Data Examples

Announcements

Examples: Lists

Lists in Environment Diagrams

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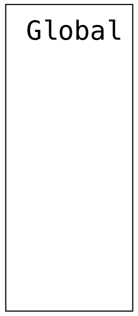

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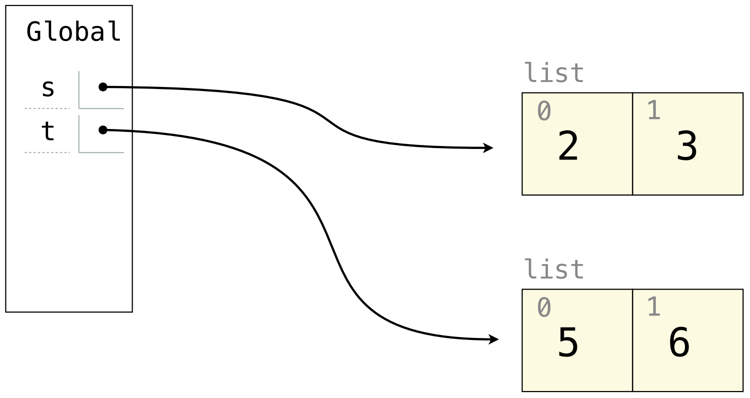

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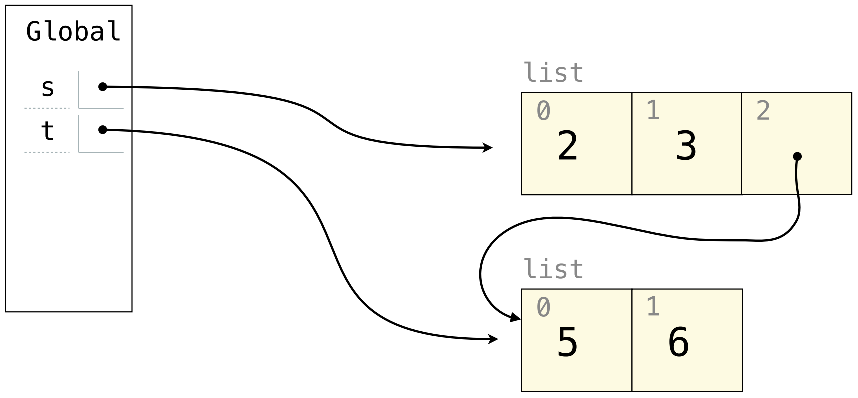

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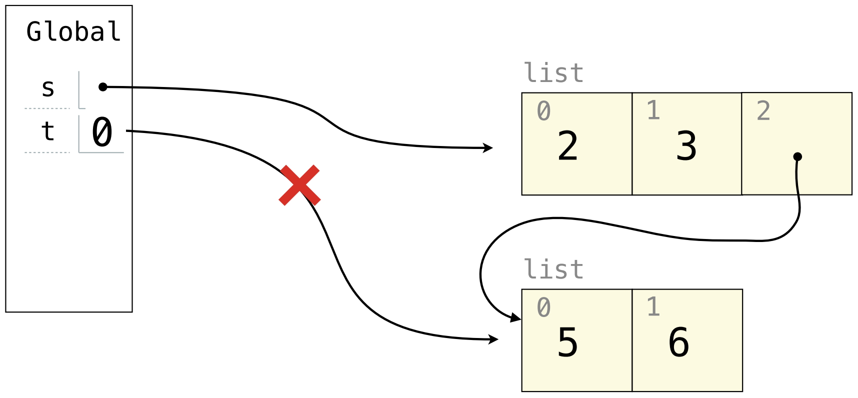

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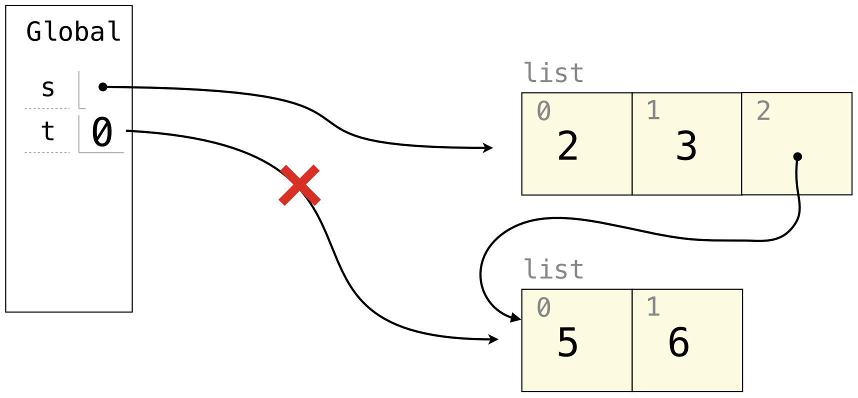

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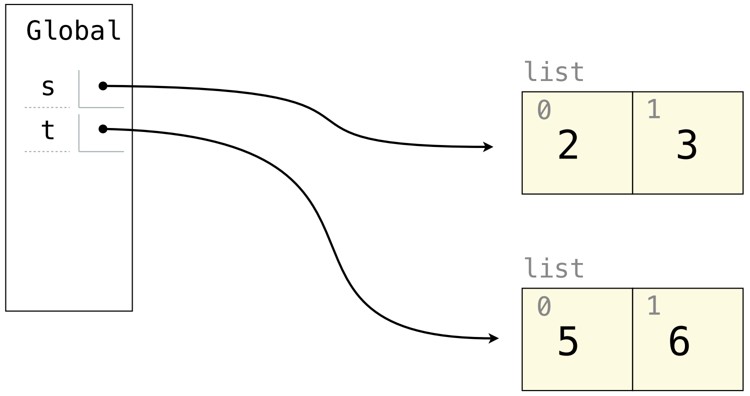

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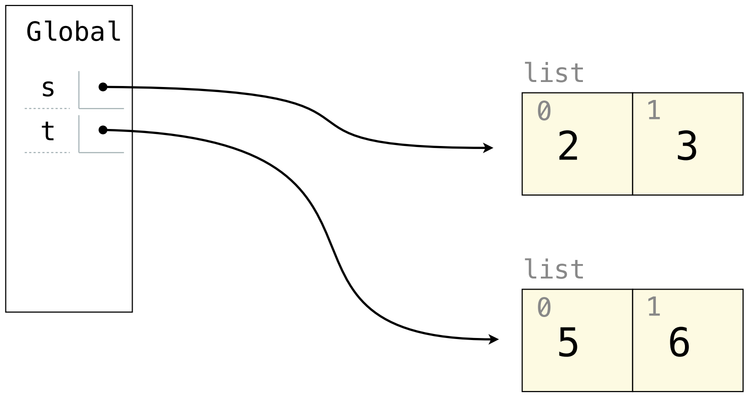

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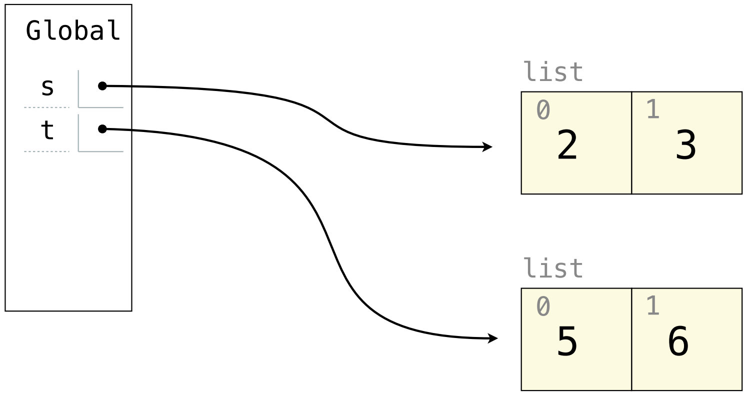

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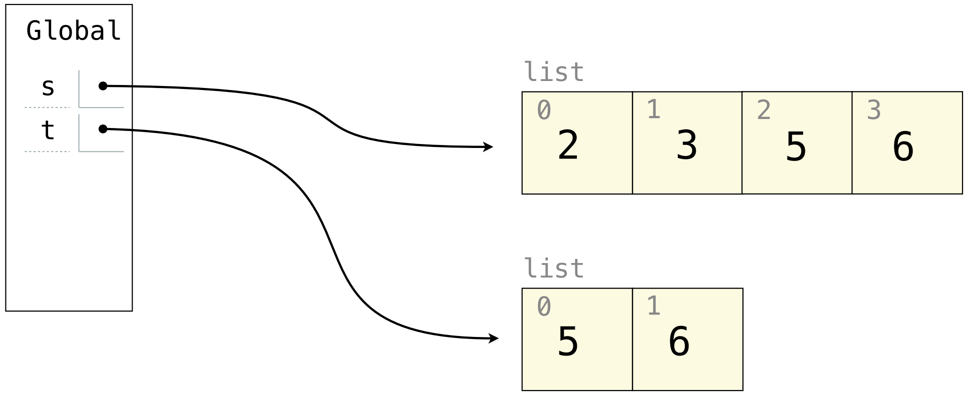

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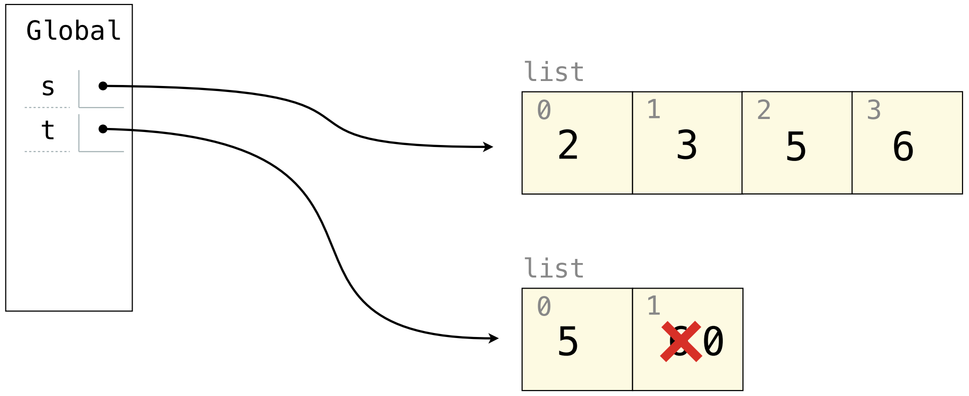

