Practice of Basic Informatics
[Week 11 Mini Lecture]
-Introduction to Programming-

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What Is a Program?

- Usually, one or more algorithms written in a programming language that can be translated to run on a real machine

- We sometimes call programs ***software***

What Is a Programming Language?

- A programming language is somewhat like a natural language, but with a very limited set of statements and strict syntax rules.
- Has statements to implement sequential, conditional and iterative processing - algorithms
- Examples: FORTRAN, COBOL, Lisp, Basic, Pascal, C, C++, Java, C#, Python, …

Programming Languages: Types

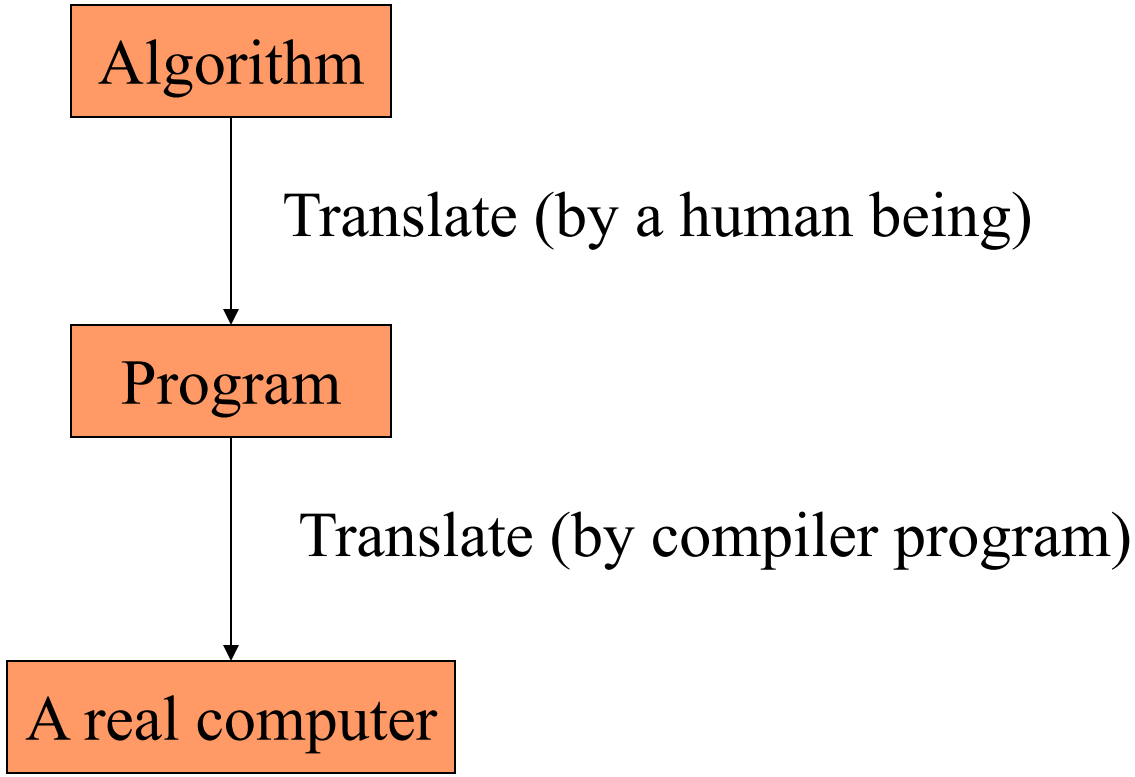
Programming Languages: Types

- Compiled
- Interpreted

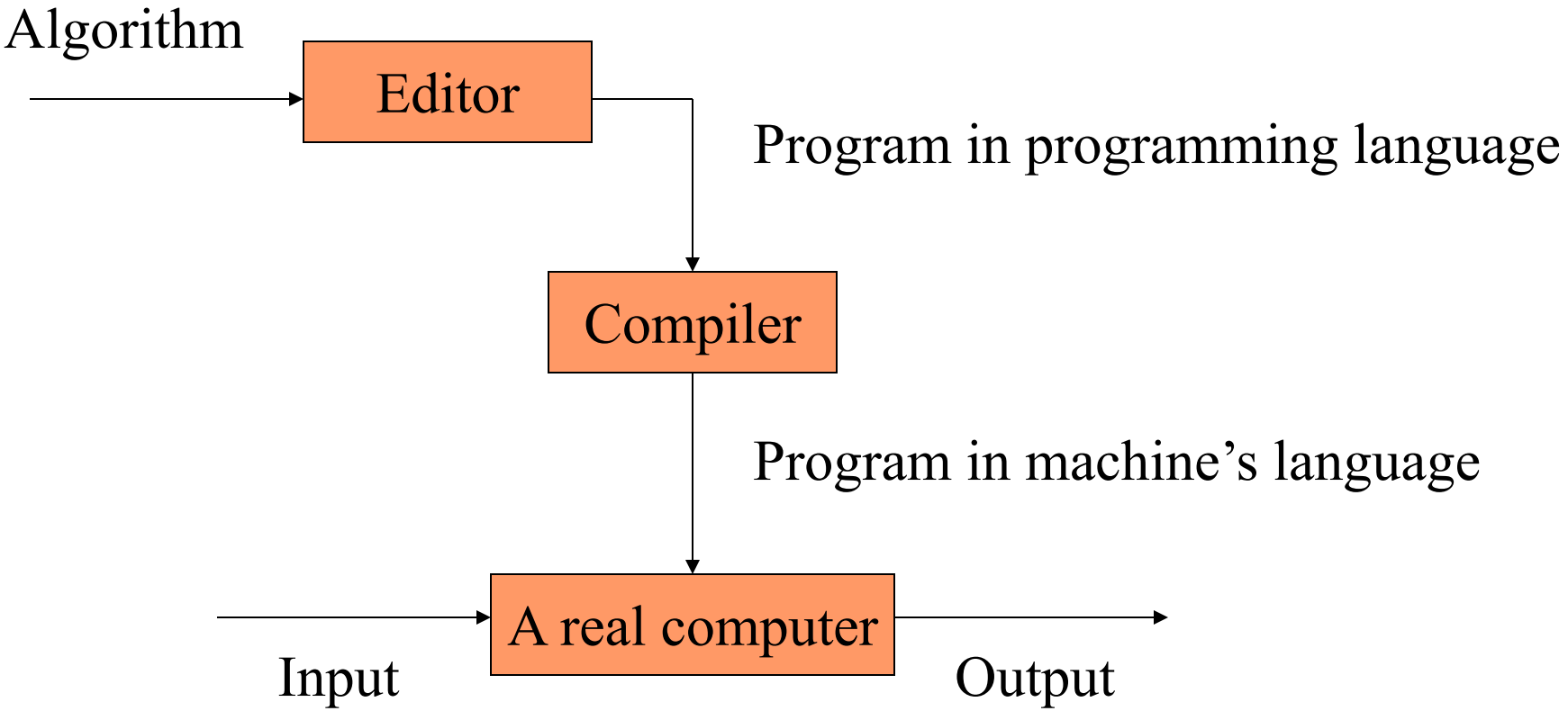
Compiler

- A *compiler* is a program that converts a program written in a programming language into a program in the native language, called *machine language*, of the machine that is to execute the program.

