Introduction

Data Types
What will each line of the following code print?
```python
print(1+1)
print(str(1)+str(1))
print(str(1)+1)
print("Hello"*2)
```

Variables
What does the following code print?
```python
foo = 20
bar = foo*2
print(bar)
```
Is this code equivalent to the code above?
```python
foo = 20
print(foo*2)
```
Is there anything wrong with this code?
```python
foo = 20
print(int(foo)*2)
```

User Input
Is there anything wrong with the code below? Will it run? Will the answer be logically correct?
```python
# double the user's input
myInput = input("Please input a number here: ")
print(myInput*2)
```

Branching Control Structures
What is the output of the following code?
```python
a = 25
b = False
if a < 25 or not b:
    b = not b
elif a >= 25 and b:
```
How could you make the code below more efficient?
```python
da = int(input("Give me a number between 1 and 3 inclusively\n"))
if a = 1:
    print("You selected 1!\n")
elif a = 2:
    print("You selected 2!\n")
elif a = 3:
    print("You selected 3!\n")
elif a > 3 or a < 1:
    print("You entered an invalid value!\n")
```

Looping Control Structures

Fibonacci Sequence
We define the \( i \)th number of the Fibonacci sequence, \( f_i \), to be \( f_{i-1} + f_{i-2} \).

1. Write the code to find \( f_i \) using a for loop.
2. Write the code to find \( f_i \) using a while loop.
3. Which of these looping styles was more effective to solve the problem? Why? In what situations could the other style have been better?

Fizz Buzz
Write code that prints the first 100 numbers on individual lines. However, for multiples of 3, print 'fizz' instead; for multiples of 5, print 'buzz' instead; and for multiples of 3 and 5, print 'fizzbuzz' instead. For example, the first part of the output should be similar to:

```
1
2
'fizz'
3
4
'buzz'
'fizz'
7
```

And so on. Justify your choice of looping structure, and do not use more if statements than necessary.

Functions

Writing Functions
Are the following two functions equivalent?
def foo(x):
    myVar = 2*x
    return myVar

def bar(x):
    return 2*x

What is the difference between the two functions below?

def baz(x):
    return 2*x
def qux(x):
    print(2*x)

Using the same function definitions as above, identify the problem in the following code. Will it run? Will the results be what you expect? Why or why not?

```python
a = baz(3)
b = qux(3)
print(a)
print(b)
```

Identify the two problems in the following piece of code.

```python
def myFunc(x):
    x = int(input("Input any number.\n"))
    if x > 10:
        return True
    return False
```

**Square Root**

Write a function that finds the integer square root of some integer \( x \). This does not need to work for floats (though that would be great practice as well). You may return -1, "Does not exist", or raise an exception, if \( x \) is not a perfect square.

**Exponent**

Write a function, that takes a numeric value \( x \) (int or float), as well as an integer \( n \), and uses a looping structure to return the exponent \( x^n \).

Can you change your function to work with any value of \( n \), int or float?

**Data Structures**

**Lists**

**Sum**

Write a function, that takes a list as an argument, to find the sum of all elements in the list using a looping
Unique List
Write a function that takes a list as an argument, and returns a new list that removes all duplicates in the list. Extra challenge: counting the return line, find a 1 line solution

References
What outputs will the following blocks produce? What is the main difference?
```
L = [1,2,3]
def doubleList(myList):
    for i in range(len(myList)):
        myList[i] *= 2
doubleList(L)
print(L)
```
```
L = [1,2,3]
def doubleList(myList):
    for ele in myList:
        ele *= 2
doubleList(L)
print(L)
```

2-D Lists
Write a function which returns a nxn 2-D list of randomly generated numbers between 0 and 100. Take n as an argument to your function.

Then, write two functions to print this 2-D list, line by line, as a string. The first function must be counter-controlled, whereas the second must use for-each loop(s). The functions must take two arguments: grid, your 2-D list, and n, the size of your list.
For example, with n=2:
```
27 4
46 9
```
Bonus: Starting with one of your two print functions, alter the code such that it only prints the values of the odd numbers, replacing all even numbers with #.
Bonus: Re-write your counter-controlled function to modify the 2D-list in-place such that it does not need to use return (as seen in the References section above).

