1. Solve the following one-dimensional Poisson problem by the Finite Element Method:

\[-u''(x) = \pi^2 \sin(\pi x) \quad 0 < x < 1\]
\[u(0) = u(1) = 0.\]

Use piecewise linear functions and verify the second order accuracy by using 20, 40, and 80 uniform elements. Note that the exact solution is:

\[u_{\text{exact}}(x) = \sin(\pi x).\]