Python

Lists

Loops let us do things many times

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Collections let us store many values together

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Collections let us store many values together

Most popular collection is a *list*

Create using `[value, value, ...]`

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Get/set values using `var[index]`

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Get/set values using `var[index]`

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print gases
['He', 'Ne', 'Ar', 'Kr']
```

Create using `[value, value, ...]`

Get/set values using `var[index]`

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print gases
['He', 'Ne', 'Ar', 'Kr']

print gases[1]
Ne
```

Index from 0, not 1

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Reasons made sense for C in 1970...

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It's an error to try to access out of range

Index from 0, not 1

Reasons made sense for C in 1970...

It's an error to try to access out of range

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print gases[4]
IndexError: list index out of range
```

Use `len(list)` to get length of list

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```
gases = ['He', 'Ne', 'Ar', 'Kr']
print len(gases)
4
```

Use `len(list)` to get length of list

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print len(gases)
4
```

Returns 0 for the *empty list*

```
etheric = []
print len(etheric)
0
```

Some negative indices work

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`values[-1]` is last element, `values[-2]` next-to-last, ...

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```
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```
gases = ['He', 'Ne', 'Ar', 'Kr']
print gases[-1], gases[-4]
Kr He
```

Some negative indices work

`values[-1]` is last element, `values[-2]` next-to-last, ...

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print gases[-1], gases[-4]
Kr He
```

`values[-1]` is much nicer than `values[len(values)-1]`

Some negative indices work

`values[-1]` is last element, `values[-2]` next-to-last, ...

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print gases[-1], gases[-4]
Kr He
```

