Announcements
Lists

['Demo']
Working with Lists
Working with Lists

```python
>>> digits = [1, 8, 2, 8]
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Working with Lists

```python
>>> digits = [1, 8, 2, 8]
>>> digits = [2//2, 2+2+2, 2, 2*2*2]
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The number of elements
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>>> digits = [1, 8, 2, 8]
>>> digits = [2//2, 2+2+2+2, 2, 2*2*2]

The number of elements

>>> len(digits)
4
```
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>>> digits = [1, 8, 2, 8]
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An element selected by its index

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>>> getitem(digits, 3)
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Concatenation and repetition

>>> digits = [2//2, 2+2+2+2, 2, 2*2*2]

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Concatenation and repetition
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>>> [2, 7] + digits * 2
[2, 7, 1, 8, 2, 8, 1, 8, 2, 8]
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```python
>>> getitem(digits, 3)
8
```

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

>>> digits = [2//2, 2+2+2+2, 2, 2*2*2]
Containers
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Built-in operators for testing whether an element appears in a compound value
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```python
>>> digits = [1, 8, 2, 8]
```
Containers

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

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

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

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

```python
>>> 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

```python
>>> 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

```python
>>> 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
def count(s, value):
    total = 0
    for element in s:
        if element == value:
            total += 1
    return total
def count(s, value):
    total = 0
    for element in s:
        if element == value:
            total = total + 1
    return total
For Statement Execution Procedure
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for <name> in <expression>:
    <suite>
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1. Evaluate the header <expression>, which must yield an iterable value (a sequence)
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2. For each element in that sequence, in order:
For Statement Execution Procedure

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   A. Bind `<name>` to that element in the current frame
For Statement Execution Procedure

```
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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```python
>>> 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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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
```
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Ranges
The Range Type

A range is a sequence of consecutive integers.*
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..., -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, ...

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\[ \text{range}(-2, 2) \]

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Length: ending value - starting value

Element selection: starting value + index

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

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

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

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

\[
[\text{map exp} \ for \ <name> \ in \ <iter \ exp> \ if \ <filter \ exp>]
\]
List Comprehensions

[<map exp> for <name> in <iter exp> if <filter exp>]

Short version: [<map exp> for <name> in <iter exp>]
List Comprehensions

```
[<map exp> for <name> in <iter exp> if <filter exp>]
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Short version: `[<map exp> for <name> in <iter exp>]`

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

[<map exp> for <name> in <iter exp> if <filter exp>]

Short version: [<map exp> for <name> in <iter exp>]

A combined expression that evaluates to a list using this evaluation procedure:
1. Add a new frame with the current frame as its parent
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
List Comprehensions

\[ \begin{align*} 
\text{[<map exp> for <name> in <iter exp> if <filter exp>]} 
\end{align*} \]

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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
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3. For each element in the iterable value of \(<\text{iter exp}>\):
List Comprehensions

\[
[\text{map exp} \text{ for } \text{name} \text{ in } \text{iter exp} \text{ if } \text{filter exp}]
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\text{map exp} \text{ for } \text{name} \text{ in } \text{iter exp}
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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 \langle\text{iter exp}\rangle:
   A. Bind \langle\text{name}\rangle to that element in the new frame from step 1
   B. If \langle\text{filter exp}\rangle evaluates to a true value, then add the value of \langle\text{map exp}\rangle 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:

"""""And, as imagination bodies forth
The forms of things to unknown, and the poet's pen
Turns them to shapes, and gives to airy nothing
A local habitation and a name.""""
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Representing programs:

'curry = lambda f: lambda x: lambda y: f(x, y)'
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String Literals Have Three Forms

```python
>>> '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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claims, Readability counts.
Read more: import this."""
'The Zen of Python\nclaims, Readability counts.\nRead more: import this.'
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A backslash "escapes" the following character

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Dictionaries

{"Dem": 0}
Limitations on Dictionaries
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Dictionaries are unordered collections of key-value pairs.
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Dictionaries are unordered collections of key-value pairs.

Dictionary keys do have two restrictions:
Limitations on Dictionaries

Dictionaries are unordered collections of key-value pairs

Dictionary keys do have two restrictions:

- A key of a dictionary cannot be a list or a dictionary (or any mutable type)
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Dictionaries are unordered collections of key-value pairs

Dictionary keys do have two restrictions:

• A key of a dictionary **cannot be** a list or a dictionary (or any mutable type)

• Two keys **cannot be equal**; There can be at most one value for a given key
Limitations on Dictionaries

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This first restriction is tied to Python's underlying implementation of dictionaries.
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The second restriction is part of the dictionary abstraction
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The second restriction is part of the dictionary abstraction

If you want to associate multiple values with a key, store them all in a sequence value