Introduction to Problem Solving and Algorithm

By:
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Lecture 1

Why Program?

Pre-Requisite: Please Install Python

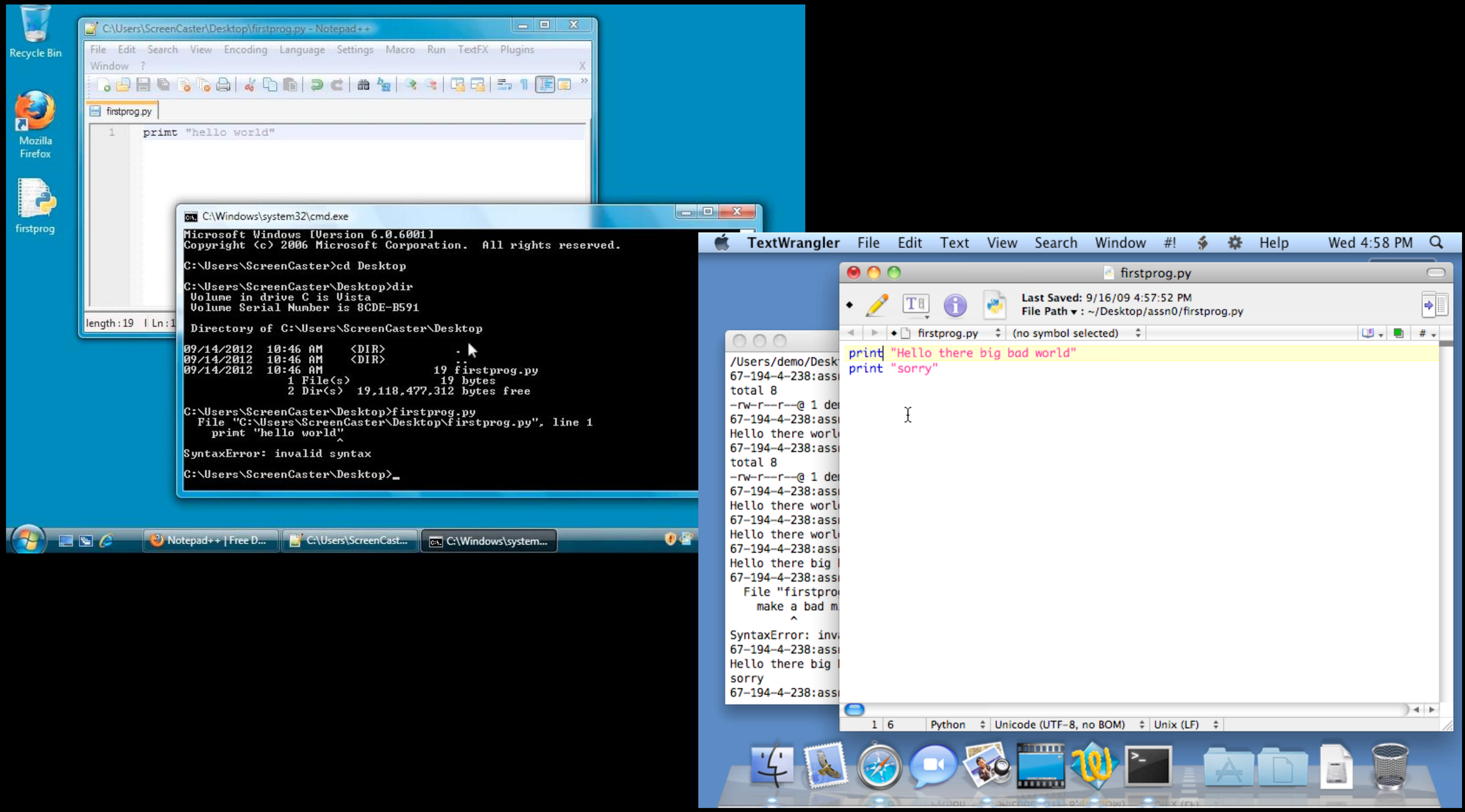
Setting up your PythonLearn Devlopment Environment

We have separate pages for each of the commonly used Operating Systems:

- Setting up the PythonLearn Environment in Microsoft Windows
- Setting up the PythonLearn Environment on a Macintosh

Note: Make sure that you install the latest version of Python 2.x - do not install Python 3.x. There are signficant differences between Python 2 and Python 3 and this book is still Python 2.

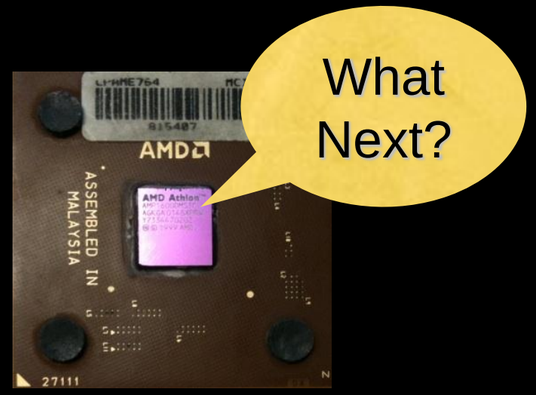
You will need Quicktime (or iTunes) installed on your computer to view any video materials or screencasts. You should probably download the high quality copies of these files or screencasts to your computer and view/play them locally. They are rather large files and you will want to move back and forth as well as start and stop the podcasts so you can perform the steps as indicated.