Dictionaries
When is a good time to use a dictionary? What are the advantages and disadvantages of using a dictionary?

Consider the following code:
myDict = {}
for i in range(1, 5):
    myDict[i] = i*2
for key in myDict:
    print(f"{key}: {myDict[key]}"

Bob says:
I believe this code will print out "1:2, 2:4, 3:6, 4:8, 5:10", in that order, all on new lines. However, Alice, disagrees. Who is correct? If Alice is correct, what are the reasons is Jacob wrong?

You are given the following code:

prices = {
    "banana": 4,
    "apple": 2,
    "orange": 1.5,
    "pear": 3,
    "bread": 3,
    "bacon": 4,
    "chips": 2
}

Write a function, receipt(userCart) , to calculate the total cost of a user's cart and print a nicely formatted receipt. Assume that the userCart variable is a list of strings representing the items in the user's cart. For example, ["banana", "apple", "bacon", "apple"] is a valid shopping cart.

Recursion

You may not use any looping structures for any of the questions in this section.

Tracing

We will calculate the sum of a list of numbers recursively. However, we will trace the steps to solve this by hand. You may also implement the code to do so if you wish. Complete the following trace:

sum([5,6,2,8,9])
5 + (sum([6,2,8,9]))
5 + (6 + (sum([2,8,9])))

Now, we will do the same for the product of a list of numbers.

prod([10,9,6,4,2])
10 * # complete this line as well

Fibonacci

Recall the earlier question regarding the Fibonacci sequence. Instead of using a looping structure, we will rewrite this recursively.
1. What is the base case?
2. What is the recursive case?
3. Write the code to define the recursive function \( fib(i) \).

**Factorial**

We define \( n! = n \times (n-1) \times (n-2) \times \ldots \times 2 \times 1 \).

1. What is the base case?
2. What is the recursive case?
3. Write the code to define the recursive function \( fact(n) \).

**Exponents**

Write a recursive function \( \text{exp}(x, n) \) which returns the value \( x^n \) for integers \( x \) and \( n \).

**Comprehension**

What will happen when this function is run?

```python
def myFunc(x):
    return x + myFunc(x-1)
```

What will happen when this function is run?

```python
def myFunc(x):
    if x == 0
        return x
    print(myFunc(x-1))
```

**Objects & Classes**

**Classes**

What are classes? Name 3 advantages.

Implement an Animal class with the following specifications:

- Having the below attributes:
  - species
  - size
  - sound (e.g. "bark!")
  - isHungry (True or False)
- Having the below methods:
  - \( \text{init} \)\( \text{self, species, size, sound} \): A constructor to initialize these attributes for the animal. You may set isHungry to True or False as you please.
  - \( \text{getSize} \)\( \text{self} \): returns the size of the animal
  - \( \text{makeNoise} \)\( \text{self} \): prints the animal's sound
  - \( \text{feed} \)\( \text{self} \): if animal is hungry, change to false; if animal is not hungry, print something like: "Giraffe already ate!"

Then, implement a Zoo class with a list of Animal objects as an attribute, and an addAnimal(a) method which takes an animal as an argument and updates the list.
Objects

What outputs will the following blocks of code produce?

```python
a = {1: 2, 2: 3}
b = {1: 2, 2: 3}
print(a == b)
print(a is b)
print(b is b)
```

```python
a = Animal("Dog", "Medium", "Bark!")
b = Animal("Dog", "Medium", "Bark!")
c = Animal("Dog", "Small", "Bark!")
print(a == b)
print(a is b)
print(b == c)
```

```python
animalList = [a, b, c]
anotherAnimalList = [a, c, b]
print(animalList == anotherAnimalList)
print(animalList is anotherAnimalList)
```

File I/O

Write a function which safely opens a text file, and returns the number of non-empty lines. This function should return an error message if not found.

Write a function which creates a list out of the lines in a given text file, and then writes the contents of the list back into the file, in random order.

Write a function which reads in lines from a text file. Return the number of lines which contain a number.