# An Introduction to Python Programming:

Python Statements

# Python: the Basics

# Running Python

- There are three different ways to start Python:
  - (1) Interactive Interpreter: You can enter python and start coding right away in the interactive interpreter by starting it from the command line. You can do this from Unix, DOS, or any other system which provides you a command-line interpreter or shell window.

    ```
    >>>
    ```

  - 2) Script from the Command-line: A Python script can be executed at command line by invoking the interpreter on your application, as in the following:

```
python  script.py        # Unix/Linux
```

3) Integrated Development Environment (IDE): You can run Python from a graphical user interface (GUI) environment. All you need is a GUI application on your system that supports Python

# First Program

Interactive mode:

- Invoking the interpreter without passing a script file as a parameter brings up the following prompt:

```
computer# python
Python 2.6.2 (r262:71600, Apr 16 2009, 09:17:39)
[GCC 4.0.1 (Apple Computer, Inc. build 5250)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

- Type the following text to the right of the Python prompt and press the Enter key:

```
>>> print "Hello, Python!";
```

- This will produce following output:

```
Hello, Python!
```

Don’t Worry about the other modes.

# First Program

- Script Mode:
    - Invoking the interpreter with a script parameter begins execution of the script and continues until the script is finished. When the script is finished, the interpreter is no longer active. All python files will have extension .py.
    - Example test.py file contains.

```
#!/usr/bin/python
print "Hello, Python!";
```

- Here I assumed that you have Python interpreter available in the /usr/bin directory. Now try to run this program as follows:

```
computer# chmod +x test.py     # This is to make file executable
computer# python test.py
```

- This will produce following output:

```
Hello, Python!
```

# Lines and Indentation

- One of the most prominent features of Python is the fact that there are no braces to indicate blocks of code for class and function definitions or flow control. Blocks of code are denoted by line indentation. The number of spaces in the indentation is variable, but all statements within the block must be indented the same amount. Example:

```
if True:
        print "True”
else:
        print "False"
```

# Lines

- Multi-Line Statements: Statements in Python typically end with a new line. Python does, however, allow the use of the line continuation character (\) to denote that the line should continue. For example:

```
total = item_one + \
        item_two + \
        item_three
```

- Statements contained within the [], {}, or () brackets do not need to use the line continuation character. For example:

```
days = ['Monday', 'Tuesday', 'Wednesday',
         'Thursday', 'Friday’]
```

- line containing only whitespace, possibly with a comment, is known as a blank line, and Python totally ignores it.

# Lines

- Quotations in Python: Python accepts single ('), double (") and triple (''' or """) quotes to denote string literals, as long as the same type of quote starts and ends the string. The triple quotes can be used to span the string across multiple lines. For example, all the following are legal:

```
word = 'word’
sentence = “This is a sentence.”
paragraph = ‘”This is a paragraph. It is made up of multiple lines
                    and sentences.’”
```

- Comments in Python: A hash sign (#) that is not inside a string literal begins a comment. All characters after the # and up to the physical line end are part of the comment, and the Python interpreter ignores them.

```
# First comment
print "Hello, Python!";  # second comment
```

# Lines

- Multiple Statements on a Single Line: The semicolon ( ; ) allows multiple statements on the single line given that neither statement starts a new code block. Here is an example:

```
import sys; x = 'foo'; sys.stdout.write(x + '|n')
```

- Multiple Statement Groups called Suites: Groups of individual statements making up a single code block are called suites. Compound or complex statements, such as “if”, “while”, “def”, and “class”, are those which require a header line and a suite. Header lines begin the statement and terminate with a colon ( : ) are followed by one or more lines form the suite. Example:

```
if expression :
    suite
elif expression :
    suite
else :
    suite
```

# The Python Standard Library

- The “Python standard library” contains several different kinds of components. It contains data types that would normally be considered part of the “core” of a language, such as numbers, strings, lists etc….

- The library also contains built-in functions and objects that can be used by all Python code without the need of an import statement. http://docs.python.org/library/stdtypes.html

- The bulk of the library (the good stuff) consists of a collection of modules which are accessed using the import statement. http://docs.python.org/library/index.html

- The standard library is huge – this is the power of Python……

# Variables and Data Types

- Python variables do not have to be explicitly declared to reserve memory space. The declaration happens automatically when you assign a value to a variable. The equal sign (=) is used to assign values to variables.

