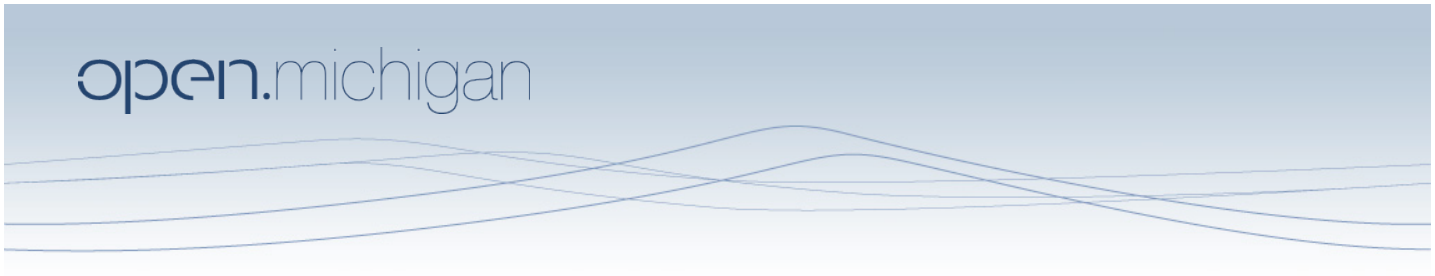
Variables, Expressions, and Statements

Chapter 2

Python for Informatics: Exploring Information
www.pythonlearn.com



Constants

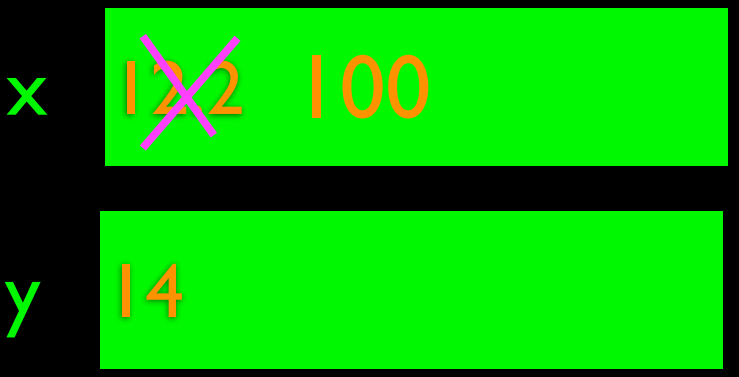
- Fixed values such as numbers, letters, and strings are called "constants" - because their value does not change
- Numeric constants are as you expect
- String constants use single-quotes (') or double-quotes (")

```
>>> print 123
123
>>> print 98.6
98.6
>>> print 'Hello world'
Hello world
```

Variables

- A variable is a named place in the memory where a programmer can store data and later retrieve the data using the variable "name"
- Programmers get to choose the names of the variables
- You can change the contents of a variable in a later statement

```
x = 12.2
y = 14
x = 100
```



Python Variable Name Rules

- Must start with a letter or underscore _
- Must consist of letters and numbers and underscores
- Case Sensitive
- Good: spam eggs spam23 _speed
- Bad: 23spam #sign var.12
- Different: spam Spam SPAM

Reserved Words

- You can not use reserved words as variable names / identifiers

and del for is raise
assert elif from lambda return
break else global not try
class except if or while
continue exec import pass yield
def finally in print

Sentences or Lines

```
x = 2          <-- Assignment Statement

x = x + 2      <-- Assignment with expression

print x        <-- Print statement
```

