Worksheet 9. Sparse Matrices

We will use sparse matrices to numerically solve the one-dimensional Poisson equation.

$$\frac{\partial^2 u}{\partial x^2} = 1 \qquad 0 < x < L \tag{1}$$

$$u = 0 \qquad x = 0 \tag{2}$$

$$u = 0 \qquad x = 1 \tag{3}$$

To solve this numerically we replace the field x with the vector x_i and the field u with $u_i = u(x_i)$. The finite difference approximation to the second derivative is

$$\frac{\partial^2 u}{\partial x^2} \approx \frac{u(x-h) - 2u(x) + u(x+h)}{h^2} \tag{4}$$

- Solve the equation analytically
- Discretise the equation and solve it using a full matrix
- Construct the sparse matrix using `spdiags`
- Use the `spy` function to visualise the matrix
- How would you decide the number of points?
- Find the largest full matrix and sparse matrix matlab will allow you to construct.