IDCE 302: Chapter 1

The Way of the Program

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Outline

- Taxonomy of computer languages
- What is a program
- Software development cycle
- Debugging

Computer Language

- Low-level Language vs. High-level Language
- Interpreted Language vs. Compiled Language

Low-level vs. High-level

- **Low-Level**: Machine/device oriented
  - Example: Assembly language (PUSH, POP, MOV, ADD)
  - For writing hardware drivers
- **High-level**: People oriented, closer to English
  - Example: C/C++, C#, Java , Visual Basic, Python
  - For writing system, software or applications

Interpreted vs. Compiled

- Two ways to translate a high-level language to low-level language:
- Interpreted

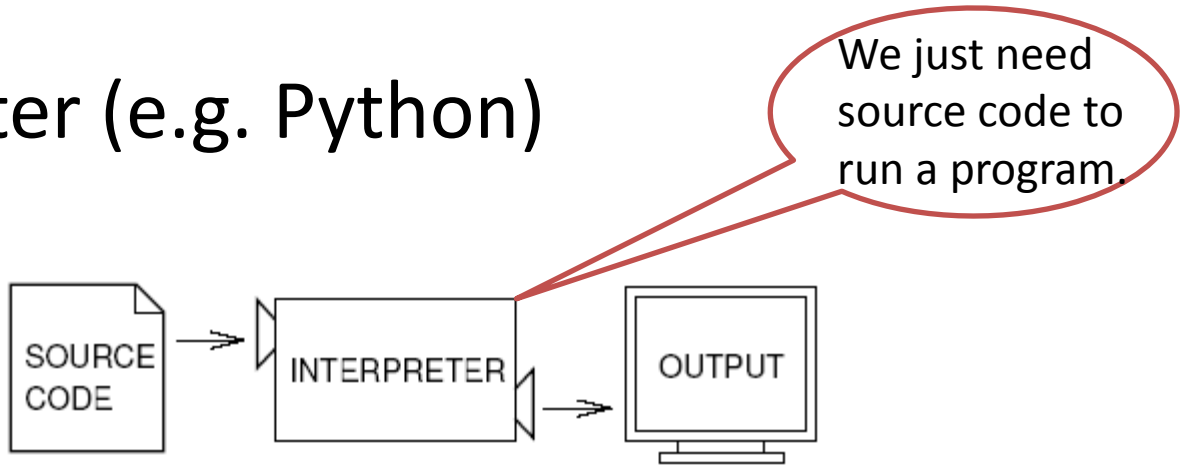
  Each instruction is executed immediately after parsing.

  e.g. Python
- Compiled:

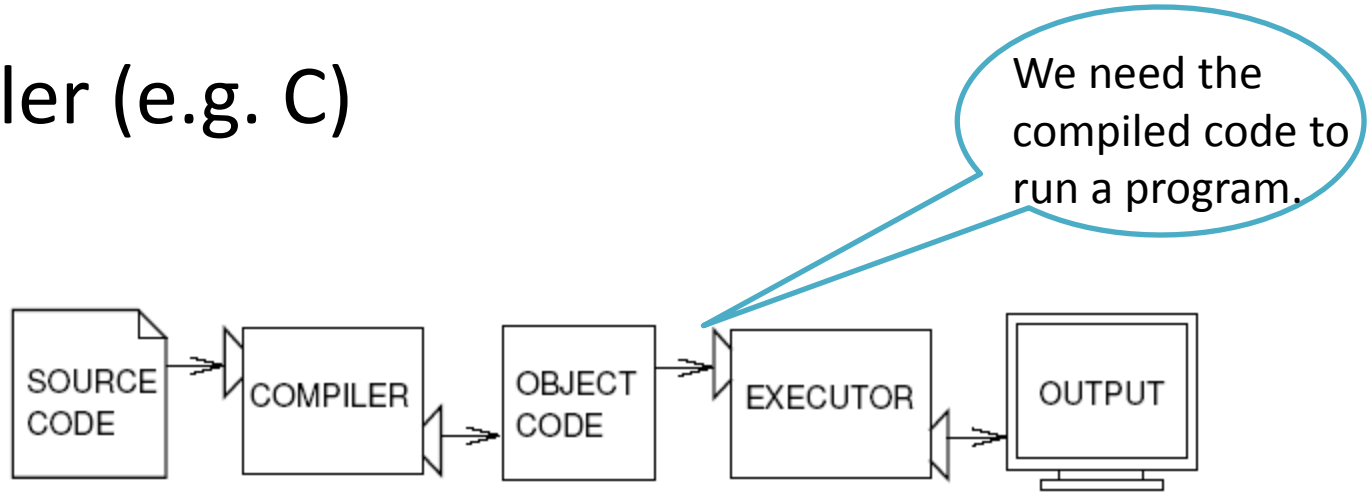
  All the instructions will be parsed into machine code first before execution.

