# Data Examples

# Announcements

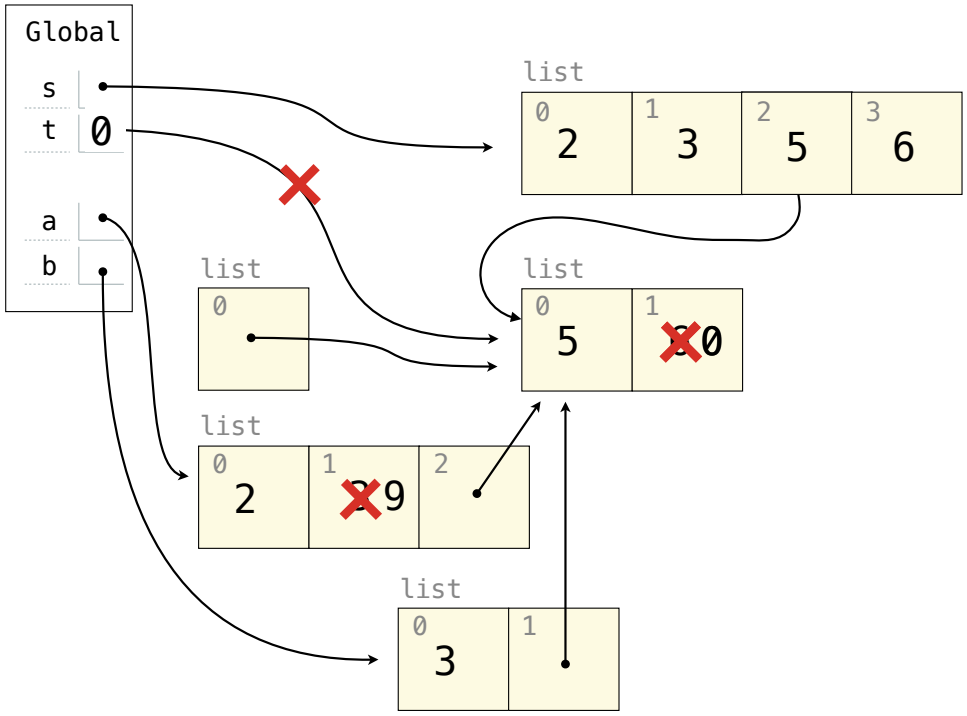
# Lists

# Lists in Environment Diagrams

**Assume that before each example below we execute:**

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

| Operation | Example | Result |
|---|---|---|
| **append** adds one element to a list | `s.append(t)`<br>`t = 0` | `s → [2, 3, [5, 6]]`<br>`t → 0` |
| **extend** adds all elements in one list to another list | `s.extend(t)`<br>`t[1] = 0` | `s → [2, 3, 5, 6]`<br>`t → [5, 0]` |
| **addition** & **slicing** create new lists containing existing elements | `a = s + [t]`<br>`b = a[1:]`<br>`a[1] = 9`<br>`b[1][1] = 0` | `s → [2, 3]`<br>`t → [5, 0]`<br>`a → [2, 9, [5, 0]]`<br>`b → [3, [5, 0]]` |



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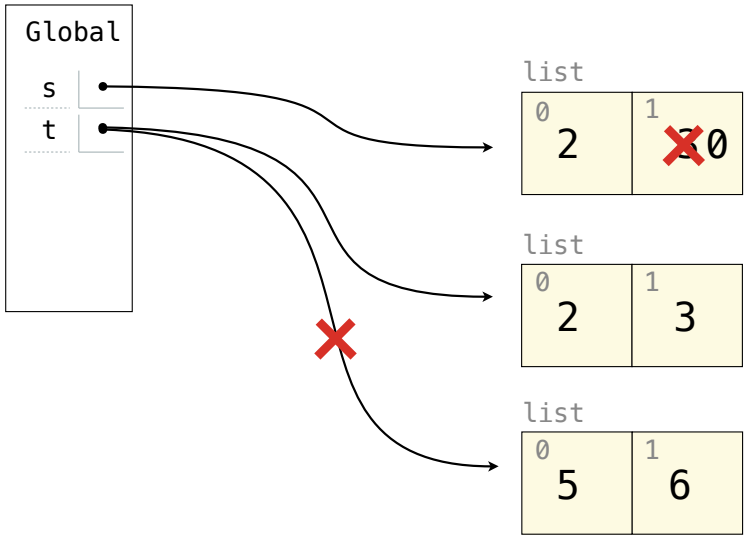
| The **list** function also creates a new list containing existing elements | `t = list(s)`<br>`s[1] = 0` | `s → [2, 0]`<br>`t → [2, 3]` |