```
#!/usr/bin/python
counter = 100          # An integer assignment
miles   = 1000.0       # A floating point
name    = "John"        # A string
```

# Assignment Statements

- **Multiple Assignment:**
- You can also assign a single value to several variables simultaneously. For example:
- Y=6
- Here, an integer object is created with the value 6

**a = b = c = 1**

- Here, an integer object is created with the value 1, and all three variables are assigned to the same memory location.
- You can also assign multiple objects to multiple variables. For example:

a, b, c = 1, 2, "john"

- Here two integer objects with values 1 and 2 are assigned to variables a and b, and one string object with the value "john" is assigned to the variable c.

# Data Types

- The data stored in memory can be of many types. For example, a persons age is stored as a numeric value and the address is stored as alphanumeric characters.
- Python has some standard types that are used to define the operations possible on them and the storage method for each of them.
- Python has five standard data types:
  - Number
  - String
  - List (entries enclosed in [ ], list methods available)
  - Tuple (comma separated values of possible different types).
  - Dictionary (un-ordered, key:value sequences in [ ]

# Numbers

- Number data types store numeric values. They are immutable data types, which means that changing the value of a number data type results in a newly allocated object. Number objects are created when you assign a value to them.
- Python supports four different numerical types:
  - int (signed integers) = C long precision
  - long (long integers [can also be represented in octal and hexadecimal]) unlimited precision
  - float (floating point real values) = C double precision
  - complex (complex numbers) = C double precision

# Number Examples

- Here are some examples of numbers:

| int | long | float | complex |
|---|---|---|---|
| 10 | 51924361L | 0.0 | 3.14j |
| 100 | -0x19323L | 15.20 | 45.j |
| -786 | 0122L | -21.9 | 9.322e-36j |
| -0490 | 535633629843L | -90. | -.6545+0J |
| -0x260 | -052318172735L | -32.54e100 | 3e+26J |
| 0x69 | -4721885298529L | 70.2-E124.53e-7j | |

- Python allows you to use a lowercase L with long, but it is recommended that you use only an uppercase L to avoid confusion with the number 1. Python displays long integers with an uppercase L.
- A complex number consists of an ordered pair of real floatingpoint numbers denoted by a + bj, where a is the real part and b is the imaginary part of the complex number.

# Number conversions

- Python converts numbers internally in an expression containing mixed types to a common type for evaluation. But sometimes, you'll need to convert a number explicitly from one type to another to satisfy the requirements of an operator or function parameter.
  - Type int(x) to convert x to a plain integer.
  - Type long(x) to convert x to a long integer.
  - Type float(x) to convert x to a floating-point number.
  - Type complex(x) to convert x to a complex number with real part x and imaginary part zero.
  - Type complex(x, y) to convert x and y to a complex number with real part x and imaginary part y. x and y are numeric expressions

# Strings

- Strings in Python are identified as a contiguous set of characters in between quotation marks.

- Python allows for either pairs of single or double quotes. Subsets of strings can be taken using the slice operator ( [ ] and [ : ] ) with indexes starting at 0 in the beginning of the string and working their way from -1 at the end.

- The plus ( + ) sign is the string concatenation operator, and the asterisk ( * ) is the repetition operator.

# String Examples

```
#!/usr/bin/python
str = 'Hello World!’
print str              # Prints complete string
Hello World!
print str[0]           # Prints first character of the string
print str[2:5]         # Prints characters starting from 3rd to 6 th
print str[2:]         # Prints string starting from 3rd character
print str * 2         # Prints string two times
print str + "TEST" # Prints concatenated string
```

- The above code will produce following output:

```
Hello World!
H
llo
llo World!
Hello World!Hello World!
Hello World!TEST
```

# String Examples

*str = 'Hello World!'*

*1) print str # Prints complete string*

Above code will produce this output: ***Hello World!***

*2) print str[0] # Prints first character of the string*

Above code will produce this output: ***H***

*3) print str[2:5] # Prints characters starting from 3rd to 6th*

Above code will produce this output: ***llo***

*4) print str[2:] # Prints string starting from 3rd character*

Above code will produce this output: ***llo World!***

*5) print str * 2 # Prints string two times*

Above code will produce this output: ***Hello World!Hello World!***

*6) print str + "TEST" # Prints concatenated string*

Above code will produce this output: ***Hello World!TEST***

# String Formatting

- String Formatting Operator:
- One of Python's coolest features is the string format operator %. This operator is unique to strings and makes up for the lack C's printf().
- Example:

*print "My name is %s and weight is %d kg!" % ('Zara', 21)*

- This will produce following result:

*My name is Zara and weight is 21 kg!*

# Lists

- Lists are the most versatile of Python's compound data types. A list contains items separated by commas and enclosed within square brackets ([ ]).
- To some extent, lists are similar to arrays in C. One difference between them is that all the items belonging to a list can be of different data type.
- The values stored in a list can be accessed using the slice operator ( [ ] and [ : ] ) with indexes starting at 0 in the beginning of the list and working their way to end-1.
- The plus ( + ) sign is the list concatenation operator, and the asterisk ( * ) is the repetition operator.
- Items may also be inserted or added to lists

# List Examples

```
#!/usr/bin/python
list = [ 'abcd', 786 , 2.23, 'john', 70.200]
tinylist = [123, 'john']
print list          # Prints complete list
print list[0]       # Prints first element of the list
print list[1:3]     # Prints elements starting from 2nd to 4th
print list[2:]      # Prints elements starting from 3rd element
print tinylist * 2  # Prints list two times
print list + tinylist # Prints concatenated lists
```

- The above code will produce following output:

```
['abcd', 786, 2.23, 'john', 70.2]
abcd
[786, 2.23]
[2.23, 'john', 70.2]
[123, 'john', 123, 'john']
['abcd', 786, 2.23, 'john', 70.2, 123, 'john']
```

# Built in List Functions and Methods

*Python List functions*

| | |
|---|---|
| *cmp(list1, list2)* | *Compares elements of both lists.* |
| *len(list)* | *Gives the total length of the list.* |
| *max(list)* | *Returns item from the list with max value.* |
| *min(list)* | *Returns item from the list with min value.* |
| *list(seq)* | *Converts a tuple into list.* |

*Python list methods*

| | |
|---|---|
| *list.append(obj)* | *Appends object obj to list* |
| *list.count(obj)* | *Returns count of how many times obj occurs in list* |
| *list.extend(seq)* | *Appends the contents of seq to list* |
| *list.index(obj)* | *Returns the lowest index in list that obj appears* |
| *list.insert(index, obj)* | *Inserts object obj into list at offset index* |
| *list.pop(obj=list[-1])* | *Removes and returns last object or obj from list* |
| *list.remove(obj)* | *Removes object obj from list* |
| *list.reverse()* | *Reverses objects of list in place* |
| *list.sort([func])* | *Sorts objects of list, use compare func if given* |

# List Functions and Method Examples

```
items = [111, 222, 333]
>>> items[111, 222, 333]
```

- To add an item to the end of a list, use:

```
>>> items.append(444)
>>> items[111, 222, 333, 444]
```

- To insert an item into a list, use:

```
>>> items.insert(0, -1)
>>> items[-1, 111, 222, 333, 444]
```

- You can also push items onto the right end of a list and pop items off the right end of a list with append and pop.

```
>>> items.append(555)
>>> items[-1, 111, 222, 333, 444, 555]
>>> items.pop()
555
>>> items[-1, 111, 222, 333, 444]
```

# Tuples

- A tuple is another sequence data type that is similar to the list. A tuple consists of a number of values separated by commas. Unlike lists, however, tuples are enclosed within parentheses.
- The main differences between lists and tuples are: Lists are enclosed in brackets ( [ ] ), and their elements and size can be changed, while tuples are enclosed in parentheses ( ( ) ) and cannot be updated. Tuples can be thought of as **read-only lists.**

# Dictionary

- Python's dictionaries are hash table type. They work like associative arrays or hashes found in Perl and consist of key-value pairs.
- Keys can be almost any Python type, but are usually numbers or strings. Values, on the other hand, can be any arbitrary Python object.
- Dictionaries are enclosed by curly braces ( { } ) and values can be assigned and accessed using square braces ( [] ).
- Dictionaries have no concept of order among elements. It is incorrect to say that the elements are "out of order"; they are simply unordered.

# Dictionary Examples