  e.g. C/C++

- Interpreter (e.g. Python)



- Compiler (e.g. C)



The Python Programming Language

- Python is a high-level language.
- Interpreted
- Object oriented (use of classes and objects)
- Standard library is large
- Has many useful modules (math, image, GUI, etc)

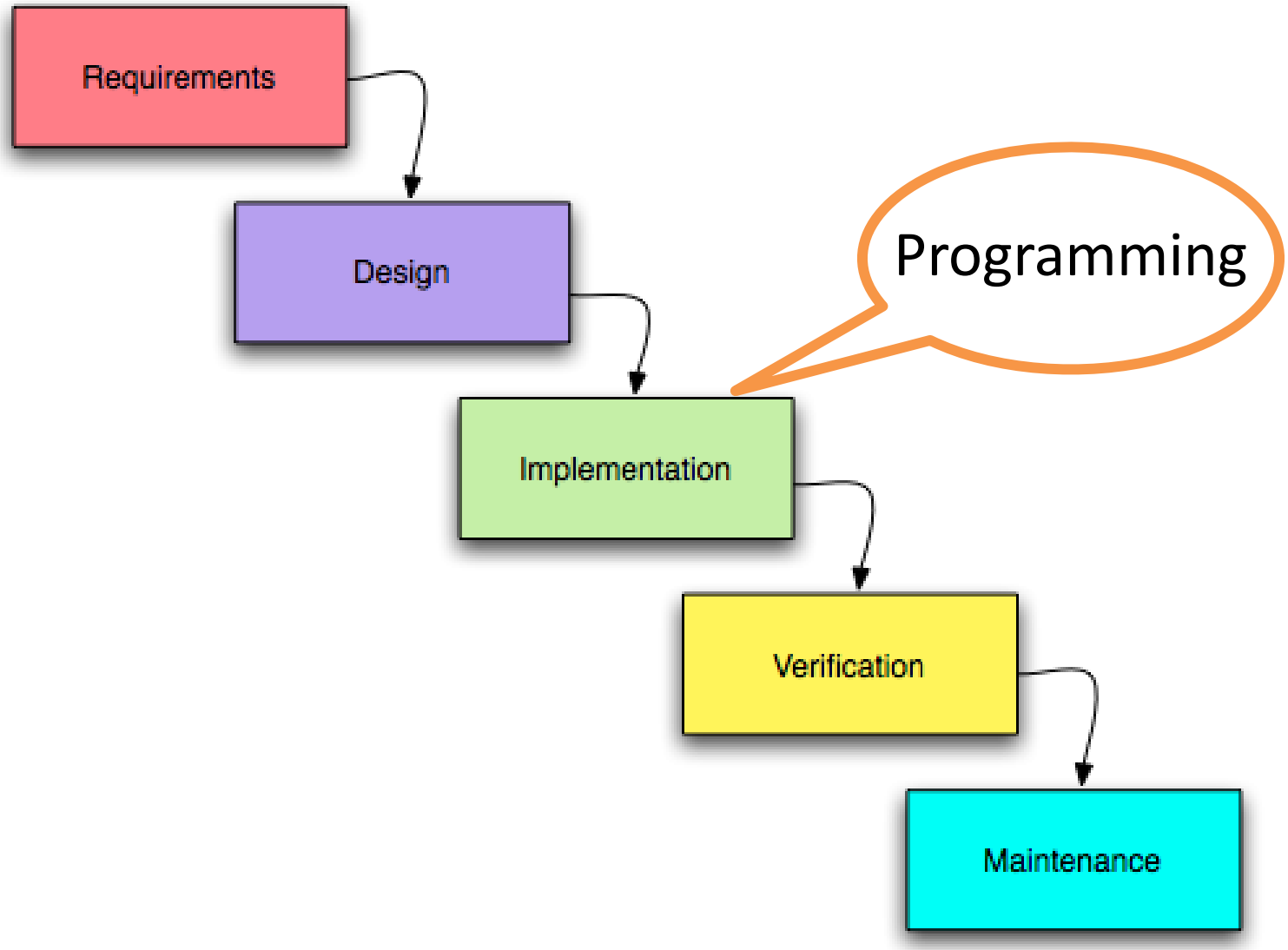
What is a program?