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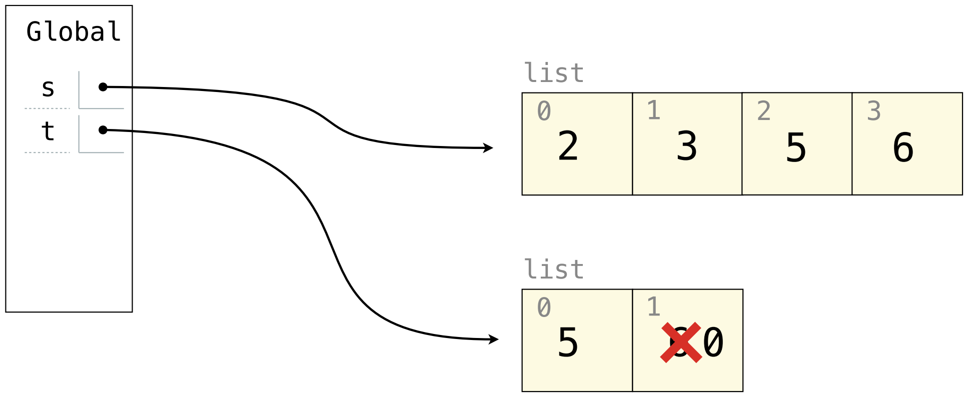

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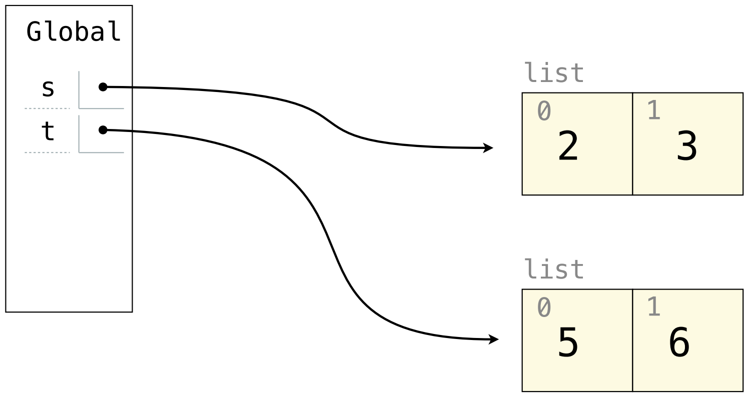

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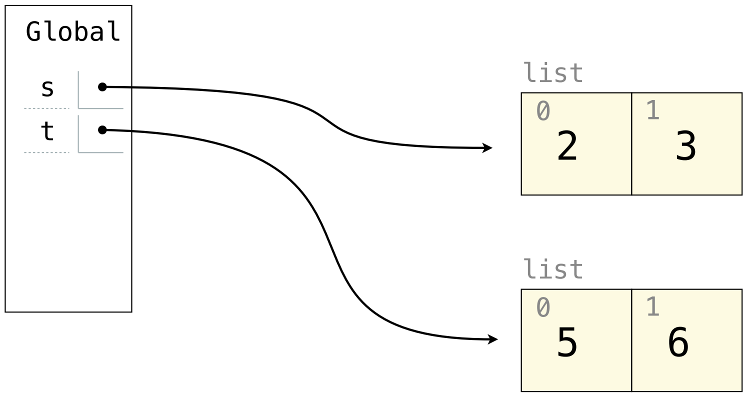

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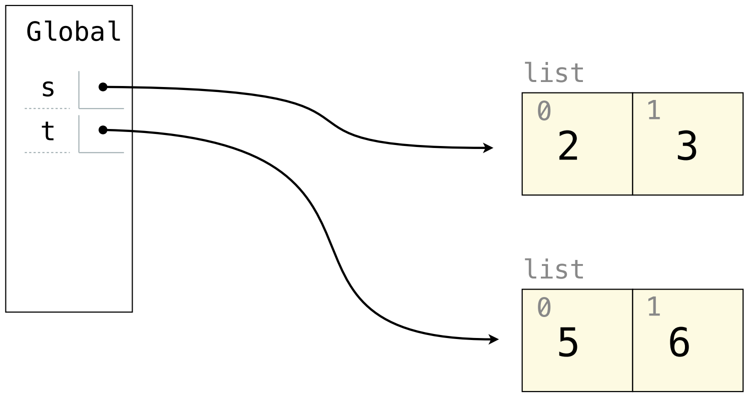

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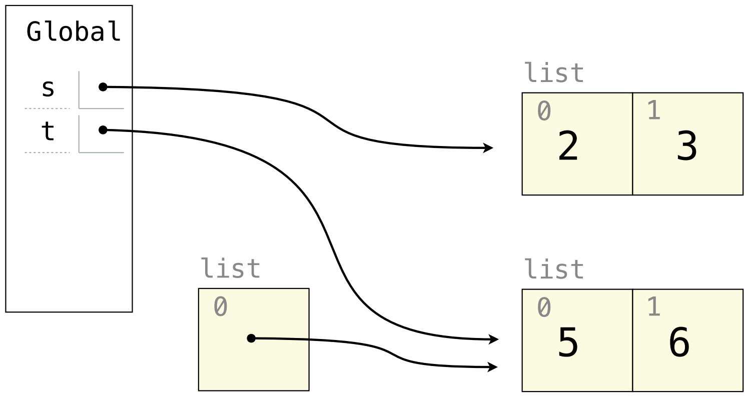

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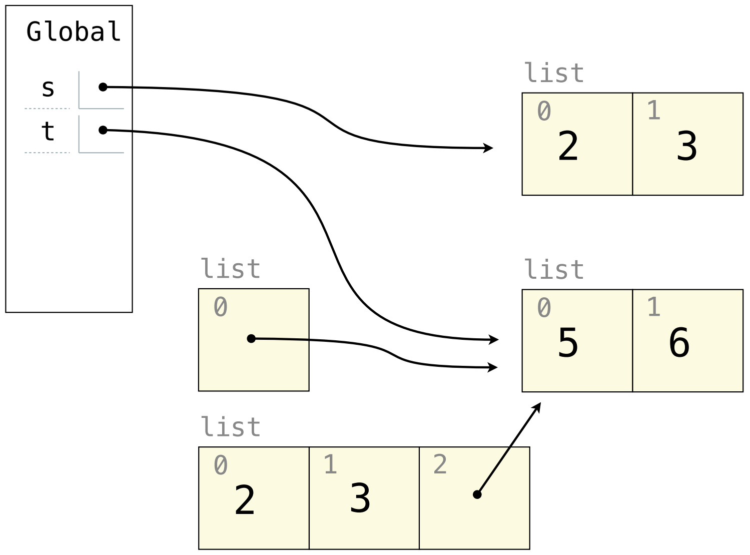

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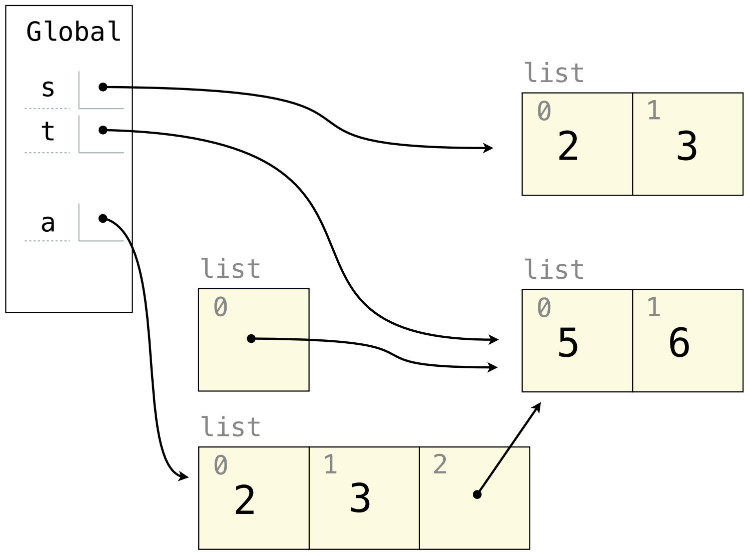

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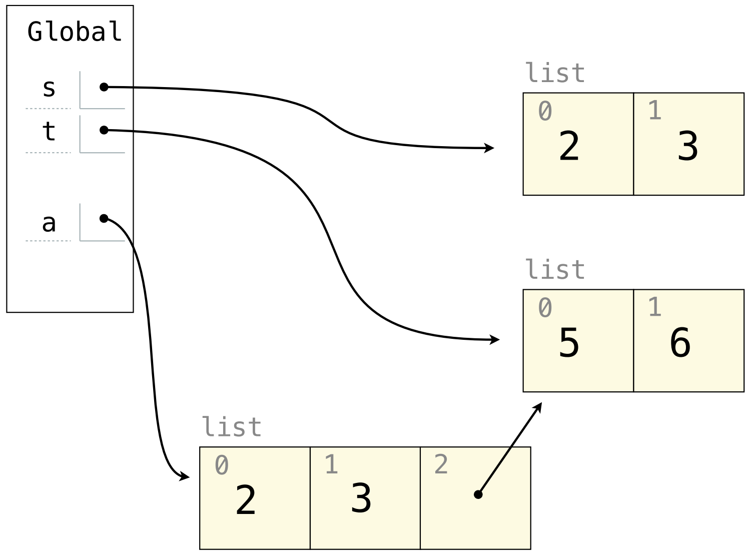

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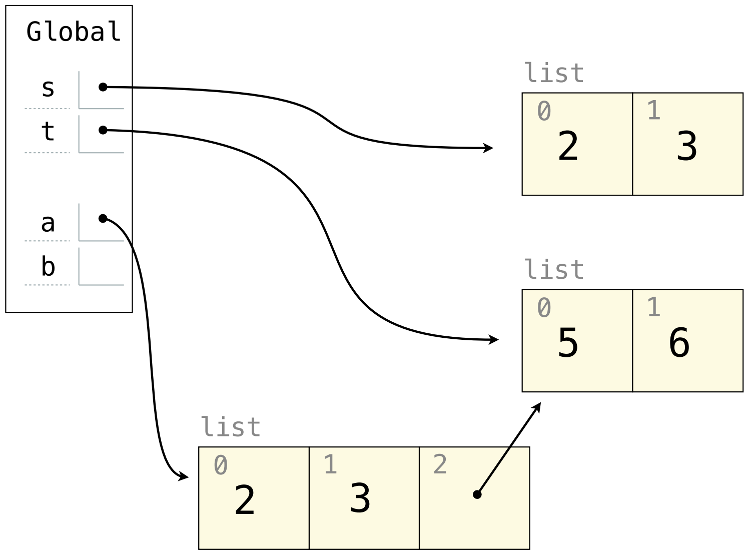