`values[-1]` is much ~~nicer~~ than `values[len(values)-1]`

less error prone

Mutable : can change it after it is created

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```
gases = ['He', 'Ne', 'Ar', 'K']  # last entry misspelled
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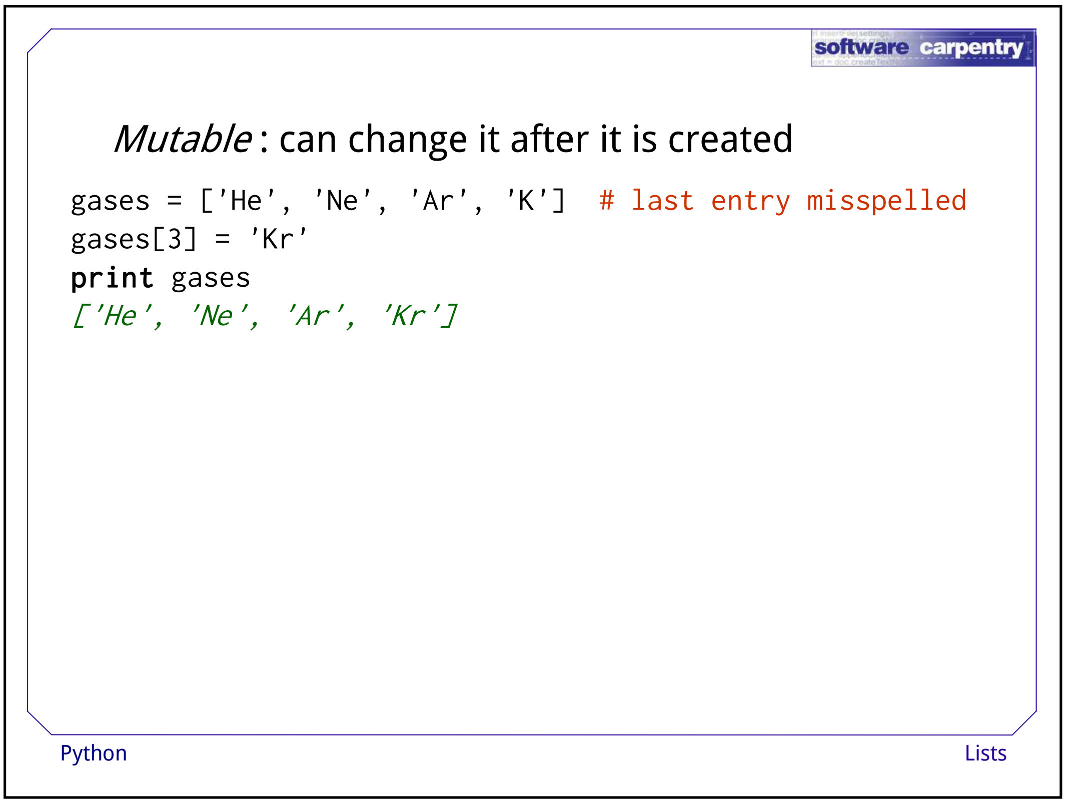
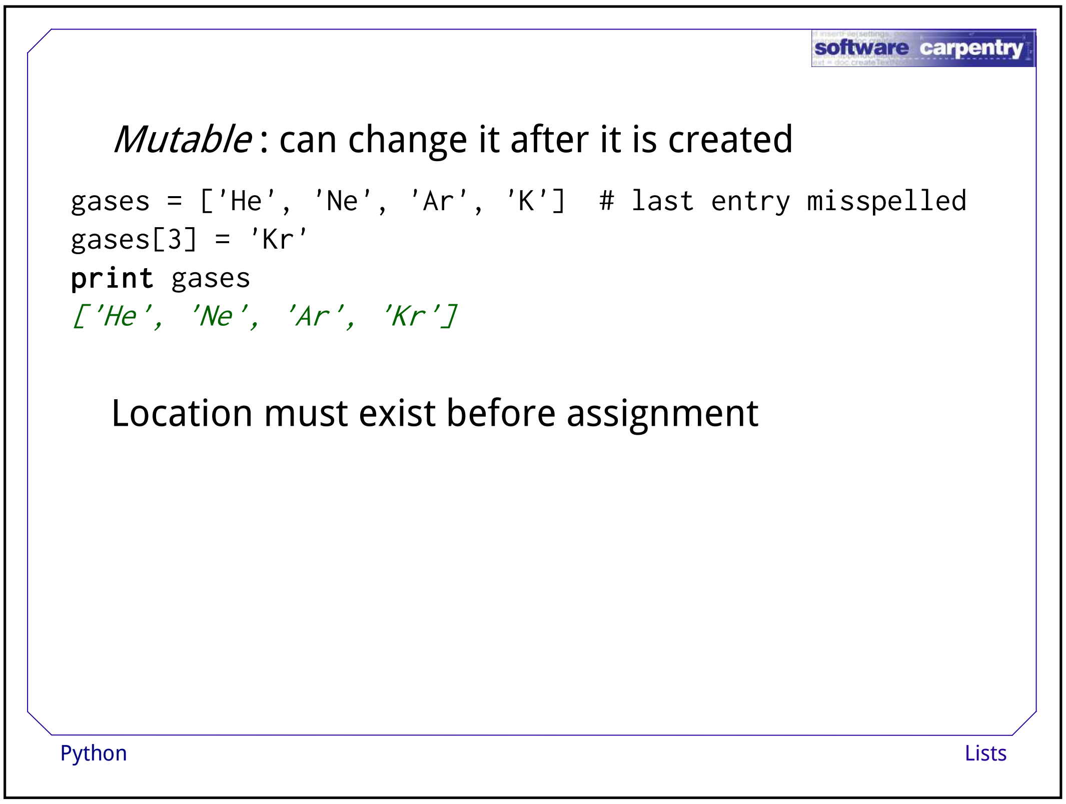
gases = ['He', 'Ne', 'Ar', 'K']  # last entry misspelled
gases[3] = 'Kr'
```



Mutable : can change it after it is created

```
gases = ['He', 'Ne', 'Ar', 'K']  # last entry misspelled
gases[3] = 'Kr'
print gases
['He', 'Ne', 'Ar', 'Kr']
```



Mutable : can change it after it is created

```
gases = ['He', 'Ne', 'Ar', 'K']  # last entry misspelled
gases[3] = 'Kr'
print gases
['He', 'Ne', 'Ar', 'Kr']
```

Location must exist before assignment

Mutable : can change it after it is created

