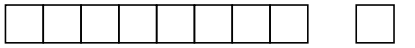
Question 1: Loops In this series of questions, you will trace code that modifies a boolean `list a`. You will respond beneath each code listing by *completely shading in the squares of items whose value is assigned* ***`True`***. If an error occurs during the evaluation of the loop, fill in the `Error` box and stop evaluating. If any item's value was assigned `True` prior to the error, keep its value shaded in.

You can assume `a` is initialized with ***`8 False`*** *elements*, as shown below, and that each question is independent of the next.

```
1 f: bool = False
2 a: list[bool] = [f, f, f, f, f, f, f, f]
```

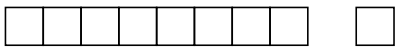
1.1. Loop 1

```
1 i: int = 0
2 while i < len(a):
3   if i % 2 == 1 and i >= 3:
4     a[i] = True
5   i += 1
```



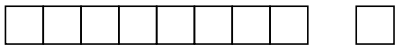
1.2. Loop 2

```
1 i: int = 1
2 while i < len(a):
3   a[i] = True
4   if i % 2 == 1:
5     i -= 1
6   else:
7     i += 2
```



1.3. Loop 3

```
1 i: int = len(a)
2 while i > 0:
3   a[i] = True
4   i -= 1
```



Question 2: Method Writing Complete the implementation of the `find` method. It should return the (row, column) of the needle parameter in the data attribute. If the needle cannot be found, return `(-1, -1)`.

```
class Table:
  width: int
  height: int
  data: list[list[int]]

  def __init__(self, width: int, height: int):
    self.width = width
    self.height = height
    self.data = []
    for _y in range(height):
      row: list[int] = []
      for _x in range(width):
        row.append(0)
      self.data.append(row)

  def find(self, needle: int) -> tuple[int, int]:
    # TODO
```

2.1. Write your function definition for `find` here.

Question 3: Identifying Elements of a Python Class Consider the following class definition.

```
1  class Pet:
2    name: str
3    age: int  # in years
4
5    def __init__(self, name: str, age: int):
6      self.name = name
7      self.age = age
8
9    def greet(self) -> str:
10     return f"{self.name} says hello"
11
12   def ages(self, n: int) -> None:
13     """Increase the pet's age by n years."""
14     self.age += n
```

3.1. On what line(s) is a *return type* declared? Write *None* if none.

3.2. List the names of the *methods* defined in class `Pet`. Write *None* if none.

3.3. On what line(s) are *arguments* found? Write *None* if none.

3.4. On what line(s) are *docstrings* found? Write *None* if none.

3.5. On what line(s) are *comments* found? Write *None* if none.

3.6. What is another name for the definition of `__init__`?

Question 4: Using a Class Continuing from the code listing above, you will make use of the `Pet` class in the following questions.

4.1. Write one line of code to declare a variable named `pup`, *explicitly* of data type `Pet`, and assign it a newly constructed `Pet` object with an initialized `name` attribute value of `"Ada"` and `age` attribute value of `2`.

4.2. Continuing from the previous sub-question, write one line of code that will cause the `pup` variable's `age` attribute to change to `3` using a *method call* on the `pup` object.

4.3. Continuing from the previous sub-question, write one line of code to declare an *explicitly typed* variable named `x`. Initialize `x` to the result of calling `greet` on `pup`.

Question 5: Identifying Elements of a Python Program Consider the following code listing:

```
1  def main() -> None:
2    """Entrypoint of program."""
3    start: int = int(input("Start: "))
4    end: int = int(input("End: "))
5    result: int = mystery(start, end)
6    print(f"Result: {result}")
7
8
9  def mystery(i: int, n: int, x: int = 0) -> int:
10   if i >= n:
11     return x + i
12   else:
13     return mystery(i + 1, n, x + i)
14
15 if __name__ == "__main__":
16   main()
```

5.1. On what line(s) is a *base case* declared? Write *None* if none.

5.2. On what line(s) is a *recursive case* declared? Write *None* if none.

5.3. Ignoring function calls to *built-in functions*, what 2 line(s) contain *function calls with arguments*?

5.4. On what line(s) are *default parameter(s)* found? Write *None* if none.

Question 6: Evaluating Functions These questions continue from the code listing above.

6.1. What value returns from `mystery(6, 6, 9)`? Write `Error` if an error occurs.

6.2. What value returns from `mystery(5, 6, 4)`? Write `Error` if an error occurs.

6.3. What value returns from `mystery(4, 6)`? Write `Error` if an error occurs.

6.4. What value returns from `mystery(1, 3)`? Write `Error` if an error occurs.

Question 7: Memory Diagram Trace a memory diagram of the following code listing. For the purposes of diagramming, you can ignore the imports, and use short-hand frames for $_{init}$.

```
1  from typing import Self
2
3  class Vec2D:
4    x: float
5    y: float
6
7    def __init__(self, x: float, y: float):
8      self.x = x
9      self.y = y
10
11   def scale(self, factor: float) -> None:
12     self.x *= factor
13     self.y *= factor
14
15   def add(self, other: Self) -> Self:
16     return Vec2D(self.x + other.x, self.y + other.y)
17
18 a: Vec2D = Vec2D(1.0, 2.0)
19 b: Vec2D = a.add(a)
20 a.scale(3.0)
21 print(f"a:({a.x}, {a.y}) - b:({b.x}, {b.y})")
```