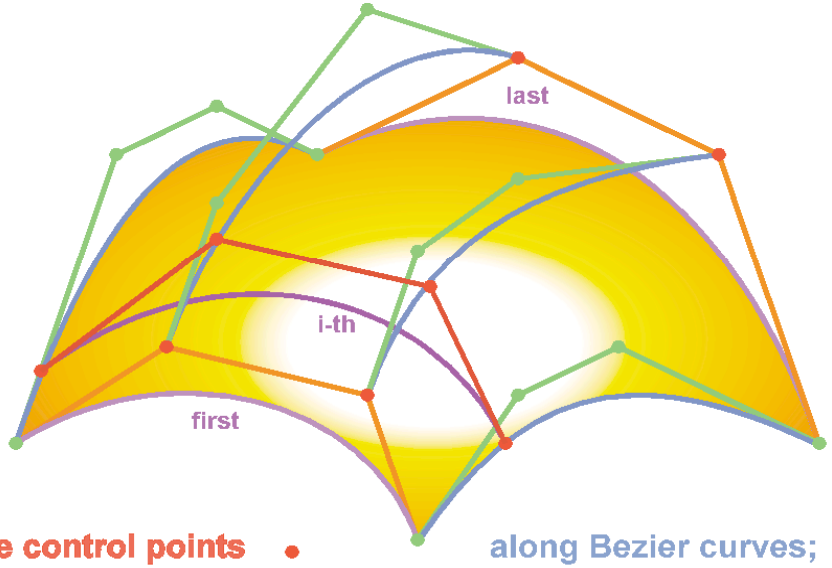
Bezier Surfaces. Smooth Operators.

```
# given the control points of a bezier curve
# and a parametric value, return the curve
# point and derivative
bezcurveinterp(curve, u)
    # first, split each of the three segments
    # to form two new ones AB and BC
    A = curve[0] * (1.0-u) + curve[1] * u
    B = curve[1] * (1.0-u) + curve[2] * u
    C = curve[2] * (1.0-u) + curve[3] * u

    # now, split AB and BC to form a new segment DE
    D = A * (1.0-u) + B * u
    E = B * (1.0-u) + C * u

    # finally, pick the right point on DE,
    # this is the point on the curve
    p = D * (1.0-u) + E * u

    # compute derivative also
    dPdu = 3 * (E - D)

    return p, dPdu
```

```
# given a control patch and (u,v) values, find
# the surface point and normal
bezpatchinterp(patch, u, v)
    # build control points for a Bezier curve in v
    vcurve[0] = bezcurveinterp(patch[0][0:3], u)
    vcurve[1] = bezcurveinterp(patch[1][0:3], u)
    vcurve[2] = bezcurveinterp(patch[2][0:3], u)
    vcurve[3] = bezcurveinterp(patch[3][0:3], u)

    # build control points for a Bezier curve in u
    ucurve[0] = bezcurveinterp(patch[0:3][0], v)
    ucurve[1] = bezcurveinterp(patch[0:3][1], v)
    ucurve[2] = bezcurveinterp(patch[0:3][2], v)
    ucurve[3] = bezcurveinterp(patch[0:3][3], v)

    # evaluate surface and derivative for u and v
    p, dPdv = bezcurveinterp(vcurve, v)
    p, dPdu = bezcurveinterp(ucurve, u)

    # take cross product of partials to find normal
    n = cross(dPdu, dPdv)
    n = n / length(n)

    return p, n
```

Bicubic Bezier Patch

Continuously Moved and Deformed Bezier Curve



Move control points ● **along Bezier curves;**
these have their own control points ●**;**
leading to a total of 16 control points for the cubic case.

```
# given a patch, perform uniform subdivision
subdividepatch(patch, step)
    # compute how many subdivisions there
    # are for this step size
    numdiv = ((1 + epsilon) / step)

    # for each parametric value of u
    for (iu = 0 to numdiv)
        u = iu * step

        # for each parametric value of v
        for (iv = 0 to numdiv)
            v = iv * step

            # evaluate surface
            p, n = bezpatchinterp(patch, u, v)
            savesurfacepointandnormal(p,n)
```

Split?

e3	e2	e1	
0	0	0	output as is
0	0	1	
0	1	0	
1	0	0	
0	1	1	
1	1	0	
1	0	1	
1	1	1