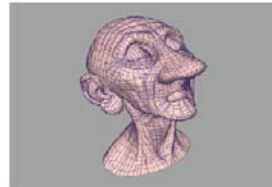




Chapter 15

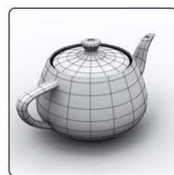
Geometric Modeling: Subdivision



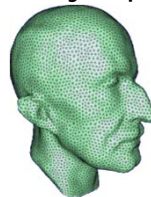
Geometry



- Mathematical models of real world shapes
 - Most common: Boundary representations

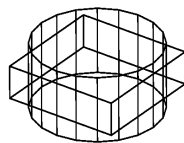


Freeform –
smooth surface

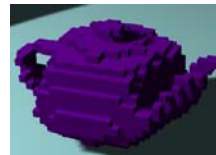
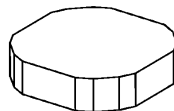


Mesh – polygonal
surface

- Alternative: Volumetric representations



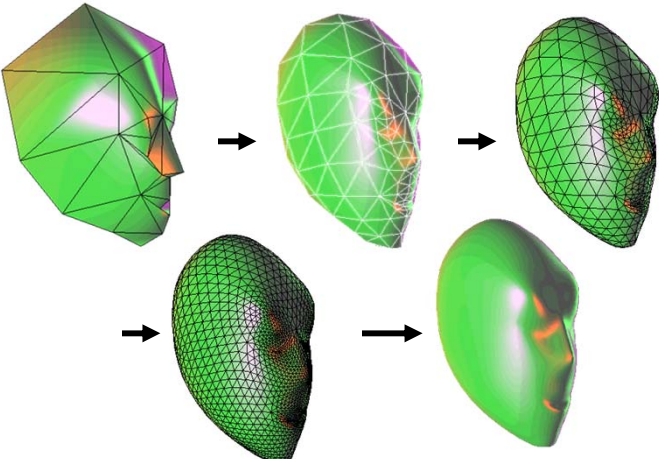
Primitive based



Voxel based

Subdivision- "Hybrid" Representation

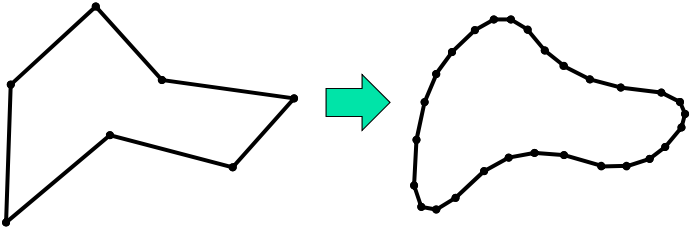
- Replace smooth surface by "infinitely" fine smooth mesh



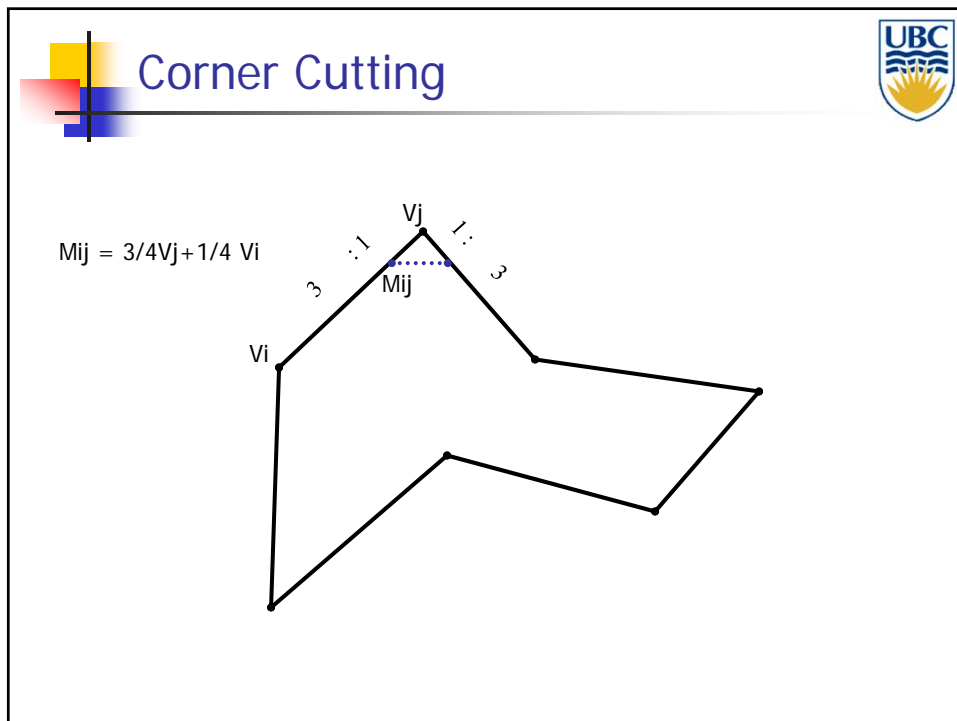
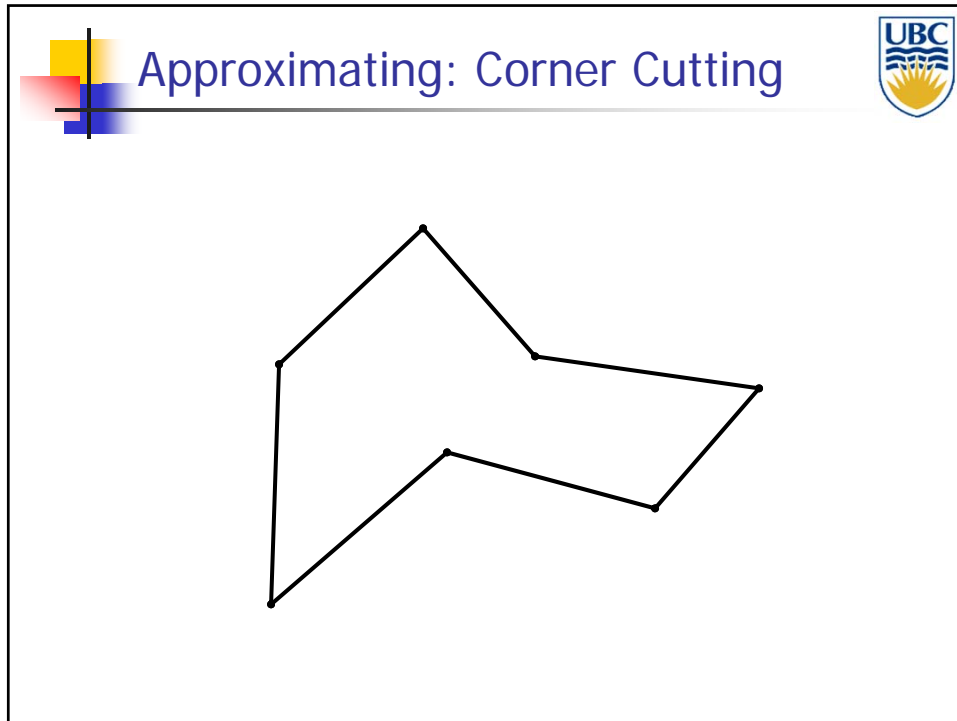
The diagram illustrates the process of subdividing a smooth surface. It begins with a coarse polyhedral mesh of a green object. Through several intermediate steps, the mesh becomes progressively finer and more uniform. The final stage shows a very dense mesh that closely approximates a smooth, continuous surface.

