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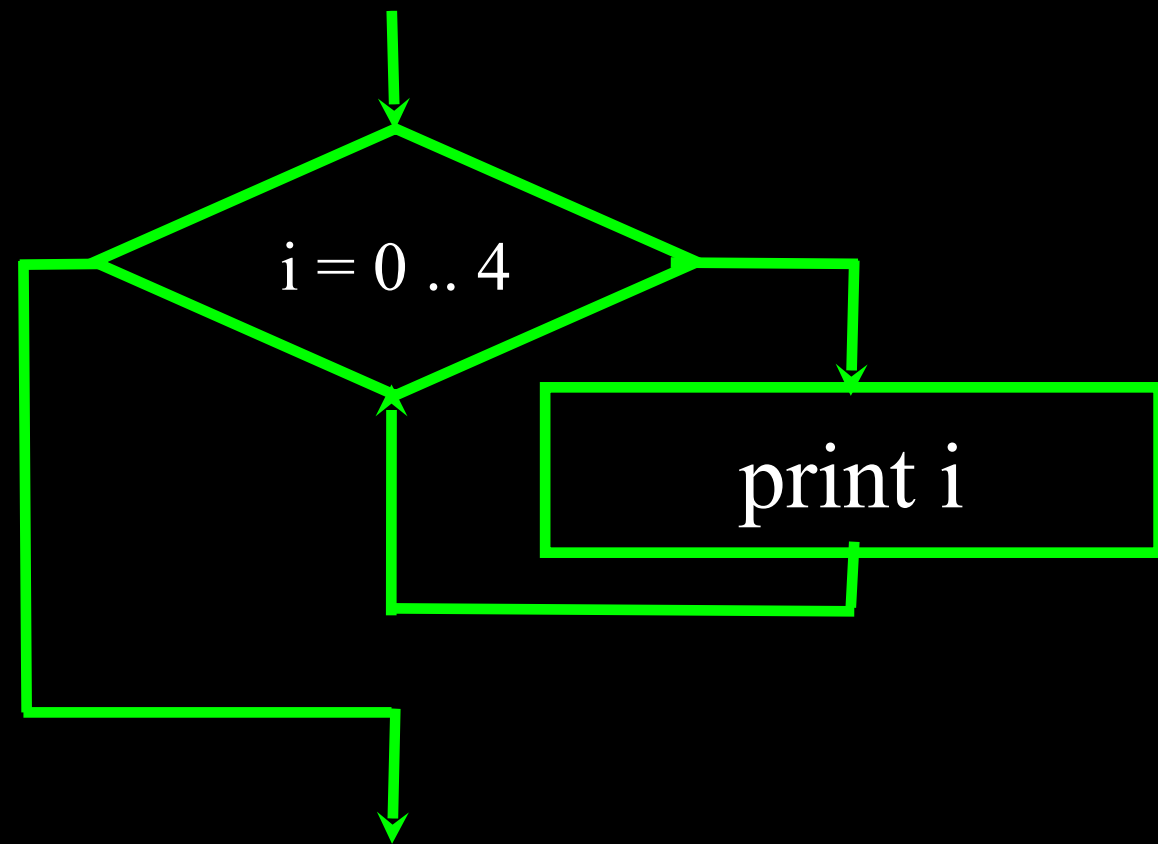
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Loop Structures and Booleans

