Data Examples

Announcements

Lists

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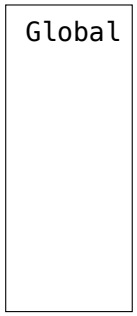

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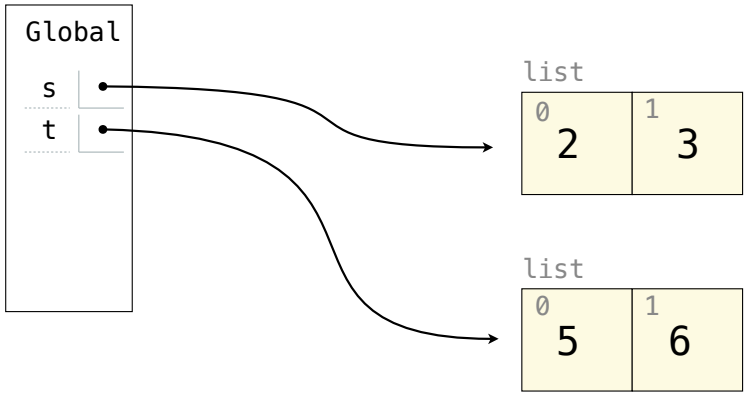

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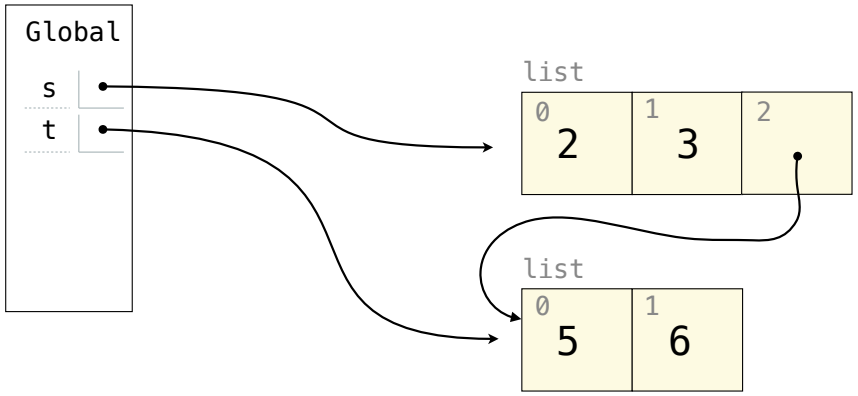

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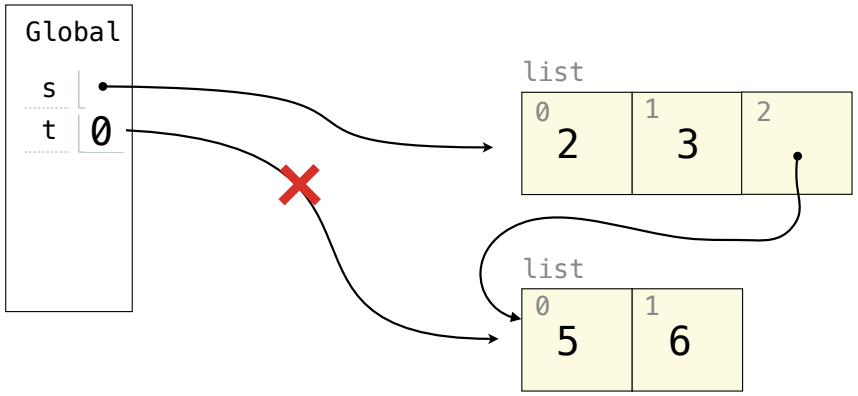

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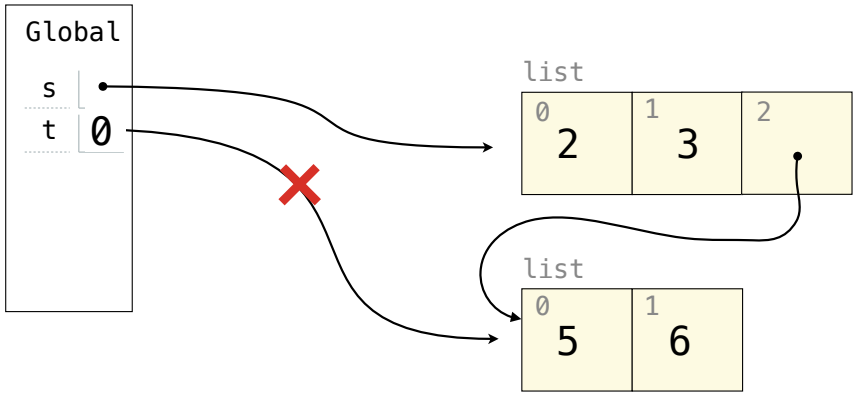

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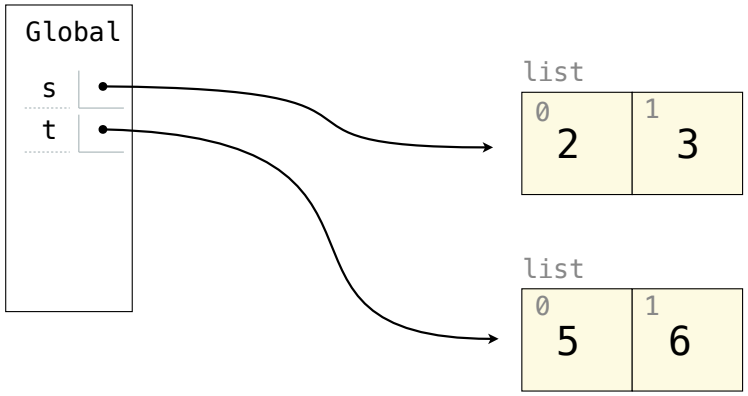

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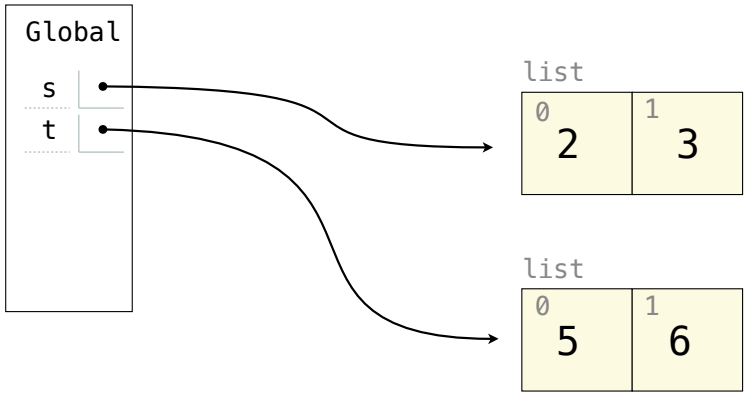

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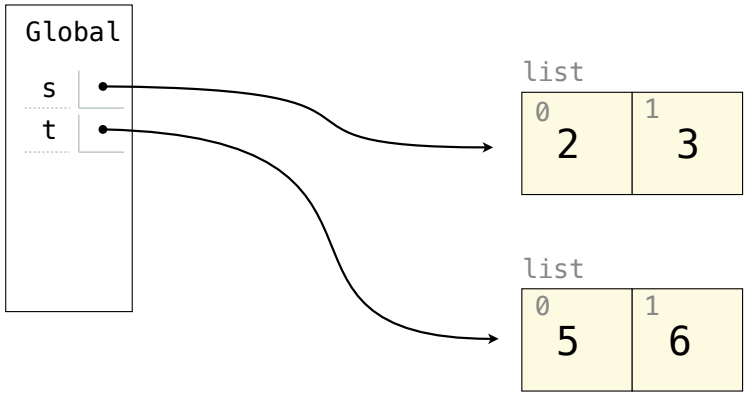

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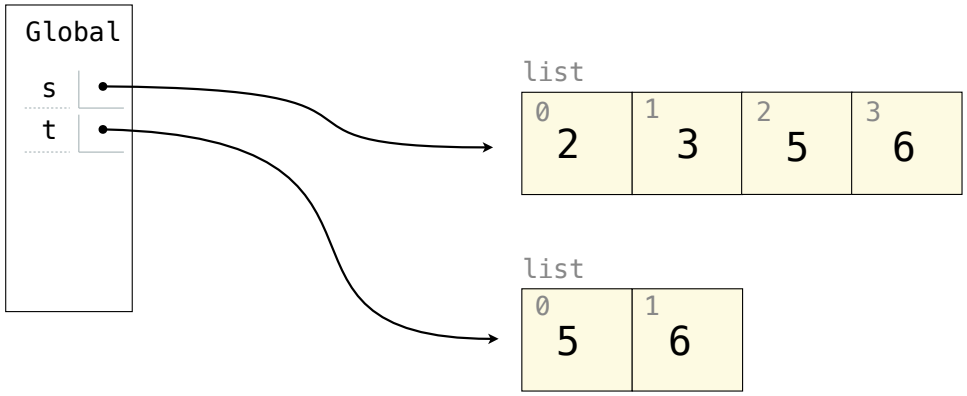

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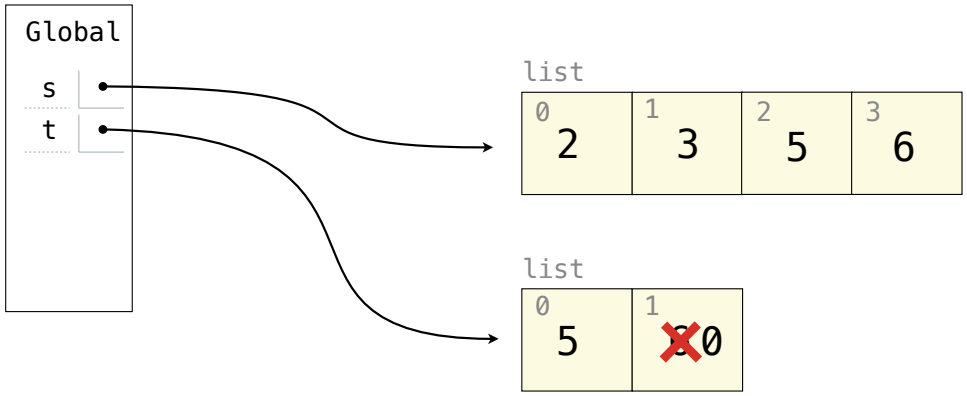

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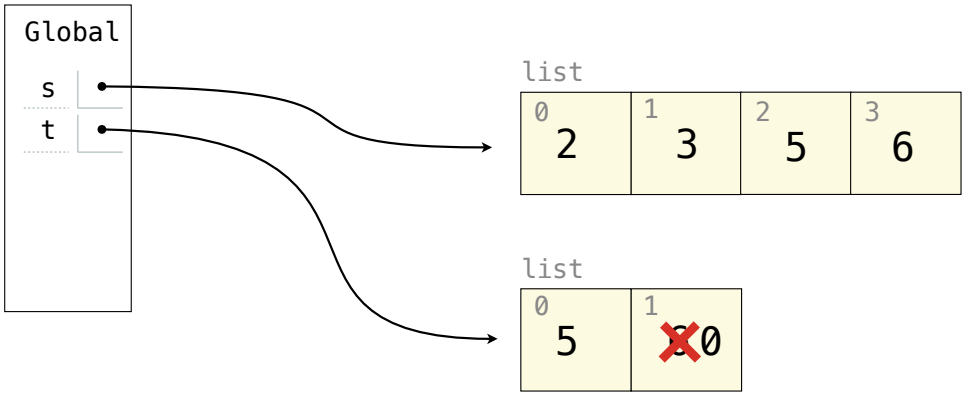

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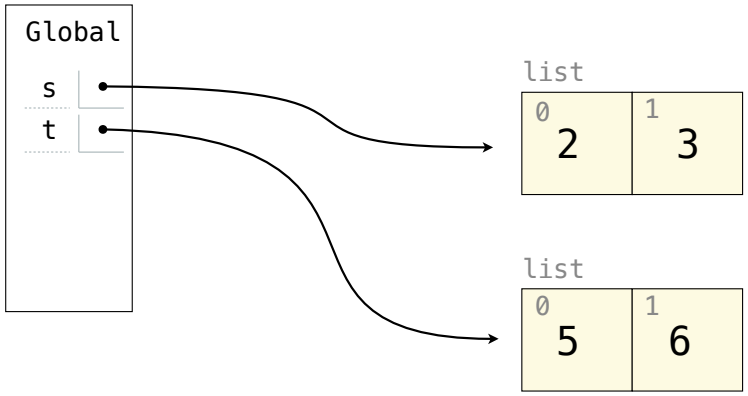

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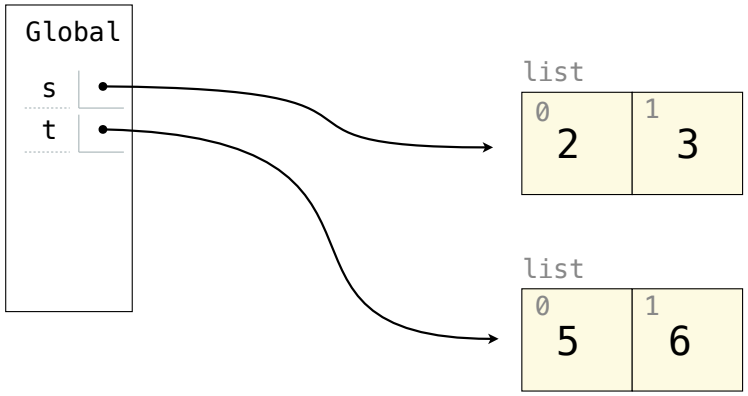

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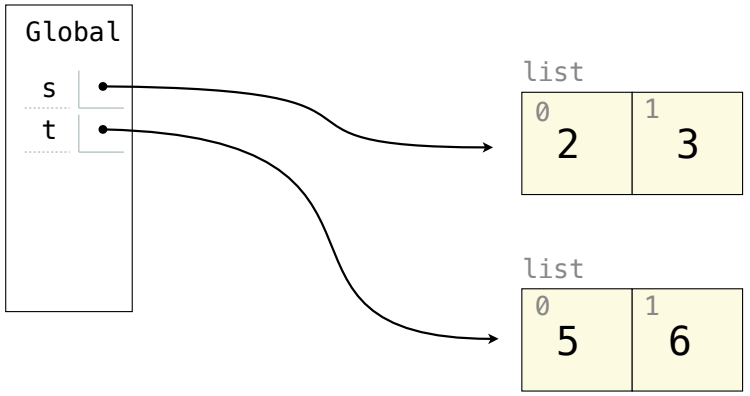

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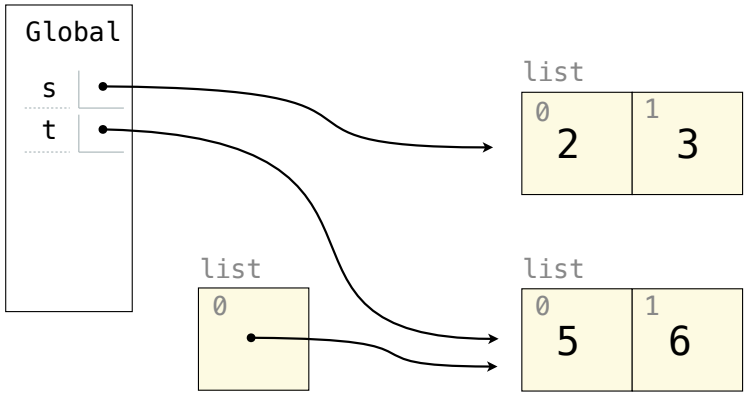