```
dict = {}; dict['one'] = "This is one”; dict[2]      = "This is two”
tinydict = {'name': 'john','code':6734, 'dept': 'sales'}
print dict                    # Prints complete dictionary
print dict['one']       # Prints value for 'one' key
print dict[2]           # Prints value for 2 key
print tinydict          # Prints complete dictionary
print tinydict.keys()   # Prints all the keys
print tinydict.values() # Prints all the values
```

- The above code will produce following output:

```
{‘one’:’This is one’,2:’This is two’}
This is one
This is two
{'dept': 'sales', 'code': 6734, 'name': 'john'}
['dept', 'code', 'name']
['sales', 6734, 'john']
```

# Data Type Conversions

- Sometimes you may need to perform conversions between the built-in types. To convert between types you simply use the type name as a function.
- There are several built-in functions to perform conversion from one data type to another. These functions return a new object representing the converted value.

# Conversions

int(x)Converts x to an integer.

long(x) Converts x to a long integer.

float(x) Converts x to a floating-point number.

complex(real [,imag]) Creates a complex number.

str(x) Converts object x to a string representation.

repr(x) Converts object x to an expression string.

eval(str) Evaluates a string and returns an object.

tuple(s) Converts s to a tuple.

list(s) Converts s to a list.

set(s) Converts s to a set.

chr(x) Converts an integer to a character.

unichr(x)Converts an integer to a Unicode character.

ord(x) Converts a single character to its integer value.

hex(x) Converts an integer to a hexadecimal string.

oct(x) Converts an integer to an octal string.

# Operators

- What is an operator?
- Simple answer can be given using expression *4 + 5 is equal to 9. Here 4 and 5 are called operands and + is called operator.*

- *Python language supports following type of operators.*
  - *Arithmetic Operators*
  - *Comparision Operators*
  - *Logical (or Relational) Operators*
  - *Assignment Operators*
  - *Conditional (or ternary) Operators*

# Arithmetic Operators

Python Arithmetic Operators: Assume a = 10 and b = 20

+ Addition - Adds values on either side of the operator: a + b will give 30

- Subtraction - Subtracts right hand operand from left hand operand: a - b will give -10

* Multiplication - Multiplies values on either side of the operator: a * b will give 200

/ Division - Divides left hand operand by right hand operand: b / a will give 2

% Modulus - Divides left hand operand by right hand operand and returns remainder: b % a will give 0

** Exponent - Performs exponential (power) calculation on operators: a**b will give 10 to the power 20

// Floor Division - The division of operands where the result is the quotient in which the digits after the decimal point are removed. 9//2 is equal to 4 and 9.0//2.0 is equal to 4.0

# Comparison Operators

Python Comparison Operators: Assume a = 10 and b = 20 then:

- ==Checks if the value of two operands are equal or not, if yes then condition becomes true. (a == b) is not true.
- != Checks if the value of two operands are equal or not, if values are not equal then condition becomes true. (a != b) is true.
- > Checks if the value of left operand is greater than the value of right operand, if yes then condition becomes true. (a > b) is not true.
- < Checks if the value of left operand is less than the value of right operand, if yes then condition becomes true. (a < b) is true.
- >=Checks if the value of left operand is greater than or equal to the value of right operand, if yes then condition becomes true. (a >= b) is not true.
- <=Checks if the value of left operand is less than or equal to the value of right operand, if yes then condition becomes true. (a <= b) is true.

# Logical Operators

Python Logical Operators: There are following logical operators supported by Python language Assume variable a = 10 and b = 20 then:

**and** Called Logical AND operator. If both the operands are true then then condition becomes true. (a and b) is true.

**or** Called Logical OR Operator. If any of the two operands are non zero then then condition becomes true. (a or b) is true.

**not** Called Logical NOT Operator. Use to reverses the logical state of its operand. If a condition is true then Logical NOT operator will make false.

# Assignment Operators

Python Assignment Operators: Assume a = 10 and b = 20 then:

= Simple assignment operator, Assigns values from right side operands to left side operand: c = a + b will assign value of a + b into c

+= Add AND assignment operator, It adds right operand to the left operand and assign the result to left operand: c += a is equivalent to c = c + a

-= Subtract AND assignment operator, It subtracts right operand from the left operand and assign the result to left operand c -= a is equivalent to c = c - a

*= Multiply AND assignment operator, It multiplies right operand with the left operand and assign the result to left operand c *= a is equivalent to c = c * a

# Assignment operators

/= Divide AND assignment operator, It divides left operand with the right operand and assign the result to left operand c /= a is equivalent to c = c / a

%= Modulus AND assignment operator, It takes modulus using two operands and assign the result to left operand c %= a is equivalent to c = c % a

**= Exponent AND assignment operator, Performs exponential (power) calculation on operators and assign value to the left operand c **= a is equivalent to c = c ** a

//= Floor Dividion and assigns a value, Performs floor division on operators and assign value to the left operand c //= a is equivalent to c = c // a

# Example Program: Temperature Converter

- Design
  - Input, Process, Output (IPO)
  - Prompt the user for input (Celsius temperature)
  - Process it to convert it to Fahrenheit using F = 9/5(C) + 32
  - Output the result by displaying it on the screen

# Example Program: Temperature Converter

- Before we start coding, let's write a rough draft of the program in *pseudocode*
- Pseudocode is precise English that describes what a program does, step by step.
- Using pseudocode, we can concentrate on the algorithm rather than the programming language.

# Example Program: Temperature Converter

- Pseudocode:
  - Input the temperature in degrees Celsius (call it celsius)
  - Calculate fahrenheit as (9/5)*celsius+32
  - Output fahrenheit
- Now we need to convert this to Python!

# Example Program: Temperature Converter

