

Just Enough Python





Python 3 and IDLE

- We will use version 3.*x* of Python (where *x* is the most recent version
 - Differences between Python 2 and Python 3 are mostly minor, but can be confusing
- Python comes with an *IDE* (*Integrated Development Environment*) called *IDLE*
 - IDLE is a *REPL* (*Read-Evaluate-Print-Loop*) that lets you enter Python statements one at a time, and see what they do
 - IDLE also lets you create, edit, run, test, and debug programs
- **Note:** Anything in *red* is a jargon term which you are expected to learn



Program components

- A program typically needs to:
 - **Read** information in from somewhere (the keyboard, or a file)
 - **Perform computations** on numbers, strings (text) and booleans (logical true/false values)
 - **Make decisions**, based on the current state of the program
 - **Repeat** the same operation over and over again
 - **Delegate**: Perform complex operations described separately and given appropriate names
 - **Write** out results to somewhere (the screen, or a file)



Values

- There are many different kinds of values, including:
 - *integers* (“whole” numbers, such as **23** and **-5**)
 - *floating-point numbers* (numbers containing a decimal point, such as **3.1416**)
 - *strings* (sequences of characters enclosed in single or double quotes, such as **"hello"**)
 - *booleans* (one of the two values **True** and **False**)
- An explicit value, written out by itself, is called a *literal* or *literal value*
- Later we will meet more kinds of values, such as *lists* and *dictionaries*, which are composed of these simpler kinds of values



Variables

- A *variable* is a name that “holds,” or is associated with, a *value*
- Values can be assigned to variables by means of an *assignment statement*
 - Example: `age = 23`
- The value of a variable can be changed (varied):
 - Example: `age = age + 1`
- In Python, the *type* (kind) of a variable can also be changed (this is not true in many languages):
 - Example: `age = "Old enough to know better!"`



Reading input from the user

- A *function* is a named piece of code that can return a value
- The **input** function is used to read input from the user
 - There are two forms, with and without an *argument*:
 - **input()** just returns a string entered by the user
 - **input(prompt)** displays the “prompt” string, then returns the string entered by the user
 - **Example: name = input("What is your name?")**
 - Usually (as in this example) you will want to save the entered value in a variable
 - The value returned by input is always a string
 - If you want to read a number from the user, use the additional functions **int** or **float**
 - **Example: age = int(input("What is your age?"))**



Doing arithmetic

- Arithmetic is slightly complicated because there are two kinds of numbers, *integers* (“whole numbers”) and *floating-point numbers* or *floats* (numbers containing a decimal point)
- Operations are $+$ (add), $-$ (subtract), $*$ (multiplication), two kinds of division, $/$ and $//$, and $\%$ (modulus, or remainder of a division)
 - When you use $+$, $-$, $*$, $//$, or $\%$ on **just integers**, you get an integer result
 - $//$ is called *integer division*
 - If the numbers don’t divide evenly, you get the smaller number as a result
 - All other combinations result of numbers and operations result in a float
- Parentheses $()$, but *not* brackets $[]$ or braces $\{\}$, can be used to group operations



Using strings

- A string is a sequence of characters enclosed in either single quotes `'...'` or double quotes `"..."`
- A string enclosed in single quotes may contain double quotes, and vice versa
- Some single characters cannot easily be entered directly into strings, and must be “escaped” (backslashed)
 - `\n` represents a newline character
 - `\t` represents a tab character
 - `\'` represents a single quote (inside a singly-quoted string)
 - `\"` represents a double quote (inside a doubly-quoted string)
- Strings can be concatenated (joined) with the `+` operator
- **Example:** `"Do you love me\nOr do you not?" + "You told me once\nBut I forgot."`
- So-called “triple quotes”, `"""..."""` or `'''...'''`, can be used to write strings that extend over multiple lines