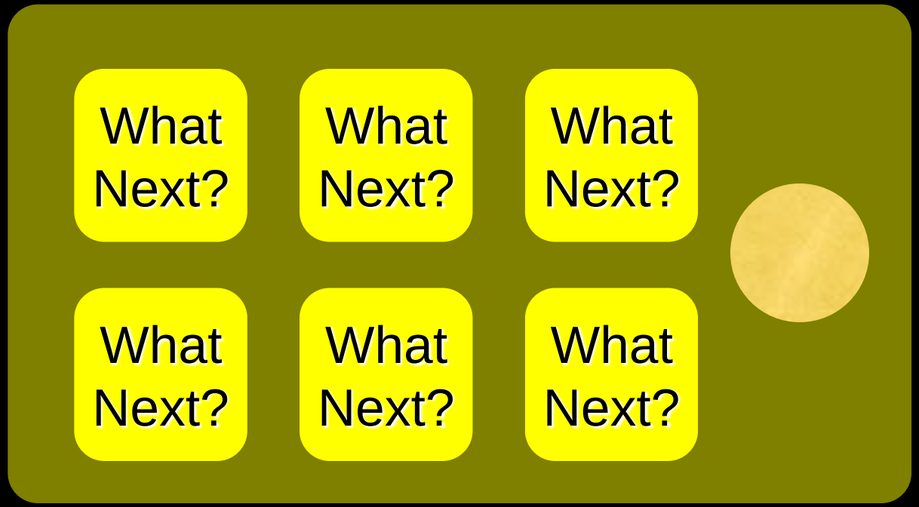

Recycle Bin
Mozilla Firefox
firstprog
C:\Users\ScreenCaster\Desktop\firstprog.py - Notepad++
File Edit Search View Encoding Language Settings Macro Run TextFX Plugins
Window ?
firstprog.py
1 primt "hello world"
length : 19 | Ln : 1
C:\Windows\system32\cmd.exe
Microsoft Windows [Version 6.0.6001]
Copyright (c) 2006 Microsoft Corporation. All rights reserved.
C:\Users\ScreenCaster>cd Desktop
C:\Users\ScreenCaster\Desktop>dir
Volume in drive C is Vista
Volume Serial Number is 8CDE-B591
Directory of C:\Users\ScreenCaster\Desktop
09/14/2012 10:46 AM <DIR> .
09/14/2012 10:46 AM <DIR> ..
09/14/2012 10:46 AM 19 firstprog.py
1 File(s) 19 bytes
2 Dir(s) 19,118,477,312 bytes free
C:\Users\ScreenCaster\Desktop>firstprog.py
File "C:\Users\ScreenCaster\Desktop\firstprog.py", line 1
primt "hello world"
^
SyntaxError: invalid syntax
C:\Users\ScreenCaster\Desktop>
Notepad++ | Free D...
C:\Users\ScreenCast...
C:\Windows\system...
TextWrangler File Edit Text View Search Window #! Help Wed 4:58 PM
firstprog.py
Last Saved: 9/16/09 4:57:52 PM
File Path : ~/Desktop/assn0/firstprog.py
firstprog.py
(no symbol selected)
print "Hello there big bad world"
print "sorry"
/Users/demo/Desk
67-194-4-238:ass
total 8
-rw-r--r--@ 1 de
Hello there worl
Hello there big
File "firstpro
make a bad m
SyntaxError: inv
sorry
1 6
Python
Unicode (UTF-8, no BOM)
Unix (LF)

Back to the Introduction...

Computers want to be helpful...

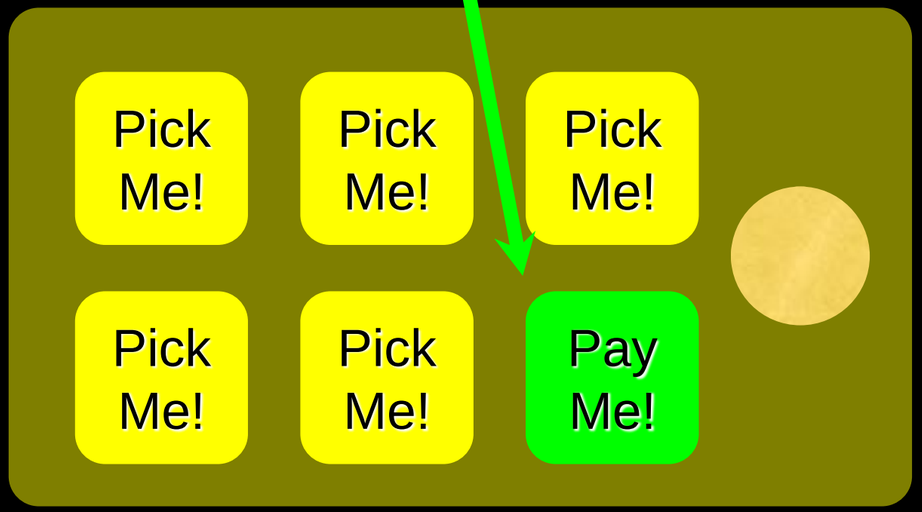
- Computers are built for one purpose - to do things for us
- But we need to speak their language to describe what we want done
- Users have it easy - someone already put many different programs (instructions) into the computer and users just pick the ones we want to use





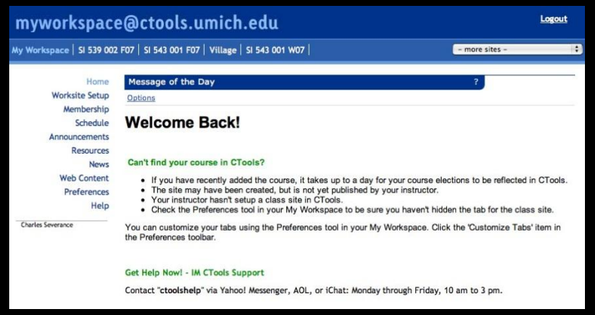
Programmers Anticipate Needs

- iPhone Applications are a market
- iPhone Applications have over 3 Billion downloads
- Programmers have left their jobs to be full-time iPhone developers
- Programmers know the ways of the program

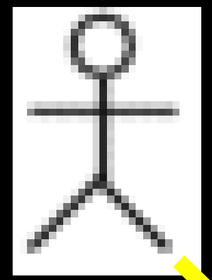


Users .vs. Programmers

- Users see computers as a set of tools - word processor, spreadsheet, map, todo list, etc.
- Programmers learn the computer “ways” and the computer language
- Programmers have some tools that allow them to build new tools
- Programmers sometimes write tools for lots of users and sometimes programmers write little “helpers” for themselves to automate a task



User



Computer
Hardware + Software

Programmer

Data

Information

....

Networks

From a software creator's point of view, we build the software. The end users (stakeholders/actors) are our masters - who we want to please - often they pay us money when they are pleased. But the data, information, and networks are our problem to solve on their behalf. The hardware and software are our friends and allies in this quest.

Why be a programer?

- To get some task done - we are the user and programmer
  - Clean up survey data
- To produce something for others to use - a programming job
  - Fix a performance problem in the Sakai software
  - Add guestbook to a web site

What is Code? Software? A Program?

