Exercises 4.4

4. By inspection determine the Jacobian norm of the four-node elementshown below. Then, compare the result with the one obtained by usingthe Jacobian matrix.

```
clear all
clc
```

```
syms xi eta
n = 2;
x = linspace (-1, 1, n);
```

```
C = [0 0 0; 1 0 0; 1 1 1; 0 1 1];
dn = quad4_deriv (xi, eta);
J1 = C' * subs (dn, [xi eta], [x(1) x(1)]);
J2 = C' * subs (dn, [xi eta], [x(2) x(1)]);
J3 = C' * subs (dn, [xi eta], [x(2) x(2)]);
J4 = C' * subs (dn, [xi eta], [x(1) x(2)]);
```

```
NormJ1 = sqrt((det(J1([1 2], [1 2])))^2 + ...
              (det(J1([2 3], [1 2])))^2 + ...
              (det(J1([3 1], [1 2])))^2)
```

NormJ1 =

$$\frac{\sqrt{2}}{4}$$

```
NormJ2 = sqrt((det(J2([1 2], [1 2]))^2) + ...
              (det(J2([2 3], [1 2]))^2) + ...
              (det(J2([3 1], [1 2]))^2));
NormJ3 = sqrt((det(J3([1 2], [1 2]))^2) + ...
              (det(J3([2 3], [1 2]))^2) + ...
              (det(J3([3 1], [1 2]))^2));
NormJ4 = sqrt((det(J4([1 2], [1 2]))^2) + ...
              (det(J4([2 3], [1 2]))^2) + ...
              (det(J4([3 1], [1 2]))^2));
```

```
function dn = quad4_deriv (xi, eta)
n = [1.0/4.0 * (1 - xi) * (1 - eta)
     1.0/4.0 * (1 + xi) * (1 - eta)
     1.0/4.0 * (1 + xi) * (1 + eta)
     1.0/4.0 * (1 - xi) * (1 + eta)];
dn = [diff(n, xi), diff(n, eta)];
end
```