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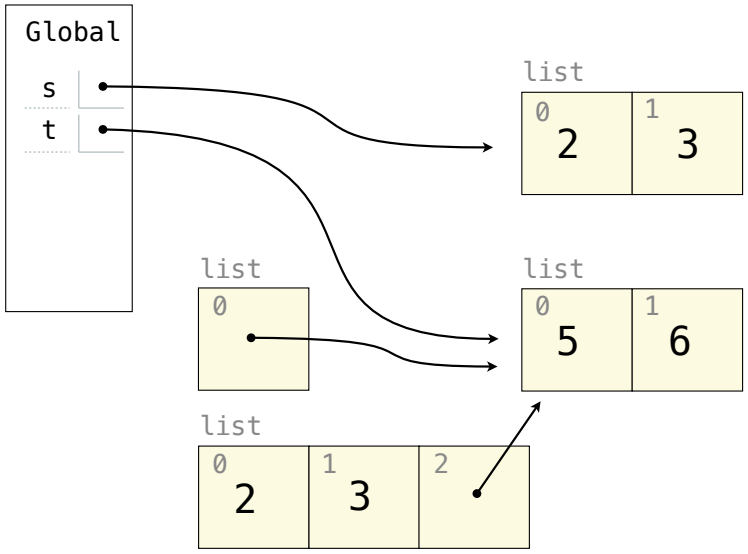

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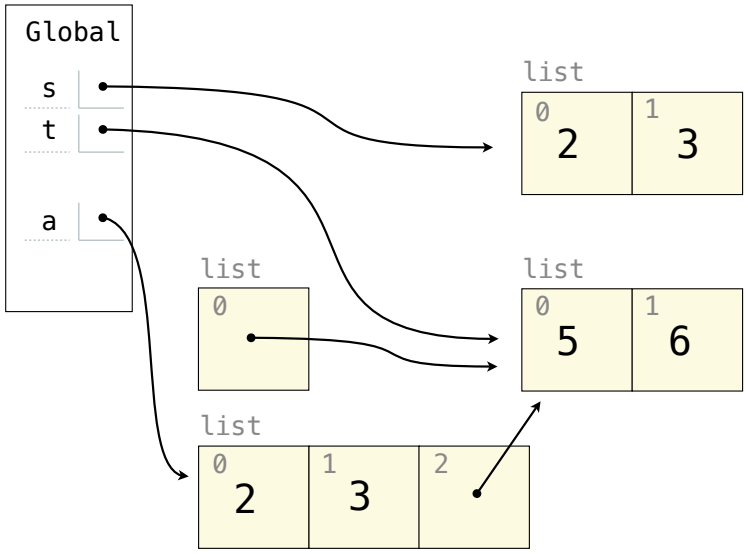

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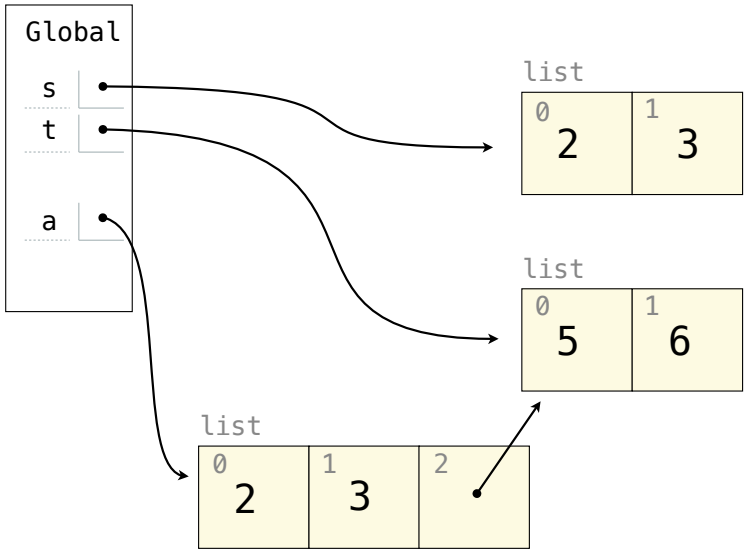

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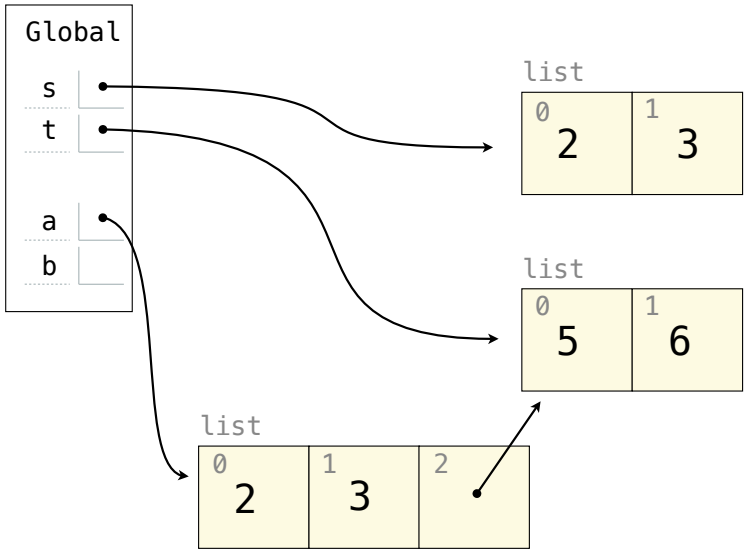

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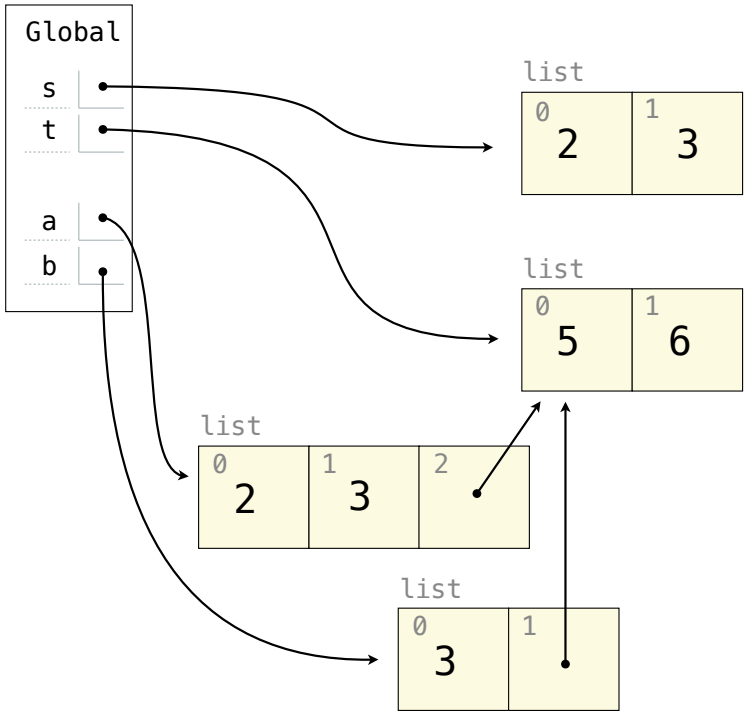

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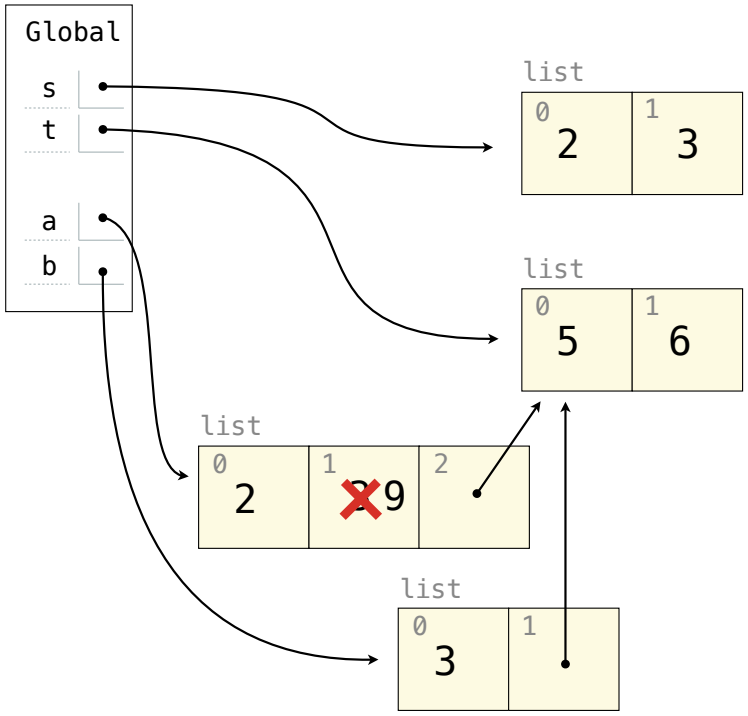

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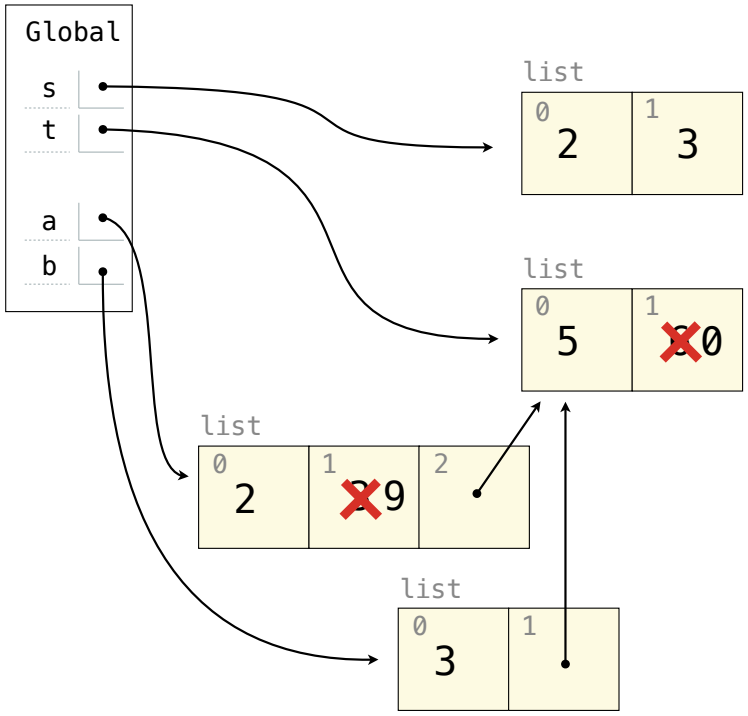

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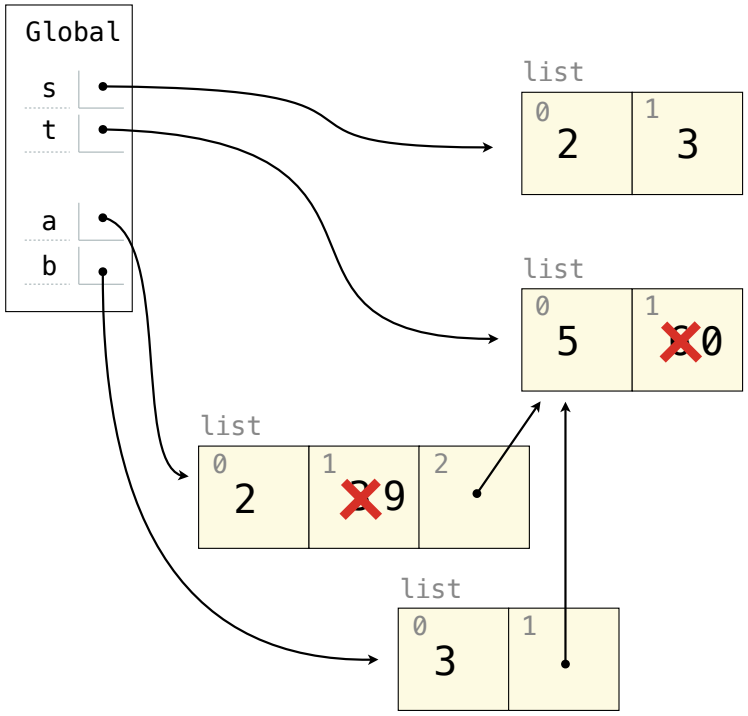

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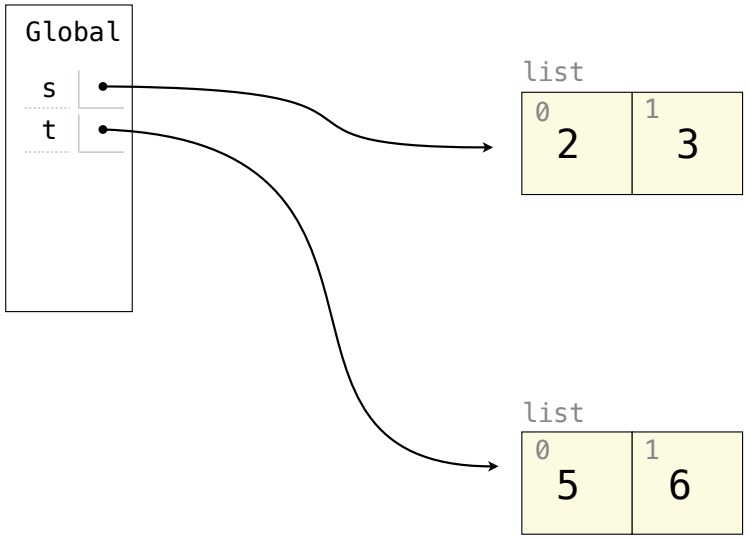

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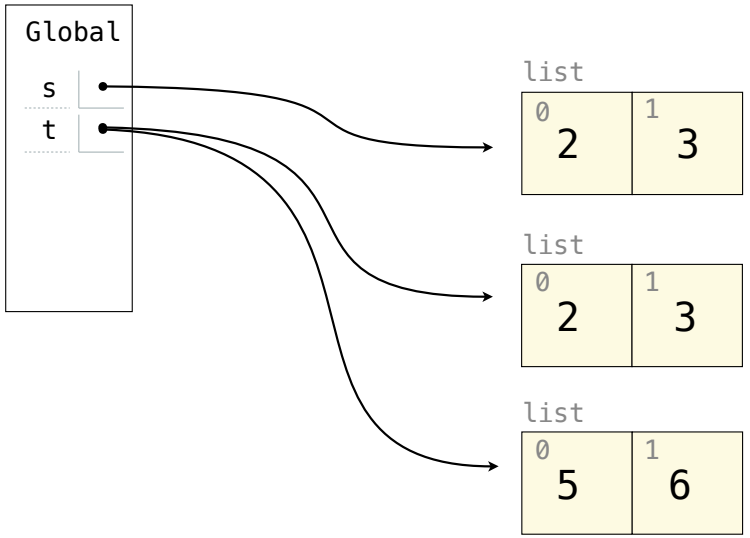

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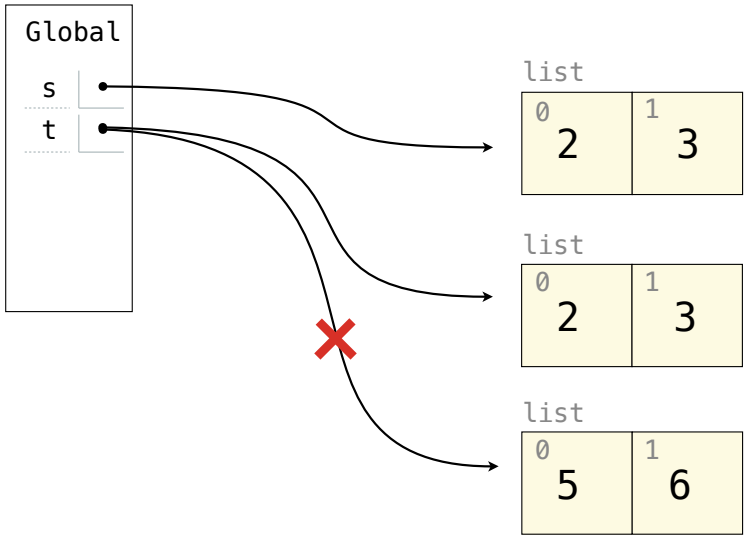

