Scientific Programming

Homework 3: Due 9/21

Practice problems (not to be turned in) The answers are at the end of the assignment.

1. The Taylor series expansion for $\cos(x)$ is:

$$\cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \cdots = \sum_{n=1}^{\infty} \frac{(-1)^n}{(2n!)} x^{2n}$$

   where x is measured in radians. Write a loop that uses the first 6 terms of the series (up to $n = 5$) to estimate $\cos(\pi/3)$ and $\cos(1)$.

2. Use loops to create a 3×5 matrix where each entry is equal to the difference of its row and column indicies divided by the sum of its indicies. For example, the value of element (2,5) is $(2-5)/(2+5) = -0.4286$.

Homework problems Do not just turn in the answers to the following problems, show the exact Matlab commands you used to find the answer.

1. Write a program using a loop that calculates the sum

$$\sqrt{\left(12 \sum_{i=1}^{n} \frac{(-1)^i}{i^2}\right)}$$

   Run the program with $n = 10$, $n = 1,000$ and $n = 100,000$.

2. Write a program that will create an $n \times (2n)$ matrix where the value of each entry is the sum of its row and column indicies. For example, the value of the element in the 6th column of the 3rd row is $6 + 3 = 9$.

3. The number e can be estimated by the formula

$$e \approx \sum_{i=0}^{n} \frac{1}{i!}$$

   Create an array `sums` that has 10 elements. The k-th entry in the array should be the approximation above with $n = k$. For example, the 3rd entry should be equal to $\sum_{i=0}^{3} \frac{1}{i!}$.

Answers to practice problems

1. 0.499999996390943 and 0.540302303791887

2. $m = \begin{bmatrix} 0 & -0.3333 & -0.5000 & -0.6000 & -0.6667 \\ 0.3333 & 0 & -0.2000 & -0.3333 & -0.4286 \\ 0.5000 & 0.2000 & 0 & -0.1429 & -0.2500 \end{bmatrix}$