Quiz 02 - Practice

COMP 110: Introduction to Programming
SS1 2025

Wednesday, May 28, 2025

Name: Solutions

9-digit PID: ____________________

Do not begin until given permission.

Honor Code: I have neither given nor received any unauthorized aid on this quiz.

Signed: ____________________

Question 1: Multiple Choice Completely fill in the bubble next to your answer using a pencil. Each question should have exactly one filled-in bubble.

1.1. A variable's value should not be reassigned after initialization.

```
x: int = 3
x = 4
```

- ○ `True`
- [✓ `False`]

1.2. Which of the following refers to the first time a variable is bound to a value?

- ○ Assignment
- [✓ Initialization]
- ○ Relative Reassignment
- ○ Declaration

1.3. Which side of the following statement should be evaluated first?

```
x = y
```

- ○ x (left-hand side)
- [✓ y (right-hand side)]

1.4. The following two statements are equivalent to one another and interchangeable:

```
x = y
y = x
```

- [✓ `False`]
- ○ `True`

1.5. The following statement increments x's value by 1.

```
x + 1 = x
```

- [✓ `False`]
- ○ `True`

1.6. The following statement increments x's value by 1.

```
x += 1
```

relative reassignment operator

- ○ `False`
- [✓ `True`]

1.7. The following statement increments x's value by 1.

```
x = x + 1
```

- ○ `False`
- [✓ `True`]

1.8. When accessing an index of a list that does not exist, what kind of error is encountered?

```
nums: list[int] = [1, 3, 6] ?
                   0  1  2  ↑
nums[3]
```

- ○ `NameError`
- ○ `KeyError`
- [✓ `IndexError`]
- ○ `StackOverflowError`

1.9. When *accessing* an element of a list, what kind of value most generically describes what is found inside the subscription notation's square brackets. E.g. `a_list[HERE]`

nums[1]
nums[0+1]

- ○ Integer Literal
- ○ Data Type
- [✓ Integer Expression]
- ○ Integer Variable Name

1.10. Generally, to avoid an infinite `while` loop, each iteration of the loop body should change a variable $^{\text{value}}$ involved in the `while` loop's test condition bringing it closer to `False`:

```
idx: int = 0
while idx < len(nums):
    ⋮
    idx += 1
⋮
```

- ○ False
- [✓ True]

1.11. Consider a function named `f` with a `while` loop. In the `while` loop's body, there is a `return` statement. At most, how many times will this `return` statement be evaluated in a single function call to `f`?

- [✓ 1]
- ○ As many times as the loop iterates
- ○ Infinite

1.12. Which of the following describes a test written to demonstrate an expected usage of a function?

- ○ Edge Case
- [✓ Use Case]

1.13. What is the evaluation of the following expression:

```
[10, 20, 30][~~[0, 1, 2][3 - 1]~~]
```

```
[0,1,2][3-1]
[0,1,2][2]
[10,20,30][2]
```

- ○ 10
- ○ 20
- [✓ 30]
- ○ IndexError

Question 2: Respond to the following questions

Consider the following code listing:

```
animals: list[str] = ["fox", "bear", "rabbit"]
                        0      1        2
ints: list[int] = [1, 1, 1, 1]
two_d: list[list[int]] = [[10, 20], [30, 40], [50, 60]]
                             0         1         2
```

2.1. Write an expression that evaluates to `"bear"`, making use of the `animals` variable.

animals[1]

2.2. Write a method call that adds the value `"mouse"` to the `animals` list.

animals.append("mouse")

2.3. Write a function call expression that evaluates to the quantity of values in the `animals` list.

len(animals)

2.4. Write an expression that increments the 3rd value in `ints` to be one greater than its previous value (regardless of what the previous value was).

relative reassignment operation

ints[2] = ints[2] + 1 OR ints[2] += 1

2.5. Write a sequence of 3 assignment statements that will swap the values of the 0 and 1 index in `animals`. You will need to declare and initialize a temporary variable.

```
temp: str = animals[0]
animals[0] = animals[1]
animals[1] = temp
```

["fox", "bear", ...] before

swap

['bear", "fox" ...] after

temp "fox"

2.6. Write an expression that accesses the value `40` stored in the `two_d` variable.

two_d[1][1]

2.7. Write an expression that accesses the list `[50, 60]` stored in the `two_d` variable.

two_d[2]