```
gases = ['He', 'Ne', 'Ar', 'K']  # last entry misspelled
gases[3] = 'Kr'
print gases
['He', 'Ne', 'Ar', 'Kr']
```

Location must exist before assignment

```
gases = ['He', 'Ne', 'Ar', 'Kr']
```

Mutable : can change it after it is created

```
gases = ['He', 'Ne', 'Ar', 'K']  # last entry misspelled
gases[3] = 'Kr'
print gases
['He', 'Ne', 'Ar', 'Kr']
```

Location must exist before assignment

```
gases = ['He', 'Ne', 'Ar', 'Kr']
gases[4] = 'Xe'
IndexError: list assignment index out of range
```

Heterogeneous : can store values of many kinds

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```
helium = ['He', 2]
neon = ['Ne', 8]
```

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```
helium = ['He', 2]
neon = ['Ne', 8]
```

[string, int]

Heterogeneous : can store values of many kinds

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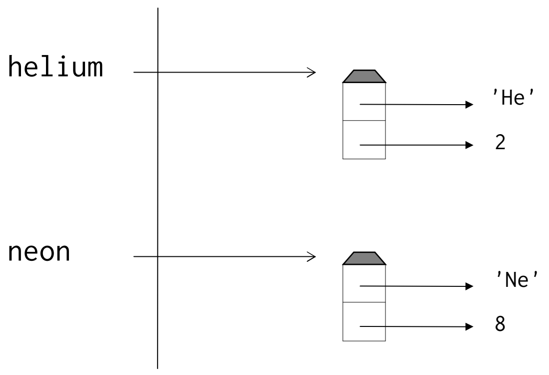

Heterogeneous : can store values of many kinds

```
helium = ['He', 2]
neon = ['Ne', 8]
gases = [helium, neon]
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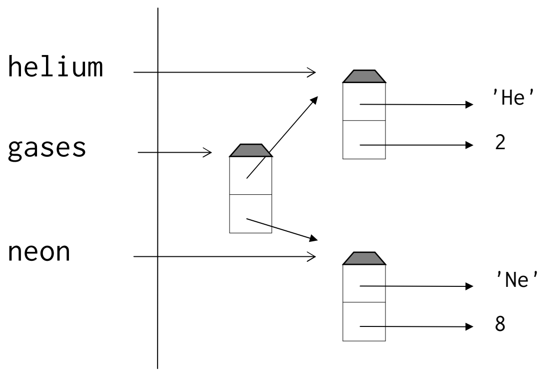
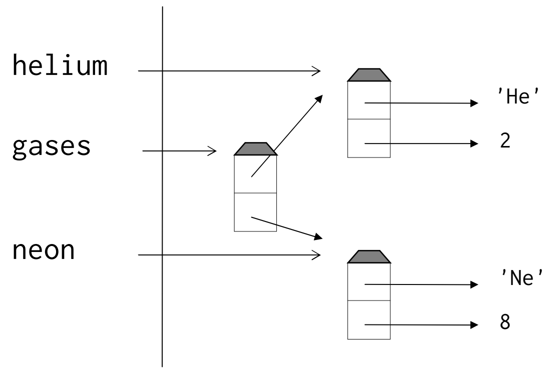
Heterogeneous : can store values of many kinds

```
helium = ['He', 2]
neon = ['Ne', 8]
gases = [helium, neon]
```



Heterogeneous : can store values of many kinds

```
helium = ['He', 2]
neon = ['Ne', 8]
gases = [helium, neon]
```



Devote a whole episode to this

Loop over elements to "do all"

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Use `while` to step through all possible indices

Loop over elements to "do all"

Use `while` to step through all possible indices

```
gases = ['He', 'Ne', 'Ar', 'Kr']
i = 0
while i < len(gases):
    print gases[i]
    i += 1
```

software carpentry

Loop over elements to "do all"

Use `while` to step through all possible indices

```
gases = ['He', 'Ne', 'Ar', 'Kr']
i = 0
while i < len(gases):
    print gases[i]
    i += 1
```

First legal index

software carpentry

Loop over elements to "do all"

Use `while` to step through all possible indices

```
gases = ['He', 'Ne', 'Ar', 'Kr']
i = 0
while i < len(gases):
    print gases[i]
    i += 1
```

