CS 543: Computer Graphics

Meshes

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(with lots of help from Prof. Emmanuel Agu :-)

Polygonal Meshes

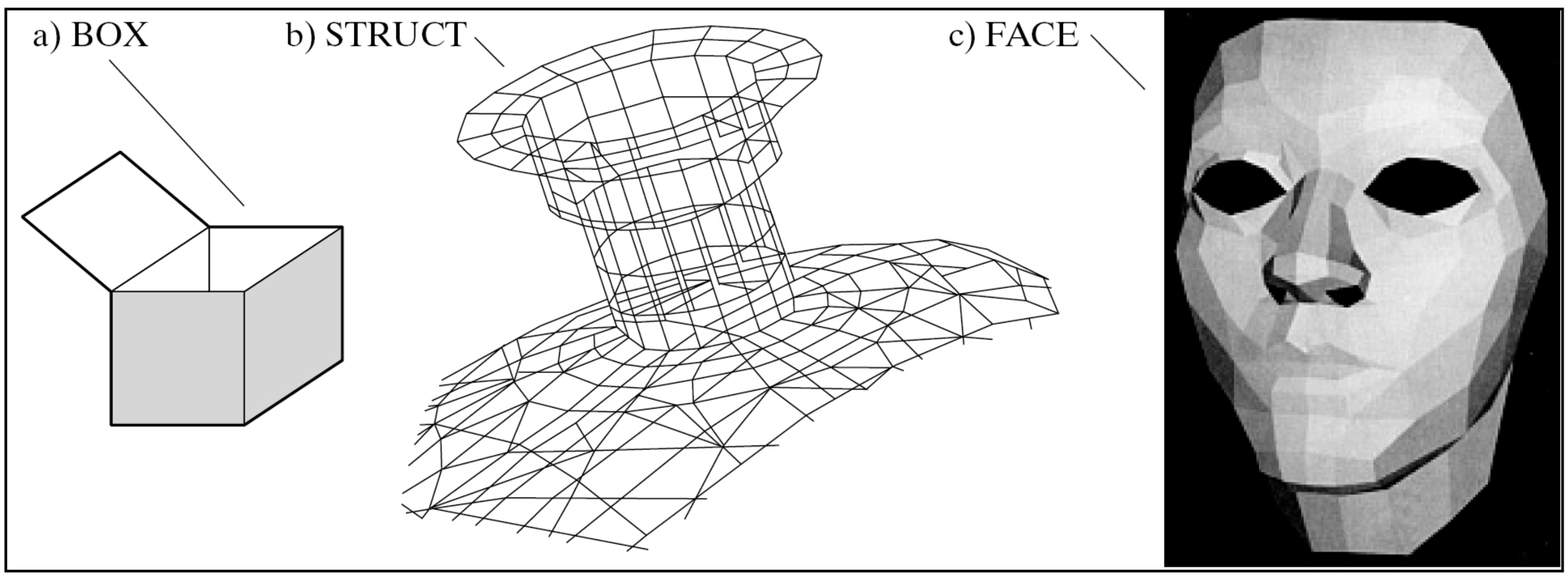
- Modeling with basic shapes (cube, cylinder, sphere, *etc.*) is too primitive
- Difficult to approach realism
- Polygonal meshes
  - Collection of polygons, or faces, that form "skin" of object
  - Offer more flexibility
  - Model complex surfaces better
  - Examples
    - Human face
    - Animal structures
    - Arbitrary curves, *etc.*

Polygonal Meshes (cont.)

- Have become standard in CG
- WebGL
  - Good at drawing polygons
  - Mesh = sequence of polygons
- Simple meshes are exact (*e.g.*, barn)
- Complex meshes are approximate (*e.g.*, human face)
- Later
  - Use shading technique to smoothen the appearance

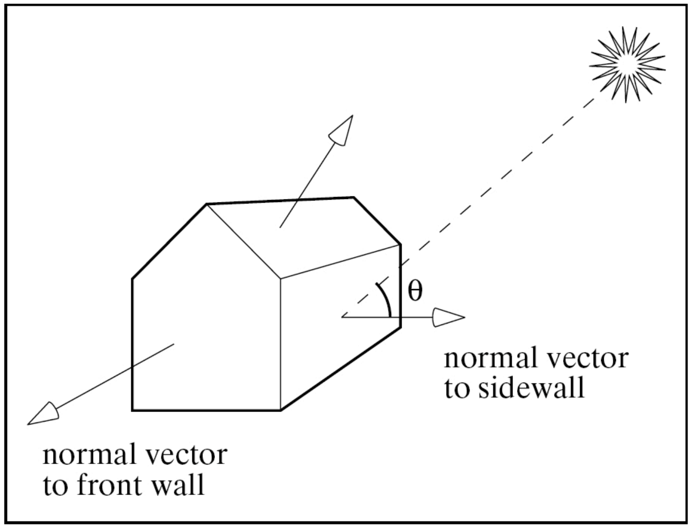
Non-Solid Objects

- Examples: box, face
- Visualize as infinitely thin *skin*
- Meshes to approximate complex objects
- Shading used later to smoothen
- Non-trivial: creating mesh for complex objects (CAD)



