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```
[3.14] gh-135034: Normalize link targets in tarfile, add
os.path.realpath(strict='allow_missing') (gh-135037) (gh-135065)

Addresses CVEs 2024-12718, 2025-4138, 2025-4330, and 2025-4517.

(cherry picked from commit 3612d8f)

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```

🔗 3.14 (#135065) · 📁 v3.14.4 ... v3.14.0b3

1 parent 78fd7ce commit 9e0ac76 📄

11 files changed +967 -170 lines changed

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Doc/library/os.path.rst

```

@@ -408,9 +408,26 @@ the :mod:`glob` module.)
408 408     system). On Windows, this function will also resolve MS-DOS (also called
409 409     style names such as ``C:\PROGRA~1`` to ``C:\Program Files``.
410 410
411 -   If a path doesn't exist or a symlink loop is encountered, and strict is
412 -   ``True``, :exc:`OSError` is raised. If strict is ``False`` these errors
413 -   are ignored, and so the result might be missing or otherwise inaccessible.
411 +   By default, the path is evaluated up to the first component that does not
412 +   exist, is a symlink loop, or whose evaluation raises :exc:`OSError`.
413 +   All such components are appended unchanged to the existing part of the path.
414 +
415 +   Some errors that are handled this way include "access denied", "not a
416 +   directory", or "bad argument to internal function". Thus, the
417 +   resulting path may be missing or inaccessible, may still contain
418 +   links or loops, and may traverse non-directories.
419 +
420 +   This behavior can be modified by keyword arguments:
421 +
422 +   If strict is ``True``, the first error encountered when evaluating the
423 +   path is
424 +   re-raised.
425 +   In particular, :exc:`FileNotFoundError` is raised if path does not exist,
426 +   or another :exc:`OSError` if it is otherwise inaccessible.
427 +   If strict is :py:data:`os.path.ALLOW_MISSING`, errors other than

```

```

428 + :exc:`FileNotFoundError` are re-raised (as with ``strict=True``).
429 + Thus, the returned path will not contain any symbolic links, but the named
430 + file and some of its parent directories may be missing.
414 431
415 432 .. note::
416 433     This function emulates the operating system's procedure for making a path
@@ -429,6 +446,15 @@ the :mod:`glob` module.)
429 446 .. versionchanged:: 3.10
430 447     The strict parameter was added.
431 448
449 + .. versionchanged:: next
450 +     The :py:data:`~os.path.ALLOW_MISSING` value for the strict parameter
451 +     was added.
452 +
453 + .. data:: ALLOW_MISSING
454 +
455 +     Special value used for the strict argument in :func:`realpath`.
456 +
457 + .. versionadded:: next
432 458
433 459 .. function:: relpath(path, start=os.curdir)
434 460

```

Doc/library/tarfile.rst

```

@@ -255,6 +255,15 @@ The :mod:`tarfile` module defines the following
exceptions:
255 255     Raised to refuse extracting a symbolic link pointing outside the
destination
256 256     directory.
257 257
258 + .. exception:: LinkFallbackError
259 +
260 +     Raised to refuse emulating a link (hard or symbolic) by extracting another
261 +     archive member, when that member would be rejected by the filter location.
262 +     The exception that was raised to reject the replacement member is
available
263 +     as :attr:`~!BaseException.__context__`.
264 +
265 + .. versionadded:: next

