

Examining the Identity of Sliced Python Sequences

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[1, 2, 3] # unaffected by the change in "a"
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>>> id(a) == id(b)
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The `id()` function returns an integer that (in CPython) is the memory address of the argument. Different objects that coexist at some moment have different memory addresses.

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>>> id(bytearray('123')) == id(bytearray('123')[:]) # bytearray
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(Here I use “`object`” to represent a literal object rather than a variable representing it.)

It isn't surprising that some other Python sequence types display the same behavior as a list when comparing the `id()` of the original object with a beginning-to-end slice — the object and its full slice are different entities:

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>>> id(buffer('123')) == id(buffer('123')[:])    # buffer
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>>> id((1, 2, 3)) == id((1, 2, 3)[:])            # tuple
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It isn't surprising that some other Python sequence types display the same behavior as a list when comparing the `id()` of the original object with a beginning-to-end slice — the object and its full slice are different entities. But it may be surprising that not all do:

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>>> id('123') == id('123'[:]) # string
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>>> id([1, 2, 3][:]) == id([1, 2, 3][:]) # Are concurrent whole slices of a list one object?
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>>> id([1, 2, 3][:]) == id([1, 2, 3][:]) # Are concurrent whole slices of a list one object?
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>>> id(array.array('i', [1, 2, 3])[:]) == id(array.array('i', [1, 2, 3])[:]) # ditto, array
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>>> x = (1, 2, 3) # integers are immutable
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>>> x = (1, 2, 3) # integers are immutable
>>> id((1, 2, 3)) == id((1, 2, 3)[:])
False
>>> id((1, 2, 3)[:]) == id((1, 2, 3)[:])
False
```

```
>>> a = [6, 7, 8] # lists are mutable
>>> x = (a, 2, 3) # so “x” is “changeable”
>>> id((a, 2, 3)) == id((a, 2, 3)[:])
True
>>> id((a, 2, 3)[:]) == id((a, 2, 3)[:])
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```

We can summarize what we know so far in a table:

<i>question</i>	<i>list, array, bytearray</i>	<i>buffer</i>	<i>tuple</i>	<i>string</i>
<code>id(object) == id(object[:])</code>	False	False	False but...	True
<code>id(object[:]) == id(object[:])</code>	False	True	False but...	True
<i>mutable?</i>	yes	can be	no	no

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There are some other interesting inconsistencies of this sort in Appendix 2, but I omit them here for the sake of brevity.

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<code>id(object[:]) == id(object[:])</code>	False	C / Py J	False but...	C Py /J
<code>var = object</code> <code>id(var[:]) == id(var[:])</code>	C Py /J	C / Py J	C Py /J	C / Py J
<code>var2 = var[:]</code> <code>id(var[:]) == id(var2[:])</code>	C Py /J	Py C/J	C Py /J	C / Py J

Key: **blue & bold = True**; red & non-bold = False

C: CPython; Py: PyPy; J: Jython.

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<code>id(object[:]) == id(object[:])</code>	False	C / Py J	False but...	C Py /J
<code>var = object</code> <code>id(var[:]) == id(var[:])</code>	C Py /J	C / Py J	C Py /J	C / Py J
<code>var2 = var[:]</code> <code>id(var[:]) == id(var2[:])</code>	C Py /J	Py C /J	C Py /J	C / Py J

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<code>id(object) == id(object[:])</code>	False	False	False but...	C Py/J
<code>id(object[:]) == id(object[:])</code>	False	C/Py J	False but...	C Py/J
<code>var = object</code> <code>id(var[:]) == id(var[:])</code>	C Py/J	C/Py J	C Py/J	C/Py J
<code>var2 = var[:]</code> <code>id(var[:]) == id(var2[:])</code>	C Py/J	Py C/J	C Py/J	C/Py J

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That is the main point of this presentation. (Note that Jython tests **False** everywhere that CPython tests **True** in these examples; PyPy is mixed.) In sum: the behavior of the `id()` function is uniform neither with respect to the various sequences nor among the three main implementations.

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<code>id(object[:]) == id(object[:])</code>	False	C/Py J	False but...	C Py/J
<code>var = object</code> <code>id(var[:]) == id(var[:])</code>	C Py/J	C/Py J	C Py/J	C/Py J
<code>var2 = var[:]</code> <code>id(var[:]) == id(var2[:])</code>	C Py/J	Py C/J	C Py/J	C/Py J

Key: **blue & bold = True**; red & non-bold = False

C: CPython; Py: PyPy; J: Jython.