2.8. Write an expression that removes the item at index 1 from `animals`.

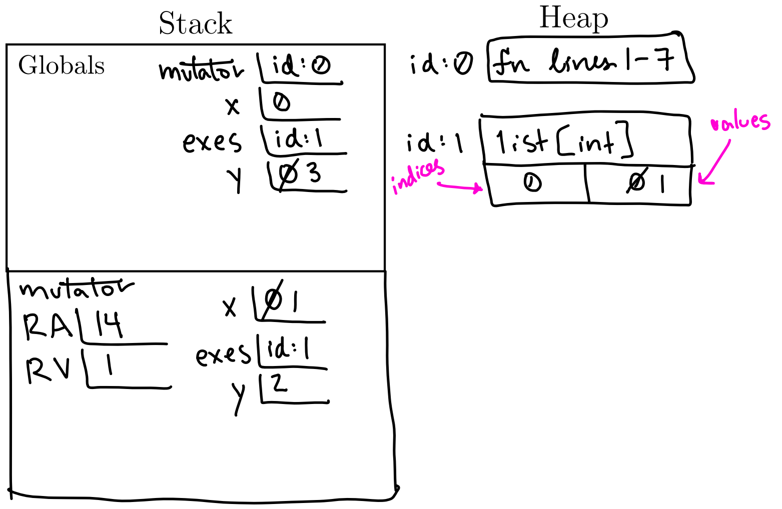
animals.pop(1)

Question 3: Memory Diagram Trace a memory diagram of the following code listing.

```
1  def mutator(x: int, exes: list[int]) -> int:
2    """An impure function..."""
3    x += 1
4    exes[0] += 1
5    y: int = x + 1
6    print(f"mutator x: {x}, exes: {exes}, y: {y}")
7    return x
8
9
10 x: int = 0
11 exes: list[int] = [0]
12 y: int = 0
13 print(f"global before x: {x}, exes: {exes}, y: {y}")
14 y = mutator(x, exes) + 2
15 print(f"global after x: {x}, exes: {exes}, y: {y}")
```

Output

```
global before x: 0, exes: [0], y: 0
mutator x: 1, exes: [1], y: 2
global after x: 0, exes: [1], y: 3
```

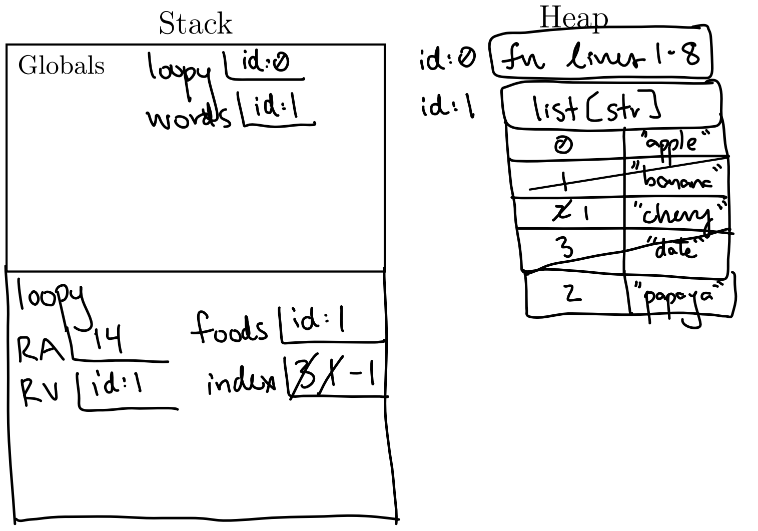


Question 4: Memory Diagram Trace a memory diagram of the following code listing.

```
1  def loopy(foods: list[str]) -> list[str]:
2    index: int = len(foods) - 1
3    while index >= 0:
4      print(foods[index])
5      foods.pop(index)
6      index -= 2
7    foods.append("papaya")
8    return foods
9
10
11 # Example usage:
12 words: list[str] = ["apple", "banana", "cherry", "date"]
13 print(words)
14 loopy(words)
15 print(words)
```

Output

```
["apple", "banana", "cherry", "date"]
date
banana
["apple", "cherry", "papaya"]
```