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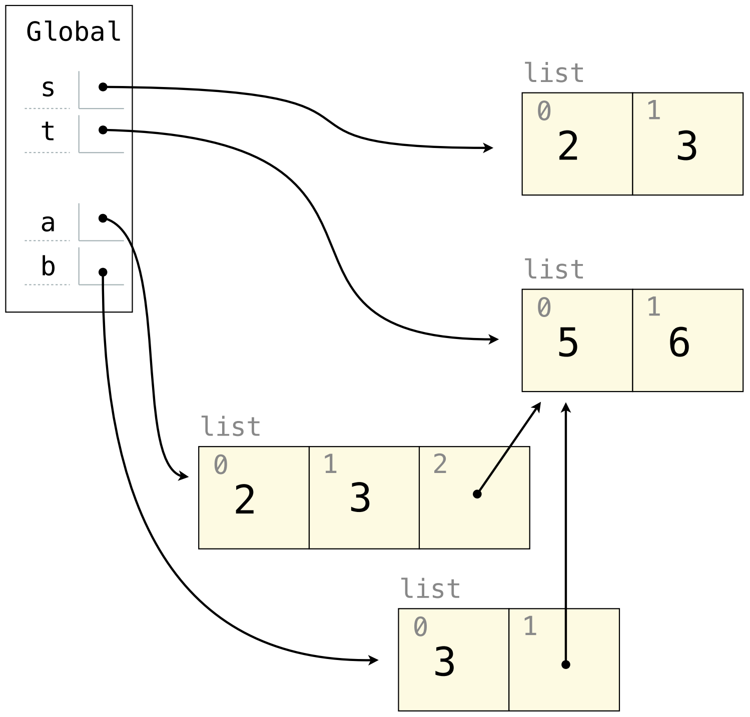

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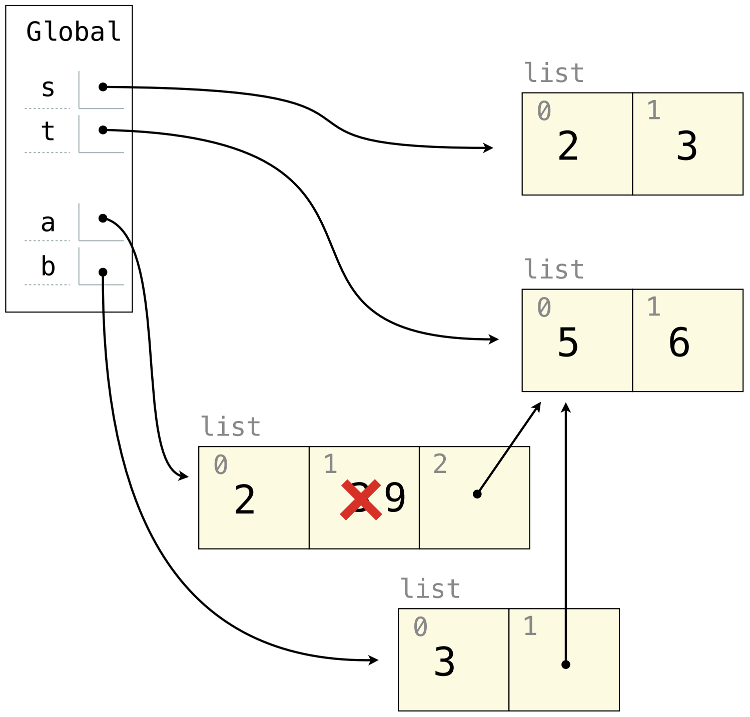

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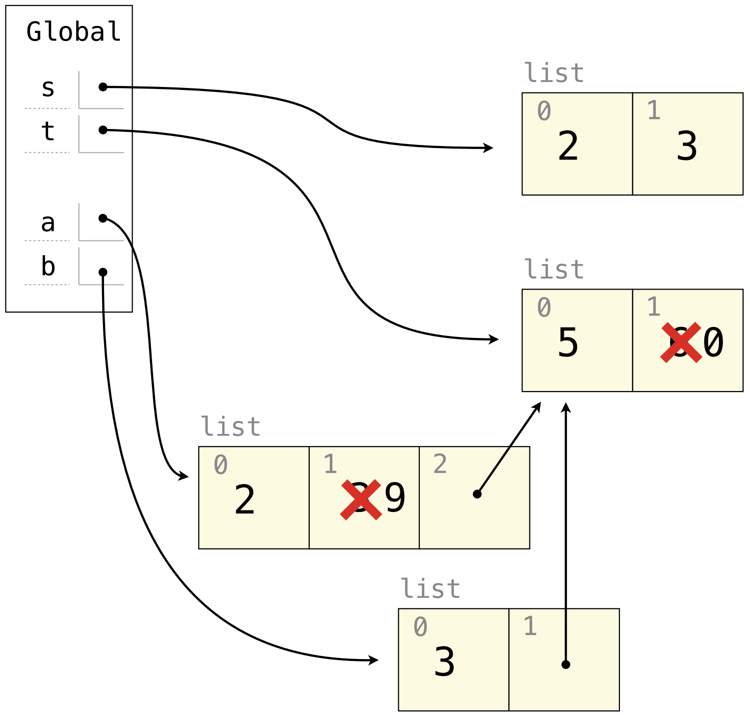

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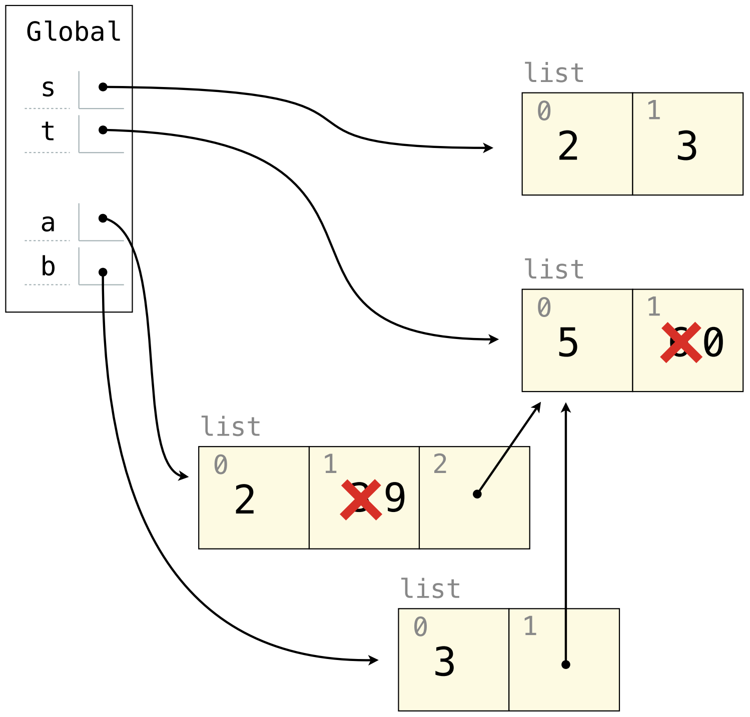

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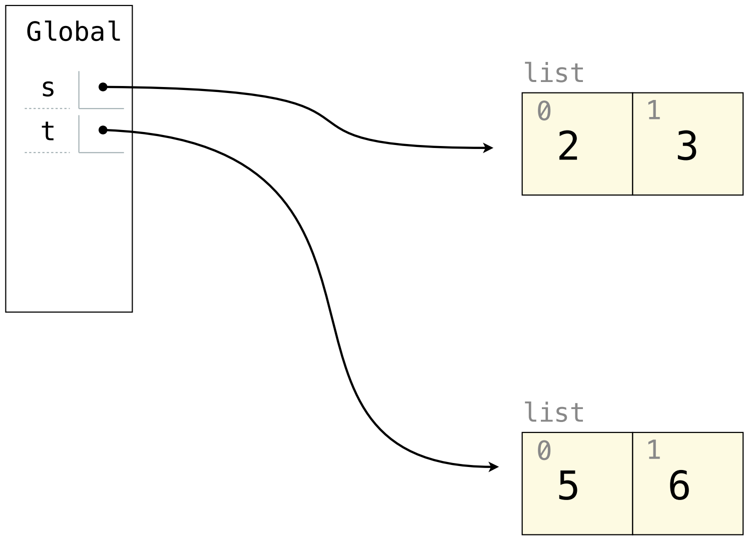

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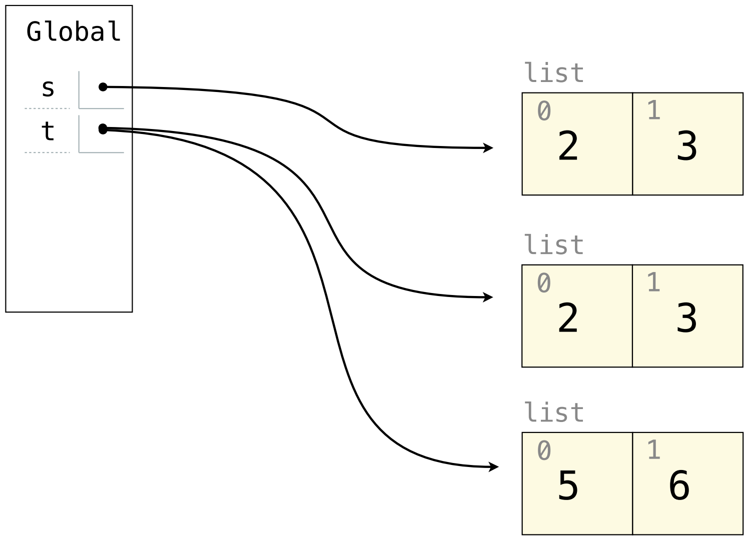

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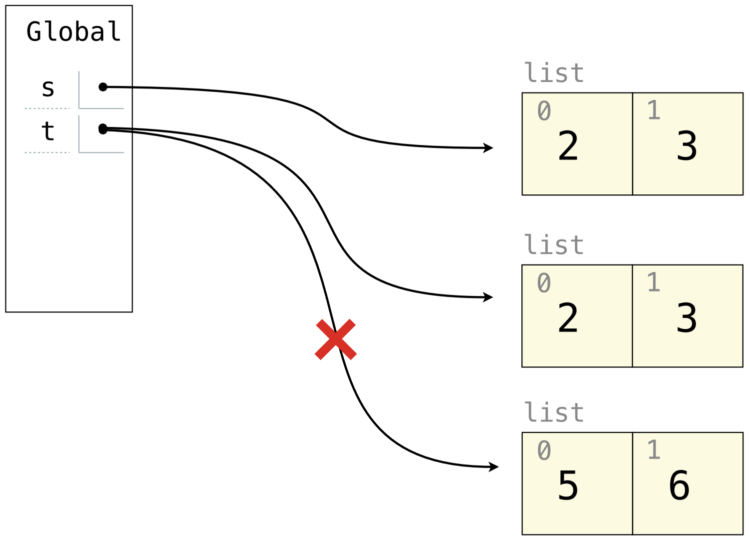

