Introduction to Python

GIS 5653 – Spatial Programming and GIS

COLLEGE OF ATMOSPHERIC AND GEOGRAPHIC SCIENCES
DEPARTMENT OF GEOGRAPHY
AND ENVIRONMENTAL SUSTAINABILITY
The UNIVERSITY of OKLAHOMA

Programming

- What is it?
- Why is it relevant?

https://www.istockphoto.com/photos/python-programming-language

What is Programming?

Writing programs: coded instructions for the automatic performance of a task

- Be lazy! (aka focus on more important tasks)
- It's fun
- Marketable skill
- Solve a difficult data analysis problem (and document it)

EASY – FAST – ACCURATE - REPRODUCIBLE

Let computers do what they do best and what we find boring!

COLLEGE OF ATMOSPHERIC AND GEOGRAPHIC SCIENCES
DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL SUSTAINABILITY
The UNIVERSITY of OKLAHOMA

Python Script

```
print("Hello world!")
```

Python Script

```
print("nlcd_16_1.asc")
```

COLLEGE OF ATMOSPHERIC AND GEOGRAPHIC SCIENCES
DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL SUSTAINABILITY
The UNIVERSITY of OKLAHOMA

Python Script

```
i = 1
while i <= 100:
    print("nlcd_16_" + str(i) + ".asc")
    i = i + 1
```

EASY – FAST – ACCURATE - REPRODUCIBLE

COLLEGE OF ATMOSPHERIC AND GEOGRAPHIC SCIENCES
DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL SUSTAINABILITY
The UNIVERSITY of OKLAHOMA

What is Python?

About the origin of Python, van Rossum in 1996:

> "Over six years ago, in December 1989, I was looking for a 'hobby' programming project that would keep me occupied during the week around Christmas. My office […] would be closed, but I had a home computer, and not much else on my hands. I decided to write an **interpreter** for the new **scripting language** I had been thinking about lately […]. I chose Python as a working title for the project, being in a slightly irreverent mood (and a big fan of **Monty Python's Flying Circus**)."

Source - http://en.wikipedia.org/

Fun fact: The Python interpreter is written in C

COLLEGE OF ATMOSPHERIC AND GEOGRAPHIC SCIENCES
DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL SUSTAINABILITY
The UNIVERSITY of OKLAHOMA

Low-level versus High-Level Languages

High-level language:

- Straightforward for humans to read and write
- CPU (Central Processing Unit) does not understand high-level language

Low-level language:

- CPU understands low-level (machine) language
- Complex syntax
- Translators required → high-level to low-level language

- **Two types of translators:** interpreters and compiler
- **High-level languages:** Java, C++, Python, JavaScript, …
- **Low-level languages:** Assembly (see figure), …

```
MONITOR FOR 6802 1.4          9-14-80  TSC ASSEMBLER  PAGE    2


C000                    ORG     ROM+$0000 BEGIN MONITOR
C000 8E 00 70  START    LDS     #STACK

                ****************************************
                * FUNCTION: INITA - Initialize ACIA
                * INPUT: none
                * OUTPUT: none
                * CALLS: none
                * DESTROYS: acc A

0013            RESETA  EQU     %00010011
0011            CTLREG  EQU     %00010001

C003 86 13      INITA   LDA A   #RESETA   RESET ACIA
C005 B7 80 04           STA A   ACIA
C008 86 11              LDA A   #CTLREG   SET 8 BITS AND 2 STOP
C00A B7 80 04           STA A   ACIA

C00D 7E C0 F1           JMP     SIGNON    GO TO START OF MONITOR

                ****************************************
                * FUNCTION: INCH - Input character
                * INPUT: none
                * OUTPUT: char in acc A
                * DESTROYS: acc A
                * CALLS: none
                * DESCRIPTION: Gets 1 character from terminal

C010 B6 80 04   INCH    LDA A   ACIA      GET STATUS
C013 47                 ASR A             SHIFT RDRF FLAG INTO CARRY
C014 24 FA              BCC     INCH      RECIEVE NOT READY
C016 B6 80 05           LDA A   ACIA+1    GET CHAR
C019 84 7F              AND A   #$7F      MASK PARITY
C01B 7E C0 79           JMP     OUTCH     ECHO & RTS

                ****************************************
                * FUNCTION: INHEX - INPUT HEX DIGIT
                * INPUT: none
                * OUTPUT: Digit in acc A
                * CALLS: INCH
                * DESTROYS: acc A
                * Returns to monitor if not HEX input

C01E 8D F0      INHEX   BSR     INCH      GET A CHAR
C020 81 30              CMP A   #'0       ZERO
C022 2B 11              BMI     HEXERR    NOT HEX
C024 81 39              CMP A   #'9       NINE
C026 2F 0A              BLE     HEXRTS    GOOD HEX
C028 81 41              CMP A   #'A
C02A 2B 09              BMI     HEXERR    NOT HEX
C02C 81 46              CMP A   #'F
C02E 2E 05              BGT     HEXERR
C030 80 07              SUB A   #7        FIX A-F
C032 84 0F      HEXRTS  AND A   #$0F      CONVERT ASCII TO DIGIT
C034 39                 RTS

C035 7E C0 AF   HEXERR  JMP     CTRL      RETURN TO CONTROL LOOP
```

https://en.wikipedia.org/wiki/Assembly_language#/media/File:Motorola_6800_Assembly_Language.png