- A sequence of stored instructions
  - It is a little piece of our intelligence in the computer
  - It is a little piece of our intelligence we can give to others - we figure something out and then we encode it and then give it to someone else to save them the time and energy of figuring it out
- A piece of creative art - particularly when we do a good job on user experience

Programs for Humans...

http://www.youtube.com/watch?v=vlzwuFkn88U
http://www.youtube.com/watch?v=sN62PAKoBfE

Programs for Humans...

while music is playing:
- Left hand out and up
- Right hand out and up
- Flip Left hand
- Flip Right hand
- Left hand to right shoulder
- Right hand to left shoulder
- Left hand to back of head
- Right ham to back of head
- Left hand to right hit
- Right hand to left hit
- Left hand on left bottom
- Right hand on right bottom
- Wiggle
- Wiggle
- Jump

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- Left hand to back of head
- Right hand to back of head
- Left hand to right hip
- Right hand to left hip
- Left hand on left bottom
- Right hand on right bottom
- Wiggle
- Wiggle
- Jump

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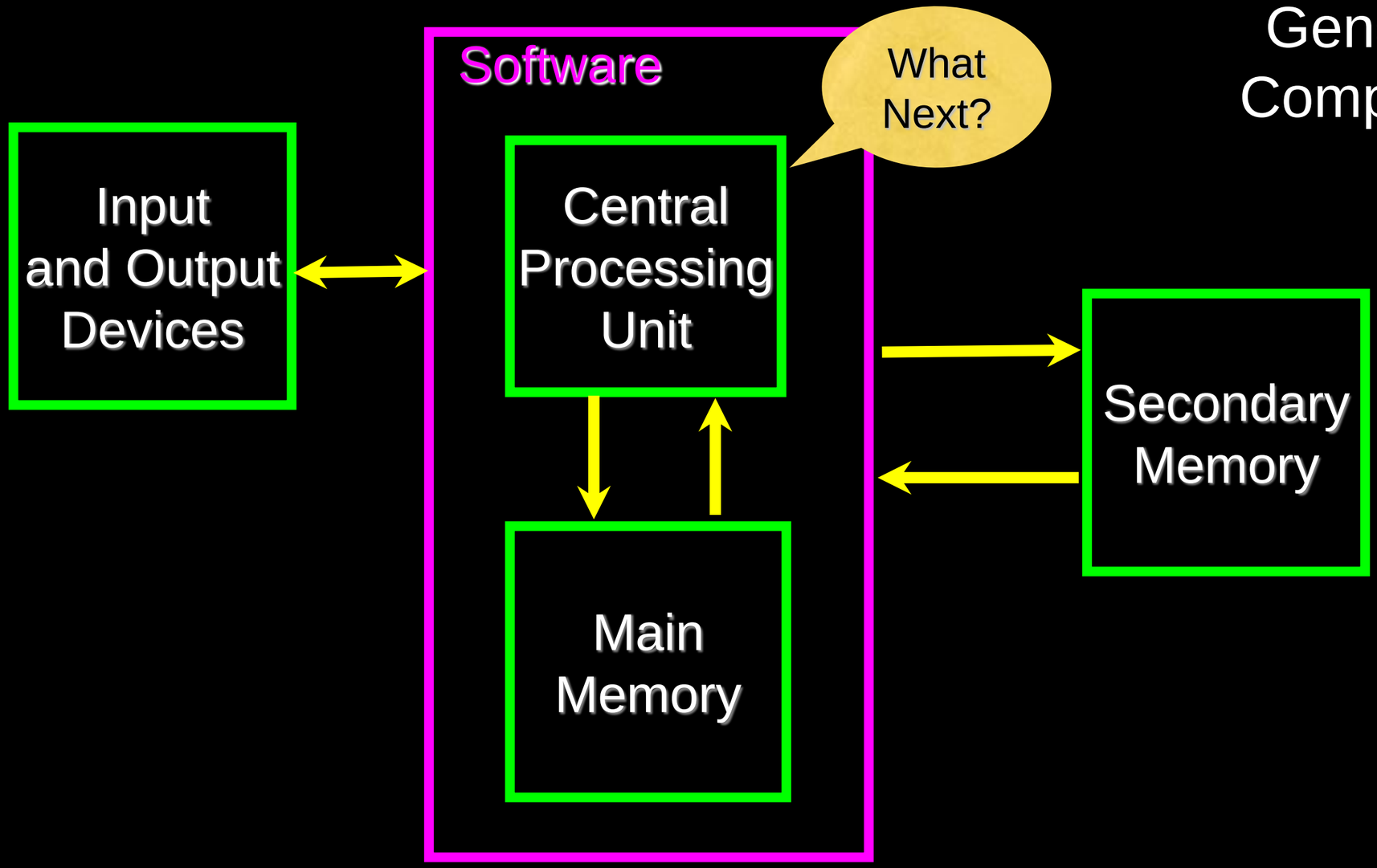
Hardware Architecture

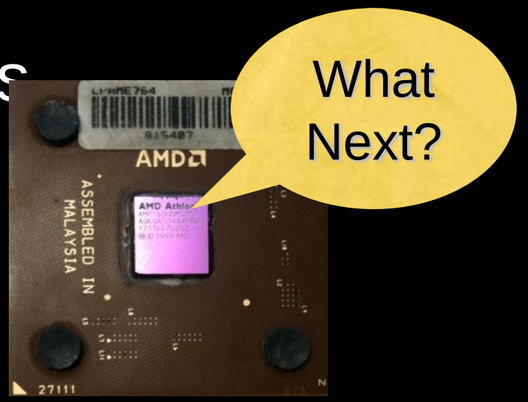
http://upload.wikimedia.org/wikipedia/commons/3/3d/RaspberryPi.jpg

