# HOMEWORK #2

Due: February 12 (Tuesday) by midnight

**Instructions:**

- The assignment consists of *three* questions, worth 3, 4, and 3 points.
- Submit your assignment *electronically* (via Email) to the address `math2t03@math.mcmaster.ca`; hardcopy submissions will not be accepted.
- It is obligatory to use the MATLAB template file available at `http://www.math.mcmaster.ca/~bprotas/MATH2T03/template.m` (see also the link in the "Computer Programs" section of the course website on the left); 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.

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1. You are given the following four vectors:

$$\mathbf{v}_1 = [3\ \ 5\ \ 6\ \ 1]^T,$$
$$\mathbf{v}_2 = [1\ \ 0\ \ 1\ \ 1]^T,$$
$$\mathbf{v}_3 = [0\ \ 2\ \ -1\ \ 1]^T,$$
$$\mathbf{v}_4 = [2\ \ 9\ \ 3\ \ 2]^T.$$

   Write a MATLAB code that will:

   (a) check if these vectors are linearly independent,
   (b) construct and print out a basis for span$\{\mathbf{v}_1,\ldots,\mathbf{v}_4\}$; the basis should be *minimal*, i.e., it should consist of as few elements as possible.

   *[3 points]*

2. You are given the matrix

$$\mathbb{B} = \begin{bmatrix} 2 & -2 \\ -1 & 1 \end{bmatrix}$$

   Write a MATLAB code that will:

   (a) visualize the subspaces null$(\mathbb{B})$ and range$(\mathbb{B})$ as lines with different colors in $\mathbb{R}^2$,
   (b) check if the subspaces null$(\mathbb{B})$ and range$(\mathbb{B})$ are orthogonal.

   *[4 points]*

3. You are given the matrix

$$\mathbb{C}(\alpha) = \begin{bmatrix} 1 & -\alpha \\ -2\alpha & 2 \end{bmatrix},$$

   where $\alpha \in \mathbb{R}$. Write a MATLAB code that will plot on a separate figures

   (a) the values $\|\mathbb{C}(\alpha)\|_1$, $\|\mathbb{C}(\alpha)\|_2$ and $\|\mathbb{C}(\alpha)\|_\infty$, and
   (b) the values $\|\mathbb{C}^{-1}(\alpha)\|_1$, $\|\mathbb{C}^{-1}(\alpha)\|_2$ and $\|\mathbb{C}^{-1}(\alpha)\|_\infty$

   corresponding to $\alpha \in [0,1)$ with the step size $\Delta\alpha = 0.05$.
   *[3 points]*