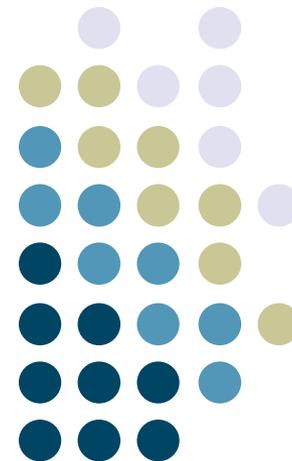


Introduction to Python (All the Basic Stuff)



CS 6452
John Stasko

Learning Objectives

- Python program development
 - Command line, IDEs, file editing
- Language fundamentals
 - Types & variables
 - Expressions
 - I/O
 - Control flow
 - Functions & scoping

Python Environment

- You've gotten Python on your machine
- Run from command line
OR
- Use an Integrated Development Environment (IDE)



Command Line (Windows)

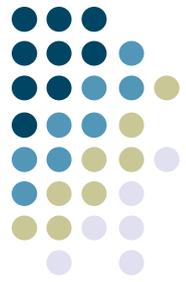
```
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

C:\Users\John>python
Python 2.7.7 (default, Jun 1 2014, 14:21:57) [MSC v.1500 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> _
```

Windows command shell

Python command

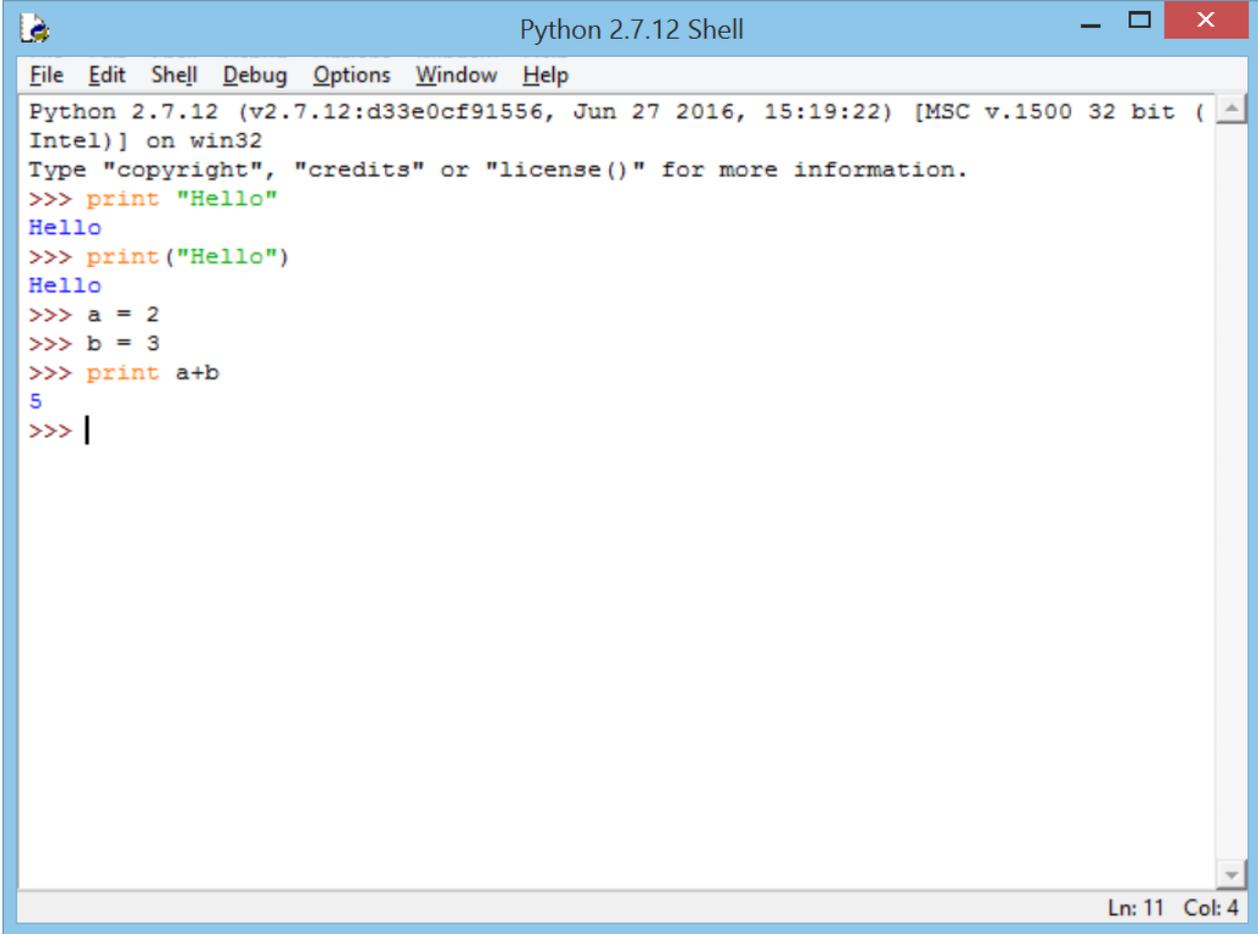
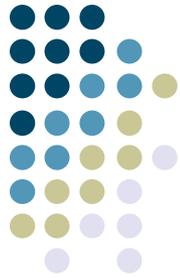
```
C:\Python27\python.exe
Python 2.7.12 (v2.7.12:d33e0cf91556, Jun 27 2016, 15:19:22) [MSC v.1500 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> _
```



