PY2105 Introduction to Computational Physics

Autumn 2019

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Problem Set 2

2.1 Draw a flow diagram and also write the corresponding C/C++ program fulfilling the following task: First, the user enters an integer number until the user has entered a number between 1 and 99. Then, the program prints this number on the screen.

2.2 Draw a flow diagram and also write a C/C++ program fulfilling the following task: First, a 10-component double vector is entered by the user and stored in a numerical array. Then, the program prints the greatest component of this vector. Use a numerical array!

2.3 Write a C/C++ program fulfilling the following task: Two 3-dimensional double vectors $\vec{v}_1, \vec{v}_2$ are entered by the user and stored in two numerical arrays. Then, the programme calculates the usual scalar product $\vec{v}_1 \cdot \vec{v}_2$ between them and prints the result. Use numerical arrays! (A flow diagram is not required.)

2.4 Free fall (one dimensional setting, neglecting air resistance): Write a C/C++ program which first allows the user to enter the values of v_0, x_0, t_f and the number of plot points N. Then, the program should plot the trajectory of a freely falling particle, namely $x(t) = \frac{1}{2}gt^2 + v_0 t + x_0$ for $0 \leq t \leq t_f$ (use $g = 9.81 m/s^2$). Moreover, the program should also plot the time-dependence of the velocity $v(t) = gt + v_0$. (A flow diagram is not required.)

2.5 Derive the Taylor series of the following functions at $x_0 = 0$ up to 2nd order in x:
(1) $\exp[a \sin(bx)]$
(2) $a\sqrt{\cos(bx)}$
where a, b are constants.
Reminder: The Taylor series of a function $f(x)$ at x_0 is given by $f(x) = \sum_{j=0}^{\infty} \frac{1}{j!} \frac{d^j f(x_0)}{dx^j} (x - x_0)^j$

The hand-written parts should be put in the post box of A. Kiely (across the hall from Kane 201). Submit the programs and results to "Canvas" using the following name convention:
Surname_Firstname_2_1.cxx
Surname_Firstname_2_2.cxx
Surname_Firstname_2_3.cxx
Surname_Firstname_2_4.cxx

The deadline is

Tuesday, 1st October, 18:00