

In the following problems, you must show your work, to get a full credit.

**Problem 1** Let  $sl_2$  be the set of  $2 \times 2$  matrices with entries in  $\mathbb{R}$  such that the sum of diagonal entries is zero.

- a) Show that  $sl_2$  is a vector space.
- b) Find a basis for  $sl_2$ . You must show that your chosen vectors form a basis.
- c) What is the dimension of  $sl_2$ ?

**Problem 2** Let  $A = \begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix}$ . Find the eigenvalues of  $A$  and the associated eigenvectors.

**Problem 3** In the above  $A$ , compute  $A^{2020}$ .

Hint: You may want to use the answer of Problem 2.