Next index

Loop over elements to "do all"

Use `while` to step through all possible indices

```
gases = ['He', 'Ne', 'Ar', 'Kr']
i = 0
while i < len(gases):
    print gases[i]
    i += 1
```

Defines set of legal indices

Loop over elements to "do all"

Use `while` to step through all possible indices

```
gases = ['He', 'Ne', 'Ar', 'Kr']
i = 0
while i < len(gases):
    print gases[i]
    i += 1
He
Ne
Ar
Kr
```

Loop over elements to "do all"

Use `while` to step through all possible indices

```
gases = ['He', 'Ne', 'Ar', 'Kr']
i = 0
while i < len(gases):
    print gases[i]
    i += 1
He
Ne
Ar
Kr
```

Tedious to type in over and over again

Loop over elements to "do all"

Use `while` to step through all possible indices

```
gases = ['He', 'Ne', 'Ar', 'Kr']
i = 0
while i < len(gases):
    print gases[i]
    i += 1
He
Ne
Ar
Kr
```

Tedious to type in over and over again

And it's easy to forget the "+= 1" at the end

Use a `for` loop to access each value in turn

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```
gases = ['He', 'Ne', 'Ar', 'Kr']
for gas in gases:
    print gas
He
Ne
Ar
Kr
```

Use a `for` loop to access each value in turn

```
gases = ['He', 'Ne', 'Ar', 'Kr']
for gas in gases:
    print gas
He
Ne
Ar
Kr
```

Loop variable assigned each *value* in turn

Use a `for` loop to access each value in turn

```
gases = ['He', 'Ne', 'Ar', 'Kr']
for gas in gases:
    print gas
He
Ne
Ar
Kr
```

Loop variable assigned each *value* in turn

Not each index

Use a `for` loop to access each value in turn

```
gases = ['He', 'Ne', 'Ar', 'Kr']
for gas in gases:
    print gas
He
Ne
Ar
Kr
```

Loop variable assigned each *value* in turn

Not each index

Because that's the most common case

Can delete entries entirely (shortens the list)

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```
gases = ['He', 'Ne', 'Ar', 'Kr']
```

Can delete entries entirely (shortens the list)

```
gases = ['He', 'Ne', 'Ar', 'Kr']
del gases[0]
```

Can delete entries entirely (shortens the list)

```
gases = ['He', 'Ne', 'Ar', 'Kr']
del gases[0]
print gases
['Ne', 'Ar', 'Kr']
```

Can delete entries entirely (shortens the list)

```
gases = ['He', 'Ne', 'Ar', 'Kr']
del gases[0]
print gases
['Ne', 'Ar', 'Kr']
del gases[2]
```

Python Lists

Can delete entries entirely (shortens the list)

```
gases = ['He', 'Ne', 'Ar', 'Kr']
del gases[0]
print gases
['Ne', 'Ar', 'Kr']
del gases[2]
print gases
['Ne', 'Ar']
```

Can delete entries entirely (shortens the list)

```
gases = ['He', 'Ne', 'Ar', 'Kr']
del gases[0]
print gases
['Ne', 'Ar', 'Kr']
del gases[2]
print gases
['Ne', 'Ar']
```

Yes, deleting an index that doesn't exist is an error

Appending values to a list lengthens it

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```
gases = []
```

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```
gases = []
gases.append('He')
```

Appending values to a list lengthens it

```
gases = []
gases.append('He')
gases.append('Ne')
```

Appending values to a list lengthens it

```
gases = []
gases.append('He')
gases.append('Ne')
gases.append('Ar')
```

Appending values to a list lengthens it

```
gases = []
gases.append('He')
gases.append('Ne')
gases.append('Ar')
print gases
['He', 'Ne', 'Ar']
```

Appending values to a list lengthens it

```
gases = []
gases.append('He')
gases.append('Ne')
gases.append('Ar')
print gases
['He', 'Ne', 'Ar']
```

Most operations on lists are *methods*

Appending values to a list lengthens it

```
gases = []
gases.append('He')
gases.append('Ne')
gases.append('Ar')
print gases
['He', 'Ne', 'Ar']
```