Using booleans

- The two *boolean* values are **True** and **False**
 - Capitalization is important!
- The three boolean operators are **not**, **and**, and **or**
- The following comparison operators on numbers will give a boolean result:
 - < (less than)
 - <= (less than or equal)
 - == (equal)
 - != (not equal)
 - >= (greater than or equal)
 - > (greater than)
 - These comparisons also work on strings (all capital letters < all lowercase letters)
- Booleans, like numbers and strings, can be assigned to variables
- **Example: `in_range = grade >= 0 and grade <= 100`**



The `print` function

- In Python 3, `print` is a function, but is used like a statement
 - More about functions later
- **Syntax:** `print(arguments)`
 - The *arguments* are values, variables, or expressions, separated by commas
 - The *arguments* are “printed” (displayed on the screen) on a single line, separated by spaces
- **Example:** `print("You have", points, "points.")`
- **Note:** `print` statements are seldom used in the REPL, because they are built into the Read-Eval-Print-Loop, so results are printed automatically



Control statements

- **Control statements** are used to decide whether and how often some other, “controlled” statements are executed
 - **if** statements decide whether or not to execute a group of statements
 - **if-else** statements decide which of two groups of statements to execute
 - **while** statements execute a group of statements as long as some condition is true
 - **for** statements execute a group of statements with a variable taking on a sequence of values
- For every kind of control statement:
 - The control statement ends in a colon, **:**
 - The controlled statements are indented four spaces
 - In IDLE, pressing the Tab key is the same as typing four spaces



Layout

- Every statement goes on a line by itself
- Put spaces around operators, including the assignment operator, =
 - `average = sum / 5`
- Put spaces after commas (but not before commas)
 - `print(2, "plus", 2, "is", 2 + 2)`
- When using a function, do not put spaces on either side of the parentheses
 - `age = input("What is your age? ")`
- *Contrary to the textbook*, do not put spaces inside parentheses
 - `age = input("What is your age? ") #`
Don't do this!



`if` statements

- The ***syntax*** of a language is the set of rules that things in the language must follow
- The syntax of an `if` statement is basically:
`if condition:`
one or more statements
- **Example:**

```
if age < 21:  
    print("Too young to drink alcohol.")
```
- **Explanation:**
If the variable `age` holds a number less than 21, the message is printed; but if it holds a number equal to or greater than 21, these statements do nothing



if-else statements

- The syntax of an **if-else** statement is basically:

if *condition*:

one or more statements

else:

one or more statements

- **Example:**

```
if age < 21:
```

```
    print("Go home, kid!")
```

```
    print("You're too young to drink.")
```

```
else:
```

```
    print("Yes, sir, how may I serve you?")
```

- **Explanation:**

If the variable **age** is less than 21, the first two messages are printed; otherwise, the third message is printed



if with elif

- The **if** statement can have any number of **elif** tests
- Only one group of statements is executed—those controlled by the first test that passes
- Example:
- ```
if grade == "A":
 print "Congratulations!"
elif grade == "B":
 print "That's pretty good."
elif grade == "C":
 print "Well, it's passing, anyway."
else:
 print "You really blew it this time!"
```



# Control statements can be nested

- Control statements may be nested; that is, control statements may be controlled by other control statements

- **Example:**

```
if sex == "male":
 if is_smoker:
 life_expectancy = 72.3
 else:
 life_expectancy = 84.3
else: # female
 if is_smoker:
 life_expectancy = 75.6
 else:
 life_expectancy = 86.6
```

- Compound variable names, such as `is_smoker`, are usually written with an underscore between the words
- The `#` symbol introduces a *comment*—ignored by the computer, but intended to help the human reader



# while loops

- A “while loop” has this syntax:  
**while** *condition* :  
    *one or more statements*
- Here’s what it does:
  1. Check the *condition*
  2. If it is **True**:
    - execute the statements
    - start the loop again (at 1)
  3. If it is **False**:
    - exit the loop
- **Example:**

```
countdown = 10
while countdown >= 0:
 print(countdown)
 countdown = countdown - 1
print("Blast off!")
```