That is the main point of this presentation. (Note that Jython tests **False** everywhere that CPython tests **True** in these examples; PyPy is mixed.) In sum: the behavior of the `id()` function is uniform neither with respect to the various sequences nor among the three main implementations. It seems doubtful that this is a matter of performance following prescription.

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Appendix 1: For reference here is how “identity” is defined in the three implementations:

- CPython: “Return the ‘identity’ of an object. This is an integer which is guaranteed to be unique and constant for this object during its lifetime. Two objects with non-overlapping lifetimes may have the same `id()` value. CPython implementation detail: **This is the address of the object in memory.**” <https://docs.python.org/2.7/library/functions.html?#id>.
Python 2.7.8 (default, Jul 2 2014, 10:14:46) [GCC 4.2.1 Compatible Apple LLVM 5.1 (clang-503.0.40)] on darwin
- PyPy: **“Using the default GC (called minimark), the built-in function `id()` [of PyPy] works like it does in CPython.** With other GCs it returns numbers that are not real addresses (because an object can move around several times) and calling it a lot can lead to performance problem.” http://pypy.readthedocs.org/en/latest/cpython_differences.html Python 2.7.6 (32f35069a16d, Jun 06 2014, 20:12:47) [PyPy 2.3.1 with GCC 4.2.1 Compatible Apple LLVM 5.0 (clang-500.2.79)] on darwin
- Jython: “Return the ‘identity’ of an object. This is an integer (or long integer) which is guaranteed to be unique and constant for this object during its lifetime. Two objects with non-overlapping lifetimes may have the same `id()` value. (Implementation note: **this is the address of the object.**)” <http://www.jython.org/docs/library/functions.html> Jython 2.7b2
(default:a5bc0032cf79+, Apr 22 2014, 21:20:17) [Java HotSpot(TM) 64-Bit Server VM (Oracle Corporation)] on java1.7.0_51

Appendix 2: A fuller list of examples.

<i>question</i>	<i>list, array, bytearray</i>	<i>buffer</i>	<i>tuple</i>	<i>string</i>
<code>id(object) == id(object[:])</code>	False	False	False but...	C Py /J
<code>id(object[:]) == id(object[:])</code>	False	C /Py J	False but...	C Py /J
<code>id(var) == id(var[:])</code>	False	False	C Py /J	C /Py J
<code>id(var) == id(var2)</code>	False	False	C Py /J	C /Py J
<code>id(var[:]) == id(var[:])</code>	C Py /J	C /Py J	C Py /J	C /Py J
<code>id(var[:]) == id(var2[:])</code>	C Py /J	Py C/J	C Py /J	C /Py J
<code>id(var) == id(object)</code>	False	False	False	C Py /J
<code>id(var2) == id(object)</code>	False	False	False	C Py /J
<code>id(var[:]) == id(object)</code>	C Py /J	False	False	C Py /J

Key: **blue & bold = True**; red & non-bold = False

Appendix 3: Another interesting feature is that CPython alternates the IDs of a sliced object and a sliced variable differently if they are simply printed rather than appearing in the same comparison:

>>> def test_list():	>>> def test_list():
... x = [1, 2, 3][:]	... print id([1, 2, 3][:])
... print id(x[:])	... print id([1, 2, 3][:])
... print id(x[:])	... print id([1, 2, 3][:])
... print id(x[:])	... print id([1, 2, 3][:])
... print id(x[:])	
>>> test_list()	>>> test_list()
4451744728	4451745160
4451744728	4451676816
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>>> test_list()	>>> test_list()
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For a list, the literal object uses two alternating memory addresses in this example, while a variable uses the same memory address.

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>>> def test_list():	>>> def test_list():
... x = [1, 2, 3][:]	... print id([1, 2, 3][:]) # do this four times
... print id(x[:]) # do this four times	
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The three implementations behave differently in this respect; Jython again is always False:

<i>question</i>	<i>list, array</i>	<i>tuple</i>	<i>string</i>
id(var[:]), 4x in fn same	C True Py/J	C True Py/J	C/Py True J
id(object[:]), 4x in fn same	C False* ; Py/J	False	C/Py True J

* IDs appear in alternation. `qqq` buffer? bytearray?

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(really, this time)