

Execution model

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

Unknown directive type "index".

```
.. index::
   single: execution model
   pair: code; block
```

Structure of a program

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference] executionmodel.rst, line 17)

Unknown directive type "index".

```
.. index:: block
```

A Python program is constructed from code blocks. A `:dfn:'block'` is a piece of Python program text that is executed as a unit. The following are blocks: a module, a function body, and a class definition. Each command typed interactively is a block. A script file (a file given as standard input to the interpreter or specified as a command line argument to the interpreter) is a code block. A script command (a command specified on the interpreter command line with the `:option:'-c'` option) is a code block. A module run as a top level script (as module `__main__`) from the command line using a `:option:'-m'` argument is also a code block. The string argument passed to the built-in functions `:func:'eval'` and `:func:'exec'` is a code block.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference] executionmodel.rst, line 19); [backlink](#)

Unknown interpreted text role "dfn".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference] executionmodel.rst, line 19); [backlink](#)

Unknown interpreted text role "option".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference] executionmodel.rst, line 19); [backlink](#)

Unknown interpreted text role "option".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference] executionmodel.rst, line 19); [backlink](#)

Unknown interpreted text role "func".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference] executionmodel.rst, line 19); [backlink](#)

Unknown interpreted text role "func".

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Unknown directive type "index".

```
.. index:: pair: execution; frame
```

A code block is executed in an `:dfn:'execution frame'`. A frame contains some administrative information (used for debugging) and determines where and how execution continues after the code block's execution has completed.

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Unknown interpreted text role "dfn".

Naming and binding

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 42)

Unknown directive type "index".

```
.. index::
   single: namespace
   single: scope
```

Binding of names

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 51)

Unknown directive type "index".

```
.. index::
   single: name
   pair: binding; name
```

:dfn: 'Names' refer to objects. Names are introduced by name binding operations.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 55); [backlink](#)

Unknown interpreted text role "dfn".

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Unknown directive type "index".

```
.. index:: single: from; import statement
```

The following constructs bind names:

- formal parameters to functions,
- class definitions,
- function definitions,
- assignment expressions,
- **:ref:** targets **<assignment>** that are identifiers if occurring in an assignment:

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Unknown interpreted text role "ref".

- **:keyword:** **for** loop header,

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Unknown interpreted text role "keyword".

- after **:keyword:** **!as** in a **:keyword:** **with** statement, **:keyword:** **except** clause or in the as-pattern in structural pattern

matching,

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Unknown interpreted text role "keyword".

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Unknown interpreted text role "keyword".

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Unknown interpreted text role "keyword".

- in a capture pattern in structural pattern matching
- `:keyword:'import'` statements.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 73); [backlink](#)

Unknown interpreted text role "keyword".

The `:keyword:'import'` statement of the form `from ... import *` binds all names defined in the imported module, except those beginning with an underscore. This form may only be used at the module level.

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Unknown interpreted text role "keyword".

A target occurring in a `:keyword:'del'` statement is also considered bound for this purpose (though the actual semantics are to unbind the name).

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 79); [backlink](#)

Unknown interpreted text role "keyword".

Each assignment or import statement occurs within a block defined by a class or function definition or at the module level (the top-level code block).

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Unknown directive type "index".

```
.. index:: pair: free; variable
```

If a name is bound in a block, it is a local variable of that block, unless declared as `:keyword:'nonlocal'` or `:keyword:'global'`. If a name is bound at the module level, it is a global variable. (The variables of the module code block are local and global.) If a variable is used in a code block but not defined there, it is a `:dfn:'free variable'`.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 87); [backlink](#)

Unknown interpreted text role "keyword".

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Unknown interpreted text role "keyword".

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Unknown interpreted text role "dfn".

Each occurrence of a name in the program text refers to the `:dfn:binding` of that name established by the following name resolution rules.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 93); [backlink](#)

Unknown interpreted text role "dfn".

Resolution of names

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 101)

Unknown directive type "index".

```
.. index:: scope
```

A `:dfn:scope` defines the visibility of a name within a block. If a local variable is defined in a block, its scope includes that block. If the definition occurs in a function block, the scope extends to any blocks contained within the defining one, unless a contained block introduces a different binding for the name.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 103); [backlink](#)

Unknown interpreted text role "dfn".

