Loop Structures and Booleans

Zelle - Chapter 8

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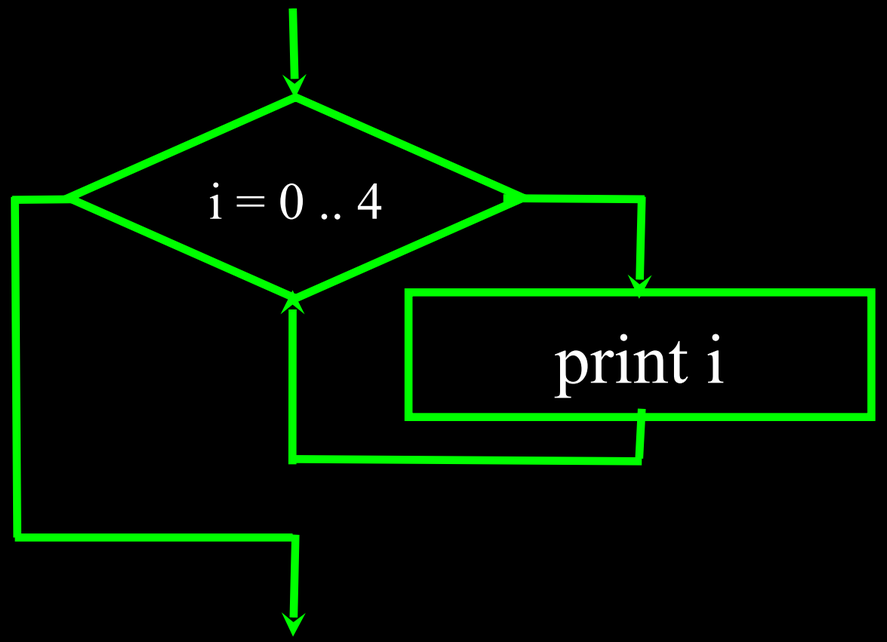
Textbook: Python Programming: An Introduction to Computer Science, John Zelle

Repeated Steps



Program:

```
for i in range(5) :
    print i
```

Output:

```
0
1
2
3
4
```

Definite Loops

Definite Loops

- Loops that run a fixed (aka definite) number of times
- Loops that "iterate" through an ordered set
- Loops that run "for" a number of times

```
for abc in range(5) :
    print "Hi"
    print abc
```

```
Hi
0
Hi
1
Hi
2
Hi
3
Hi
4
```

Definite Loops

- Loops that run a fixed (aka definite) number of times
- Loops that "iterate" through an ordered set
- Loops that run "for" a number of times

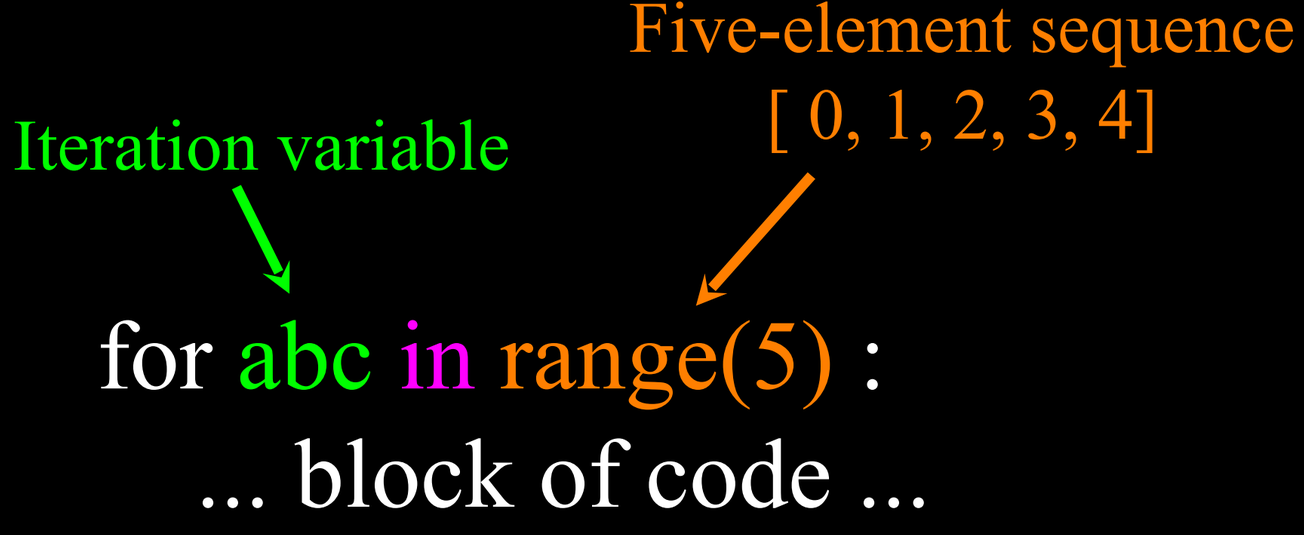
```
for abc in range(5) :
    print "Hi"
    print abc
```

```
Hi
0
Hi
1
Hi
2
Hi
3
Hi
4
```