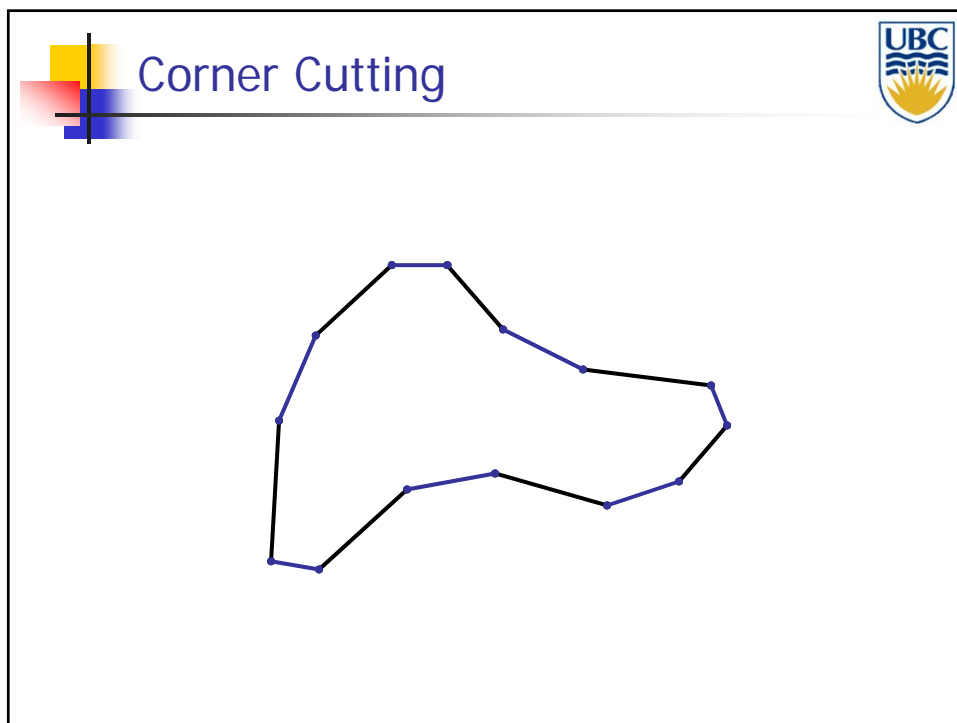
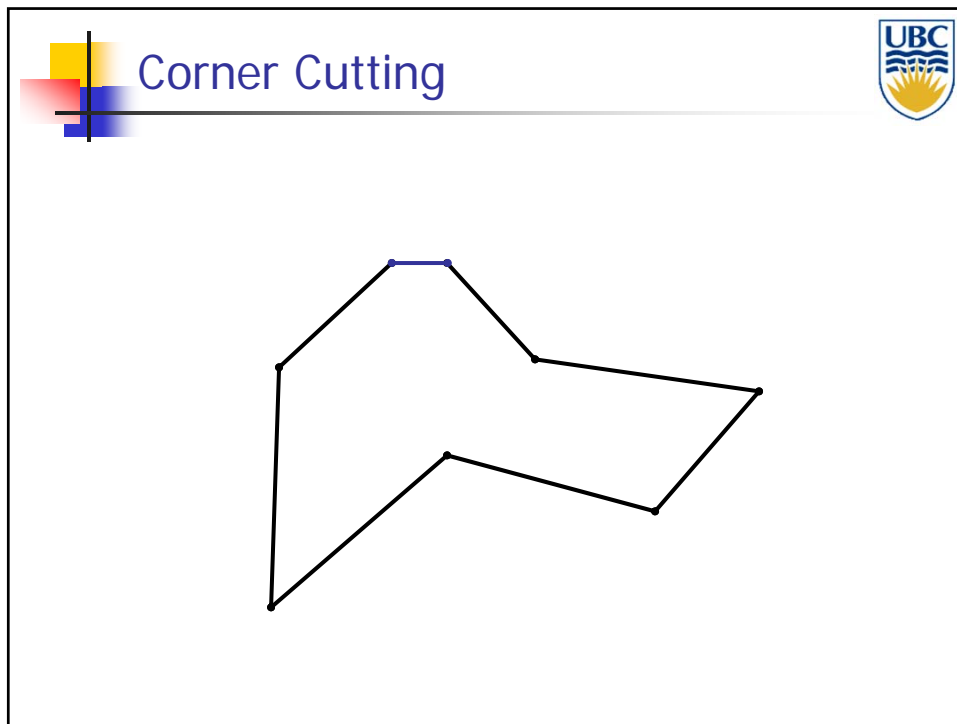
Subdivision Curves

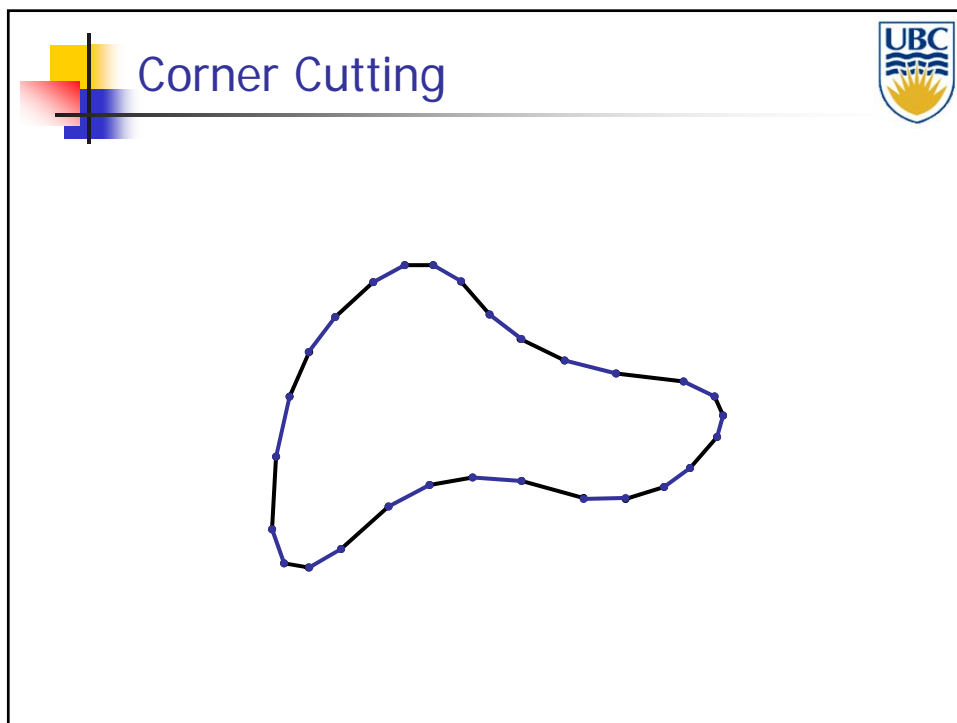
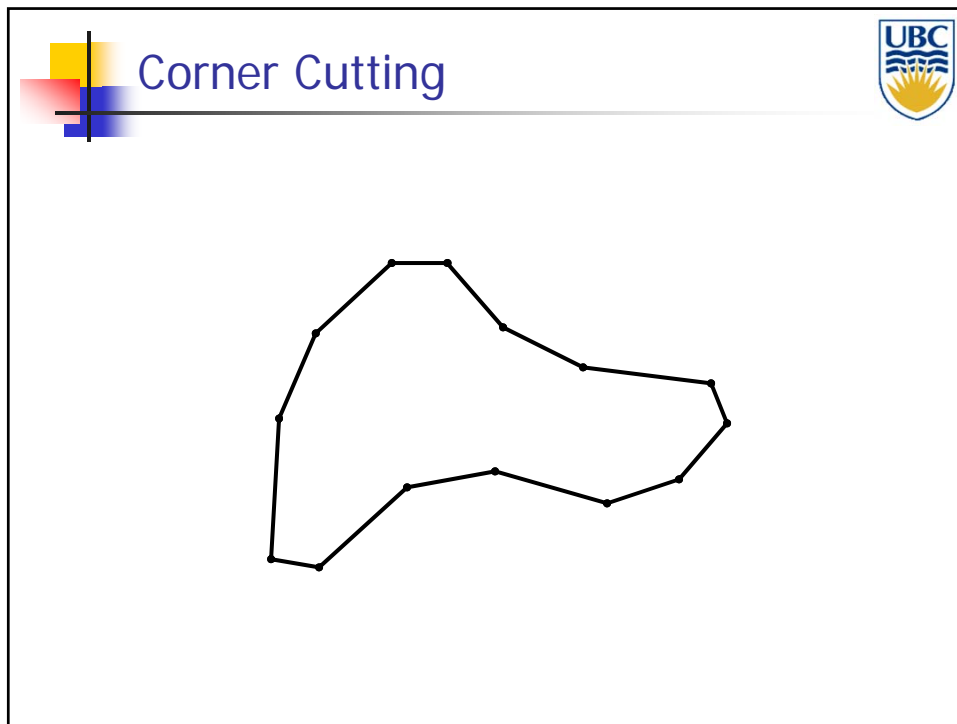
- Represent smooth curve by approximating polyline
- At the limit = curve
- Recursive refinement - Each iteration add new points (~double)

