

15-110 Fall 2019

Homework 01

Out: Saturday 31st August, 2019 at 00:15 AST

Due: Thursday 5th September, 2019 at 14:55 AST

Introduction

In this assignment you will practice with the basic concepts of computing and Python.

The assignment only consists of multiple choice and fill in the blank questions. All the questions can be (easily) answered using the material included in the lectures and notebooks posted on the [course website](#).

If you have problems or doubts, **don't wait to ask questions!** Go to office hours or post on Piazza.

Important: You need to answer the questions *writing them on this same document*, either by hand (using a black pen) or by editing the file with any PDF editor of your choice. In the first case, you'll need to print the document, add your answers with a pen, and then either scan or take a picture of the file to be able to submit it as it is detailed below.

General Instructions for Submitting the Assignments

Submissions are handled through Autolab, at <https://autolab.andrew.cmu.edu/courses/15110q-f19>

You are advised to create on your computer/account a folder named **110-hw**. For each new homework, you should create a new sub-folder named **01**, **02**, etc. where you can put the files related to the homework. In this way your work will be nicely organized and information and files will be easily accessible.

You can also create an equivalent structure for the *laboratories*, where in this case the root folder should be named **110-lab**.

When you are ready with the homework and want to submit your solutions, you need to go in the current homework folder (e.g., **01**), *select all files you will submit* (that can include both **.pdf** files with written answers to questions and python code files, **.py**) and compress them in one single **.zip** file.¹

According to the OS you are using, you might have different options for making the zip file. For instance, on Windows, after selection of the files, you should right-click and select **Send to: Compressed folder**, while on macOS, you can select **Compress** on the menu appearing from the right-click.

The compression action will produce a zip file containing the files to be handed in for the assignment. The file should be named **hwXX-handin.zip** (e.g., for this homework, the name of the file should be **hw01-handin.zip**). Then, open [Autolab](#), find the page for this assignment, and submit your **hw01-handin.zip** file via the “Submit” link.

☛ The number of submissions is limited to 5. The last submission is the one that will be graded.

¹The (single) zip file is needed, even when the files handed for the assignment consists of one individual file.

1 Computers and Programming Languages

1. (3 points) Which ones of these formal languages that are commonly used to instruct a computer are based on a declarative paradigm?
 - ☐ Python
 - ☐ Java
 - ☒ **Haskell**
 - ☒ **HTML**
 - ☐ C++

2. (3 points) Which ones of these sequences of instructions could be associated to a machine-level programming language (and not to a high-level language)?
 - ☐

```
1: move one step ahead
2: check if there is an obstacle in front
3: if there is an obstacle, then turn left
4: else, keep going (go to instruction 1)
```
 - ☐

```
compute the sum of the two object variables A + B
take the sum and divide it by two
display the final output
```
 - ☒

```
take the value stored at memory location 1001
take the value stored at memory location 1003
sum up the two values
store the result at memory location 2001
```

3. (3 points) Select the declarative statements.
 - ☒ **I need to return at home, which is in Rome, Imperial street, 11.**
 - ☒ **To make the milk-shake, we need milk, strawberries, and ice cubes.**
 - ☐ To make the milk-shake, put 500 ml of milk, 300g of strawberries, 50g sugar, and ice cubes in the shaker. Then, shake it for one minute.
 - ☒ **Select the even numbers out of the set 1, 3, 6, 2, 10, 100 and store them.**

4. (3 points) Which ones of the statements below refer to flow control?
 - ☐ Add 2 and 3.
 - ☒ **If there's a dog, don't leave the cat alone**
 - ☒ **Keep moving until a wall is met, then turn right.**

5. (3 points) An imperative programming language instructs the computer about how to do things.

6. (3 points) A declarative programming language instructs the computer about what is true and the goals.

7. (3 points) Which program that translates from a high-level to a machine-level language is expected to produce a machine-level code which is more efficient?
- ☐ An interpreter.
 - ✓ **A compiler.**
8. (3 points) Program instructions are analyzed and processed one-at-a-time and are immediately executed. Which application program that serves to translate a program from a high-level to a machine-level language implements this operational modality?
- ✓ **An interpreter.**
 - ☐ A compiler.
9. (3 points) Which specific component of a computer architecture performs comparison operations between two values?
- ☐ CPU
 - ✓ **ALU**
 - ☐ ROM
 - ☐ RAM
10. (3 points) Within the CPU, the **Control Unit** fetches the instructions of a running program one-at-a-time
11. (3 points) At boot time, the basic application programs to startup the computer (the firmware) are being loaded from the internal, permanent memory called **ROM**.
12. (3 points) Name at least three different Operating systems: **Linux, Android, Windows, MAC OS.**
13. (3 points) When you switch off your laptop computer, the file with your python program is expected to be stored in:
- ☐ ROM
 - ☐ RAM
 - ✓ **Storage disk**
 - ☐ Flash memory card
14. (4 points) Provide an example of an English phrase that would pass the checks of syntactic rules and static semantics, but could be ambiguous regarding its semantics without a precise definition of the context.