Zelle - Chapter 8

Charles Severance - www.dr-chuck.com

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

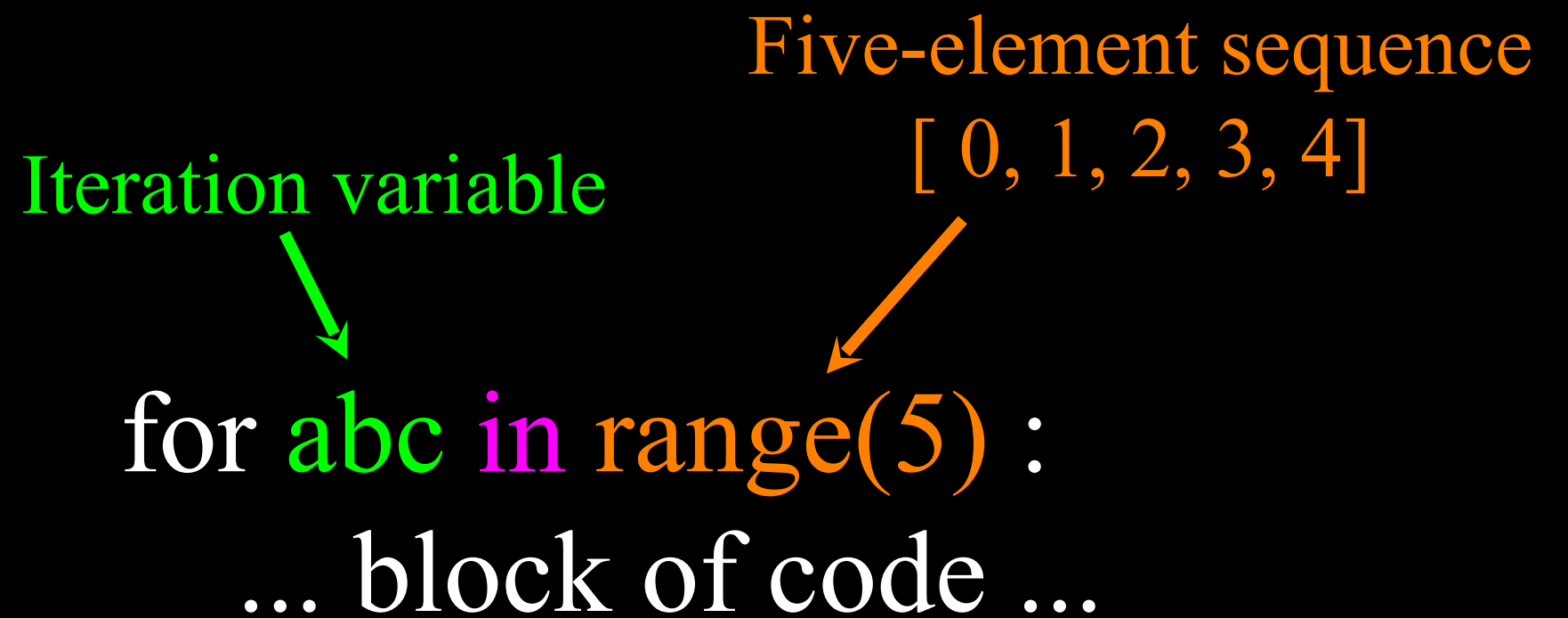
```
for abc in range(5) :  
    print “Hi”  
    print abc
```

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

Hi
0
Hi
1
Hi
2
Hi
3
Hi
4

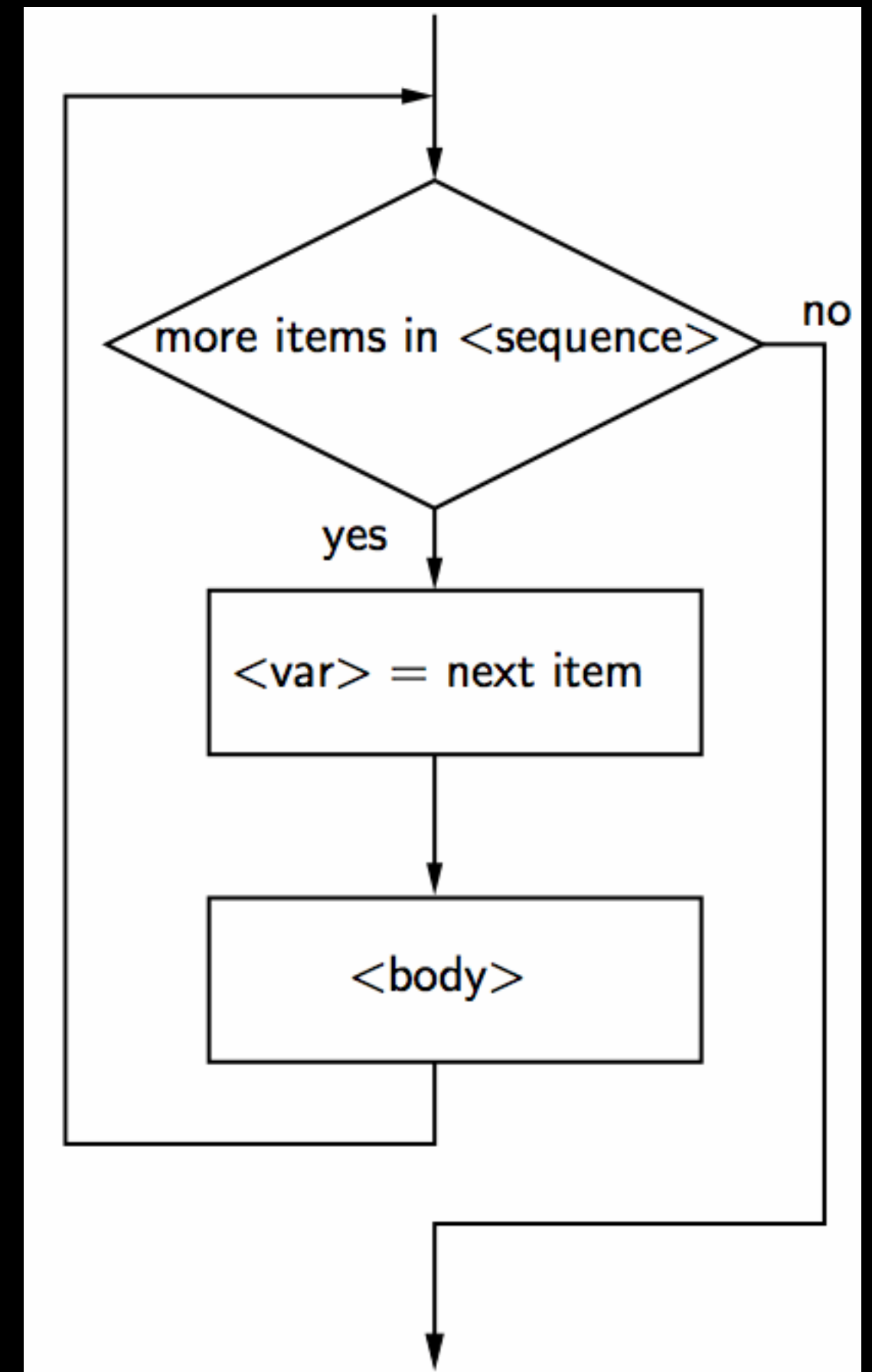
Looking at **in**...

