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

Use len(list) to get length of list

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

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
```

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
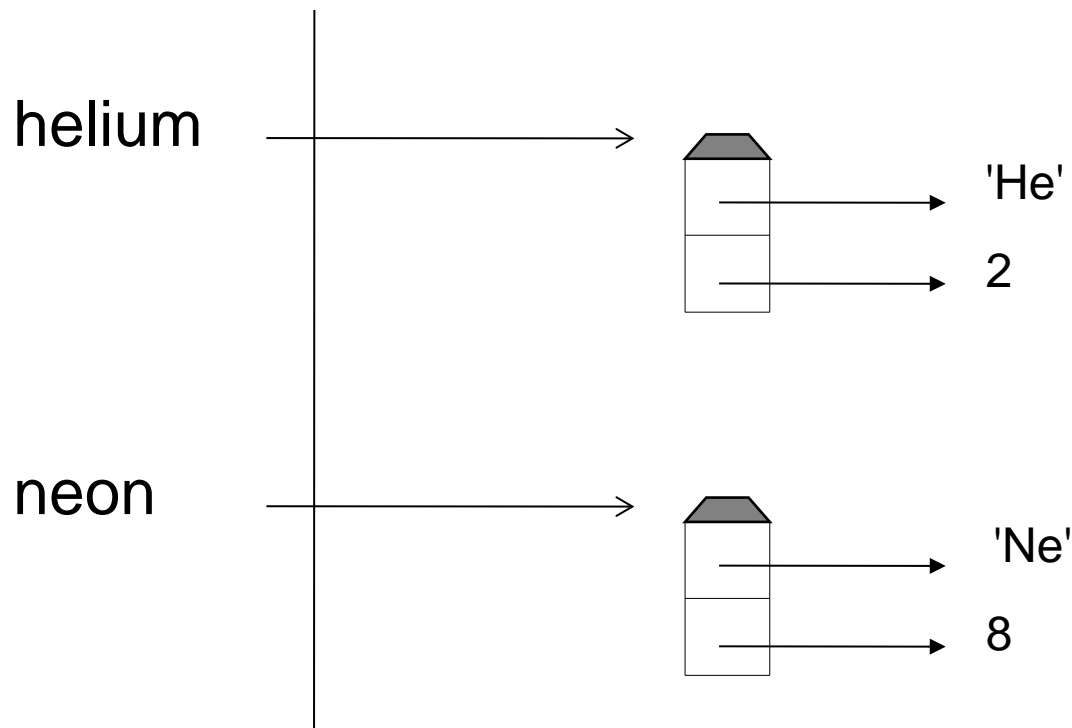
Heterogeneous : can store values of many kinds

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

Heterogeneous : can store values of many kinds

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

[string, int]

Heterogeneous : can store values of many kinds

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

helium   → 'He'

2

neon   → 'Ne'

8

Heterogeneous : can store values of many kinds

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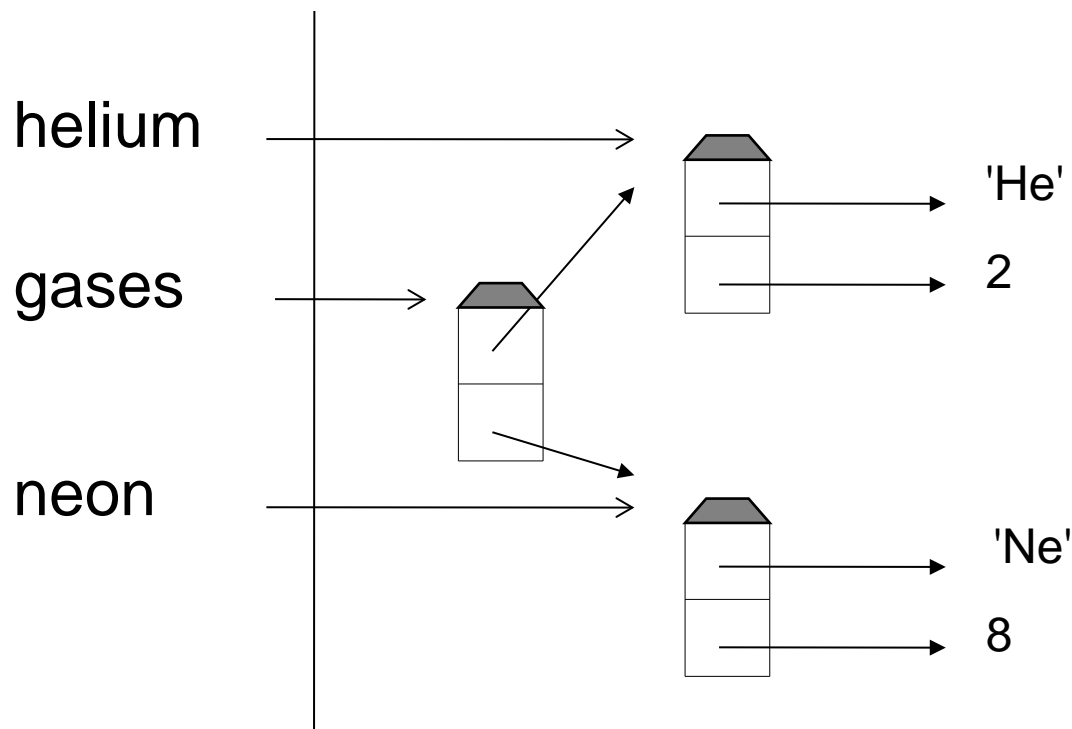
Heterogeneous : can store values of many kinds

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

Heterogeneous : can store values of many kinds

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

helium

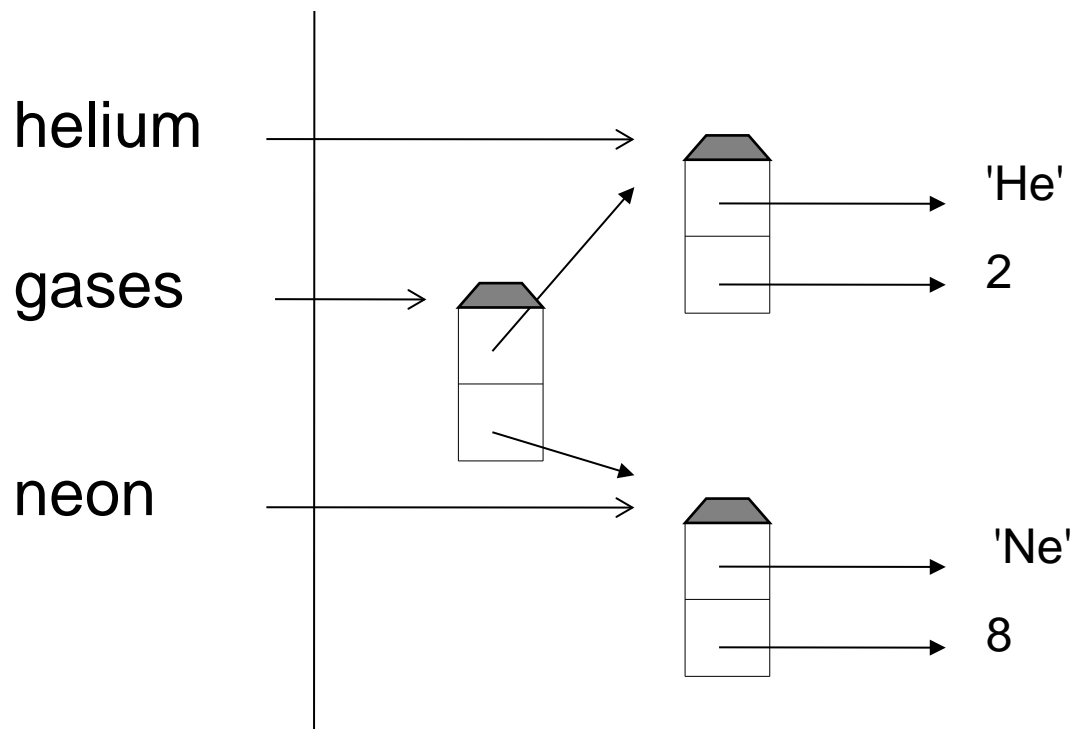gases

neon

'He'

2

'Ne'

8

Devote a whole

episode to this

Loop over elements to "do all"

Loop over elements to "do all"

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
```

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

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

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

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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```python
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]
```

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 = []
```

Appending values to a list lengthens it

```
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

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```
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

Use `in` to test for membership

```
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
```
if 'Pu' in gases:
    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]

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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

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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

```
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]
```
0 He

1 Ne

2 Ar

3 Kr

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]
0 He
1 Ne
2 Ar
3 Kr
```

A very common *idiom* in Python

software carpentry

narrated by

Dominique Vuvan

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