Functions as Objects

Radical Claim:

Functions are Objects

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Functions are Objects

implications:

- variables can reference functions
- lists/dicts can reference functions
- we can pass function references to other functions
- we can pass lists of function references to other functions
- ...

Function References

Outline

- functions as objects
- sort

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

def f():
    return "hi"

g = f

z = f()
```

your notes should probably include this example, with an explanation of what each of the 5 steps do!

which line of code is most novel for us?

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

def f():
    return "hi"

g = f

z = f()
```

State:

references

objects

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

def f():
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```
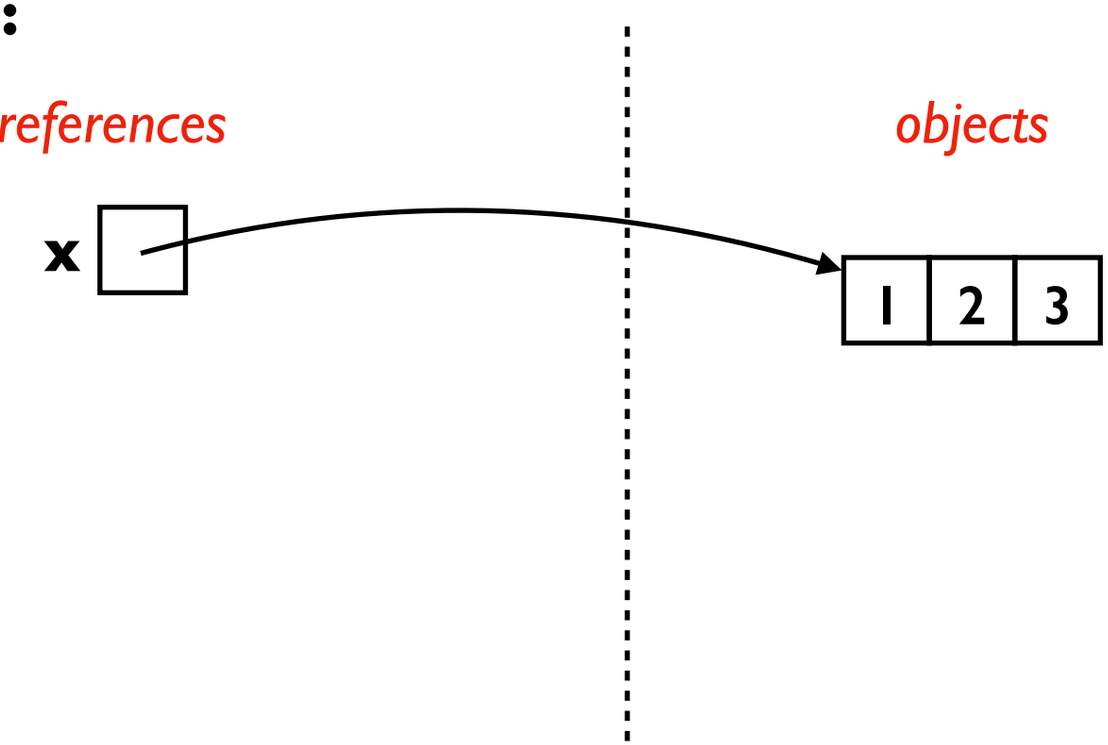

Explanation: x should reference a new list object

State:



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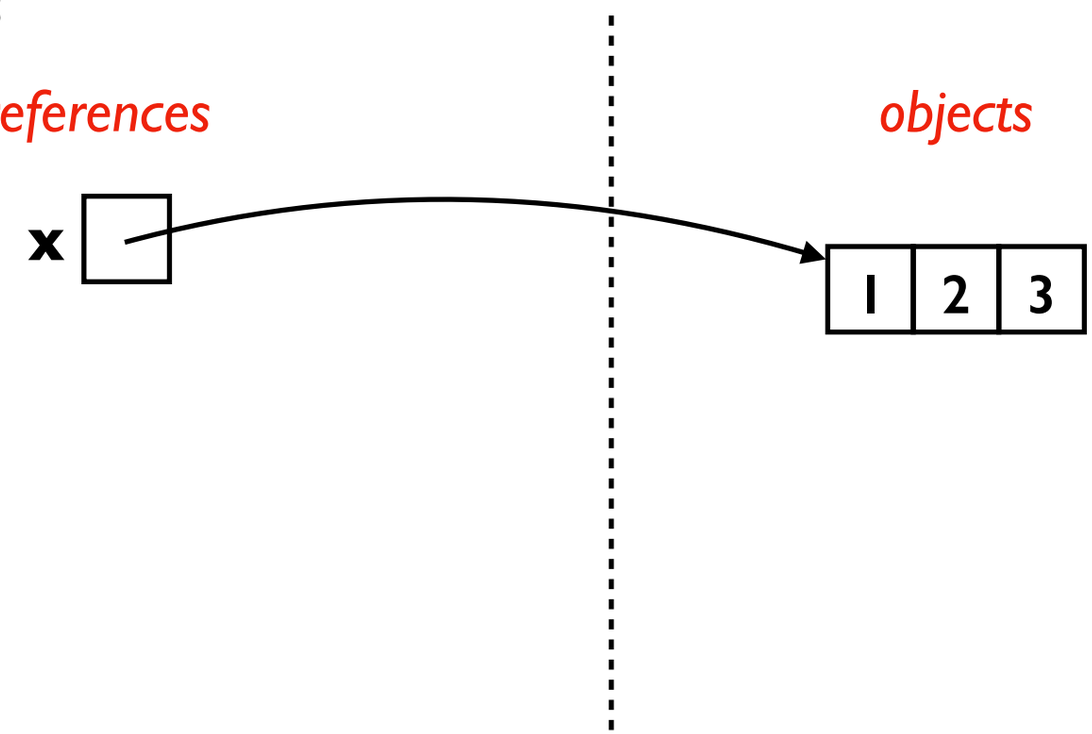

```
x = [1,2,3]
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def f():
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Explanation: x should reference a new list object

Explanation: y should reference whatever x references