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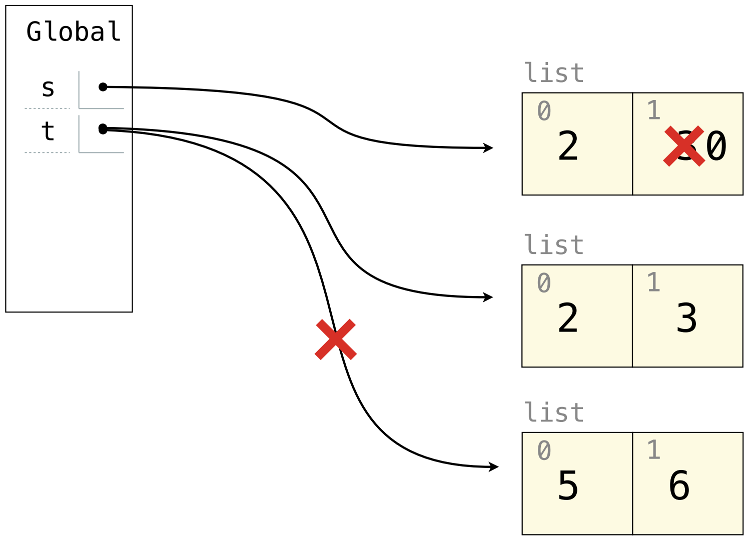

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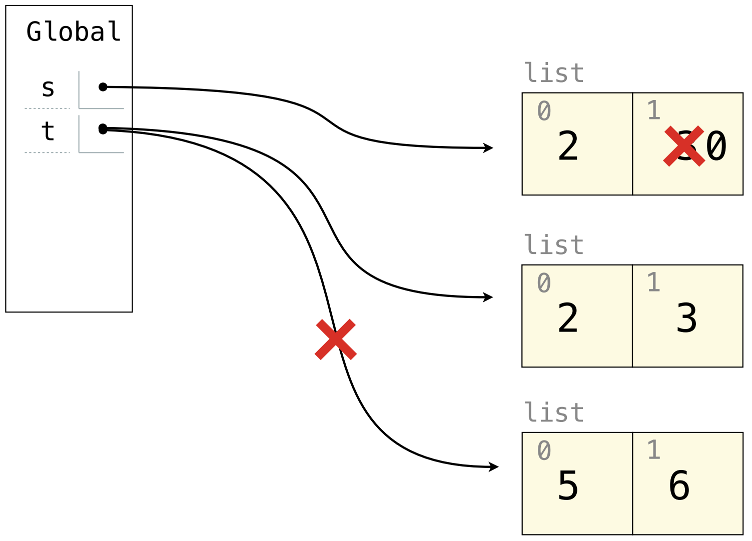
		t → [5, 0]

addition & **slicing** create new lists containing existing elements	a = s + [t]
	b = a[1:]
	a[1] = 9
	b[1][1] = 0
		s → [2, 3]
		t → [5, 0]
		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]



Lists in Environment Diagrams

Assume that before each example below we execute:

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

Operation	Example	Result

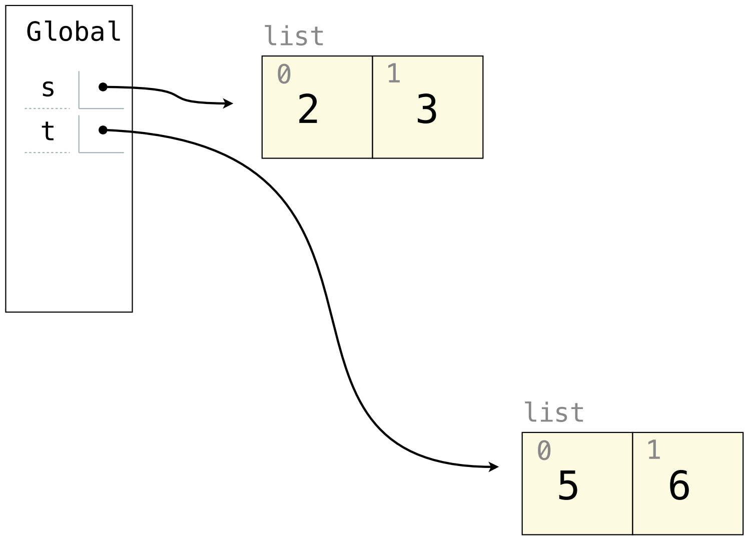
append adds one element to a list	s.append(t)
	t = 0
		s → [2, 3, [5, 6]]
		t → 0

extend adds all elements in one list to another list	s.extend(t)
	t[1] = 0
		s → [2, 3, 5, 6]
		t → [5, 0]

addition & **slicing** create new lists containing existing elements	a = s + [t]
	b = a[1:]
	a[1] = 9
	b[1][1] = 0
		s → [2, 3]
		t → [5, 0]
		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	



Lists in Environment Diagrams

Assume that before each example below we execute:

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

Operation	Example	Result

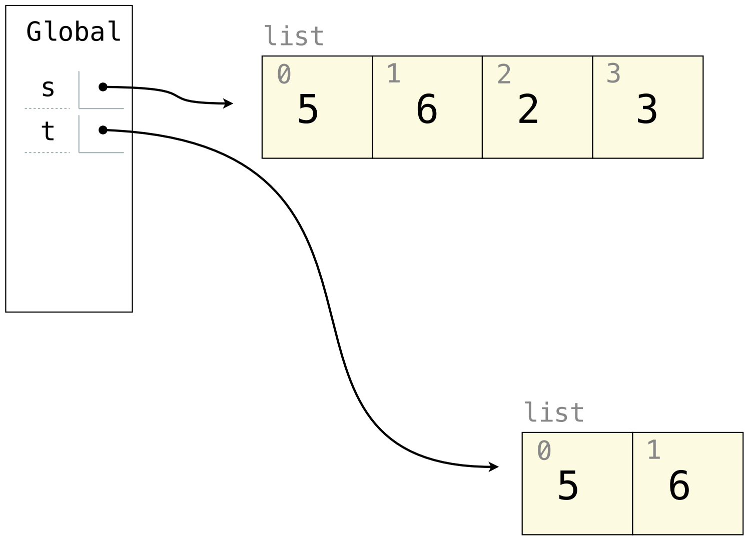
append adds one element to a list	`s.append(t)`
	`t = 0`
		`s → [2, 3, [5, 6]]`
		`t → 0`

extend adds all elements in one list to another list	`s.extend(t)`
	`t[1] = 0`
		`s → [2, 3, 5, 6]`
		`t → [5, 0]`

addition & **slicing** create new lists containing existing elements	`a = s + [t]`
	`b = a[1:]`
	`a[1] = 9`
	`b[1][1] = 0`
		`s → [2, 3]`
		`t → [5, 0]`
		`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`	



Lists in Environment Diagrams

Assume that before each example below we execute:

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

Operation	Example	Result

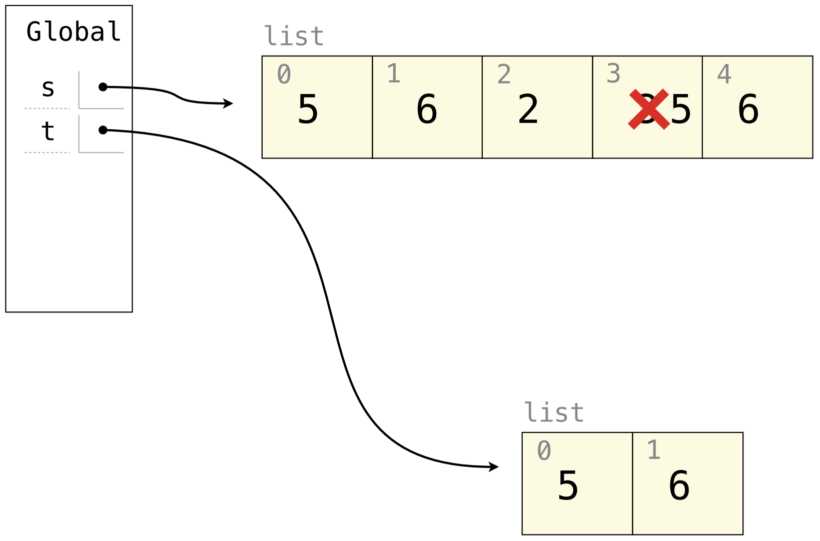
append adds one element to a list	`s.append(t)`
	`t = 0`
		`s → [2, 3, [5, 6]]`
		`t → 0`

extend adds all elements in one list to another list	`s.extend(t)`
	`t[1] = 0`
		`s → [2, 3, 5, 6]`
		`t → [5, 0]`

addition & **slicing** create new lists containing existing elements	`a = s + [t]`
	`b = a[1:]`
	`a[1] = 9`
	`b[1][1] = 0`
		`s → [2, 3]`
		`t → [5, 0]`
		`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`	



Lists in Environment Diagrams

Assume that before each example below we execute:

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

Operation	Example	Result

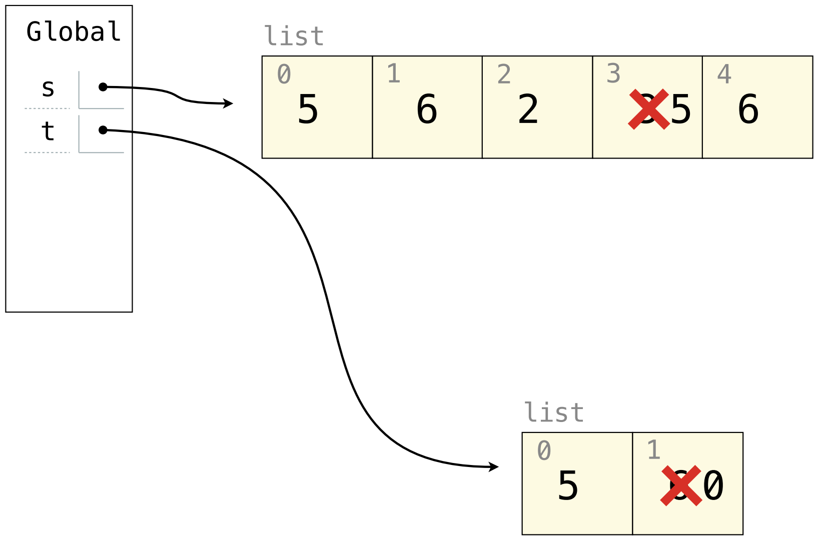
append adds one element to a list	s.append(t)
	t = 0
		s → [2, 3, [5, 6]]
		t → 0

extend adds all elements in one list to another list	s.extend(t)
	t[1] = 0
		s → [2, 3, 5, 6]
		t → [5, 0]

addition & **slicing** create new lists containing existing elements	a = s + [t]
	b = a[1:]
	a[1] = 9
	b[1][1] = 0
		s → [2, 3]
		t → [5, 0]
		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	



Lists in Environment Diagrams

Assume that before each example below we execute:

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

Operation	Example	Result

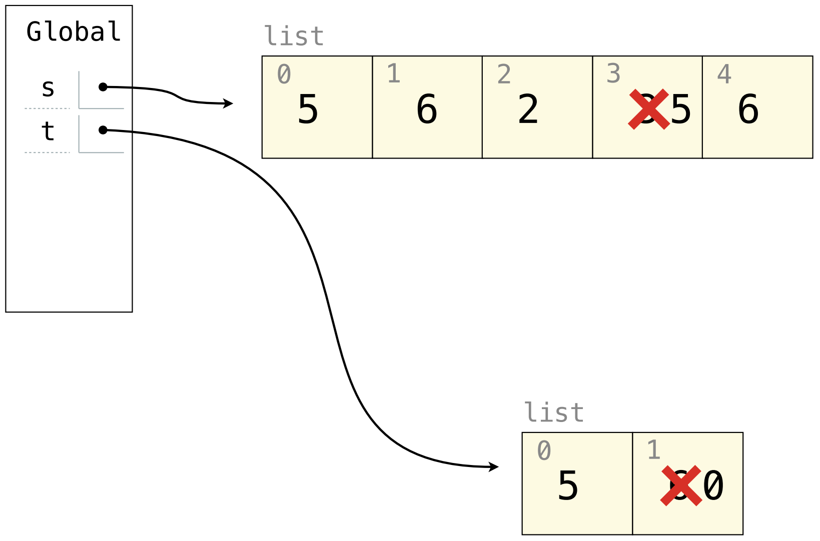
append adds one element to a list	`s.append(t)`
	`t = 0`
		`s → [2, 3, [5, 6]]`
		`t → 0`

extend adds all elements in one list to another list	`s.extend(t)`
	`t[1] = 0`
		`s → [2, 3, 5, 6]`
		`t → [5, 0]`

addition & **slicing** create new lists containing existing elements	`a = s + [t]`
	`b = a[1:]`
	`a[1] = 9`
	`b[1][1] = 0`
		`s → [2, 3]`
		`t → [5, 0]`
		`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

```
Assume that before each example below we execute:
s = [2, 3]
t = [5, 6]
```

Lists in Environment Diagrams

Assume that before each example below we execute:

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

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:

```
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)`
		s → [2, 3]
		t → [6, 5, 6]

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)`
		s → [2, 3]
		t → [6, 5, 6]

slice assignment can remove elements from a list by assigning [] to a slice.		

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)`
		`s → [2, 3]`
		`t → [6, 5, 6]`

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

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)`
		`s → [2, 3]`
		`t → [6, 5, 6]`

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

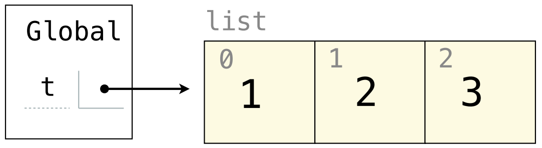
Lists in Lists in Lists in Environment Diagrams

```
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

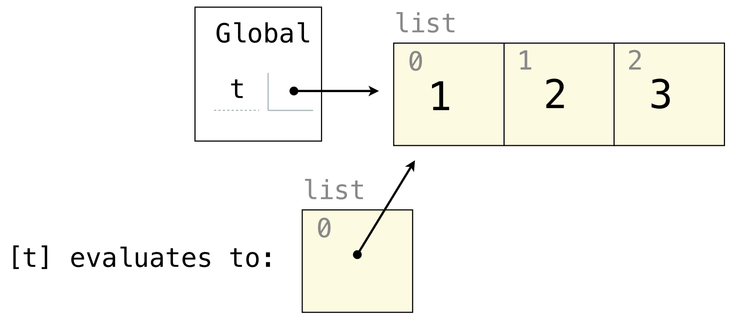
```
t = [1, 2, 3]
t[1:3] = [t]
t.extend(t)
```



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

Lists in Lists in Lists in Environment Diagrams

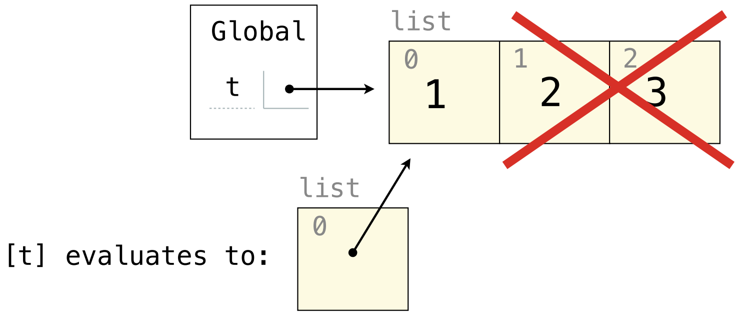
```
t = [1, 2, 3]
t[1:3] = [t]
t.extend(t)
```



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

Lists in Lists in Lists in Environment Diagrams

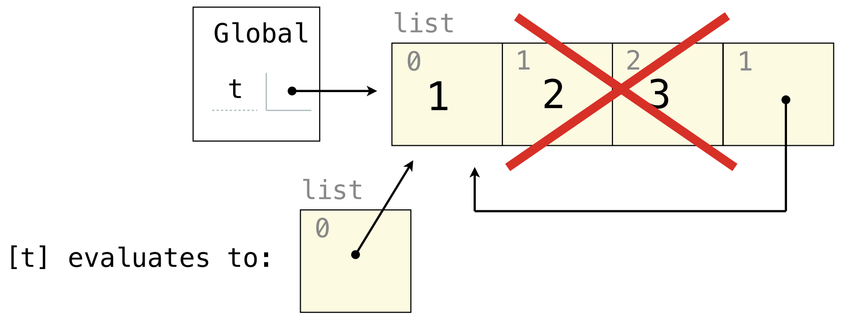
```
t = [1, 2, 3]
t[1:3] = [t]
t.extend(t)
```



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

Lists in Lists in Lists in Environment Diagrams

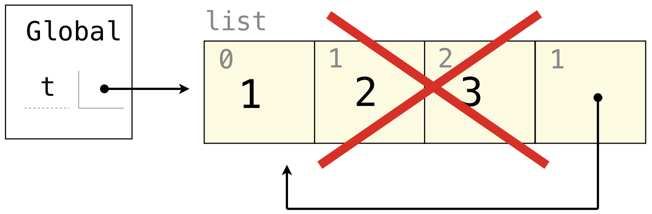
```
t = [1, 2, 3]
t[1:3] = [t]
t.extend(t)
```



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

Lists in Lists in Lists in Environment Diagrams

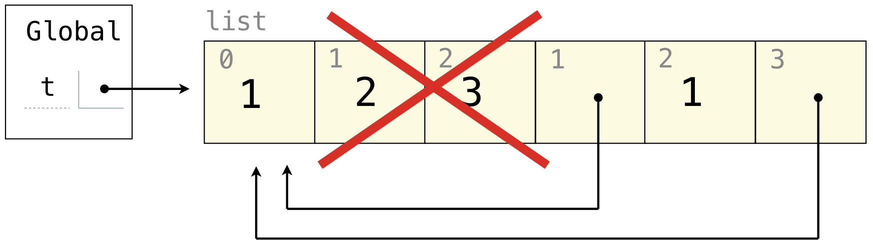
```
t = [1, 2, 3]
t[1:3] = [t]
t.extend(t)
```



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

Lists in Lists in Lists in Environment Diagrams

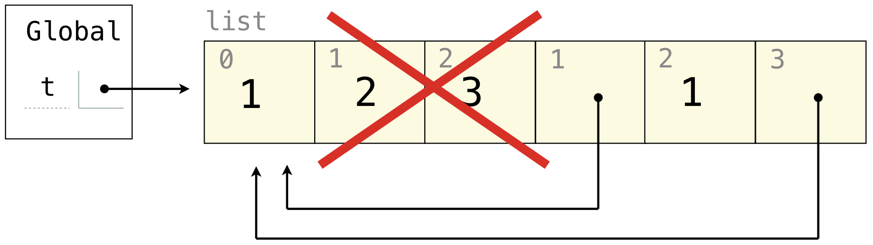
```
t = [1, 2, 3]
t[1:3] = [t]
t.extend(t)
```



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

Lists in Lists in Lists in Environment Diagrams

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

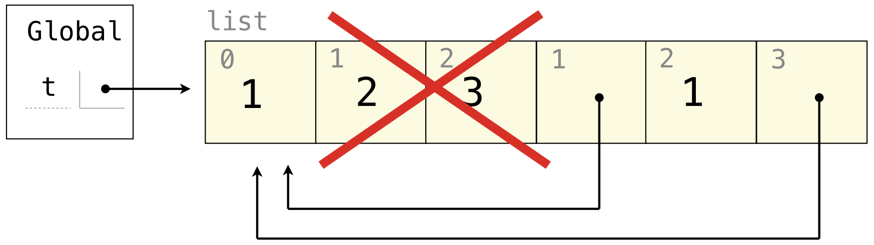


```
[1, [...], 1, [...]]
```

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

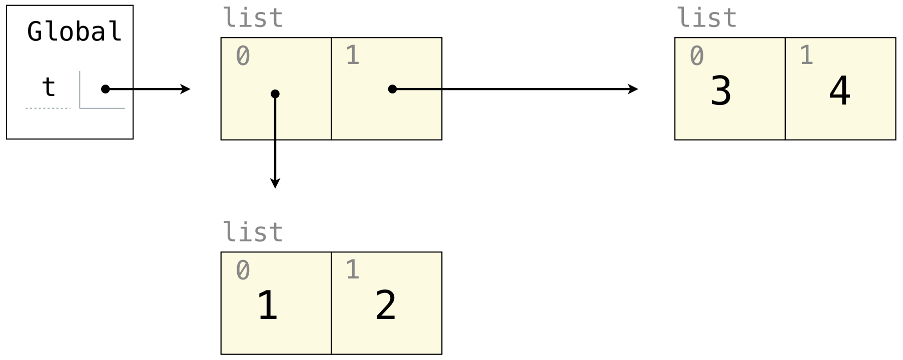
Lists in Lists in Lists in Environment Diagrams

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



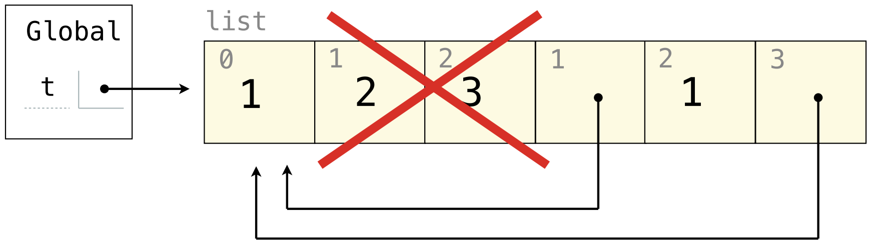
```
[1, [...], 1, [...]]
```

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



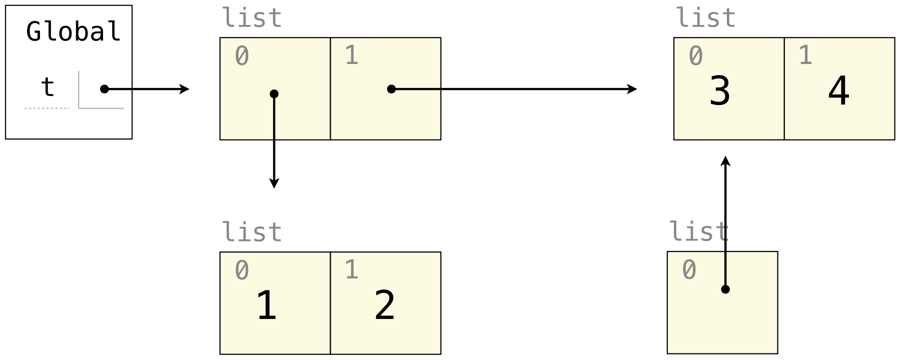
Lists in Lists in Lists in Environment Diagrams