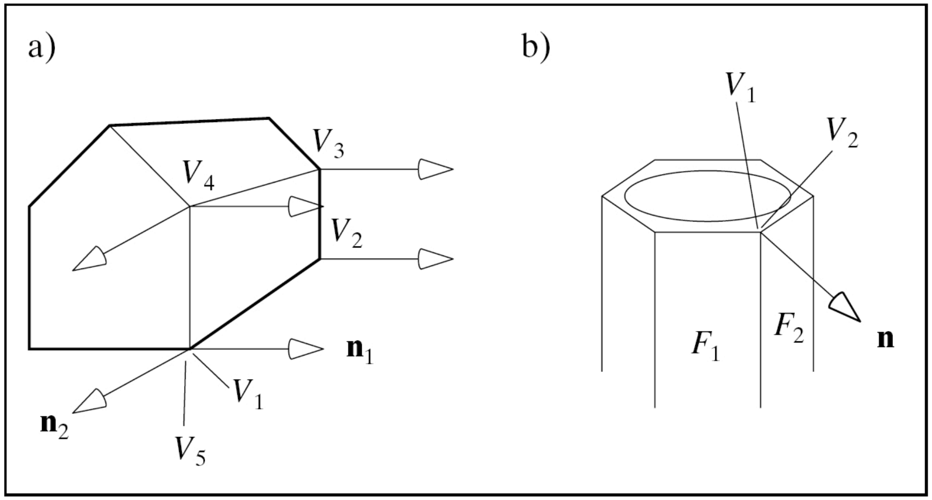
What is a Polygonal Mesh?

- Polygonal mesh defined by
  - List of polygons
  - *Normal* of each polygon
  - Normal vectors used in shading
    - Normal & light vectors determine shading