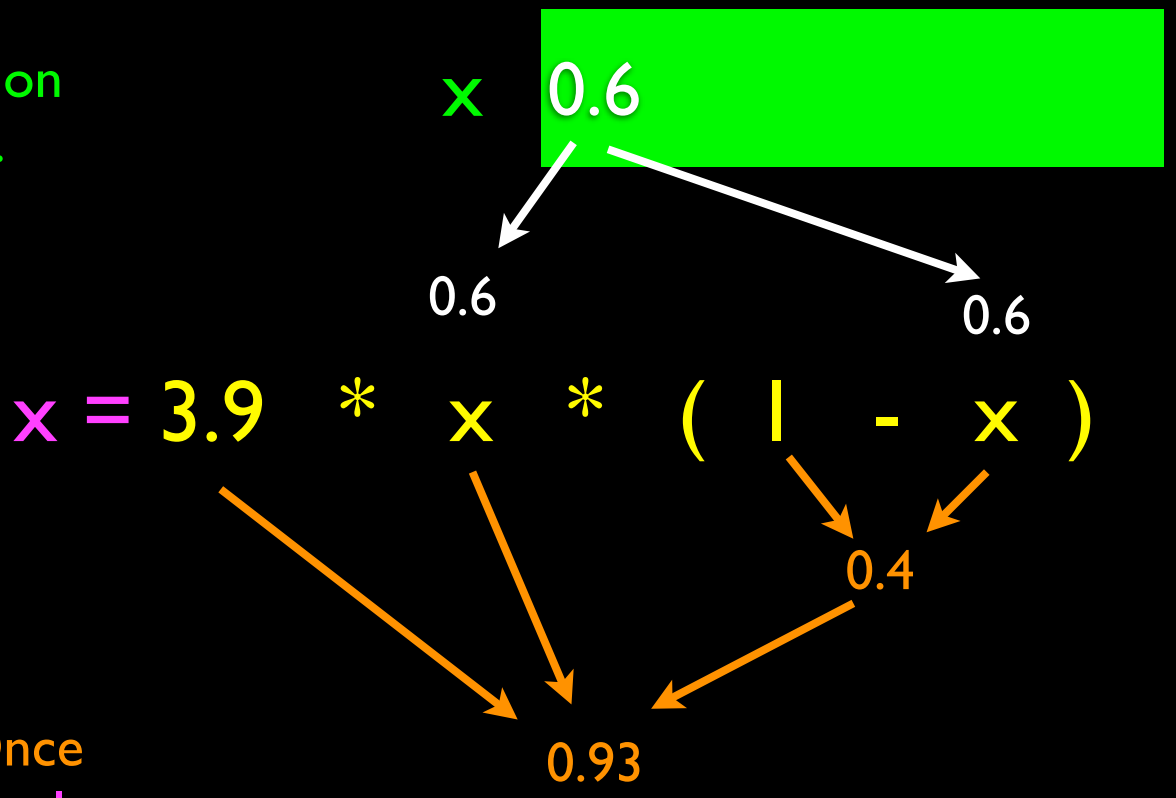
Variable Operator Constant Reserved Word

Assignment Statements

- We assign a value to a variable using the assignment statement (=)
- An assignment statement consists of an expression on the right hand side and a variable to store the result