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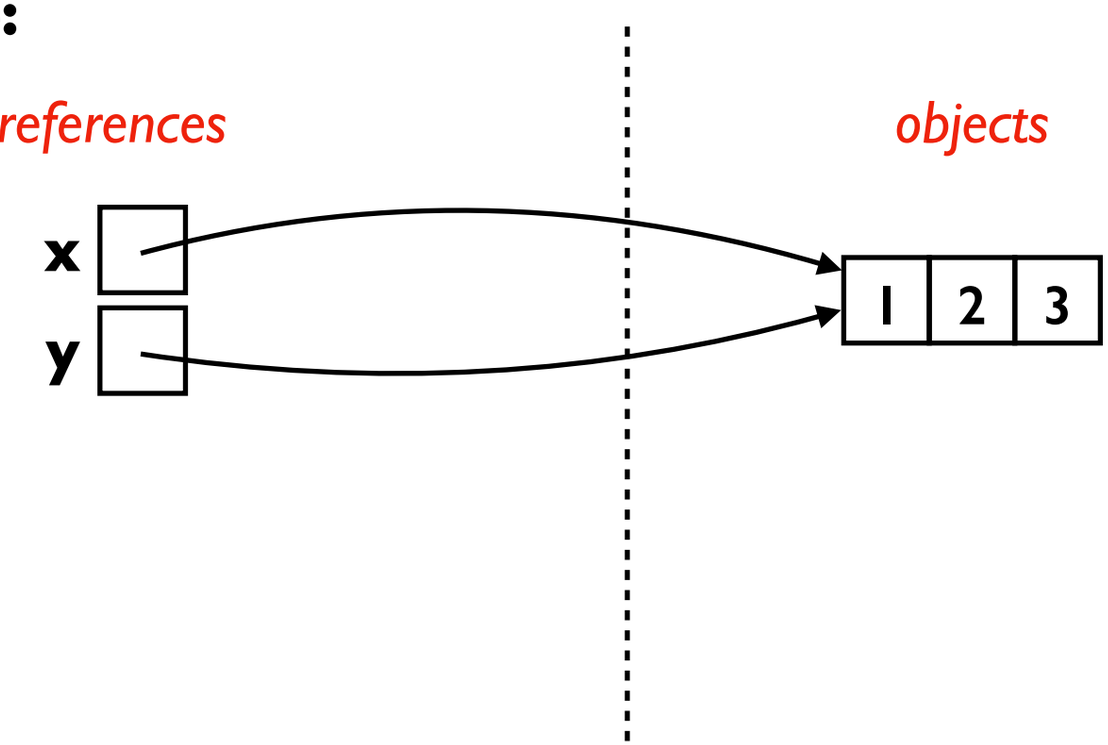

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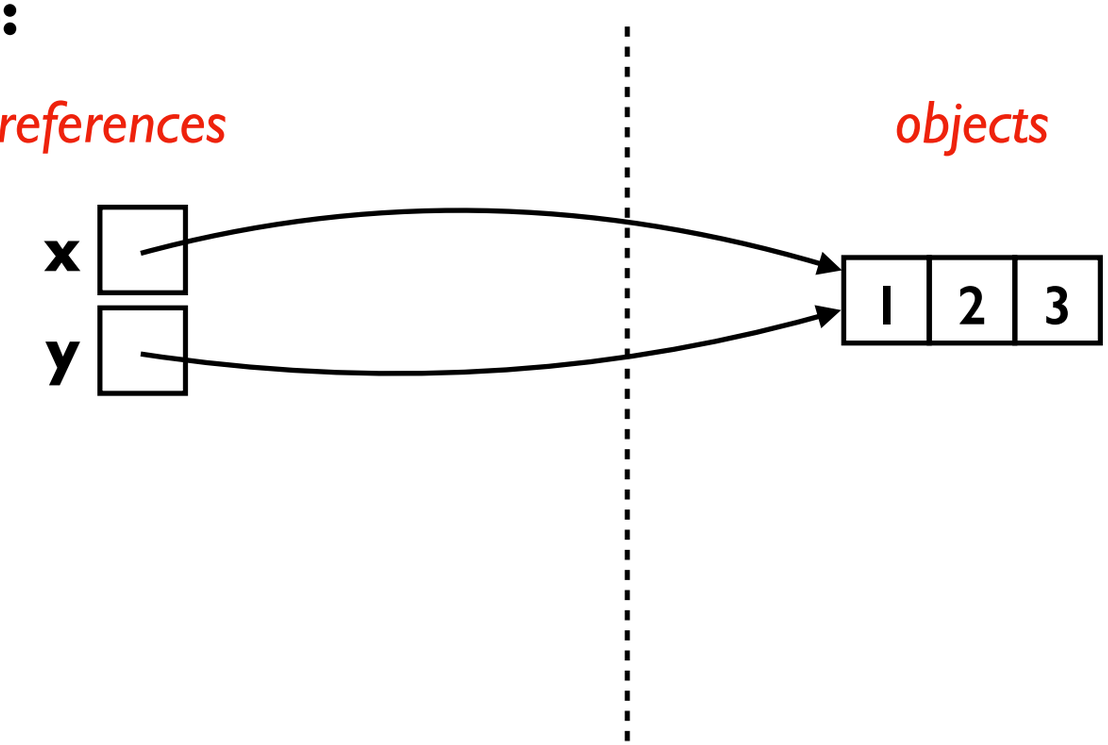

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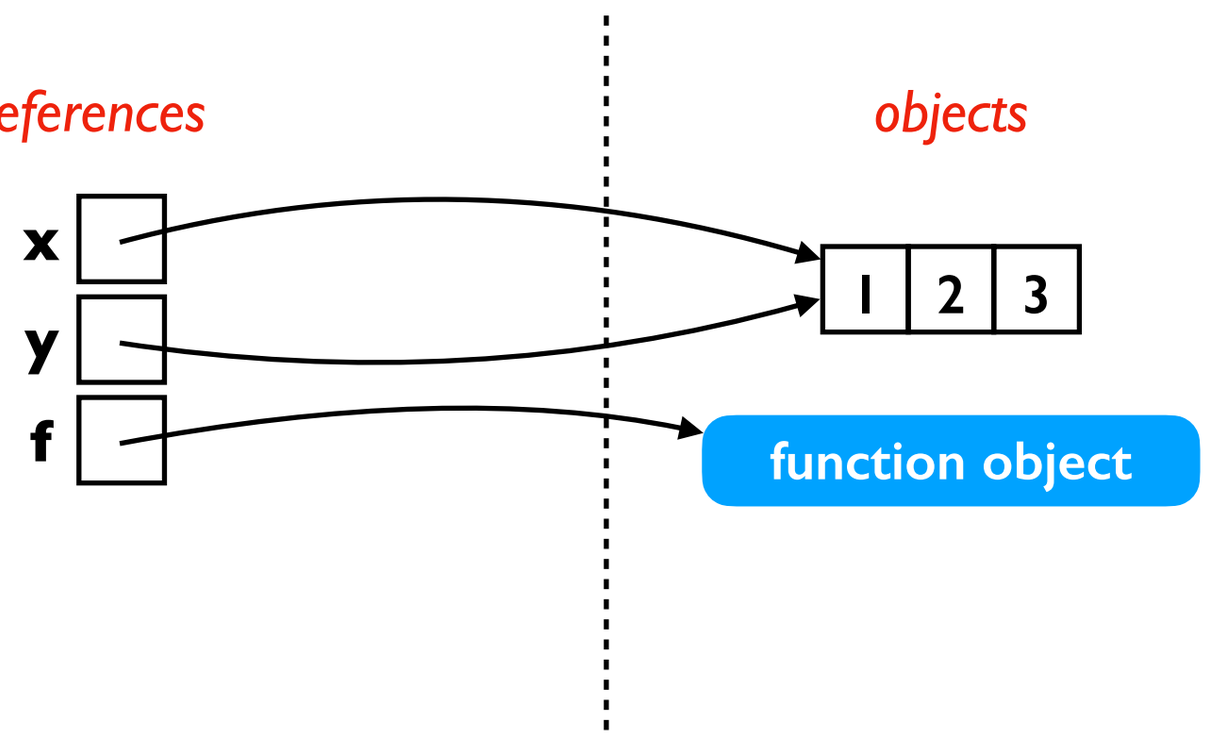