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addition & **slicing** create new lists containing existing elements	`a = s + [t]`
	`b = a[1:]`
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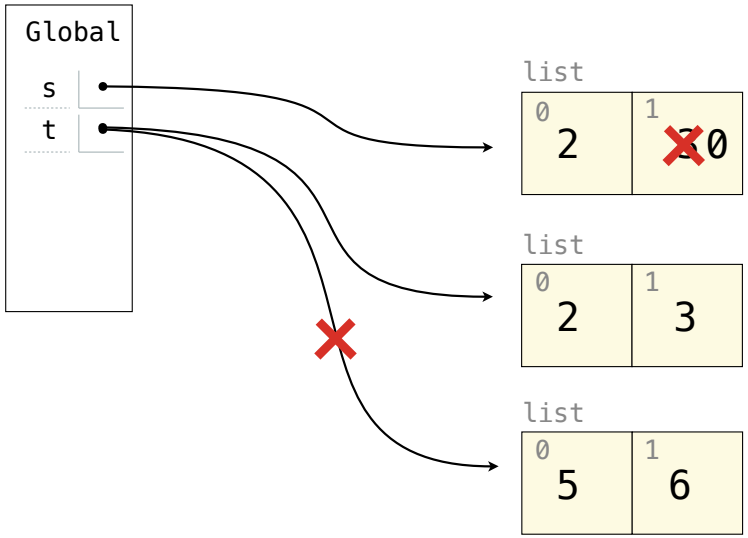
The **list** function also creates a new list containing existing elements	`t = list(s)` `s[1] = 0`	



Lists in Environment Diagrams

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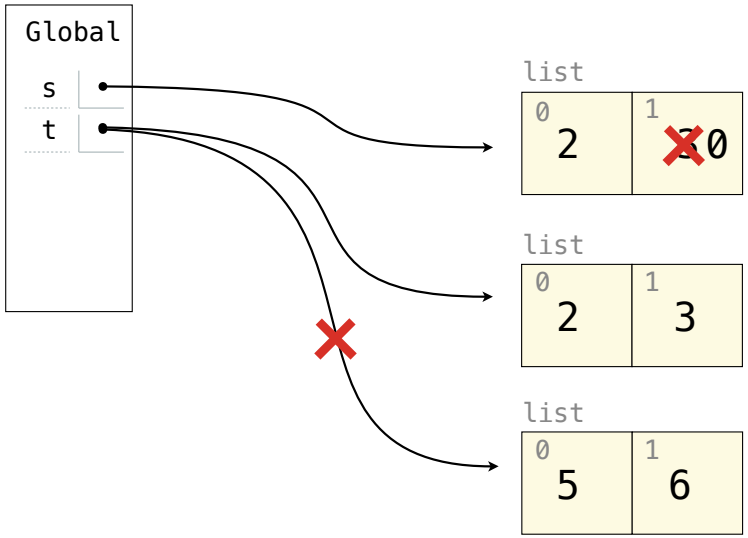

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The **list** function also creates a new list containing existing elements	`t = list(s)` `s[1] = 0`	`s → [2, 0]` `t → [2, 3]`

slice assignment replaces a slice with new values	`s[0:0] = t`
	`s[3:] = t`
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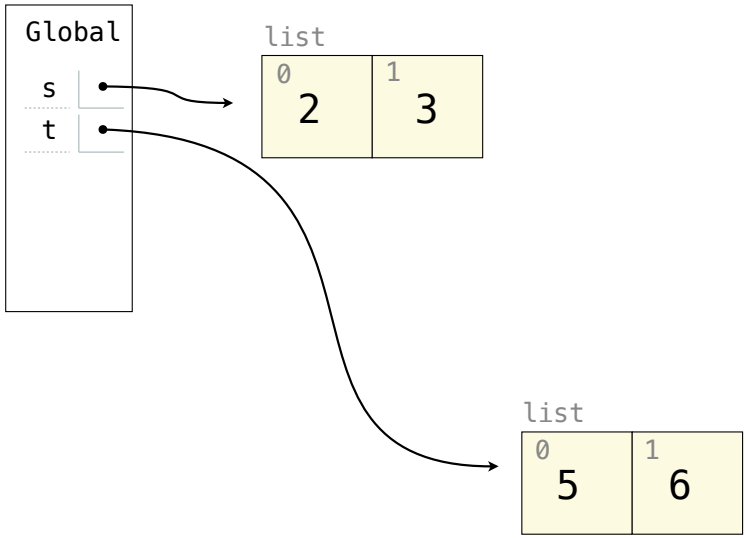

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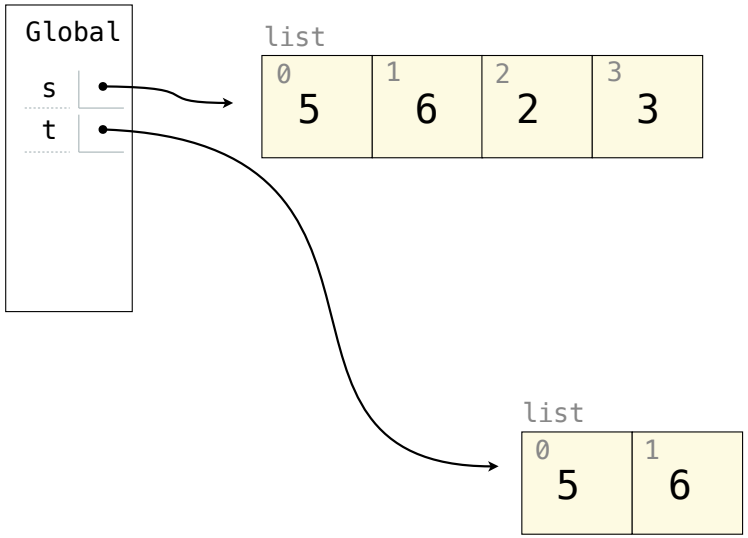

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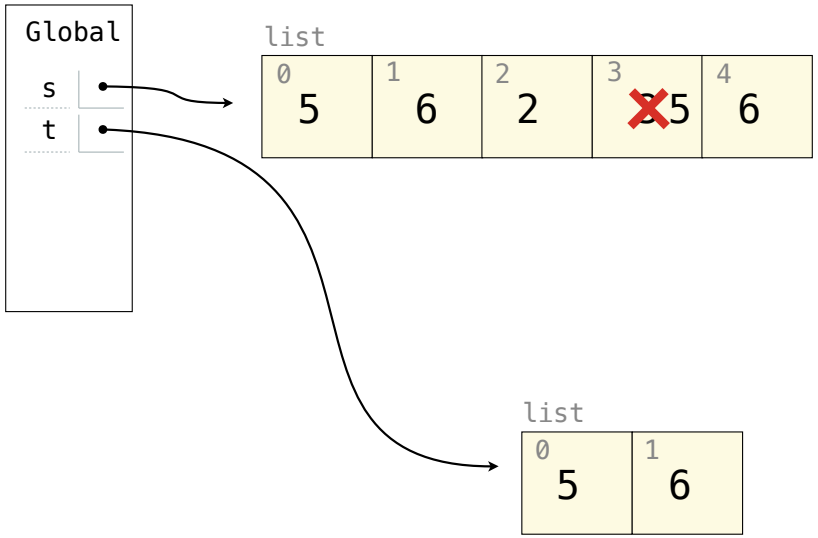

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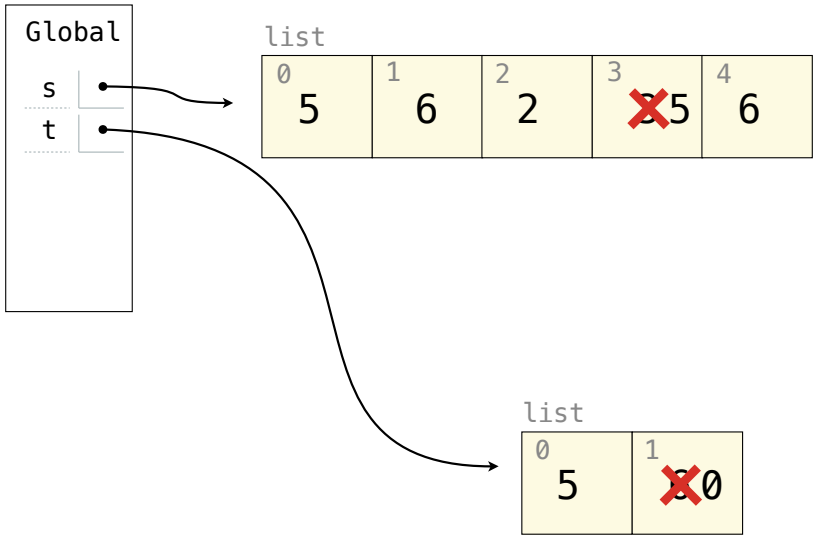

Lists in Environment Diagrams

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t = [5, 6]
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		`s → [2, 3]`
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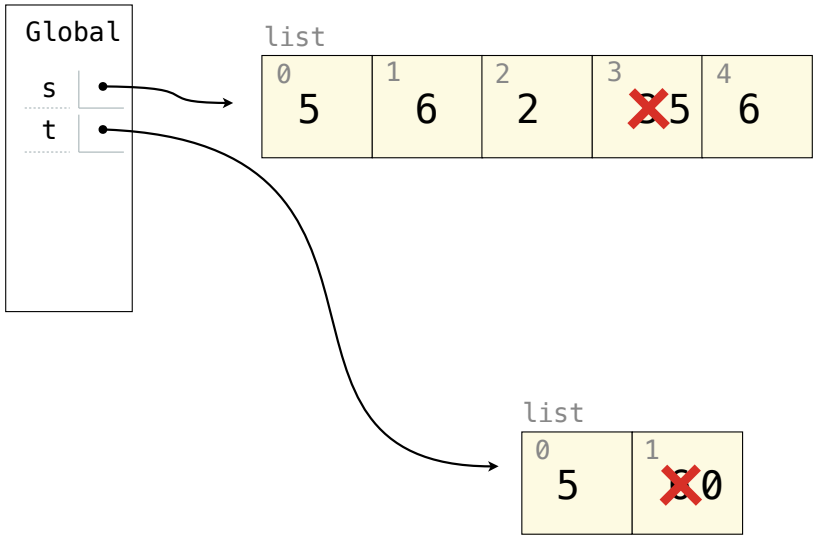
		`a → [2, 9, [5, 0]]`
		`b → [3, [5, 0]]`

The **list** function also creates a new list containing existing elements	`t = list(s)` `s[1] = 0`	`s → [2, 0]` `t → [2, 3]`

slice assignment replaces a slice with new values	`s[0:0] = t`
	`s[3:] = t`
	`t[1] = 0`
		`s → [5, 6, 2, 5, 6]`
		`t → [5, 0]`



Lists in Environment Diagrams

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t = [5, 6]
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Lists in Environment Diagrams

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Operation	Example	Result

Lists in Environment Diagrams

Assume that before each example below we execute:

```
s = [2, 3]
t = [5, 6]
```

Operation	Example	Result
pop removes & returns the last element		

Lists in Environment Diagrams

Assume that before each example below we execute:

```
s = [2, 3]
t = [5, 6]
```

Operation	Example	Result
pop removes & returns the last element	t = s.pop()	

Lists in Environment Diagrams

Assume that before each example below we execute:

```
s = [2, 3]
t = [5, 6]
```

Operation	Example	Result
pop removes & returns the last element	t = s.pop()	s → [2] t → 3

Lists in Environment Diagrams

Assume that before each example below we execute:

```
s = [2, 3]
t = [5, 6]
```

Operation	Example	Result
pop removes & returns the last element	`t = s.pop()`	`s → [2]` `t → 3`
remove removes the first element equal to the argument		

Lists in Environment Diagrams

Assume that before each example below we execute:

```
s = [2, 3]
t = [5, 6]
```

Operation	Example	Result
pop removes & returns the last element	`t = s.pop()`	`s → [2]` `t → 3`
remove removes the first element equal to the argument	`t.extend(t)` `t.remove(5)`	

Lists in Environment Diagrams

Assume that before each example below we execute:

```
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```

Operation	Example	Result
pop removes & returns the last element	`t = s.pop()`	`s → [2]` `t → 3`
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Lists in Environment Diagrams

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slice assignment can remove elements from a list by assigning [] to a slice.	`s[:1] = []` `t[0:2] = []`	`s → [3]` `t → []`

Lists in Lists in Lists in Environment Diagrams

