Exercises 4.5

4. Compute the surface area shown at right. How many integration pointsare required to find the area with precision of 0.01?

```
clear all
clc
```

```
syms xi eta
```

```
C = [0 0 1; 1 0 1; 1 1 0; 0 1 1];
dn = quad4_deriv (xi, eta);
J = C' * dn;
```

```
NormJ = sqrt((det(J([1 2], [1 2])))^2 + ...
             (det(J([2 3], [1 2])))^2 + ...
             (det(J([3 1], [1 2])))^2);
A = int(int(NormJ, xi, -1, 1), eta, -1, 1);
valor_analitico = vpa(A, 4)
```

```
valor_analitico = 1.281
```

```
quadrature_1_pts = [0.0  0.0  4.0];

quadrature_4_pts = [
    -0.577350269189626 -0.577350269189626  1.0
     0.577350269189626 -0.577350269189626  1.0
    -0.577350269189626  0.577350269189626  1.0
     0.577350269189626  0.577350269189626  1.0];

quadrature_9_pts = [
    -0.774596669241483 -0.774596669241483  0.3086419753086419
     0.0               -0.774596669241483  0.4938271604938271
     0.774596669241483 -0.774596669241483  0.3086419753086419
    -0.774596669241483  0.0                0.4938271604938271
     0.0                0.0                0.7901234567901234
     0.774596669241483  0.0                0.4938271604938271
    -0.774596669241483  0.774596669241483  0.3086419753086419
     0.0                0.774596669241483  0.4938271604938271
     0.774596669241483  0.774596669241483  0.3086419753086419];

N = (quadrature_4_pts);
A = 0.00;
[s, r, w] = quadrature(N);
for i = 1:size(N, 1)
    A = (subs(NormJ, [xi eta], [s(i) r(i)])) * w(i) + A;
end
valor_numerico = vpa(A, 4)
```

```
valor_numerico = 1.281
```

```
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

function [xi, eta, w] = quadrature (quadrature)
Npst = size(quadrature, 1);
for i = 1:Npst
    xi(i, 1)  = quadrature (i, 1);
    eta(i, 1) = quadrature (i, 2);
    w(i, 1)   = quadrature (i, 3);
end
end
```