Problem 1: Consider an axial force element composed of two segments of length $L_1$ and $L_2$ such that $L_1 + L_2 = l$. The cross sectional area of each segment is $a$ and the applied axial force is $f$. If $L_1 \sim U(0, l)$, and the elastic moduli of the segments are $e_1$ and $e_2 = 2e_1$, calculate the mean, variance, and coefficient of variation of the elongation of the bar, $D$.

Problem 2: Consider the two phase heterogeneous material shown below composed of square elements with two different elastic moduli. That is $P(E_{ij} = E_1) = 0.5$ and $P(E_{ij} = E_2) = 0.5$.

Develop an approach for calculating an effective elastic modulus of this system based on the parallel and series systems we studied in class. Explain your thinking carefully. Develop a numerical example that allows you to compare your effective elastic modulus to the Voigt and Reuss bounds.

Problem 3: Consider a one-dimensional two phase material composed of discrete elements of fixed length $l$. The volume fraction is 0.5 for each phase, and the phase in each element is independent of that in other elements. Develop an exact expression or estimate by MC simulation the two point probability function for this material.