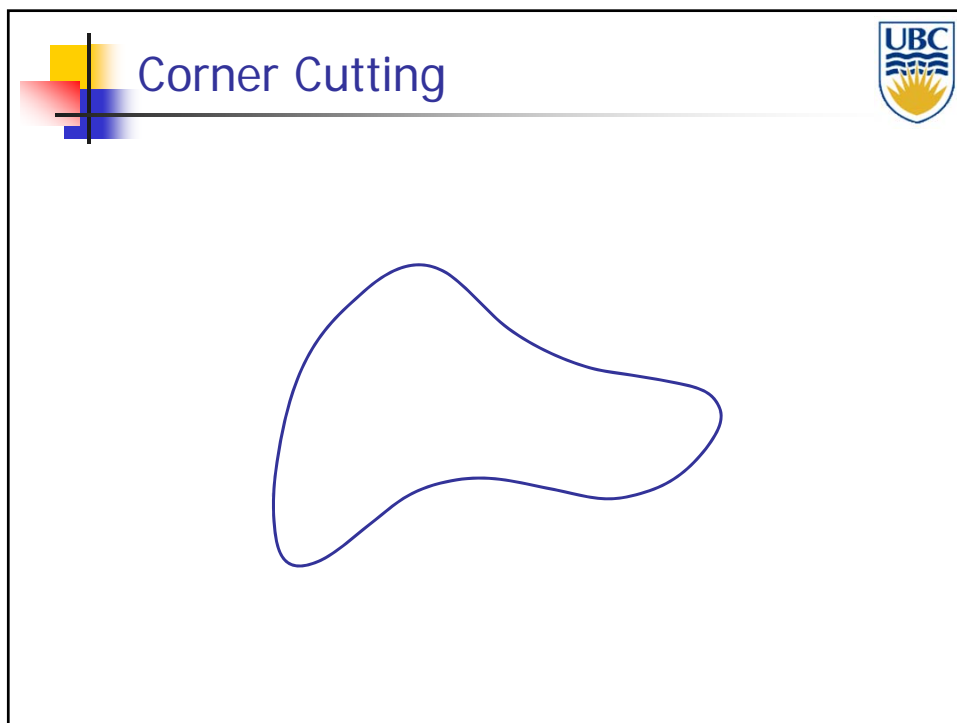
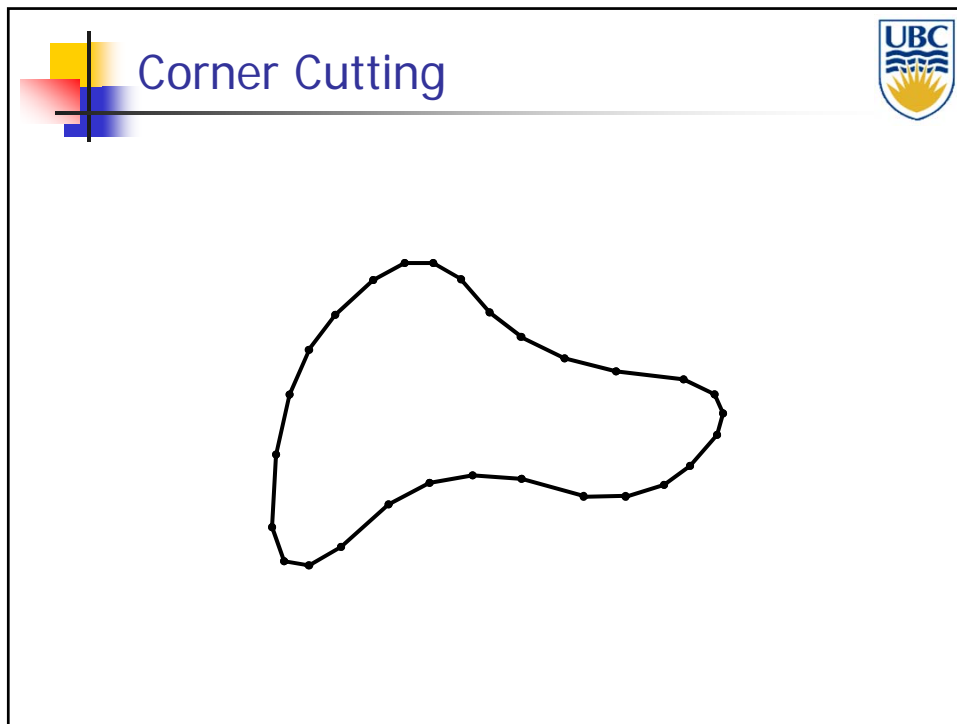




The diagram shows a smooth curve being approximated by a polyline. On the left, a simple polygonal shape is shown. A green arrow points to the right, where the same shape is shown with a much denser set of points along its edges, representing the limit of recursive refinement.