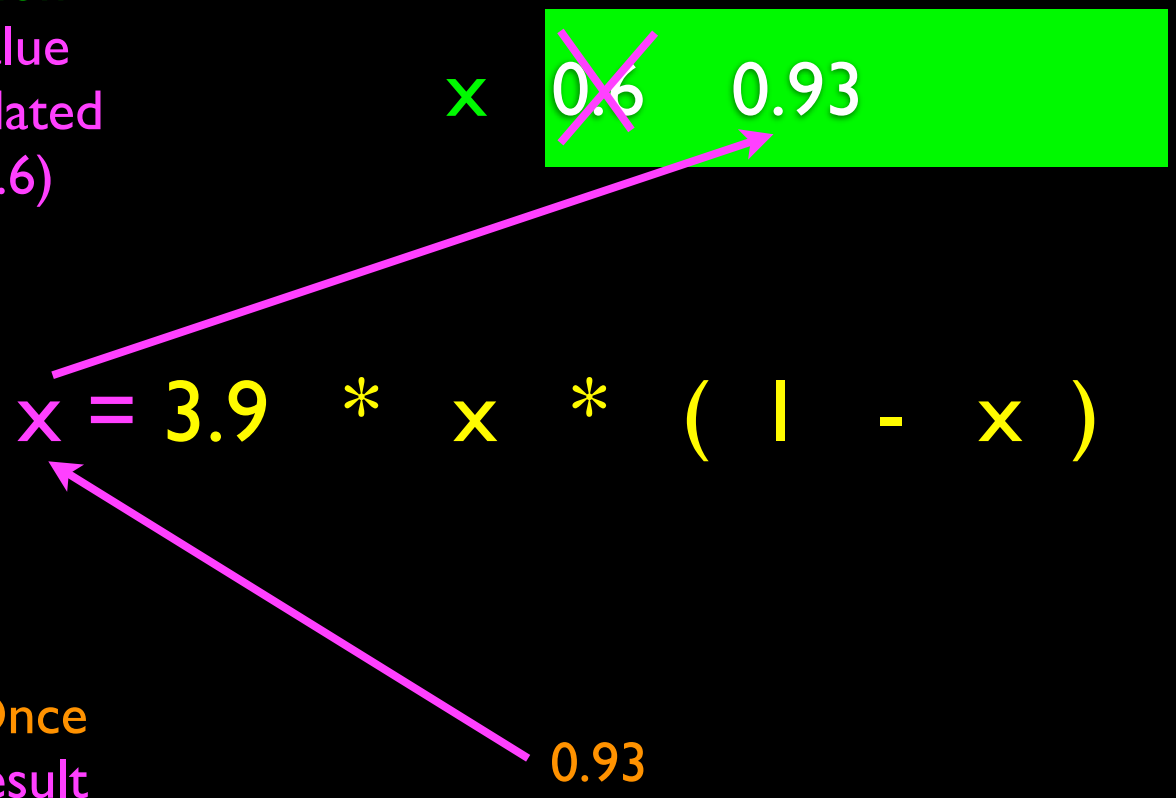
```
x = 3.9 * x * ( 1 - x )
```

A variable is a memory location used to store a value (0.6).



Right side is an expression. Once expression is evaluated, the result is placed in (assigned to) x.

A variable is a memory location used to store a value. The value stored in a variable can be updated by replacing the old value (0.6) with a new value (0.93).



Right side is an expression. Once expression is evaluated, the result is placed in (assigned to) the variable on the left side (i.e. x).

Numeric Expressions

- Because of the lack of mathematical symbols on computer keyboards - we use "computer-speak" to express the classic math operations
- Asterisk is multiplication
- Exponentiation (raise to a power) looks different from in math.

Operator	Operation
+	Addition
-	Subtraction
*	Multiplication
/	Division
**	Power
%	Remainder

Numeric Expressions

```
>>> xx = 2
>>> xx = xx + 2
>>> print xx
4
>>> yy = 440 * 12
>>> print yy
5280
>>> zz = yy / 1000
>>> print zz
5
```

```
>>> jj = 23
>>> kk = jj % 5
>>> print kk
3
>>> print 4 ** 3
64
```

```
      4 R 3
    ---------
5 |  23
     20
    ----
      3
```

Operator	Operation
+	Addition
-	Subtraction
*	Multiplication
/	Division
**	Power
%	Remainder

Order of Evaluation

- When we string operators together - Python must know which one to do first
- This is called "operator precedence"
- Which operator "takes precedence" over the others