```
t = [1, 2, 3]
t[1:3] = [t]
t.extend(t)
```

```
t = [[1, 2], [3, 4]]
t[0].append(t[1:2])
```

Lists in Lists in Lists in Environment Diagrams

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t = [1, 2, 3]
t[1:3] = [t]
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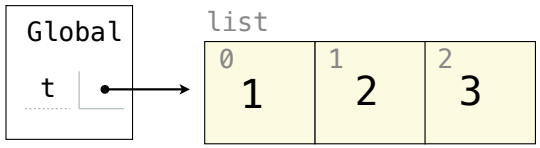

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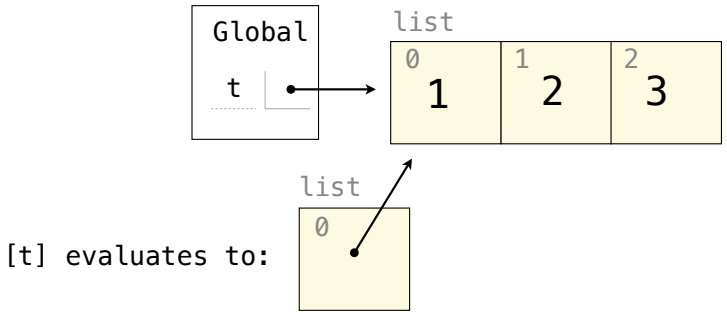

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Lists in Lists in Lists in Environment Diagrams

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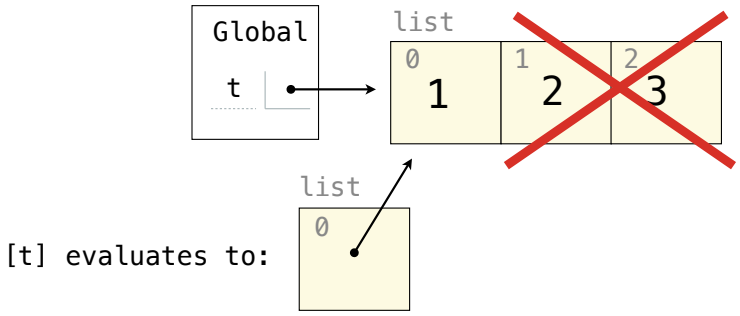

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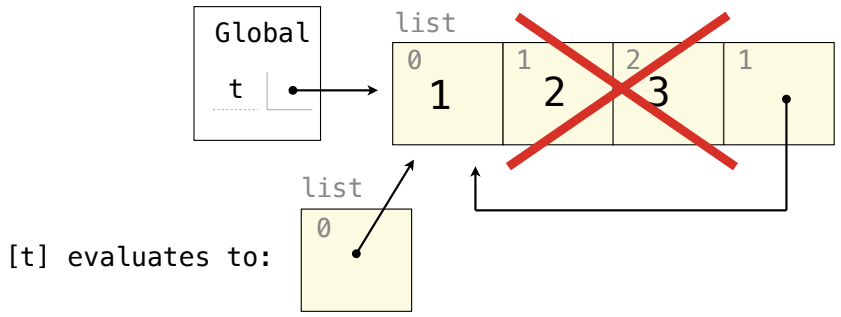

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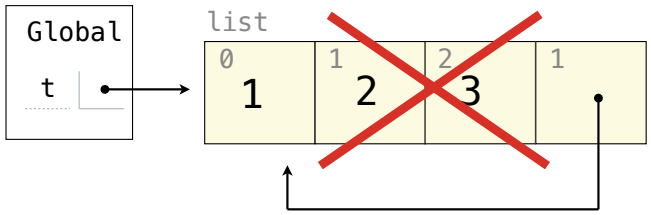

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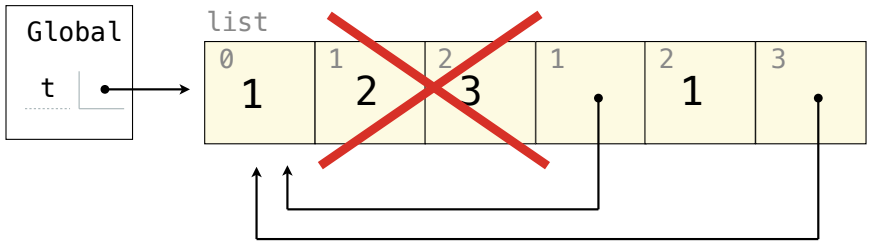

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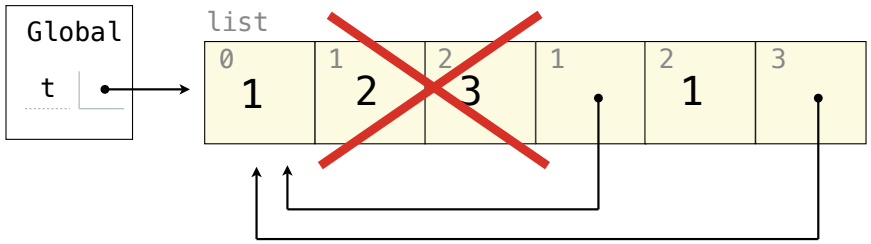


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Lists in Lists in Lists in Environment Diagrams

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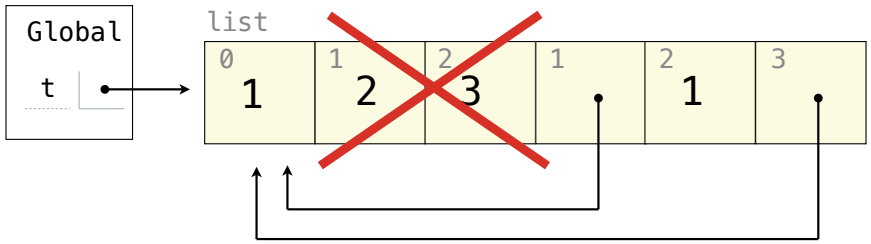


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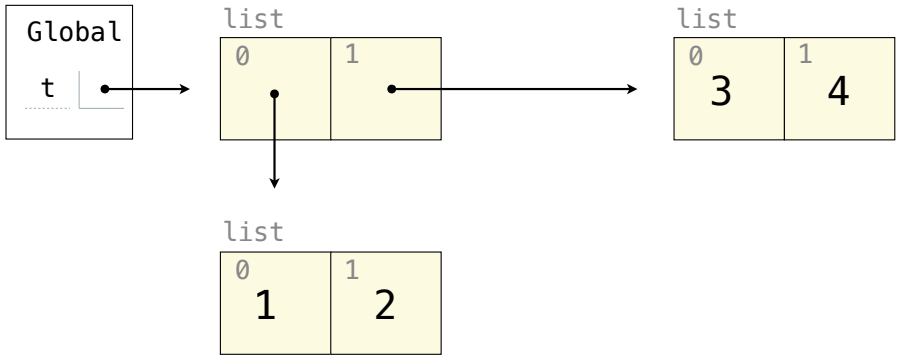

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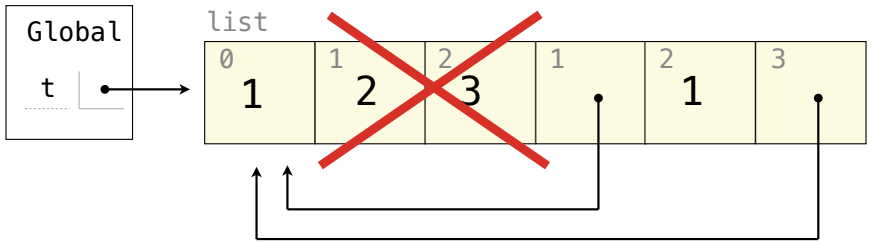


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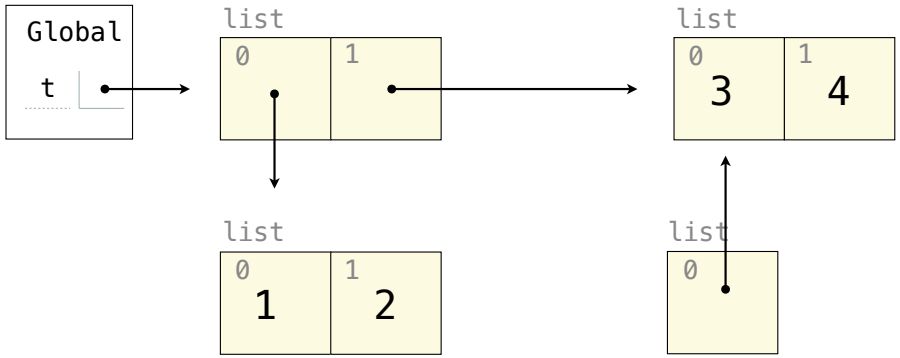

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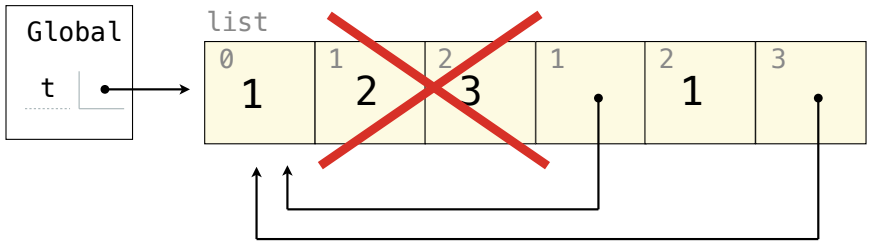


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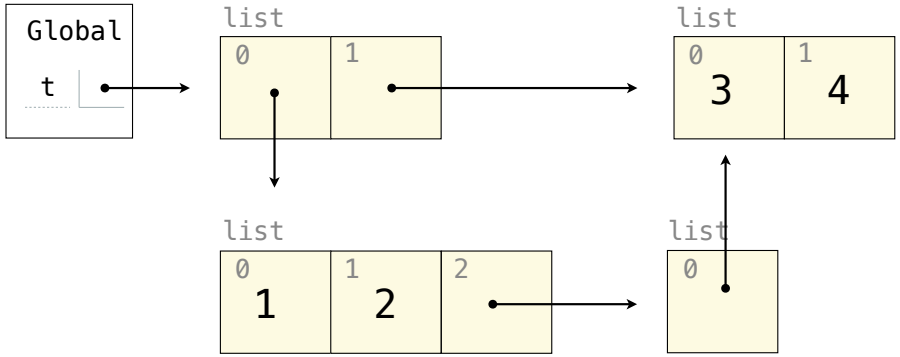

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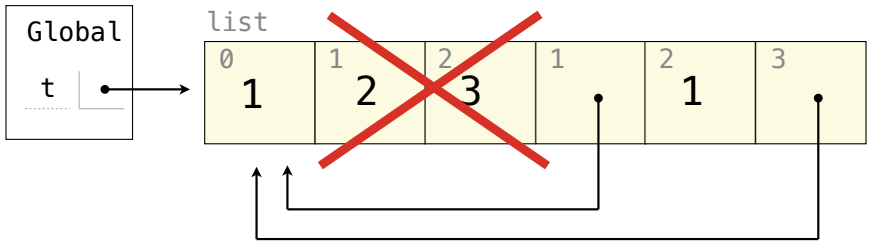


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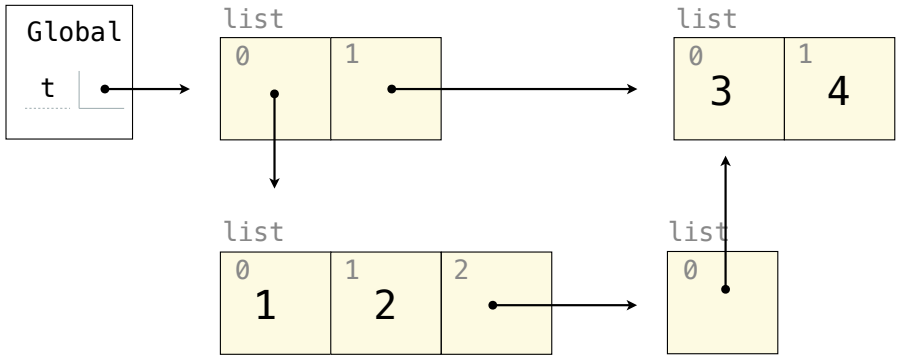


```
[[1, 2, [[3, 4]]], [3, 4]]
```

Objects

Land Owners

Instance attributes are found before class attributes; class attributes are inherited

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Instance attributes are found before class attributes; class attributes are inherited

```
class Worker:
```

Land Owners

Instance attributes are found before class attributes; class attributes are inherited

```
class Worker:
    greeting = 'Sir'
```

Land Owners

Instance attributes are found before class attributes; class attributes are inherited

```
class Worker:
    greeting = 'Sir'
    def __init__(self):
        self.elf = Worker
```

Land Owners

Instance attributes are found before class attributes; class attributes are inherited

```
class Worker:
    greeting = 'Sir'
    def __init__(self):
        self.elf = Worker
    def work(self):
        return self.greeting + ', I work'
```

Land Owners

Instance attributes are found before class attributes; class attributes are inherited

```
class Worker:
    greeting = 'Sir'
    def __init__(self):
        self.elf = Worker
    def work(self):
        return self.greeting + ', I work'
    def __repr__(self):
        return Bourgeoisie.greeting
```

Land Owners

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class Worker:
    greeting = 'Sir'
    def __init__(self):
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class Bourgeoisie(Worker):
```

Land Owners

Instance attributes are found before class attributes; class attributes are inherited

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class Worker:
    greeting = 'Sir'
    def __init__(self):
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    def work(self):
        return self.greeting + ', I work'
    def __repr__(self):
        return Bourgeoisie.greeting

class Bourgeoisie(Worker):
    greeting = 'Peon'
```

Land Owners

Instance attributes are found before class attributes; class attributes are inherited

```
class Worker:
    greeting = 'Sir'
    def __init__(self):
        self.elf = Worker
    def work(self):
        return self.greeting + ', I work'
    def __repr__(self):
        return Bourgeoisie.greeting

