Containers

Announcements

Lists

```
['Demo']
```

Working with Lists

Working with Lists

```
>>> digits = [1, 8, 2, 8]
```

Working with Lists

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>>> digits = [1, 8, 2, 8]
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```
>>> digits = [2//2, 2+2+2+2, 2, 2*2*2]
```

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The number of elements

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>>> len(digits)
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>>> digits[3]
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```
>>> getitem(digits, 3)
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Concatenation and repetition

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```

Concatenation and repetition

```
>>> [2, 7] + digits * 2
[2, 7, 1, 8, 2, 8, 1, 8, 2, 8]
```

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```
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8
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```
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8
```

Concatenation and repetition

```
>>> [2, 7] + digits * 2
[2, 7, 1, 8, 2, 8, 1, 8, 2, 8]
```

```
>>> add([2, 7], mul(digits, 2))
[2, 7, 1, 8, 2, 8, 1, 8, 2, 8]
```

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```

Nested lists

Working with Lists

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```

```
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An element selected by its index

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>>> digits[3]
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```
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```

Concatenation and repetition

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>>> [2, 7] + digits * 2
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```

```
>>> add([2, 7], mul(digits, 2))
[2, 7, 1, 8, 2, 8, 1, 8, 2, 8]
```

Nested lists

```
>>> pairs = [[10, 20], [30, 40]]
>>> pairs[1]
[30, 40]
>>> pairs[1][0]
30
```

Containers

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Built-in operators for testing whether an element appears in a compound value

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```
>>> digits = [1, 8, 2, 8]
```

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```
>>> digits = [1, 8, 2, 8]
>>> 1 in digits
True
```

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```
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>>> 1 in digits
True
>>> 8 in digits
True
```

Containers

Built-in operators for testing whether an element appears in a compound value

```
>>> digits = [1, 8, 2, 8]
>>> 1 in digits
True
>>> 8 in digits
True
>>> 5 not in digits
True
```

Containers

Built-in operators for testing whether an element appears in a compound value

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>>> digits = [1, 8, 2, 8]
>>> 1 in digits
True
>>> 8 in digits
True
>>> 5 not in digits
True
>>> not(5 in digits)
True
```

Containers

Built-in operators for testing whether an element appears in a compound value

```
>>> digits = [1, 8, 2, 8]
>>> 1 in digits
True
>>> 8 in digits
True
>>> 5 not in digits
True
>>> not(5 in digits)
True
```

(Demo)

For Statements

(Demo)

Sequence Iteration

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```
def count(s, value):
    total = 0
    for element in s:


        if element == value:
            total = total + 1
    return total
```

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        if element == value:
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```

Name bound in the first frame of the current environment (not a new frame)

For Statement Execution Procedure

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for <name> in <expression>:
    <suite>
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For Statement Execution Procedure

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   A. Bind <name> to that element in the current frame

For Statement Execution Procedure

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for <name> in <expression>:
    <suite>
```

1. Evaluate the header <expression>, which must yield an iterable value (a sequence)
2. For each element in that sequence, in order:
   A. Bind <name> to that element in the current frame
   B. Execute the <suite>

Sequence Unpacking in For Statements

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```
>>> pairs = [[1, 2], [2, 2], [3, 2], [4, 4]]
>>> same_count = 0
```

Sequence Unpacking in For Statements

A sequence of fixed-length sequences

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>>> pairs = [[1, 2], [2, 2], [3, 2], [4, 4]]
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Sequence Unpacking in For Statements

A sequence of fixed-length sequences

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>>> pairs = [[1, 2], [2, 2], [3, 2], [4, 4]]
>>> same_count = 0
```

```
>>> for x, y in pairs:
...     if x == y:
...         same_count = same_count + 1

>>> same_count
2
```

Sequence Unpacking in For Statements

A sequence of fixed-length sequences

```
>>> pairs = [[1, 2], [2, 2], [3, 2], [4, 4]]
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```

A name for each element in a fixed-length sequence

```
>>> for x, y in pairs:
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>>> same_count
2
```

Sequence Unpacking in For Statements

A sequence of fixed-length sequences

```
>>> pairs = [[1, 2], [2, 2], [3, 2], [4, 4]]
>>> same_count = 0
```

A name for each element in a fixed-length sequence

Each name is bound to a value, as in multiple assignment

```
>>> for x, y in pairs:
...     if x == y:
...         same_count = same_count + 1

>>> same_count
2
```

Ranges

The Range Type

```
A range is a sequence of consecutive integers.*
```

The Range Type

A range is a sequence of consecutive integers.*

* Ranges can actually represent more general integer sequences.