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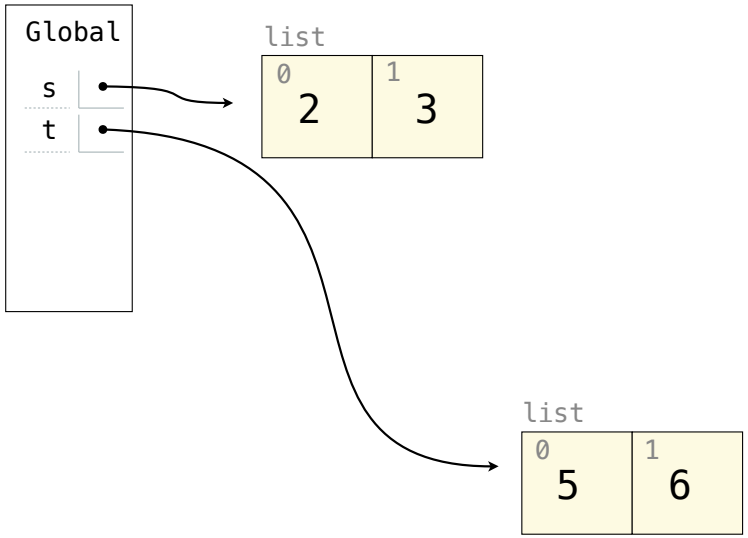
| **slice assignment** replaces a slice with new values | `s[0:0] = t`<br>`s[3:] = t`<br>`t[1] = 0` | |



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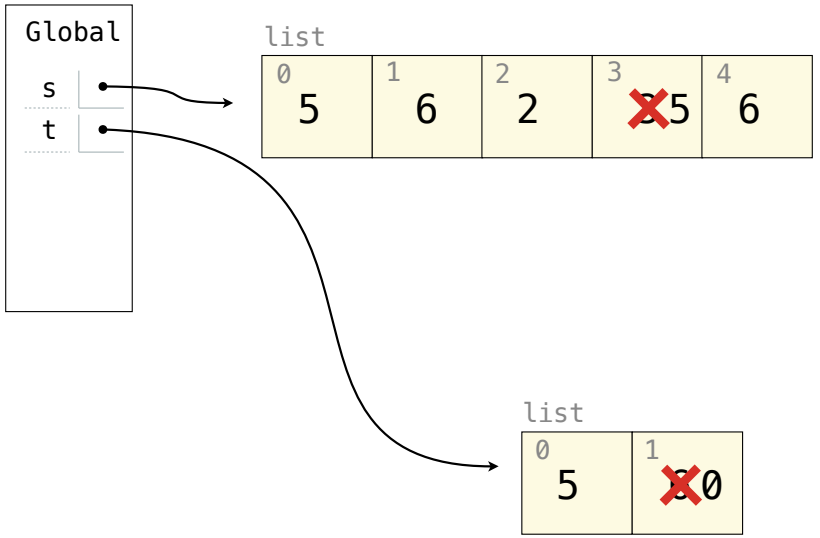
| The **list** function also creates a new list containing existing elements | `t = list(s)`<br>`s[1] = 0` | `s → [2, 0]`<br>`t → [2, 3]` |
| **slice assignment** replaces a slice with new values | `s[0:0] = t`<br>`s[3:] = t`<br>`t[1] = 0` | `s → [5, 6, 2, 5, 6]`<br>`t → [5, 0]` |