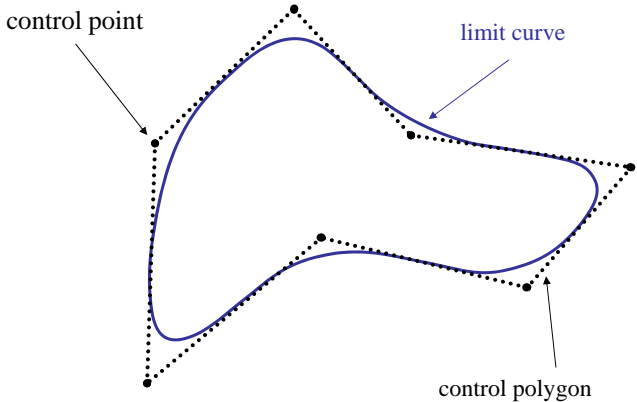








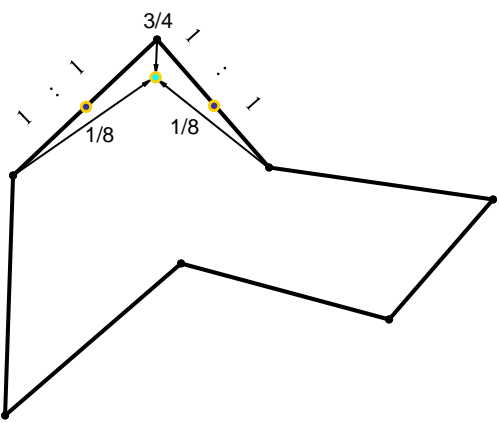


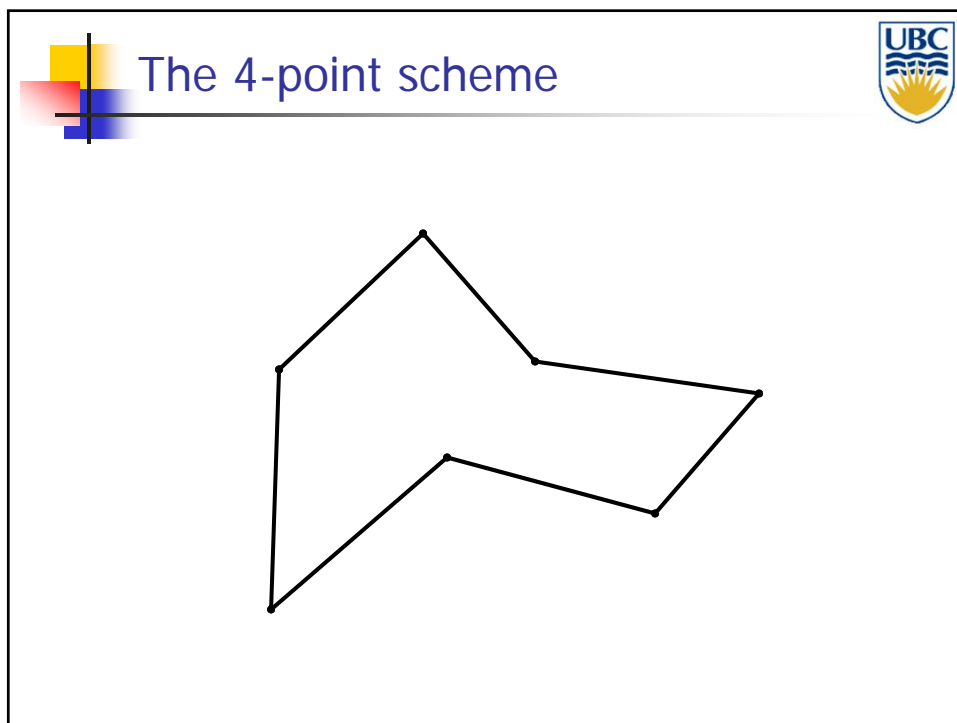
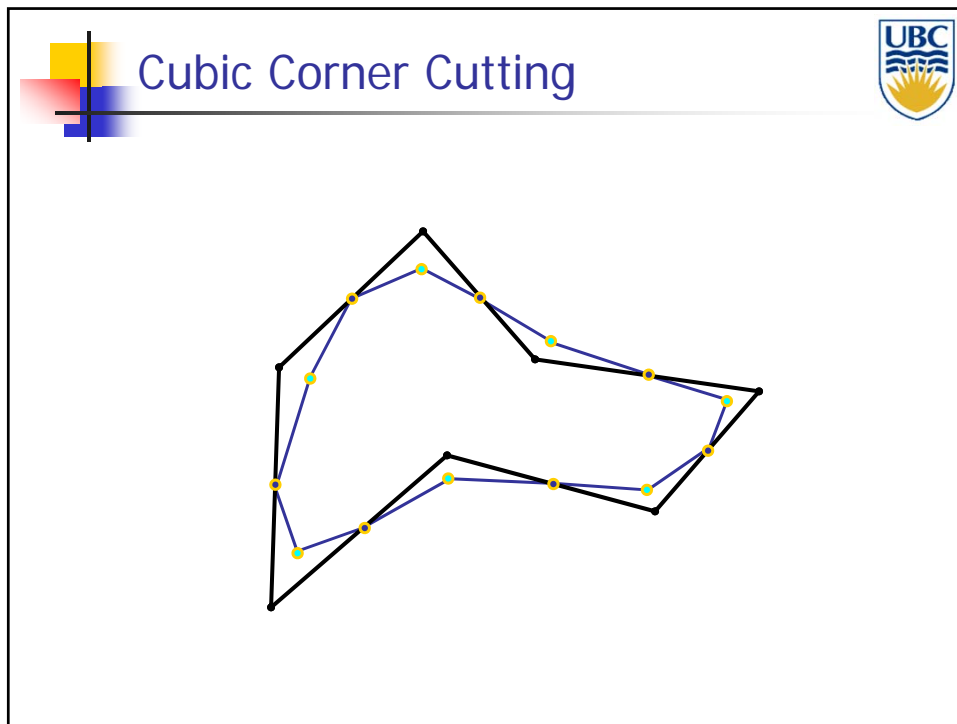
 **Corner Cutting – Chaikin Algorithm** 

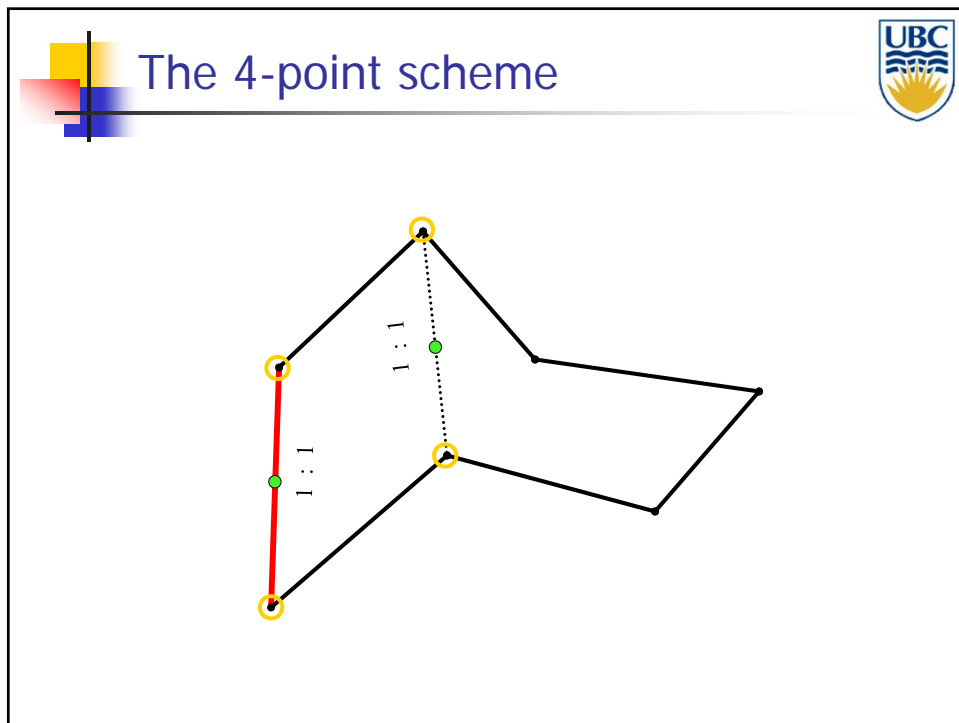
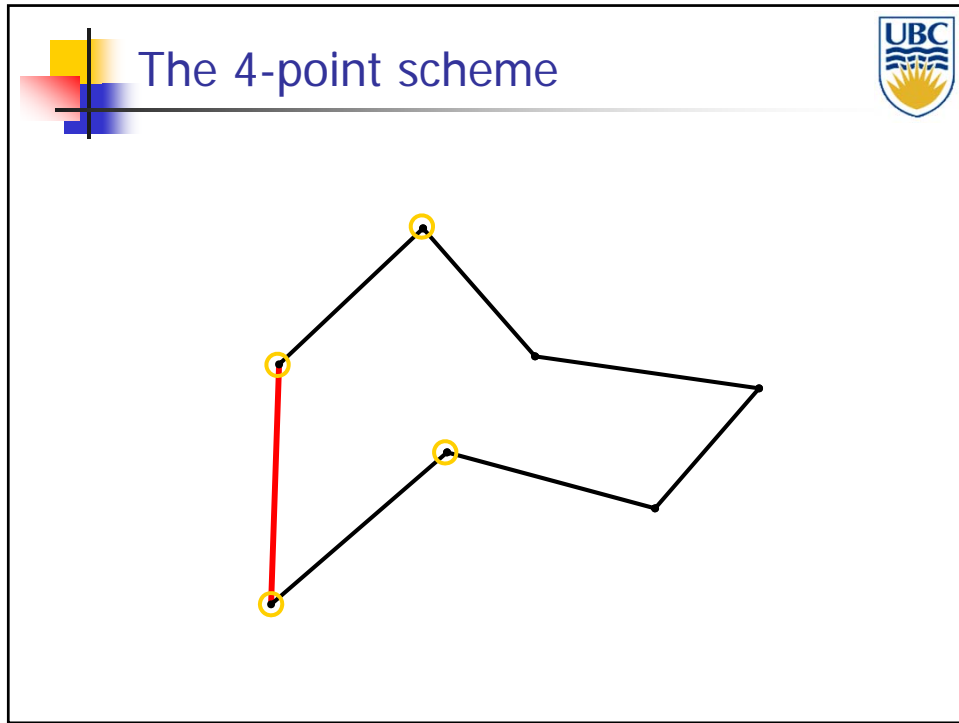




