ABC for classes that provide `__aiter__` method. See also the definition of `term:asynchronous iterable`.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-

main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 330); [backlink](#)

Unknown interpreted text role "term".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 333)

Unknown directive type "versionadded".

```
.. versionadded:: 3.5
```

ABC for classes that provide `__aiter__` and `__anext__` methods. See also the definition of `term`asynchronous iterator``.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 337); [backlink](#)

Unknown interpreted text role "term".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 340)

Unknown directive type "versionadded".

```
.. versionadded:: 3.5
```

ABC for asynchronous generator classes that implement the protocol defined in [PEP 525](#) and [PEP 492](#).

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 347)

Unknown directive type "versionadded".

```
.. versionadded:: 3.6
```

Examples and Recipes

ABCs allow us to ask classes or instances if they provide particular functionality, for example:

```
size = None
if isinstance(myvar, collections.abc.Sized):
    size = len(myvar)
```

Several of the ABCs are also useful as mixins that make it easier to develop classes supporting container APIs. For example, to write a class supporting the full `class`Set`` API, it is only necessary to supply the three underlying abstract methods: `meth`__contains__``, `meth`__iter__``, and `meth`__len__``. The ABC supplies the remaining methods such as `meth`__and__`` and `meth`isdisjoint``:

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 359); [backlink](#)

Unknown interpreted text role "class".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 359); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 359); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 359); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 359); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\cpython-main] [Doc] [library]collections.abc.rst, line 359); [backlink](#)

Unknown interpreted text role "meth".

```
class ListBasedSet(collections.abc.Set):
    ''' Alternate set implementation favoring space over speed
    and not requiring the set elements to be hashable. '''
    def __init__(self, iterable):
        self.elements = lst = []
        for value in iterable:
            if value not in lst:
                lst.append(value)

    def __iter__(self):
        return iter(self.elements)
```

```

def __contains__(self, value):
    return value in self.elements

def __len__(self):
    return len(self.elements)

s1 = ListBasedSet('abcdef')
s2 = ListBasedSet('defghi')
overlap = s1 & s2          # The __and__() method is supported automatically

```

Notes on using `:class:'Set'` and `:class:'MutableSet'` as a mixin:

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 388); [backlink](#)
Unknown interpreted text role "class".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 388); [backlink](#)
Unknown interpreted text role "class".

1. Since some set operations create new sets, the default mixin methods need a way to create new instances from an iterable. The class constructor is assumed to have a signature in the form `ClassName(iterable)`. That assumption is factored-out to an internal classmethod called `:meth:'from_iterable'` which calls `cls(iterable)` to produce a new set. If the `:class:'Set'` mixin is being used in a class with a different constructor signature, you will need to override `:meth:'from_iterable'` with a classmethod or regular method that can construct new instances from an iterable argument.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 391); [backlink](#)
Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 391); [backlink](#)
Unknown interpreted text role "class".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 391); [backlink](#)
Unknown interpreted text role "meth".

2. To override the comparisons (presumably for speed, as the semantics are fixed), redefine `:meth:'__le__'` and `:meth:'__ge__'`, then the other operations will automatically follow suit.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 402); [backlink](#)
Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 402); [backlink](#)
Unknown interpreted text role "meth".

3. The `:class:'Set'` mixin provides a `:meth:'_hash'` method to compute a hash value for the set; however, `:meth:'_hash__'` is not defined because not all sets are hashable or immutable. To add set hashability using mixins, inherit from both `:meth:'Set'` and `:meth:'Hashable'`, then define `__hash__ = Set._hash`.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 407); [backlink](#)
Unknown interpreted text role "class".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 407); [backlink](#)
Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 407); [backlink](#)
Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 407); [backlink](#)

[library]collections.abc.rst, line 407); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc]

[library]collections.abc.rst, line 407); [backlink](#)

Unknown interpreted text role "meth".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\library\[cpython-main] [Doc] [library]collections.abc.rst, line 413)

Unknown directive type "seealso".

```
.. seealso::
```

```
* `OrderedSet` recipe <https://code.activestate.com/recipes/576694/>`_ for an
  example built on :class:`MutableSet`.
```

```
* For more about ABCs, see the :mod:`abc` module and :pep:`3119`.
```