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



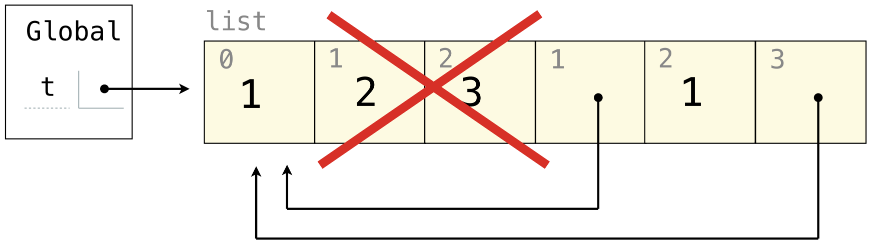
```
[1, [...], 1, [...]]
```

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



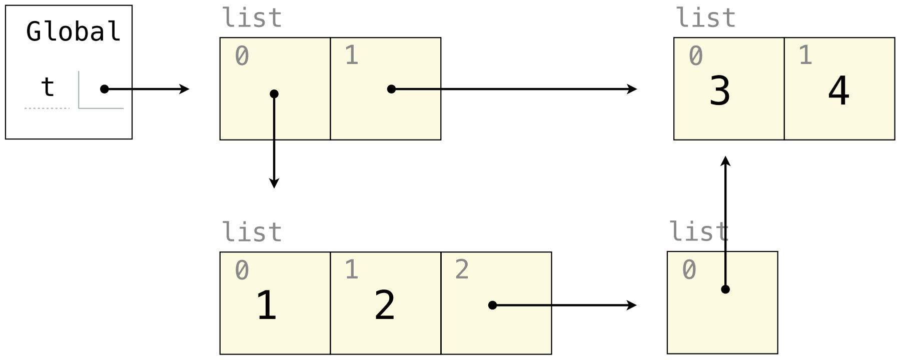
Lists in Lists in Lists in Environment Diagrams

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



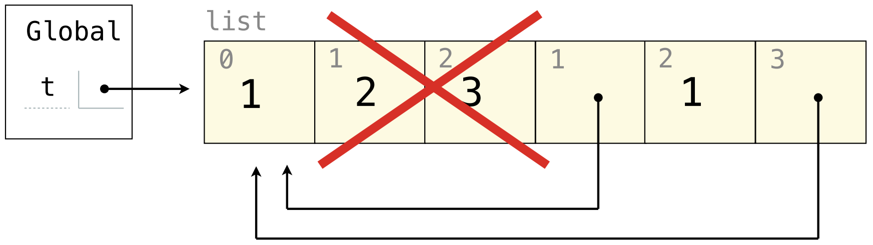
```
[1, [...], 1, [...]]
```

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



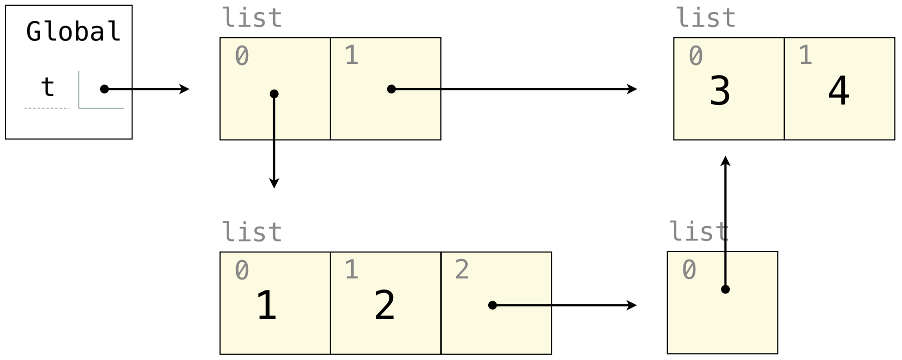
Lists in Lists in Lists in Environment Diagrams

```
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]]
```

Examples: Objects

Land Owners

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

Land Owners

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

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):
```

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'
```

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

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'
```

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()

>>> jack

>>> jack.work()

>>> john.work()

>>> john.elf.work(john)
```

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()

>>> jack

>>> jack.work()

>>> john.work()

>>> john.elf.work(john)
```

<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
    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()

>>> jack

>>> jack.work()

>>> john.work()

>>> john.elf.work(john)
```

```
<class Worker>
greeting: 'Sir'

<class Bourgeoisie>
greeting: 'Peon'
```

Land Owners

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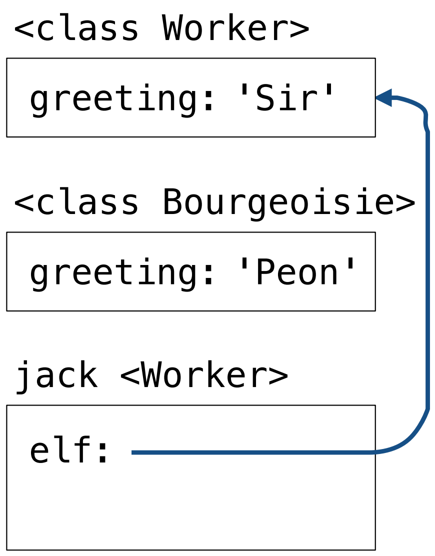

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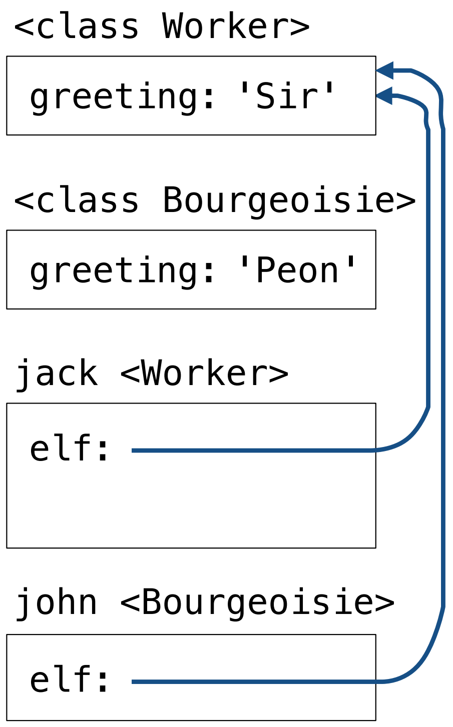

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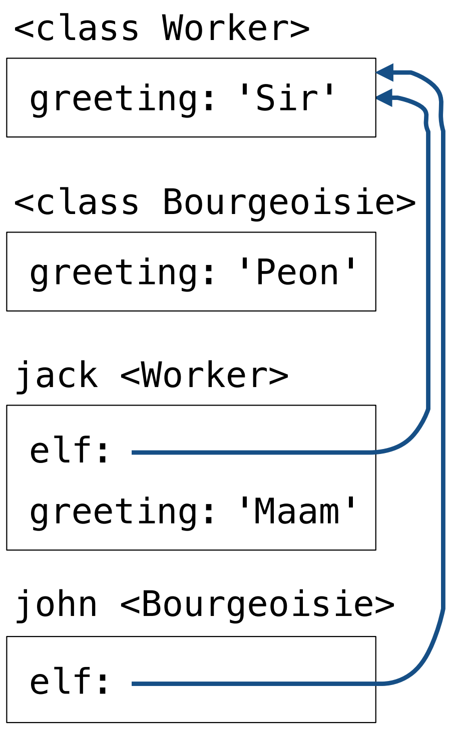

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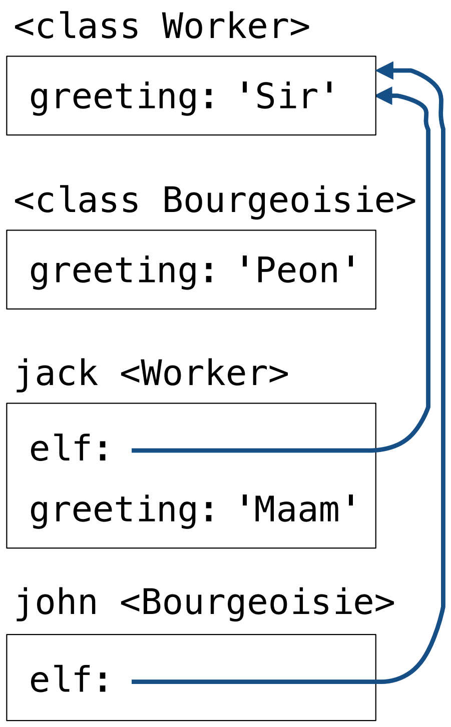

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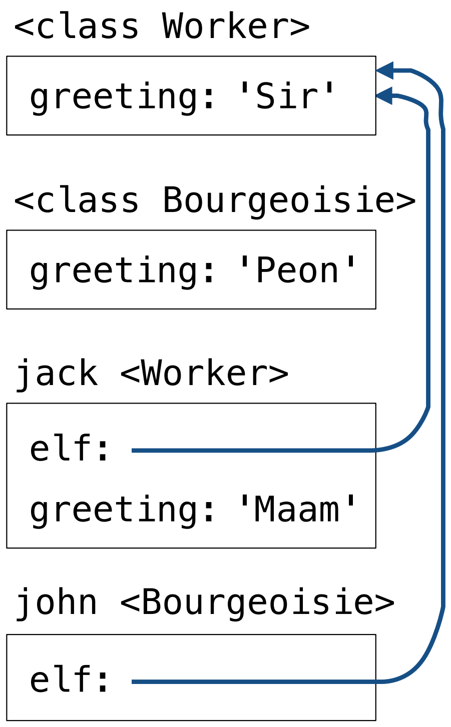

