1. Determine the eigenvalues of the Jacobi iteration matrix when applied to the “diagonal” five-point scheme given by

\[
\frac{1}{h^2}(v_{m-1,l-1} + v_{m-1,l+1} + v_{m+1,l-1} + v_{m+1,l+1} - 4v_{ml}) = f_{ml}
\]
on a uniform grid with \( \Delta x = \Delta y = h \).

Hint: The eigenvectors are the same as the ones for the usual Jacobi method.

2. Using SOR(\( w \)) solve

\[ u_{xx} + u_{yy} = -2 \cos x \sin y \]
on the unit square. The boundary conditions and the exact solutions are given by \( u = \cos x \sin y \). Plot the solution.

Demonstrate that convergence takes time that is linear in \( N = 1/h \). Namely show that it takes \( O(N) \) steps for the difference between two consecutive iterates (measured in \( L^2 \) norm as \( \|e\| = (\sum_{m,l} |e_{ml}|^2 h^2)^{1/2} \)) to become (say) \( 10^{-6} \).