Most operations on lists are *methods*

A function that belongs to (and usually operates on) specific data

Appending values to a list lengthens it

```
gases = []
gases.append('He')
gases.append('Ne')
gases.append('Ar')
print gases
['He', 'Ne', 'Ar']
```

Most operations on lists are *methods*

A function that belongs to (and usually operates on) specific data

```
thing . method (args)
```

Some useful list methods

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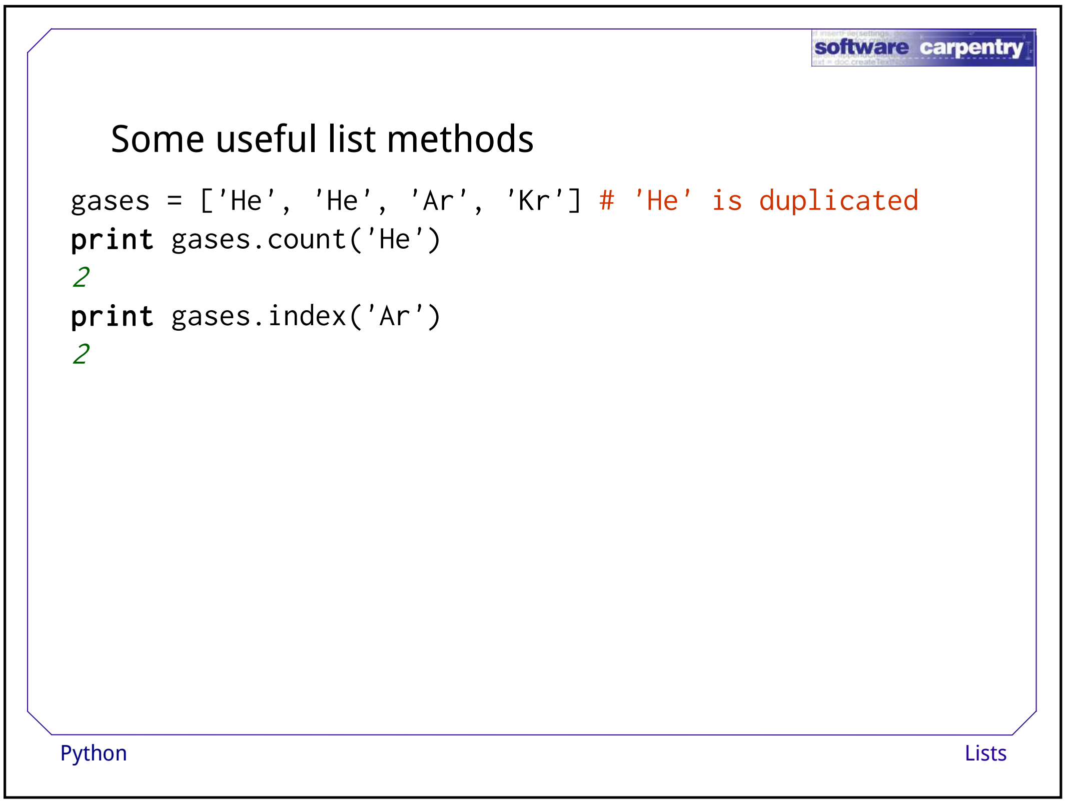
```
gases = ['He', 'He', 'Ar', 'Kr'] # 'He' is duplicated
```