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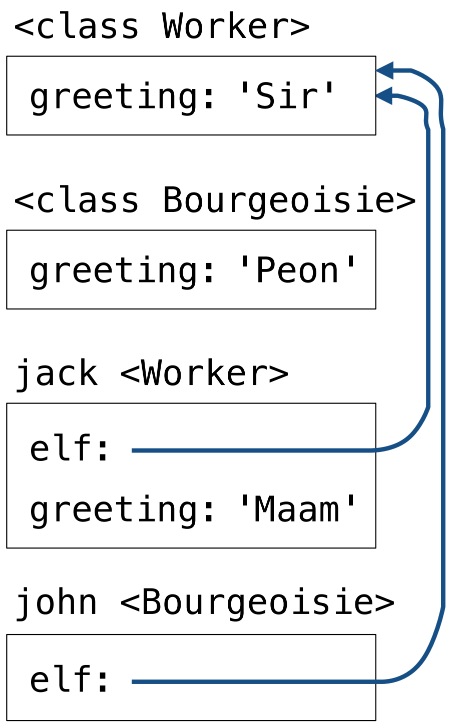

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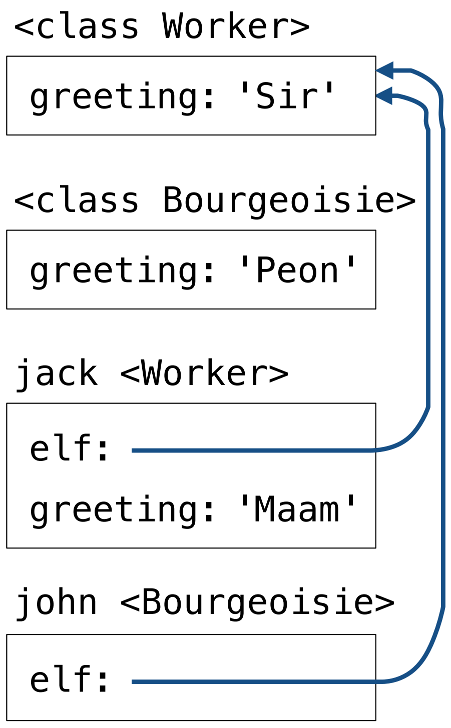

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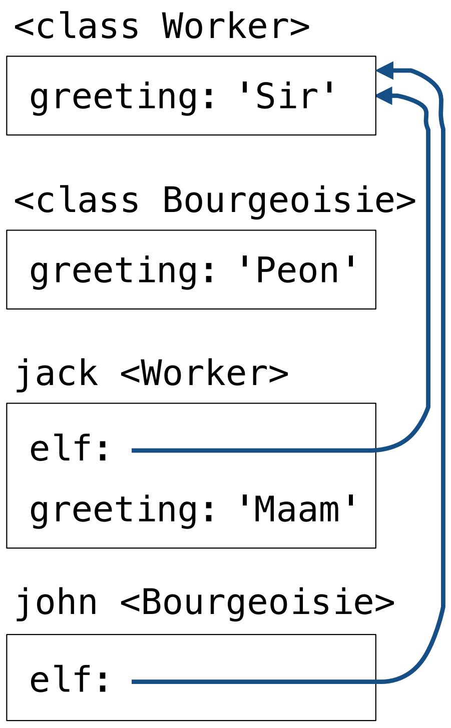

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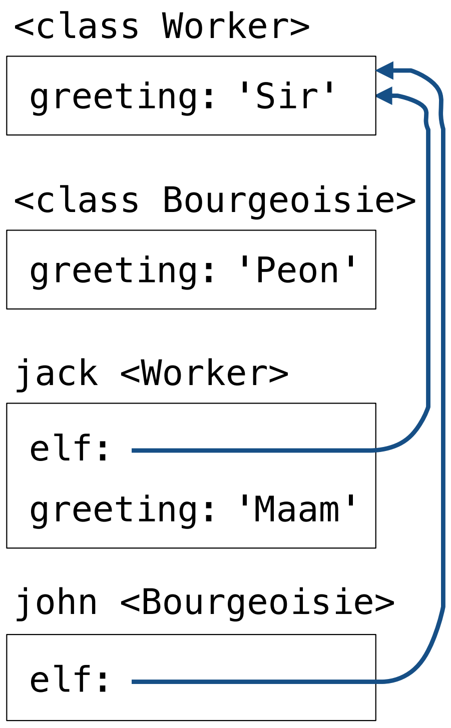

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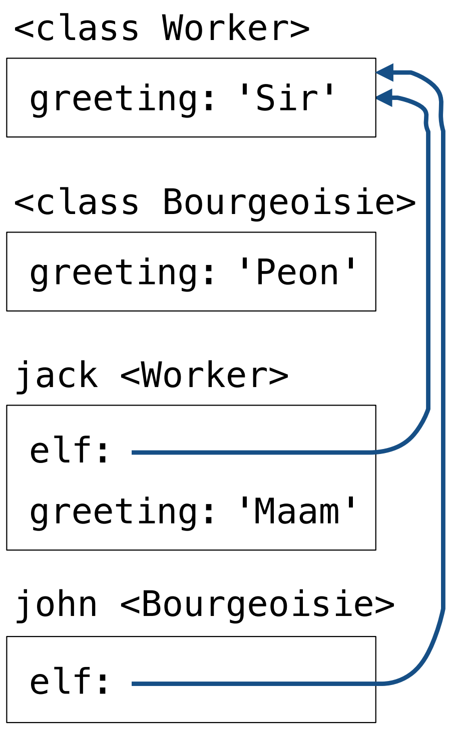

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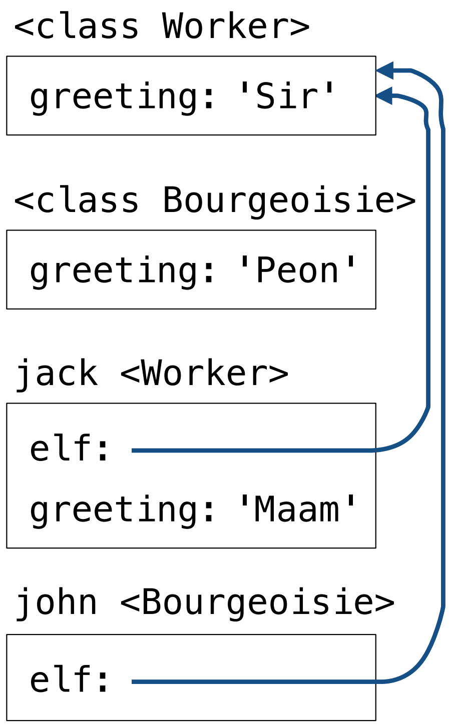

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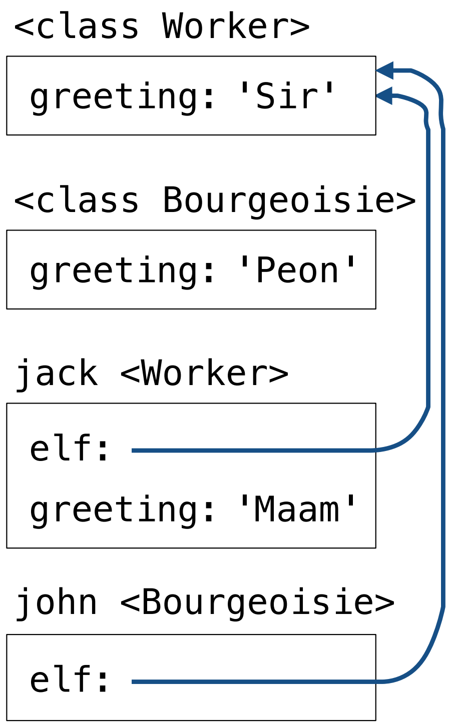

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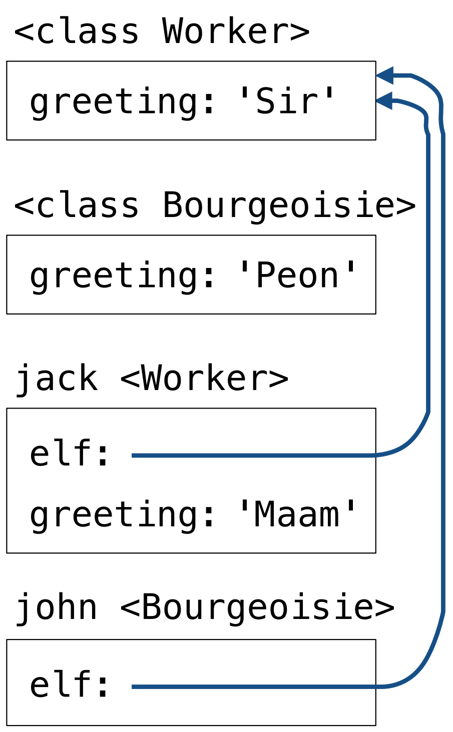

Examples: Iterables & Iterators

Using Built-In Functions & Comprehensions

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```
What are the indices of all elements in a list s that have the smallest absolute value?
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Using Built-In Functions & Comprehensions

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What are the indices of all elements in a list s that have the smallest absolute value?

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Using Built-In Functions & Comprehensions

What are the indices of all elements in a list s that have the smallest absolute value?

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[-4, -3, -2,  3,  2,  4]  ▷  [2, 4]
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```

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What's the largest sum of two adjacent elements in a list s? (Assume len(s) > 1)

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Create a dictionary mapping each digit d to the lists of elements in s that end with d.

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[5, 8, 13, 21, 34, 55, 89]
```

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Create a dictionary mapping each digit d to the lists of elements in s that end with d.

```
[5, 8, 13, 21, 34, 55, 89]  ▷  {1: [21], 3: [13], 4: [34], 5: [5, 55], 8: [8], 9: [89]}
```

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What are the indices of all elements in a list s that have the smallest absolute value?

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Does every element equal some other element in s?

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```
[-4, -3, -2,  3,  2,  4] ▷ False
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Does every element equal some other element in s?

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[-4, -3, -2,  3,  2,  4]  ▷  False       [4, 3, 2, 3, 2, 4]  ▷  True
```

Examples: Linked Lists

Linked List Exercises

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`Is a linked list s ordered from least to greatest?`

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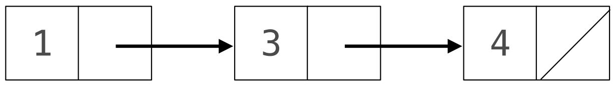

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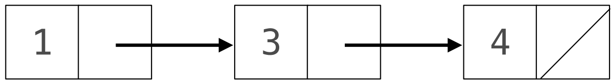

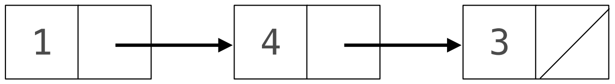

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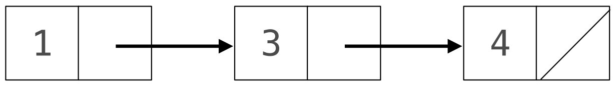

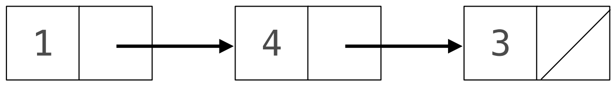

Is a linked list s ordered from least to greatest by absolute value (or a key function)?