# Lists in Environment Diagrams

**Assume that before each example below we execute:**

```
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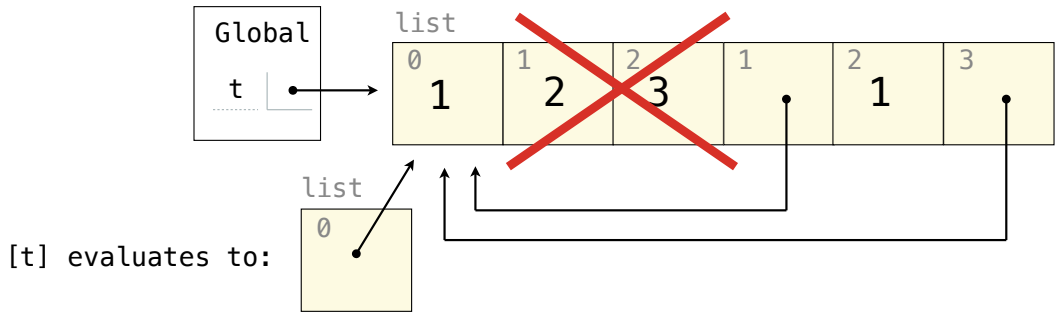
t = [5, 6]
```

| Operation | Example | Result |
|---|---|---|
| **pop** removes & returns the last element | `t = s.pop()` | `s → [2]`<br>`t → 3` |
| **remove** removes the first element equal to the argument | `t.extend(t)`<br>`t.remove(5)` | `s → [2, 3]`<br>`t → [6, 5, 6]` |
| **slice assignment** can remove elements from a list by assigning [] to a slice. | `s[:1] = []`<br>`t[0:2] = []` | `s → [3]`<br>`t → []` |

# Lists in Lists in Lists in Environment Diagrams

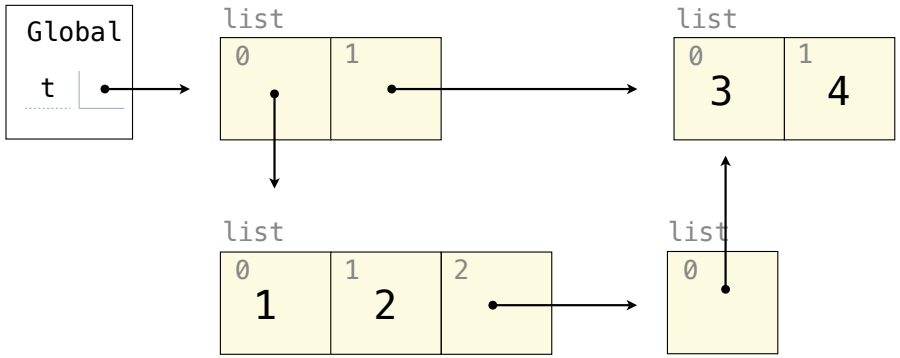
```
t = [1, 2, 3]
t[1:3] = [t]
t.extend(t)
```




```
[1, [...], 1, [...]]
```

---

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




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

# Objects

# 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'

jack = Worker()
john = Bourgeoisie()
jack.greeting = 'Maam'
```

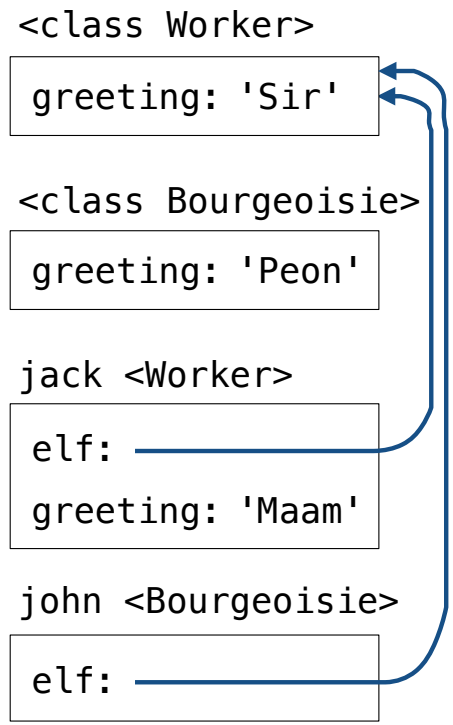
```
>>> Worker().work()
'Sir, I work'

>>> jack
Peon

>>> jack.work()
'Maam, I work'