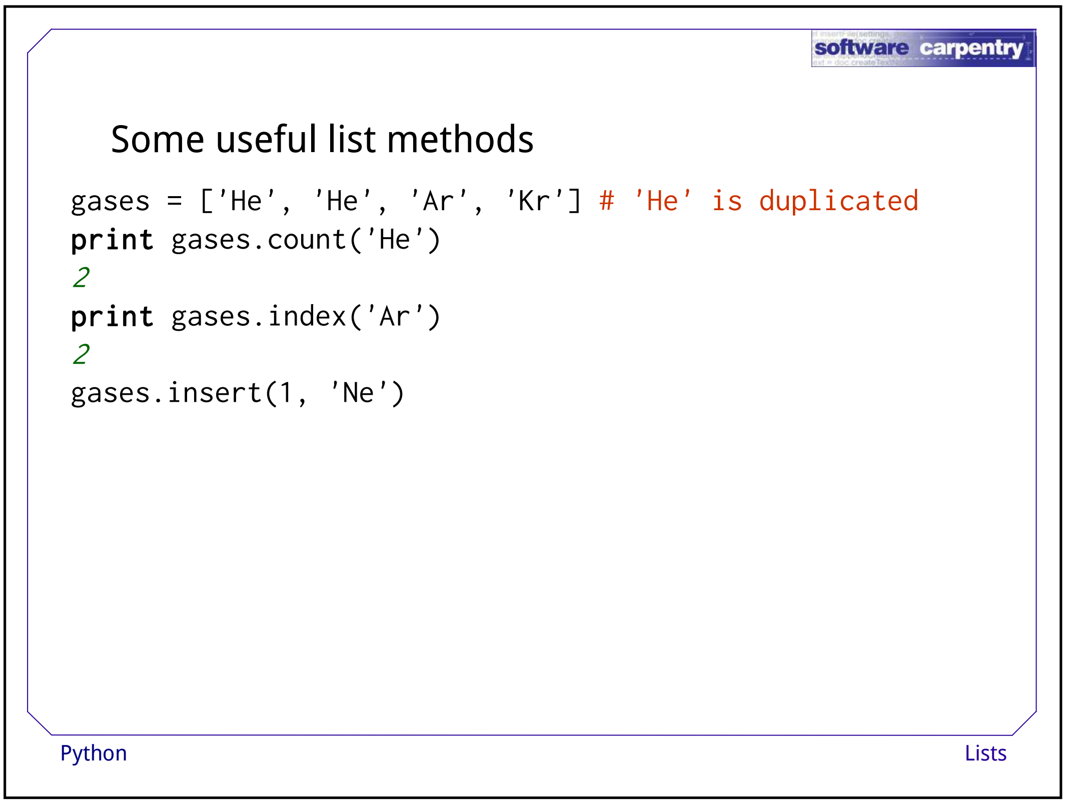
Some useful list methods

```
gases = ['He', 'He', 'Ar', 'Kr'] # 'He' is duplicated
print gases.count('He')
2
```



Some useful list methods

```
gases = ['He', 'He', 'Ar', 'Kr'] # 'He' is duplicated
print gases.count('He')
2
print gases.index('Ar')
2
```



Some useful list methods

```
gases = ['He', 'He', 'Ar', 'Kr'] # 'He' is duplicated
print gases.count('He')
2
print gases.index('Ar')
2
gases.insert(1, 'Ne')
```

Some useful list methods

```
gases = ['He', 'He', 'Ar', 'Kr'] # 'He' is duplicated
print gases.count('He')
2
print gases.index('Ar')
2
gases.insert(1, 'Ne')
print gases
['He', 'Ne', 'He', 'Ar', 'Kr']
```

Two that are often used incorrectly

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```
gases = ['He', 'Ne', 'Ar', 'Kr']
```

Two that are often used incorrectly

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print gases.sort()
None
```

Two that are often used incorrectly

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print gases.sort()
None
print gases
['Ar', 'He', 'Kr', 'Ne']
```

Two that are often used incorrectly

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print gases.sort()
None
print gases
['Ar', 'He', 'Kr', 'Ne']
print gases.reverse()
None
```

Two that are often used incorrectly

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print gases.sort()
None
print gases
['Ar', 'He', 'Kr', 'Ne']
print gases.reverse()
None
print gases
['Ne', 'Kr', 'He', 'Ar']
```

Two that are often used incorrectly

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print gases.sort()
None
print gases
['Ar', 'He', 'Kr', 'Ne']
print gases.reverse()
None
print gases
['Ne', 'Kr', 'He', 'Ar']
```

A common bug

Two that are often used incorrectly

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print gases.sort()
None
print gases
['Ar', 'He', 'Kr', 'Ne']
print gases.reverse()
None
print gases
['Ne', 'Kr', 'He', 'Ar']
```

A common bug

`gases = gases.sort()` assigns `None` to `gases`

Use `in` to test for membership

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```
gases = ['He', 'Ne', 'Ar', 'Kr']
```