```
#convert.py
# A program to convert Celsius temps to Fahrenheit
# by: Susan Computewell

def main():
    celsius = input("What is the Celsius temperature? ")
    fahrenheit = (9.0/5.0) * celsius + 32
    print "The temperature is ",fahrenheit," degrees Fahrenheit."

main()
```

# Example Program: Temperature Converter

- Once we write a program, we should test it!

```
>>>
What is the Celsius temperature? 0
The temperature is  32.0  degrees Fahrenheit.
>>> main()
What is the Celsius temperature? 100
The temperature is  212.0  degrees Fahrenheit.
>>> main()
What is the Celsius temperature? -40
The temperature is  -40.0  degrees Fahrenheit.
>>>
```

# Elements of Programs

- Names
  - Names are given to variables (celsius, fahrenheit), modules (main, convert), etc.
  - These names are called *identifiers*
  - Every identifier must begin with a letter or underscore (“_”), followed by any sequence of letters, digits, or underscores.
  - Identifiers are case sensitive.

# Elements of Programs

- These are all different, valid names
  - X
  - Celsius
  - Spam
  - spam
  - spAm
  - Spam_and_Eggs
  - Spam_And_Eggs

# Elements of Programs

- Some identifiers are part of Python itself. These identifiers are known as *reserved words*. This means they are not available for you to use as a name for a variable, etc. in your program.
- and, del, for, is, raise, assert, elif, in, print, etc.
- For a complete list, see table 2.1

# Elements of Programs

- Expressions
  - The fragments of code that produce or calculate new data values are called *expressions*.
  - *Literals* are used to represent a specific value, e.g. 3.9, 1, 1.0
  - Simple identifiers can also be expressions.

# Elements of Programs