Colon (:) defines the start of a block. Indenting determines which lines belong to the block.

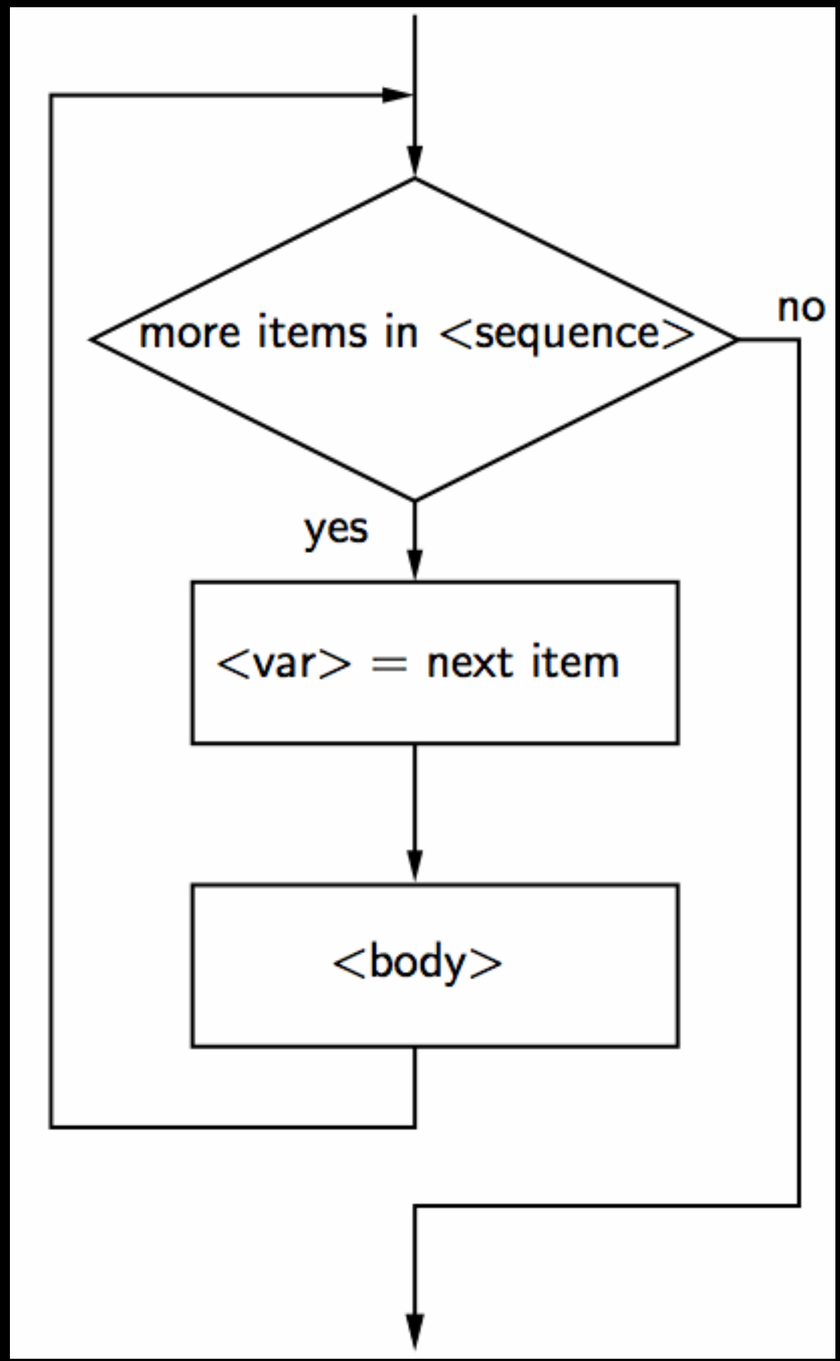
Looking at In...