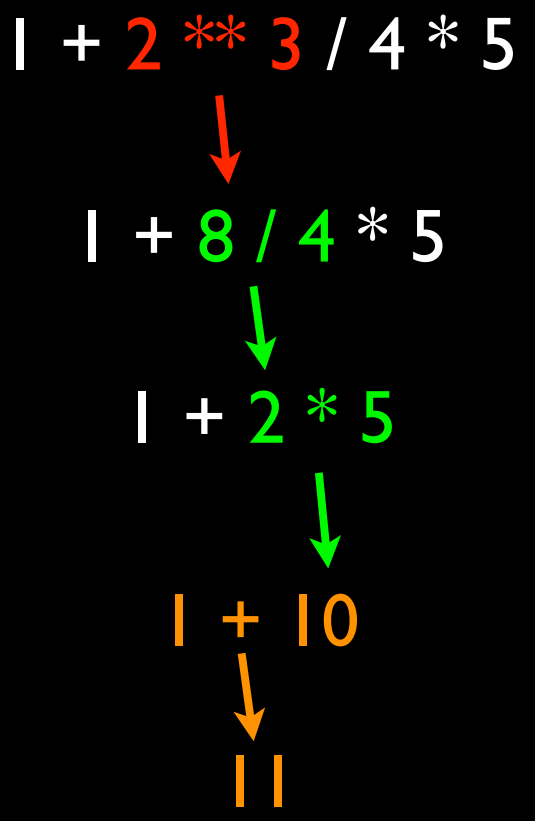
```
x = 1 + 2 * 3 - 4 / 5 ** 6
```

Operator Precedence Rules

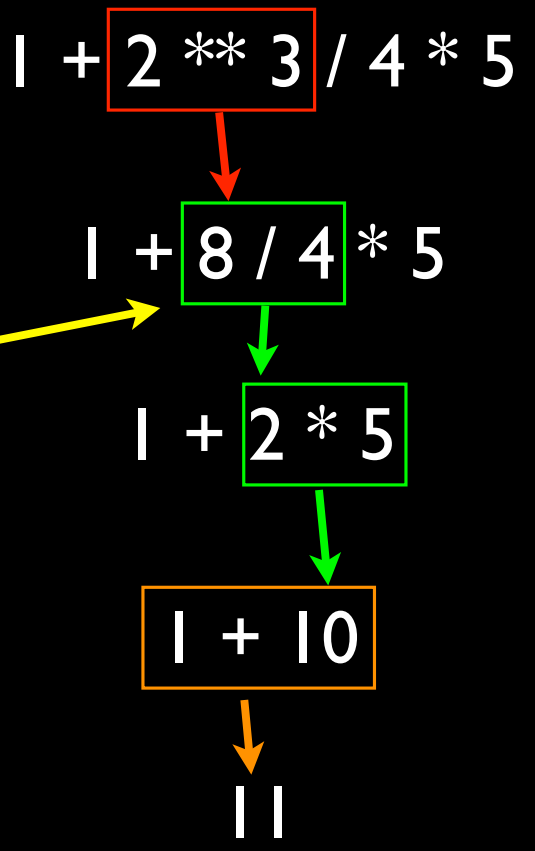
- Highest precedence rule to lowest precedence rule
  - Parenthesis are always respected
  - Exponentiation (raise to a power)
  - Multiplication, Division, and Remainder
  - Addition and Subtraction
  - Left to right

```
>>> x = 1 + 2 ** 3 / 4 * 5
>>> print x
11
>>>
```

Parenthesis
Power
Multiplication
Addition
Left to Right



```
>>> x = 1 + 2 ** 3 / 4 * 5
>>> print x
11
>>>
```



Note 8/4 goes before 4*5 because of the left-right rule.

Parenthesis
Power
Multiplication
Addition
Left to Right

Operator Precedence

- Remember the rules top to bottom
- When writing code - use parenthesis
- When writing code - keep mathematical expressions simple enough that they are easy to understand
- Break long series of mathematical operations up to make them more clear

Exam Question: x = 1 + 2 * 3 - 4 / 5

Python Integer Division is Weird!

- Integer division truncates
- Floating point division produces floating point numbers

```
>>> print 10 / 2
5
>>> print 9 / 2
4
>>> print 99 / 100
0
>>> print 10.0 / 2.0
5.0
>>> print 99.0 / 100.0
0.99
```

This changes in Python 3.0

Mixing Integer and Floating

- When you perform an operation where one operand is an integer and the other operand is a floating point the result is a floating point
- The integer is converted to a floating point before the operation

```
>>> print 99 / 100
0
>>> print 99 / 100.0
0.99
>>> print 99.0 / 100
0.99
>>> print 1 + 2 * 3 / 4.0 - 5
-2.5
>>>
```

What does "Type" Mean?

