SAMS
Programming A/B

Week 2 Lecture – Loops
July 19, 2018

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Outline for Today

- But first, a word from our sponsor:
  - So how did the homework go?
  - Problem solving before coding (e.g., setKthDigit)
  - Test calls and how to use them (more in lab)
  - How to handle assert errors

- Iteration
  - for loops
  - while loops

Why Iteration?

- More generality, so more power
- Example: remember the tip function:

```
def tip(total):
    return total * .18

>>> tip(25)
4.5
```

But what if we wanted a table of tip amounts?

Getting a table of results (the hard way)

```
def tipTable():
    print(tip(10))
    print(tip(11))
    print(tip(12))
    print(tip(13))
    # etc. for more values

>>> tipTable()
1.7999999999999998
1.98
2.16
2.34
```

Getting a table of results (the easy way)

```
def tipTable(low, high):
  for amount in range(low, high+1):
    print(tip(amount))

>>> tipTable(10,20)
1.7999999999999998
1.98
2.16
2.34
2.52
2.6999999999999997
2.88
3.06
3.2399999999999998
3.42
3.5999999999999996
>>>
```

`for` Loop (simple version)

```
for loopVariable in range(n):
    loop body
```

- The loopVariable is a new variable name
- The loop body is one or more instructions that you want to repeat.
- If `n` > 0, the `for` loop repeats the loop body `n` times.
- If `n` <= 0, the entire loop is skipped.
- Remember to indent loop body

`for` Loop Example

Loop variable

```
for i in range(5):
    print("hello world")
```

```
hello world
hello world
hello world
hello world
hello world
```

for Loops and range()

- for loop
  - Used to iterate over a known interval/set of values
  - range() is your friend! (**ints only, if you please!**)
- range(), a Python built-in, has some options:
  - range(n) – generates the ints 0 to n-1, counting by 1
  - range(start, end) – generates start to end-1, counting by 1
  - range(start, end, increment) – generates start to the largest int less than n, counting by increment

Some range examples

- for num in range(10):

  print(num) # prints ?

- for num in range(5,11):

  print(num) # prints ?

- for num in range(5, 11, 2):

  print(num) # prints ?

- for num in range(15, 5, -2):

  print(num) # prints ?

negative step generates from start to smallest int > end

Detour: some printing options

```
>>> for i in range(5):
...     print(i, end=" ")
0 1 2 3 4 >>>
>>>
>>> for i in range(5):
>>>     print(i, end="")
01234>>>
```

Blank space after printing expression

No space after printing expression

The default is `end="\n"`.

That is, when you don't include the `end` argument

`print` will go to the next line after printing the expression.

Accumulating an answer

```
def total():
  # sums first 5 positive integers
  sum = 0 # initialize accumulator
  for i in range(what goes here?):
     sum = sum + i # update accumulator
  return sum # return accumulated result

>>> total()
15
```

Generalizing sum

```
def total(n):
  # sums the first n positive integers
  sum = 0 # initialize
  for x in range(n + 1):
     sum = sum + x # update
  return sum # accumulated result
```

```
total(6)      returns 21
total(100)    returns 5050
total(15110)returns 114163605
```

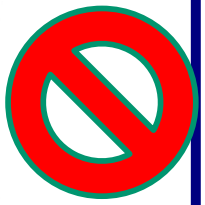
Danger! Don't change the loop variable!

```
for i in range(5):
  print(i, end=" ")
  i = 10

0 1 2 3 4
```

Even if you modify the loop variable in the loop, it will be reset to its next expected value in the next iteration.

```
for i in range(5):
  i = 10
  print(i, end=" ")

10 10 10 10 10
```

NEVER modify the loop variable inside a `for` loop.



Nested for Loop example

What does the following nested loop do?

```
for row in range(1,11):
        for col in range(1,11):
                print(row * col, end=" ")
        print()
print()
```

While loop

- An *indefinite* loop – used when you don't know the exact interval that you are looping over
- while (*condition*):

  statement(s)

  # at least one statement needs to modify a variable
  # used in the condition!
- As long as the *condition* is true, the loop will execute

While loop example

```
def leftDigit(num):
        num = abs(num)
        while (num >= 10):
                num = num // 10
        return num

assert(leftDigit(1234) = = 1)
```

More coding examples…

They will be posted to the course website…