```
>>> x = 5
>>> x
5
>>> print x
5
>>> print spam

Traceback (most recent call last):
  File "<pyshell#15>", line 1, in -toplevel-
    print spam
NameError: name 'spam' is not defined
>>>
```

- NameError is the error when you try to use a variable without a value assigned to it.

# Elements of Programs

- Simpler expressions can be combined using *operators*.
- +, -, *, /, **
- Spaces are irrelevant within an expression.
- The normal mathematical precedence applies.
- operators with the highest precedence appear at the top of the table, those with the lowest appear at the bottom.
- Expressions in parentheses ( ) is given the highest priority

# Python precedence of operators

| Operator | Description |
|---|---|
| ** | Exponentiation (raise to the power) |
| ~ + - | Ccomplement, unary plus and minus (method names for the last two are +@ and -@) |
| * / % // | Multiply, divide, remainder and integer division |
| + - | Addition and subtraction |
| >> << | Right and left bitwise shift |
| & | Bitwise 'AND'td> |
| ^ \| | Bitwise exclusive `OR' and regular `OR' |
| <= < > >= | Comparison operators |
| <> == != | Equality operators |
| = %= /= //= -= += *= **= | Assignment operators |
| is is not | Identity operators |
| in not in | Membership operators |
| not or and | Logical operators |

# Python precedence of operators

- Operator precedence affects how an expression is evaluated.
- For example, x = 7 + 3 * 2;
    - here, x is assigned 13, not 20 because operator * has higher precedence than +, so it first multiplies 3*2 and then adds into 7.

# Example

- a = 20;  b = 10; c = 15; d = 5; e = 0

- Value of (a + b) * c / d is 90
- Value of ((a + b) * c) / d is 90
- Value of (a + b) * (c / d) is 90
- Value of a + (b * c) / d is 50

# Elements of Programs

- Output Statements
  - A print statement can print any number of expressions.
  - Successive print statements will display on separate lines.
  - A bare print will print a blank line.
  - If a print statement ends with a “,”, the cursor is not advanced to the next line.

# Elements of Programs

```
print 3+4                         7
print 3, 4, 3+4                   3 4 7
print
print 3, 4                        3 4
print 3+      4                   7
print “The answer is”, 3+4        The answer is 7
```

# Assignment Statements

- Simple Assignment
- <variable> = <expr>
  variable is an identifier, expr is an expression
- The expression on the RHS is evaluated to produce a value which is then associated with the variable named on the LHS.

# Assignment Statements

- x = 3.9 * x * (1-x)
- fahrenheit = 9.0/5.0 * celsius + 32
- x = 5

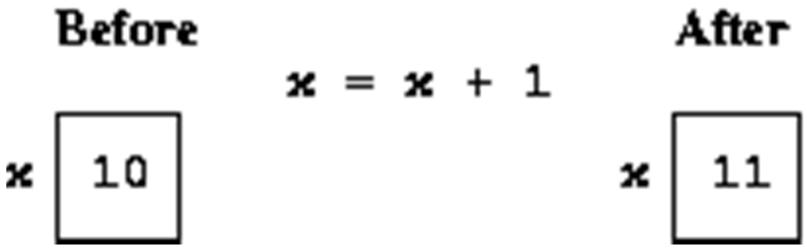
# Assignment Statements

- Variables can be reassigned as many times as you want!

```
>>> myVar = 0
>>> myVar
0
>>> myVar = 7
>>> myVar
7
>>> myVar = myVar + 1
>>> myVar
8
>>>
```

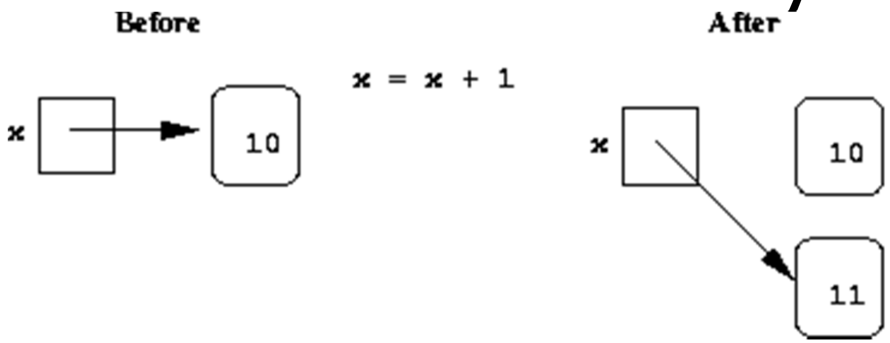
# Assignment Statements

- Variables are like a box we can put values in.
- When a variable changes, the old value is erased and a new one is written in.



# Assignment Statements

- Technically, this model of assignment is simplistic for Python.
- Python does not recycle these memory locations (boxes).
- Assigning a variable is more like putting a "sticky note" on a value and saying, "this is x".



# Assigning Input

- The purpose of an input statement is to get input from the user and store it into a variable.
- <variable> = input(<prompt>)
- E.g., x = input(“Enter a temperature in Celsius: ”)

# Assigning Input

- First the prompt is evaluated
- The program waits for the user to enter a value and press <enter>
- The expression that was entered is evaluated and assigned to the input variable.

