

i s t a n b u l t e c h n i c a l u n i v e r s i t y
a r c h i t e c t u r a l d e s i g n c o m p u t i n g g r a d u a t e p r o g r a m
dads 2011: a springtime venture

The Digital Shape or...

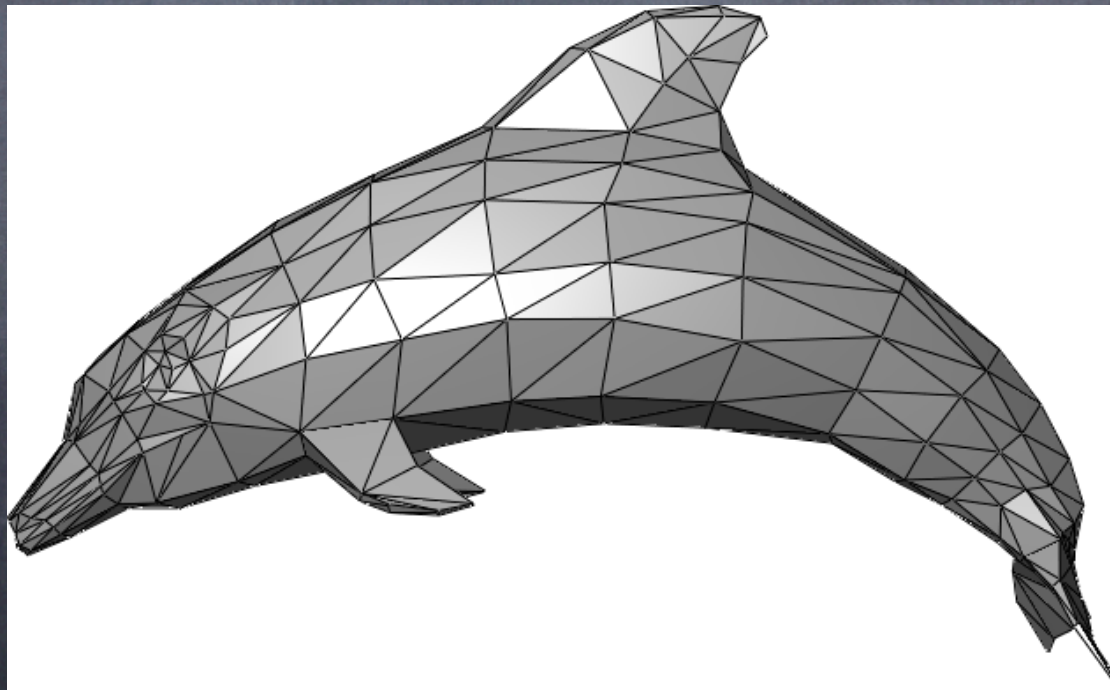
Mind the Gap Reloaded!

Lecture VII
Polygonal Meshes

Ceyhun Burak Akgül, PhD
www.cba-research.com

Polygonal Mesh

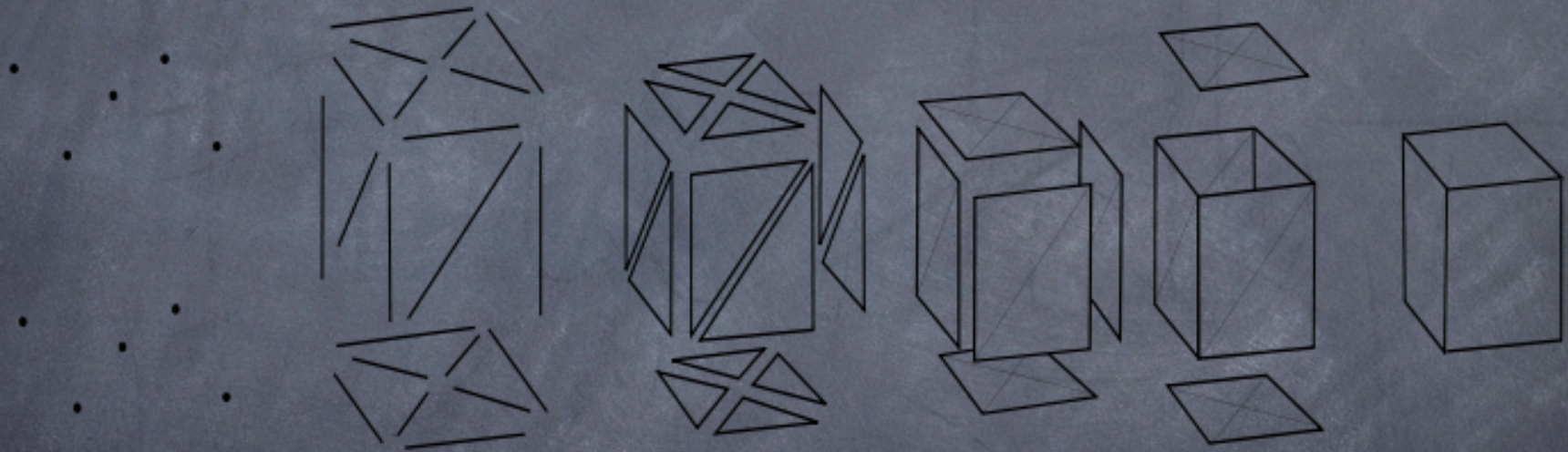
- **Unstructured grid** of vertices, edges, and faces
- Defines the shape of a **polyhedral** object
- Faces can be triangles, quadrilaterals, or other convex polygons