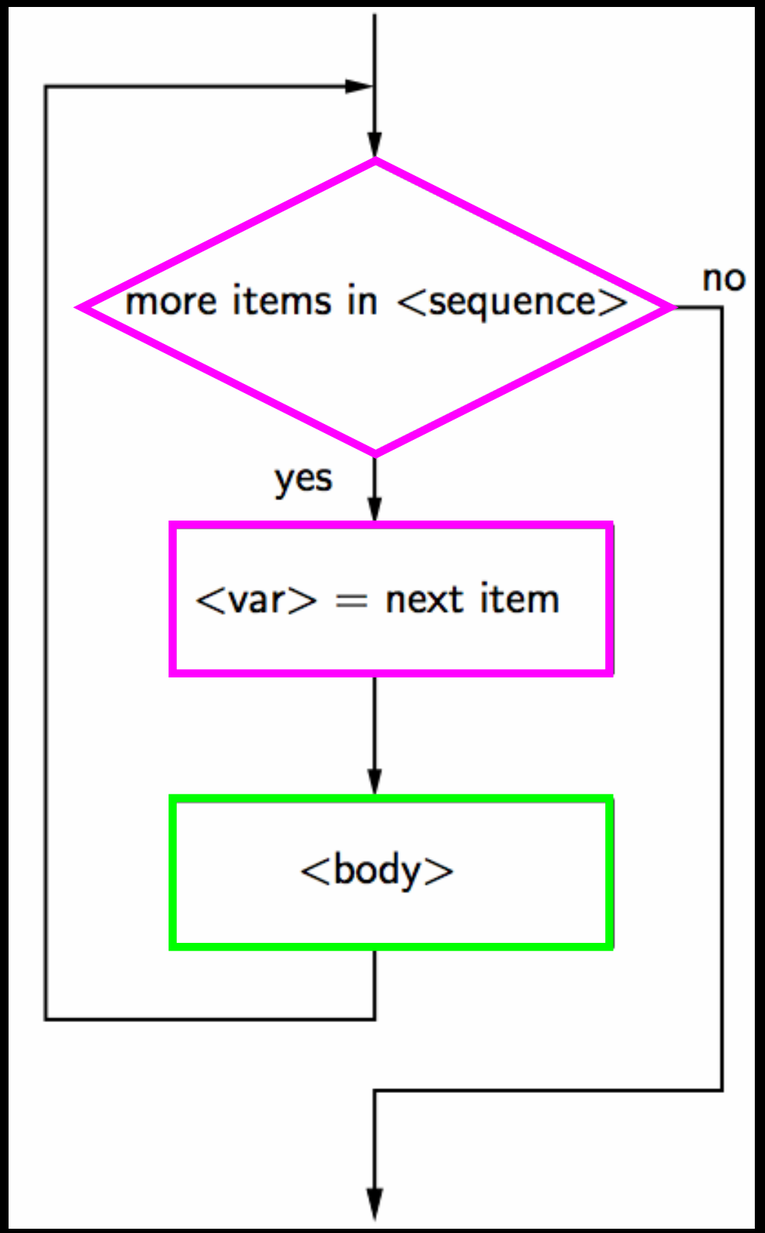
- The iteration variable "iterates" though the sequence (ordered set)
- The block (body) of code is executed once for each value in the sequence
- The iteration variable moves through all of the values in the sequence



In a FlowChart

- The iteration variable "iterates" though the sequence (ordered set)
- The block (body) of code is executed once for each value in the sequence
- The iteration variable moves through all of the values in the sequence