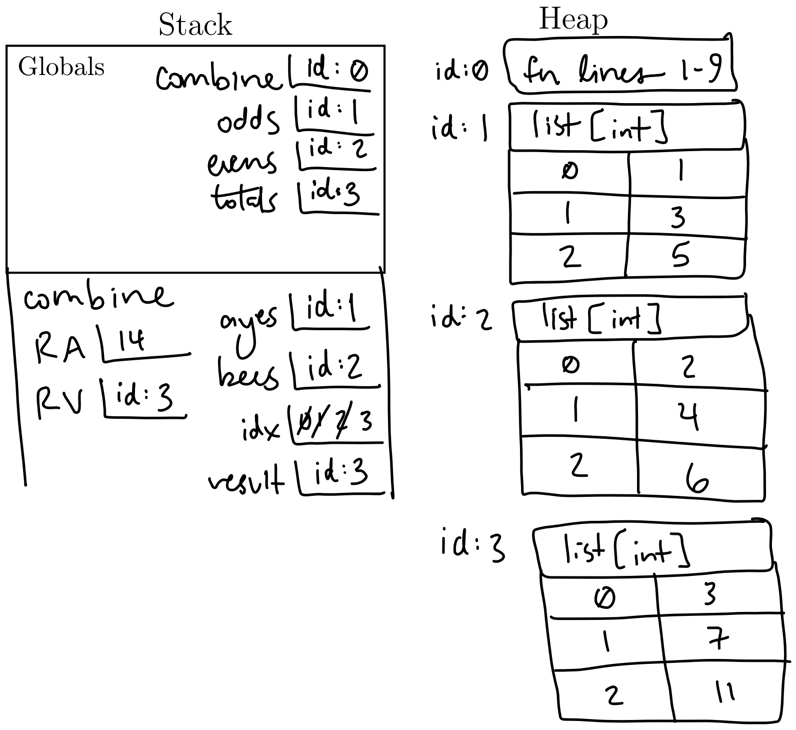


Question 5: Memory Diagram Trace a memory diagram of the following code listing.

```
1  def combine(ayes: list[int], bees: list[int]) -> list[int]:
2    """Add the items of two lists item-wise."""
3    assert len(ayes) == len(bees)
4    idx: int = 0
5    result: list[int] = []
6    while idx < len(ayes):
7      result.append(ayes[idx] + bees[idx])
8      idx += 1
9    return result
10
11
12 odds: list[int] = [1, 3, 5]
13 evens: list[int] = [2, 4, 6]
14 totals: list[int] = combine(odds, evens)
15 print(totals)
```