Command Line (Mac)

```
Terminal - Python - 80x34
Last login: Thu Aug 25 12:19:05 on console
caledonia% python
Python 2.7.10 (default, Jul 14 2015, 19:46:27)
[GCC 4.2.1 Compatible Apple LLVM 6.0 (clang-600.0.39)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> x = 3
>>> print(x)
3
>>> █
```

IDLE IDE

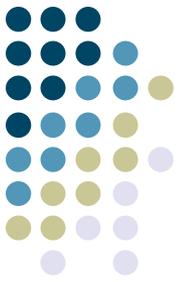


```
Python 2.7.12 Shell
File Edit Shell Debug Options Window Help
Python 2.7.12 (v2.7.12:d33e0cf91556, Jun 27 2016, 15:19:22) [MSC v.1500 32 bit (
Intel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> print "Hello"
Hello
>>> print("Hello")
Hello
>>> a = 2
>>> b = 3
>>> print a+b
5
>>> |
```

Ln: 11 Col: 4

Other Python IDEs

- Pydev (Eclipse)
- PyCharm
- Wing
- Spyder Python
- ...

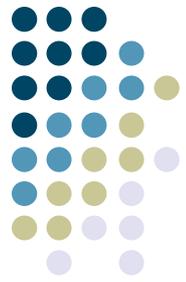


Creating/Editing Programs

- Text editor: Notepad, WordPad, Sublime text, Emacs, ...

```
C:\Users\John\Desktop\Python\family.py - Sublime Text (UNREGISTERED)
File Edit Selection Find View Goto Tools Project Preferences Help
family.py
1 import random
2
3
4 def main():
5     print "Starting Family Simulator"
6     keep_going = 'y'
7     while keep_going == 'y':
8         new_run()
9         keep_going = raw_input("Run again? (y/n) ")
10
Starting Family Simulator
How many families? 5
Line 1, Column 1 Tab Size: 4 Python
```

Doesn't work
ie, not interactive



Running Programs

Running an existing file

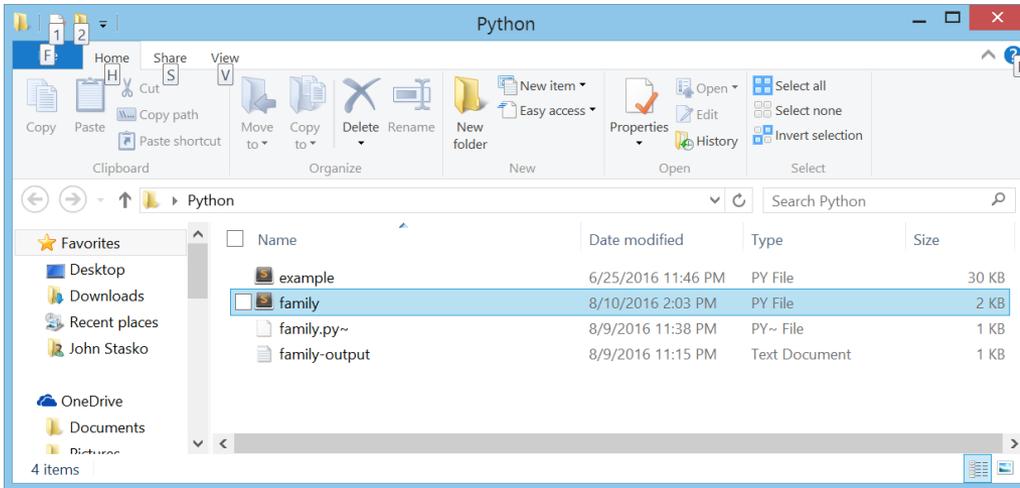
```
C:\Windows\system32\cmd.exe

C:\Users\John\Desktop\Python>python family.py
Starting Family Simulator
How many families? 5
Simulating families
1 - G G G G B
2 - B G
3 - B G
4 - B G
5 - B G
The average number of children born was 2.6 and the maximum was 5 .
A total of 8 girls were born and 5 boys.
Run again? (y/n) n

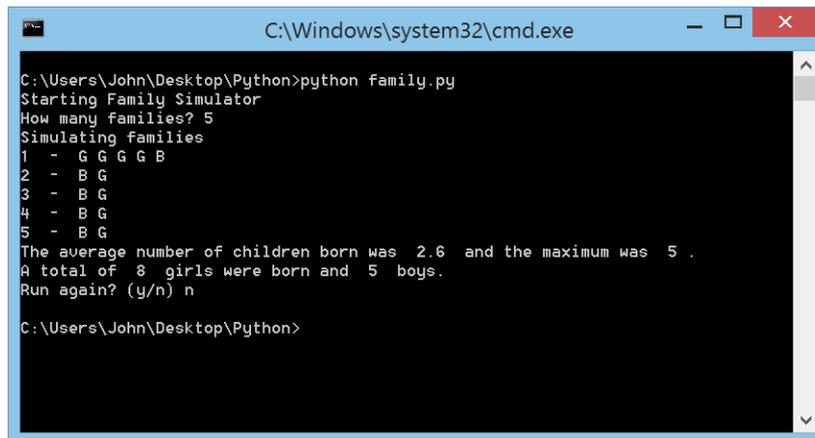
C:\Users\John\Desktop\Python>_
```



