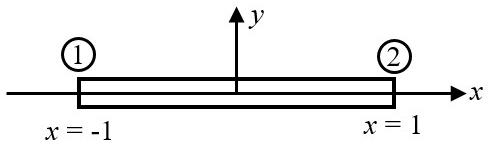
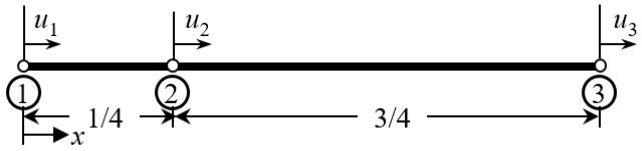
1. Determine shape functions of a bar element shown in the figure by assuming the following form of displacement: $u(x) = a_1 x + a_2 x^2$; that is, obtain $N_1(x)$ and $N_2(x)$ such that $u(x) = N_1(x)u_1 + N_2(x)u_2$. Calculate axial strain $\varepsilon_{xx} = \mathrm{d}u \,/\, \mathrm{d}x$ when $u_1 = u_2 = 1$ (rigid body motion). Explain why strain is not zero under the rigid-body motion.



2. Consider a finite element with three nodes, as shown in the figure. When the solution is approximated using $u(x) = N_1(x)u_1 + N_2(x)u_2 + N_3(x)u_3$,

   (a) calculate the interpolation functions $N_1(x)$, $N_2(x)$, and $N_3(x)$ if it is intended to obtain the displacement field in the following form: $u(x) = c_0 + c_1\sqrt{x} + c_2 x$; and

   (b) when the nodal displacements are given as: $u_1 = 0, u_2 = 0.5$, and $u_3 = 1$, sketch the function $u(x)$.



3. Derive shape functions of a beam element using parametric coordinate $s \in [-1,1]$.