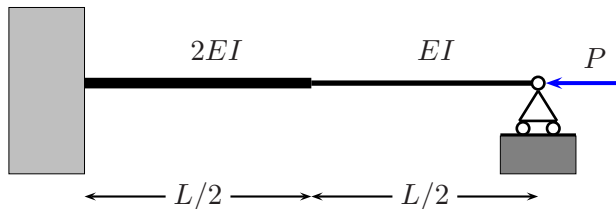


## Stability of structures

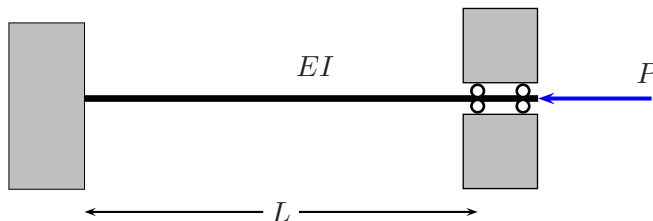
### 8. exercise – FEM and FDM

1. Determine the critical buckling load for the structure shown below using the finite element method (FEM). Use two Euler-Bernoulli beam elements. Compute also the second buckling load



When 10 elements are used for the analysis, then the two lowest buckling loads are  $25.1848EI/L^2$  and  $82.8257EI/L^2$ . Extrapolate the exact solution:

- (a) using the information that the convergence rate of the eigenvalues for the Euler-Bernoulli beam element is 4, or
  - (b) by using Richardson's extrapolation technique, which does not need the knowledge of the convergence rate.
2. Compute the buckling load of the clamped beam by the finite difference method (FDM) using the mesh sizes  $h = L/2$ ,  $L/4$  and  $L/6$ . Use symmetry if you compute the eigenvalue by hand. Usually in buckling analysis symmetry conditions should be used with care! Extrapolate also the exact solution.



3. Compute the buckling load of the clamped beam by the finite difference method (FDM) using the mesh size  $h = L/2$

