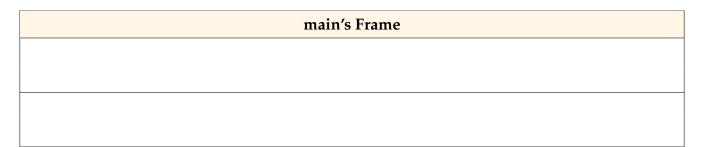
Nested data and iteration

Name:

1. Consider this program:

```
def main() -> None:
1
       a = [0,0]
2
       l = a
3
       1[0] = 1
4
       print(a)
5
       print(1)
6
       a = [3,3]
7
       print(a)
8
       print(1)
9
       1[1] = 2
10
       print(a)
       print(1)
12
13
  main()
14
```

What is the output of this program? Draw the function frame diagrams (showing the variables in each function frame) while tracing the code.



Name:

2. Consider this program:

```
def mystA(x: int, a: list) -> None:
1
       x = x + 1
2
       a[x] = a[x] + 2
3
       print(x)
4
       print(a)
5
   def mystB(n: int, lst: list) -> int:
6
       lst = [5,5]
7
       lst[0] = n
8
       n = n + 2
9
       print(n)
       print(lst)
11
       return n
12
   def main() -> None:
13
       x = 0
14
       a = [0,0]
15
       mystA(x, a)
16
       print(x)
17
       print(a)
18
       x = x + 1
19
       mystB(x, a)
20
       print(x)
21
       print(a)
22
23 main()
```

What is the output of this program? Draw the function frame diagrams (showing the variables in each function frame) while tracing the code.

main's Frame	mystA's Frame	mystB's Frame

Model 1 Nested Lists

Elements in a list can be of sequence type (string or list), for example, in a list of words, each element is a string type. Similarly, here is an example of a list of lists:

```
states = [
    ['AL','AK','AZ','AR'],
    ['CA', 'CO','CT'],
    ['DC','DE'],
    ['FL'],
    ['GA'],
    ['HI'],
    ['ID','IL','IN','IA']
]
```

The states list contains sub-lists with states that start with the same letter.

3. Evaluate each expression in order and record the output for each line in the second column.

Python code	Output
<pre>print(states[0])</pre>	
<pre>print(states[-1])</pre>	
<pre>print(states[4][-1])</pre>	
<pre>print(states[5][0])</pre>	
<pre>print(len(states))</pre>	
<pre>print(len(states[1]))</pre>	
<pre>print(len(states[3]))</pre>	
<pre>print(len(states[3][0]))</pre>	
<pre>print(len(states[3][1]))</pre>	
print(states[3][0][0])	

4. What does the following code snippet print?

```
1 for sublist in states:
2 letters = ''
3 for state in sublist:
4 letters += state[1]
5 print(letters)
```

5. Modify the code in the previous problem to print all the letters inside the list, that is: 'ALAKAZARCACOCTDCDEFLGAHIIDILINIA'

6. Write a function called max_states that takes in the list of states and returns the maximum size of its sublists.

7. Write a function called min_states that takes in the list of states and returns the first sublist with minimum size.

8. **Challenging:** Modify the code in the previous problem to print all the unique letters inside the list, that is: 'ACDFGHILKZROTEN'

Model 2 Nested Dictionaries

Collections/containers (sequence-type like strings and lists, and dictionaries/maps) can be nested in arbitrary ways. For example, the following data could be described as a "dictionary of dictionaries of integers and lists of strings":

```
movies = {
    "Casablanca": {
        "year": 1942,
        "genres": ["Drama", "Romance", "War"],
    },
    "Star Wars": {
        "year": 1977,
        "genres": ["Action", "Adventure", "Fantasy"],
    },
    "Groundhog Day": {
        "year": 1993,
        "genres": ["Comedy", "Fantasy", "Romance"],
    },
}
```

9. Evaluate the following expressions in the order that they are listed:

Python code	Output
movies	
movies["Casablanca"]	
movies["Casablanca"]["year"]	
movies["Casablanca"]["genres"]	
type(movies)	
<pre>type(movies["Casablanca"])</pre>	
<pre>type(movies["Casablanca"]["year"])</pre>	
<pre>type(movies["Casablanca"]["genres"])</pre>	
len(movies)	
<pre>len(movies["Casablanca"])</pre>	
<pre>len(movies["Casablanca"]["year"])</pre>	
<pre>len(movies["Casablanca"]["genres"])</pre>	
for key in movies: print(key)	
<pre>for key, val in movies.items(): print(key, val)</pre>	

10. Explain the TypeError you encountered.

11. In the expression movies["Casablanca"]["genres"], describe the purpose of the strings "Casablanca" and "genres".

12. When iterating a dictionary using a for loop (i.e., for x in movies), what gets assigned to the variable?

13. What is wrong with the following code that attempts to print each movie?

```
for i in range(len(movies)):
    print(movies[i])
```

14. Write nested loops that outputs (prints) every *genre* found under the movies dictionary. Trace your code to ensure that it outputs a total of nine lines.

15. Each movie in Model 2 has a title, a year, and three genres.

- a) Is it necessary that all movies have the same format?
- b) Name one advantage of storing data in the same format:
- c) Show how you would represent The LEGO Movie (2014) with a runtime of 100 min and the plot keywords "construction worker" and "good cop bad cop".