```
>>> def inp():
      x = input("Enter something ")
      print x


>>> inp()
Enter something 3+4
7
```

# Simultaneous Assignment

- Several values can be calculated at the same time
- <var>, <var>, … = <expr>, <expr>, …
- Evaluate the expressions in the RHS and assign them to the variables on the LHS

# Simultaneous Assignment

- sum, diff = x+y, x-y
- How could you use this to swap the values for x and y?
  - Why doesn't this work?
    x = y
    y = x
- We could use a temporary variable…

# Simultaneous Assignment

- We can swap the values of two variables quite easily in Python!
  - x, y = y, x

```
>>> x = 3
>>> y = 4
>>> print x, y
3 4
>>> x, y = y, x
>>> print x, y
4 3
```

# Simultaneous Assignment

- We can use this same idea to input multiple variables from a single input statement!
- Use commas to separate the inputs

```
>>> def spamneggs():
        spam, eggs = input("Enter the number of slices of spam followed by the
number of eggs: ")
        print "You ordered", eggs, "eggs and", spam, "slices of spam. Yum!“

>>> spamneggs()
Enter the number of slices of spam followed by the number of eggs: 3, 2
You ordered 2 eggs and 3 slices of spam. Yum!
>>>
```

# Definite Loops

- A *definite* loop executes a definite number of times, i.e., at the time Python starts the loop it knows exactly how many *iterations* to do.
- for <var> in <sequence>:
      <body>
- The beginning and end of the body are indicated by indentation.

# Definite Loops

```
for <var> in <sequence>:
    <body>
```

- The variable after the *for* is called the *loop index*. It takes on each successive value in *sequence*.

# Definite Loops

```
>>> for i in [0,1,2,3]:
      print i


0
1
2
3
>>> for odd in [1, 3, 5, 7]:
      print odd*odd


1
9
25
49
>>>
```

# Definite Loops

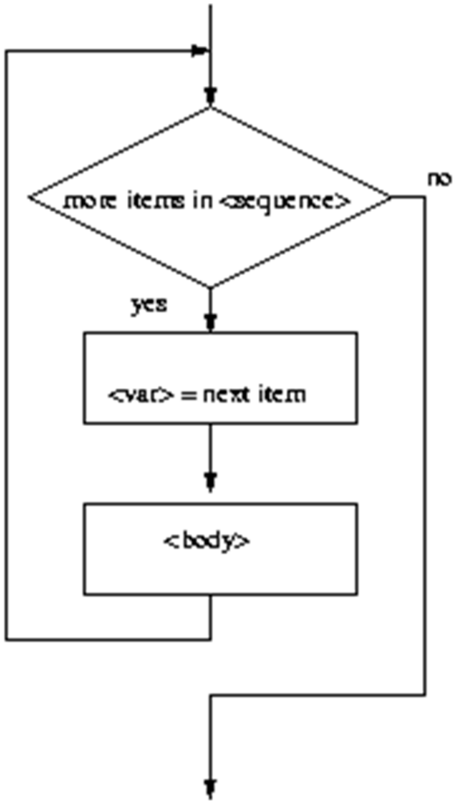
- In chaos.py, what did *range(10)* do?

```
>>> range(10)
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```

- Range is a built-in Python function that returns a list of numbers, starting with 0.
- Range(10) will make the body of the loop execute 10 times.

# Definite Loops

- **for** loops alter the flow of program execution, so they are referred to as *control structures*.



# Example Program: Future Value

- Analysis
  - Money deposited in a bank account earns interest.
  - How much will the account be worth 10 years from now?
  - Inputs: principal, interest rate
  - Output: value of the investment in 10 years

# Example Program: Future Value

- Specification
  - User enters the initial amount to invest, the principal
  - User enters an annual percentage rate, the interest
  - The specifications can be represent like this …

# Example Program: Future Value

- **Program** Future Value
- **Inputs**
  **principal** The amount of money being invested, in dollars
  **apr** The annual percentage rate expressed as a decimal number.
- **Output** The value of the investment 10 years in the future
- **Relatonship** Value after one year is given by *principal* * (1 + *apr*). This needs to be done 10 times.