>>> john.work()
Peon, I work
'I gather wealth'

>>> john.elf.work(john)
'Peon, I work'
```



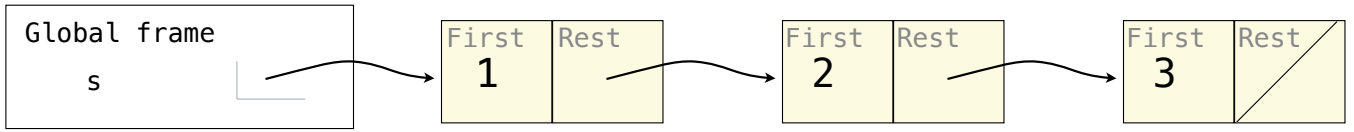
# Mutable Linked Lists

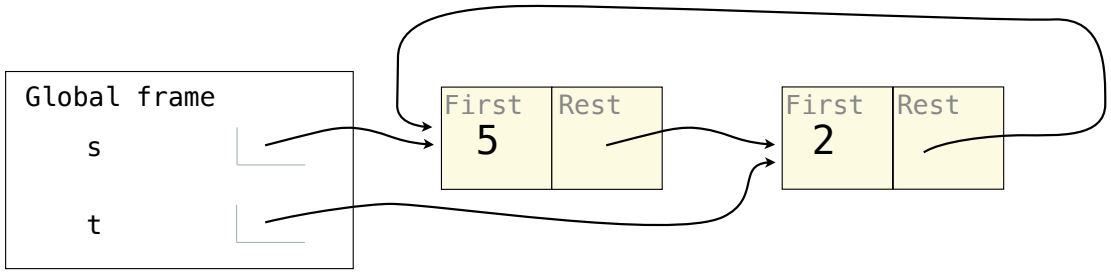
# Recursive Lists Can Change

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

The rest of a linked list can contain the linked list as a sub-list

```
>>> s = Link(1, Link(2, Link(3)))
>>> s.first = 5
>>> t = s.rest
>>> t.rest = s
>>> s.first
5
>>> s.rest.rest.rest.rest.rest.first
2
```

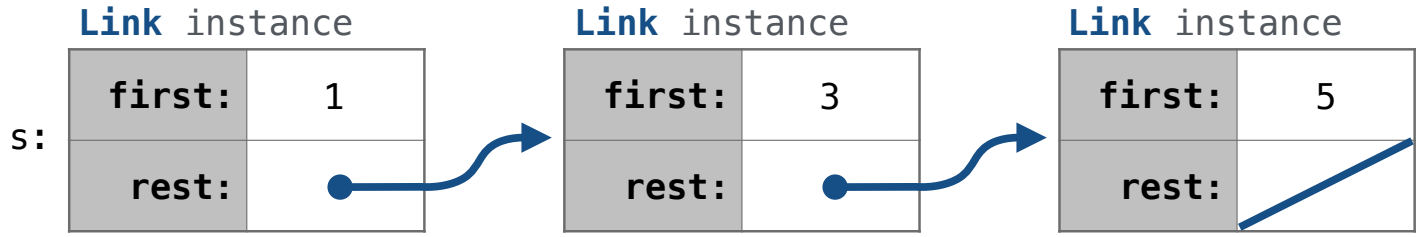



Note: The actual environment diagram is much more complicated.

# Linked List Mutation Example

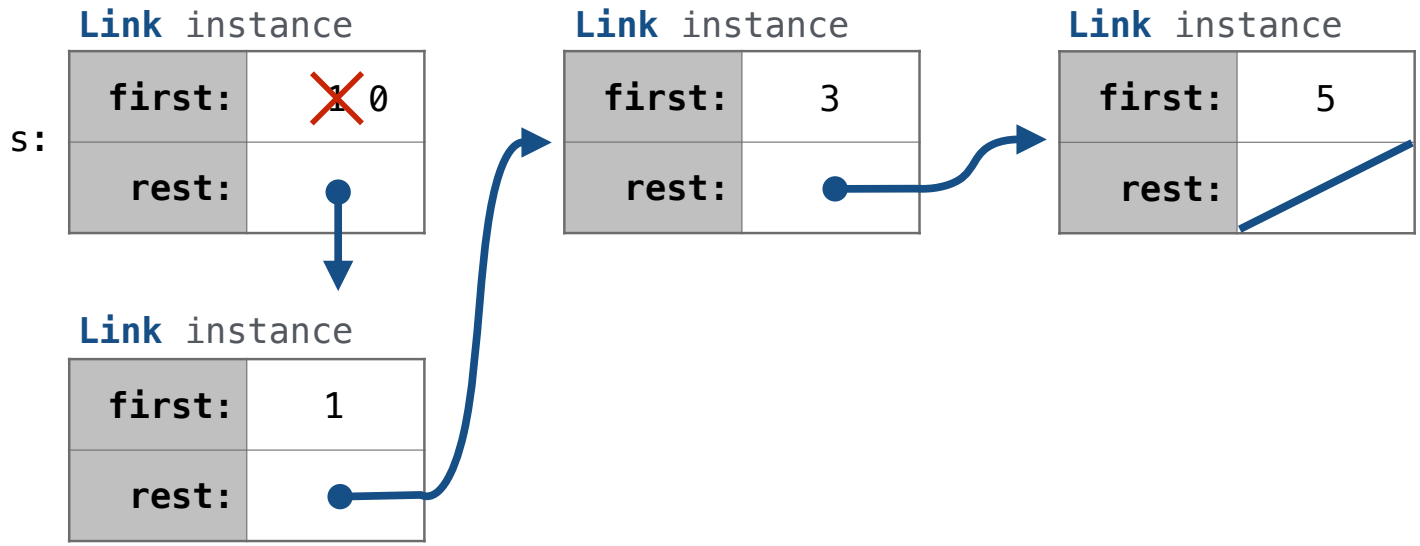
# Adding to an Ordered List




