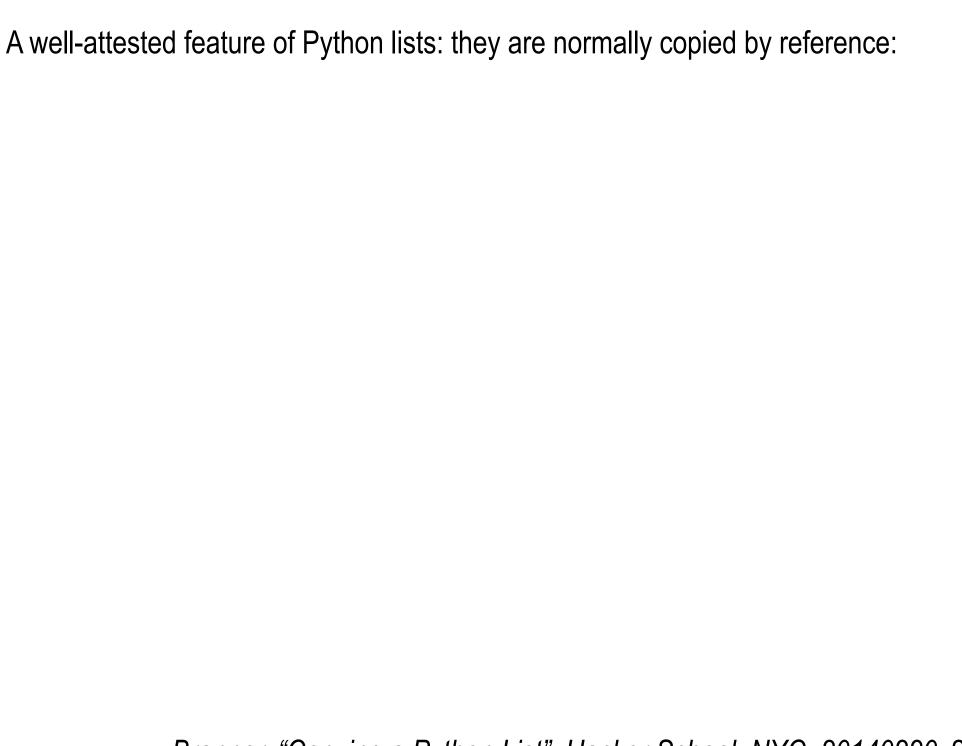
Copying a Python List

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Branner, "Copying a Python List"; Hacker School, NYC; 20140220. 2

>>>
$$x = [1, 2, 3]$$

```
>>> x = [1, 2, 3]
>>> y = x
>>> x.append(4)
>>>
```

```
>>> x = [1, 2, 3]
>>> y = x
>>> x.append(4)
>>> x
```

```
>>> x = [1, 2, 3]
>>> y = x
>>> x.append(4)
>>> x
[1, 2, 3, 4]
>>>
```

```
>>> x = [1, 2, 3]
>>> y = x
>>> x.append(4)
>>> x
[1, 2, 3, 4]
>>> y
```

```
>>> x = [1, 2, 3]
>>> y = x
>>> x.append(4)
>>> x
[1, 2, 3, 4]
>>> y
[1, 2, 3, 4]
>>> >
```

```
>>> x = [1, 2, 3]
>>> y = x
>>> x.append(4)
>>> x
[1, 2, 3, 4]
>>> y
[1, 2, 3, 4]
>>> # y changes because it isn't independent of x
```

```
>>> import copy
>>>
```

```
>>> import copy
>>> x = [1, 2, 3]
>>>
```

```
>>> import copy
>>> x = [1, 2, 3]
>>> y = copy.deepcopy(x)
>>>
```

```
>>> import copy
>>> x = [1, 2, 3]
>>> y = copy.deepcopy(x)
>>> x.append(4)
>>>
```

```
>>> import copy
>>> x = [1, 2, 3]
>>> y = copy.deepcopy(x)
>>> x.append(4)
>>> x
```

```
>>> import copy
>>> x = [1, 2, 3]
>>> y = copy.deepcopy(x)
>>> x.append(4)
>>> x
[1, 2, 3, 4]
>>>
```

```
>>> import copy
>>> x = [1, 2, 3]
>>> y = copy.deepcopy(x)
>>> x.append(4)
>>> x
[1, 2, 3, 4]
>>> y
```

```
>>> import copy
>>> x = [1, 2, 3]
>>> y = copy.deepcopy(x)
>>> x.append(4)
>>> x
[1, 2, 3, 4]
>>> y
[1, 2, 3]
```

```
>>> import copy
>>> x = [1, 2, 3]
>>> y = copy.deepcopy(x)
>>> x.append(4)
>>> x
[1, 2, 3, 4]
>>> y
[1, 2, 3]
```

```
>>> import copy
>>> x = [1, 2, 3]
>>> y = copy.deepcopy(x)
>>> x.append(4)
>>> x
[1, 2, 3, 4]
>>> y
[1, 2, 3]
>>> # As a deep copy, y is independent of x.
```