Output

```
[3,7,11]
```

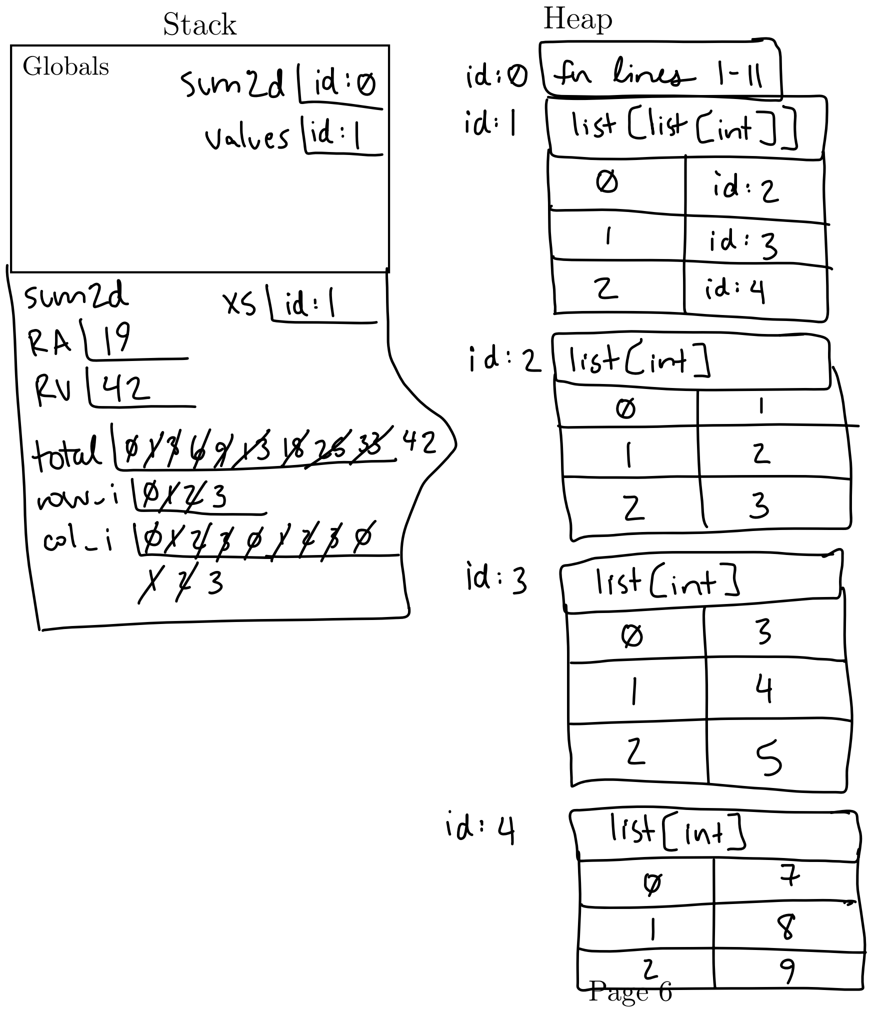


Question 6: Memory Diagram Trace a memory diagram of the following code listing and then answer the sub-questions. You do not need to diagram the sub-questions.

```
1  def sum2d(xs: list[list[int]]) -> int:
2    """Calculate the sum of a 2-dimensional list of lists."""
3    total: int = 0
4    row_i: int = 0
5    while row_i < len(xs):
6      col_i: int = 0
7      while col_i < len(xs[row_i]):
8        total += xs[row_i][col_i]
9        col_i += 1
10     row_i += 1
11   return total
12
13
14 values: list[list[int]] = [
15   [1, 2, 3],
16   [3, 4, 5],
17   [7, 8, 9]
18 ]
19 print(sum2d(values))
```

Output

42

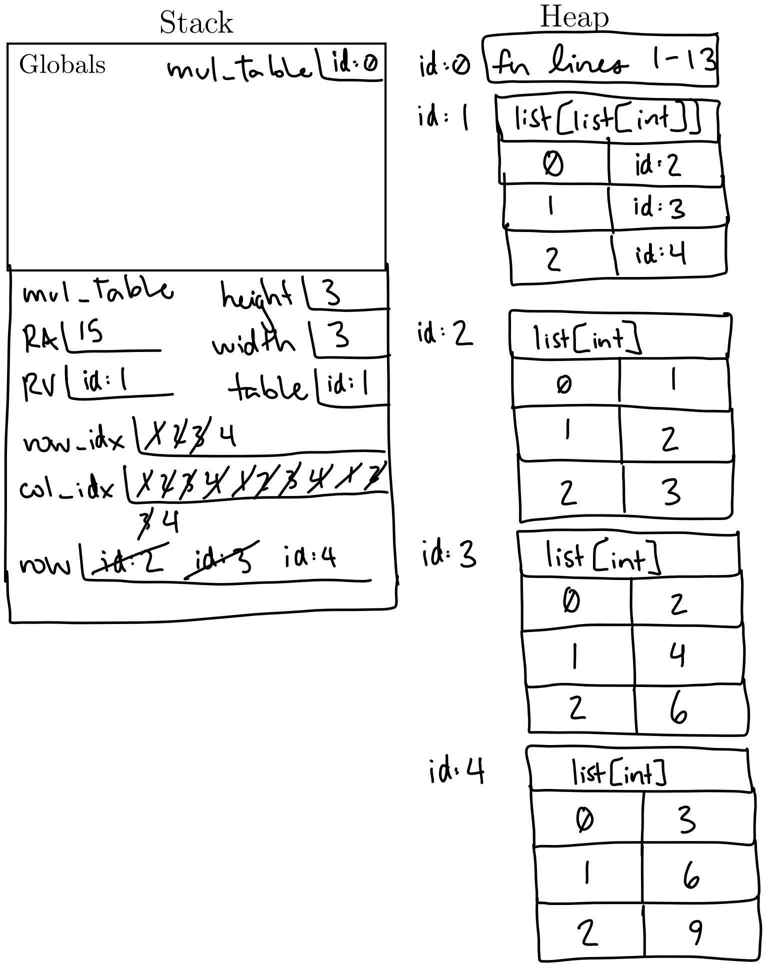


Question 7: Memory Diagram Trace a memory diagram of the following code listing.

```
1  def mul_table(height: int, width: int) -> list[list[int]]:
2    """Generate a multiplication table."""
3    table: list[list[int]] = []
4    row_idx: int = 1
5    while row_idx <= height:
6      col_idx: int = 1
7      row: list[int] = []
8      while col_idx <= width:
9        row.append(row_idx * col_idx)
10       col_idx += 1
11     table.append(row)
12     row_idx += 1
13   return table
14
15
16 print(mul_table(3, 3))
```

Output

```
[[1,2,3],[2,4,6],[3,6,9]]
```



id:1 list[list[int]]

0	id:2
1	id:3
2	id:4

id:2 list[int]

0	1
1	2
2	3

id:3 list[int]

0	2
1	4
2	6

id:4 list[int]