Generic Computer



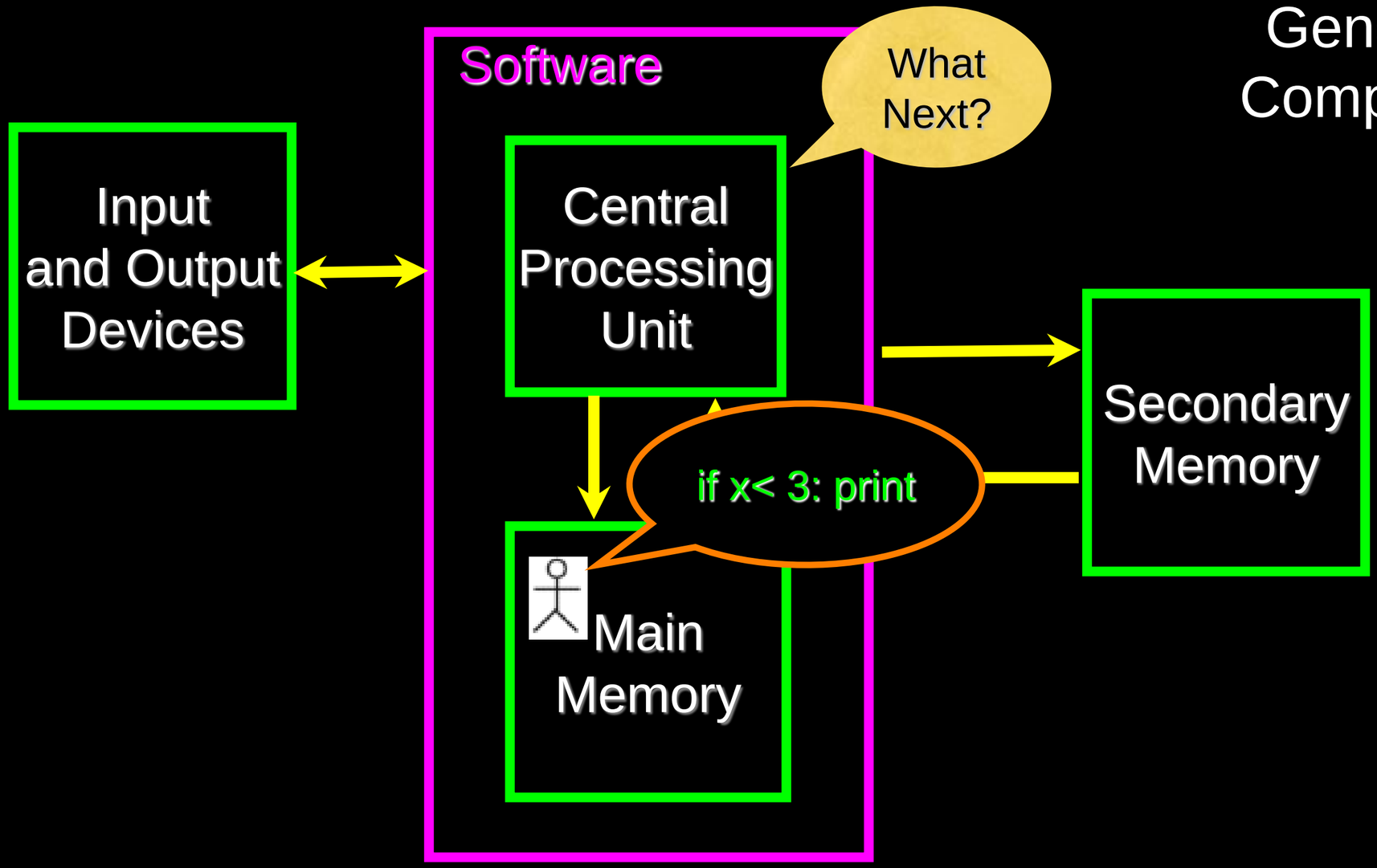
Definitions

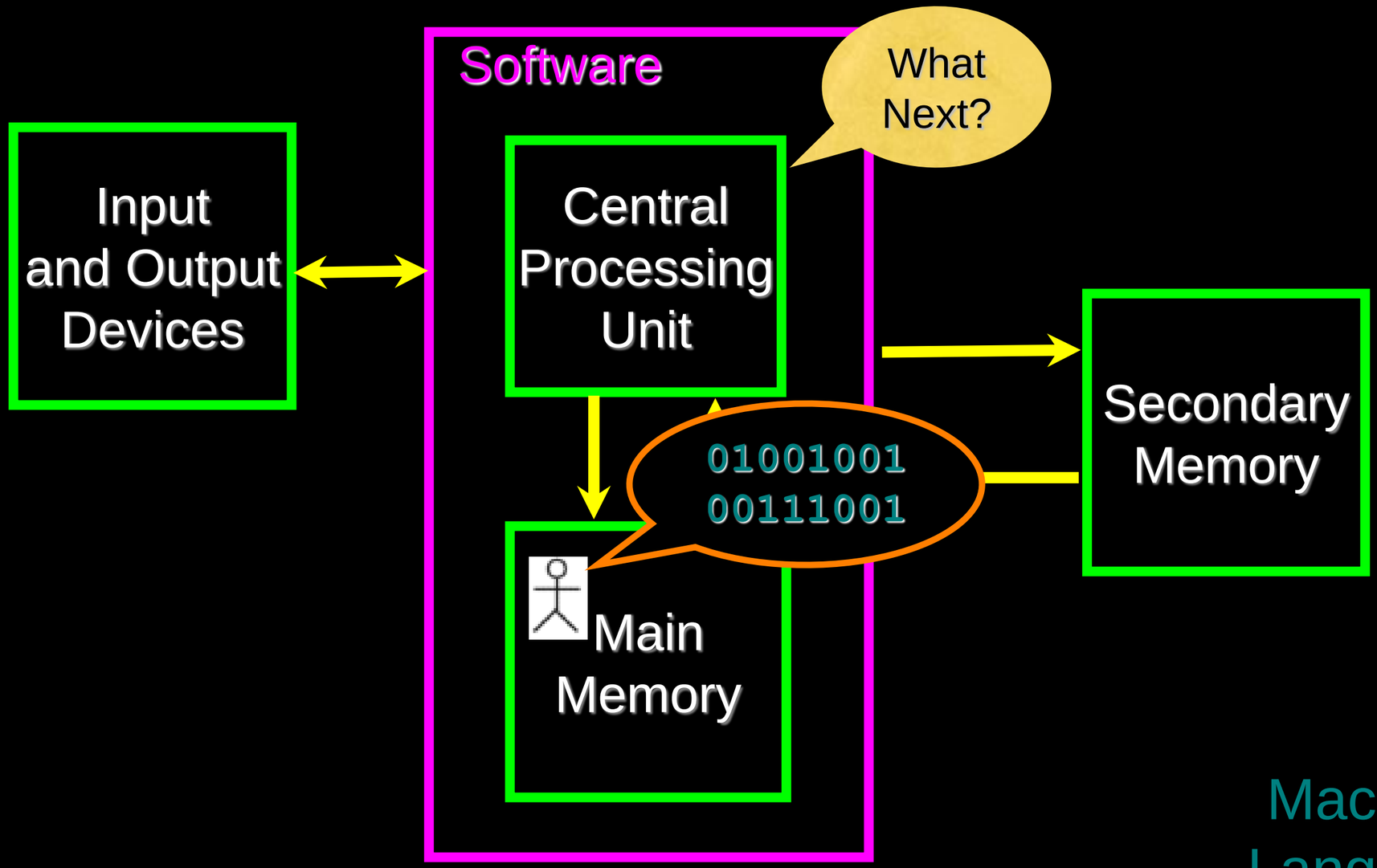
- Central Processing Unit: Runs the Program - The CPU is always wondering “what to do next”? Not the brains exactly - very dumb but very very fast