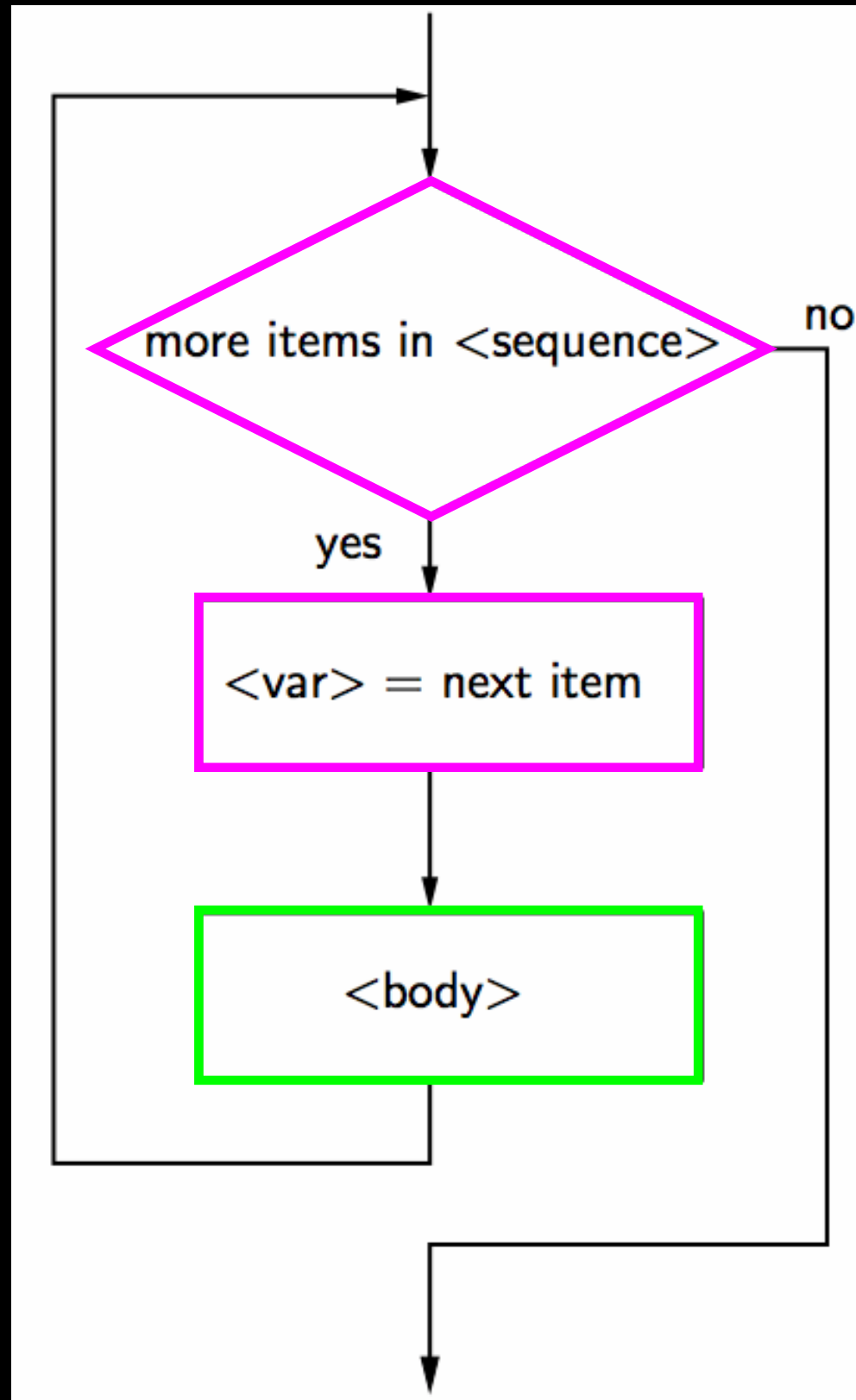
- The iteration variable “iterates” through the sequence (ordered set)
- The block (body) of code is executed once for each value **in** the sequence
- The iteration variable moves through all of the values **in** the sequence



