Lecture 01 - Objectives

• Course Introduction
• Introduce Algorithms
• Introduce Python
• Explain how to print text to the screen
• Demonstrate Python's development environment, IDLE, using it to write, edit, run, and save programs
CSCI A201/A597 - Introduction to Programming I

About us:

• **Mitja Hmeljak**
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  • office: Luddy Hall 2012

• PhD, Computer Science, IU

• Interest Areas:
  Computer Graphics & Visualization, Music & Audio, VR, Mobile App Dev

• programming since...
  ...UCSD Pascal on an Apple-II

• Some CSCI courses I teach:
  • A201 Intro to Programming I
  • A290 (Python, Swift, ...)
  • B481 Computer Graphics
  • C322 OOP Design Patterns
  • C343 Data Structures
  • iOS App Dev
    (new C323 course in Spring 2019!)
About us:

- Assistant Instructors and Undergraduate Instructors:
  - Jing Huang – huang230@iu.edu
  - Nick (Nicholas) Lombardi – ndlombar@iu.edu
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  - Kevin (Jiawei) Zhang – zhang435 @ iu.edu
  - (others TBA)
About You:

given a 4"x6" index card – please fill its front side with the following information:

<table>
<thead>
<tr>
<th>A201/A597</th>
<th>First Name, Last Name</th>
<th>Today's Date</th>
</tr>
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<tbody>
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1. Name, Major, Class Year

2. Why are you taking this course?

3. Do you have any previous programming experience?
   If yes, in what language(s)?

4. Your self-confidence in programming (on a scale 0-10)

5. What are your concerns about this course (if any) ?

6. What would you like to be able to do with a programming language?

7. Do you own a laptop that you prefer to use for coursework?
   What operating system does it run?

8. Do you own a mobile device (smartphone, tablet) that you always have with you?
   What operating system does it run?
CSCI A201/A597 - Introduction to Programming I

About The A201/A597 Course:

- **CSCI A201/A597 Fall 2018 website:**
  https://homes.soic.indiana.edu/classes/fall2018/csci/a201-mitja/2018/
  (authenticate with your IU username and password if necessary)

  The syllabus, all notes, reading assignments, homework, programming assignments, etc. are posted to the course website.

- **IU Canvas page:**
  https://iu.instructure.com/courses/1735811

- **contact us at:**
  csci-a201-a597-ai-l@list.indiana.edu
  to reach both instructor and AIs/ULs.
  Note: this email address receives messages **from IU email addresses** only!
CSCI A201/A597 - Introduction to Programming I

the first question is... Why Python?

here's why...

source:

http://xkcd.com/353/
Introducing Python

• Python is a "Powerful yet easy to use programming language"

• developed by Guido van Rossum (the BDFL)

• first released in 1991, now at version 3.xx...

• named after comedy group Monty Python

• therefore, even in the Python documentation there's a number of references to spam, eggs, and the number 42...
Python Is Easy to Use

- a high-level language: separate from the low-level processor operations; closer to human language than machine language

- someone called Python programming: "Programming at the speed of thought"

- increases readability & productivity
  - Python programs are much shorter than Java, C++, ...
  - and yet they remain readable.
Python Is Easy to Use (continued)

- Python Program
  ```python
  print("Game Over!")
  ```

- C++ Program
  ```cpp
  #include <iostream>
  
  int main()
  {
    std::cout << "Game Over!" << std::endl;
    return 0;
  }
  ```
Python Is Powerful

• Used by large organizations
  • Industrial Light & Magic
  • NASA
  • Google
  • Microsoft

• Used in published games
  • Battlefield 2
  • Civilization IV
  • Disney's Toontown Online

• Used in scientific software
  • IU's CompuCell3D:
    http://www.compucell3d.org
Python Is Object-Oriented

• Object-oriented programming (OOP): Methodology that defines problems in terms of objects that send messages to each other
  • for example, in a game, a software Missile object could send a software Ship object a message to Explode

• in Python however, OOP is not required (unlike Java and C#)
Python Is a “Glue” Language