>>>
$$x = [1, 2, 3]$$

```
>>> x = [1, 2, 3]
>>> y = x[:]
>>>
```

```
>>> x = [1, 2, 3]
>>> y = x[:]
>>> y
[1, 2, 3]
>>>
```

```
>>> x = [1, 2, 3]
>>> y = x[:]
>>> y
[1, 2, 3]
>>> x.append(4)
>>>
```

```
>>> x = [1, 2, 3]
>>> y = x[:]
>>> y
[1, 2, 3]
>>> x.append(4)
>>> x
```

```
>>> x = [1, 2, 3]
>>> y = x[:]
>>> y
[1, 2, 3]
>>> x.append(4)
>>> x
[1, 2, 3, 4]
>>>
```

```
>>> x = [1, 2, 3]
>>> y = x[:]
>>> y
[1, 2, 3]
>>> x.append(4)
>>> x
[1, 2, 3, 4]
>>> y
```

```
>>> x = [1, 2, 3]
>>> y = x[:]
>>> y
[1, 2, 3]
>>> x.append(4)
>>> x
[1, 2, 3, 4]
>>> y
[1, 2, 3]
>>> y
```

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```
>>> x = [1, 2, 3]
>>> y = x[:]
>>>
```

```
>>> x = [1, 2, 3]
>>> y = x[:]
>>> x == y
```

```
>>> x = [1, 2, 3]
>>> y = x[:]
>>> x == y
True
>>>
```

```
>>> x = [1, 2, 3]
>>> y = x[:]
>>> x == y
True
>>> id(x) == id(y) # id() returns memory location
```

Slicing a list creates an independent list.

```
>>> x = [1, 2, 3]
>>> y = x[:]
>>> x == y
True
>>> id(x) == id(y) # id() returns memory location
False
>>>
```

Slicing a list creates an independent list.