- Input Devices: Keyboard, Mouse, Touch Screen
- Output Devices: Screen, Speakers, Printer, DVD Burner
- Main Memory: Fast small temporary storage - lost on reboot - aka RAM
- Secondary Memory: Slower large permanent storage - lasts until deleted - disk drive / memory stick

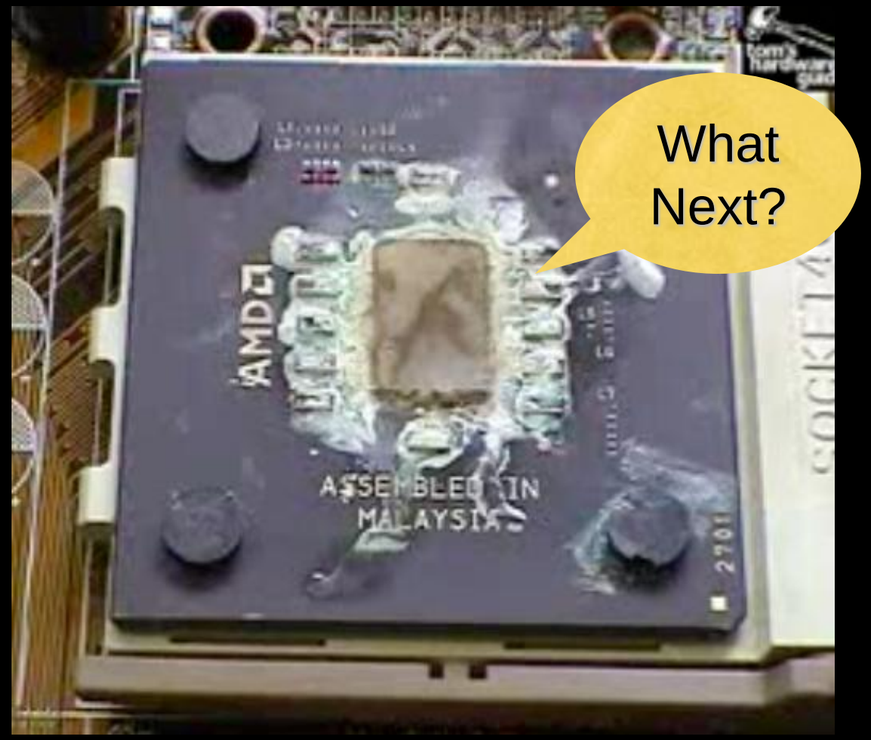
Generic Computer





Machine Language

Totally Hot CPU



http://www.youtube.com/watch?v=y39D4529FM4

Hard Disk in Action

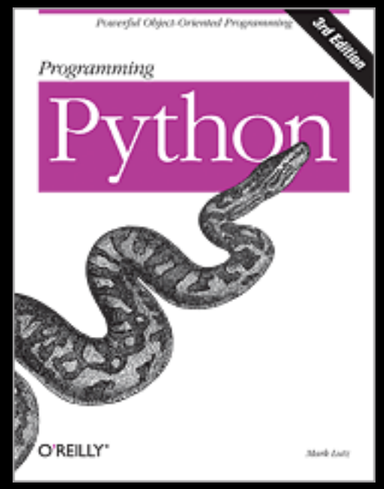
http://www.youtube.com/watch?v=9eMWG3fwiEU

Python as a Language

Parseltongue is the language of serpents and those who can converse with them. An individual who can speak Parseltongue is known as a Parselmouth. It is a very uncommon skill, and may be hereditary. Nearly all known Parselmouths are descended from Salazar Slytherin.

http://harrypotter.wikia.com/wiki/Parseltongue

Python is the language of the Python Interpreter and those who can converse with it. An individual who can speak Python is known as a Pythonista. It is a very uncommon skill, and may be hereditary. Nearly all known Pythonistas use software inititiallv developed by Guido van Rossum.



Early Learner: Syntax Errors

- We need to learn the Python language so we can communicate our instructions to Python. In the beginning we will make lots of mistakes and speak gibberish like small children.

- When you make a mistake, the computer does not think you are “cute”. It says “syntax error” - given that it *knows* the language and you are just learning it. It seems like Python is cruel and unfeeling.

