Loops in Python (part 1)

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Loops

Iteration
Loops allow us to carry out one or more statements repeatedly.

Syntax:

```python
while <test>:
    do . . .
    do . . .
```

(http://www.greenteapress.com/thinkpython/html/thinkpython008.html)
While

Example

counter = 1
while counter <= 100:
    print(counter)
    counter += 1

- The test is executed first, and if it is positive (True), the body of the loop is executed
  - The body of the loop is executed until the test is False
- If the test is False, the next statement after the loop is executed
  - If the test is False from the beginning, the body of the loop is not executed at all
Counting down

From *Think Python* (section 7.3):

For any value of \( n \), this will terminate:

**Example**

```python
while n > 0:
    print(n)
    n = n - 1
```
Flow of execution

From *Think Python* (section 7.3):

1. Evaluate the condition, yielding True or False.
2. If the condition is false, exit the *while* statement and continue execution at the next statement.
3. If the condition is true, execute the body and then go back to step 1.

Proving that the loop will terminate at some point is important ...
Termination

From *Think Python* (section 7.3):

Does this code terminate?

Example

```python
while n != 1:
    print(n, end=' ',)  
    if n%2 == 0:  # n is even
        n = n/2
    else:  # n is odd
        n = n*3+1
```

Note also the way we keep printing on the same line
Beware of infinite loops!

It is easy to create infinite loops with `while`. Make sure that your `while` condition will return false at some point.
Common errors

Forgetting to advance your control variable
Make sure that the variable involved in the test changes in the body of the loop.

Example

```python
counter = 1
while counter <= 100:
    print(counter)
```
Common errors

Wrong incrementing
If you want to decrement, make sure that you do not automatically increment

Example

counter = 100
def while counter > 0:
    print(counter)
counter += 1
Common errors

Off-by-1 errors
Getting the beginning and the end of a loop right can be tricky: Should it start with 0 or 1? And remember that the control variable is incremented before the loop is finished.

Example

```
print('multiples of 33')
counter = 0
while counter <= 100:
    counter += 33
    print(counter)
print('This is the end: ' + str(counter))
```
Use #1: iteration

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

- Commonly done by iterating over integers: integers easily count how many times you do something.
- You can change the way you iterate: \( i += 2, i -= 1, \ldots \)
Use #2: until

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

Example

```python
user_input = ""
while len(user_input) < 3:
    user_input = input('Please enter long string: ')

print("Thank you for entering a long enough string!")
```
breaking out of loops

The break command allows you to stop a loop prematurely

Example

```python
while True:
    word = input('Please enter a word: ')  # input
    if not word: break
    print('The word was ' + word)
```

Note also the one-line if statement, allowed when the block of code (e.g., break) is one line long