Use `in` to test for membership

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print 'He' in gases
True
```

Use `in` to test for membership

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print 'He' in gases
True
if 'Pu' in gases:
    print 'But plutonium is not a gas!'
else:
    print 'The universe is well ordered.'
```

Use `in` to test for membership

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print 'He' in gases
True
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    print 'But plutonium is not a gas!'
else:
    print 'The universe is well ordered.'
The universe is well ordered.
```

Use `range` to construct lists of numbers

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```
print range(5)
[0, 1, 2, 3, 4]
```

Use range to construct lists of numbers

```
print range(5)
[0, 1, 2, 3, 4]
print range(2, 6)
[2, 3, 4, 5]
```

Use range to construct lists of numbers

```
print range(5)
[0, 1, 2, 3, 4]
print range(2, 6)
[2, 3, 4, 5]
print range(0, 10, 3)
[0, 3, 6, 9]
```

Use range to construct lists of numbers

```
print range(5)
[0, 1, 2, 3, 4]
print range(2, 6)
[2, 3, 4, 5]
print range(0, 10, 3)
[0, 3, 6, 9]
print range(10, 0)
[]
```

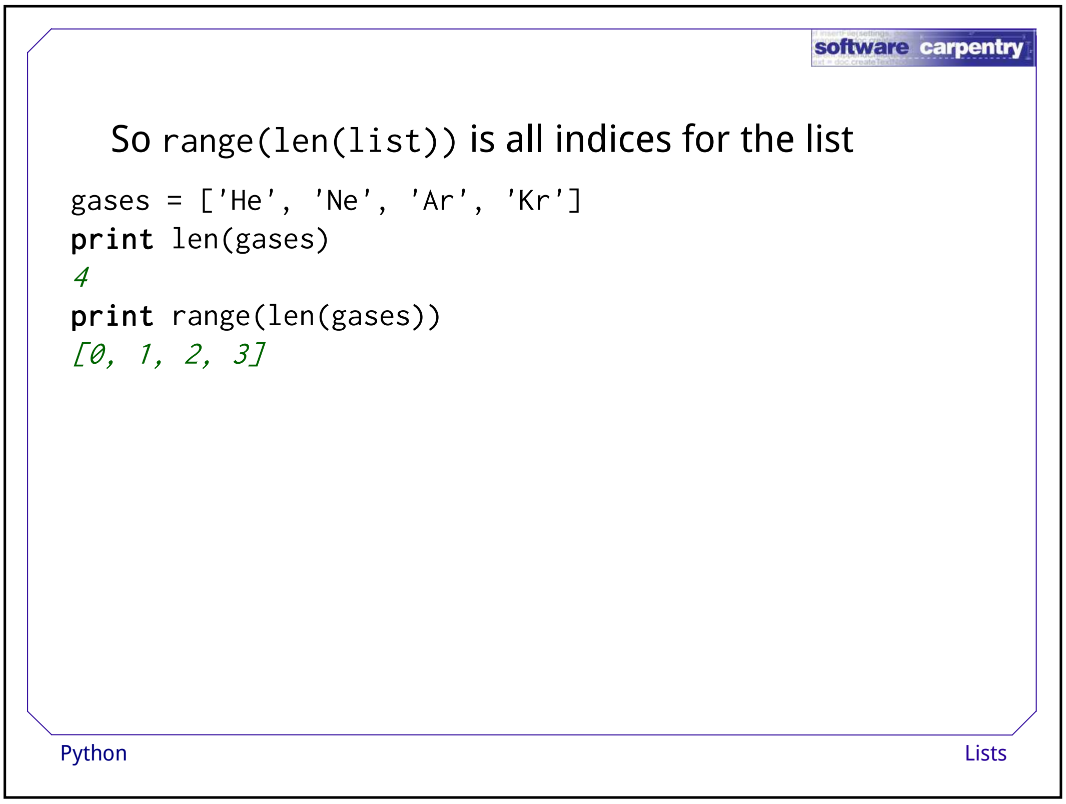
So range(len(list)) is all indices for the list

