Computer Science & Engineering Department
I. I. T. Kharagpur

Principles of Programming Languages: CS40032

Elective

Assignment – 4: Lambda and Functors in C++ *Marks: 25*

Assign Date: *17 March, 2022* Submit Date: *23:55, 24 March, 2022*

---

1. Answer the following questions: **[9]**

   (a) What is lambda expression in C++? **[1]**
      i. A technique of C++ that allows us to write inline functions without a name
      ii. A technique of C++ that allows us to write overloaded functions
      iii. A technique of C++ that allows us to write functions that are called more than once
      iv. A technique of C++ that allows us to write functions without parameters

   (b) What is the correct statement about lambda expression? **[1]**
      i. The return type of lambda expression can be neglected in some cases
      ii. return type of lambda expression must be specified in all cases
      iii. Lambda expression should be very large functions
      iv. Lambda expression is also available in C

   (c) In how many ways we can capture the external variables in the lambda expression? **[1]**
      i. 1
      ii. 2
      iii. 3
      iv. 4

   (d) Write a program that defines a vector of integers. **[2]**
   Sort the vector in a descending order using the std::sort function, and a user-provided lambda function as a predicate.

   (e) Write a program that defines a vector of integers. **[2]**
   Use the std::count_if function and a user-provided lambda function to count only even numbers.

   (f) Write a program that defines a local lambda expression that can capture and modify the variable defined inside the main() function: **[2]**

2. Write a C++ code to implement the 'Towers of Hanoi' problem using: **[4 * 2 = 8]**

   (a) Functors

   (b) Lambda Expressions

   The Problem Statement:
   Tower of Hanoi is a mathematical puzzle where we have three rods and n disks. The objective of the puzzle is to move the entire stack to another rod, obeying the following simple rules:
      i. Only one disk can be moved at a time.
      ii. Each move consists of taking the upper disk from one of the stacks and placing it on top of another stack i.e. a disk can only be moved if it is the uppermost disk on a stack.

iii. No disk may be placed on top of a smaller disk.

3. Write a C++ code to print all permutations of a given string using **[4 * 2 = 8]**

   (a) Functors

   (b) Lambda Expressions

   You can print the permutations in any order and no character will be repeated in input string.
   Example: - For string ABC permutations will be:
   ABC
   ACB
   BAC
   BCA
   CAB
   CBA