```
def add(s, v):
    """Add v to an ordered list s with no repeats, returning modified s."""
    (Note: If v is already in s, then don't modify s, but still return it.)

        add(s, 0)
```

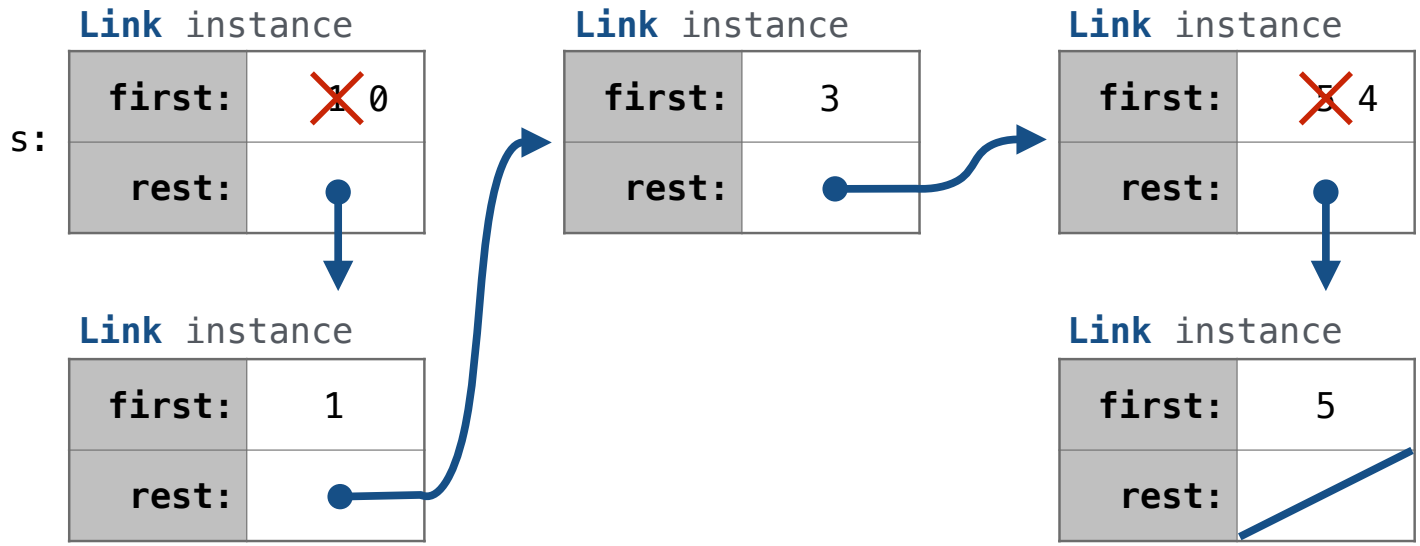
# Adding to an Ordered List




```
def add(s, v):
    """Add v to an ordered list s with no repeats, returning modified s."""
    (Note: If v is already in s, then don't modify s, but still return it.)

