

Iterating in Python (while loops & lists)

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The while loop

As we saw before ...

A `while` loop does a condition check (like an `if` statement), and then runs a block of code as long as that condition evaluates to `True`.

```
i = 0
while (i < 10):
    print i
    i += 1
```

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Blocks of code

Python treats everything that is indented as a **block** of code.

- For `while` loops, this means that as long as the condition is true, the block of code is run
- In other words, the same block of code is run multiple times ...
 - ... usually with some of the variable values being different

It helps to *trace* your code to see this, i.e., observe what happens at every step

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Tracing a while loop

```
i = 1
while i <= 10:
    # this indented block of code will run from i = 1 to i = 10

    print "Starting value of i: " + str(i)

    squared = i**2
    print i,
    print squared

    # remember to increment (i.e., avoid infinite loops):
    i = i + 1

    print "Ending value of i: " + str(i)
    print
```

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Trace output

```
Starting value of i: 1
1 1
Ending value of i: 2

Starting value of i: 2
2 4
Ending value of i: 3

...

Starting value of i: 10
10 100
Ending value of i: 11
```

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Use #1: iteration

As we've just seen, `while` loops can be used to **iterate** over a sequence.

- This is most commonly done by iterating over integers, because integers easily count how many times you do something.
- You can change the way you iterate—e.g., `i += 2` or `i -= 1` or whatever

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Use #2: until

Another, subtly different use is to perform the same actions until a certain condition is reached.

```
user_input = ""
while len(user_input) < 3:
    print "Please enter a string longer than 2 characters:"
    sys.stdout.flush()
    user_input = raw_input()

    print

print "Thank you for entering a long enough string!"
```

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Output

Please enter a string longer than 2 characters:
as

Please enter a string longer than 2 characters:
a

Please enter a string longer than 2 characters:
asd

Thank you for entering a long enough string!

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Another example

```
user_input = ""
while user_input != 'y' and user_input != 'n':
    print "Do you want some cookies (y/n)?"
    sys.stdout.flush()
    user_input = raw_input()
    print

if user_input == 'y':
    print "So do I!"
else:
    print "What's wrong with you?"
```

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Logical operators

As you no doubt just noticed, Python makes a difference between an assignment equals sign (=) and a logical equivalence sign (==)

- = assigns a value to a variable; == checks to see if two values are identical (used for if and while statements)

In general, we have the following operators to compare two values: ==, !=, <, >, <=, and >=

- We can also combine (and embed) conditions with and and or
- while user_input != 'y' and user_input != 'n':
- while (user_input != 'y') and (user_input != 'n'):

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Lists

Python has a number of (compound) data types for combining other values, most notably **lists**

```
a = ['hotel', 'motel', 100]
```

- Lists are concatenated and sliced in the same way that strings are

```
>>> aa = ['word']
>>> bb = ['up']
>>> cc = aa + bb          ## cc = ['word', 'up']
>>> cc[1]
'up'
```

- len gets the length of the list: len(a) equals 4
- sort and reverse do what you pretty much expect them to

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List operations

- append—add list item to back of list
a.append('inn') # a = ['hotel', 'motel', 100, 'inn']
- insert—add item at a given position
a.insert(0, 'hostel') # a = ['hostel', 'hotel', 'motel', 100, 'inn']
- pop—remove item at a given position

a = ['hotel', 'hotel', 'motel', 100, 'inn']
a.pop() # a = ['hotel', 'hotel', 'motel', 100]
a.pop(0) # a = ['hotel', 'motel', 100]
- remove—remove item with a given value
a.remove(100) # a = ['hotel', 'motel']
- index—get index of element

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Out of bounds errors

A common mistake is to try to index a part of the list that isn't there

```
>>> a = ['hotel', 'motel']
>>> a[2]
Traceback (most recent call last):
  File "<stdin>", line 1, in ?
IndexError: list index out of range
```

If you're trying to add new items, the best way is to use append

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A new way to iterate

With a list, e.g., a list of input words, we can pop items from it until there is no more list:

```
>>> a = ['hotel', 'motel', 'inn']
>>> while a:
...     print "Are you staying in a(n) " + a.pop() + "?"
...
Are you staying in a(n) inn?
Are you staying in a(n) motel?
Are you staying in a(n) hotel?
>>> a
[]
```

NB: Only do this if you don't need the list contents when you're done

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Another iteration method

A for loop allows you to iterate directly over the items in a list

```
>>> a = ['hotel', 'motel', 'inn']
>>> for item in a:
...     print "Are you staying in a(n) " + item + "?"
...
Are you staying in a(n) hotel?
Are you staying in a(n) motel?
Are you staying in a(n) inn?
>>> a
['hotel', 'motel', 'inn']
```

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And yet another ...

The built-in function `range` takes an integer `i` and returns a list of integers from 0 to `i-1`

- So, we can use this in combination with `len`

```
>>> for i in range(len(a)):
...     print "Are you staying in a(n) " + a[i] + "?"
...
Are you staying in a(n) hotel?
Are you staying in a(n) motel?
Are you staying in a(n) inn?
>>> a
['hotel', 'motel', 'inn']
```

Allows you to access both the index (here, `i`) and the list value at that index (`a[i]`), which is useful sometimes.

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