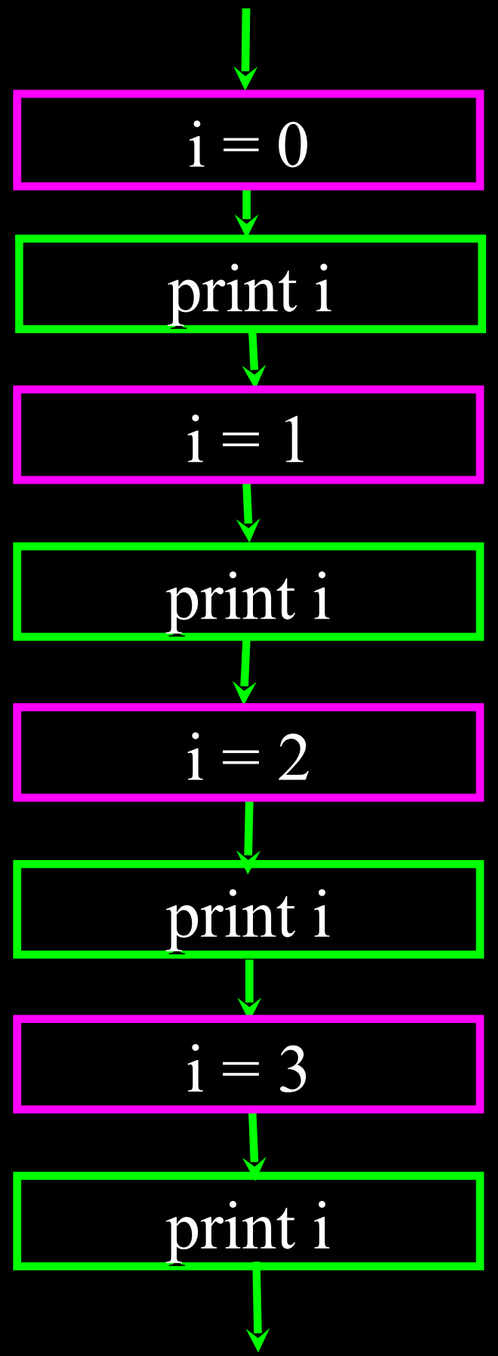




Program:

```
for i in range(4) :
    print i
```

Loop body is run repeatedly



What is range(10) ?

- range(10) is a built in function that returns a sequence of numbers
- The for statement can iterate through any sequence
- A sequence can have values of different types

```
>>> range(10)
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
>>> for i in [0, 1, 2] :
...         print I
...
0
1
2
>>> for i in [0, "abc", 9, 2, 3.6] :
...         print I
...
0
abc
9
2
3.6
```

File Processing

File Processing

- A text file can be thought of as a sequence of lines

From stephen.marquard@uct.ac.za Sat Jan 5 09:14:16 2008
Return-Path: <postmaster@collab.sakaiproject.org>
Date: Sat, 5 Jan 2008 09:12:18 -0500To: source@collab.sakaiproject.orgFrom: stephen.marquard@uct.ac.zaSubject: [sakai] svn commit: r39772 - content/branches/Details: http://source.sakaiproject.org/viewsvn/?view=rev&rev=39772

Opening a File

- Before we can read the contents of the file we must tell Python which file we are going to work with and what we will be doing with the file
- This is done with the open() function
- open() returns a "file handle" - a variable used to perform operations on the file
- Kind of like "File -> Open" in a Word Processor

Using open()

- handle = open(filename, mode)

```
fhand = open("mbox.txt", "r")
```

  - returns a handle use to manipulate the file
  - filename is a string
  - mode is “r” if we are planning on reading the file and “w” if we are going to write to the file.

http://docs.python.org/lib/built-in-funcs.html

File Handle as a Sequence

- A file handle open for read can be treated as a sequence of strings where each line in the file is a string in the sequence
- We can use the for statement to iterate through a sequence
- Remember - a sequence is an ordered set

```
xfile = open("mbox.txt", "r")

for cheese in xfile:
    print cheese
```

Counting Lines in a File

- Open a file read-only
- Use a for loop to read each line
- Count the lines and print out the number of lines

```
pizza = open("mbox.txt", "r")

howmany = 0
for slice in pizza:
    howmany = howmany + 1

print howmany
```

What We Do in Loops

Note: Even though these examples are simple the patterns apply to all kinds of loops

Patterns in Loops

- Counting in loops
- Summing in loops
- Averaging in loops
- Searching in loops
- Detecting in loops
- Largest or smallest
- Using break in a loop
- Using Continue in a loop

Looping through a Set

```
print “Before”
for thing in [3, 41, 12, 9, 74, 15] :
    print thing
print “After”
```

```
$ python basicloop.py
Before
3
41
12
9
74
15
After
```

What is the Largest Number?

- 3 41 12 9 74 15

What is the Largest Number?