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Unknown directive type "index".

```
.. index:: single: environment
```

When a name is used in a code block, it is resolved using the nearest enclosing scope. The set of all such scopes visible to a code block is called the block's `:dfn:environment`.

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Unknown interpreted text role "dfn".

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Unknown directive type "index".

```
.. index::
   single: NameError (built-in exception)
   single: UnboundLocalError
```

When a name is not found at all, a `:exc:NameError` exception is raised. If the current scope is a function scope, and the name refers to a local variable that has not yet been bound to a value at the point where the name is used, an `:exc:UnboundLocalError` exception is raised. `:exc:UnboundLocalError` is a subclass of `:exc:NameError`.

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

main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 119); [backlink](#)

Unknown interpreted text role "exc".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 119); [backlink](#)

Unknown interpreted text role "exc".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 119); [backlink](#)

Unknown interpreted text role "exc".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 119); [backlink](#)

Unknown interpreted text role "exc".

If a name binding operation occurs anywhere within a code block, all uses of the name within the block are treated as references to the current block. This can lead to errors when a name is used within a block before it is bound. This rule is subtle. Python lacks declarations and allows name binding operations to occur anywhere within a code block. The local variables of a code block can be determined by scanning the entire text of the block for name binding operations.

If the `:keyword:'global'` statement occurs within a block, all uses of the names specified in the statement refer to the bindings of those names in the top-level namespace. Names are resolved in the top-level namespace by searching the global namespace, i.e. the namespace of the module containing the code block, and the builtins namespace, the namespace of the module `:mod:'builtins'`. The global namespace is searched first. If the names are not found there, the builtins namespace is searched. The `:keyword:'!global'` statement must precede all uses of the listed names.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 132); [backlink](#)

Unknown interpreted text role "keyword".

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Unknown interpreted text role "mod".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 132); [backlink](#)

Unknown interpreted text role "keyword".

The `:keyword:'global'` statement has the same scope as a name binding operation in the same block. If the nearest enclosing scope for a free variable contains a global statement, the free variable is treated as a global.

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Unknown interpreted text role "keyword".

The `:keyword:'nonlocal'` statement causes corresponding names to refer to previously bound variables in the nearest enclosing function scope. `:exc:'SyntaxError'` is raised at compile time if the given name does not exist in any enclosing function scope.

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Unknown interpreted text role "keyword".

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Unknown interpreted text role "exc".

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Unknown directive type "index".

```
.. index:: module: __main__
```

The namespace for a module is automatically created the first time a module is imported. The main module for a script is always called `:mod:`__main__``.

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Unknown interpreted text role "mod".

Class definition blocks and arguments to `:func:`exec`` and `:func:`eval`` are special in the context of name resolution. A class definition is an executable statement that may use and define names. These references follow the normal rules for name resolution with an exception that unbound local variables are looked up in the global namespace. The namespace of the class definition becomes the attribute dictionary of the class. The scope of names defined in a class block is limited to the class block; it does not extend to the code blocks of methods -- this includes comprehensions and generator expressions since they are implemented using a function scope. This means that the following will fail:

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Unknown interpreted text role "func".

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Unknown interpreted text role "func".

```
class A:
    a = 42
    b = list(a + i for i in range(10))
```

Builtins and restricted execution

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 177)

Unknown directive type "index".

```
.. index:: pair: restricted; execution
```

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Unknown directive type "impl-detail".

```
.. impl-detail::

    Users should not touch ``__builtins__``; it is strictly an implementation
    detail. Users wanting to override values in the builtins namespace should
    :keyword:`import` the :mod:`builtins` module and modify its
    attributes appropriately.
```

The builtins namespace associated with the execution of a code block is actually found by looking up the name `__builtins__` in its global namespace; this should be a dictionary or a module (in the latter case the module's dictionary is used). By default, when in the `:mod:`__main__`` module, `__builtins__` is the built-in module `:mod:`builtins``; when in any other module, `__builtins__` is an alias for the dictionary of the `:mod:`builtins`` module itself.