class Bourgeoisie(Worker):
    greeting = 'Peon'
    def work(self):
        print(Worker.work(self))
        return 'I gather wealth'
```

Land Owners

Instance attributes are found before class attributes; class attributes are inherited

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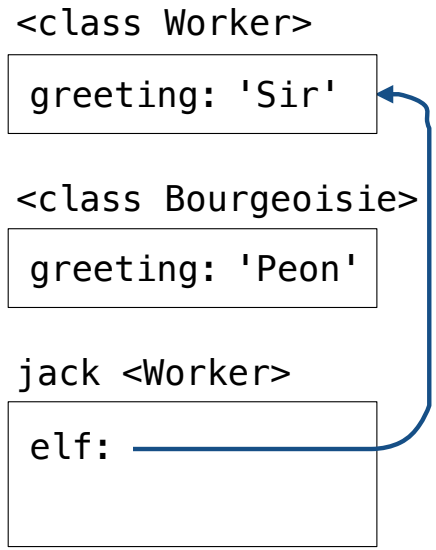

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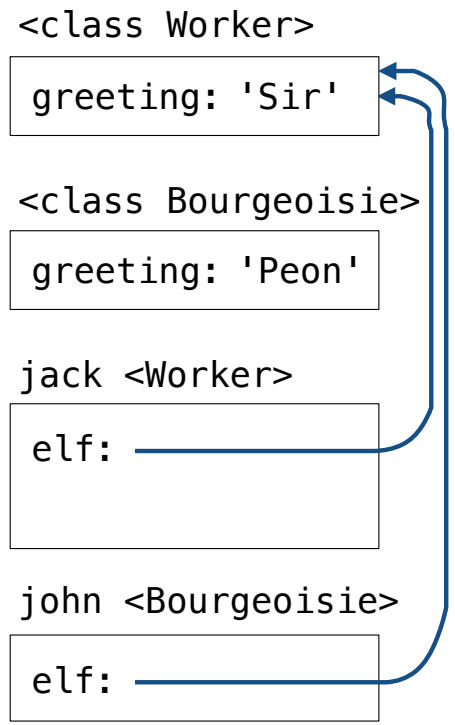

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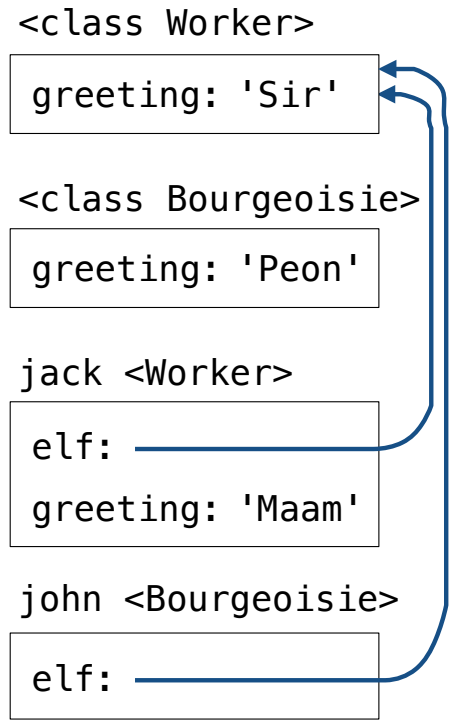

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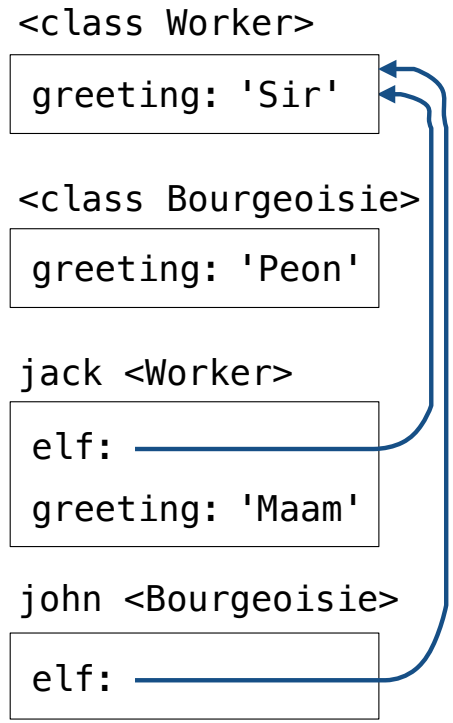

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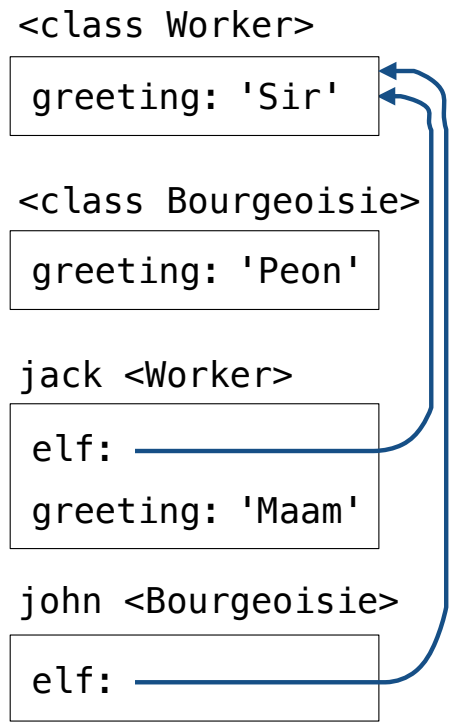

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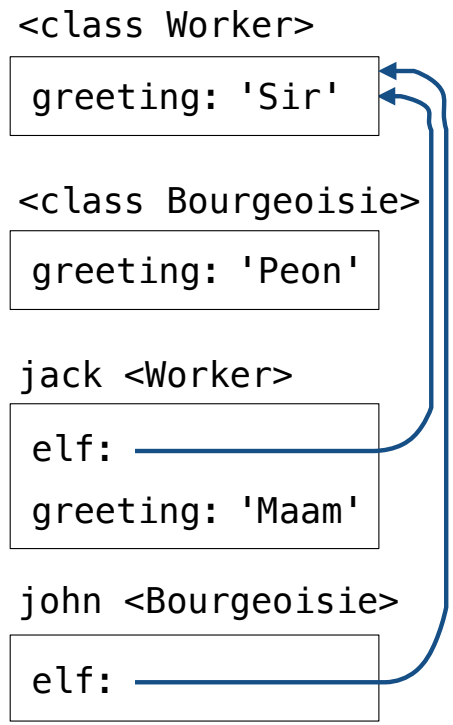

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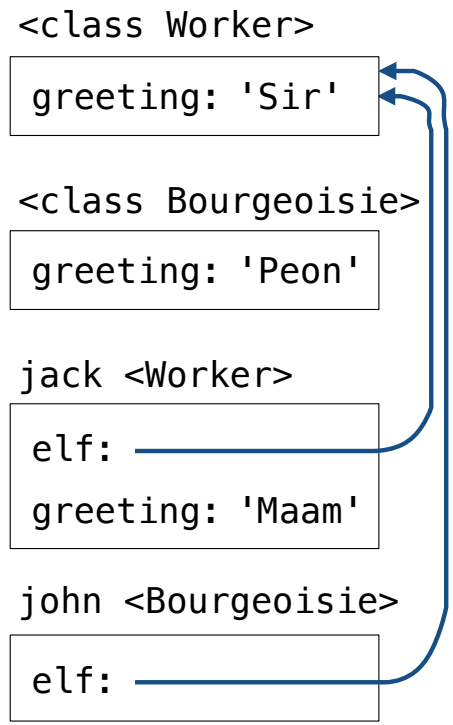

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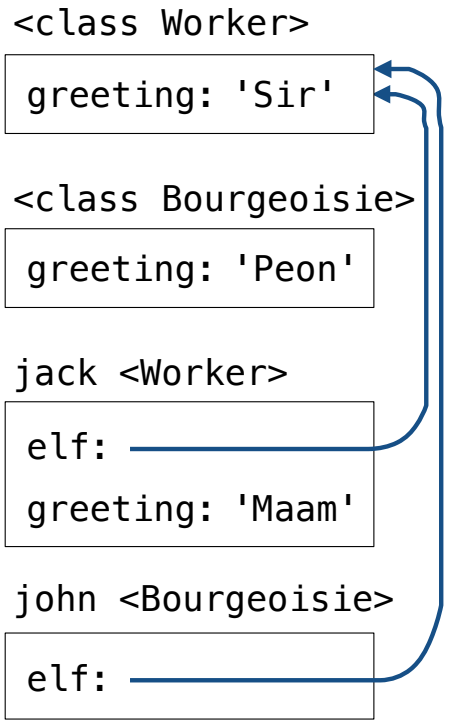

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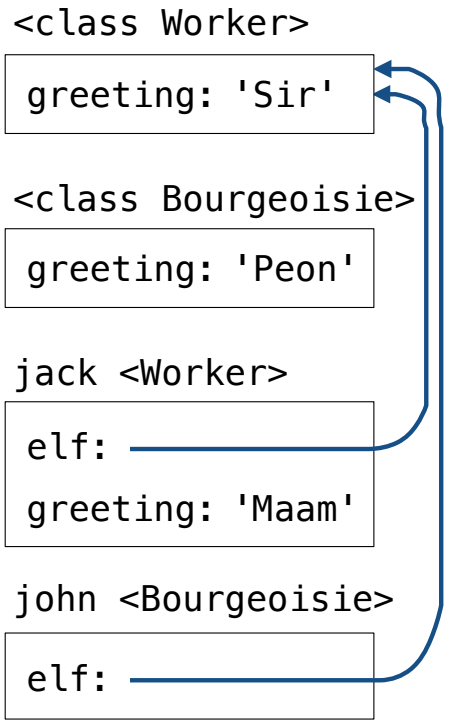

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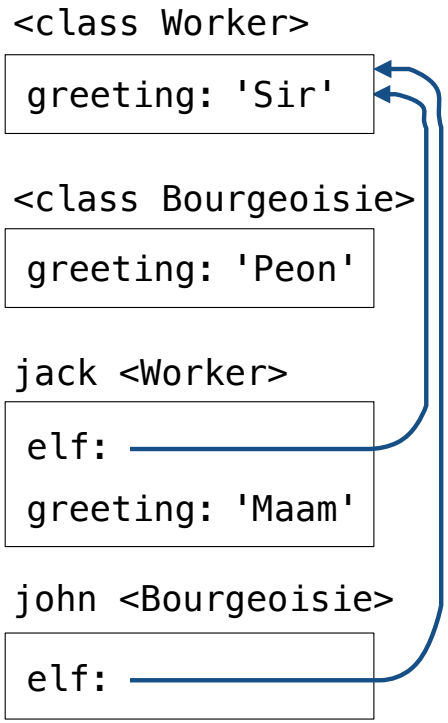

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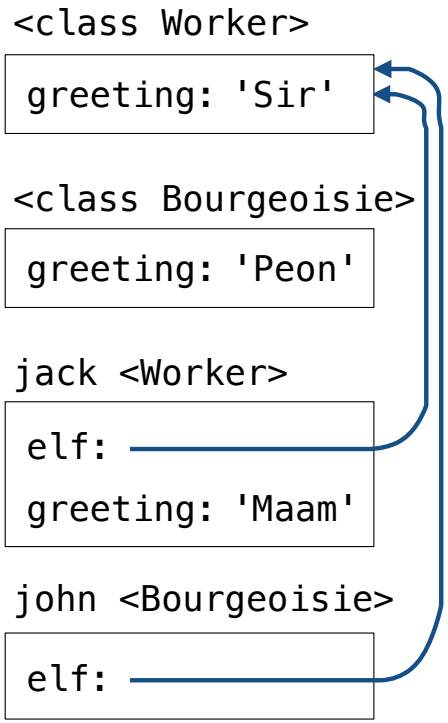

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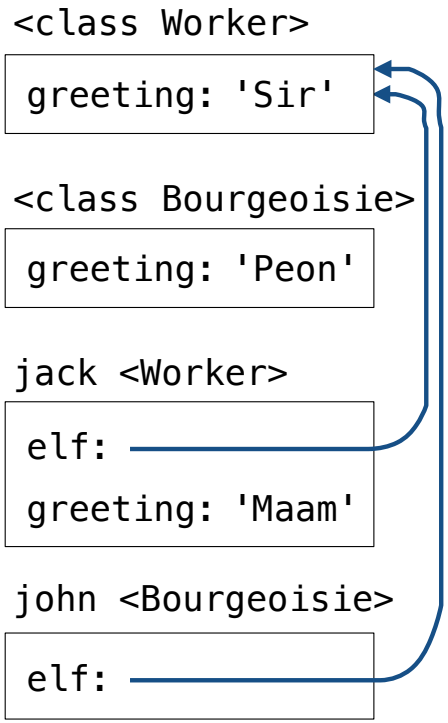

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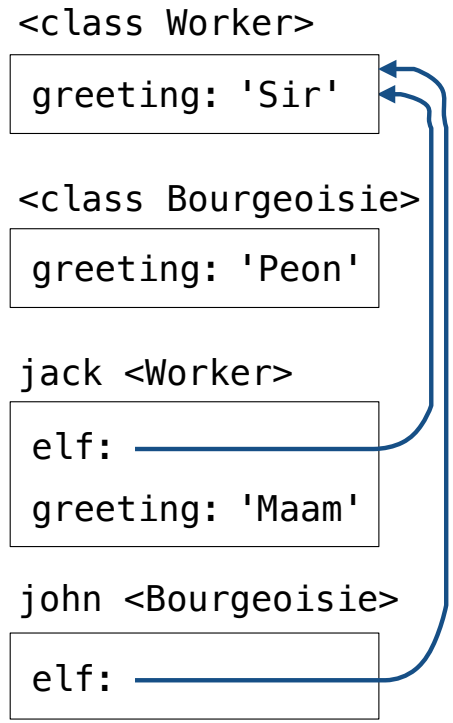

Mutable Linked Lists

Recursive Lists Can Change

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Attribute assignment statements can change first and rest attributes of a Link
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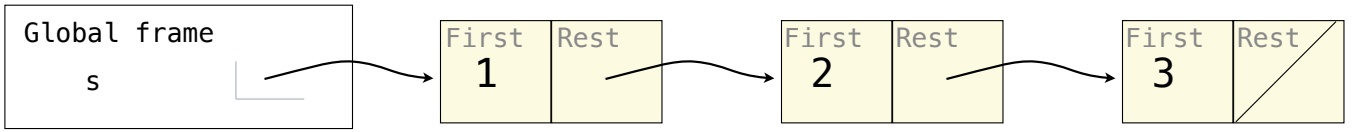

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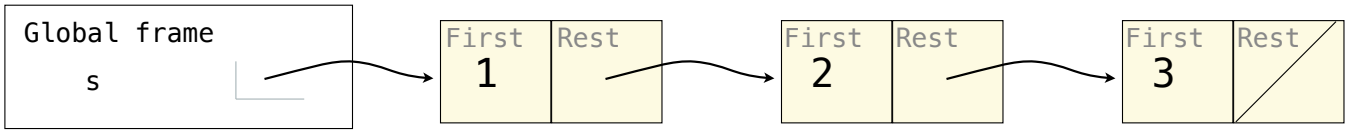

Note: The actual environment diagram is much more complicated.

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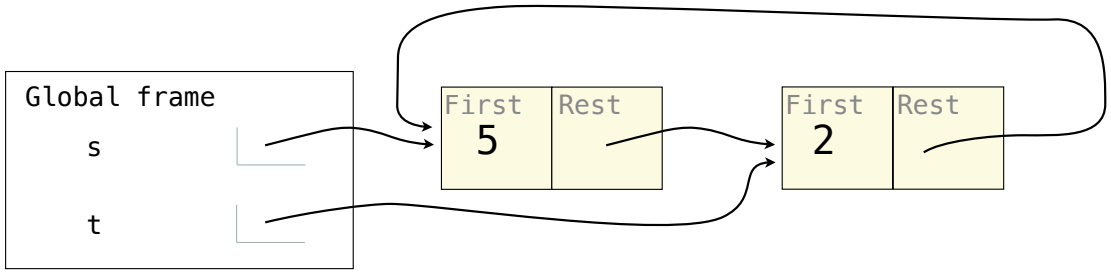

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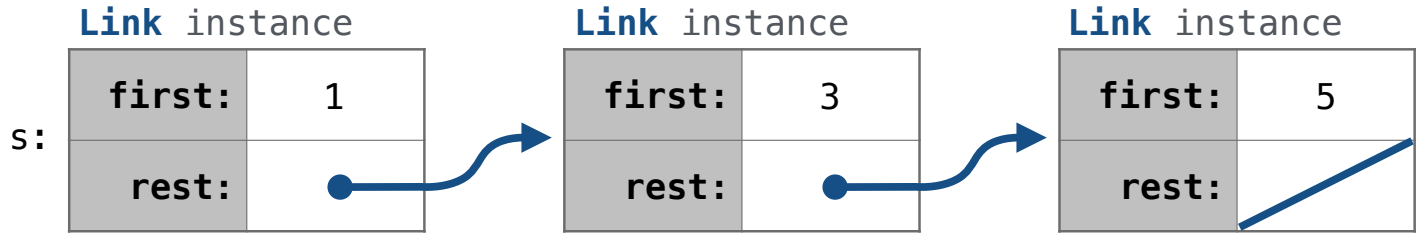
Linked List Mutation Example

Adding to an Ordered List



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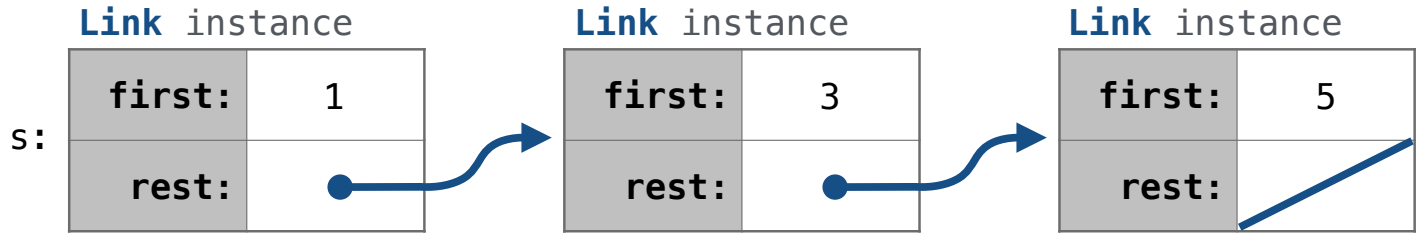


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    """Add v to an ordered list s with no repeats, returning modified s."""
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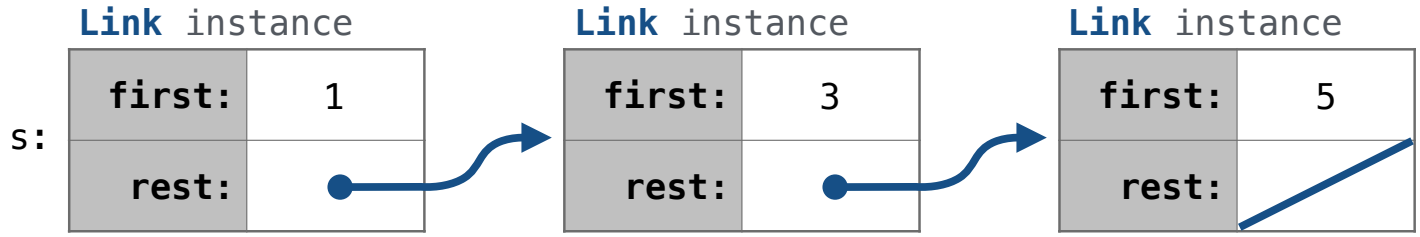


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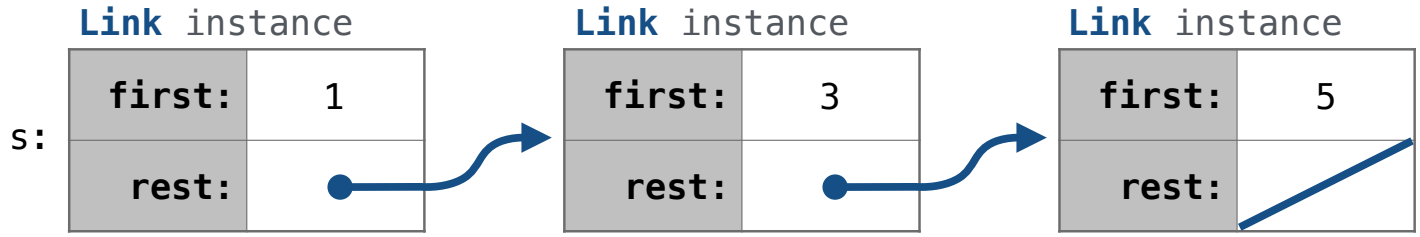


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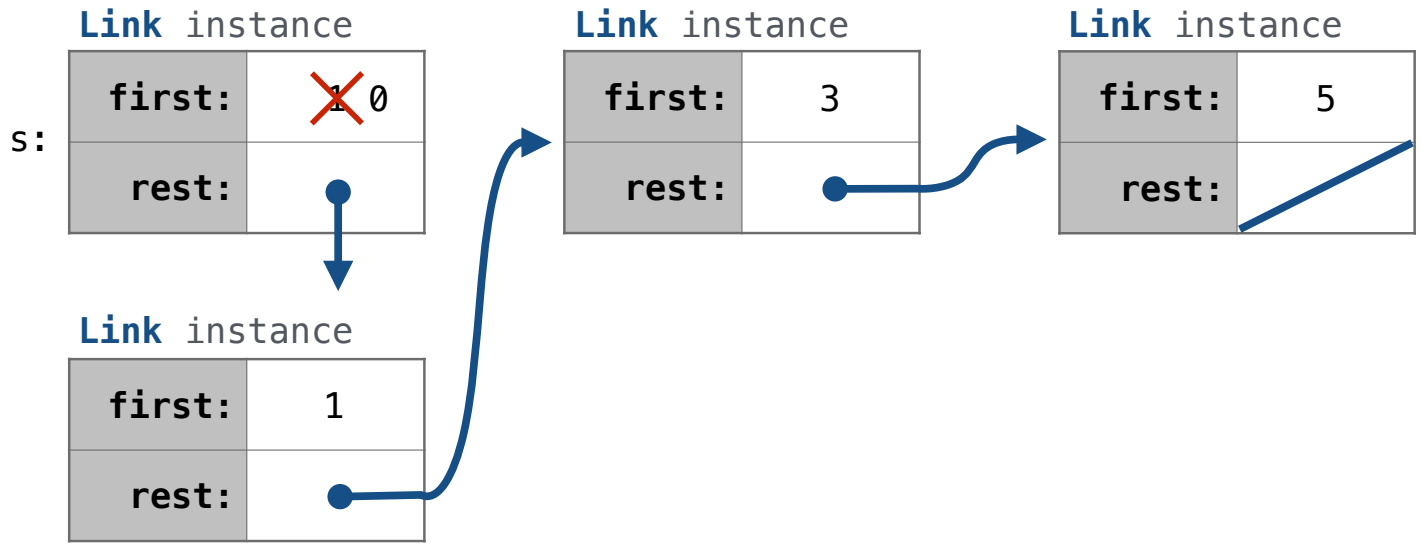


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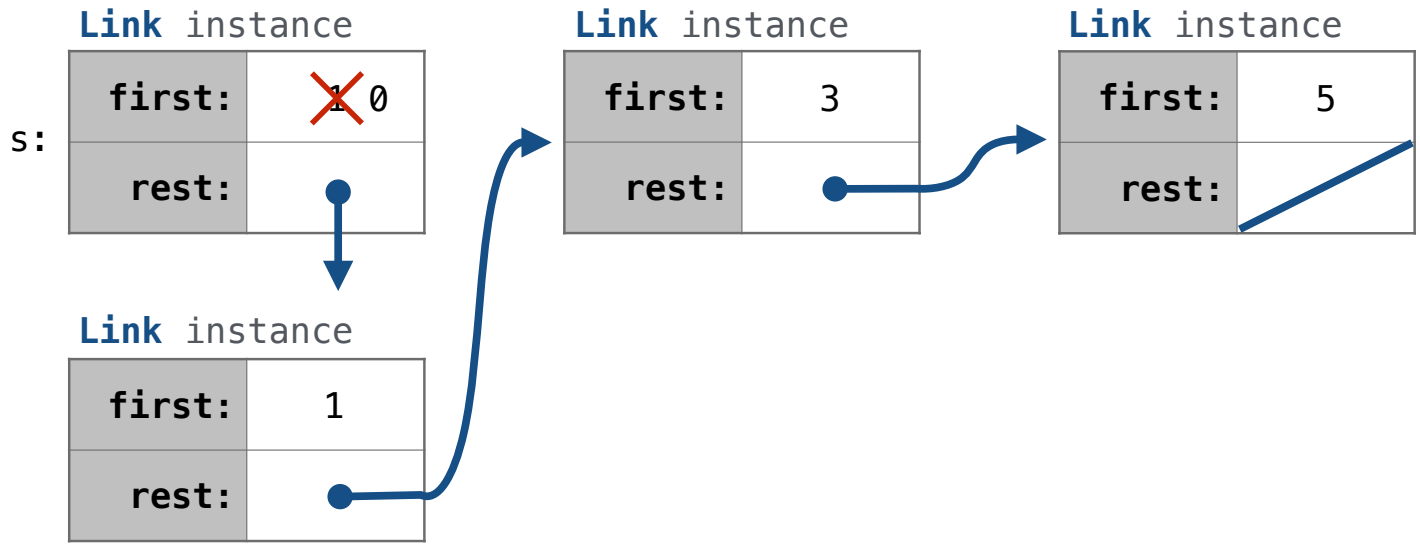


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def add(s, v):
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        add(s, 0)      add(s, 3)
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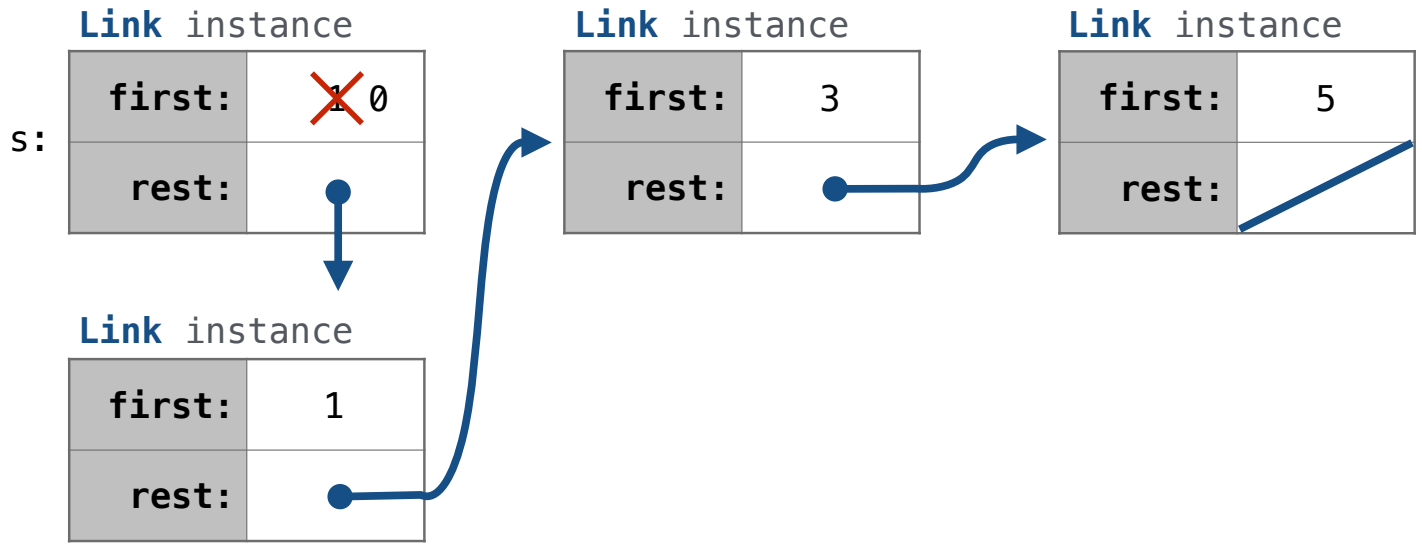


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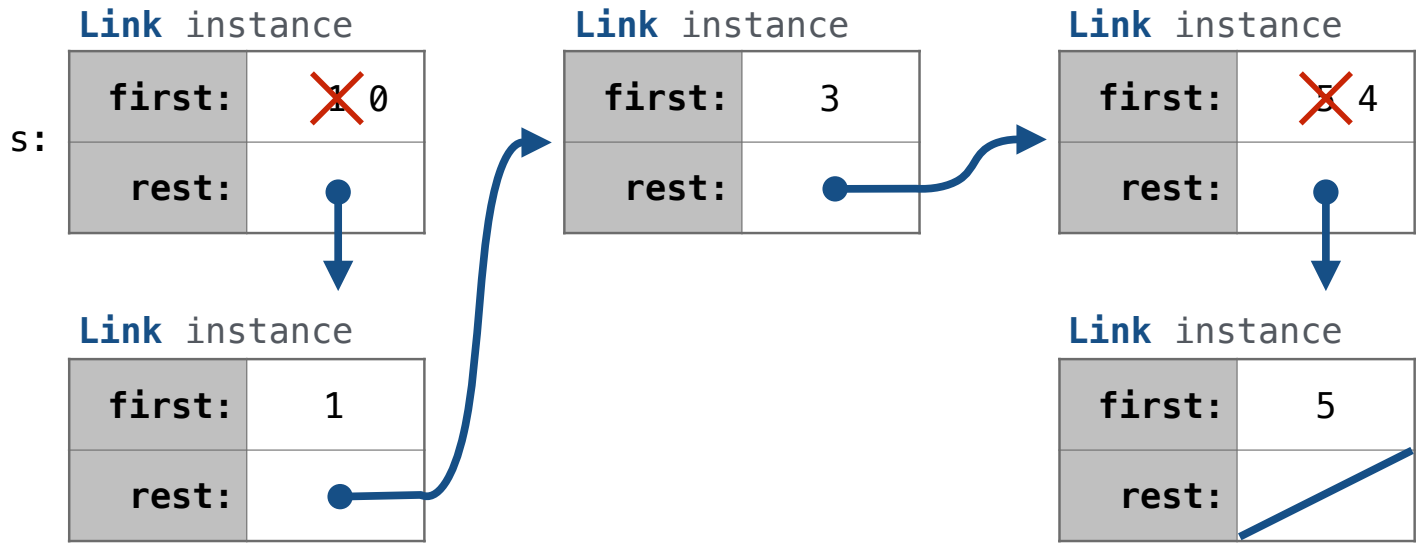
Adding to an Ordered List

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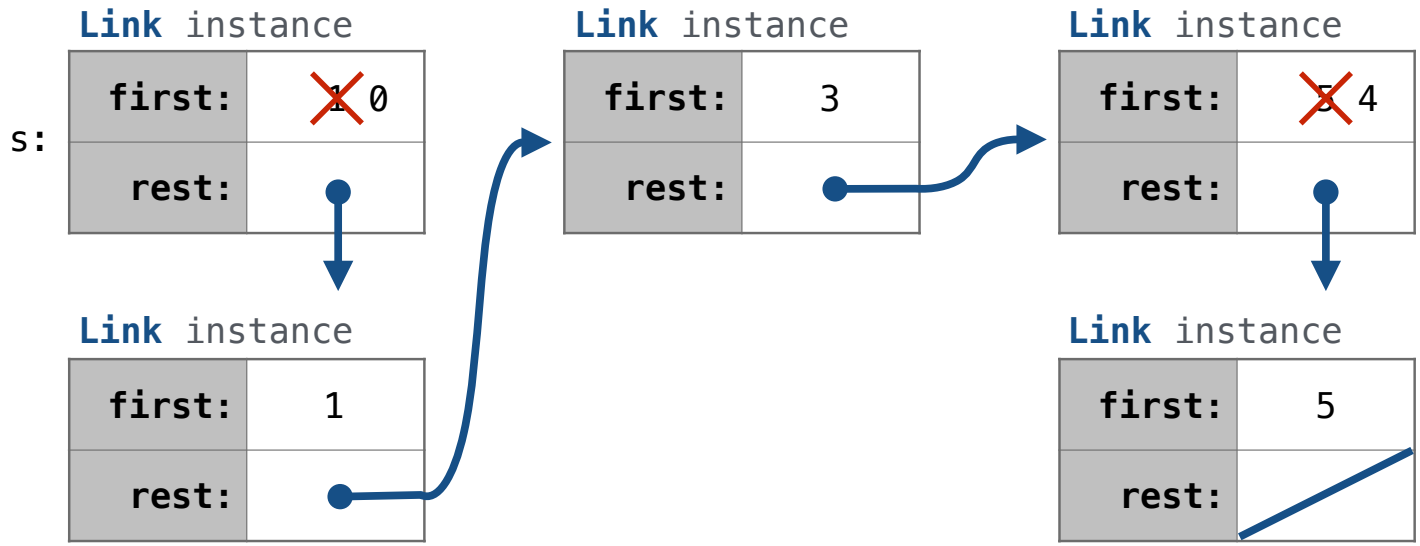
Adding to an Ordered List

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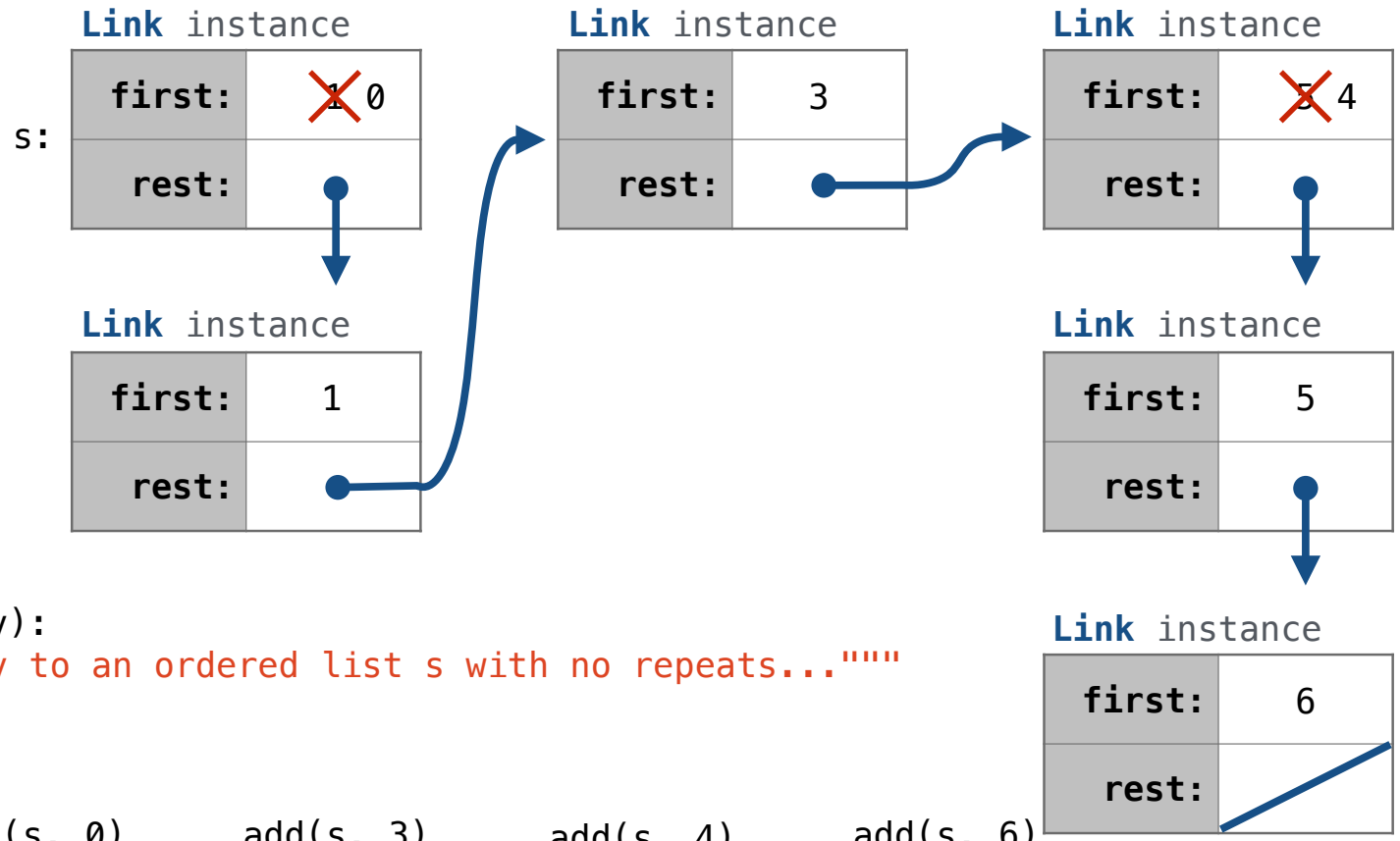
add(s, 0) add(s, 3) add(s, 4) add(s, 6)

Adding to an Ordered List

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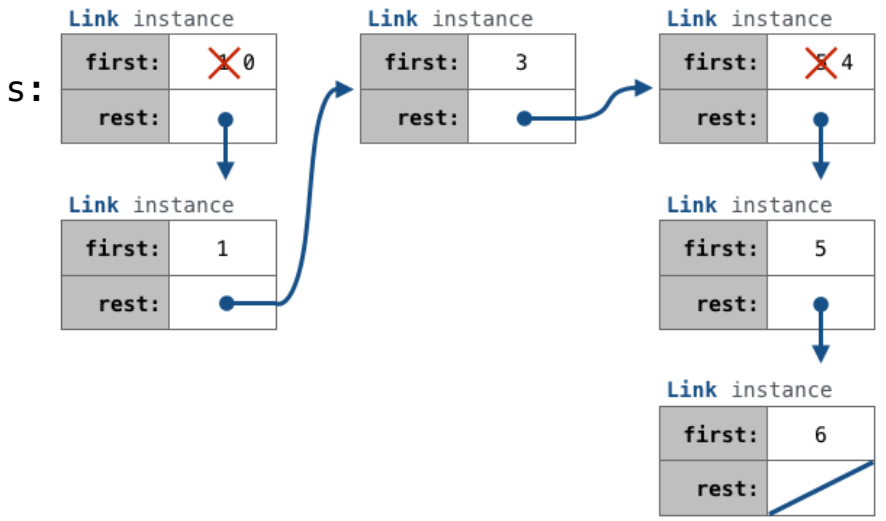
Adding to a Set Represented as an Ordered List



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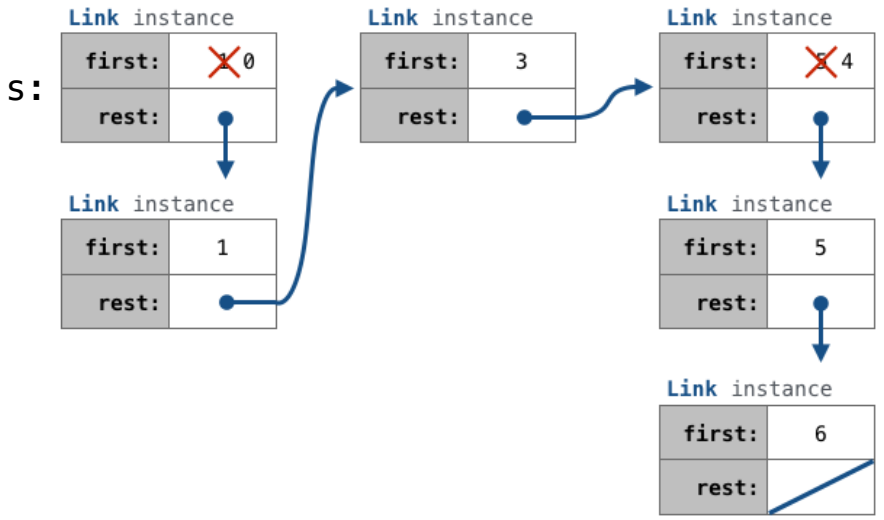
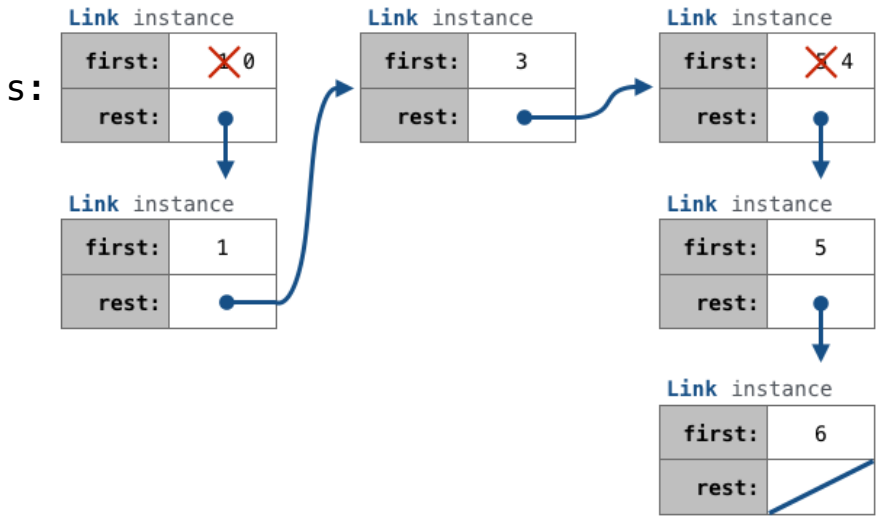


Adding to a Set Represented as an Ordered List