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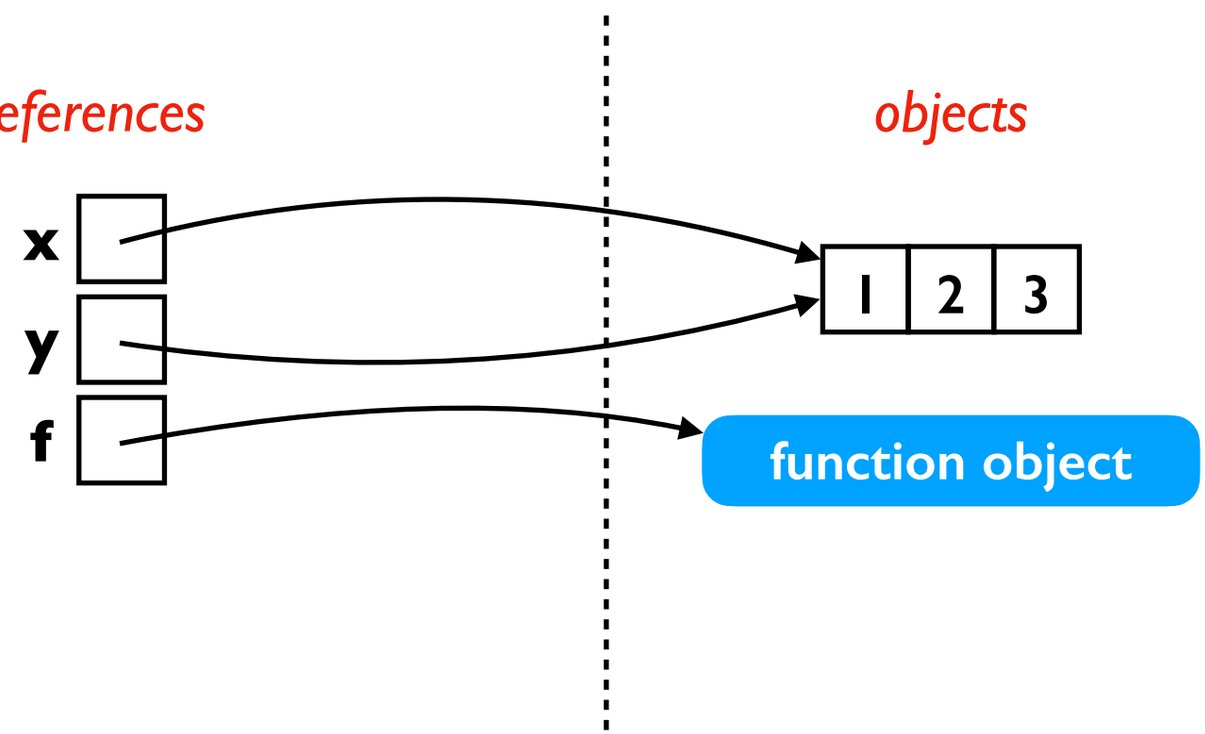

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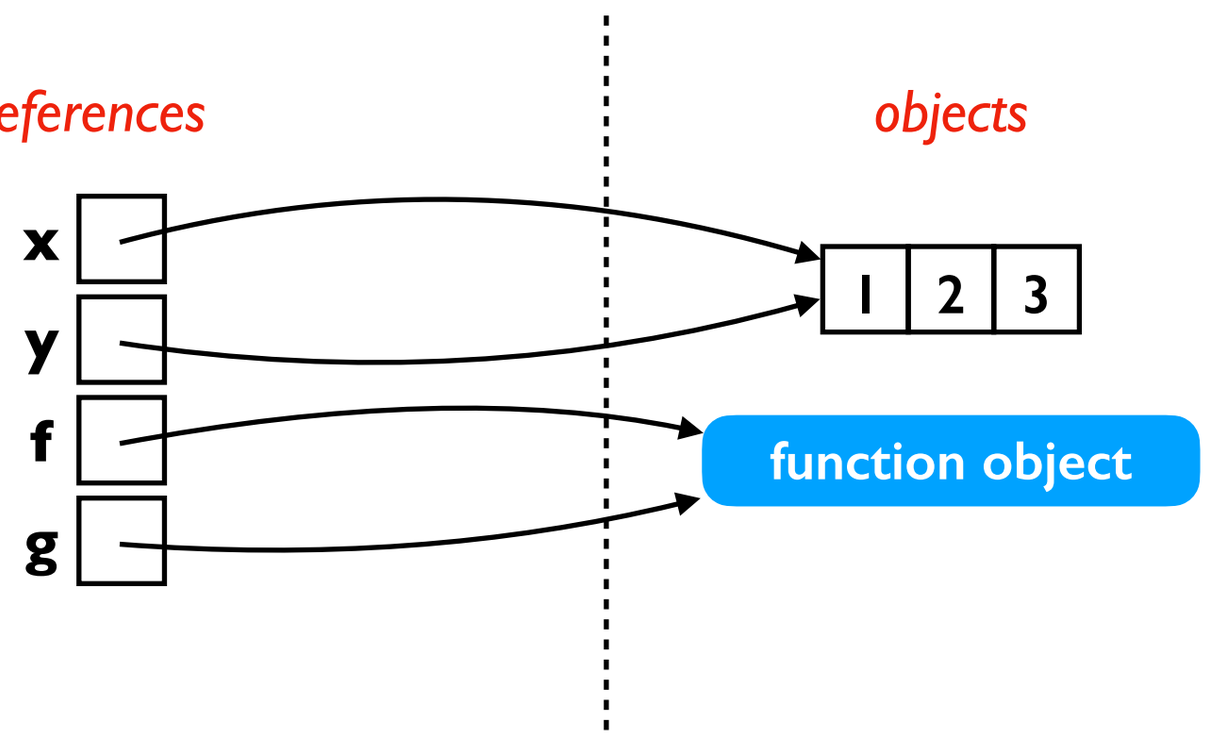

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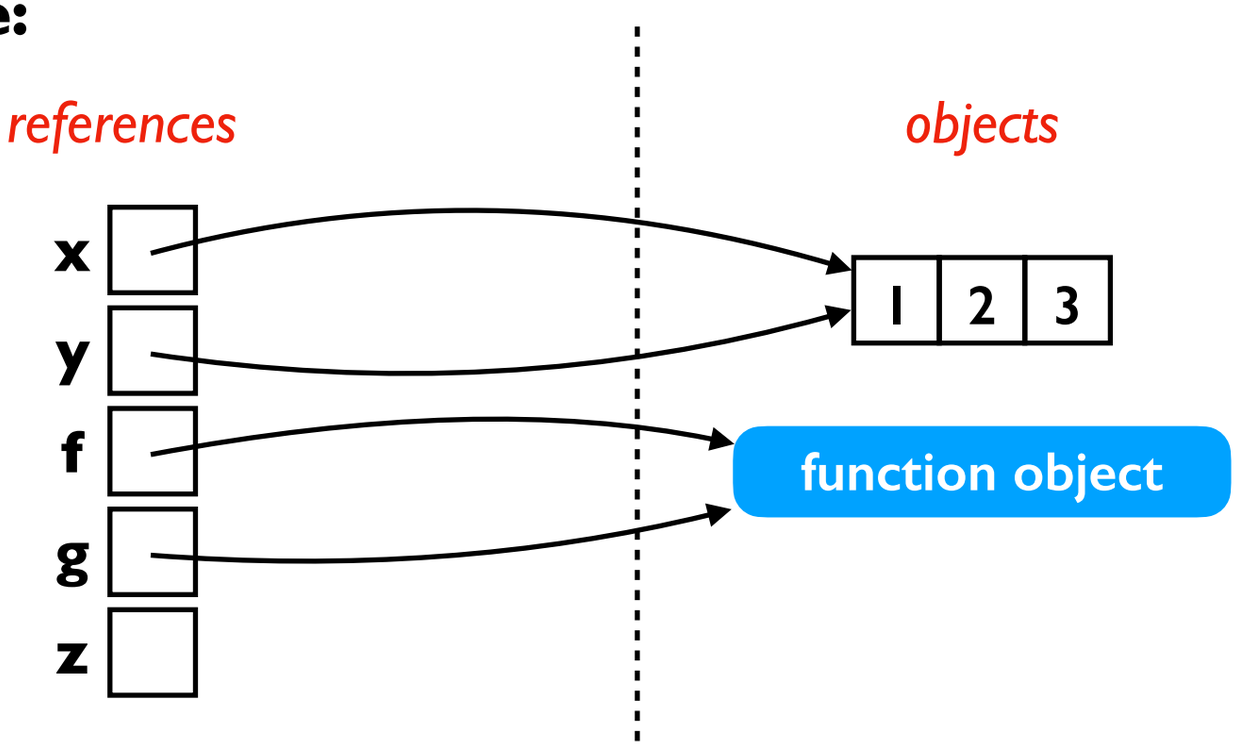

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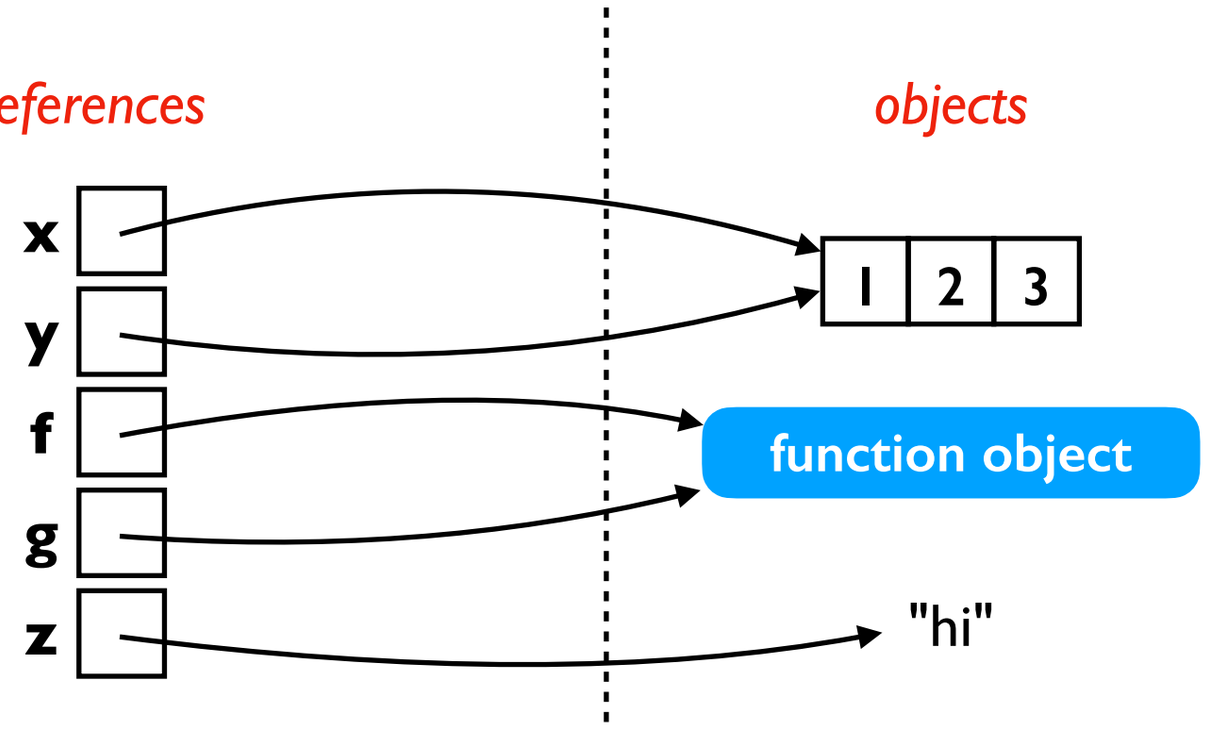