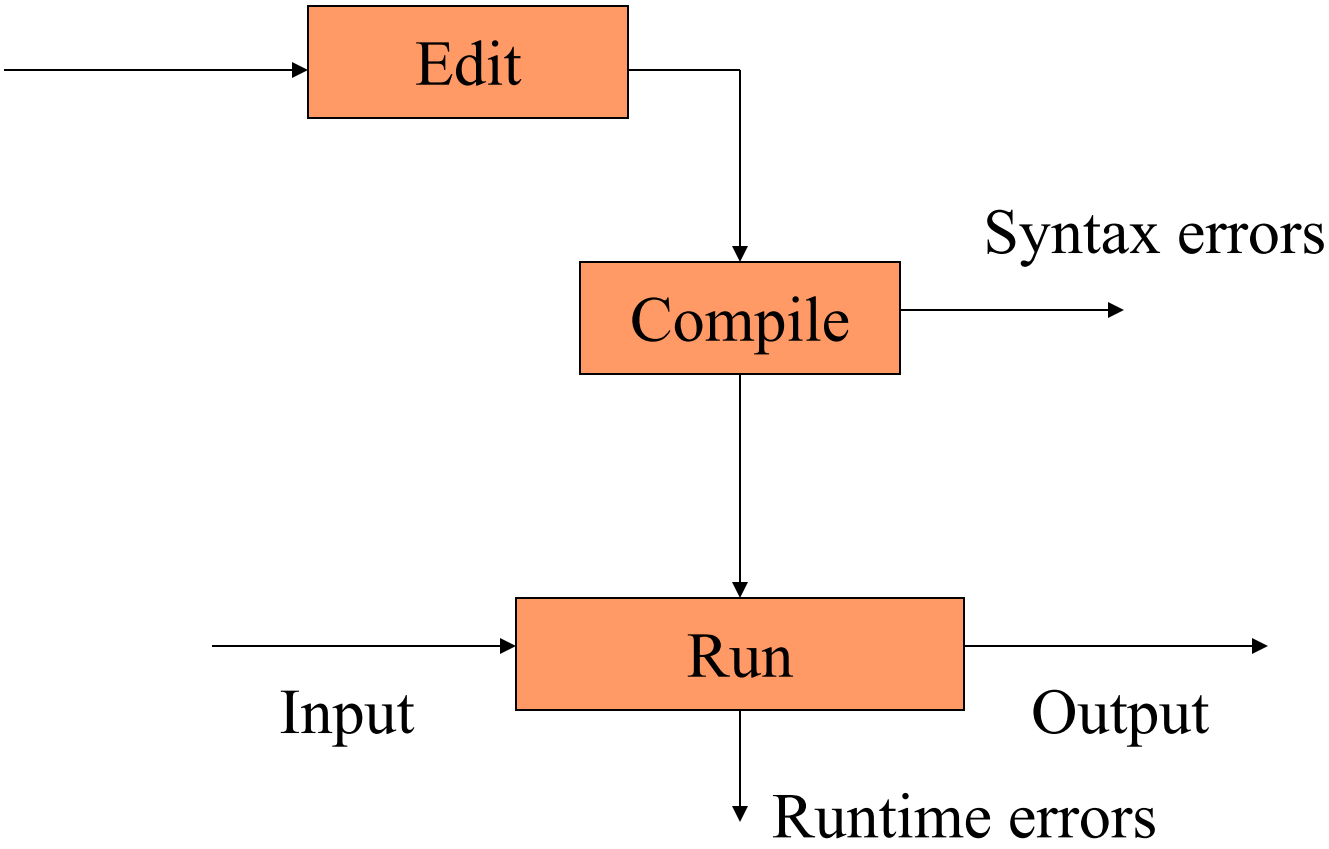
From Algorithms to Hardware (with compiler)



The Program Development Process (Data Flow)



The Program Development Process (Control Flow)



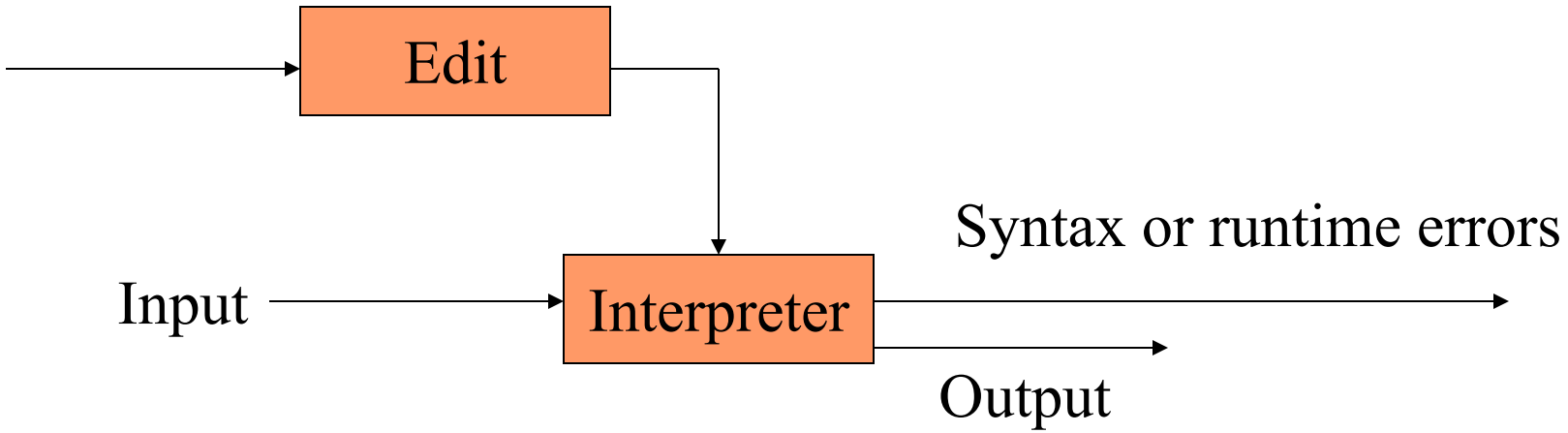
Three kinds of errors

- *Syntax error* : Some statement in the program is not a legal statement in the language.
- *Runtime error* : An error occurs while the program is executing, causing the program to terminate (divide by zero, etc.)
- *Logic error* : The program executes to completion, but gives incorrect results.

