

## MIT GSL Programming Questions

### Level One Questions - Basics and Data Structures

1. Make a function that takes no arguments and prints "Hello World" as a string.
2. Make a function that takes no arguments and returns "Hello World" as a string.
3. Make a function that takes no arguments and prints your explanation of the difference between return and print as a string.
4. You need to keep a list of who is in your group. Design a Python function that takes five arguments that are all strings of the names of your group members (each argument is a unique member) and RETURNS a list of the members in your group (with names as strings).
5. It's great that you can return the members in your group, but you also want to print to console. Design a function that PRINTS a list of members in the group (instead of returning). All other specifications are identical to the specifications in 1.
6. Write a function that can find the percentage of a number. Your inputs should be two INTEGERS: the first integer being the number you want to take a percentage of and the second integer being the percentage you want to take (ie you would put 5 if you want 5%). You should return a float.

### Level Two Questions - For Loops, If Statements, and Variables

7. Make a function that does some mathematical operation on a number. You have one argument: a float. This will be the number that you're doing the operation on. You return the result (as either an integer or a float - decide which one is best for your operation and explain why AS A COMMENT). You MUST use a variable in your function and perform an operation on the variable you use.
8. Make a function that takes in a list of integers and adds them up. You may not use the `sum()` function. You should return an integer.
9. Suppose you want a program that converts 24 hour time into 12 hour time with an AM/PM marker. Write a Python function that takes as input an integer between 0 through 23 (inclusive) indicating the time and returns a tuple containing an integer as the first item and a string as a second. The first item in the tuple should be the hour and the second item should be the AM/PM marker. The time you return should be the same one you were given. (Hint: A tuple is a compound data type. It's actual a pair of two pieces of data. To make a tuple, just do the following: `(item1, item2)`).

### Level Three Questions - Dictionaries and Scoping

10. Given a dictionary mapping names to grades as input (names as strings and grades as integers), return the name (as a string) of the student with the highest grade.

11. Write a function that has a for loop and a separate function being created inside of it. Make variables in both the for loop and the separate function. In the comments, explain the scope of each variable. You may accept any input and return any output.

**STOP! You might need the Intro to Programming III workshop for this. When you get here, let us know! We'll try to get you up to speed with the workshop materials.**

#### **Level Four Questions - Recursion and Object Oriented Programming**

12. You want to keep track of what has been sold in your store. Create a class that represents a store item and have it include an attribute indicating whether or not it has been sold. Create a method that changes this attribute (no arguments or return necessary). Create a method that allows someone to see the value of that attribute (should return the value).
13. A Fibonacci sequence is a sequence of numbers that follows the following pattern: a given number  $n$  is equal to the sum of the number two places before ( $n-2$ ) and the number one place before ( $n-1$ ). The sequence will look as follows: 0, 1, 1, 2, 3, 5, 8, 13, ... . Make a Python function that takes an integer  $n$  as input and returns the Fibonacci sequence number at  $n$  as an integer as output.

#### **Level Five Questions - Dynamic Programming**

14. Suppose you have a backpack that can store  $x$  units in volume. You have a series of objects that each take up a different number of units in volume and have a different value to you. Write a function that, given input volume  $x$  as an integer and a dictionary mapping and item to a tuple of volume units (as an integer) and value (as integer), MAXIMIZES the total value you get without having your total volume exceed the volume that your backpack can store. You should return a list of all the items you can put in. (This problem is known as the knapsack problem - I strongly encourage you to look it up! It's really interesting! Try to come to a solution on your own first, though.) (Hint: use dynamic programming)
15. For the following problems, assume you have large amounts of data (ie you should pick a data structure that would be best for large amounts of data. Explain why in the comments):
  - a. Assume you have a collection of names. You want to find if a given name is in the collection. Design a system in Python that can do this for you.
  - b. Assume you have a collection of names. You want to very quickly retrieve the order in which the names were added. Design a system in Python that can do this for you."System" above can be a collection of multiple Python functions. You are allowed to have a "pre processing function" (ie a function that formats your data) and a function that carries out the check (ie a function that does what is listed).

16. (This one might be a bit hard. Feel free to ask! We might talk about this during a possible algorithms workshop. Also feel free to try things/do some online research! Try to solve on your own though). Given a list of integers as input, return a sorted version of the list of integers. You may not use Python's `sorted()` or `list.sort()` methods.