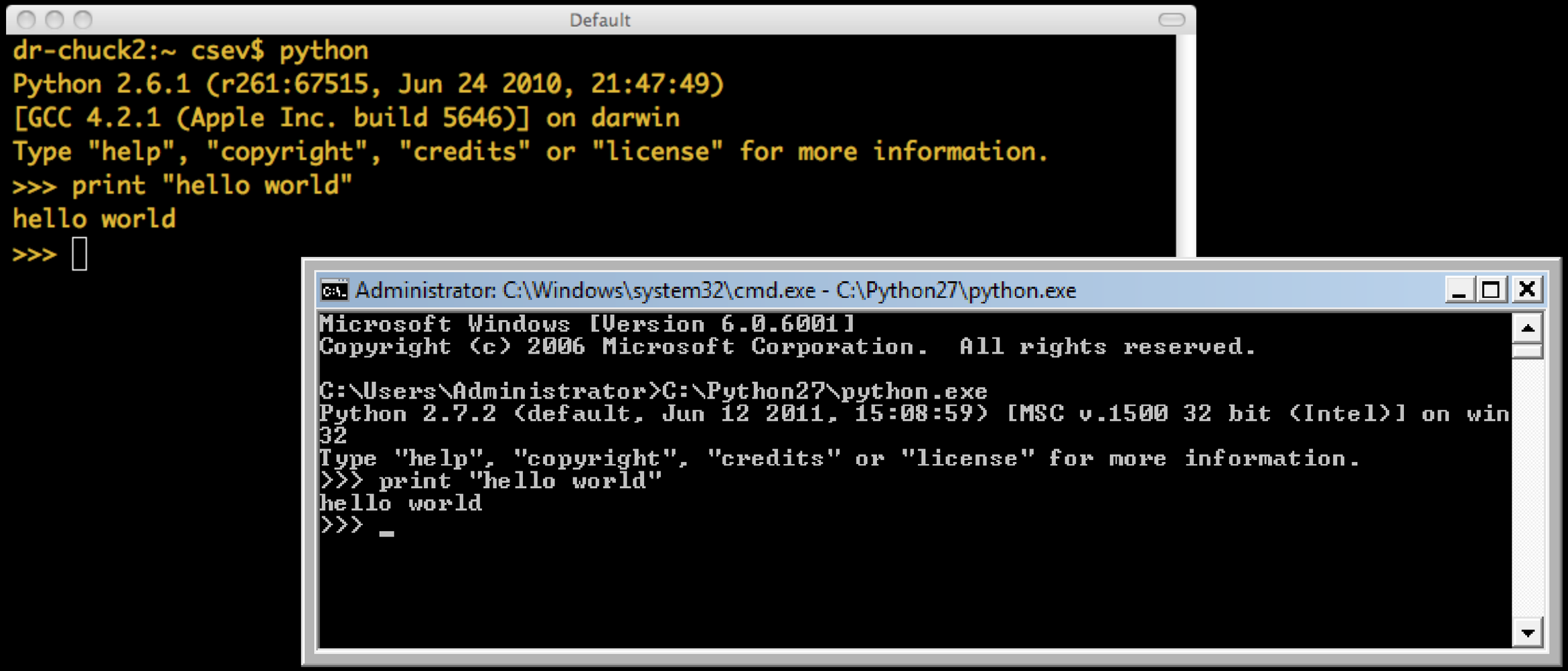
- You must remember that *you* are intelligent and *can* learn - the computer is simple and very fast - but cannot learn - so it is easier for you to learn Python than for the computer to learn English...

Talking to Python

```
csev$ pythonPython 2.5 (r25:51918, Sep 19 2006, 08:49:13)
[GCC 4.0.1 (Apple Computer, Inc. build 5341)] on darwinType
"help", "copyright", "credits" or "license" for more information.\
>>> x = 1
>>> print x
1
>>> x = x + 1
>>> print x
2
>>> exit()
```

This is a good test to make sure that you have Python correctly installed. Note that quit() also works to end the interactive session.

Lets Talk to Python...



What do we Say?

Elements of Python

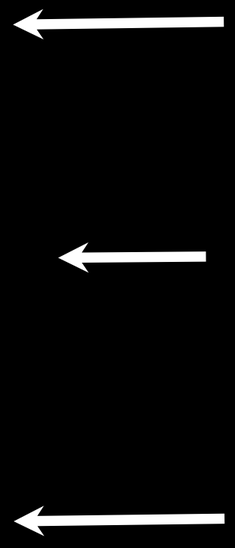
- Vocabulary / Words - Variables and Reserved words (Chapter 2)
- Sentence structure - valid syntax patterns (Chapters 3-5)
- Story structure - constructing a program for a purpose