Some Definitions: In Words

- A **vertex** is a 3D position along with other information:
 - color
 - normal vector
 - texture
- An **edge** is a connection between two vertices
- A **face** is a closed set of edges

Some Definitions: In Pictures



vertices

edge

faces

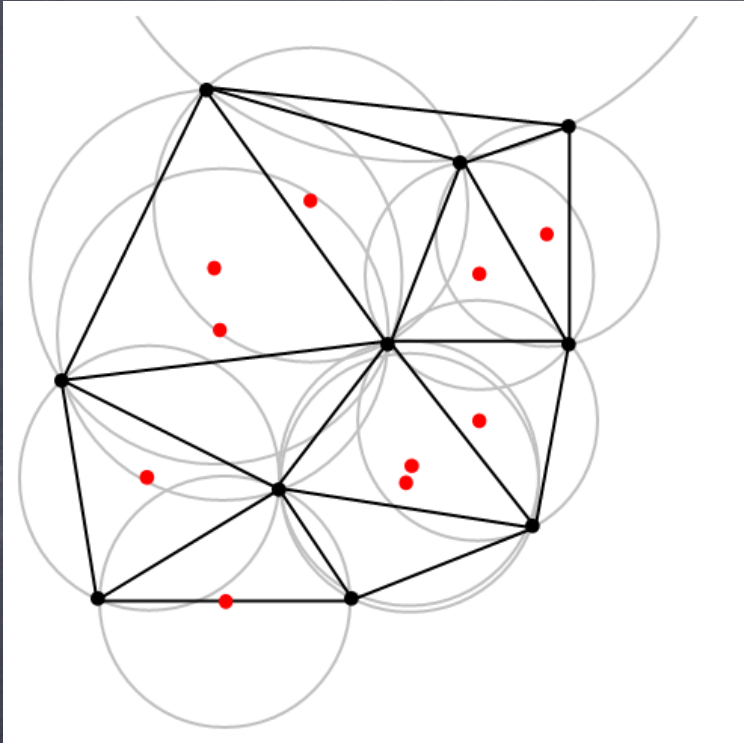
polygons

surfaces

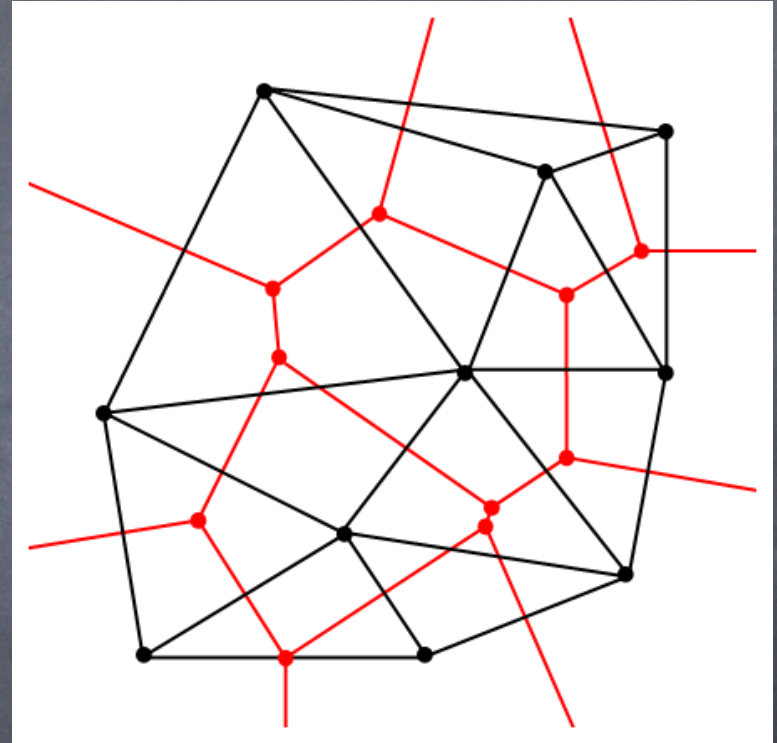
Construction of Polygon Meshes

- You can always model a mesh manually
- Box modeling: Two Basic Operations
 - Subdivide
 - Extrude
- Inflation modeling
- Connecting/Manipulating primitives
- Triangulation

Delaunay Triangulation



Delaunay Triangulation



Voronoi Tessellation

Operations in Mesh Modeling

- **Creations:** Loft, extrude, revolve
- **Binary ops:** Add, subtract, intersect, union, attach
- **Deformations:** Deform (weighted), morph, bend, twist
- **Manips:** Simplify, subdivide, convex hull, cut, stitch
- **Measurements:** Volume, surface area, collision detection, fitting, distances, cross-sections, centroid, center-of-mass, normals, curvature, ...

Pros & Cons of Mesh Modeling

• **Upsides**

- Relatively simple to produce
- Fast to render

• **Downsides**

- Non-accurate representation of curved surfaces!
- Large storage size for detailed models
- Level-of-detail processing can be complex

Subdivision

A smooth surface can be approximated by a coarse mesh as the limit of recursive process of subdividing each polygonal face of the mesh