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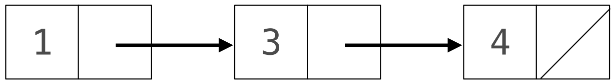

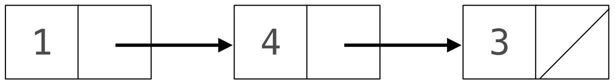

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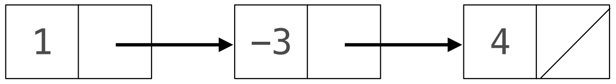

Linked List Exercises

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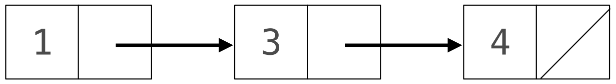

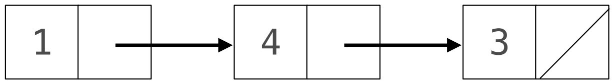

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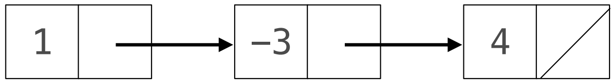

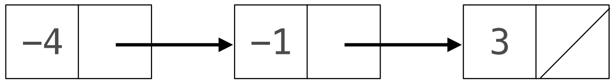

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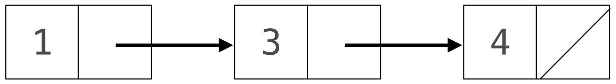

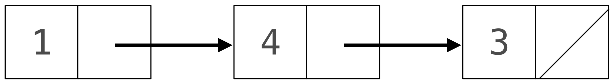

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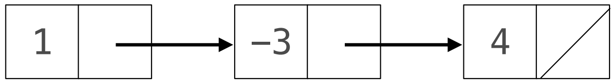

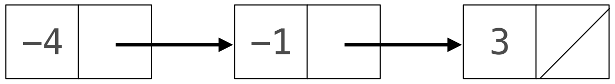

`Create a sorted Link containing all the elements of both sorted Links s & t.`

Linked List Exercises

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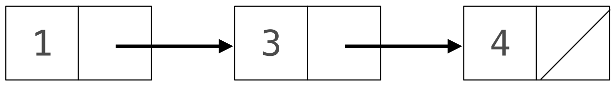

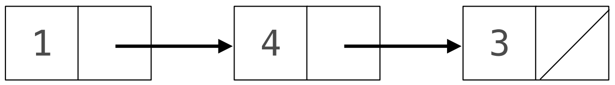

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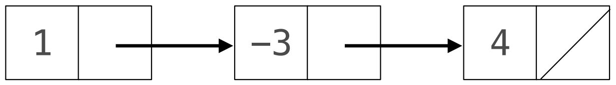

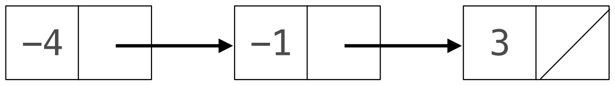

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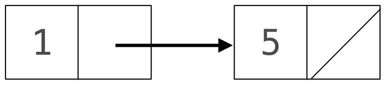

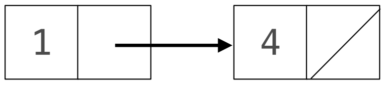

Linked List Exercises

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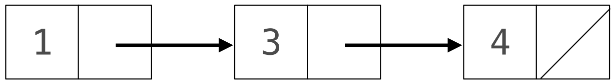

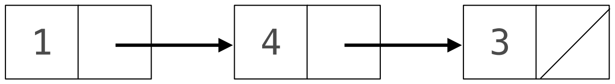

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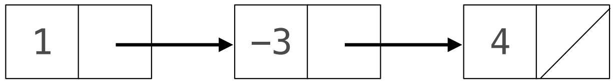

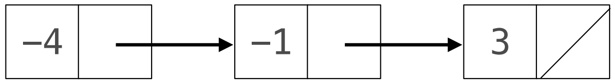

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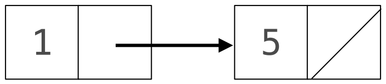

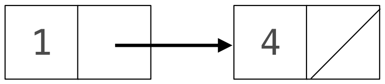

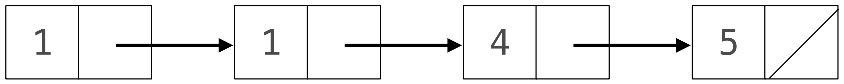

Linked List Exercises

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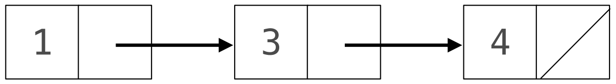

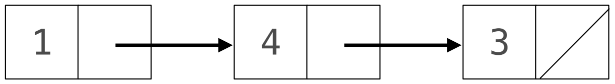

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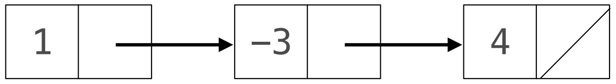

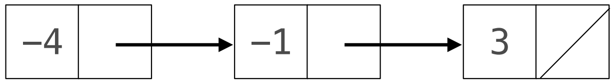

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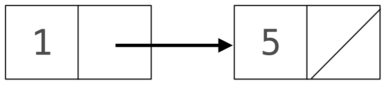

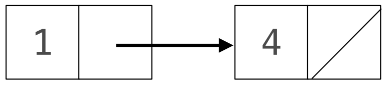

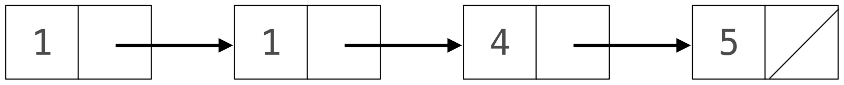

Do the same thing, but never call Link.

Linked List Exercises

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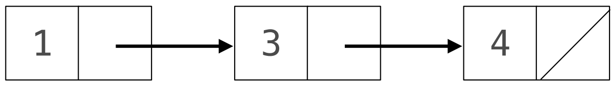

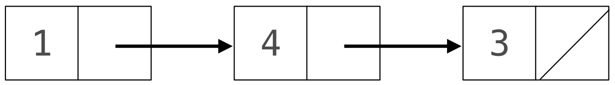

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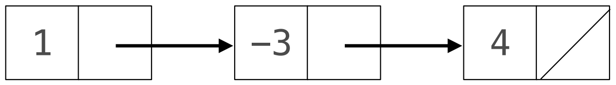

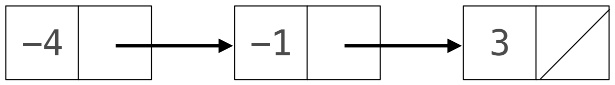

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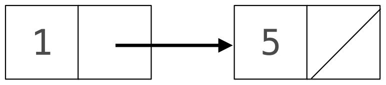

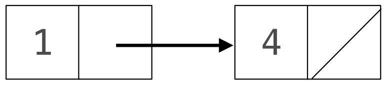

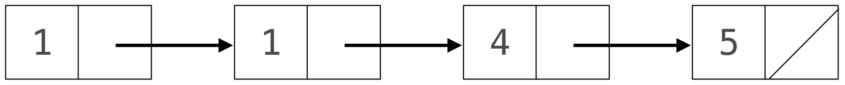

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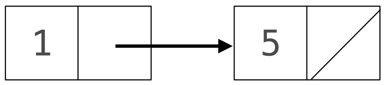

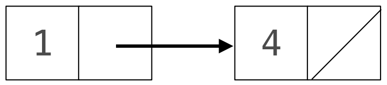

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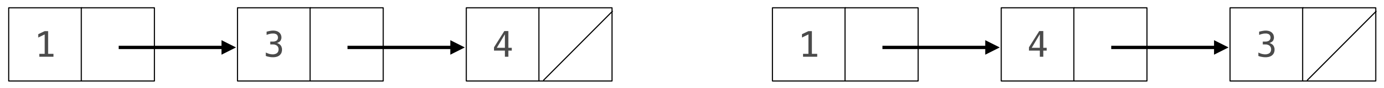

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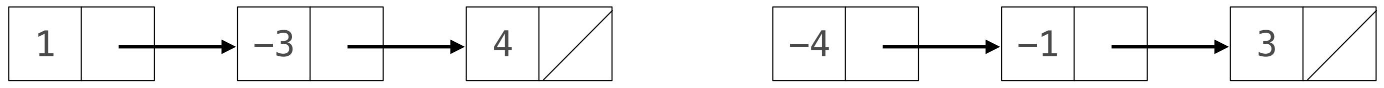

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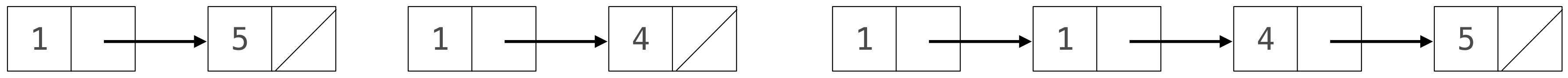

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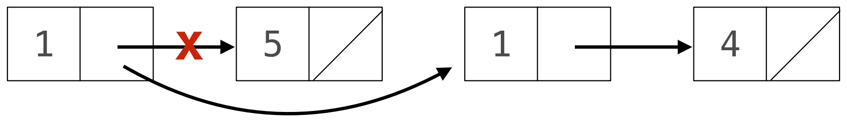

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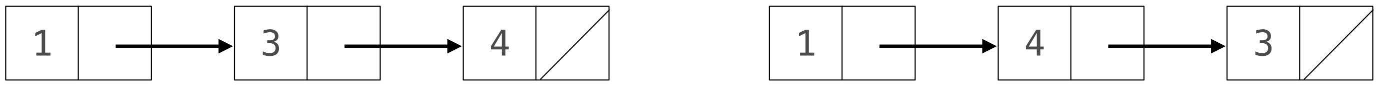

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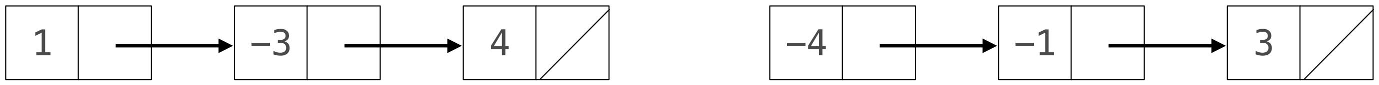

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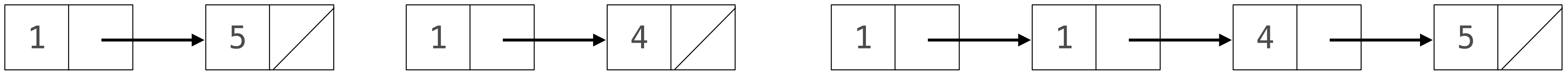

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