```
def add(s, v):
    """Add v to s, returning modified s."""
```



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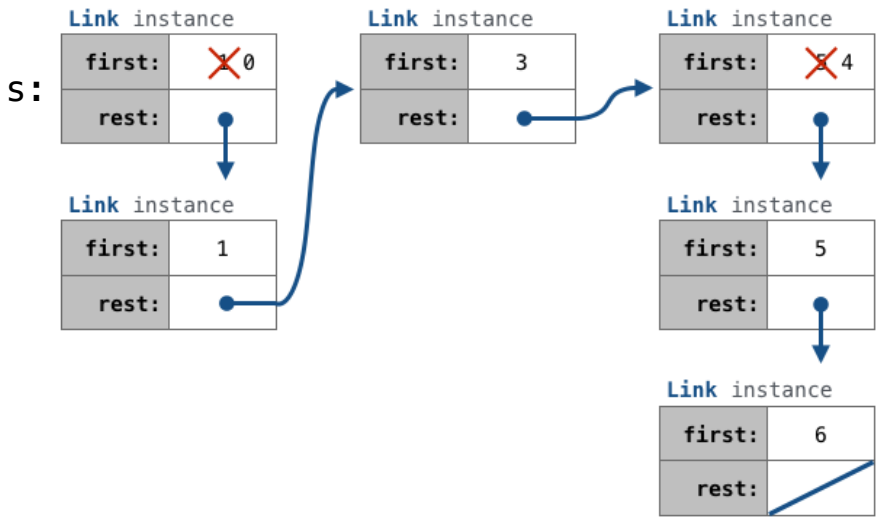
    >>> s = Link(1, Link(3, Link(5)))
```