- A program is a sequence of instructions that specifies how to perform a computation.
- Basic elements of a programming language
  - **Input**: Get data from the keyboard or a file
  - **Output**: Display data on the screen or send data to a file or database.
  - **Math:** Perform basic mathematical operations like addition and multiplication.

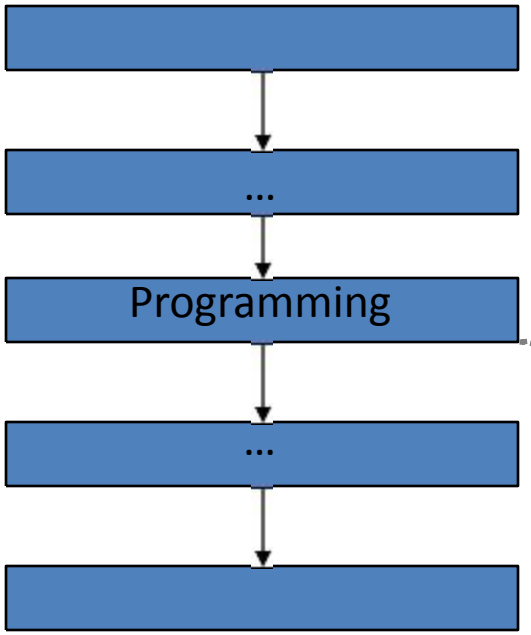
- Basic elements (cont'd)
  - **Sequence of statements**.
  - **Conditional execution**: Check for certain conditions and execute the appropriate sequence of statements.
  - **Repetition**: Perform some action repeatedly, usually with some variation.

```
def printColors():
    colors = ["red", "green", "blue"]
    i = 0
    while i<3:
        print colors[i]
        i = i+1

def printFileNames():
    filenames = ["land1990.shp", "land2000.shp",
                 "land2010.shp"]
    i = 0
    while i<3:
        print filenames[i]
        i = i+1

printColors()
printFileNames()
```

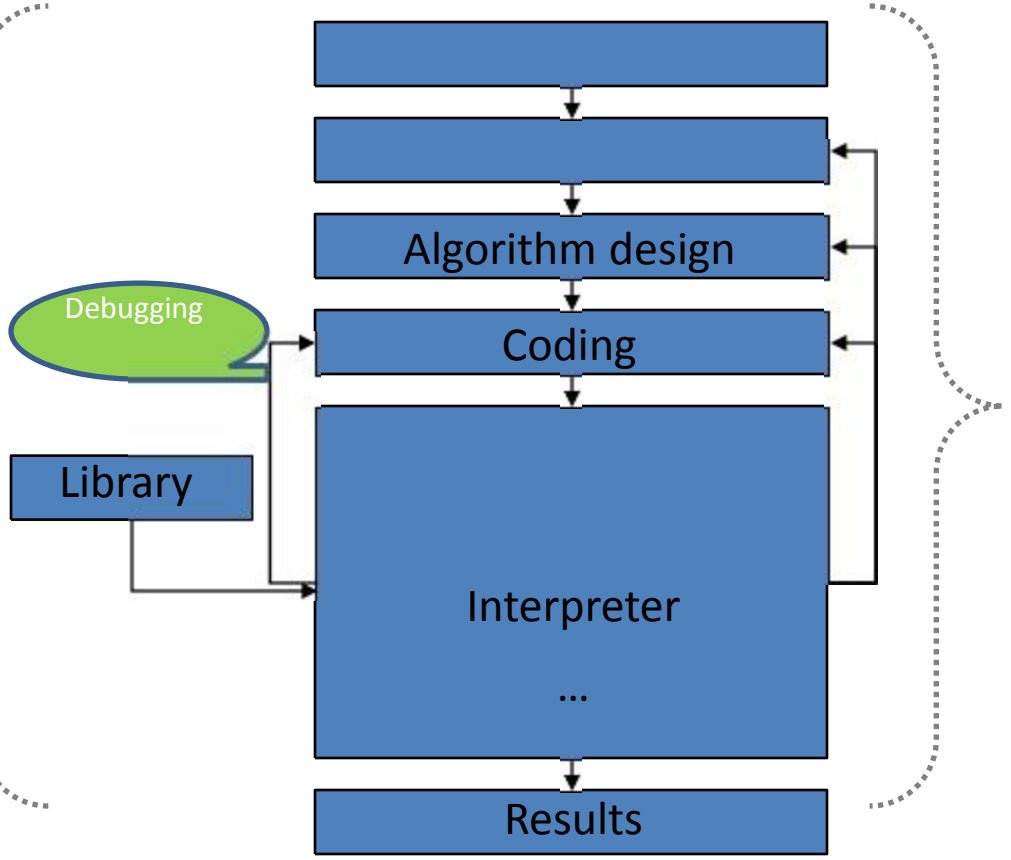
Software Development Cycle



Software Development Cycle



Programming Cycle



What is debugging?