Interpreter

- An alternative to a compiler is a program called an *interpreter*. Rather than convert our program to the language of the computer, the interpreter takes our program one statement at a time and executes a corresponding set of machine instructions.

Interpreter



Python

- Python uses an interpreter. Not only can we write complete programs, we can work with the interpreter in a statement by statement mode enabling us to experiment quite easily.

- Python is especially good for our purposes in that it does not have a lot of "overhead" before getting started.

- It is easy to jump in and experiment with Python in an interactive fashion.

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→ Python is OO

Language terminology

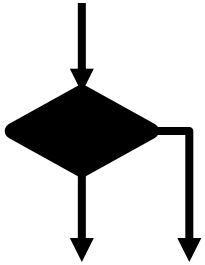
- Syntax: The formal rules for legal statements in the language.

- Semantics: The meaning of the statements - what happens when the statement is executed.

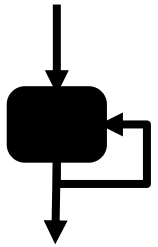
Three major control constructs of programming

- Sequential: Simply do steps one after the other in order they are listed.

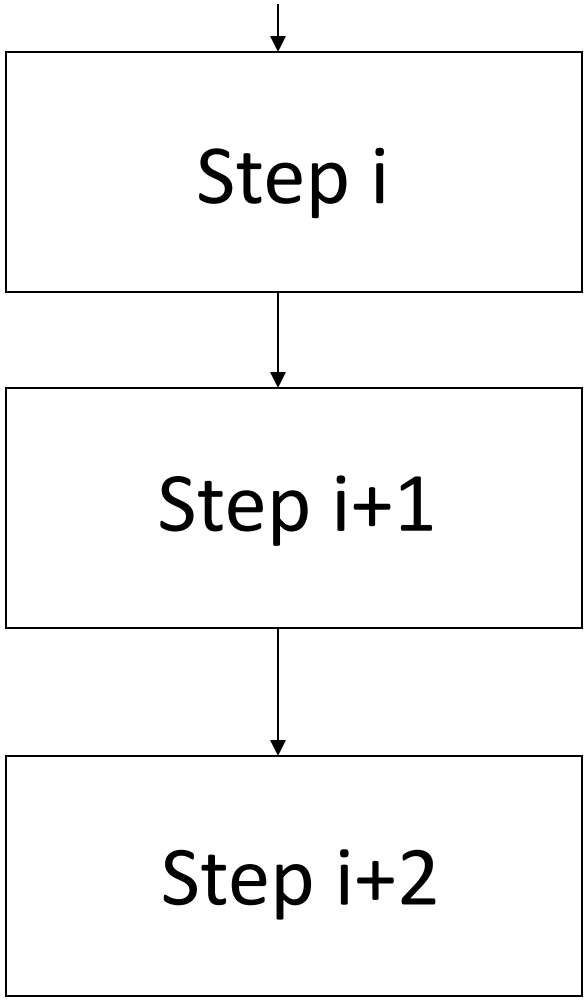
- Conditional: Decide which statement to do next based on some true/false test.



- Iterative: A set of statements is repeated over and over until some condition is met.



Sequential Operations
“Atomic”



- Input
- Computation
- Output

The Basic Pattern

- Most of our programs will use the basic pattern of
  - Get some user input
  - Perform some algorithm on the input
  - Provide results as output

Identifiers

- *Identifiers* are names of various program elements in the code that uniquely identify the elements. They are the names of things like variables or functions to be performed. They're specified by the programmer and should have names that indicate their purpose.

- In Python, identifiers
  - Are made of letters, digits and underscores
  - Must begin with a letter or an underscore
  - Examples: temperature, myPayrate, score2

Keywords

- *Keywords* are reserved words that have special meaning in the Python language. Because they are reserved, they can not be used as identifiers. Examples of keywords are *if, while, class, import*.

Variables in Python

- A variable has
  - A name – identifier
  - A data type - int, float, str, etc.
  - Storage space sufficient for the type.

Numeric Data Types

- int

  This type is for whole numbers, positive or negative. Examples: 23, -1756

- float

  This type is for numbers with possible fraction parts. Examples: 23.0, -14.561

Integer operators

The operations for integers are:

+ for addition

- for subtraction

* for multiplication

/ for integer division: The result of 14/5 is 2

% for remainder: The result of 14 % 5 is 4

- *, /, % take precedence over +, -
  x + y * z will do y*z first

- Use parentheses to dictate order you want.
  (x+y) * z will do x+y first.