Reserved Words

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

and del for is raise assert if 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
x = x + 2
print x
```

Assignment Statement

Assignment with expression

Print statement

Variable Operator Constant Reserved Word

Programming Paragraphs

Python Scripts

- Interactive Python is good for experiments and programs of 3-4 lines long
- But most programs are much longer so we type them into a file and tell python to run the commands in the file.
- In a sense we are “giving Python a script”
- As convention, we add “.py” as the suffix on the end of these files to indicate they contain Python

Writing a Simple Program

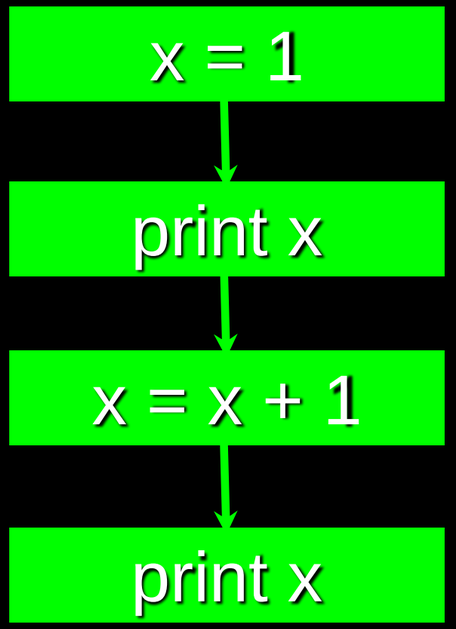
Interactive versus Script

- Interactive
  - You type directly to Python one line at a time and it responds
- Script
  - You enter a sequence of statements (lines) into a file using a text editor and tell Python to execut the statements in the file

Program Steps or Program Flow

- Like a recipe or installation instructions, a program is a sequence of steps to be done in order
- Some steps are conditional - they may be skipped
- Sometimes a step or group of steps are to be repeated
- Sometimes we store a set of steps to be used over and over as needed several places throughout the program (Chapter 4)

Sequential Steps



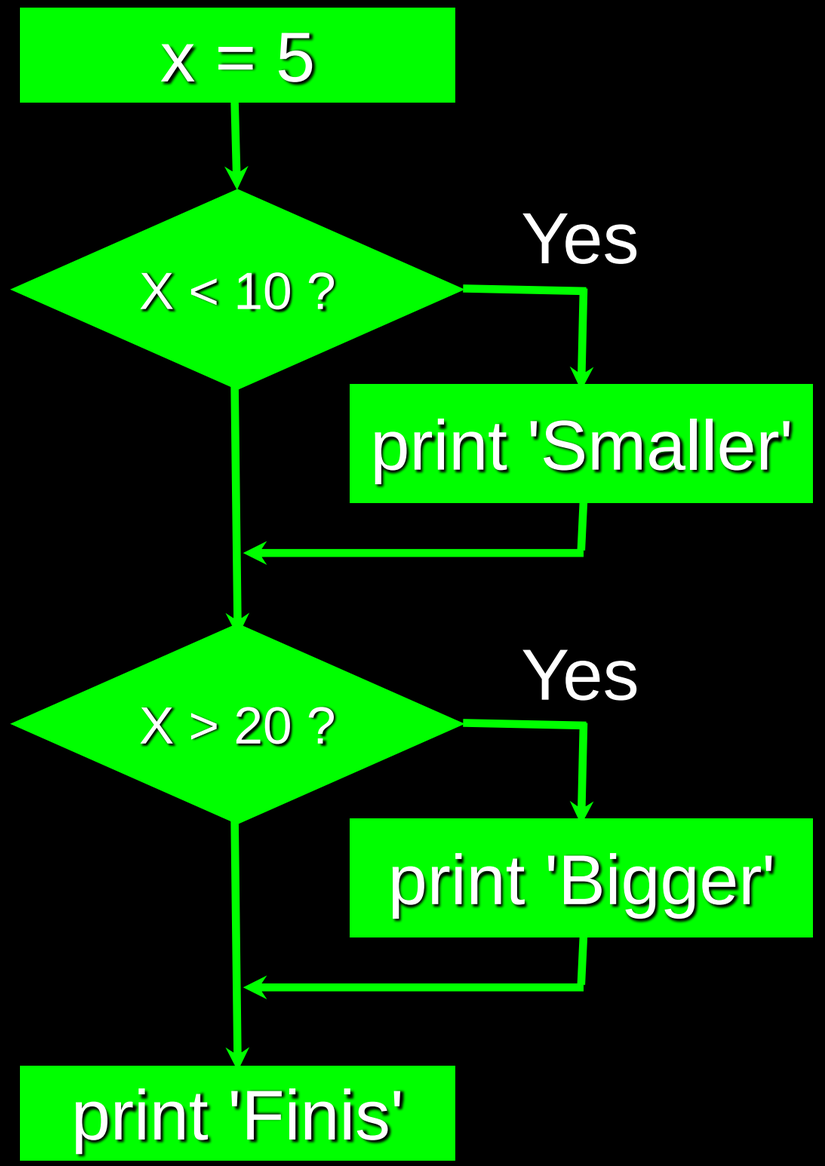
Program:

```
x = 2
print x
x = x + 2
print x
```

Output:

```
2
4
```

When a program is running, it flows from one step to the next. We as programmers set up “paths” for the program to follow.



Conditional Steps

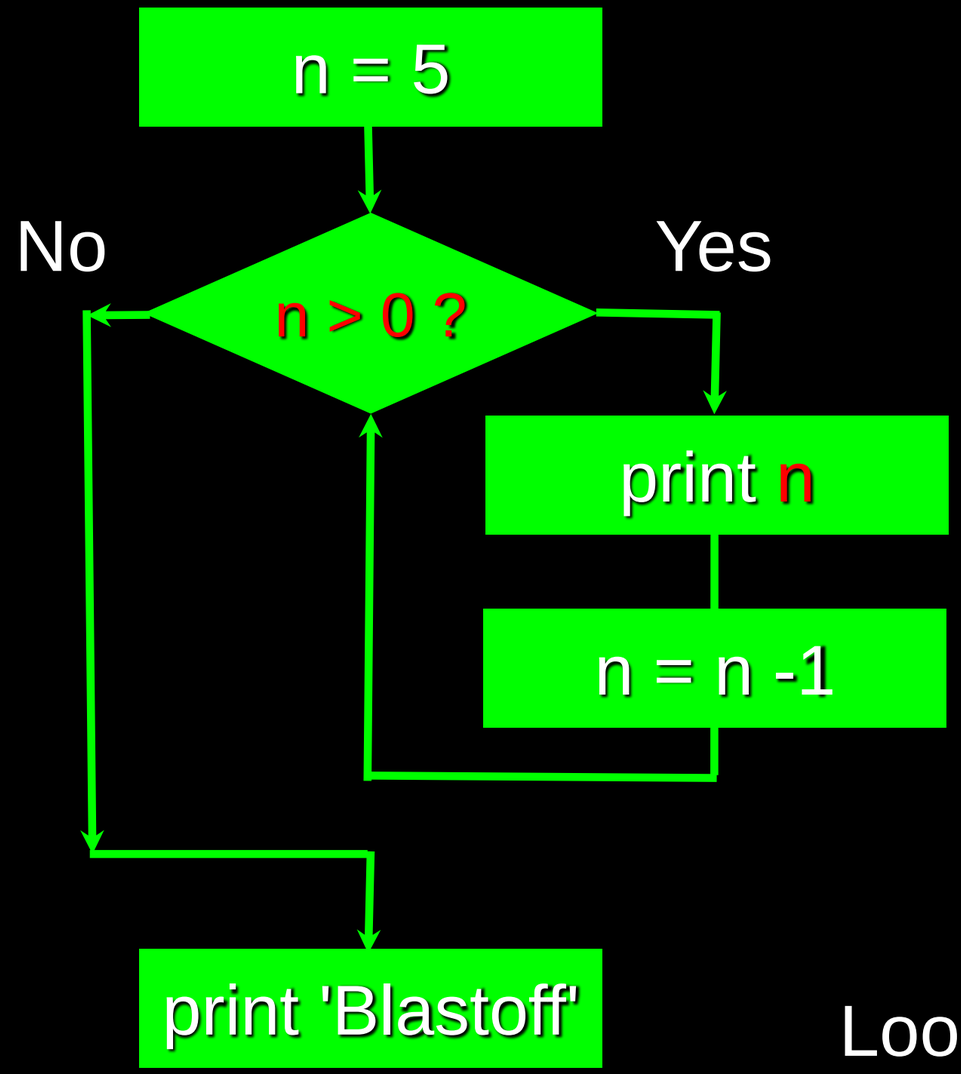
Program:

```
x = 5
if x < 10:    print 'Smaller'
if x > 20:    print '
print 'Finis'
```

Output:

```
Smaller
Finis
```

Repeated Steps



Program:

```
n = 5
while n > 0 :
    print n
    n = n - 1
print 'Blastoff!'
```

Output:

```
5
4
3
2
1
Blastoff!
```

Loops (repeated steps) have iteration variables that change each time through a loop. Often these iteration variables go through a sequence of numbers.

Sequential

Repeated

Conditional

```
name = raw_input('Enter file:')handle = open(name, 'r')text = handle.read()words = text.split()counts = dict()for word in words:    counts[word] = counts.get(word,0) + 1bigcount = Nonebigword = Nonefor word,count in counts.items():    if b
```

An Animated Short Python Story...

Finding the largest number in a list of numbers...

