Programming Fundamentals

Lecture 1 – Variables, Statements and Expressions

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Learning Outcomes

- This lecture addresses LO2 for the module
- On completion of this lecture, students are expected to explain and apply
  - Problem Solving, algorithm and programs
  - Values, Types and Variables
  - Assignment Statements
  - Arithmetic Operators
  - String Operations
  - Program Comments
  - Order of precedence

Problem Solving

- Identify the problem
- Understand the problem
- Identify alternative solutions/algorithm
- Select the best solution
- List instructions to solve the problem
- Evaluate the solution

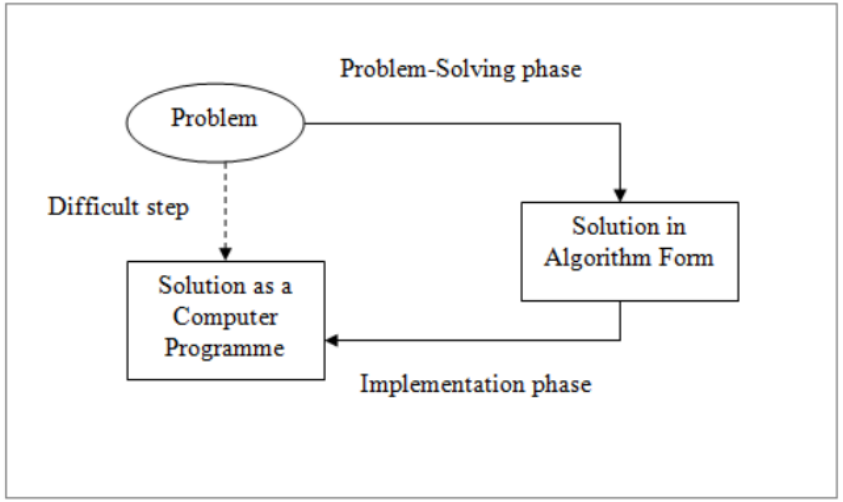
Software Development Life Cycle

- Analysis and Planning
- Requirements
- Design and prototype
- Software Development
- Testing
- Deployment
- Maintenance

What is an Algorithm?

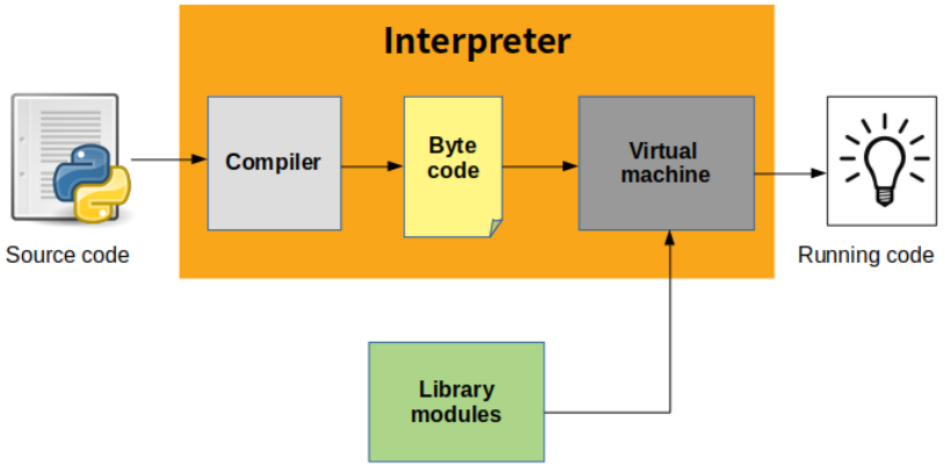
- Informally: “An algorithm is a set of steps that define how a task is performed.”

- Formally: “An algorithm is an ordered set of unambiguous executable steps, defining a terminating process.”
  - Ordered set of steps: structure!
  - Executable steps: doable!
  - Unambiguous steps: Well defined instructions!
  - Terminating: must have an end!



Computer program?

- Sequence of instructions to perform computation.
- **Human readable** high level source code
- Compile and create a **machine readable** byte code
- Different languages with various syntax
- Core instructions appear in all languages



Basic Instructions

- **Input :** get data from the keyword, a file or some other device.
- **Output :** display data, save it in a file, etc.
- **Math :** addition, multiplication, etc.
- **Conditional execution:** check conditions before run appropriate commands
- **Repetition :** execute commands repeatedly.

Python Values and Types

- Primitive Data types
  - Integer : Whole numbers (4,20,-45)
  - Floating point numbers : numbers with decimal points (15.6,56.256)
  - String : (“Hello”)
  - Boolean : True/False
- Non –primitive data type
  - List
  - Dictionaries
- Custom objects and classes

Python Variables

- Storage location to place values
- Can update later or reuse again
- Descriptive variable names
  - Unable to use keywords
  - Case sensitivity
  - No spaces
  - Naming convention depends on the language
    - Python : your_firstname, final_amount

Assignments and Statements

- Value assignments
  - message='value for the variable'
  - pi=3.14

- Statement
  - Code unit which has an effect
    - n=45
      print(n)

Arithmetic operations

Operator	Operation	Example
+	Addition	c=4+6
-	Subtraction	total=current-6
*	multiplication	total=cost*5
/	Division	answer=6/5
%	Modulus	result= 8%3
**	Exponent	answer=4**2
//	Floor division	result=8//3

Exercise 1

- Swap the values of following variables
  - a=10 , b=20
- What is the value of ‘b’ ?
  - a = 2
    b = 3
    a = b + a
    b = a + a
- Output ?
  - first= ‘hello ’
    second=‘world’
    print(first+second) #?

```
a = 10
b = 20

print("Before swap:")
print("a =", a)
print("b =", b)

# Swap the values of a and b using a temporary variable
temp = a
a = b
b = temp

print("After swap:")
print("a =", a)
print("b =", b)
```

Operator Precedence

- Useful when an expression consists of multiple operators
  - **P**arenthesis
  - **E**xponentiation
  - **M**ultiplication and **D**ivision : Left to Right
  - **A**ddition and **S**ubtraction : Left to Right

- Cannot perform mathematical operations on Strings
  - ‘4’-’1’ #not legal
  - But can use + and * when necessary

Exercise 2

- Calculate answers
  - 16 - 2 * 5 // 3 + 1 = ?
  - (12-2)**(1**2) = ?

- How to calculate the final answer?

  - height = velocity × time − (1/2) × 9.8 × time^2

Comments

- Add notes to explain what the program is doing
- Helps to understand complex logic
- Comment only when necessary. Do not repeat same comment
- Hint : good variable names reduce the need for commenting.
- Example
  - # compute the percentage of the hour that has elapsed
    percentage = (minute * 100) / 60
  - Not useful : v = 5 # assign 5 to v

Summary

- Basic instructions : Input, output, Math, Conditional execution and repetition
- Values and types : Integer, float, string, boolean
- Variables, assignments and statements
  - Set of rules when naming a variable
- Arithmetic operations and the order of execution
  - PEMDAS
  - +,-,%,*,/,**,//
- Comments: Use #