Midterm Exam

Introduction to Scientific Computing with C++

Name: **30 June 2011**

- *Answer TEN of the following ELEVEN Questions. Cross out the number of the question you wish to omit.*
- *During this exam, you are allowed to refer to notes you have made, on two sheets of paper. No other references are allowed.*
- *I am not asking you to write complete C++ programs! However, when you write your C++ statements, you should include the necessary declarations and initializations.*
- *If I ask you to write a C++ function, I want a complete function, including the function header, curly brackets, and returned value.*

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1. Write a **for** loop which prints the integers from 100 down to 0 by fives; that is, the first three lines should be 100, 95, 90...

2. A user is going to input several integers to a program, terminating with an extra, dummy value of 999. Write C++ code which reads the user's data and computes the sum, while ignoring the final 999 value.

3. A cab company charges $2.50 on entry into the cab, an additional $1.75 per mile for each of the first 10 miles, and an additional $1.00 per mile for each mile traveled beyond 10 miles. If the **int** variable **miles** contains the miles traveled, display the C++ statements necessary to compute **bill**, the amount of money owed.

4. Write C++ code that will find and print the first integer which is greater than 1000, is divisible by 347, and is not divisible by 7.

5. The array **a** has dimension 100. Write C++ code that will print the array using 25 lines of output, with each line containing four entries of the array.

6. Suppose the function **rand_float()** has returned a random number **r** between 0 and 1. Write a one-line C++ formula that converts **r** to a random number **s** between the values **a** and **b**.

7. Suppose the variable **c** has been declared as **double c[100]**, and that values have been assigned to each entry, and that many, but not all, values are zero. Write C++ code that will find and print the largest index **i** such that **c[i]** is not zero.

8. Write a C++ function called **summer()** that accepts a **float** array **d** and an integer **n**, the dimension of the array, and which returns the number of negative entries in **d**.

9. A sequence starts with $x_0 = 0.5$, and subsequent entries are determined by:

$$x_{n+1} = 0.7 * x_n * (1 - x_n);$$

Write a C++ loop that computes the value of the 1,000,000th entry, but which uses as little memory as possible. In other words, do not use an array to store the entries of **x**!

10. The factorial function n! is defined by

$$n! \equiv n \cdot n - 1 \cdot ... \cdot 3 \cdot 2 \cdot 1$$

and 0! is defined to be 1. Write a C++ function called **fact()** whose input is a nonnegative integer **n** and which returns the value of **n!**.

11. Write C++ statements to estimate the integral of $f(x) = x^2 + \sin(x)$ over the interval [0,1], using 10,000 function evaluations. You may assume that there is a function available, called **random_double()**, which will return random **double** values in the interval [0,1].