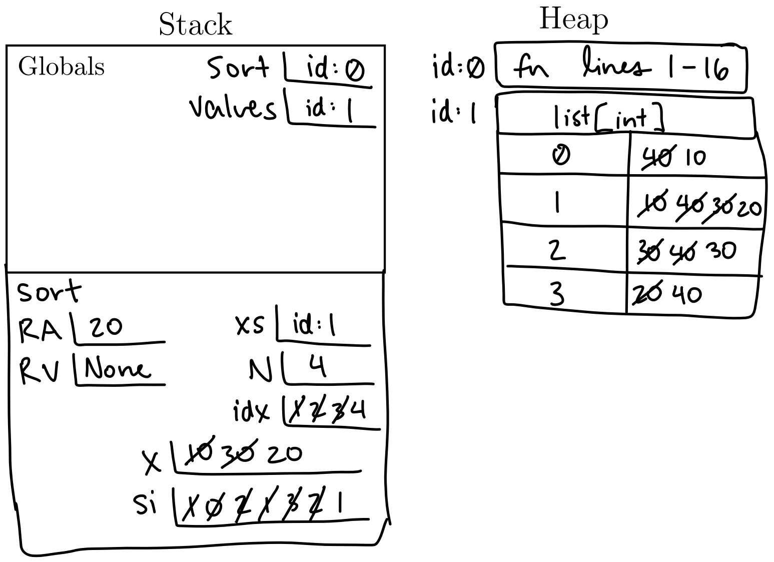
0	3
1	6
2	9

Question 8: CHALLENGE Memory Diagram Trace a memory diagram of the following code listing.

```
 1 def sort(xs: list[int]) -> None:
 2   """Sort with the insertion sort algorithm."""
 3   N: int = len(xs) # Number of items
 4   idx: int = 1 # "current index"
 5   x: int # "current value"
 6   si: int # "shift index" searching backward
 7
 8   while idx < N:
 9     print(xs)
10     x = xs[idx] # store current value
11     si = idx
12     while si > 0 and x < xs[si - 1]:
13       xs[si] = xs[si - 1] # shift greater value forward one
14       si -= 1
15     xs[si] = x # *insert* (assign) "current value" in correct position
16     idx += 1
17
18
19 values: list[int] = [40, 10, 30, 20]
20 sort(values)
21 print(values)
```

Output

```
[40, 10, 30, 20]
[10, 40, 30, 20]
[10, 30, 40, 20]
[10, 20, 30, 40]
```



Question 9: Function Writing Write a function definition for `reverse` with the following expectations:

- The `reverse` function should accept a `list[str]` parameter and return a `list[str]`.
- The returned `list` should have every item of the parameter list in reversed order, such that the first value of the returned list was the last value of the input list, the second value of the returned list was the second to last value of the input list, and so on.
- The function *must not mutate* its parameter.
- The function *must not use* the `copy`, `reverse`, or `insert` methods of `list`.
- You should explicitly type all variables, parameters, and return types.

9.1. Write your function definition for `reverse` here.

```
def reverse(xs: list[str]) -> list[str]:
    """Reverse elements of input list without mutation."""
    reversed: list[str] = []
    idx: int = len(xs) - 1
    while idx >= 0:
        reversed.append(x[idx])
        idx -= 1
    return reversed
```

9.2. Write a test function for a use case that demonstrates expected usage with at least three values in the list. (Note that there are infinite correct answers!)

```
def test_reverse_3() -> None:
    """Test reversal of three-element list."""
    assert reverse(["one", "two", "three"]) == ["three", "two", "one"]
```

Note: this test will pass if the return value of this function call (after the keyword, assert) matches the list to the right of the ==. Otherwise, the test will fail. Since this is an expected use of the reverse function, this is testing a "use case".

Question 10: CHALLENGE Function Writing Write a function definition for `flip_flop` with the following expectations:

- The `flip_flop` function should accept a `list[str]` parameter and return `None`.
- The function *must mutate* its parameter such that pairs of subsequent indices are swapped. For example, index 0's value should be swapped with index 1's value. Index 2's value should be swapped with index 3's value, and so on. If there are an odd number of indices, leave the final element in its place.
- You should explicitly type all variables, parameters, and return types.

10.1. Write your function definition for `flip_flop` here.

```
def flip_flop(strs: list[str]) -> None:
    idx: int = 1
    while idx < len(strs):
        temp: str = strs[idx]
        strs[idx] = strs[idx-1]
        strs[idx-1] = temp
        idx += 2
```

10.2. Write a test function for a use case that demonstrates expected usage with at least three values in the list. This is one solution - infinite possible tests!

```
def test_flip_flop_5() -> None:
    """Test flip_flop with 5 elements."""
    letters: list[str] = ["a", "b", "c", "d", "e"]
    flip_flop(letters)
    assert letters == ["b", "a", "d", "c", "e"]
```

Note: Reminder that, since letters and the parameter (strs) in the flip_flop function refer to the same exact list in the heap, when the elements of the strs list are reassigned, letters' elements are also being reassigned!

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