```
>>> x = [1, 2, 3]
>>> y = x[:]
>>> x == y
True
>>> id(x) == id(y) # id() returns memory location
False
>>> # Not the same memory location;
>>> # x and y are different objects
```

| | time (µsec) | | | | | |
|---------|------------------|--------|--|--|--|--|
| | CPython 2.7.5 | | | | | |
| n | list[:] deepcopy | | | | | |
| 10 | 0.121 | 15.9 | | | | |
| 100 | 0.375 | 72 | | | | |
| 1000 | 2.01 | 631 | | | | |
| 10000 | 23.3 | 5650 | | | | |
| 100000 | 247 | 57500 | | | | |
| 1000000 | 2780 | 569000 | | | | |

Timings (timeit):

| | time (µsec) | | | | | |
|---------|------------------|--------|--|--|--|--|
| | CPython 2.7.5 | | | | | |
| n | list[:] deepcopy | | | | | |
| 10 | 0.121 | 15.9 | | | | |
| 100 | 0.375 | 72 | | | | |
| 1000 | 2.01 | 631 | | | | |
| 10000 | 23.3 | 5650 | | | | |
| 100000 | 247 | 57500 | | | | |
| 1000000 | 2780 | 569000 | | | | |

Both appear to be running in linear time.

Timings (timeit):

| | time (µsec) | | | | |
|---------|------------------|--------|--|--|--|
| | CPython 2.7.5 | | | | |
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| 10000 | 23.3 | 5650 | | | |
| 100000 | 247 | 57500 | | | |
| 1000000 | 2780 | 569000 | | | |

Both appear to be running in linear time. (A tenfold increase in list-length brings about a ten-fold increase in running time.)

| | time (µsec) | | | | | |
|---------|---------------|----------|---------------------|--|-----------------------|--|
| | CPython 2.7.5 | | PyPy ~ Python 2.7.3 | | Jython ~ Python 2.5.2 | |
| n | list[:] | deepcopy | | | | |
| 10 | 0.121 | 15.9 | | | | |
| 100 | 0.375 | 72 | | | | |
| 1000 | 2.01 | 631 | | | | |
| 10000 | 23.3 | 5650 | | | | |
| 100000 | 247 | 57500 | | | | |
| 1000000 | 2780 | 569000 | | | | |

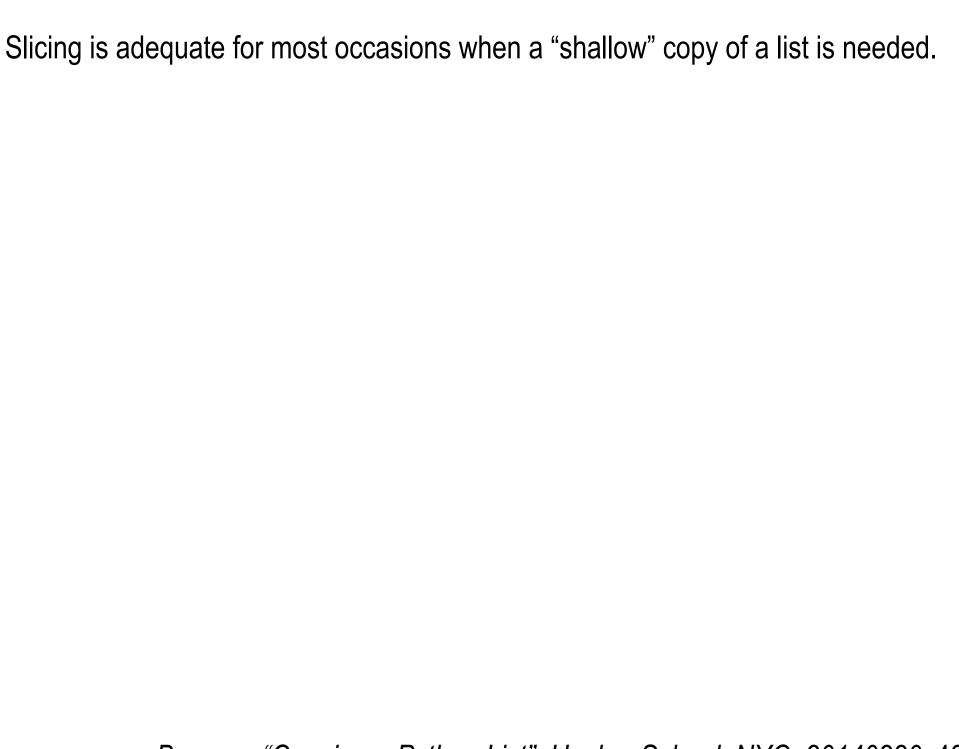
| | time (µsec) | | | | | |
|---------|---------------|----------|---------------------|----------|-----------------------|--|
| | CPython 2.7.5 | | PyPy ~ Python 2.7.3 | | Jython ~ Python 2.5.2 | |
| n | list[:] | deepcopy | list[:] | deepcopy | | |
| 10 | 0.121 | 15.9 | 0.0373 | 2.36 | | |
| 100 | 0.375 | 72 | 0.0847 | 18.2 | | |
| 1000 | 2.01 | 631 | 0.621 | 177 | | |
| 10000 | 23.3 | 5650 | 8.14 | 3820 | | |
| 100000 | 247 | 57500 | 387 | 63400 | | |