- Limit – quadratic B-spline curve

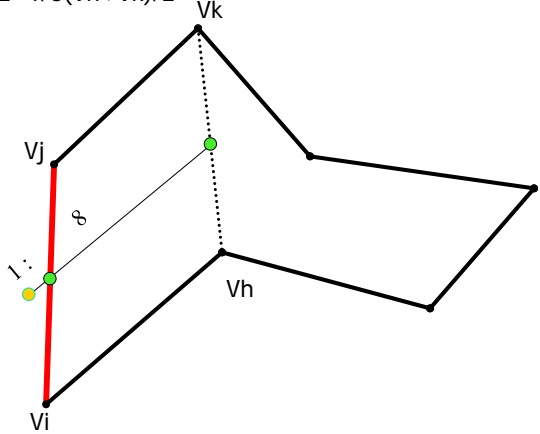
 **Cubic B-Spline (corner cutting)** 





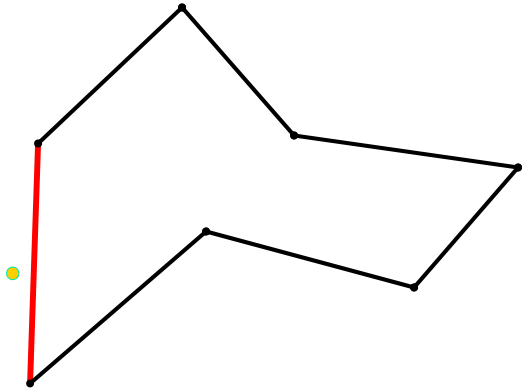


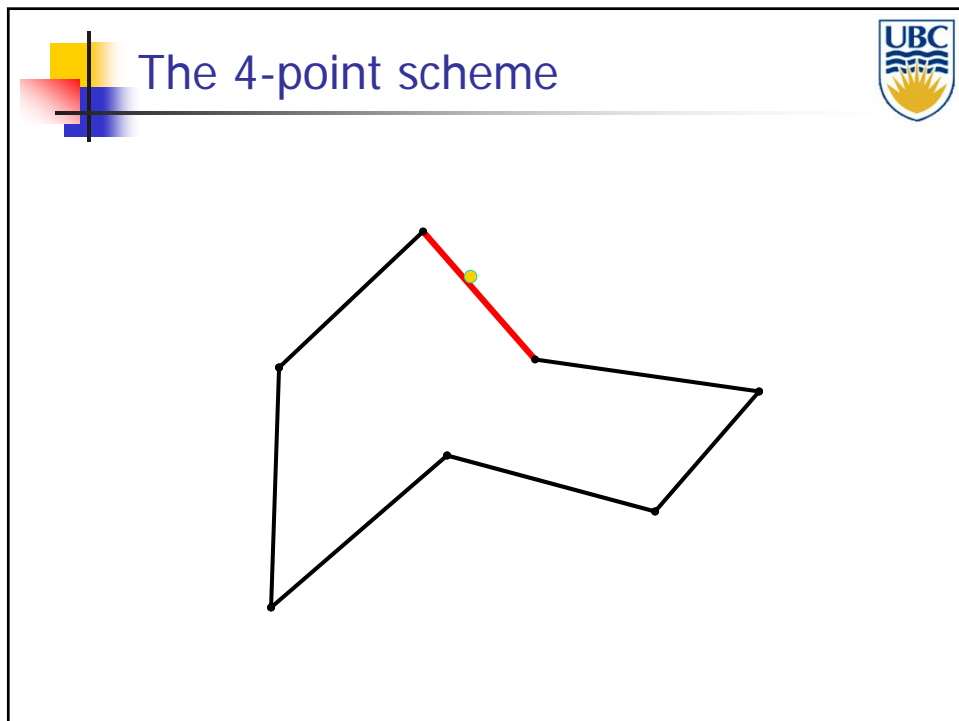
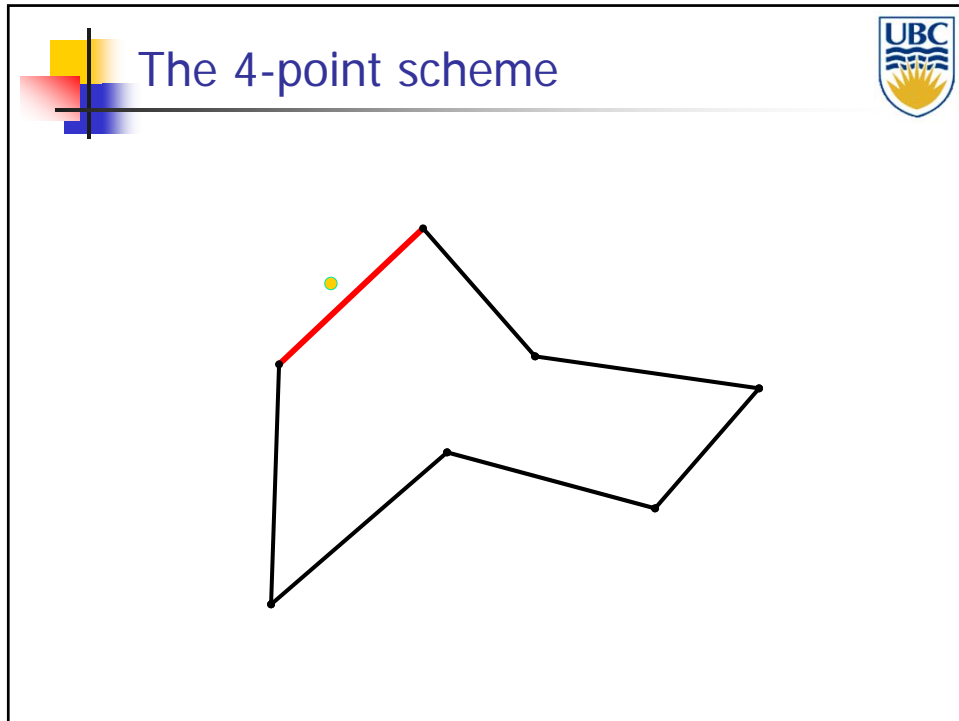