# Example Program: Future Value

- Design

```
Print an introduction
Input the amount of the principal (principal)
Input the annual percentage rate (apr)
Repeat 10 times:
   principal = principal * (1 + apr)
Output the value of principal
```

# Example Program: Future Value

- Implementation
  - Each line translates to one line of Python (in this case)
  - Print an introduction

    ```
    print "This program calculates the future"
    print "value of a 10-year investment."
    ```

  - Input the amount of the principal

    ```
    principal = input("Enter the initial principal: ")
    ```

# Example Program: Future Value

- Input the annual percentage rate

  ```
  apr = input(“Enter the annual interest rate: ”)
  ```

- Repeat 10 times:

  ```
  for i in range(10):
  ```

- Calculate principal = principal * (1 + apr)

  ```
    principal = principal * (1 + apr)
  ```

- Output the value of the principal at the end of 10 years

  ```
  print “The value in 10 years is:”, principal
  ```

# Example Program: Future Value

```
# futval.py
#    A program to compute the value of an investment
#    carried 10 years into the future

def main():
    print "This program calculates the future value of a 10-year investment."

    principal = input("Enter the initial principal: ")
    apr = input("Enter the annual interest rate: ")

    for i in range(10):
        principal = principal * (1 + apr)

    print "The value in 10 years is:", principal

main()
```

# Example Program: Future Value

```
>>> main()
This program calculates the future value of a 10-year investment.
Enter the initial principal: 100
Enter the annual interest rate: .03
The value in 10 years is: 134.391637934
>>> main()
This program calculates the future value of a 10-year investment.
Enter the initial principal: 100
Enter the annual interest rate: .10
The value in 10 years is: 259.37424601
```

# Conditional Statements

- Making Decisions in Python

# If, Eles,  Elif

- The if statement of Python is similar to that of other languages.
- The if statement contains a logical expression using which data is compared, and a decision is made based on the result of the comparison.
- The syntax of the if statement is:

```
if expression:
    statement(s)
```

Note: In Python, all the statements indented by the same number of character spaces after a programming construct are considered to be part of a single block of code. Python uses indentation as its method of grouping statements.

# If, Else,  Elif

- An else statement can be combined with an if statement. An else statement contains the block of code that executes if the conditional expression in the if statement resolves to 0 or a false value.The *else statement is an optional statement and there could be at most only one else statement following an if .*
- The elif statement allows you to check multiple expressions for truth value and execute a block of code as soon as one of the conditions evaluates to true. Like the else, the elif statement is optional. However, unlike else, for which there can be at most one statement, there can be an arbitrary number of elif statements following an if.

# Example

```
if expression1:
        statement(s)
elif expression2:
        statement(s)
elif expression3:
        statement(s)
else:
        statement(s)
```

# While loop

- The while loop is one of the looping constructs available in Python. The while loop continues until the expression becomes false. The expression has to be a logical expression and must return either a *true or a false value*
- *The syntax of the while look is:*

```
while expression:
    statement(s)
```

*Example:*

```
#!/usr/bin/python
count = 0
while (count < 9):
        print 'The count is:', count
        count = count + 1
print "Good bye!"
```

# Infinite loop!

- Following loop will continue till you enter CNTL+C at the command prompt:

```
var = 1
while var == 1 :  # This constructs an infinite loop
        num = raw_input("Enter a number  :")
        print "You entered: ", num
print "Good bye!"
```

# For Loop

- The for loop in Python has the ability to iterate over the items of any sequence, such as a list or a string.
- The syntax of the loop look is:

```
for iterating_var in sequence:
    statements(s)
```

- For a conventional loop through index system (ie., same as Fortran do I = 1, 10 or C for (i=1; I =<10;++) { use
  for I in range(1,n+1):
- NOTE the need to go 1 more

# For Loop example

```
for letter in 'Python':     # First Example
    print 'Current Letter :', letter
fruits = ['banana', 'apple',  'mango']
for fruit in fruits:        # Second Example
          print 'Current fruit :', fruit
print "Good bye!”
```

This will produce following output:

```
Current Letter : P
Current Letter : y
Current Letter : t
Current Letter : h
Current Letter : o
Current Letter : n
Current fruit : banana
Current fruit : apple
Current fruit : mango
Good bye!
```