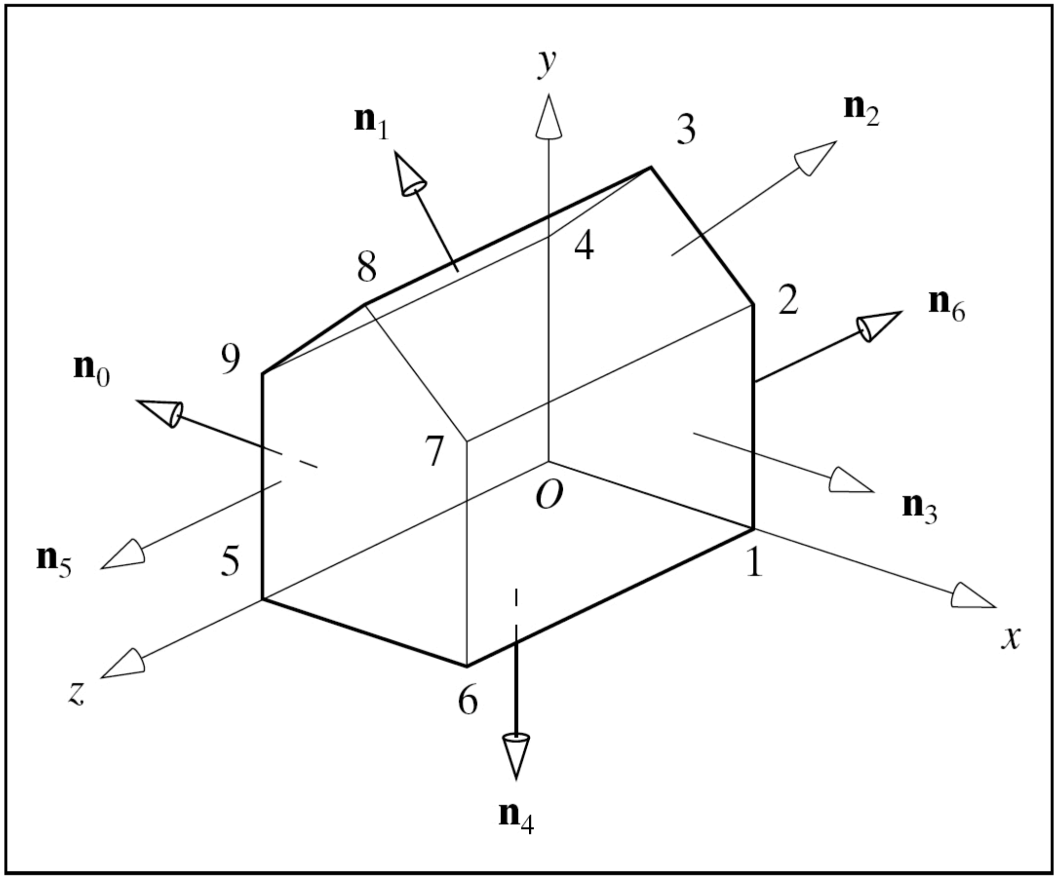
Vertex Normals

- Use vertex normal instead of face normal
- See advantages later
  - Facilitates clipping / culling
  - Shading of smoothly curved shapes
  - Flat surfaces
    - All vertices associated with same **n**
  - Smoothly curved surfaces
    - V_1, V_2 with common edge share **n**



Defining a Polygonal Mesh

- Barn example

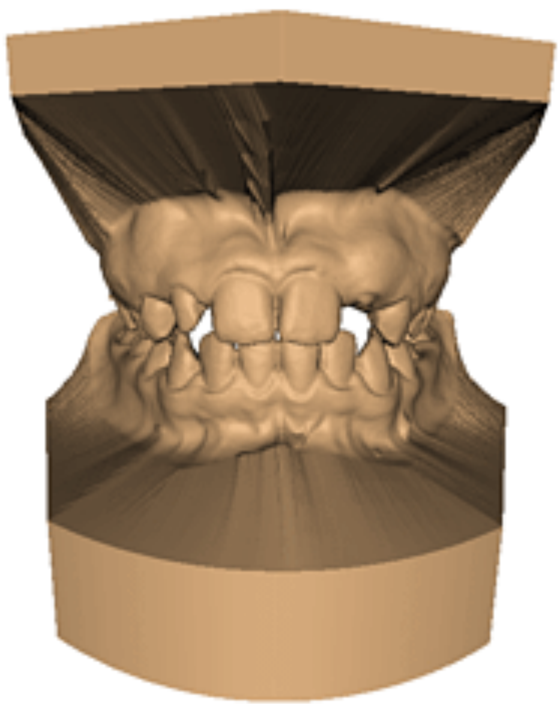


Defining a Polygonal Mesh

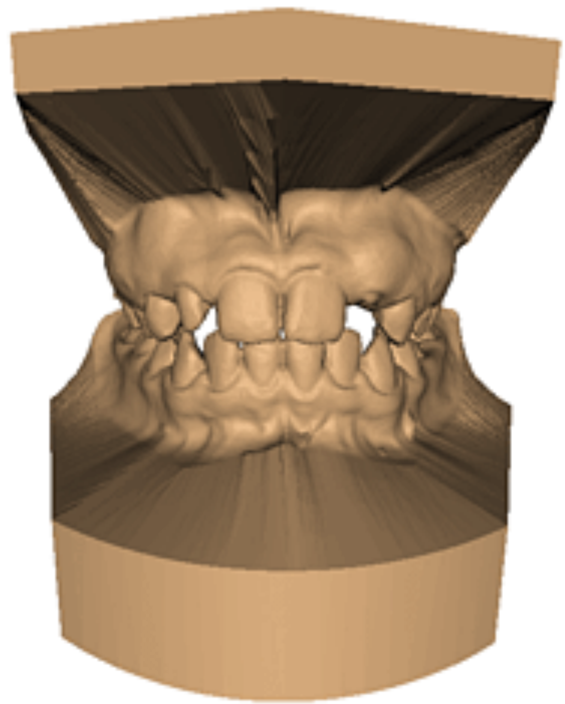
- Three lists:
  - Vertex list
    - Distinct vertices (vertex number, V_x, V_y, V_z)
  - Normal list
    - Normals to faces (normalized n_x, n_y, n_z)
  - Face list
    - Indices into vertex and normal lists. *i.e.*, vertices and normals associated with each face
- Face list convention
  - Traverse vertices *counter-clockwise*
  - Interior on left, exterior on right

WPI

3D Simplification Example



Original: 424,000 triangles



60,000 triangles (14%)

1000 triangles (0.2%)

(courtesy of Michael Garland and Data courtesy of Iris Development.)