**ESM 5734**

**Homework 3**

**Due date: 16 September 2022 at 11:15 AM**

For the following boundary-value problem

$$
\begin{aligned}
&-u'' + u = 2, \quad 0 < x < 1, \\
&u(0) = 3, \quad u'(1) = 2, \\
&u' = \frac{du}{dx},
\end{aligned}
$$

(a) develop a weak formulation of the problem,

(b) develop a matrix formulation of the problem,

(c) use a uniform finite element mesh of 4 elements and piece-wise linear finite element basis functions to find the element stiffness matrix and the element load vector,

(d) find the global stiffness matrix and the global load vector,

(e) find the approximate solution,

(f) compute the error $\left(e = \left(u_{app} - u_{anal}\right) / \left|u_{anal}\right|\right)$ and plot $e$ vs. $x$ for $0 < x < 1$,

(g) display $u_{app}$ and $u_{anal}$ on the same plot.