HOMEWORK #1: INTRODUCTION TO MATLAB

Due: midnight on September 28

Instructions:

- The assignment consists of *four* questions worth, respectively, 3, 3, 3, and 1 point.
- Submit your assignment *electronically* to the Email address specific to your last name as indicated on the course website; the file containing your assignment must be named `Name_0XXXXXX_hwN.m`, where "`Name`" is your last name, "`XXXXXX`" is your student ID number, and "`N`" is the consecutive number of the assignment; hardcopy submissions will not be accepted.
- It is obligatory to use the MATLAB template file available at `http://www.math.mcmaster.ca/bprotas/public_html/MATH2Z03a/template.m`; submissions non compliant with this template will not be accepted.
- Make sure to enter your name and student I.D. number in the appropriate section of the template.
- Late submissions and submissions which do not comply with these guidelines will not be accepted.
- All graphs should contain suitable titles and legends.
- Reference: "**Numerical Mathematics**" by M. Grasselli and D. Pelinovsky (Jones and Bartlett, 2008), sections 1.1–1.6.

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1. You are given the matrix

$$\mathbf{A} = \begin{bmatrix} 2 & 3 & 2 \\ 7 & 1 & -7 \\ 3 & 8 & 4 \end{bmatrix}$$

and the vector $\mathbf{B} = [16 \quad 14 \quad 27]^T$. Compute the column vector $\mathbf{X} = [x_1 \quad x_2 \quad x_3]^T$ as the solution of the equation $\mathbf{AX} = \mathbf{B}$ using *Cramer's Rule*

$$x_i = \frac{\det(\mathbf{A}_i)}{\det(\mathbf{A})}, \quad i = 1, 2, 3,$$

where $\mathbf{A}_i$ is the matrix formed by replacing the ith column of $\mathbf{A}$ with the column vector $\mathbf{B}$, and save the result in the variable `Answer1`. Compute also the vector $\mathbf{X} = \mathbf{A}^{-1}\mathbf{B}$ using the backslash operator and save the result in the variable `Answer2`.
(**Hint:** Use MATLAB function `det` as well as colon operator).

2. Consider the numerical series $S = \sum_{n=1}^{\infty} a_n$, where

$$a_n = \frac{2n+1}{\sqrt{n\,2^n}}.$$

Find the number of terms N in the partial sum $S_N = \sum_{n=1}^{N} a_n$ satisfying the condition

$$\frac{|S_{N-1} - S_N|}{S_{N-1}} \leq \varepsilon, \tag{1}$$

where ε is the tolerance. Take $\varepsilon = 0.001$ and save the result N in the variable `Answer3`.
(**Hint:** Use the loop construction `while ... end` to check condition (1) and to compute the sum S_N).

3. Let the curve be given in the Cartesian coordinates by $(x^2+y^2)^3 = a^2(x^2-y^2)$. Convert this equation to the polar coordinates using the representation

$$\begin{cases} x = r\ \cos(t), \\ y = r\ \sin(t). \end{cases}$$

   Assume $a = 2$ and use the command `polar` to graph the curve with the step size $\Delta t = \pi/100$ in the polar representation for $t \in [0, 2\pi]$. The graph should appear as `Figure 1`.

4. Use the MATLAB command `surf` to graph the surface $z = \sin(x^2+y^2)$ for $-3 \leq x \leq 3$ and $-3 \leq y \leq 3$ with the step sizes $\Delta x = \Delta y = 0.1$. The graph should appear as `Figure 2`.