Object Oriented Programming (MA-5741)

Midsemester Examination

22 September, 2024

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- The question paper has five questions, totalling to 30 marks and all are to be answered.
- Answer to any question should be completed before another is started. No question should be answered partially in two or more places.

Q.1 Are the following two statements equivalent?
for (sum = 0, i = 0; i < 100; sum += i, i++);
for (sum = 0, i = 0; i < 100; i++, sum += i);
Explain.
(4 Marks)</pre>

- Q. 2 Write a function to print out a decimal integer v in base b having the prototype: void print(int v, int b = 10); What is the significance of "b = 10" in the above expression, explain. (4 Marks)
- **Q.3** Write a programme that computes the number of (decimal) digits of a given integer n, e.g. when n = 145, the number of digits of n is 3. (6 Marks)
- Q.4 Design a class called safe_array. The safe_array should,
 - take the number of elements the array should have.
 - The array should allocate memory dynamically.
 - There should be a way to access its elements.
 - It should throw error if non-existent elements of the array are tried to be accessed.

Write a program that asks for the number of elements in an array and then fills them in.

(4 Marks)

Q.5 A numerical quadrature has the general form:

$$\int_{a}^{b} f(x)dx = \sum_{i=0}^{n-1} w_i f(x_i)$$

where x_i are called quadrature points and w_i are called weights. In a Gauss quadrature, x_i and w_i are chosen such that the quadrature is exact if f(x) is a polynomial of degree k, for

k as big as possible. Such x_i are called Gauss points and such k is called the degree of exactness. It can be shown that the degree of exactness of a Gauss quadrature is 2n - 1, where n is the number of Gauss points. An example of a Gauss quadrature is:

$$\int_{-1}^{1} f(x)dx = \frac{8}{9}f(0) + \frac{5}{9}f\left(-\sqrt{\frac{3}{5}}\right) + \frac{5}{9}f\left(\sqrt{\frac{3}{5}}\right).$$

- Write a C++ code which implements this Gauss quadrature as a class with Gauss points and weights as private members. (6 Marks)
- Write a main function to check that this quadrature is exact when the integrand f(x) is a polynomial of degree less than or equal to 5. (6 Marks)