Define problem $u_{,xx} + f = 0$

$u(1) = g = 1$

$-u_{,x}(0) = h = 0$

Set up the mesh

polynomial degree pp;

$n_{en} = pp + 1$, n_{el}, $n_{np} = n_{el} \times pp + 1$

$n_{eq} = n_{np} - 1$

$hh = \dfrac{1}{n_{np} - 1}$ space between 2 nodes

x coordinate $= 0:hh:1$

Create IEN array

for $ee = 1 : n_{el}$ element

for $aa = 1 : n_{en}$ element node

$IEN(ee, aa) = (ee-1) \times pp + aa$

$$\begin{array}{cc} & \overbrace{\quad\quad\quad\quad\quad\quad\quad}^{aa} \\ ee & \left\{\begin{array}{cccc} 1 & 2 & 3 & \cdots \\ 2 & 3 & 4 & \cdots \\ 3 & 4 & 5 & \cdots \\ \vdots & & & \\ \vdots & & & \end{array}\right. \end{array}$$

Set up ID array

$ID = 1 : n_{np}$ $ID(end) = 0$

1 2 3 4 . . . 0

Set up quadrature rule

Gauss function $N = 6$

get ξ and weights

Create K and F

$K = \text{spalloc}(n_{eq}, n_{eq}, (2 \times pp + 1) \times n_{eq})$

space matrix

$F = \text{zeros}(n_{eq}, 1)$

Assembly of K and F

$ee = 1 : n_{el}$ each element

k_{ele} : $n_{en} \times n_{en}$ element matrix

f_{ele} : $n_{en} \times 1$

x_{ele} : $x_{coor} \times (IEN(ee, :))$

determine x_l , $\frac{dx}{d\xi}$, $\frac{d\xi}{dx}$, f_{ele} , k_{ele}

```
for qua = 1 : int
    for aa = 1 : nen
        xl = xl + xele(aa) × polyshape(pp, aa, xi(qua),
                                                  0);
    ⋮
```

↓

Assembly of kele to K, fele to F

```
for aa = 1 : nen
    P = ID(IEN(ee, aa))
    If P > 0
        F(P) = F(P) + fele(aa)
        for bb = 1 : nen
            Q = ID(IEN(ee, bb))
            If Q > 0
                K(P, Q) = K(P, Q) + kele(aa, bb)
            else
                F(P) = F(P) - k_ele(aa, bb)
```

↓ B.C $-u_{,x}(0) = h$

```
F(ID(IEN(1,1))) = F(ID(IEN(1,1))) + h
```

$d_{temp} = K \backslash F$ solve d

↓

$disp = [d_{temp}; g]$

↓

post - proceeding

show u^h and u by sample points