What is the Largest Number?

largest_so_far

-13 41 74

Making "smart" loops

- The trick is "knowing" something about the whole loop when you are stuck writing code that only sees one entry at a time

- Favorite dog food…

Set some variables to initial values

For thing in data:

Look for something or do something to each entry separately, updating a variable.

Look at the variables.

Finding the largest value

```
Largest = -1
print “Before”, largest
For value in [3, 41, 12, 9, 74, 15]:
    if value > largest:
        largest = value
    print largest, value

Print “After”, largest
```

```
$ python largest.py
Before -1
3 3
41 41
41 12
41 9
74 74
74 15
After 74
```

We make a variable that contains the largest value we have seen so far. If the current value is larger, it becomes the new largest value we have seen so far.

Counting in a Loop

```
zork = 0
print "Before", zork
for thing in [3, 41, 12, 9, 74, 15] :
    zork = zork + 1
    print zork, thing
print "After", zork
```

```
$ python countloop.py
 Before 0
1 3
2 41
3 12
4 9
5 74
6 15
After 6
```

To count how many times we execute a loop we introduce a counter variable that starts at 0 and we add one to it each time through the loop.

Summing in a Loop

```
zork = 0
print "Before", zork
for thing in [3, 41, 12, 9, 74, 15] :
    zork = zork + thing
    print zork, thing
print "After", zork
```

```
$ python countloop.py
 Before 0
3 3
44 41
56 12
65 9
139 74
154 15
After 154
```

To add up a value we encounter in a loop, we introduce a sum variable that starts at 0 and we add the value to the sum each time through the loop.

Finding the Average in a Loop

```
count = 0
sum = 0
print "Before", count, sum
for value in [3, 41, 12, 9, 74, 15] :
    count +=1
    sum += value
    print count, sum, value
print "After", count, sum, sum / count
```

```
$ python averageloop.py
Before 0 0
1 3 3
2 44 41
3 56 12
4 65 9
5 139 74
6 154 15
After 6 154 25
```

An average just combines the counting and sum patterns
and divides when the loop is done.

Searching in a Loop

```
print "Before“
for value in [3, 41, 12, 9, 74, 15] :
    if value > 20:
            print "Large number",value
print "After"
```

```
$ python search1.py
Before
Large number 41
Large number 74
After
```

We use an if statement in the loop to catch the values we are looking for.

Did we encounter a value?

```
found = 0
print "Before", found
for value in [3, 41, 12, 9, 74, 15] :
    if value == 9:
        found = 1
    print found, value
print "After", found
```

```
$ python search1.py
Before 0
0 3
0 41
0 12
1 9
1 74
1 15
After 1
```

If we just want to search and know if a value was found - we use a variable that starts at zero and is set to one as soon as we find what we are looking for.

Using a Boolean Variable

```
found = False
print "Before", found
for value in [3, 41, 12, 9, 74, 15] :
    if value == 9:
        found = True
    print found, value

print "After", found
```

```
$ python search1.py
Before False
False 3
False 41
False 12
True 9
True 74
True 15
After True
```

If we just want to search and know if a value was found - we use a variable that starts at zero and is set to one as soon as we find what we are looking for.

Remembering where...

```
found = False
where = -1
count = 0print "Before", found
for value in [3, 41, 12, 9, 74, 15] :
    count = count + 1
    if value == 9:
        found = True
        where = count
    print found, where, value

print "After", found, where
```

```
$ python search1.py
Before False
False -1 3
False -1 41
False -1 12
True 4 9
True 4 74
True 4 15
After True 4
```

Finding the largest value

```
largest = -1
print "Before", largest
for value in [3, 41, 12, 9, 74, 15] :
    if value > largest :
        largest = value
    print largest, value

print "After", largest
```

```
$ python largest.py
Before -1
3 3
41 41
41 12
41 9
74 74
74 15
After 74
```

We make a variable that contains the largest value we have seen so far. If the current value is larger, it becomes the new largest value we have seen so far.

```
count = 0
print "Before“
for value in [9, 41, 12, 3, 74, 15] :
    if count == 0 :
       smallest = value

    count = count + 1
    if value < smallest :
       smallest = value
    print smallest, value

print "After", smallest
```

Finding the smallest value

```
$ python smallest.py
 Before
9 9
9 41
9 12
3 3
3 74
3 15
After 3
```

We still have a variable that is the smallest so far. The first time through the loop we take the first value to be the smallest.