```

266	+	
258	267	
259	268	The following constants are available at the module level:
260	269	
↓		@@ -1068,6 +1077,12 @@ reused in custom filters:
↑		
1068	1077	Implements the ``'data'`` filter.
1069	1078	In addition to what ``tar_filter`` does:
1070	1079	
1080	+	- Normalize link targets (:attr:`TarInfo.linkname`) using
1081	+	:func:`os.path.normpath`.
1082	+	Note that this removes internal ``..`` components, which may change the
1083	+	meaning of the link if the path in :attr:`!TarInfo.linkname` traverses
1084	+	symbolic links.
1085	+	
1071	1086	- :ref:`Refuse <tarfile-extraction-refuse>` to extract links (hard or soft)
1072	1087	that link to absolute paths, or ones that link outside the destination.
1073	1088	
↓		@@ -1099,6 +1114,10 @@ reused in custom filters:
↑		
1099	1114	Note that this filter does not block <i>all</i> dangerous archive features.
1100	1115	See :ref:`tarfile-further-verification` for details.
1101	1116	
1117	+	.. versionchanged:: next
1118	+	
1119	+	Link targets are now normalized.
1120	+	
1102	1121	
1103	1122	.. _tarfile-extraction-refuse:
1104	1123	
↓		@@ -1127,6 +1146,7 @@ Here is an incomplete list of things to consider:
↑		
1127	1146	* Extract to a :func:`new temporary directory <tempfile.mkdtemp>`
1128	1147	to prevent e.g. exploiting pre-existing links, and to make it easier to
1129	1148	clean up after a failed extraction.
1149	+	* Disallow symbolic links if you do not need the functionality.
1130	1150	* When working with untrusted data, use external (e.g. OS-level) limits on
1131	1151	disk, memory and CPU usage.
1132	1152	* Check filenames against an allow-list of characters
↓		

```

Doc/whatsnew/3.14.rst
@@ -1608,6 +1608,16 @@ os
(Contributed by Cody Maloney in :gh:`129205`.)
1609 1609
1610 1610
1611 + os.path
1612 + -----
1613 +
1614 + * The strict parameter to :func:`os.path.realpath` accepts a new value,
1615 + :data:`os.path.ALLOW_MISSING`.
1616 + If used, errors other than :exc:`FileNotFoundError` will be re-raised;
1617 + the resulting path can be missing but it will be free of symlinks.
1618 + (Contributed by Petr Viktorin for :cve:`2025-4517`.)
1619 +
1620 +
1611 1621 pathlib
1612 1622 -----
1613 1623
@@ -1796,6 +1806,28 @@ sysconfig
(Contributed by Xuehai Pan in :gh:`131799`.)
1797 1807
1798 1808
1809 + tarfile
1810 + -----
1811 +
1812 + * :func:`~tarfile.data_filter` now normalizes symbolic link targets in order
to
1813 + avoid path traversal attacks.
1814 + (Contributed by Petr Viktorin in :gh:`127987` and :cve:`2025-4138`.)
1815 + * :func:`~tarfile.TarFile.extractall` now skips fixing up directory
attributes
1816 + when a directory was removed or replaced by another kind of file.
1817 + (Contributed by Petr Viktorin in :gh:`127987` and :cve:`2024-12718`.)
1818 + * :func:`~tarfile.TarFile.extract` and :func:`~tarfile.TarFile.extractall`
1819 + now (re-)apply the extraction filter when substituting a link (hard or
1820 + symbolic) with a copy of another archive member, and when fixing up
1821 + directory attributes.
1822 + The former raises a new exception, :exc:`~tarfile.LinkFallbackError`.

```

```

1823 + (Contributed by Petr Viktorin for :cve:`2025-4330` and :cve:`2024-12718`.)
1824 + * :func:`~tarfile.TarFile.extract` and :func:`~tarfile.TarFile.extractall`
1825 + no longer extract rejected members when
1826 + :func:`~tarfile.TarFile.errorlevel` is zero.
1827 + (Contributed by Matt Prodan and Petr Viktorin in :gh:`112887`
1828 + and :cve:`2025-4435`.)
1829 +
1830 +

