Activity #9: Nested Loops
Recorder's Report

Manager: Reader:

Recorder: Driver:

Date: Score: Satisfactory / Not Satisfactory

Record your team's answers to the key questions (marked with ) below.

a) Model 1, Question #5

b) Model 2, Question #8 (describe your solution)

c) Model 3, Question #13 (write out your code)

Activity #9: Nested Loops

In this course, you will work in teams of 3–4 students to learn new concepts. This activity will introduce you to nested loops in C++.

Content Learning Objectives

After completing this activity, students should be able to:

- Read and write nested `for` loops.
- Identify inner and outer loops.

Process Skill Goals

During the activity, students should make progress toward:

- Write code that uses nested `for` loops.

Model 1 A C++ Program

```
1  #include <iostream>
2  #include <string>
3
4  using namespace std;
5
6  int main() {
7    string name;
8    cout << "What is your name? ";
9    cin >> name;
10   for (int i=0; i<5; i++) {
11     for (int j=0; j<3; j++) {
12       cout << name << " ";
13     }
14     cout << endl;
15   }
16 }
17
```

Refer to Model 1 above as your team develops consensus answers to the questions below.

Questions (15 min) Start time:

1. What does this program display? Try to determine this without running it first, then check your work against the output of the program in `activity09a.cpp`.

2. Answer the following questions regarding the `for` loops in this code snippet.

a) How many `for` loops are in this code?:

b) Does one loop completely finish before the next begins?

c) What do you call this arrangement of loops?

3. How many times does each `cout` statement in this model execute?

a) The `cout` on line 8 of the model:

b) The `cout` on line 12 of the model:

c) The `cout` on line 14 of the model:

4. A loop that appears within another loop is called a *nested loop*. We can refer to the two loops as the *outer loop* and the *inner loop*.

a) On what line number in the model does the outer loop start?

b) On what line number in the model does the inner loop start?

c) On what line number does the inner loop in the model end?

d) On what line number does the outer loop in the model end?

5. What does each of the loops in the model do?

a) What does the inner loop do?

b) What does the outer loop do?

Model 2 Output from Several Nested Loops

```
* * * * *
* * * * *
* * * * *
* * * * *
* * * * *
* * * * *
* * * * *
```

(a)

```
1 1 1 1 1
2 2 2 2 2
3 3 3 3 3
4 4 4 4 4
5 5 5 5 5
6 6 6 6 6
7 7 7 7 7
```

(b)

```
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
```

(c)

Refer to Model 2 above as your team develops consensus answers to the questions below.

Questions (20 min) Start time:

6. There are several ways to write a C++ program that outputs the contents of box (a) above. Briefly describe how it could be done using the following methods.

a) Using a set of `cout` statements without any loops.

b) Using a single `for` loop (without any nesting).

7. In this exercise we will create the output in box (a) using nested loops.

a) Surround the `cout` statement below by a `for` so that five `*` characters are printed on a single line.

```
cout << "* ";
```

b) Now build on the block of code above by wrapping the loop you created in another `for` loop that prints seven of these lines, with an `endl` between each one.

8. Suppose that variables `int rows` and `int cols` contain the number of rows and columns of `*`'s you wish to print. How would you modify your code above to print out that number of rows and columns? Test your solution in `activity09b.cpp`.

9. How would you modify your code in the previous question to produce the output seen in box (b), assuming that `int rows = 7` and `int cols = 4`?

10. How would you modify your code so that the output matches the output in box (c) instead of (b)?

Model 3 More Nested Loop Output

```
1
1 2
1 2 3
1 2 3 4
1 2 3 4 5
```

(a)

```
1 2 3 4 5
1 2 3 4
1 2 3
1 2
1
```

(b)

```
1
1 2
1 2 3
1 2
1
```

(c)

Refer to Model 3 above as your team develops consensus answers to the questions below.

Questions (15 min) Start time:

11. How are the output samples in this model different from those in model 2? Note: Write a single general statement that summarizes the difference for all output boxes.

12. The code below will produce one of these three outputs. Determine which one and justify your answer.

```
int numRows = 5;
for (int j=numRows; j>0; j--) {
  for (int i=1; i<=j; i++) {
    cout << i << " ";
  }
  cout << endl;
}
```

13. The code from the previous problem is in `activity09c.cpp`. Rewrite it so that it produces the output in the other of box (a) or (b).

14. Add some initialization code that prompts the user to enter the number of rows in the triangle that your program creates. Test your solution to verify that it works.

15. Use nested `for` loops to produce the output in box (c) above.

16. Write a program that prompts the user for information on three students. For each student, collect the student name and three quiz grades. Then display the name and quiz average (formatted to two decimal places). Sample output is shown below.

```
Enter name of student 1: Mary
Enter score 1: 78
Enter score 2: 90
Enter score 3: 91
Name: Mary
Average: 86.33

Enter name of student 2: Kevin
Enter score 1: 90
Enter score 2: 77
Enter score 3: 85
Name: Kevin
Average: 84.00

Enter name of student 3: Jose
Enter score 1: 79
Enter score 2: 83
Enter score 3: 92
Name: Jose
Average: 84.67
```