- Programming errors are called bugs
- The process of resolving the errors is called debugging.
- **3 types** of errors:
  - Syntax errors
  - Runtime errors
  - Semantic errors

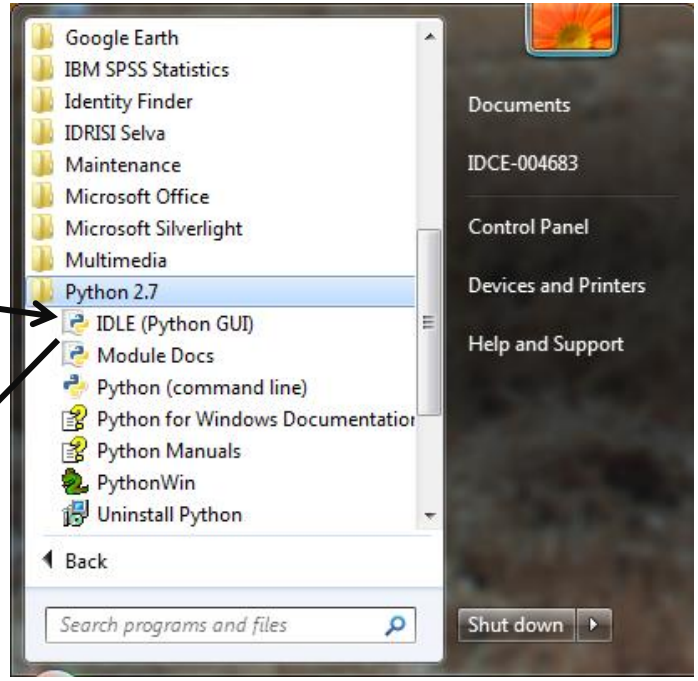
- **Syntax errors**: Program does not run because of the syntax errors (e.g. grammar error)
- **Runtime errors**: Program runs, but yield errors in the middle or at the end of the process (e.g. 100/0)
- **Semantic errors**: Program runs fine, but the result is not what you expected.

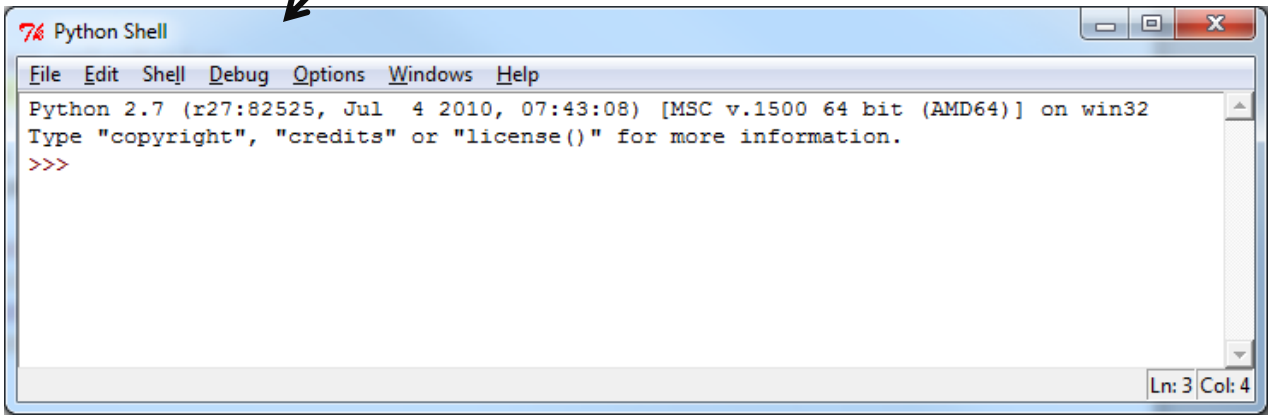
Python Interpreters

- PythonWin
- IDLE
  - Integrated Development Environment for Python
- PyScripter
- Online ones
  - e.g. http://www.trypython.org/