```

```
1799 1831 threading
```

```
1800 1832 -----
```

```
1801 1833
```



Lib/genericpath.py



```
@@ -8,7 +8,7 @@
```

```

8 8
9 9  __all__ = ['commonprefix', 'exists', 'getatime', 'getctime', 'getmtime',
10 10          'getsize', 'isdevdrive', 'isdir', 'isfile', 'isjunction', 'islink',
11 -          'lexists', 'samefile', 'sameopenfile', 'samestat']
11 +          'lexists', 'samefile', 'sameopenfile', 'samestat', 'ALLOW_MISSING']

```

```
12 12
```

```
13 13
```

```
14 14 # Does a path exist?
```



```
@@ -189,3 +189,12 @@ def _check_arg_types(funcname, *args):
```

```

189 189          f'os.PathLike object, not
        {s.__class__.__name__!r}') from None
190 190          if hasstr and hasbytes:
191 191          raise TypeError("Can't mix strings and bytes in path components") from
        None
192 +
193 + # A singleton with a true boolean value.
194 + @object.__new__
195 + class ALLOW_MISSING:
196 +     """Special value for use in realpath()."""
197 +     def __repr__(self):
198 +         return 'os.path.ALLOW_MISSING'
199 +     def __reduce__(self):
200 +         return self.__class__.__name__

```

```

Lib/ntpath.py
@@ -29,7 +29,7 @@
29 29         "abspath","curdir","pardir","sep","pathsep","defpath","altsep",
30 30
31 31         "extsep","devnull","realpath","supports_unicode_filenames","relpath",
32 31         "samefile", "sameopenfile", "samestat", "commonpath", "isjunction",
32 -         "isdevdrive"]
32 +         "isdevdrive", "ALLOW_MISSING"]
33 33
34 34     def _get_bothseps(path):
35 35         if isinstance(path, bytes):
@@ -601,9 +601,10 @@ def abspath(path):
601 601         from nt import _findfirstfile, _getfinalpathname, readlink as _nt_readlink
602 602         except ImportError:
603 603             # realpath is a no-op on systems without _getfinalpathname support.
604 -         realpath = abspath
604 +         def realpath(path, *, strict=False):
605 +             return abspath(path)
606 else:
606 -         def _readlink_deep(path):
607 +         def _readlink_deep(path, ignored_error=OSError):
607 608             # These error codes indicate that we should stop reading links and
608 609             # return the path we currently have.
609 610             # 1: ERROR_INVALID_FUNCTION
@@ -636,7 +637,7 @@ def _readlink_deep(path):
636 637                 path = old_path
637 638                 break
638 639                 path = normpath(join(dirname(old_path), path))
639 -         except OSError as ex:
640 +         except ignored_error as ex:
640 641                 if ex.winerror in allowed_winerror:
641 642                     break
642 643                 raise
@@ -645,7 +646,7 @@ def _readlink_deep(path):
645 646                 break
646 647                 return path
647 648

```

```

648 - def _getfinalpathname_nonstrict(path):
649 + def _getfinalpathname_nonstrict(path, ignored_error=OSError):
649 650 # These error codes indicate that we should stop resolving the path
650 651 # and return the value we currently have.
651 652 # 1: ERROR_INVALID_FUNCTION
@@ -673,25 +674,26 @@ def _getfinalpathname_nonstrict(path):
673 674     try:
674 675         path = _getfinalpathname(path)
675 676         return join(path, tail) if tail else path
676 - except OSError as ex:
677 + except ignored_error as ex:
677 678         if ex.winerror not in allowed_winerror:
678 679             raise
679 680         try:
680 681             # The OS could not resolve this path fully, so we attempt
681 682             # to follow the link ourselves. If we succeed, join the
        tail
682 683             # and return.
683 - new_path = _readlink_deep(path)
684 + new_path = _readlink_deep(path,
685 +                             ignored_error=ignored_error)
684 686             if new_path != path:
685 687                 return join(new_path, tail) if tail else new_path
686 - except OSError:
688 + except ignored_error:
687 689             # If we fail to readlink(), let's keep traversing
688 690             pass
689 691             # If we get these errors, try to get the real name of the file
        without accessing it.
690 692             if ex.winerror in (1, 5, 32, 50, 87, 1920, 1921):
691 693                 try:
692 694                     name = _findfirstfile(path)
693 695                     path, _ = split(path)
694 - except OSError:
696 + except ignored_error:
695 697                     path, name = split(path)
696 698                 else:
697 699                     path, name = split(path)
@@ -721,24 +723,32 @@ def realpath(path, *, strict=False):