The Range Type

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```
..., -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, ...
```

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The Range Type

A range is a sequence of consecutive integers.*

... -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, ...

```
range(-2, 2)
```

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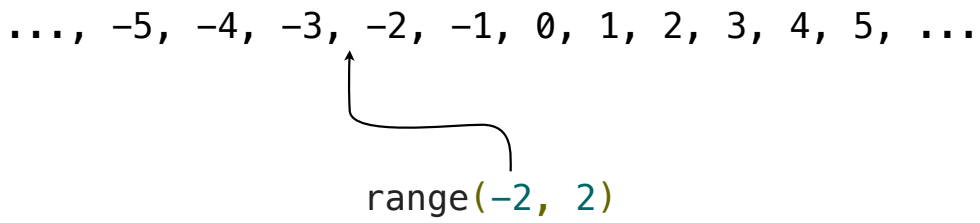

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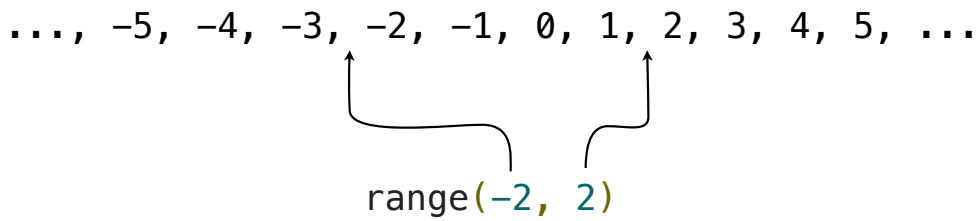

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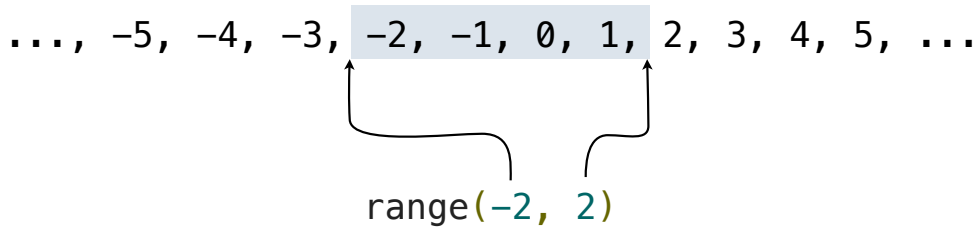

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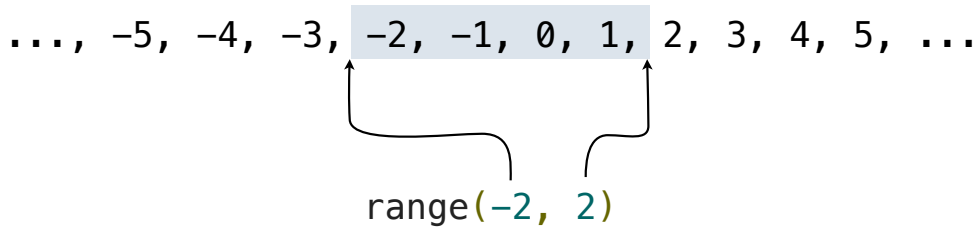

Length: ending value - starting value

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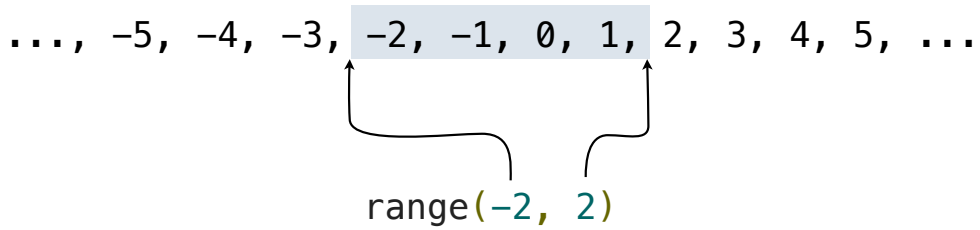

Length: ending value − starting value

Element selection: starting value + index

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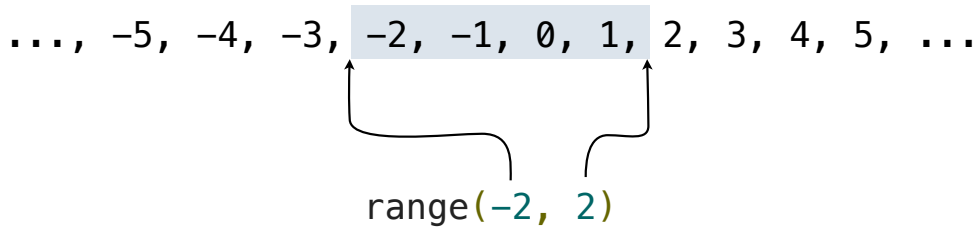

Length: ending value - starting value

Element selection: starting value + index