- Python can be integrated with other languages
  - C/C++
  - Java
- use existing code
- leverage strengths of other languages
  - extra speed that C or C++ offers
  - e.g. in CompuCell3D, high-speed numerical computation is achieved in C++, while user-end scripting, GUI, etc. are all written in Python
Python Runs Everywhere

• Python is platform independent: the language is independent of the specific computer operating system

• Python runs on
  • Windows
  • Mac OS
  • Linux
  • Android
  • iOS
  • many more...
Python Has a Strong Community

• As an approachable language, has approachable community

• for example, the Python Tutor mailing list
  • http://mail.python.org/mailman/listinfo/tutor
  • perfect for beginners
  • (not actual "tutors" or "students")
Python Is Free and Open Source

- Python is open source: and publicly available; open source software typically programmed by volunteers; anyone can use source code without fee
- can modify or even resell Python
- embracing open-source ideals is part of what makes Python successful
and now...

- algorithms
- computer programs
- scripts...

- what are all those?
Algorithms & Computer programs

• Program or Script
  • "a sequence of instructions that are executed to accomplish some task"

• computer programs can be written in high-level programming languages (e.g., Python, Perl, C, C++, Java), or in a low-level programming language (Assembly) that's closer to hardware
High-level Programming Language

- high-level programming languages
  - instructions are separate from the low-level processor operations
  - closer to human language than machine language

- abstraction + detail hiding = programmer-friendly
Algorithms and Pseudocode

• An algorithm is a finite set of precise instructions for performing a computation or solving a problem.

• in A201, we typically write algorithms in pseudocode or "structured English":

• Example of an algorithm description for
  How to add, or sum, a list of numbers:

  1. Start a count at 0.
  2. Are there more numbers? If so, add the next one to the count. If not, stop.
  3. Return to step 2.
Lecture 01 Task: "Peg Puzzle" Team Work

- Goal: move the disks so that they all end up on peg C in the same order as at start, with the following rules:
  1. Only one disk may be moved at a time.
  2. No disk may be placed on top of a smaller disk.
  3. Only the top disk on a peg may be moved, and it becomes the new top disk on its destination peg.
use the same 4"x6" index card as before – please write on its reverse side now:

A201/A597  First Name, Last Name  Today's Date

1. team up with a neighbor (no individual solutions for this task today!)
   write down their First and Last Name here

2. Devise a written solution to the Peg Puzzle, i.e. an algorithm that solves the goal.

3. Bonus question: How many moves does your algorithm take to achieve the goal?
Lecture 01 Task: "Peg Puzzle" Team Work

- How many moves?

- Minimum is $2^4 - 1 = 15$

- However, your algorithm can have many fewer steps in it!
Lecture 01 Task:  
"Peg Puzzle" Team Work

• Solution 1:
  1. Make the legal move between pegs A and B
  2. Make the legal move between pegs A and C
  3. Make the legal move between pegs B and C
  4. If not done, return to step 1.

• Or…
Lecture 01 Task: "Peg Puzzle" Team Work

• Solution 2:

1. Move the smallest piece to the right, wrapping around if needed.

2. Make the only legal move that doesn't involve the smallest piece.

3. If not done, return to step 1

Whichever way you worked on a solution, congratulations to you, you just worked on an algorithm!
some starting terminology

• now that we've seen what's an algorithm

• let's learn about ...

.... interpreted languages, compiled languages, etc.
Python is an Interpreted Language

- A python program (.py file) is just a text file.