```

		↑
721	723	<code>if normcase(path) == devnull:</code>
722	724	<code>return '\\\\.\NUL'</code>
723	725	<code>had_prefix = path.startswith(prefix)</code>
726	+	
727	+	<code>if strict is ALLOW_MISSING:</code>
728	+	<code>ignored_error = FileNotFoundError</code>
729	+	<code>strict = True</code>
730	+	<code>elif strict:</code>
731	+	<code>ignored_error = ()</code>
732	+	<code>else:</code>
733	+	<code>ignored_error = OSError</code>
734	+	
724	735	<code>if not had_prefix and not isabs(path):</code>
725	736	<code>path = join(cwd, path)</code>
726	737	<code>try:</code>
727	738	<code>path = _getfinalpathname(path)</code>
728	739	<code>initial_winerror = 0</code>
729	740	<code>except ValueError as ex:</code>
730	741	<code># gh-106242: Raised for embedded null characters</code>
731	-	<code># In strict mode, we convert into an OSError.</code>
742	+	<code># In strict modes, we convert into an OSError.</code>
732	743	<code># Non-strict mode returns the path as-is, since we've already</code>
733	744	<code># made it absolute.</code>
734	745	<code>if strict:</code>
735	746	<code>raise OSError(str(ex)) from None</code>
736	747	<code>path = normpath(path)</code>
737	-	<code>except OSError as ex:</code>
738	-	<code>if strict:</code>
739	-	<code>raise</code>
748	+	<code>except ignored_error as ex:</code>
740	749	<code>initial_winerror = ex.winerror</code>
741	-	<code>path = _getfinalpathname_nonstrict(path)</code>
750	+	<code>path = _getfinalpathname_nonstrict(path,</code>
751	+	<code>ignored_error=ignored_error)</code>
742	752	<code># The path returned by _getfinalpathname will always start with \\?\ -</code>
743	753	<code># strip off that prefix unless it was already provided on the original</code>
744	754	<code># path.</code>
		↓

