Error analysis

Construct a matrix $\boldsymbol{V}$ with the following elements:

$$V_{ij} = \frac{(-1)^{i+j}}{i+2j},\ i,j = 1,\ldots,N$$

and let $\boldsymbol{r}$ be the first column vector of $\boldsymbol{V}$.
For $N = 2,\ldots,10$, compute the condition number of V and solve

$$\boldsymbol{V}\boldsymbol{x} = \boldsymbol{r}$$

using LUP-decomposition (you can use `scipy.linalg.solve` function or the LUP/foraward substitution/backward substitution function in the repository). Of course, the exact solution is $\boldsymbol{x} = \boldsymbol{e}_1$ (verify this by hand!). Compute the relative residual and error for all matrix sizes N.
Plot the relative error along with the maximal relative error (according to the upper bound in lecture 7) on a semilogarithmic scale (use `matplotlib`).
Answer the following questions:

1. What happens to the condition number for increasing N? Is that bad news or good news when we are solving linear systems?
2. What happens to the relative errors and residuals for increasing N?
3. Up to what matrix size does the numerically obtained solution make sense?