In a FlowChart

- The iteration variable “iterates” through 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

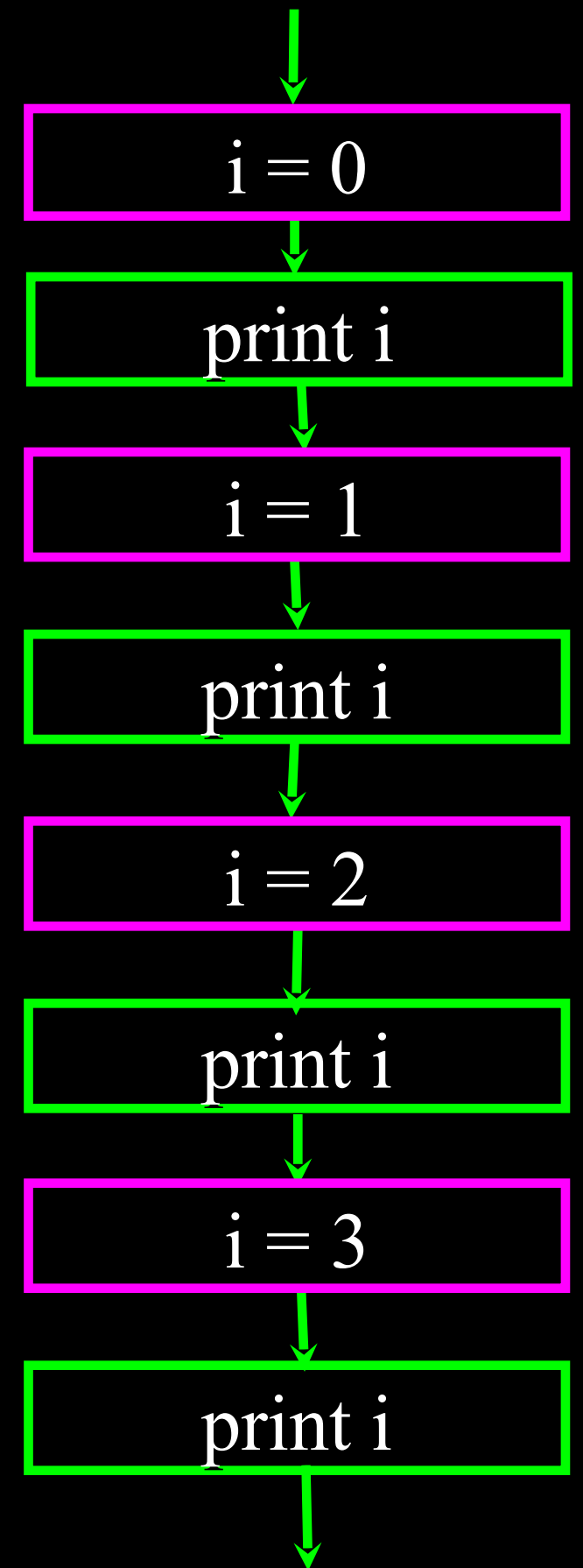




Program:

```
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 -0500 To: source@collab.sakaiproject.org From:
stephen.marquard@uct.ac.za Subject: [sakai] svn commit: r39772 -
content/branches/Details: [http://source.sakaiproject.org/viewsvn/?
view=rev&rev=39772](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.

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 = 0
print "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 (out)

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

Breaking out of a loop

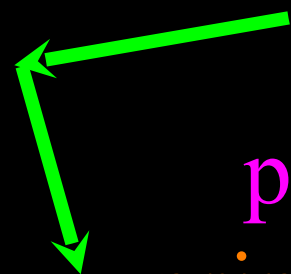
```
print "Before"  
for value in [3, 41, 12, 9, 74, 15]:  
    print "Loop top",value  
    if value == 12 :  
        break  
    print "Loop bottom", value  
print "After"
```

```
$ 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

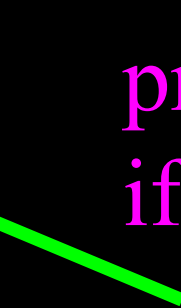
Loop top 15

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