Tips & tricks (Windows)



Shift right click in background of window to get menu with “Open command window here” operation



Then run
python foobar.py

Types, Variables

- `int, float, str`
- No variable declarations
- Weakly typed language
- ```
x = 1
x = "hello"
print x
```
- Boolean values `True` and `False`

# Math Expressions

- `+`, `-`, `*`, `/`, `%`, `**`  
(`%` - remainder, `**` - exponentiation)

`5 % 3 is`

`3 / 2 is`

`3 / 2.0 is`

- Assignment statements

`x = (a + 10) * (b**3 / d * f)`

`tax = tax + .01`

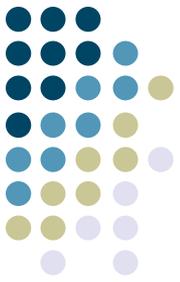
# Type Conversions

- You have two integers  $a$  and  $b$   
You want  $a/b$  (the floating point value)

`a / float(b)`

- Mixed type expression, the integer is converted to a float:

`17.5 / 6`



# Output

```
print 'Hello'
print "Hello"
print distance
print a, b
print "The value is ", val
```

Suppresses the newline

```
print a, ←
```

---

## Version 3

```
print('Hello')
print(a, b)
print(a, end=" ") ←
```

Suppresses the newline

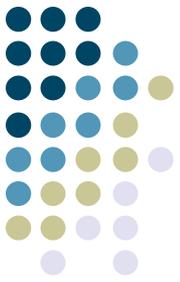
# Input (Python 2)

- Reading strings

```
firstName = raw_input('Enter your first name')
```

- Reading numbers

```
age = input('How old are you?')
```



# Input (Python 3)

- Reading strings

```
firstName = input('Enter your first name')
```

- Reading numbers

```
age = eval(input('How old are you?'))
```

# Intermission

- Admin stuff



# Control Flow

- Not all programs are “straight line”
  - Conditional statements
  - Iteration
  - Functions and procedures

# Conditional Expressions

- Conditionals: *if*

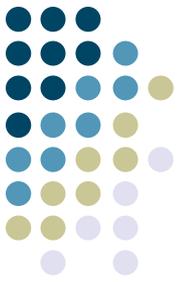
```
if x == 1:
 print "X is one"
elif x == 0:
 print "X is zero"
else:
 print "X is something else"
```

# Indentation

- Blocks are denoted by exact indentation

```
if x == 10:
 a = b * 5
 print "Hello"
 y = y + 1
print a, b
```

A source of headaches...



# What is X after the code runs?

```
x = 7
if x > 22:
 x = 5
elif x <= 7:
 x = x*3
elif x == 21:
 x = x*2

print(x)
```

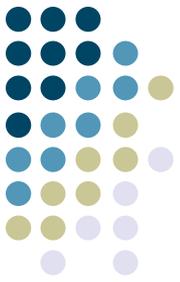
1. 5
2. 7
3. 21
4. 42
5. I have no idea

# Iteration - while

- General form: *while* *<test>*: will continue to iterate as long as *<test>* is true (not 0 or *none*)
- Special keywords to control looping
  - *break* - jumps out of the loop
  - *continue* - jumps back to the top of the loop (the *while* statement)

```
x = 15
while x > 0:
 print x
 x = x - 1
```

Watch that indentation!