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

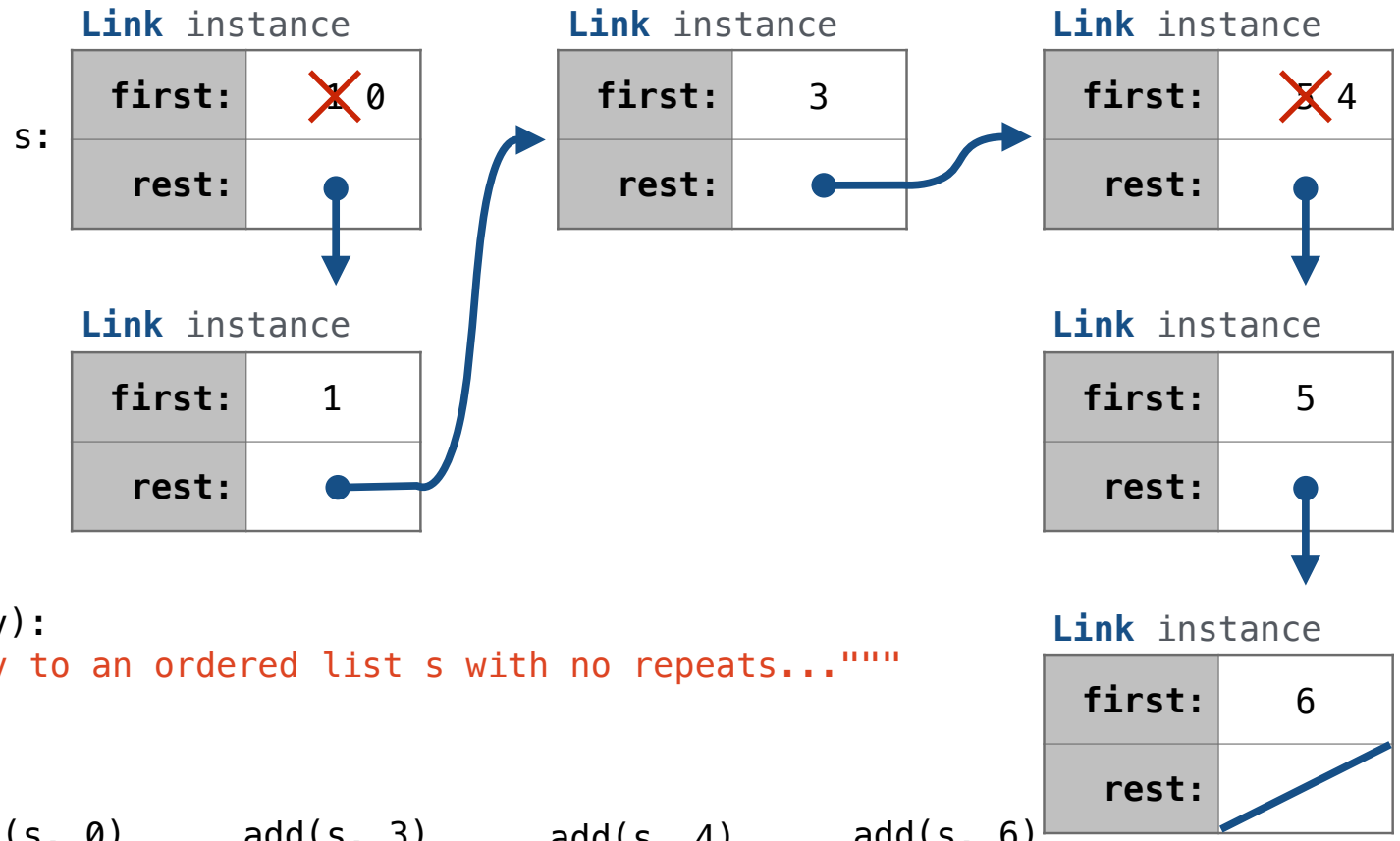
# Adding to an Ordered List




```
def add(s, v):
    """Add v to an ordered list s with no repeats..."""
```