Integer Expressions

- Integer expressions are formed using
  - Integer Constants
  - Integer Variables
  - Integer Operators
  - Parentheses

Python Assignment Statements

- In Python, = is called the *assignment operator* and an *assignment statement* has the form

  <variable> = <expression>

- Here
  - <variable> would be replaced by an actual variable
  - <expression> would be replaced by an expression

- Python: age = 19

Python Assignment Statement

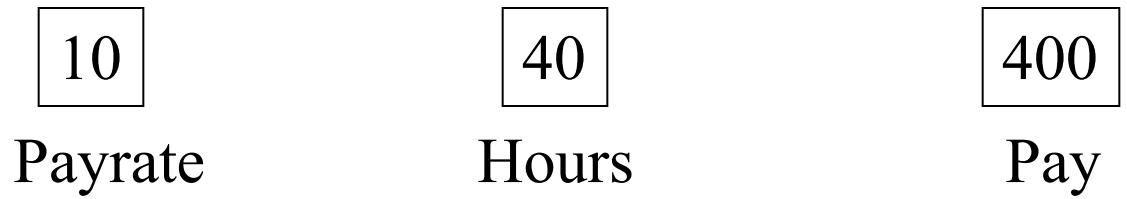
- Syntax: <variable> = <expression>
  - Note that variable is on left

- Semantics:

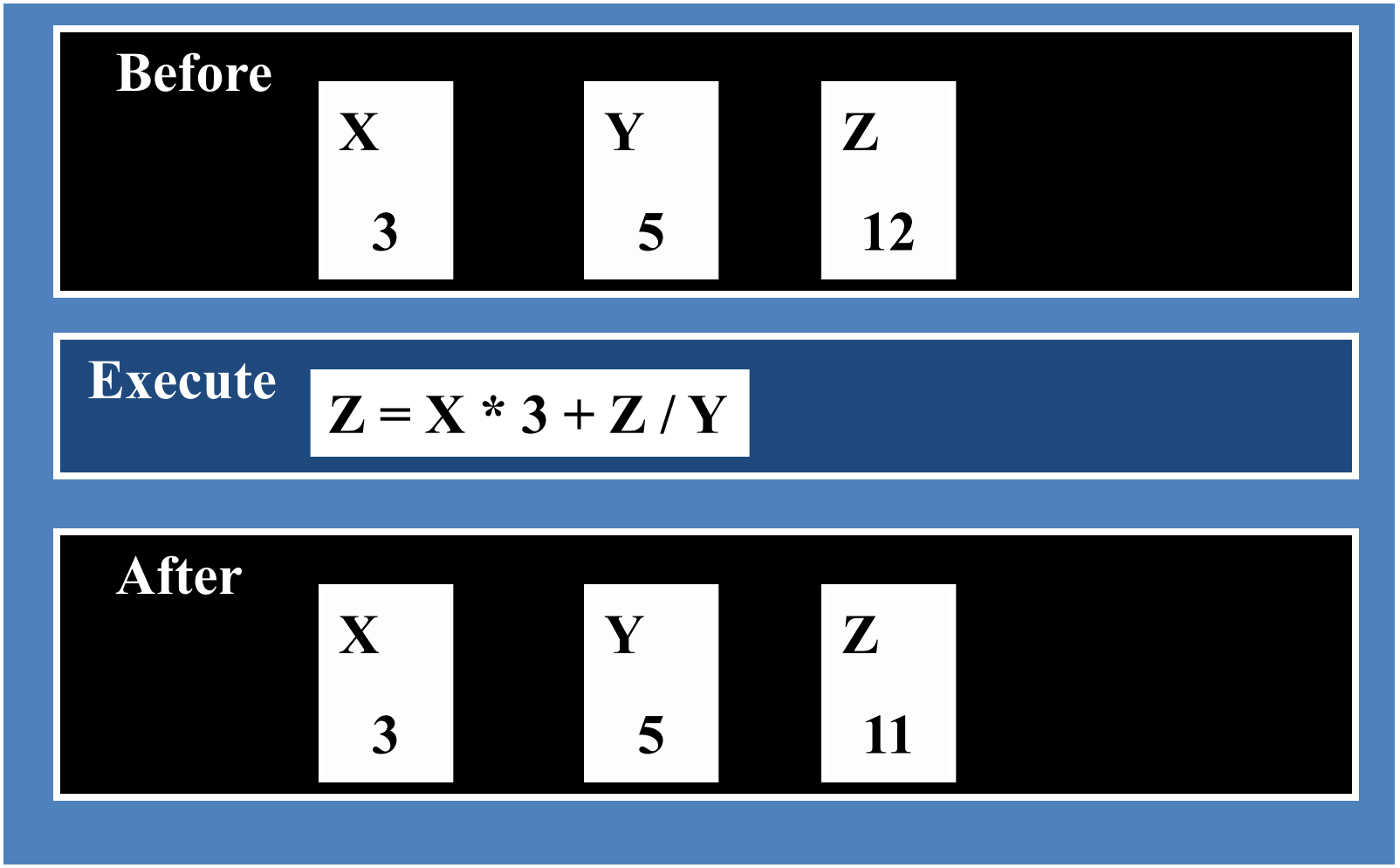
  Compute value of expression

  Store this as new value of the variable

- Example: Pay = PayRate * Hours



Assignment Example



Comments in a Program

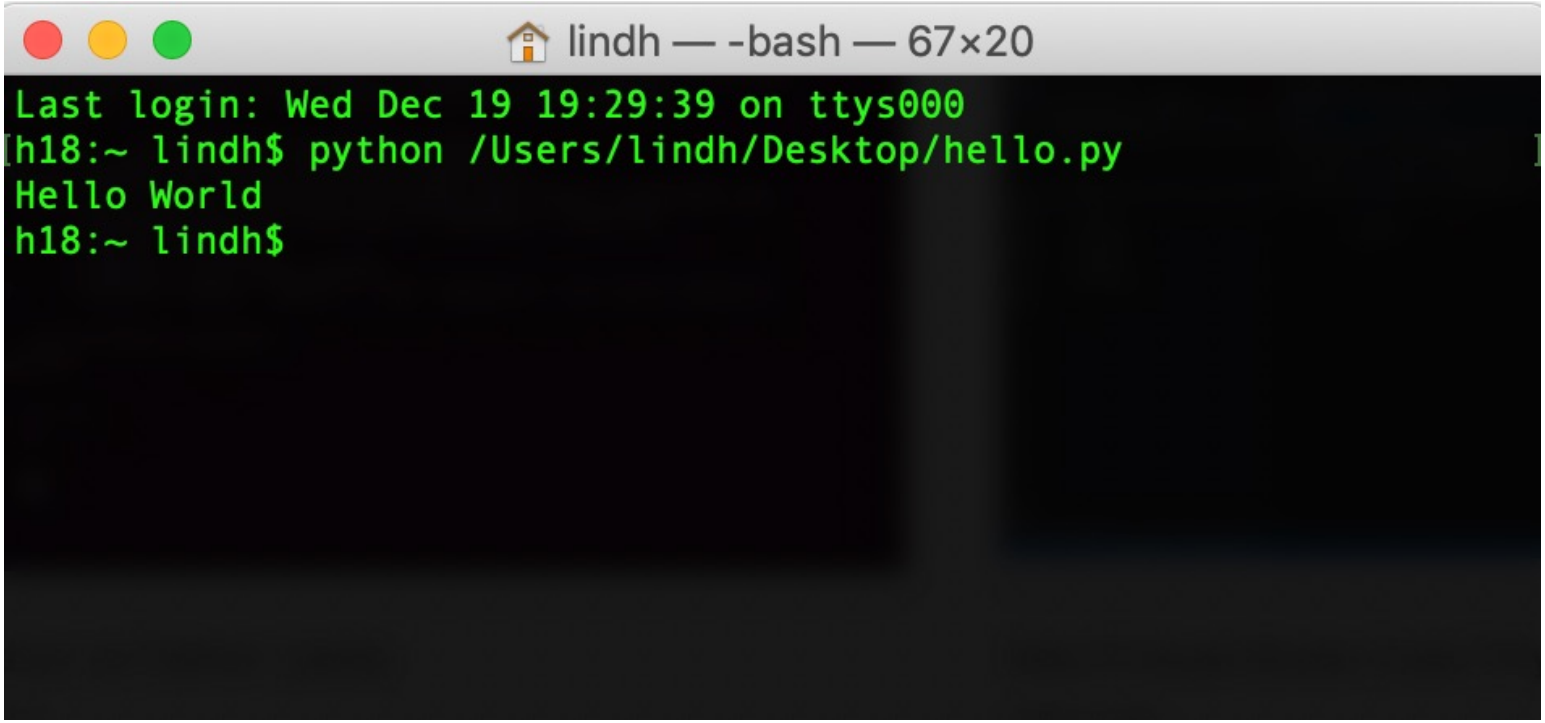
- Often we want to put some documentation in our program. These are comments for explanation, but not executed by the computer.
- If we have # anywhere on a line, everything following this on the line is a comment – ignored
- Use of “
- Good source codes always include comments