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Unknown interpreted text role "mod".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 186); [backlink](#)

Unknown interpreted text role "mod".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 186); [backlink](#)

Unknown interpreted text role "mod".

Interaction with dynamic features

Name resolution of free variables occurs at runtime, not at compile time. This means that the following code will print 42:

```
i = 10
def f():
    print(i)
i = 42
f()
```

The `:func:eval` and `:func:exec` functions do not have access to the full environment for resolving names. Names may be resolved in the local and global namespaces of the caller. Free variables are not resolved in the nearest enclosing namespace, but in the global namespace. [1] The `:func:exec` and `:func:eval` functions have optional arguments to override the global and local namespace. If only one namespace is specified, it is used for both.

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Unknown interpreted text role "func".

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Unknown interpreted text role "func".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 211); [backlink](#)

Unknown interpreted text role "func".

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Unknown interpreted text role "func".

Exceptions

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\[cpython-main] [Doc] [reference]executionmodel.rst, line 224)

Unknown directive type "index".

```
.. index:: single: exception
```

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Unknown directive type "index".

```
.. index::
   single: raise an exception
   single: handle an exception
   single: exception handler
   single: errors
   single: error handling
```

Exceptions are a means of breaking out of the normal flow of control of a code block in order to handle errors or other exceptional

conditions. An exception is *raised* at the point where the error is detected; it may be *handled* by the surrounding code block or by any code block that directly or indirectly invoked the code block where the error occurred.

The Python interpreter raises an exception when it detects a run-time error (such as division by zero). A Python program can also explicitly raise an exception with the `keyword: 'raise'` statement. Exception handlers are specified with the `keyword: 'try'` ... `keyword: 'except'` statement. The `keyword: 'finally'` clause of such a statement can be used to specify cleanup code which does not handle the exception, but is executed whether an exception occurred or not in the preceding code.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\cpython-main [Doc] [reference] executionmodel.rst, line 239); [backlink](#)

Unknown interpreted text role "keyword".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\cpython-main [Doc] [reference] executionmodel.rst, line 239); [backlink](#)

Unknown interpreted text role "keyword".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\cpython-main [Doc] [reference] executionmodel.rst, line 239); [backlink](#)

Unknown interpreted text role "keyword".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\cpython-main [Doc] [reference] executionmodel.rst, line 239); [backlink](#)

Unknown interpreted text role "keyword".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\cpython-main [Doc] [reference] executionmodel.rst, line 247)

Unknown directive type "index".

```
.. index:: single: termination model
```

Python uses the "termination" model of error handling: an exception handler can find out what happened and continue execution at an outer level, but it cannot repair the cause of the error and retry the failing operation (except by re-entering the offending piece of code from the top).

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Unknown directive type "index".

```
.. index:: single: SystemExit (built-in exception)
```

When an exception is not handled at all, the interpreter terminates execution of the program, or returns to its interactive main loop. In either case, it prints a stack traceback, except when the exception is `exc: 'SystemExit'`.

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Unknown interpreted text role "exc".

Exceptions are identified by class instances. The `keyword: 'except'` clause is selected depending on the class of the instance: it must reference the class of the instance or a `term: non-virtual base class <abstract base class>` thereof. The instance can be received by the handler and can carry additional information about the exceptional condition.

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Unknown interpreted text role "keyword".

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\cpython-main\Doc\reference\cpython-main [Doc] [reference] executionmodel.rst, line 260); [backlink](#)

Unknown interpreted text role "term".

Note

Exception messages are not part of the Python API. Their contents may change from one version of Python to the next without warning and should not be relied on by code which will run under multiple versions of the interpreter.

See also the description of the `:keyword:'try'` statement in section `:ref:'try'` and `:keyword:'raise'` statement in section `:ref:'raise'`.

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Unknown interpreted text role "keyword".

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Unknown interpreted text role "ref".

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Unknown interpreted text role "keyword".

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Unknown interpreted text role "ref".

Footnotes

- [1] This limitation occurs because the code that is executed by these operations is not available at the time the module is compiled.