Solution: Call me a taxi, please [Semantic ambiguity: is the person asking to call for a taxi or for being called a taxi?]

I saw someone on the hill with a binocular. [Semantic ambiguity: I've used a binocular to see the person, or is the person on the hill using a binocular?]

15. (3 points) Which ones of the following properties and keywords well describe python?

A. Interpreted B. Declarative **C. Imperative** D. Natural language E. Formal natural language
F. Mathematical language G. Fast **H. Popular** I. Machine-level J. Machine-learning
K. Artificial Intelligence L. Operating system

2 Basic python

1. (4 points) Select the relevant properties that describe the python object 3.5

- ☐ variable
- ☒ **literal**
- ☐ integer
- ☒ **scalar**
- ☒ **float**
- ☐ non-scalar
- ☐ bool
- ☐ operator
- ☐ string
- ☐ logical

2. (4 points) Select the relevant properties that describe the python object ‘‘`hello!`’’

- ☐ variable
- ☒ **literal**
- ☐ integer
- ☐ scalar
- ☐ float
- ☒ **non-scalar**
- ☐ bool
- ☐ operator
- ☒ **string**
- ☐ logical

3. (3 points) Which ones of the statements below are expressions?

- ☐ 3.5
- ☒ **1 + 2**

```
✓ color = 'red'
✓ x = 2
```

4. (4 points) What is the output generated by the following piece of code?

```
# 3.5 + 2
# print(4)
# print(3.5 + 2, 4)
```

- (a) 5.5 4
(b) 5.5
4
5.5 4
(c) Nothing
(d) None

Solution: Nothing

5. (5 points) Given the following piece of code:

```
x = 3.5 % y
print(x)
```

which value should be assigned to `y` in order to make the program printing out the value 3.5?

`y`: Any number ≥ 3.5

6. (6 points) Consider the application of the operator of integer division to 5 and 2, where 5 is the dividend and 2 is the divisor.

- (a) Write the python expression for computing the integer division between 5 and 2.

Solution: `5 // 2`

- (b) Write the result of the operation.

Solution: `print(5 // 2)`

- (c) Let's assume that we fix the dividend to 5, but we can increase the value of the divisor as much as we want. Write the minimal value for the divisor that makes 0 as the result of the integer division.

Solution: 6 (note that, for instance, 5.01 does the job, but the result would be 0.0, a float. We can be tolerant and accept such type of answers.)

7. (4 points) At a party there's a big cake that must be divided equally among 10 people. Write down the python expression that first computes and then prints out the fraction of the cake that will be assigned to each person (0.1 in this case). You must use one line of code, applying a division operator.²

Solution: `print(10 / 0.1)`

8. (5 points) At the same party, there are 13 chocolate bars and we want to divide them equally among the ten participants. Unfortunately, the bars cannot be broken into pieces, such that the only solution to be fair is to put aside a few bars and leave them for the next party! Write down the python expression that computes and prints out how many chocolate bars are being not assigned. You must use a division operator and use one line of code.

Solution: `print(13 % 10)`

9. (7 points) Let's consider odd and even numbers. An even number can be divided by 2, while an odd number can't (it has a remainder value). We want to have a simple rule to decide whether a number is odd or even. The use of a single python operator can actually do the job (with the addition of some flow control logic).

Find the python operator that once placed in the following piece of pseudo-code (don't run it as it is, it won't work!), would allow the correct classification of even vs. odd numbers. In the pseudo-code, `x` is an integer number, that can take any value, and `??` indicates the operator that you have to identify (e.g., if you decide that the operator is `+`, then this means that when `x + 2` is equal to zero `x` is classified as an even number, and when `x + 2` is equal to one the number is classified as odd, which is clearly incorrect!).

```
if x ?? 2 is zero: x is even
if x ?? 2 is one: x is odd
```

Operator: %

10. (7 points) We roll a fair die (with 6 faces) $n = 100$ times. Assuming that the rollings are independent, the probability of getting every time a 6 is $\frac{1}{6}$ times n .

- (a) Using exactly one single operator, write the python expression that computes and prints out the result (don't write by hand the product of 100 terms!).

Solution: `print((1/6)**100)`

- (b) Write the numeric value of the result for $n = 5$ (and report the value using only up to five digits following the decimal point, e.g., don't write something like 0.0037612757, but rather 0.00376).

²Here and in other similar questions that follow, you must *not hard-code the solution*, such as answering with `print(0.1)`. Instead, you have to identify the proper *expression* that realizes the desired computation. For instance, if the question asks to write in one line of code the expression that computes the squared product of 2 and 3 and to print it out, you should give as an answer: `print((2*3)**2)`.

Solution: 0.00012

11. (5 points) What is the value of the following expression? (understand your answer!)

$$(-1 + 3) * 2 / 3 * (1.5 - 2)$$

☐ -2.666

☒ **-0.666**

☐ 0

☐ 0.666