# Iteration - for

- General form: the *for* statement iterates over a sequence of items, such as a list

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

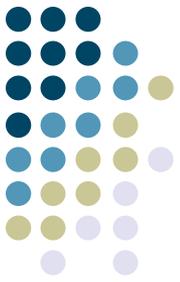
prints 0, 1, 2, 3, 4

```
for x in range(2, 5):
 print x
```

prints 2, 3, 4

```
for x in ["spam", "eggs", "ham"]:
 print x
```

prints spam, eggs, ham

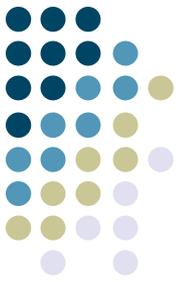


# What is z after the code runs?

```
x = 5
z = 0
for x in range(5):
 y = 6
 if x == 3:
 break
 while y > 0:
 y = y - 1
 z = z + 1

print(z)
```

1. 0
2. 18
3. 24
4. 64
5. I have no idea



# Exercise

- Write a program that:

Takes integer input from the user, until -1 is entered  
Calculates and prints the average of those numbers  
(excluding the -1)

# Functions

- It's helpful to break your code into smaller pieces that each do some specific function or operation
  - Can test each one individually
  - Makes debugging easier

- Python uses the

```
def fct_name():
 statement
 statement
 etc
 return expression
```

**syntax**

# Example

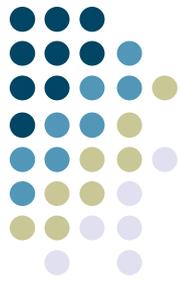
- ```
def sum(num1, num2):  
    result = num1 + num2  
    return result
```

Elsewhere in code

```
a = 3  
b = 12  
c = sum(a, b)
```

Modularity

- We typically have multiple functions in a file
 - Name one main as the “starter”
 - Call it to get things going



Example

```
def main():  
    code goes here  
  
def fct1():  
    code goes here  
  
def fct2():  
    code goes here  
  
...  
  
main()
```

Random Numbers

- Built-in functions for that
- `import random`

```
number = random.randint(1, 100)
```

Gives random integer between 1 and 100, inclusive

- `number = random.uniform(1.0, 10.0)`

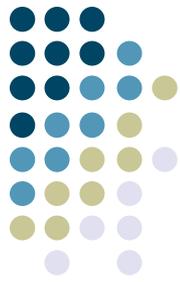
Gives random float between 1.0 and 10.0

Modules

- Each separate file is called a *module*
- Usually contains a set of related functions that provide some useful operations
- You then `import` these modules
- When you downloaded Python, you got a bunch of them
 - `random, math`

Scoping

- What is scoping?
- Scoping is a fancy word that just means “the rules about what you can see from where” in a program
- The *namespace* is the collection of stuff that you can see from any given point in a program

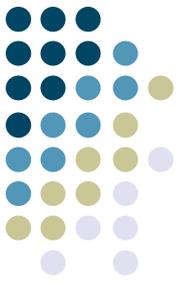


An Example Scoping Error

```
welcomeMsg = "Hello!"  
def changeWelcomeMsg():  
    welcomeMsg = "Bonjour!"  
    print "New welcome  
message is", welcomeMsg
```

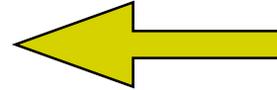
```
changeWelcomeMsg()  
>>> New welcome message is  
Bonjour!  
print welcomeMsg  
Hello!
```

Why?



An Example: Scoping Error

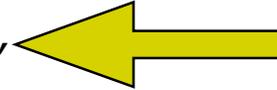
- `welcomeMsg = "Hello!"`



`welcomeMsg` is defined in the **global scope**

- `def changeWelcomeMsg():`

- `welcomeMsg = "Bonjour!"`



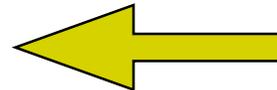
This line defines a *new* variable with the same name, in the **local scope!**