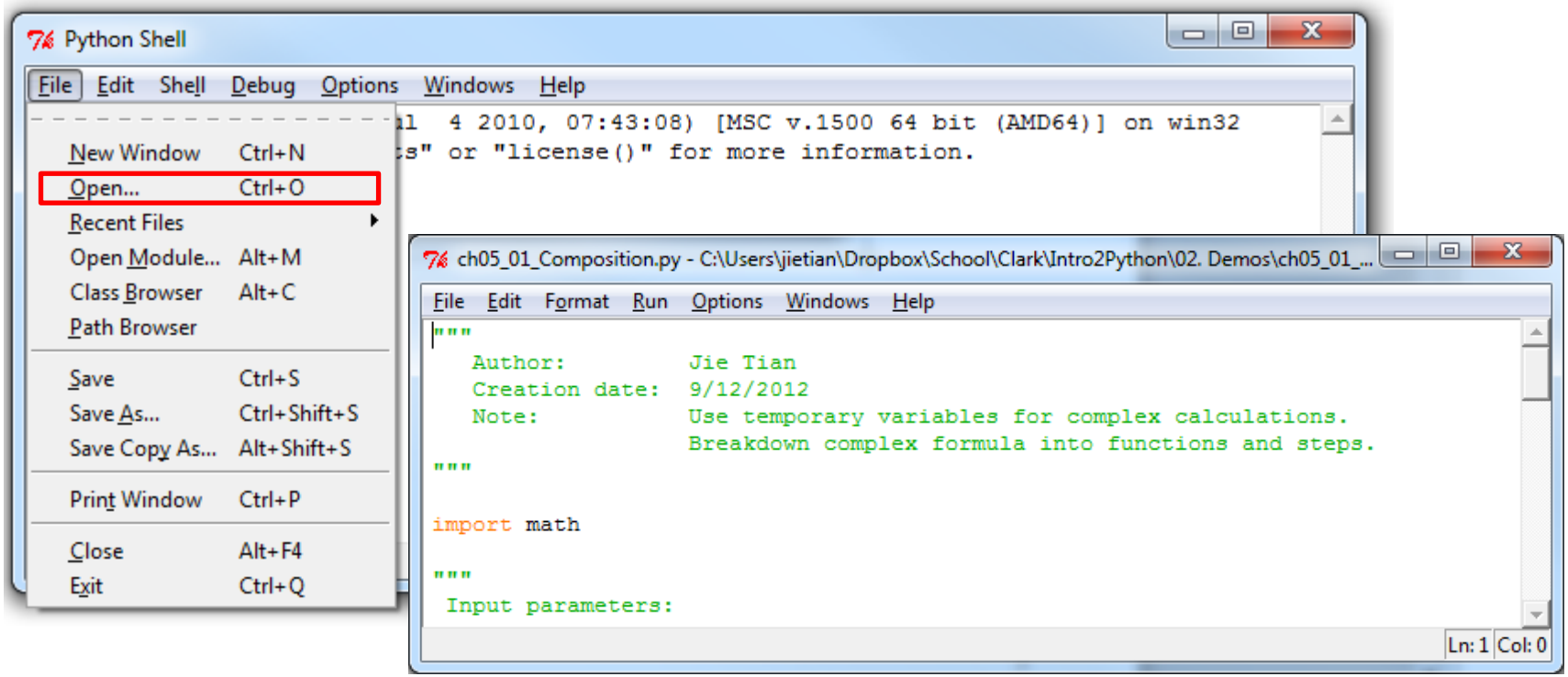
IDLE

Start IDLE





Python Shell and Program Editor



IDLE Example

1) Start IDLE.

2) Type in:

```
x=2
y=3
z=x+y
print z
```

3) From IDLE, open a new script window.

4) Copy what you just typed in Shell window and paste it into the new script window, its title is *Untitled*.

5) File-->Save As… : ch01_01_useIDLE.py

6) Run Module (F5). The result (i.e. 5) is shown in the Shell window.

The First Python Program

In Python

```
print 'Hello World!'
```

In C++

```
#include "stdafx.h"
#include <iostream>

int main(int argc, char* argv[]){
    std::cout<<"Hello world!";
    return 0;
}
```

In Java

```
public class HelloWorld {
   public static void main(String[] args) {
       System.out.println("Hello world!");
    }
}
```

Summary

- Python is an interpreted, high-level programming language.
- Very useful for GIS professionals.
- A program is a sequence of instructions on computation.
- Three types of errors
- Write your “Hello World” in Python!