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Explanation: x should reference a new list object

Explanation: y should reference whatever x references

Explanation: f should reference a new function object

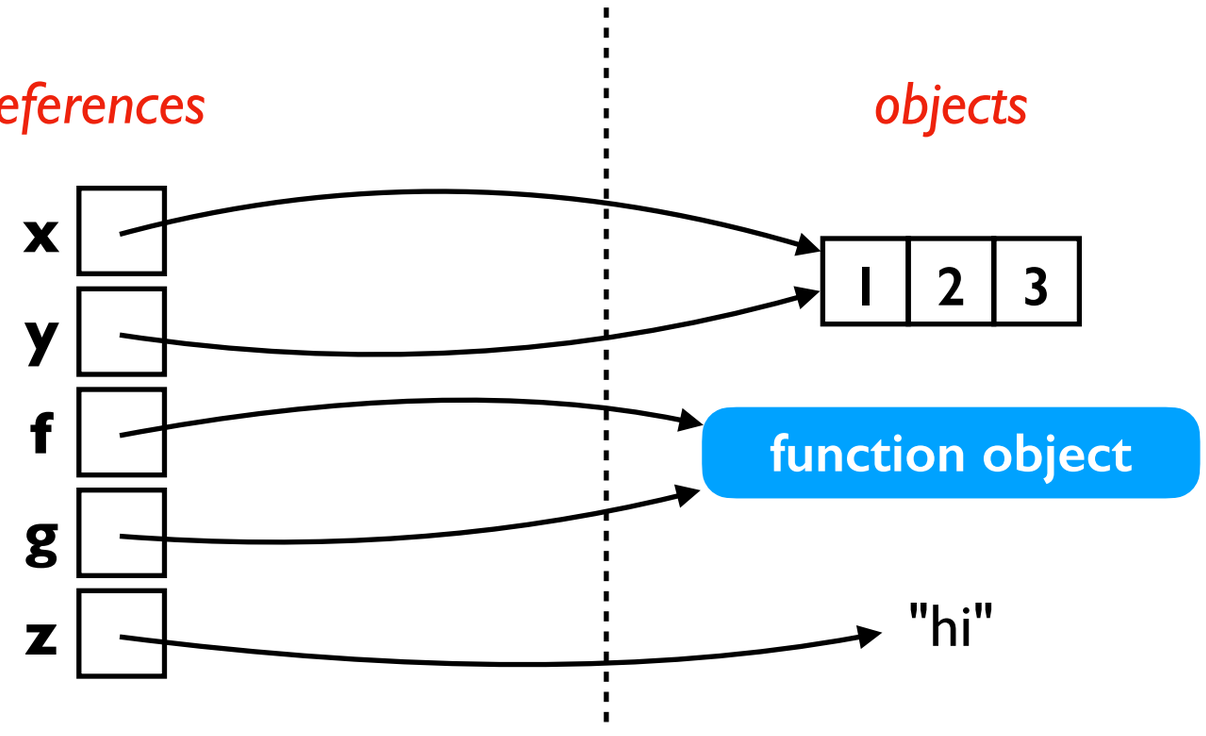