So `range(len(list))` is all indices for the list

```
gases = ['He', 'Ne', 'Ar', 'Kr']
```

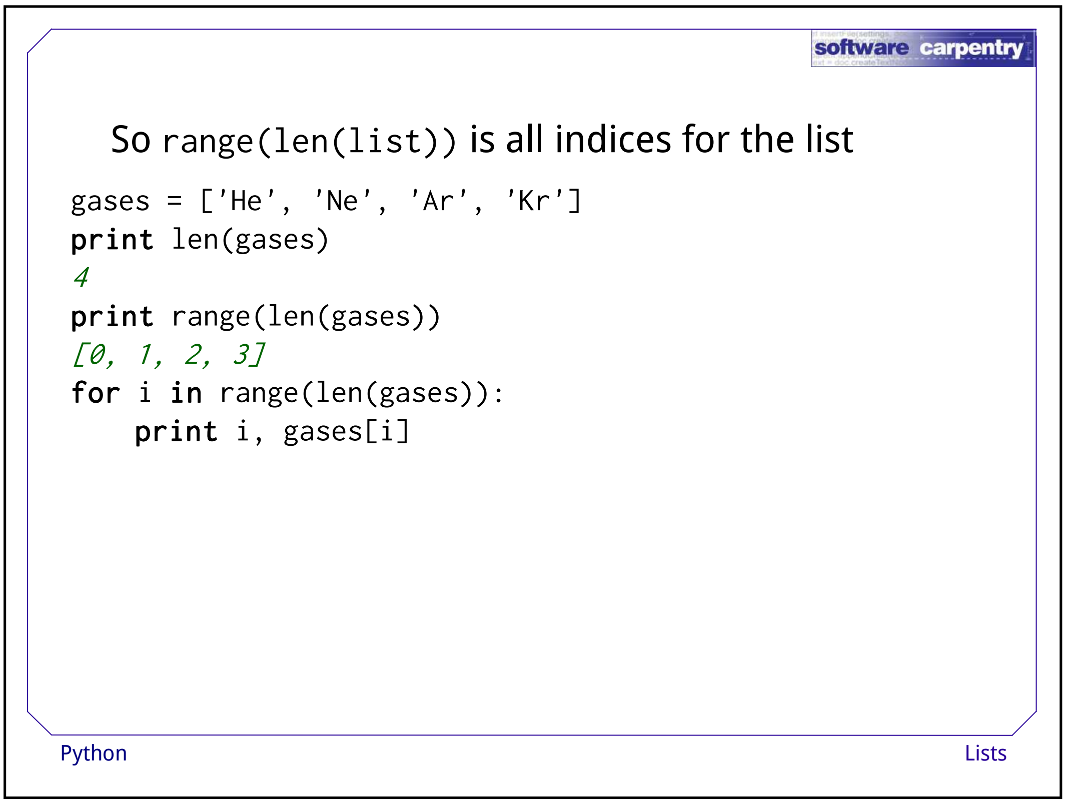
So `range(len(list))` is all indices for the list

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print len(gases)
4
```



So `range(len(list))` is all indices for the list

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print len(gases)
4
print range(len(gases))
[0, 1, 2, 3]
```



So `range(len(list))` is all indices for the list

```
gases = ['He', 'Ne', 'Ar', 'Kr']
print len(gases)
4
print range(len(gases))
[0, 1, 2, 3]
for i in range(len(gases)):
    print i, gases[i]
```

So `range(len(list))` is all indices for the list

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gases = ['He', 'Ne', 'Ar', 'Kr']
print len(gases)
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print range(len(gases))
[0, 1, 2, 3]
for i in range(len(gases)):
    print i, gases[i]
0 He
1 Ne
2 Ar
3 Kr
```

So `range(len(list))` is all indices for the list

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gases = ['He', 'Ne', 'Ar', 'Kr']
print len(gases)
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for i in range(len(gases)):
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0 He
1 Ne
2 Ar
3 Kr
```

A very common *idiom* in Python

narrated by

Dominique Vuvan

October 2010