- In Python variables, literals, and constants have a "type"
- Python knows the difference between an integer number and a string
- For example "+" means "addition" if something is a number and "concatenate" if something is a string

```
>>> ddd = 1 + 4
>>> print ddd
5
>>> eee = 'hello ' + 'there'
>>> print eee
hello there
```

concatenate = put together

Type Matters

- Python knows what "type" everything is
- Some operations are prohibited
- You cannot "add 1" to a string
- We can ask Python what type something is by using the type() function.

```
>>> eee = 'hello ' + 'there'
>>> eee = eee + 1
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: cannot concatenate 'str'
and 'int' objects
>>> type(eee)
<type 'str'>
>>> type('hello')
<type 'str'>
>>> type(1)
<type 'int'>
>>>
```

Several Types of Numbers

- Numbers have two main types
  - Integers are whole numbers: -14, -2, 0, 1, 100, 401233
  - Floating Point Numbers have decimal parts: -2.5 , 0.0, 98.6, 14.0
- There are other number types - they are variations on float and integer

```
>>> xx = 1
>>> type (xx)
<type 'int'>
>>> temp = 98.6
>>> type(temp)
<type 'float'>
>>> type(1)
<type 'int'>
>>> type(1.0)
<type 'float'>
>>>
```

Type Conversions

- When you put an integer and floating point in an expression the integer is implicitly converted to a float
- You can control this with the built in functions int() and float()

```
>>> print float(99) / 100
0.99
>>> i = 42
>>> type(i)
<type 'int'>
>>> f = float(i)
>>> print f
42.0
>>> type(f)
<type 'float'>
>>> print 1 + 2 * float(3) / 4 - 5
-2.5
>>>
```

String Conversions

- You can also use int() and float() to convert between strings and integers
- You will get an error if the string does not contain numeric characters

```
>>> sval = '123'
>>> type(sval)
<type 'str'>
>>> print sval + 1
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: cannot concatenate 'str' and 'int'
>>> ival = int(sval)
>>> type(ival)
<type 'int'>
>>> print ival + 1
124
>>> nsv = 'hello bob'
>>> niv = int(nsv)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
ValueError: invalid literal for int()
```

User Input

- We can instruct Python to pause and read data from the user using the raw_input function
- The raw_input function returns a string

```
nam = raw_input('Who are you?')
print 'Welcome', nam
```

```
Who are you? Chuck
Welcome Chuck
```

Converting User Input

- If we want to read a number from the user, we must convert it from a string to a number using a type conversion function
- Later we will deal with bad input data

```
inp = raw_input('Europe floor?')
usf = int(inp) + 1
print "US floor", usf
```

```
Europe floor? 0
US floor 1
```

Comments in Python

- Anything after a # is ignored by Python
- Why comment?
  - Describe what is going to happen in a sequence of code
  - Document who wrote the code or other ancillary information
  - Turn off a line of code - perhaps temporarily

```
# Get the name of the file and open it
name = raw_input("Enter file:")
handle = open(name, "r")
text = handle.read()
words = text.split()

# Count word frequency
counts = dict()
for word in words:
   counts[word] = counts.get(word,0) + 1

# Find the most common word
bigcount = None
bigword = None
for word,count in counts.items():
    if bigcount is None or count > bigcount:
        bigword = word
        bigcount = count

# All done
print bigword, bigcount
```

String Operations

- Some operators apply to strings
  - + implies "concatenation"
  - * implies "multiple concatenation"
- Python knows when it is dealing with a string or a number and behaves appropriately

```
>>> print 'abc' + '123'
abc123
>>> print 'Hi' * 5
HiHiHiHiHi
>>>
```

Mnemonic Variable Names

- Since we programmers are given a choice in how we choose our variable names, there is a bit of "best practice"
- We name variables to help us remember what we intend to store in them ("mnemonic" = "memory aid")
- This can confuse beginning students because well named variables often "sound" so good that they must be keywords

http://en.wikipedia.org/wiki/Mnemonic

```
x1q3z9ocd = 35.0
x1q3z9afd = 12.50
x1q3p9afd = x1q3z9ocd * x1q3z9afd
print x1q3p9afd
```

```
a = 35.0
b = 12.50
c = a * b
print c
```

What is this code doing?

```
hours = 35.0
rate = 12.50
pay = hours * rate
print pay
```

Exercise

Write a program to prompt the user for hours and rate per hour to compute gross pay.

Enter Hours: 35
Enter Rate: 2.75
Pay: 96.25

Summary

- Type
- Resrved words
- Variables (mnemonic)
- Operators
- Operator precedence
- Integer Division
- Conversion between types
- User input
- Comments (#)