- Interpreted
  - Read and executed directly - no compilation stage!
  - Examples: Python, Perl, Ruby, Java

- Compiled
  - Compiled languages are transformed into an executable form before running.
  - Examples: C (and C++)
Introducing IDLE

• Integrated DeveloPment Environment (IDLE) = an IDE!
  (i.e. an Integrated Development Environment

• IDLE ships with most Python versions

• IDLE allows two main modes of working in Python:

  • Interactive mode: You tell Python what to do, and it will do it immediately

  • Script mode: You write, edit, load, and save python programs (just like you write a document in a word processor).
Examining the Game Over Program

"Game Over" Program Output

... the all-too familiar words from a computer game

(side note: these slides show screen captures from IDLE version Python 3.
For our class, we'll use Python 3.7.x, i.e. any recent version of Python 3.
As long as you're not trying to run the same code on older Python versions such as Python 2.7 or older, you should be OK. Please consult your AI about any specific version of Python you may be using)
Examining the Game Over Program

• “Hello World” program: By tradition, prints "Hello, world!”
  • Often used as first program

• we could also run the "Hello World" program directly from command-line, e.g. from a:
  • CMD or Console window: Provides a text-based interface to Windows operating system
  • Terminal application: Provides a text-based interface to Mac OS X and Linux operating systems

• but we're typically going to use Python IDLE, an Integrated Development Environment (IDE) that we're going to introduce today.
Introducing IDLE

• Integrated Development Environment (IDE): Application that helps software developers write programs
  • Like a word processor for your code

• IDE that ships with Python

• Has two “modes”: Interactive and Script

• IDLE for Python 3.x is available in all STC labs on campus (Windows and Mac) for your use!
Programming in Interactive Mode

Python in interactive mode, awaiting your command.

- Great for immediate feedback
  - Test a simple idea
  - Remember how something works
Programming in Interactive Mode (continued)

• At command prompt in IDLE (>>>), type:

```python
print("Game Over")
```

• Python responds with: Game Over
Programming in Interactive Mode (continued)

• `print` is a Python Function that can display a string (actually, any expression)

• String: Sequence of characters

• Function: a block of organized programming code that can be executed by calling its name (in this case, `print`). A function may receive values, and do some work with those values.

• Argument: Value passed to a function
  • `print("Game Over")`
Programming in Interactive Mode (continued)

some more terminology:

• **Statement**: a single unit in programming language that performs some action.

• **Expression**: Something which has a value or that can be evaluated to a single value
  • "Game Over"
  • 7 + 2

• **Code**: Sequence of programming statements, function calls, etc.
• Syntax highlighting: Displaying programming code in different colors or fonts, according to the category of each item

• Errors
  • programming languages take everything literally:
  • `primt("Game Over")` produces an Error Message: `NameError: name 'primt' is not defined`
  • Name error: in this case, a function with the name "primt" could not be found by Python, and Python alerts us of this!
  • Bug: Error in programming code
Programming in Script Mode

Python in script mode, a blank canvas.
Programming in Script Mode
(continued)

• Great for programs you want to run later
  • Write, edit, save, and load programs
  • Like word processor for your programs
    • Find and replace
    • Cut and paste

• Open a script window
  • in IDLE, select File menu, New File
Programming in Script Mode (continued)

- Write program
  - In script window, type `print ("Game Over")`

- Save program
  - Select File, Save As, name `game_over.py`
  - Always save before running

- Run Program
  - Select Run, Run Module
  - Results displayed in interactive window
Programming in Script Mode (continued)

Python 3.6.2 (v3.6.2:5fd33b5926, Jul 16 2017, 20:11:06)
[GCC 4.2.1 (Apple Inc. build 5666) (dot 3)] on darwin
Type "copyright", "credits" or "license()" for more information.

>>> 
================== RESTART: /Users/Shared/game_over.py ===================
Game Over!

>>> 

Python after a script has been run
The results of running the Game Over program
Summary

- Python is a high-level, object-oriented programming language that's powerful yet easy to use.
- Python can interface with other programming languages.
- IDLE is Python's standard IDE.
- IDLE has an interactive mode that offers immediate response to Python code.
- IDLE has a script mode that allows programmers to write, edit, load, save, and run their programs.
Summary (continued)

• A string is a sequence of characters

• A Python statement is a single unit of programming that performs some action

• A Function is a block of organized programming code that can be executed by calling the function's name.

• There are built-in functions in Python, already defined for you to use in your code.

• `print()` is one of such built-in Python functions.