Explanation: g should reference whatever f references

Explanation: z should reference whatever f returns

both of these calls would have run the same code, returning the same result:

- `z = f()`
- `z = g()`

State:



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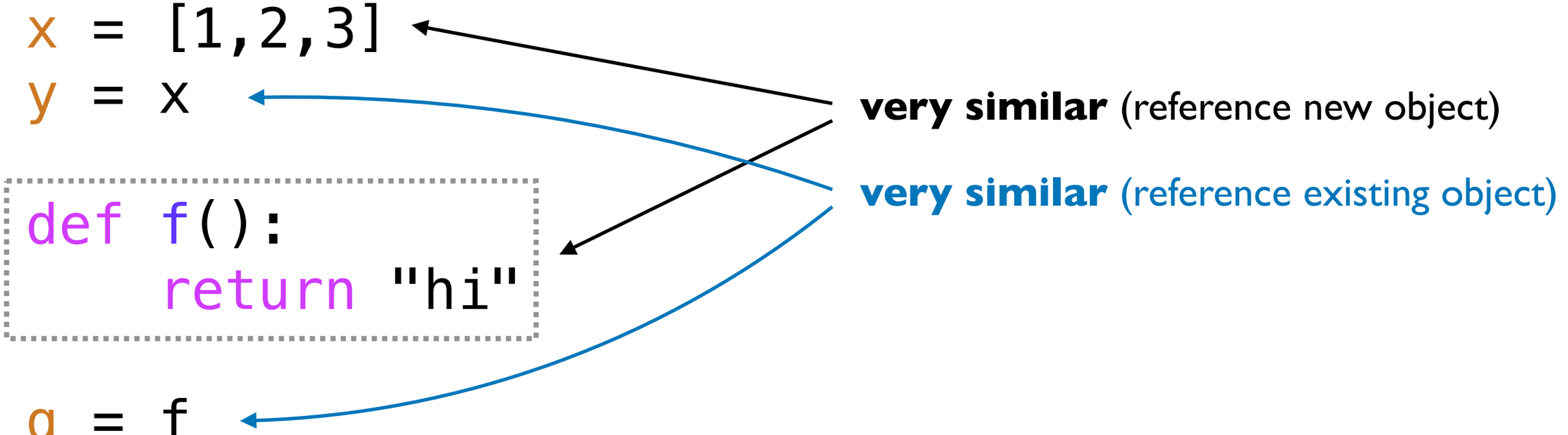

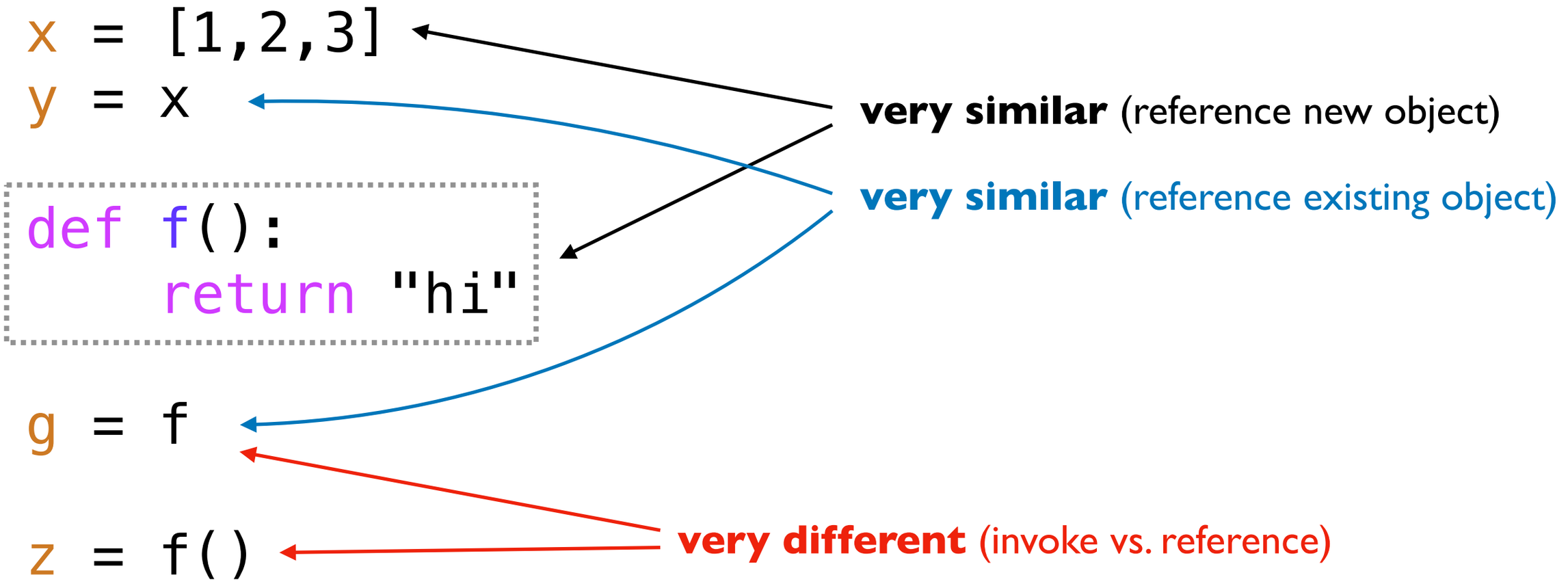
x = [1,2,3]
y = x
def f():
return "hi"
g = f
z = f()
very similar (reference new object)
very similar (reference existing object)
very different (invoke vs. reference)

CODING DEMOS

[Python Tutor]

Function References

Outline

- functions as objects
- sort

Example: Sorting Names

List of tuples:

```
names = [
     (“Catherine”, “Baker”),
     (“Alice”, “Clark”),
     (“Bob”, “Adams”),
]
```

Catherine	Baker
Bob	Adams
Alice	Clark

Example: Sorting Names

List of tuples:

```
names = [
      (“Catherine”, “Baker”),
      (“Alice”, “Clark”),
      (“Bob”, “Adams”),
]
```

Catherine	Baker
Bob	Adams
Alice	Clark

```
names.sort()
```

sorting tuples is done on first element
(ties go to 2nd element)

Alice	Clark
Bob	Adams
Catherine	Baker

Example: Sorting Names

List of tuples:

```
names = [
     (“Catherine”, “Baker”),
     (“Alice”, “Clark”),
     (“Bob”, “Adams”),
]
```

Catherine	Baker
Bob	Adams
Alice	Clark

```
names.sort()
```

what if we want to sort by the last name?

Alice	Clark
Bob	Adams
Catherine	Baker

Example: Sorting Names

List of tuples:

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names = [
     (“Catherine”, “Baker”),
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     (“Bob”, “Adams”),
]
```

Catherine	Baker
Bob	Adams
Alice	Clark

```
names.sort()
```

what if we want to sort by the last name?

or by the length of the name?

Alice	Clark
Bob	Adams
Catherine	Baker

Example: Sorting Names

List of tuples:

```
names = [
     (“Catherine”, “Baker”),
     (“Alice”, “Clark”),
     (“Bob”, “Adams”),
]
```

Catherine	Baker
Bob	Adams
Alice	Clark

```
def extract(name_tuple):
     return name_tuple[1]

names.sort(key=extract)
```

Example: Sorting Names

List of tuples:

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     (“Catherine”, “Baker”),
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]
```

```
def extract(name_tuple):
     return name_tuple[1]

names.sort(key=extract)
```

Catherine	Baker
Bob	Adams
Alice	Clark

Bob	Adams
Catherine	Baker
Alice	Clark

Example: Sorting Names

List of tuples:

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names = [
     (“Catherine”, “Baker”),
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     (“Bob”, “Adams”),
]
```

Catherine	Baker
Bob	Adams
Alice	Clark

```
def extract(name_tuple):
     return len(name_tuple[0])

names.sort(key=extract)
```

Example: Sorting Names

List of tuples:

```
names = [
     (“Catherine”, “Baker”),
     (“Alice”, “Clark”),
     (“Bob”, “Adams”),
]
```

```
def extract(name_tuple):
     return len(name_tuple[0])

names.sort(key=extract)
```

Catherine	Baker
Bob	Adams
Alice	Clark

Bob	Adams
Alice	Clark
Catherine	Baker

Demo: Sort by Number of Vowels

List of tuples:

```
words = [
    "Python",
    "queue",
    "Ada",
    "marshmellow",
]
```

```
def countv(word):
    ????

words.sort(key=countv)
```