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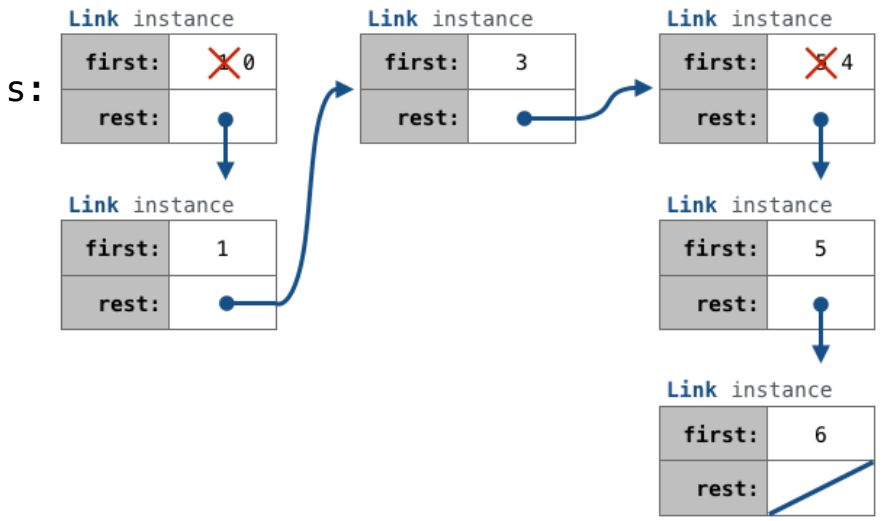

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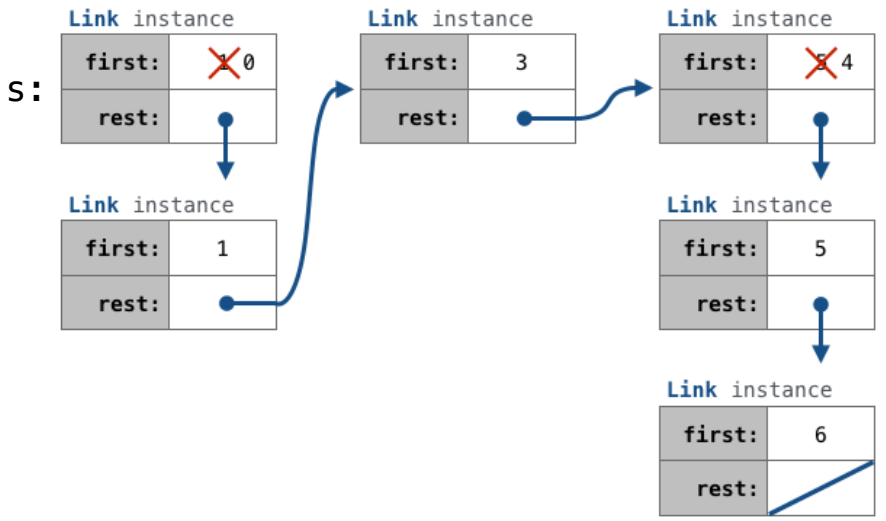

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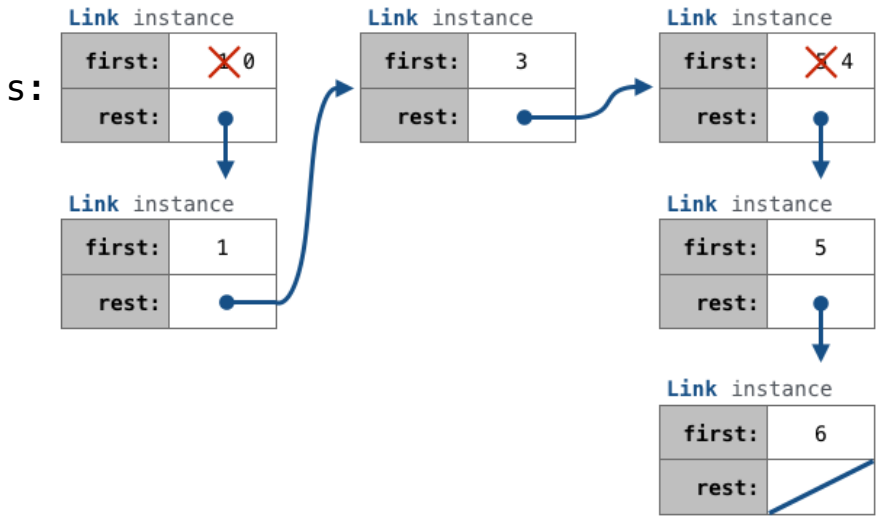

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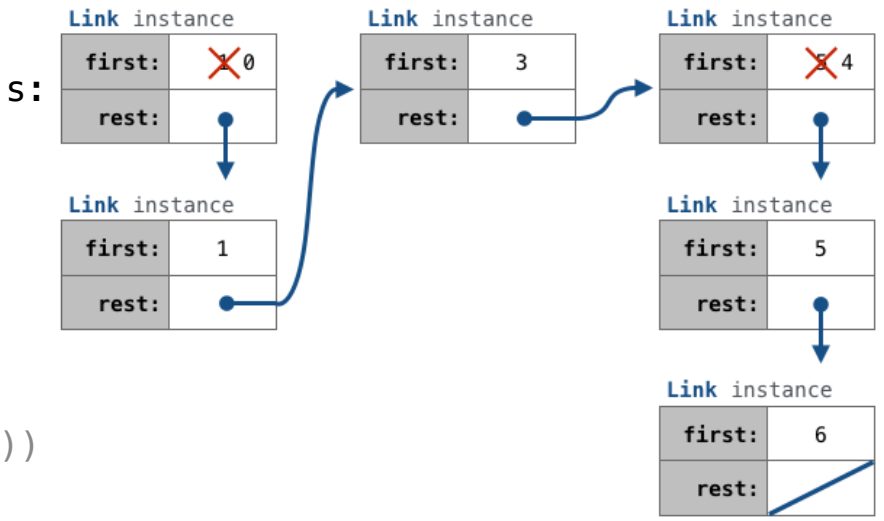
    """
```



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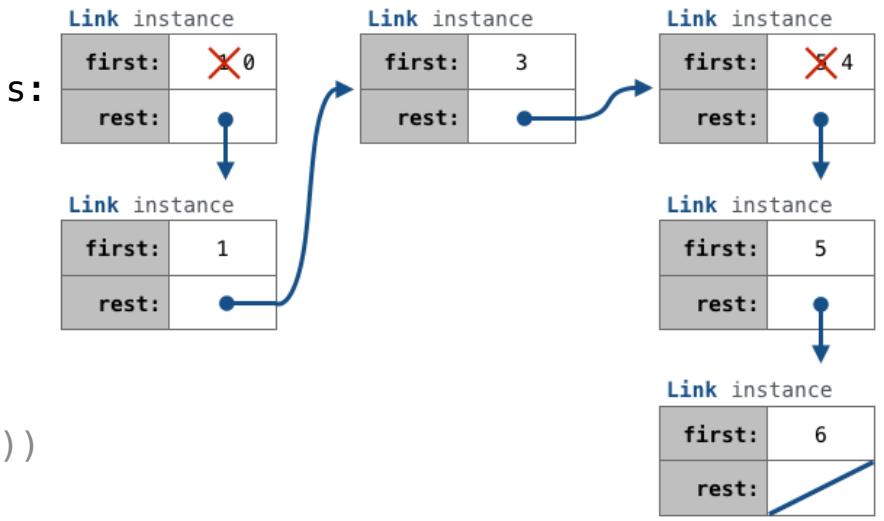
    """
    assert s is not List.empty
```



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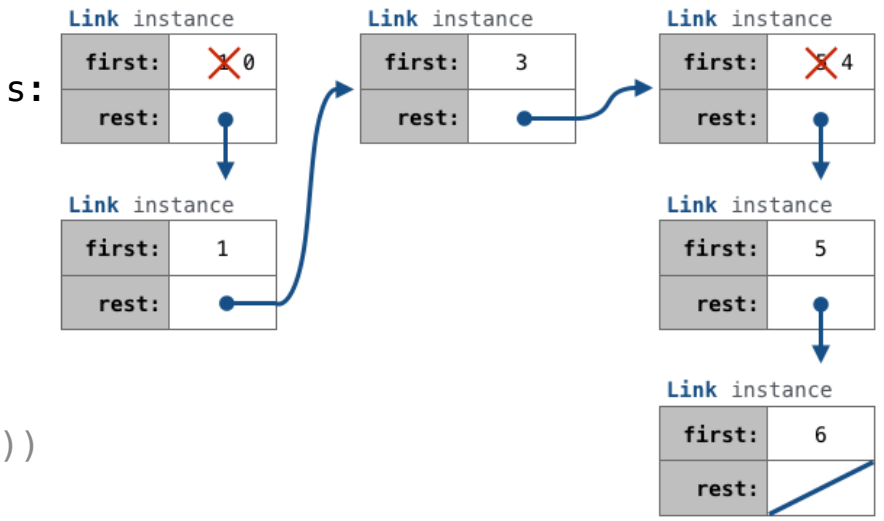
    assert s is not List.empty
    if s.first > v:
        s.first, s.rest = _____________________________ , _____________________________
```



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    assert s is not List.empty
    if s.first > v:
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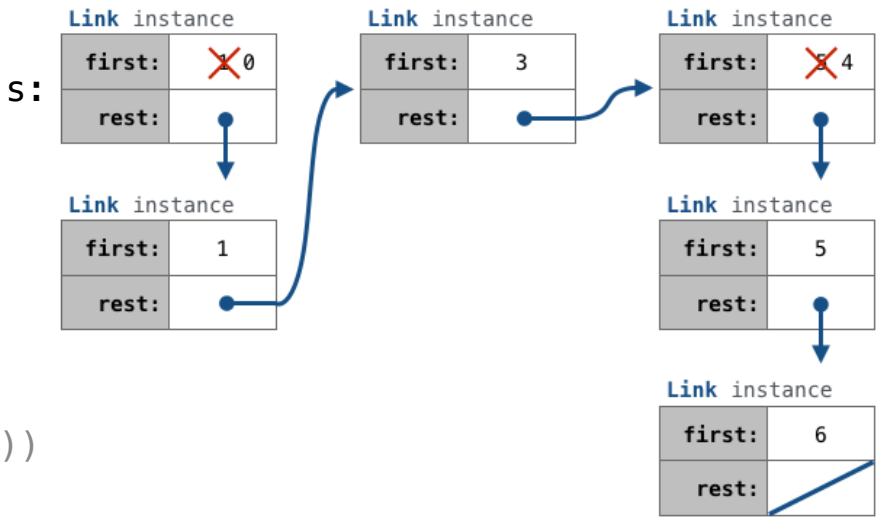
    elif s.first < v and empty(s.rest):
        s.rest = ____________________________________________________________________
```



