Assignment-2

PHY617/PHY473-Computational Physics

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Explain the algorithm you are using for each question. Use 'if'/'if-else'/'while'/'for' as required.

Question 1. In mathematics the Fibonacci series or Fibonacci sequence are the numbers in the following integer sequence 0,1,1,2,3,5... By definition, the first two numbers in the Fibonacci sequence are 0 and 1, and each subsequent number is the sum of the previous two. In mathematical terms, the sequence F_n of Fibonacci numbers is defined by the recurrence relation:

$$F_n = F_{n-1} + F_{n-2}$$

Take n as input. Compute and print the ratio $\frac{F_n}{F_{n-1}}$ rounded off up to 2 decimal places.
Note: If n is large, this ratio tends to a fixed ratio. It is known as the golden mean.

[**Marks: 10**]

Question 2.. Write a python program to check if three points are collinear. [**Marks: 5**]

Question 3. Write a python program that returns x_n using $x_{n+1} = f(x_n)$, where $f(x) = ax(1-x)$. The the values of a and x_0 as an input from the keyboard. First line contains the value of N and second and third lines contain the value of a and x_0 respectively. The input value of a and x_0 should be float input. Round the answer upto three decimal places using np.round(x,3) function of python. [**Marks: 5**]

Question 4. Using python programming find and print the variance (up to two decimal places) of the elements of a numpy array of length N (take the array of numbers from 1 to 100). Take the inputs in N+1 lines, where the first line is the value of N which is an integer then take N elements of the array in the next N lines. Variance is defined as $\sigma^2 =< x^2 > - < x >^2$, where, $< x^2 >$ is average of the square of the elements of the array and $< x >$ is the average of the elements. [**Marks:10**]

Question 5. [**Marks:10**] As an egg cooks, the proteins first denature and then coagulate. When the temperature exceeds a critical point, reactions begin and proceed faster as the temperature increases. In the egg white, the proteins start to coagulate for temperatures above 63 C, while in the yolk the proteins start to coagulate for temperatures above 70 C. For a soft boiled egg, the white needs to have been heated long enough to coagulate at a temperature above 63 C, but the yolk should not be heated above 70 C. For a hard boiled egg, the center of the yolk should be allowed to reach 70 C.

The following formula expresses the time t it takes (in seconds) for the center of the yolk to reach the temperature T_y (in Celsius degrees):

$$t = \frac{M^{2/3} c \rho^{1/3}}{K \pi^2 (4\pi/3)^{2/3}} ln \left[0.76 \frac{T_o - T_w}{T_y - T_w} \right]$$

Here, M, ρ, c, and K are properties of the egg: M is the mass, ρ is the density, c is the specific heat capacity, and K is thermal conductivity. Relevant values are M =47g for a small egg and M =67g for a large egg, $\rho = 1.038\ g\ cm^{-3}$, $c = 3.7J\ g^{-1}\ K^{-1}$ and $K = 5.4 \times 10^{-3}\ W\ cm^{-1}K^{-1}$. Furthermore, T_w is the temperature (in C degrees) of the boiling water, and T_o is the original temperature (in C degrees) of the egg before being put in the water. Implement the formula in a program, set $T_w = 100$ C and $T_y = 70$ C, and compute t for a large egg taken from the fridge ($T_o = 4$ C) and from room temperature ($T_o = 20$ C).