```
>>> list(range(-2, 2))
[-2, -1, 0, 1]

>>> list(range(4))
[0, 1, 2, 3]
```

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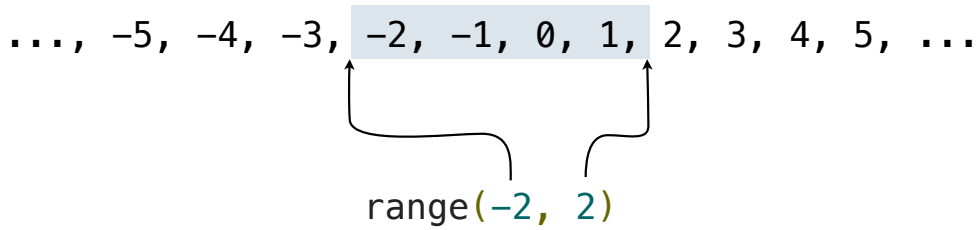

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List constructor

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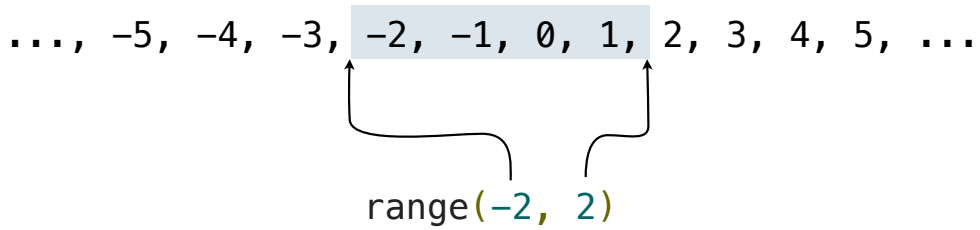

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List constructor

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Range with a 0 starting value

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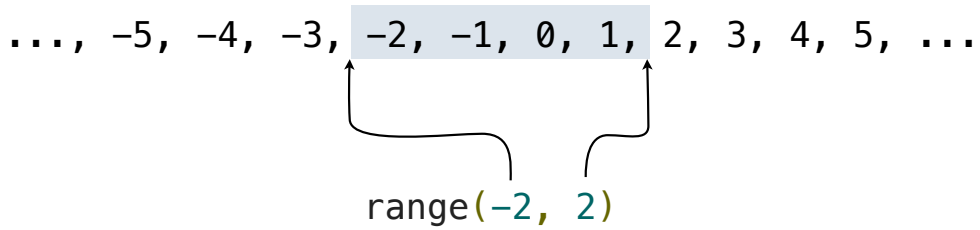

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Element selection: starting value + index

(Demo)

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>>> list(range(-2, 2))
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List constructor