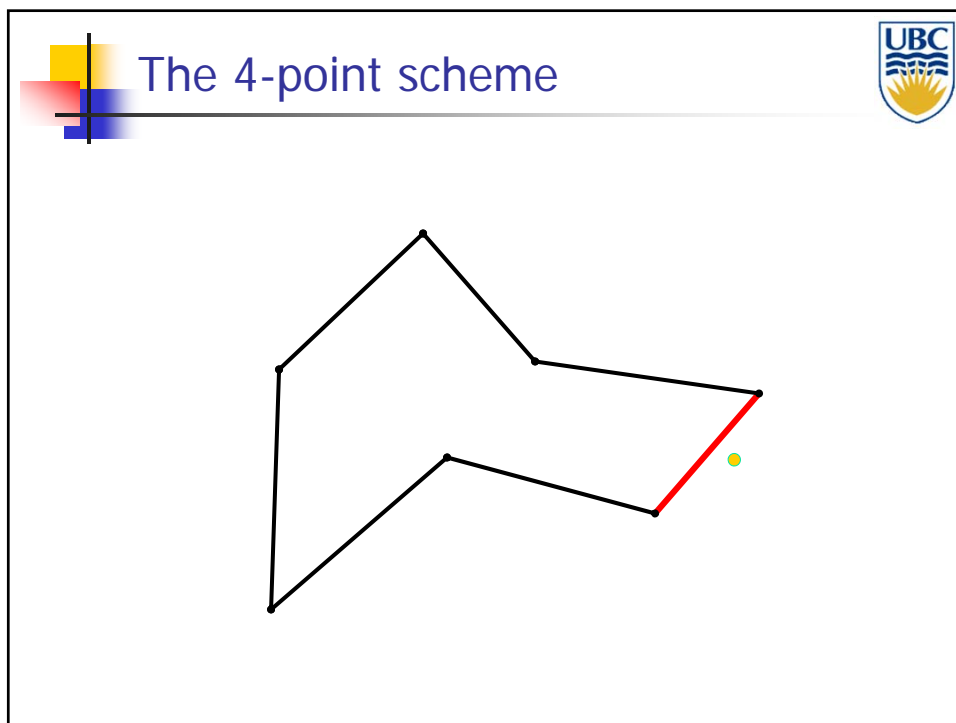
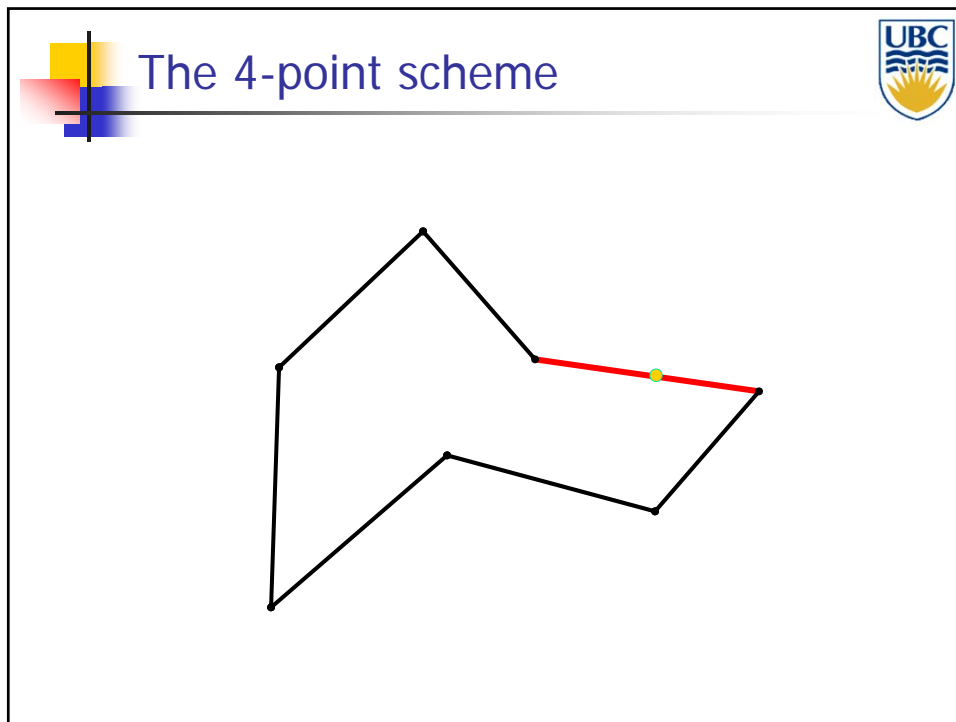
 The 4-point scheme 

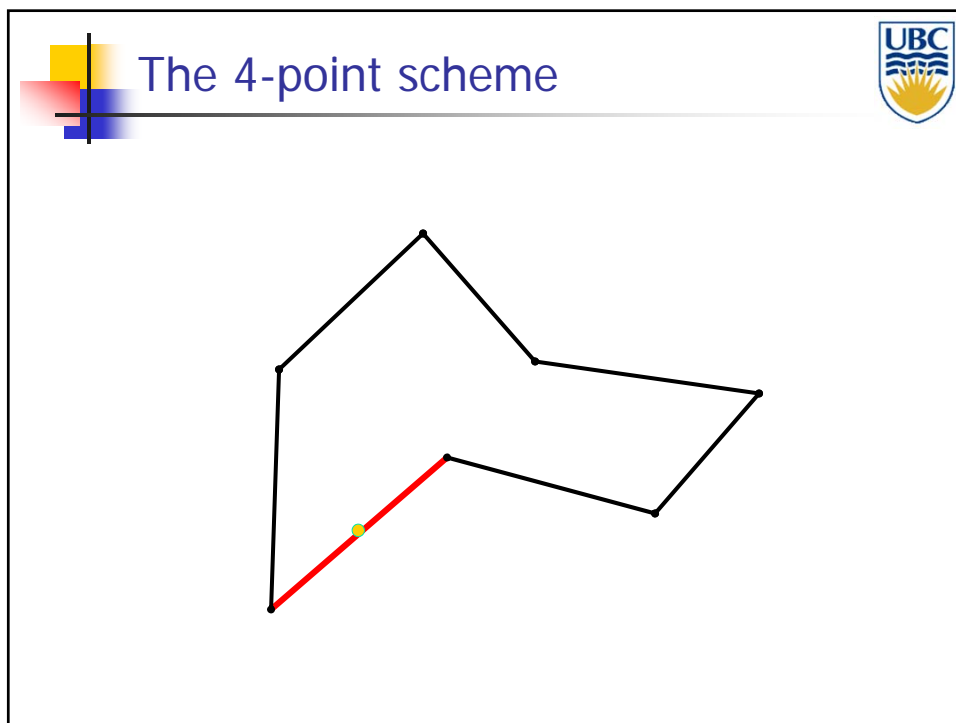
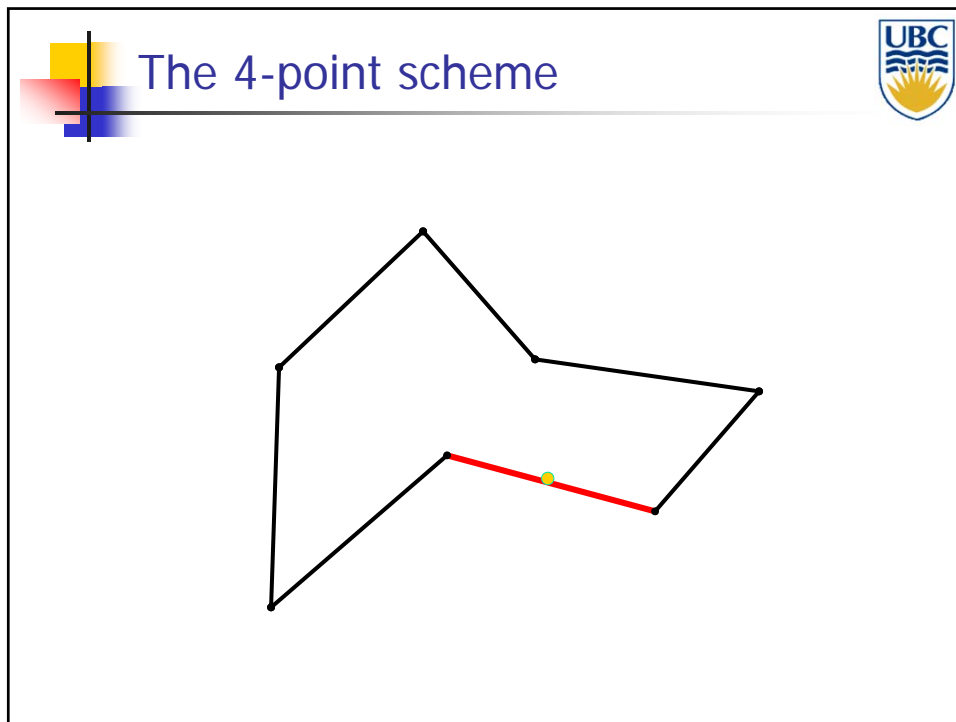
$$M_{ij} = 9/8(V_i + V_j)/2 - 1/8(V_h + V_k)/2$$