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

# Adding to an Ordered List

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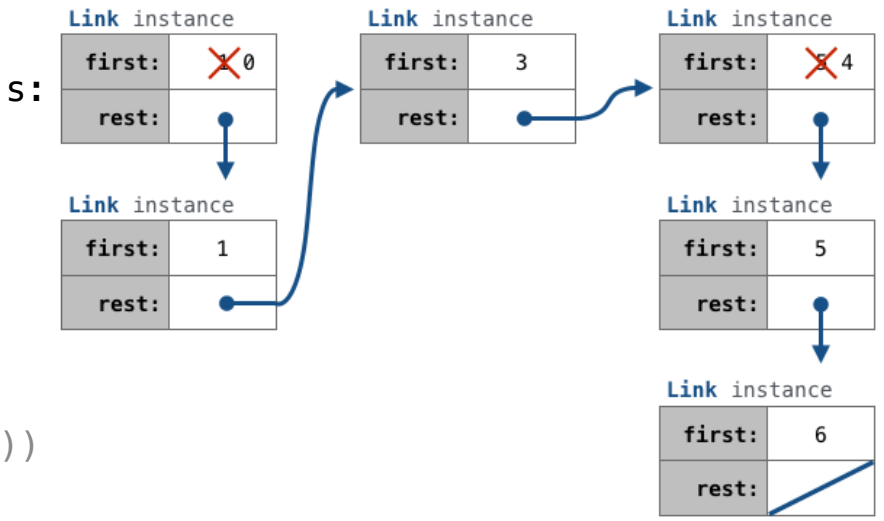
    """Add v to an ordered list s with no repeats..."""
```

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

# Adding to a Set Represented as an Ordered List

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

    >>> s = Link(1, Link(3, Link(5)))
    >>> add(s, 0)
    Link(0, Link(1, Link(3, Link(5))))
    >>> add(s, 3)
    Link(0, Link(1, Link(3, Link(5))))
    >>> add(s, 4)
    Link(0, Link(1, Link(3, Link(4, Link(5)))))
    >>> add(s, 6)
    Link(0, Link(1, Link(3, Link(4, Link(5, Link(6))))
    """
    assert s is not List.empty
    if s.first > v:
        s.first, s.rest = _____v_____ , _____Link(s.first, s.rest)_____
    elif s.first < v and empty(s.rest):
        s.rest = _____Link(v)_____
    elif s.first < v:
        _____add(s.rest, v)_____
    return s
```

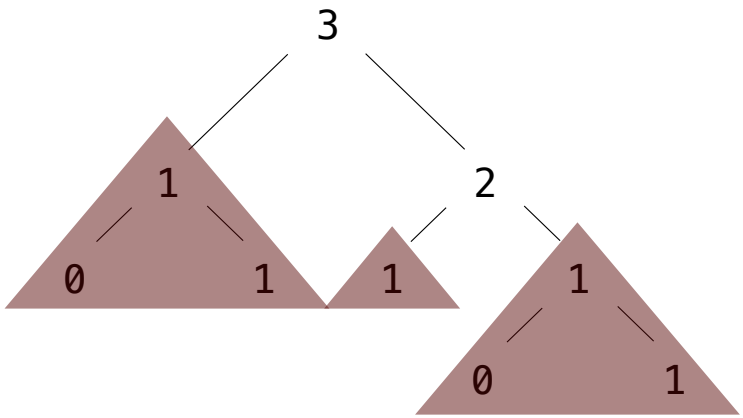


# Tree Mutation

# Example: Pruning Trees

Removing subtrees from a tree is called *pruning*

Prune branches before recursive processing




```
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(_____________b_____________, _____________n_____________)
```