```
>>> list(range(4))
[0, 1, 2, 3]
```

Range with a 0 starting value

* Ranges can actually represent more general integer sequences.

Recursive Sums

Sum (recursively)

```
def mysum(L):
    if (L == []):
        return 0
    else:
        return L[0] + mysum( L[1:] )
```

```
mysum( [2, 4, 1, 5] )

2 + mysum( [4, 1, 5] )
    4 + mysum( [1, 5] )
        1 + mysum( [5] )
            5 + mysum( [] )
                0
```

```
# --- DRILL ---
# Write an iterative function that takes as input
# integer “n” and returns the sum of the first “n”
# integers: sum(5) returns 1+2+3+4+5
```

```
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def sum_iter(n):
    sum = 0
    for i in range(0,n+1):
        sum = sum + i

    return( sum )
```

```
# --- DRILL ---
# Write a recursive function that takes as input
# integer “n” and returns the sum of the first “n”
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```
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# Write a recursive function that takes as input
# integer “n” and returns the sum of the first “n”
# integers: sum(5) returns 1+2+3+4+5


def sum_rec(n):
    if( n == 0 ):
        return(0)
    else:
        return n + sum_rec(n-1)
```

List Comprehensions

List Comprehensions

```
>>> letters = ['a', 'b', 'c', 'd', 'e', 'f', 'm', 'n', 'o', 'p']
>>> [letters[i] for i in [3, 4, 6, 8]]
```

List Comprehensions

```
>>> letters = ['a', 'b', 'c', 'd', 'e', 'f', 'm', 'n', 'o', 'p']
>>> [letters[i] for i in [3, 4, 6, 8]]
['d', 'e', 'm', 'o']
```

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```
[<map exp> for <name> in <iter exp> if <filter exp>]
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1. Add a new frame with the current frame as its parent
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3. For each element in the iterable value of <iter exp>:

List Comprehensions

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[<map exp> for <name> in <iter exp> if <filter exp>]
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   A. Bind <name> to that element in the new frame from step 1

List Comprehensions

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A combined expression that evaluates to a list using this evaluation procedure:

1. Add a new frame with the current frame as its parent
2. Create an empty *result list* that is the value of the expression
3. For each element in the iterable value of <iter exp>:
   A. Bind <name> to that element in the new frame from step 1
   B. If <filter exp> evaluates to a true value, then add the value of <map exp> to the result list

Strings

Strings are an Abstraction

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Representing data:

```
'200'      '1.2e-5'      'False'      '[1, 2]'
```

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Representing language:

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A local habitation and a name.
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'curry = lambda f: lambda x: lambda y: f(x, y)'
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'curry = lambda f: lambda x: lambda y: f(x, y)'
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(Demo)

String Literals Have Three Forms

```
>>> 'I am string!'
'I am string!'

>>> "I've got an apostrophe"
"I've got an apostrophe"

>>> '您好'
'您好'
```

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Single-quoted and double-quoted strings are equivalent

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>>> """The Zen of Python
claims, Readability counts.
Read more: import this."""
'The Zen of Python\nclaims, Readability counts.\nRead more: import this.'
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Single-quoted and double-quoted strings are equivalent

A backslash "escapes" the following character

"Line feed" character represents a new line

Reversing a String

Reversing a List (recursively)

```
reverse("ward") = "draw"

reverse("ward") = reverse("ard") + "w"

    reverse("ard") = reverse("rd") + "a"

        reverse("rd") = reverse("d") + "r"

            reverse("d") = "d"
```

Reversing a List (recursively)

```
reverse("ward") = "draw"

reverse("ward") = reverse("ard") + "w"

    reverse("ard") = "d" + "r" + "a"
```

Reversing a List (recursively)

```
def reverse(s):
    if len(s) == 1:
        return s
    else:
        return reverse(s[1:]) + s[0]
```