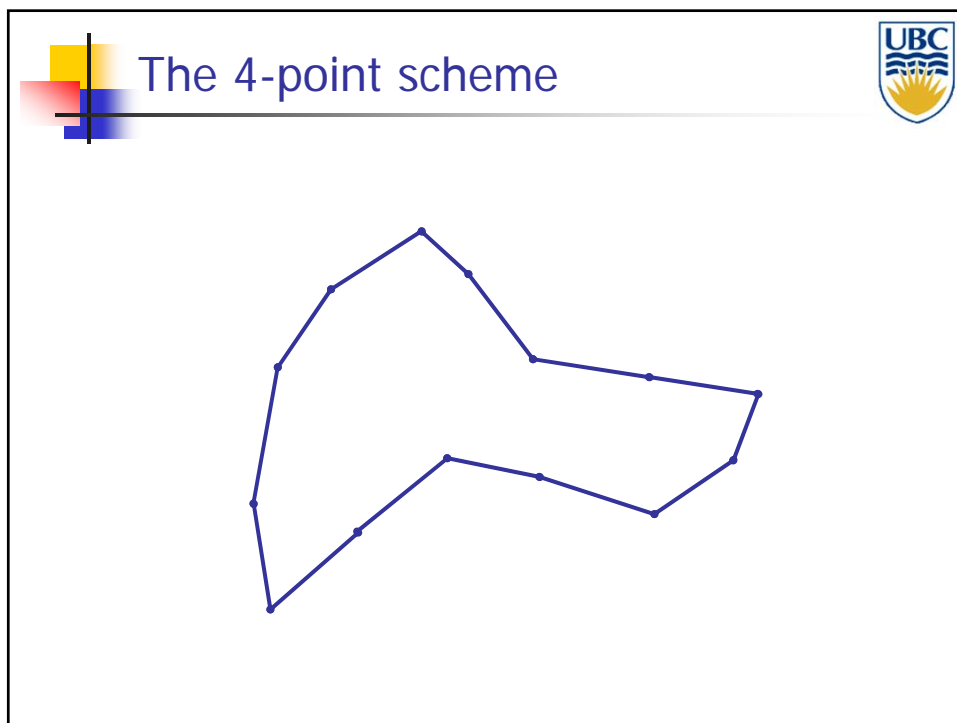
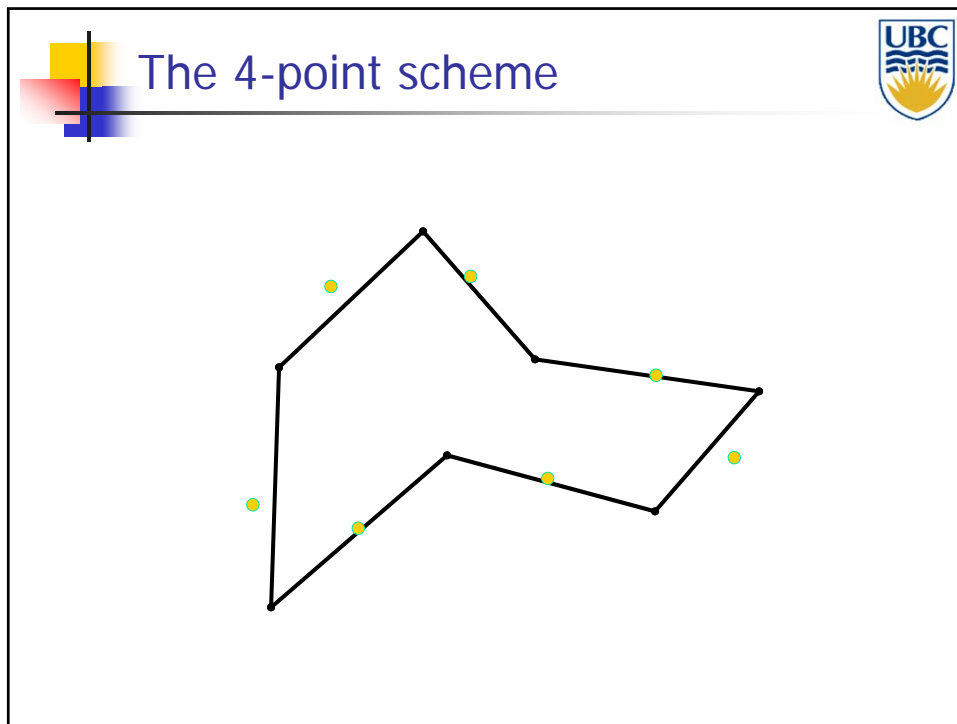
 The 4-point scheme 

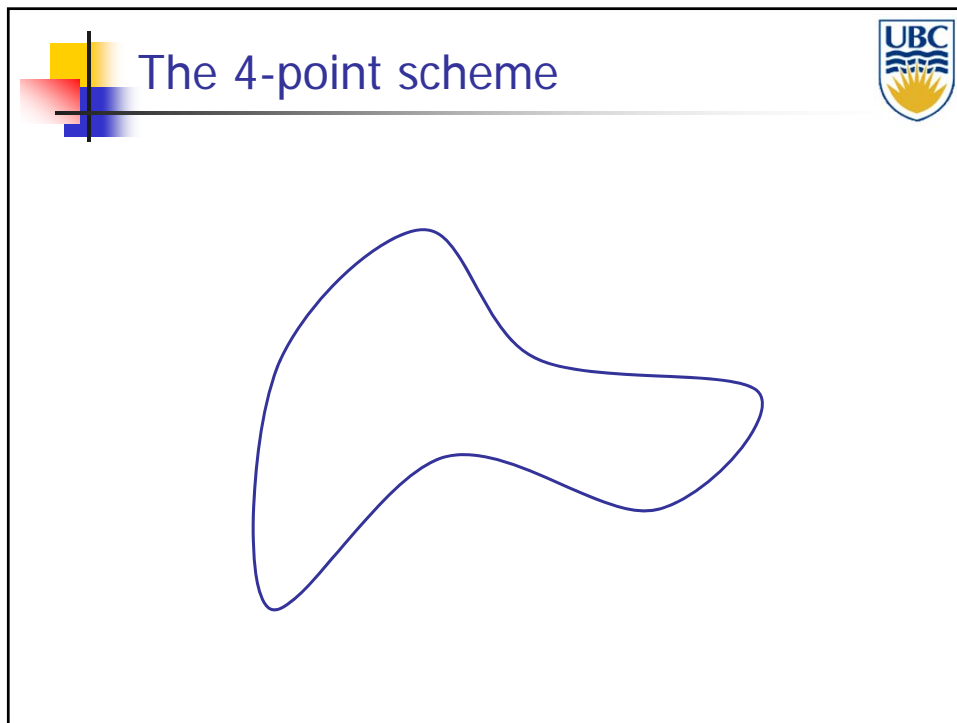
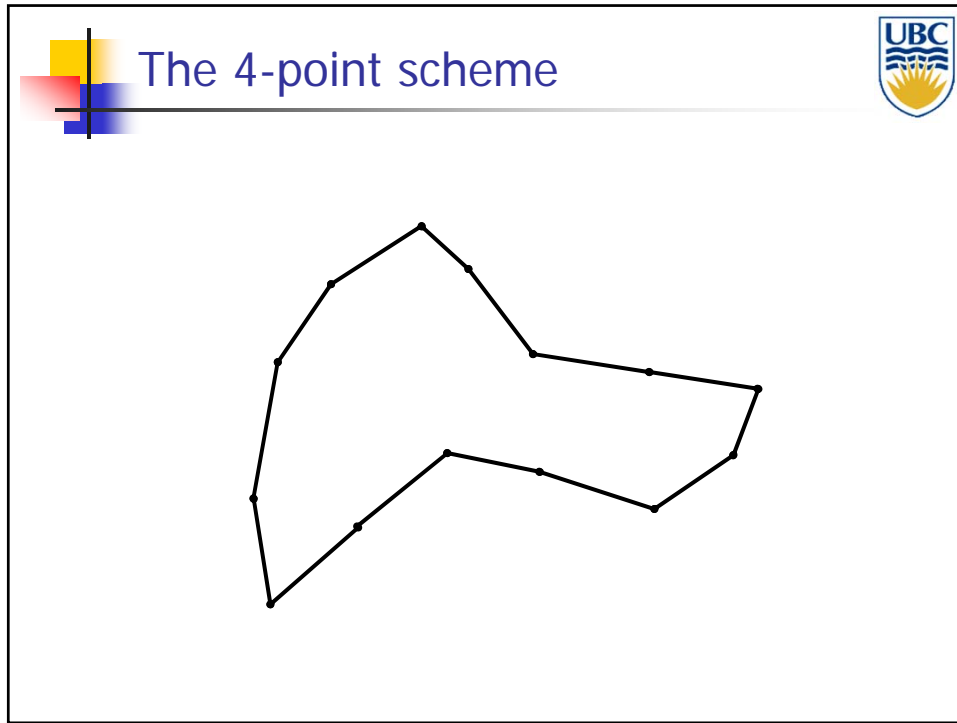