COLLEGE OF ATMOSPHERIC AND GEOGRAPHIC SCIENCES
DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL SUSTAINABILITY
The UNIVERSITY of OKLAHOMA

Translators

Interpreter:

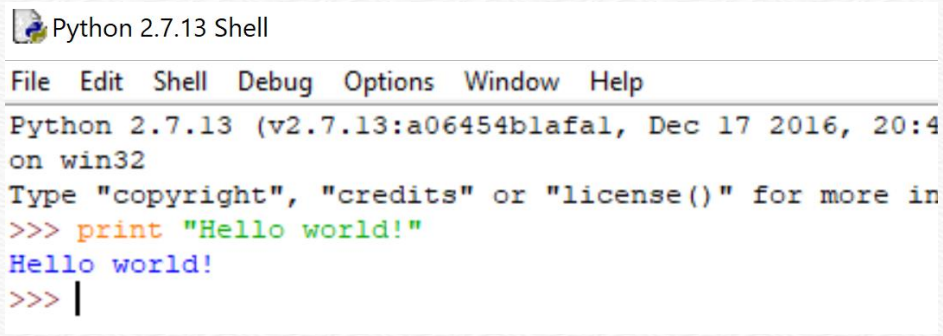
- Runs a process to translate the **high-level** source code to machine language
- Reads and parses the source code
- Interprets instructions on-the-fly

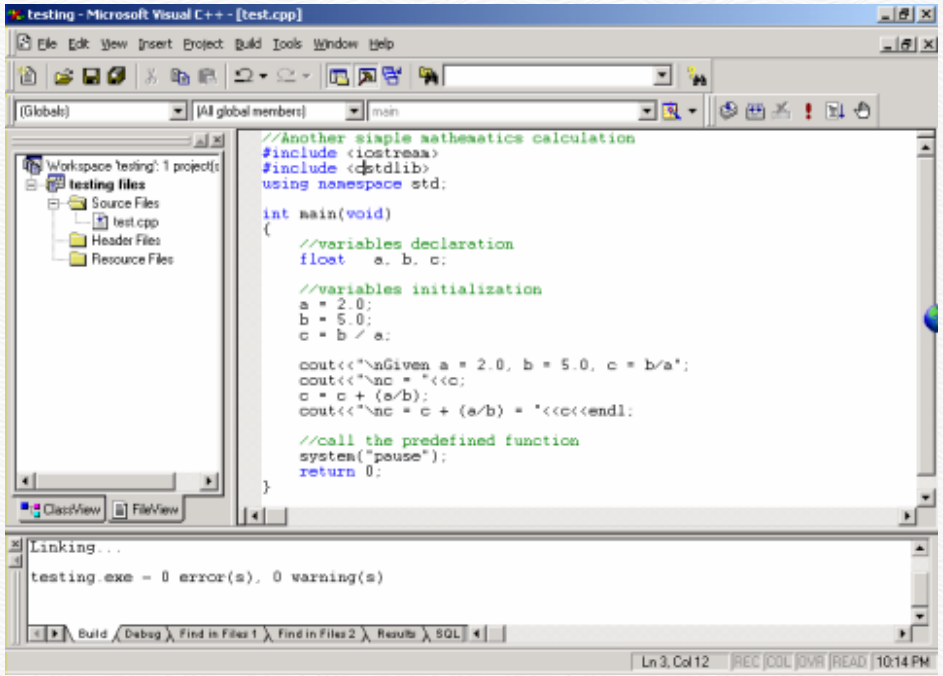
→ Interactive

Compiler:

- Also runs a process to translate the **high-level** source code to machine language
- Needs the entire program
- Compiler puts machine language code in a file for later execution
- Executables or dynamic loadable library → binary

Python interpreter (Python.exe) is written in C





https://www.tenouk.com/Visualc.html

Which one is it: Scripting or Programming?

Strength of Python

- (Relatively) simple and easy to learn
- Free and open source
- Cross platform
- Interpreted (uses interpreter → interactive)
- Object oriented
- Supported by ESRI products

→ Excellent for programming beginners

Basic Terminology

Comment:

Information in a program that is meant for other programmers (or anyone reading the source code) and has no effect on the execution of the program.

Variable:

A name that refers to a value.

Value:

One of the basic units of data, like a number or string, that a program manipulates.

Data Type:

A category of values.

```
# first code example
x = "Hello"
for i in range(0,4):
    print(x)
```

COLLEGE OF ATMOSPHERIC AND GEOGRAPHIC SCIENCES
DEPARTMENT OF GEOGRAPHY
AND ENVIRONMENTAL SUSTAINABILITY
The UNIVERSITY *of* OKLAHOMA