2108-511 Numerical Techniques in Geomatics
Assignment#3

1. The value of pi can be estimated with the series

$$pi \approx \sum_{k=0}^{\infty} 4\left(\frac{-1^k}{2k+1}\right)$$

Assume that the value of pi provided by Matlab/Octave **pi** is correct, if the required accuracy of the estimation is 1.0×10^{-7}, what is the value of **k**?

2. Another series that can estimate the value of pi is

$$pi \approx 3 + \frac{4}{2\times3\times4} - \frac{4}{4\times5\times6} + \frac{4}{6\times7\times8} - \frac{4}{8\times9\times10} + \ldots..$$

How many terms are required to get the value of pi having error less than 1.0×10^{-7}, assuming that Matlab's **pi** value is correct.

3. The Fibonacci sequence is a sequence whose first two members are 0 and 1. From the 3rd member on, the value of each member is the sum of the previous two members. For examle, the 7th member of the Fibonacci sequence is 8 and the first ten members of the sequence are

0, 1, 1, 2, 3, 5, 8, 13, 21, 34

a) What is the value of the 17622th member of Fibonacci sequence
b) If ***r*** is the ratio of a member in Fibonacci sequence and the previous one (***r*** = f_n/f_{n-1}, n = 3, 4, 5, … where f_n is the nth member of the sequence), what is the value that ***r*** converges to?

4. A formula to approximate the value of Euler's number ***e*** (2.71828….) is

$$e \approx \left(1 + \frac{1}{n}\right)^n$$ where ***n*** is a positive integer.

Assume that the value of ***e*** from Matlab (result of **exp(1)**) is correct and we want the error to be less than one billionth (1.0e-9) from the above formula, what is the smallest value of ***n***?

5. A research on a certain species of mosquito reports that they live for at most 3 weeks. The research divides the female mosquitoes into three age classes: **larva** (0-1 week), **young** (1-2 weeks), and **adult** (2-3 weeks). The research finds that each young female mosquito produces an average of 4 female larvae, and each adult produces an average of three 3 larvae. (The larvae do not lay eggs!)

The survival rate for female larvae is 50% (this is the probability of a larva that grows to become a young mosquito). The survival rate of young female mosquitoes is 25%.

Suppose at the beginning of the rainy season, an area in Bangkok has a population of 100 female mosquitoes: 40 larvae, 40 youngs and 20 adults. Use the research finding to predict:

a the number of female mosquitoes in each age class after 12 weeks
larvae:……. young: ……... adult: ……

b how many weeks would the number of female mosquitoes be greater than 1,000,000? …… weeks

Hint: Google 'Leslie matrix' to get an understanding about how to model population growth.