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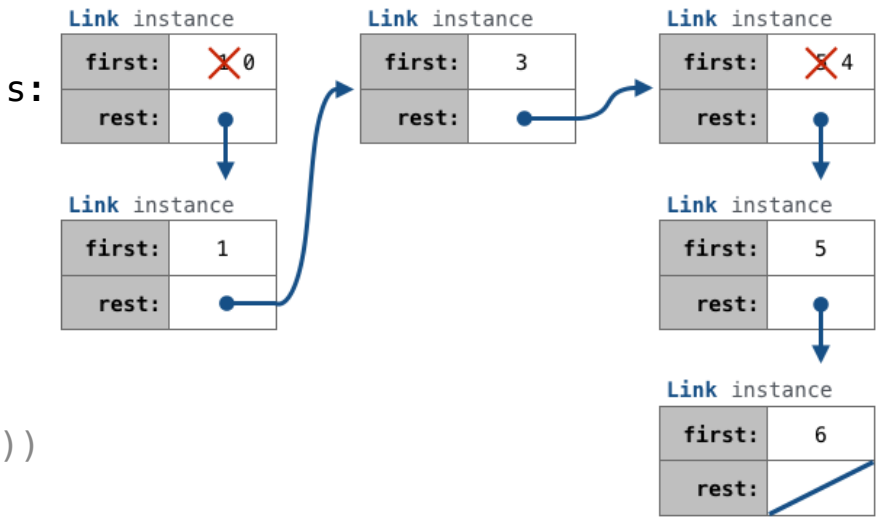
    return s
```



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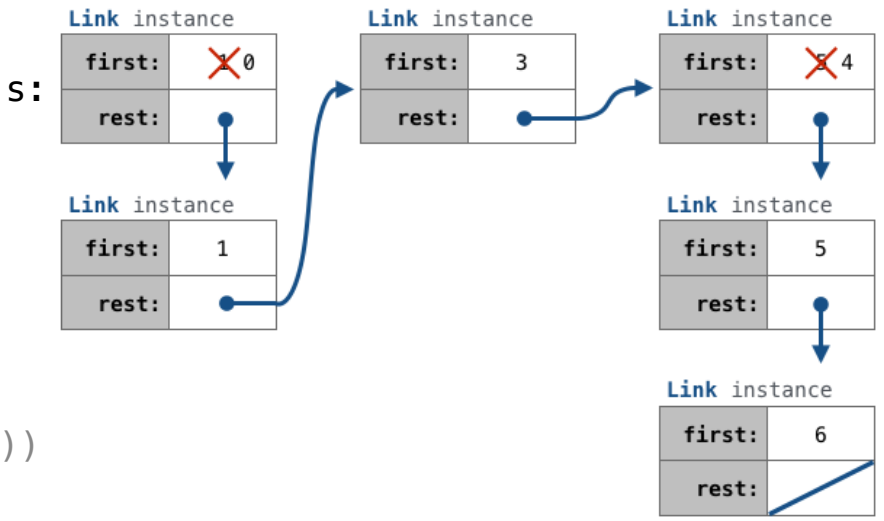
v



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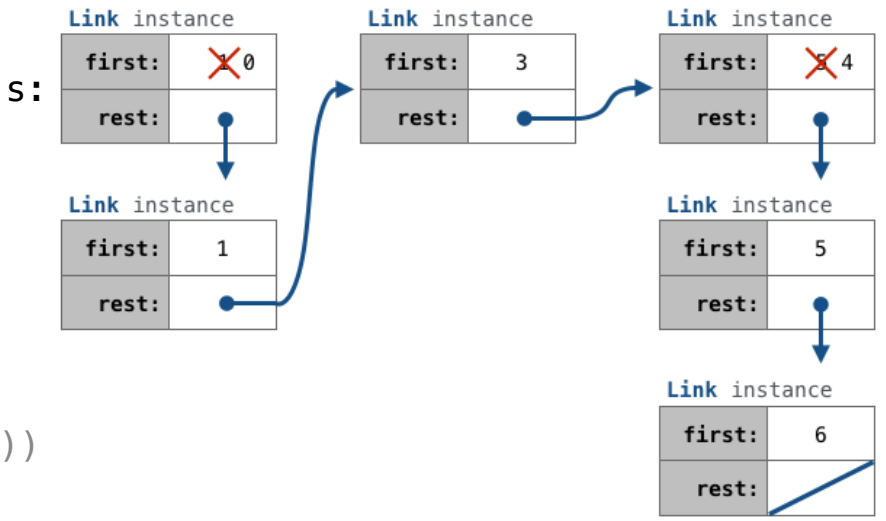

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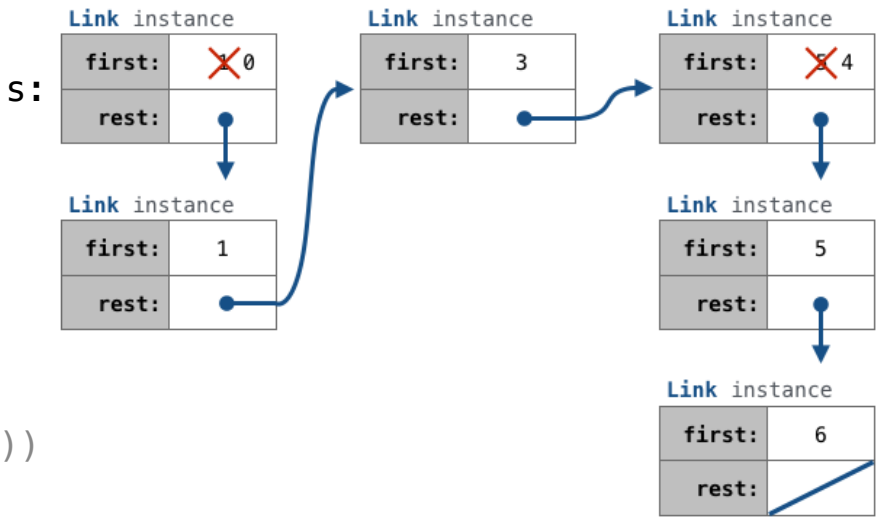

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    elif s.first < v and empty(s.rest):
        s.rest = _____Link(v)_____
    elif s.first < v:
        _____add(s.rest, v)_____
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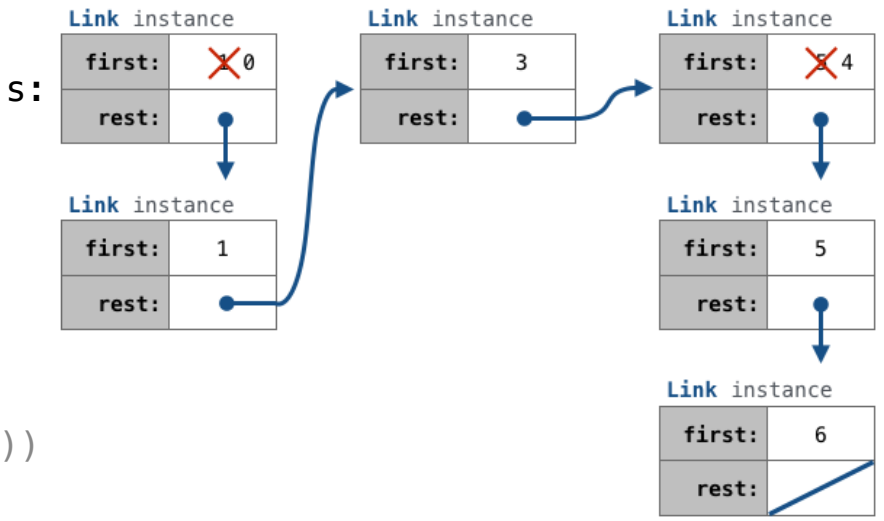
```



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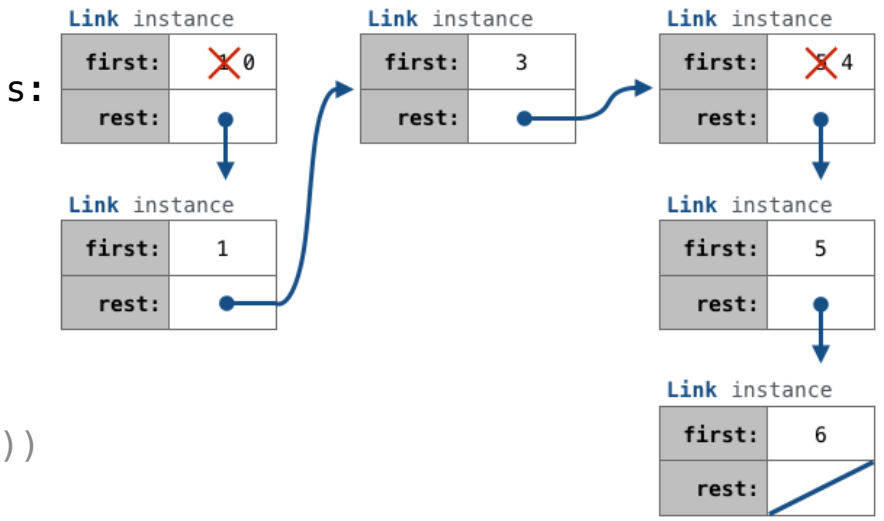

Tree Mutation

Example: Pruning Trees

Removing subtrees from a tree is called *pruning*

Prune branches before recursive processing

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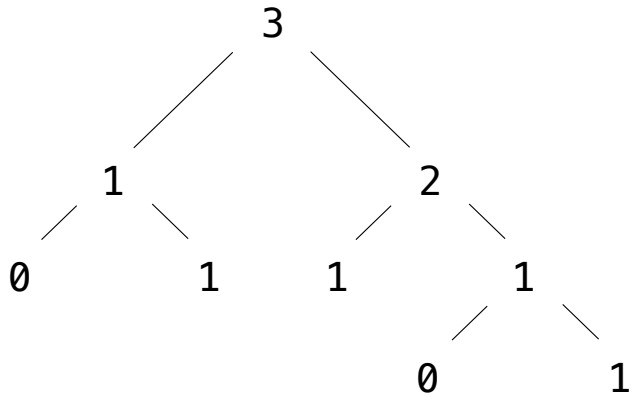

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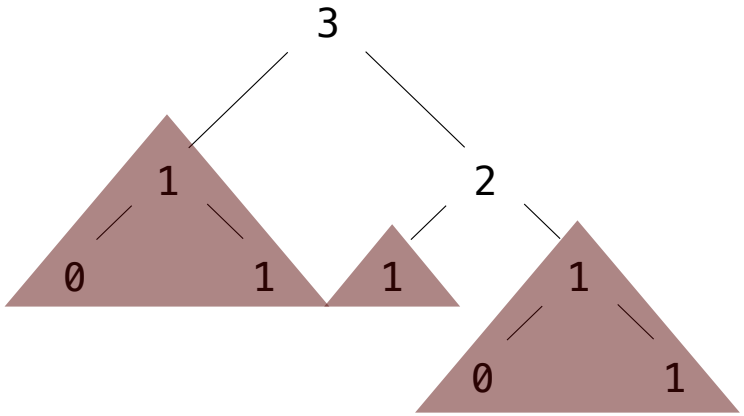

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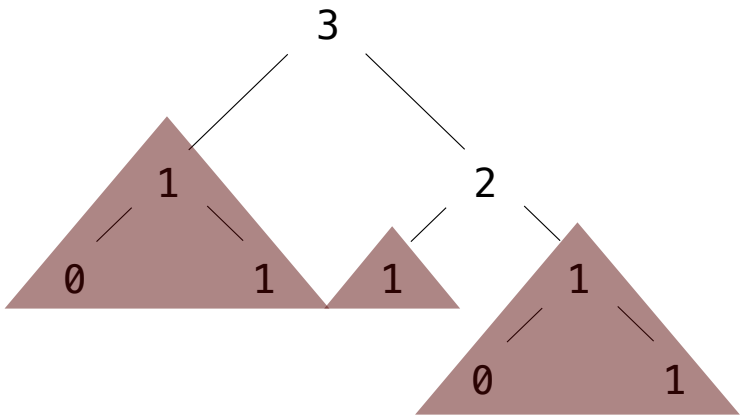


```
def prune(t, n):
    """Prune all sub-trees whose label is n."""
    t.branches = [_____________ for b in t.branches if ____________________]
    for b in t.branches:
        prune(_____________________________, _____________________________)
```

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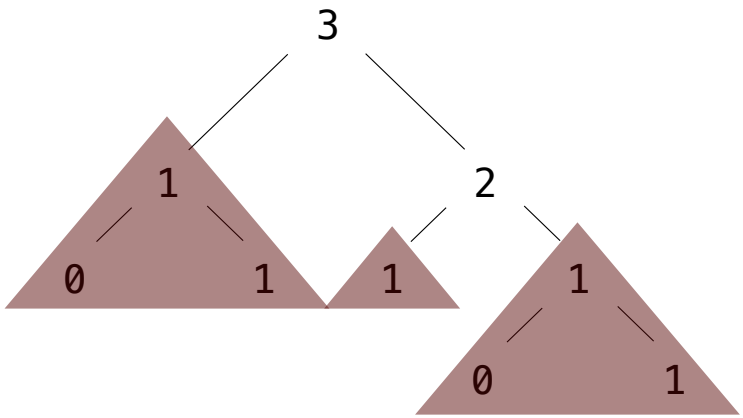


```
def prune(t, n):
    """Prune all sub-trees whose label is n."""
    t.branches = [b for b in t.branches if b.label != n]
    for b in t.branches:
        prune(_____, _____)
```

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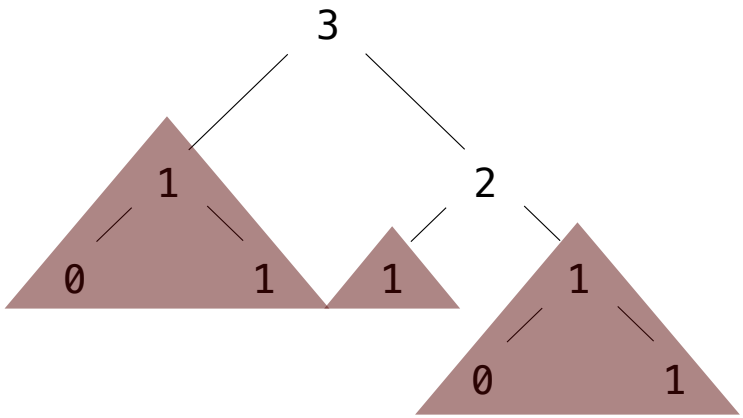
Removing subtrees from a tree is called *pruning*

Prune branches before recursive processing

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