```
 25   1   114 117 150 152 120   46   19 126
191 121 104 116 160 105   89 125   40   14
31 139 113   94   97 193 154 140 195 122
112 163 177   48   78 101 130   83   35 197
44   54 106 143   59   38   3   41   93   81
20 184   4   11 131   0 107   71 159   69
181 178 173 148   62 142 170   72   37 145
60 187 198   99   15   82   26   8   192   17
129   73   45   9    24 188   42 151   51 183
179   79   50   76   34   33 185 102 193 184
```

What is the Largest Number?

```
 25   1   114 117 150 152 120   46   19 126
191 121 104 116 160 105   89 125   40   14
31 139 113   94   97 193 154 140 195 122
112 163 177   48   78 101 130   83   35 197
44   54 106 143   59   38   3    41   93   81
20 164   4    11 131   0   107   71 159   69
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```
 25   1   114 117 150 152 120   46   19 126
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181 178 173 148   62 142 170   72   37 145
60 187 169   99   15   82   26   8   092   17
129   73   45   9    24 188   42 151   51 183
179   79   50   76   34   33 185 102 193 184
```

What is the Largest Number?

3 41 13 0 74

13

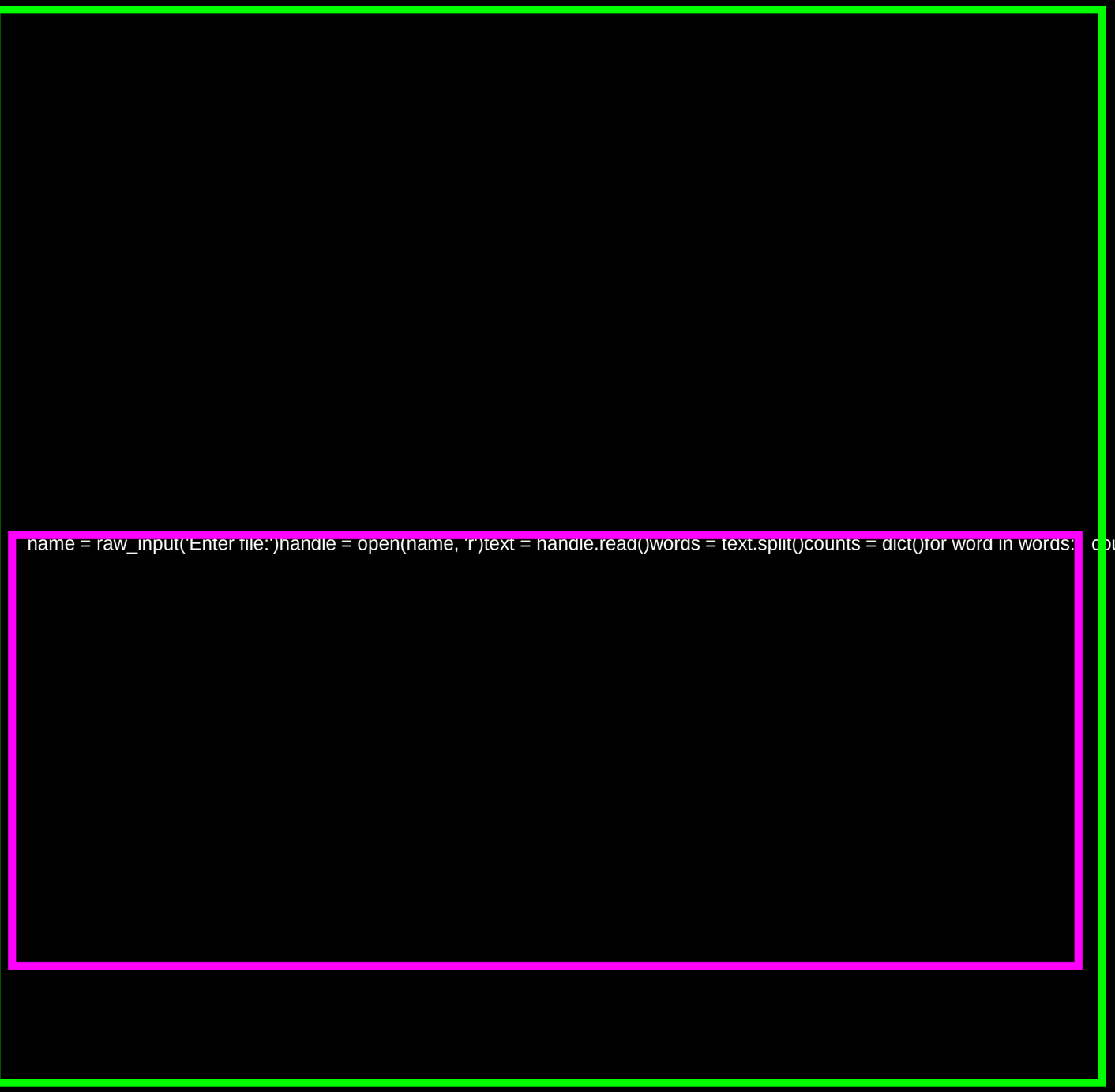
What is the Largest Number?

-13 41 13 0 74

-13

largest_so_far

-13 41 74



A short "Story" about how to count words in a file in Python.

A word used to read data from a user.

A sentence about updating one of many counts.

A paragraph about how to find the largest item in a list.

Summary

- This is a quick overview of Chapter 1
- We will revisit these concepts throughout the course
- Focus on the big picture