

## 3.2P: Answer Sheet

Recall task 2.2P *Counter Class* and answer the following questions.

1. How many *Counter* objects were created?

2. Variables declared without the ***new*** keyword are different to the objects created using ***new***. In the ***Main*** function, what is the relationship between the variables initialized with and without the ***new*** keyword?

3. In the ***Main*** function, explain why the statement ***myCounters[2].Reset()***; also changes the value of ***myCounters[0]***.

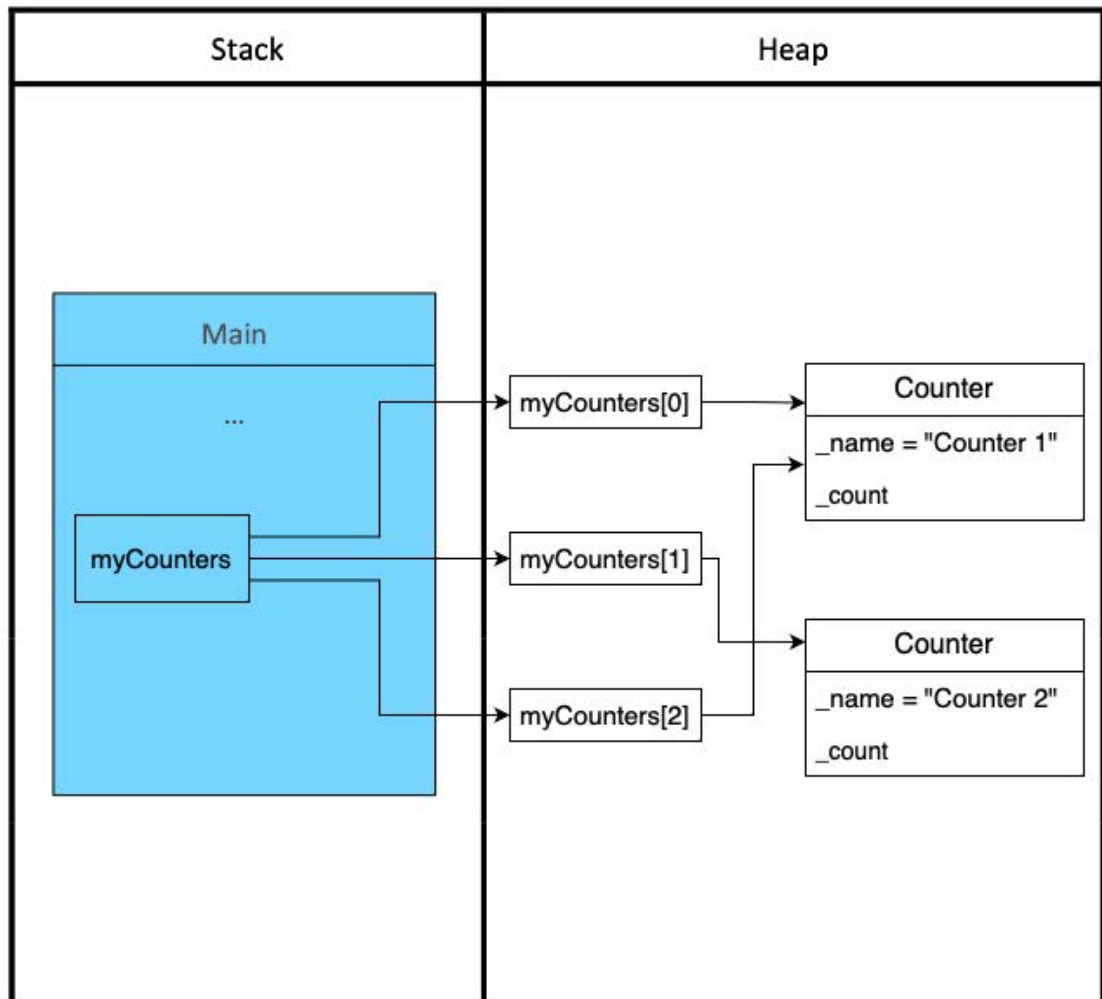
4. The difference between *heap* and *stack* is that heap holds “*dynamically allocated memory*.” What does this mean? In your answer, focus on the size and lifetime of the allocations.

5. Are objects allocated on the heap or on the stack? What about local variables?

6. What is the meaning of the expression ***new*** *ClassName*(), where *ClassName* refers a class in your application? What is the value of this expression?

7. Consider the statement “*Counter* ***myCounter***;”. What is the value of ***myCounter*** after this statement? Why?

8. Based on the code you wrote in task 2.2P *Counter Class*, draw a diagram showing the locations of the variables and objects in function **Main** and their relationships to one another.



9. If the variable **myCounters** is assigned to null, then you want to change the value of **myCounters[X]**, where X is the last digit of your student ID, what will happen? Please provide your observation with screenshots and explanation.

When I assign null to **myCounters**, it no longer references a valid array, and the previously referenced array becomes eligible for garbage collection. Attempting to access or modify **myCounters** will throw a `NullReferenceException` because I'm trying to use a null reference as if it were a valid object.

```
(base) minh6559@MacBook-Air-cua-minhan6559 Memory % dotnet run
Counter 1 is 0
Counter 2 is 0
Counter 3 is 0
Counter 4 is 0
Counter 5 is 0
Unhandled exception. System.NullReferenceException: Object reference not set to an instance of an object.
   at CounterTask.Program.Main(String[] args) in /Users/minhan6559/Desktop/COS20007-00P/Week 3/3.2/Memory/Program.cs:line 26
```

## Screenshot of the Main function and the output:

```
C# Program.cs 2, U × C# Counter.cs U
Week 3 > 3.2 > Memory > C# Program.cs > Program > Main
4      internal class Program
12      {
13
14      0 references
14      static void Main(string[] args)
15      {
16          Counter[] myCounters = new Counter[5];
17          myCounters[0] = new Counter("Counter 1");
18          myCounters[1] = new Counter("Counter 2");
19          myCounters[2] = new Counter("Counter 3");
20          myCounters[3] = new Counter("Counter 4");
21          myCounters[4] = new Counter("Counter 5");
22
23          PrintCounters(myCounters);
24
25          myCounters = null;
26          myCounters[4].Name = "Minh An Nguyen - 104844794";
27
28          PrintCounters(myCounters);
29      }
30  }
31  }
```

PROBLEMS 2 OUTPUT DEBUG CONSOLE TERMINAL COMMENTS

```
(base) minhan6559@MacBook-Air-cua-minhan6559 Memory % dotnet run
Counter 1 is 0
Counter 2 is 0
Counter 3 is 0
Counter 4 is 0
Counter 5 is 0
Unhandled exception. System.NullReferenceException: Object reference not set to an instance of an object.
   at CounterTask.Program.Main(String[] args) in /Users/minhan6559/Desktop/COS20007-00P/Week 3/3.2/Memory/Program.cs:line 26
```