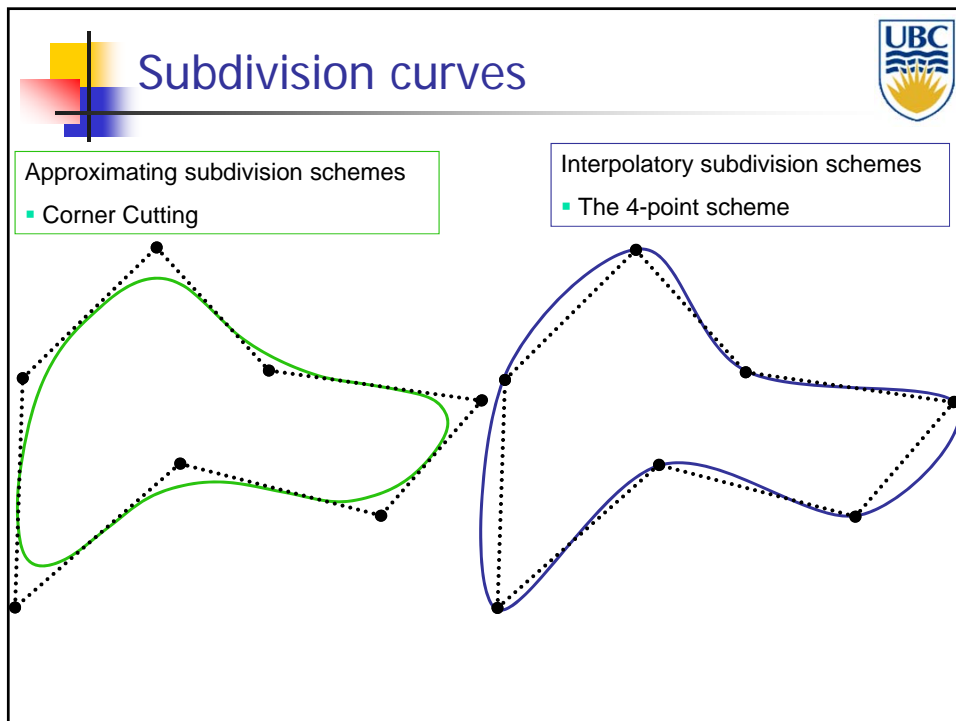
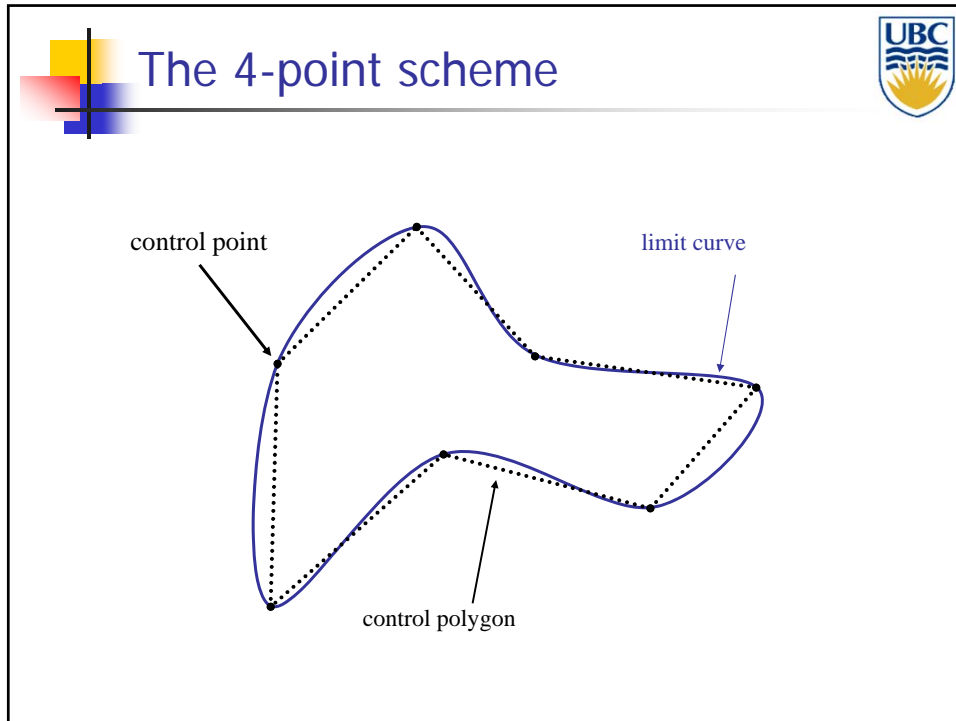

















Continuity




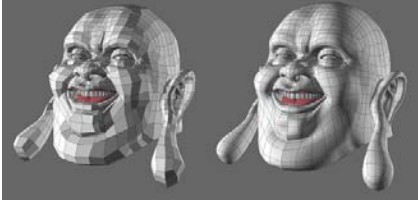
- Continuity
 - Visual “smoothness”
 - Formal: continuity of function + derivatives
 - C_i – where i corresponds to i 's derivative
- Continuity of subdivision limit curve
 - Corner cutting– C_{inf} nearly everywhere, C_2 at a finite number of points

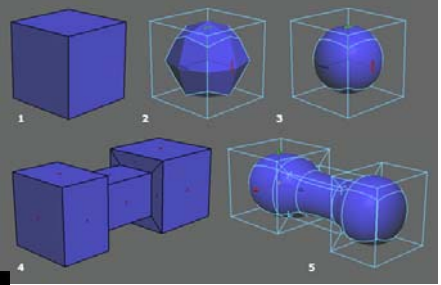
 - Four-point scheme – C_1 everywhere




Subdivision surfaces:









SubDiv
A brief Maya Tutorial
by Christer Dahl