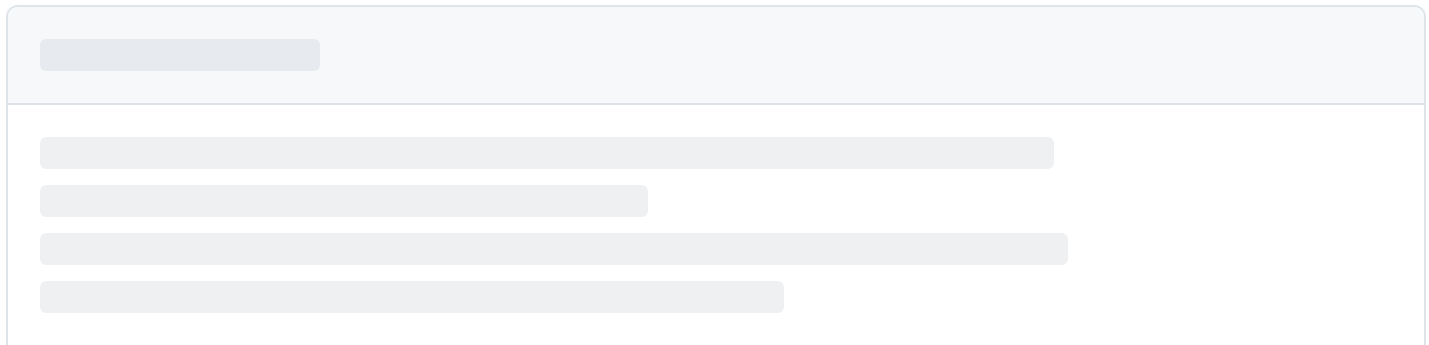
```

Lib/posixpath.py
@@ -36,7 +36,7 @@
36 36         "samefile", "sameopenfile", "samestat",
37 37         "curdir", "pardir", "sep", "pathsep", "defpath", "altsep", "extsep",
38 38         "devnull", "realpath", "supports_unicode_filenames", "relpath",
39 -         "commonpath", "isjunction", "isdevdrive"]
39 +         "commonpath", "isjunction", "isdevdrive", "ALLOW_MISSING"]
40 40
41 41
42 42     def _get_sep(path):
@@ -402,10 +402,18 @@ def realpath(filename, *, strict=False):
402 402         curdir = '.'
403 403         pardir = '..'
404 404         getcwd = os.getcwd
405 -         return _realpath(filename, strict, sep, curdir, pardir, getcwd)
405 +         if strict is ALLOW_MISSING:
406 +             ignored_error = FileNotFoundError
407 +             strict = True
408 +         elif strict:
409 +             ignored_error = ()
410 +         else:
411 +             ignored_error = OSError
412 +
413 +         lstat = os.lstat
414 +         readlink = os.readlink
415 +         maxlinks = None
406 416
407 - def _realpath(filename, strict=False, sep=sep, curdir=curdir, pardir=pardir,
408 -             getcwd=os.getcwd, lstat=os.lstat, readlink=os.readlink,
409 -             maxlinks=None):
409 417         # The stack of unresolved path parts. When popped, a special value of None
410 418         # indicates that a symlink target has been resolved, and that the original
411 419         # symlink path can be retrieved by popping again. The [::-1] slice is a
@@ -477,27 +485,28 @@ def _realpath(filename, strict=False, sep=sep,
477 485             path = newpath
478 486             continue
479 487             target = readlink(newpath)

```

```
480 -         except OSError:
481 -             if strict:
482 -                 raise
483 -             path = newpath
488 +         except ignored_error:
489 +             pass
490 +         else:
491 +             # Resolve the symbolic link
492 +             if target.startswith(sep):
493 +                 # Symlink target is absolute; reset resolved path.
494 +                 path = sep
495 +                 if maxlinks is None:
496 +                     # Mark this symlink as seen but not fully resolved.
497 +                     seen[newpath] = None
498 +                     # Push the symlink path onto the stack, and signal its
499 +                     # specialness
500 +                     # by also pushing None. When these entries are popped, we'll
501 +                     # record the fully-resolved symlink target in the 'seen'
502 +                     # mapping.
503 +                     rest.append(newpath)
504 +                     rest.append(None)
505 +                     # Push the unresolved symlink target parts onto the stack.
506 +                     target_parts = target.split(sep)[::-1]
507 +                     rest.extend(target_parts)
508 +                     part_count += len(target_parts)
509 +                     continue
510 +             # Resolve the symbolic link
511 +             if target.startswith(sep):
512 +                 # Symlink target is absolute; reset resolved path.
513 +                 path = sep
514 +                 if maxlinks is None:
515 +                     # Mark this symlink as seen but not fully resolved.
516 +                     seen[newpath] = None
517 +                     # Push the symlink path onto the stack, and signal its specialness
518 +                     # by also pushing None. When these entries are popped, we'll
519 +                     # record the fully-resolved symlink target in the 'seen' mapping.
520 +                     rest.append(newpath)
521 +                     rest.append(None)
522 +                     # Push the unresolved symlink target parts onto the stack.
523 +                     target_parts = target.split(sep)[::-1]
```

```
499 - rest.extend(target_parts)
500 - part_count += len(target_parts)
508 + # An error occurred and was ignored.
509 + path = newpath
501 510
502 511     return path
503 512
```



Comments 0