Preparation of Python Environments

- Many options
  - Python 3 interpreter from the official site
    - Latest version: Python 3.10
    - https://www.python.org/downloads/
  - Anaconda
    - Python interpreter with a lot of modules for data analysis, data plotting, etc.
    - https://www.anaconda.com/download/
  - You can also use online environments like Google Colaboratory (Recommended for beginners)

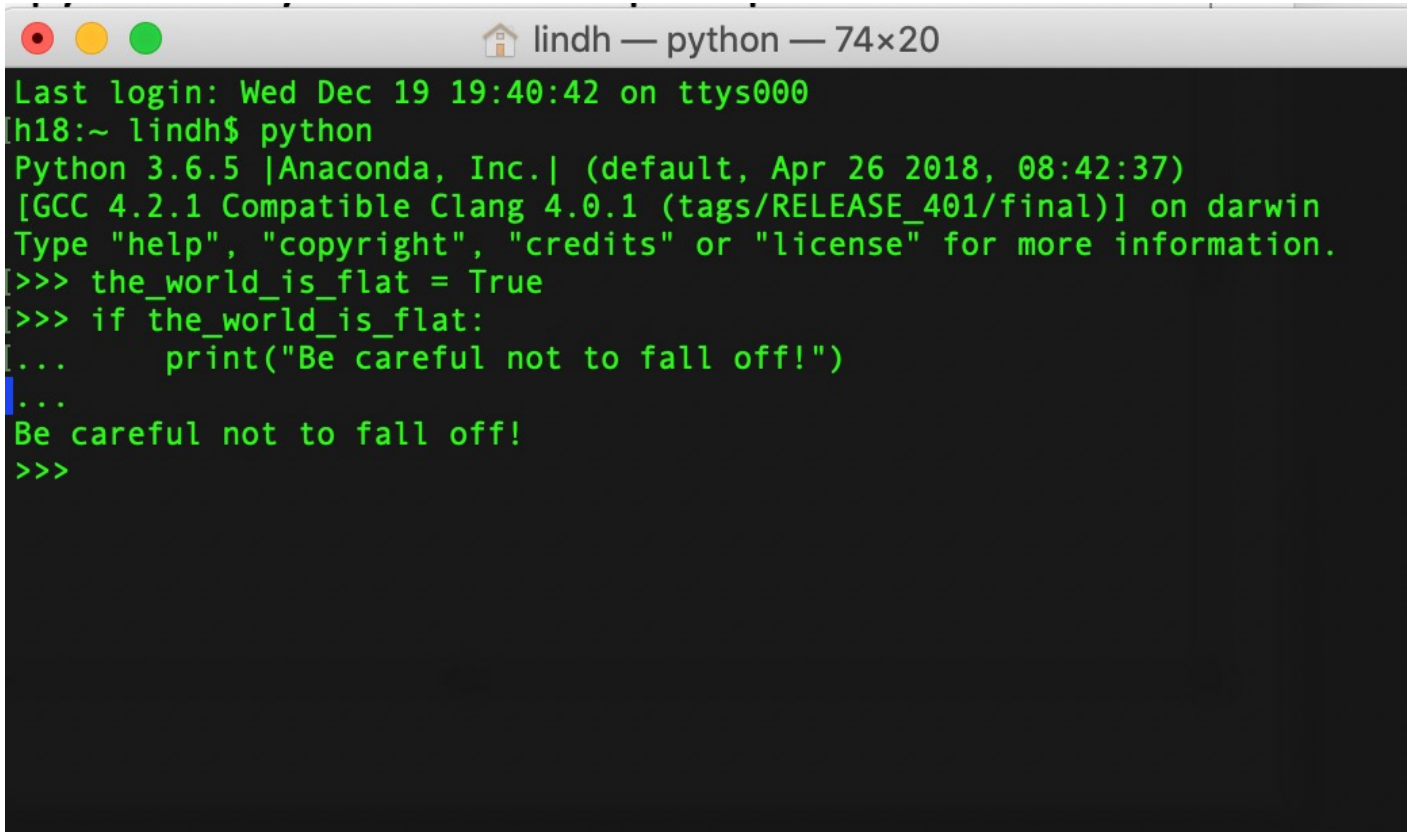
How to Execute Python Programs (1)

- Command prompt in Windows (or Terminal in MAC OS)
  - C:\Users\lindh> python C:\PBI\hello.py