Breaking out of a loop

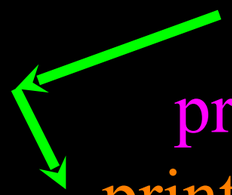
```
print "Before“
for value in [3, 41, 12, 9, 74, 15] :
    print "Loop top",value
    if value == 12 :
        break
    print "Loop bottom", value
print "After"
```

```
$ python breakloop.py
Before
Loop top 3
Loop bottom 3
Loop top 41
Loop bottom 41
Loop top 12
After
```

Break immediately terminates the current loop and jumps out of the loop.

Breaking out of a loop

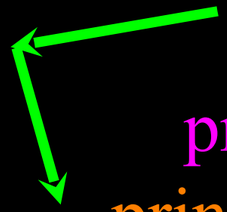
```
print "Before“
for value in [3, 41, 12, 9, 74, 15] :
    print "Loop top",value
    if value == 12 :
        break
    print "Loop bottom", value
print "After"
```



```
$ python breakloop.py
Before
Loop top 3
Loop bottom 3
Loop top 41
Loop bottom 41
Loop top 12
After
```

Break immediately terminates the current loop and jumps out of the loop.

```
found = False
where = -1
count = 0
print "Before", found
for value in [3, 41, 12, 9, 74, 15] :
    count = count + 1
    if value == 9:
        found = True
        where = count
        break
    print found, value
print "After", found, where
```



Remembering where the *first* one was...

Continuing with the next iteration

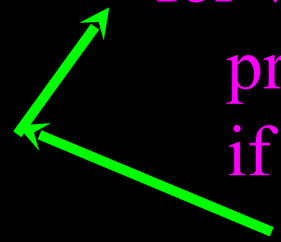
```
print "Before“
for value in [3, 41, 12, 9, 74, 15] :
    print "Loop top",value
    if value > 10 :
        continue
    print "Loop bottom", value
print "After"
```

```
$ python breakloop.py
Before
Loop top 3
Loop bottom 3
Loop top 41
Loop top 12
Loop top 9
Loop bottom 9
Loop top 74
Loop top 15
After
```

Continue immediately terminates the current loop iteration and jumps to the top of the loop and starts the next iteration of the loop.

Continuing with the next iteration

```
print "Before“
for value in [3, 41, 12, 9, 74, 15] :
    print "Loop top",value
    if value > 10 :
        continue
    print "Loop bottom", value
print "After"
```



```
$ python breakloop.py
Before
Loop top 3
Loop bottom 3
Loop top 41
Loop top 12
Loop top 9
Loop bottom 9
Loop top 74
Loop top 15
After
```

Continue immediately terminates the current loop iteration and jumps to the top of the loop and starts the next iteration of the loop.

Nested Loops

```
for out in [1, 2, 3] :
    print "Top", out
    for nest in ["X", "Y"] :
        print out, nest
    print "Bottom", out
```

Each time the outer loop runs once,
the inner loop runs completely
through the loop.

```
$ python nested.py
 Top 1
1 X
1 Y
Bottom 1
Top 2
2 X
2 Y
Bottom 2
Top 3
3 X
3 Y
Bottom 3
```

Boolean Operators and Expressions

Boolean Operations

- We can do calculations with boolean variables just like with integer variables
- The boolean operations are: and or not
- Comparison operators < > <= >= == != return boolean (True or False)

Boolean Operators

P	Q	P and Q
T	T	T
T	F	F
F	T	F
F	F	F

(x == 4) and (y ==2)

True if both expressions are true.

(x == 4) or (y == 2)

Evaluates to true if either expression is true.

P	Q	P or Q
T	T	T
T	F	T
F	T	T
F	F	F

P	not P
T	F
F	T

not (x == 4)

Not "flips" the logic - True becomes False and False becomes True.

Boolean Operation Example

```
import string

for str in ["bob", "bark at the moon", "where at" ] :
   words = string.split(str)
   if len(words) >= 2 and words[1] == "at" :
         print "+++++", str
   else:
         print "-----", str
```

```
$ python findat.py
----- bob
+++++ bark at the moon++++
 where at
```

Summary

- Loops over a set
- File Loops
- Counting in loops
- Summing in loops
- Averaging in loops
- Searching in loops

- Detecting in loops
- Largest or smallest
- Using break in a loop
- Using continue in a loop
- Boolean operations and, or, not