# for loops

- A “for loop” has this syntax:  
**for** *variable* **in** *sequence* :  
*one or more statements*
- One way to get a sequence is to list the members of the sequence in brackets, **[ ]**, separated by commas
  - **for word in ["one", "two", "three"]:**  
**print(word)**
- Another way is to use the range function, **range(start, end)** which will return a sequence of integers from *start* up to, but not including, *end*
  - **for number in range(1, 11):**  
**print(number)**
    - This prints the numbers 1 through 10, each on a separate line



# Functions

- A *function* is a named chunk of code that can be executed (“*called*”) by giving its name and whatever arguments it requires
  - The *arguments* are matched up to the *parameters*
    - There must be the same number of arguments as there are parameters, and they are matched up by position
  - A function may (or may not) *return* a value
- **Syntax:**  
**def** *function\_name* (*parameters*) :  
    *Optional string describing the function, usually triple-quoted*  
    *One or more statements*
- Functions are sometimes called *methods*
  - For now, treat the two words as synonyms; we will explain the difference later



# Function example

- **Example function definition:**

```
def lcd(a, b):
 """Compute largest common divisor of a and b"""
 while b != 0:
 r = a % b
 a = b
 b = r
 return a
```

- This function has two parameters, so it should be called with two arguments
- Since the parameters are treated as numbers, the arguments to it should be numbers (or variables containing numbers)
- **Example function call:**

```
print("The LCD of", 12, "and", 5, "is", lcd(12, 5))
```



# Programs

- A *program* is code that has been saved to a file
  - The file should have the **.py** extension
  - You can create a new file in IDLE, or load in an existing file
  - The file can be executed by hitting the **F5** key
- A program is executed as it is loaded in, top to bottom. It can be either:
  - Just a collection of statements, executed one after the other, or
  - A collection of functions that can be called individually from the REPL, or
  - A collection of functions, plus special code to start the program and call the various functions as needed. The special code is:

```
if __name__ == "__main__":
```

*Statements to execute when the program is loaded*



# Errors

- **Errors are inevitable.** You will make mistakes. If this embarrasses you, *get over it!*
- Most of computer science is learning how to minimize errors, find them when they occur, and recover from them
- Kinds of errors:
  - A ***syntax error*** is one recognized by the ***compiler*** (the thing that gets your program ready to execute), and prevents it from even starting  
Example: `print('This won't work')`
  - A ***runtime error*** is one that causes your program to “crash”  
Example: `y = 3 / (x - x)`
  - A ***logic error*** or ***semantic error*** is one that causes your program to produce incorrect results  
Example: `hypotenuse = math.sqrt(a * a + b + b)`
  - A ***user error*** is when the user provides invalid input to the program, causing the program to crash or to produce incorrect results
    - We will discuss how to handle user errors in a later lecture



# Comments

- A ***comment*** is a note to any human looking at the program; comments are ignored by the computer.
- A comment begins with **#** and extends to the end of the line
- Good uses of comments:
  - At the beginning of a program, to tell what the program does
  - When using someone else's code, to say where you got it from
  - To explain any code that's hard to understand
- Bad uses of comments:
  - To explain something that's obvious anyway
  - To explain code that's hard to understand, but could be made simpler
  - To add irrelevant comments, like **# Go Eagles!**
  - When you should instead use a *doc string* (the string describing what a function does)



# A Complete Sample Program

```
▪ def main():
 """Converts between Fahrenheit and Celsius"""
 f_to_c = mode()
 print("OK. Enter Q or q to quit.")

 t = input("\nEnter a temperature: ")
 while t != 'Q' and t != 'q':
 t = float(t)
 if f_to_c:
 print(t, "F is", 5 * (t - 32) / 9, "C")
 else:
 print(t, "C is", 1.8 * t + 32, "F")
 t = input("\nEnter a temperature: ")
 print("Done.")

def mode():
 print("Type F to convert TO Fahrenheit,")
 answer = input(" C to convert TO Celsius: ")
 if answer == 'C':
 return True
 elif answer == 'F':
 return False
 else:
 return mode()

if __name__ == "__main__":
 main()
```



# The End

“Programming is an art form that fights back.”

-- Anonymous