- `print "New welcome message is", welcomeMsg`

- `changeWelcomeMsg()`

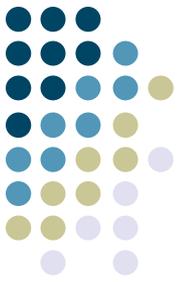
- `>>> New welcome message is Bonjour!`

- `print welcomeMsg`



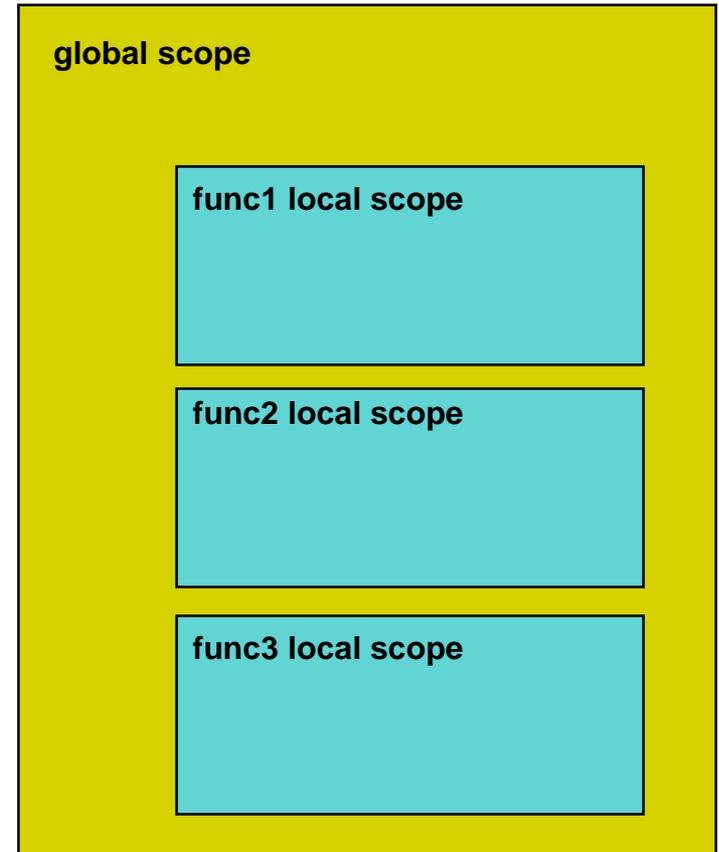
Since this call to *print* is outside the function `changeWelcomeMsg()`, it refers to the `welcomeMsg` variable in the global scope.

- `"Hello!"`



Thinking About Scopes

- Variables named in the global scope are available to statements in any scope
 - Unless they have been “hidden” by a local variable with the same name, as in the error example
- Variables named in a local scope are only available to statements in that scope
- The first assignment to a variable determines the scope it is in





More on Scopes

- “Global” really means the file the variable is in
 - When you start developing with multiple files, each file defines its own scope that is “global” for that file
- Each call to a function creates a new local scope
 - Thus if a variable `foo` is defined in function `func()`, each call to `func()` has its own new “namespace” and its own separate `foo`
- By default, *all* assignments that you make in a function create names in the local scope
 - Advanced: you can use the *global* statement if you want to change a global variable from within a function
 - Dangerous, but useful. We’ll talk about it in a later lecture
- Names not assigned to in a function are assumed to be globals

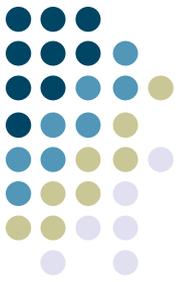
Still More on Scopes

- What all this boils down to is...
 - Local variables (those first assigned to within a function) serve as temporary names you need only when a function is running
 - This helps modularity of your program ("hide" details within a function)
- But:
 - You need to be careful when using a name within a function that's defined outside
 - Subtle and hard to track bugs...
 - Just don't do it

A common bug

```
def print0to9():  
    maxmum = 10  
    for i in range(maximum):  
        print(i)
```

```
maximum = 5  
for i in range(1, maximum):  
    print(i)  
print0to9()
```



Scoping Gotchas

- Subtly different than some other languages

- 1. Local scopes don't nest

```
def outerfunc(x, y):  
    def innerfunc(z):  
        if z > 0:  
            print x, y  
    innerfunc(x)
```

- x and y aren't available inside the local scope for innerfunc
- 2. There are actually *three* scopes: global, local, and `__builtin__`
 - First, the local scope is checked
 - Then, the global scope
 - Finally, the scope defined by the module called `__builtin__`
 - `len`, `abs`, `max`, `min`, ...

HW



- Family simulation (see website)
- Due Tuesday at class time
- Turn in via t-square
- If you're having a tough time with it, seek help from Amit or John

More Administratia

- Late policy for assignments:
 - Clear with me *first* if you have a valid excuse for missing a due date
 - Examples: medical or family emergency
 - My policy is -10% per late day, maximum 3 days late