| 1000000 | 2780 | 569000 | 5450 | 1410000 | | |

| | time (µsec) | | | | | |
|---------|---------------|----------|---------------------|----------|-----------------------|----------|
| | CPython 2.7.5 | | PyPy ~ Python 2.7.3 | | Jython ~ Python 2.5.2 | |
| n | list[:] | deepcopy | list[:] | deepcopy | list[:] | deepcopy |
| 10 | 0.121 | 15.9 | 0.0373 | 2.36 | 0.0756 | 37 |
| 100 | 0.375 | 72 | 0.0847 | 18.2 | 0.245 | 300 |
| 1000 | 2.01 | 631 | 0.621 | 177 | 1.91 | 1300 |
| 10000 | 23.3 | 5650 | 8.14 | 3820 | 18.2 | 13000 |
| 100000 | 247 | 57500 | 387 | 63400 | 207 | 163000 |
| 1000000 | 2780 | 569000 | 5450 | 1410000 | 2450 | 2290000 |

Timings (timeit):

| | time (µsec) | | | | | |
|---------|---------------|----------|---------------------|----------|-----------------------|----------|
| | CPython 2.7.5 | | PyPy ~ Python 2.7.3 | | Jython ~ Python 2.5.2 | |
| n | list[:] | deepcopy | list[:] | deepcopy | list[:] | deepcopy |
| 10 | 0.121 | 15.9 | 0.0373 | 2.36 | 0.0756 | 37 |
| 100 | 0.375 | 72 | 0.0847 | 18.2 | 0.245 | 300 |
| 1000 | 2.01 | 631 | 0.621 | 177 | 1.91 | 1300 |
| 10000 | 23.3 | 5650 | 8.14 | 3820 | 18.2 | 13000 |
| 100000 | 247 | 57500 | 387 | 63400 | 207 | 163000 |
| 1000000 | 2780 | 569000 | 5450 | 1410000 | 2450 | 2290000 |

(PyPy is fast at small values of n, but then slows down and does not seem to be running consistently in linear time at some higher values of n.)



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```
>>> x = []
>>> x.append(x)
>>>
```

```
>>> x = []
>>> x.append(x)
>>> x
[[...]]
>>>
```

```
>>> x = []
>>> x.append(x)
>>> x
[[...]]
>>> y = copy.deepcopy(x)
>>>
```

```
>>> x = []
>>> x.append(x)
>>> x
[[...]]
>>> y = copy.deepcopy(x)
>>> y
```

```
>>> x = []
>>> x.append(x)
>>> x
[[...]]
>>> y = copy.deepcopy(x)
>>> y
[[...]]
>>>
```

```
>>> x = []
>>> x.append(x)
>>> x
[[...]]
>>> y = copy.deepcopy(x)
>>> y
[[...]]
>>> z = x[:]
>>>
```

```
>>> x = []
>>> x.append(x)
>>> x
[[...]]
>>> y = copy.deepcopy(x)
>>> y
[[...]]
>>> z = x[:]
>>> z
```

```
>>> x = []
>>> x.append(x)
>>> x
[[...]]
>>> y = copy.deepcopy(x)
>>> y
[[...]]
>>> z = x[:]
>>> z
[[[...]]]
>>> >
```

```
>>> x = []
>>> x.append(x)
>>> x
[[...]]
>>> y = copy.deepcopy(x)
>>> y
[[...]]
>>> z = x[:]
>>> z
[[[...]]]
>>> >
```

End