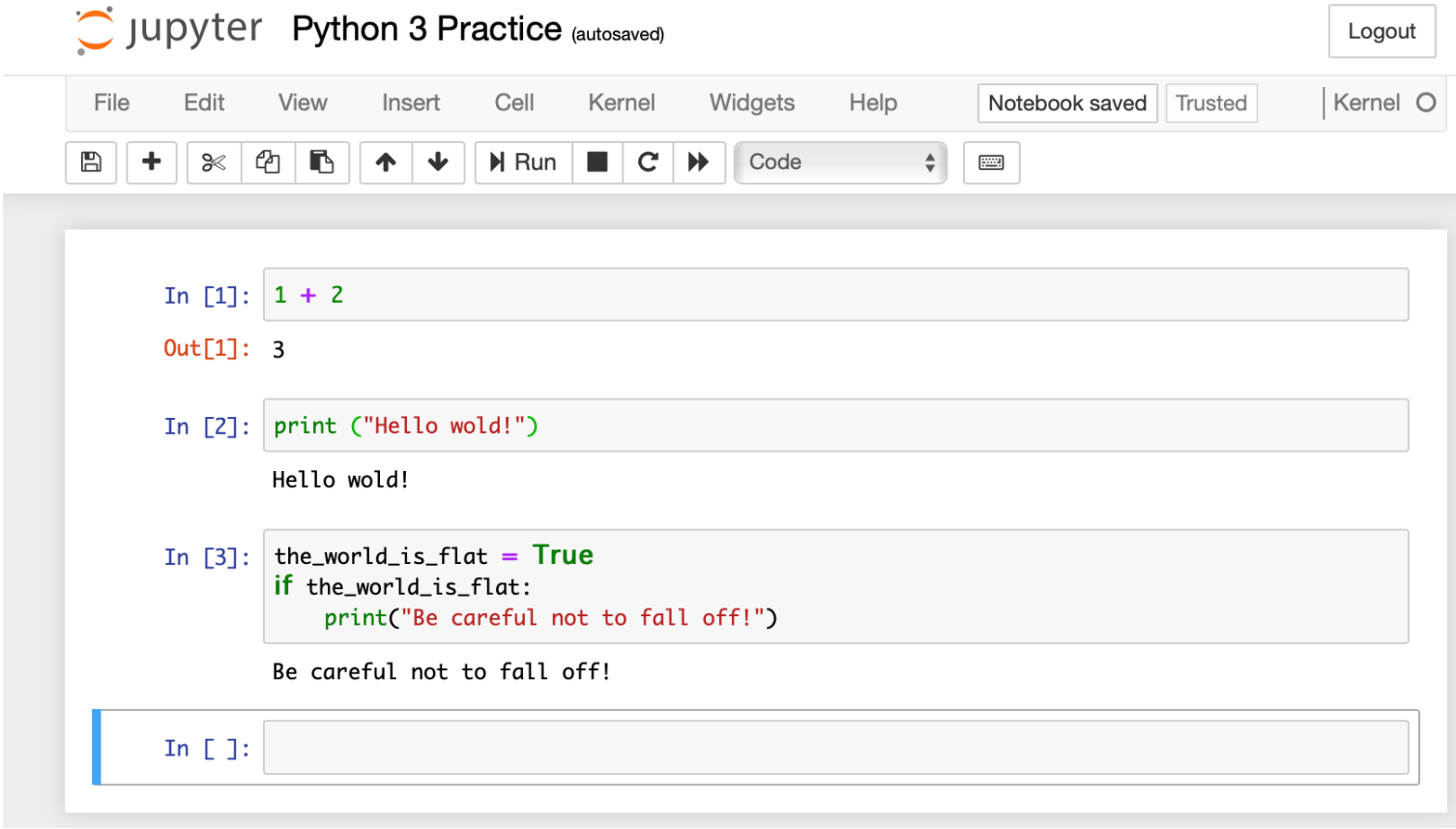
How to Execute Python Programs (2)

- Python Interactive Mode
  - Input “python” in your command prompt or terminal



How to Execute Python Programs (3)

- Jupyter Notebook (Recommended)
  - Can be started from Anaconda or Google Colaborotory



Python 3 Tutorials

- Suggested Python 3 Tutorials
  - A Byte of Python
    - https://python.swaroopch.com
  - Official Python 3 Documentation
    - https://docs.python.org/3/
    - Tutorial: https://docs.python.org/3.10/tutorial/index.html
- Read until *Data Structures* and you will get most of the necessary knowledge for your assignment 07

How to Learn Programming Efficiently

- Learn by examples
  - Type the examples by yourself
  - Execute the examples
  - Read line by line and analyze the execution result
  - Create some errors manually and understand the error message during execution