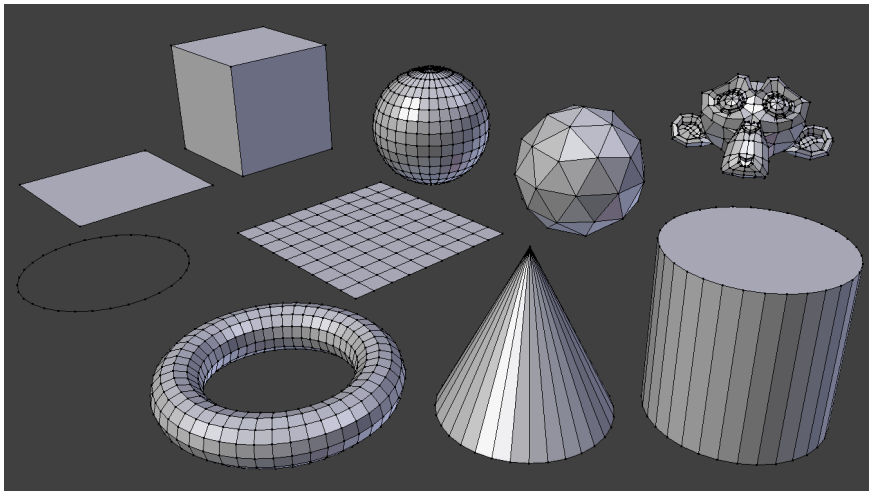
# CMSC427
# Parametric surfaces and polygonal meshes

# Note

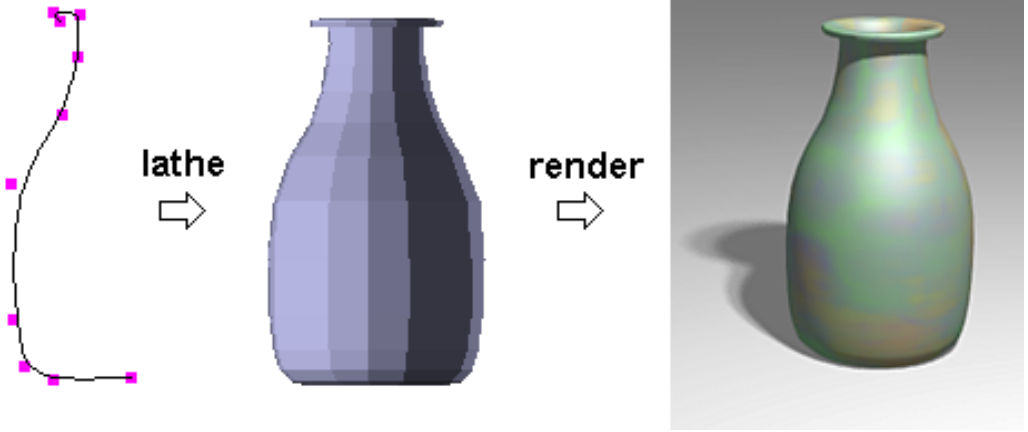
- These slides are incomplete
- See accompanying PDF with detailed outline
- Will develop many equations in class
- Reading later to supplement

# Moving to 3D

- Polygonal meshes
  - Set of standard shapes in Blender

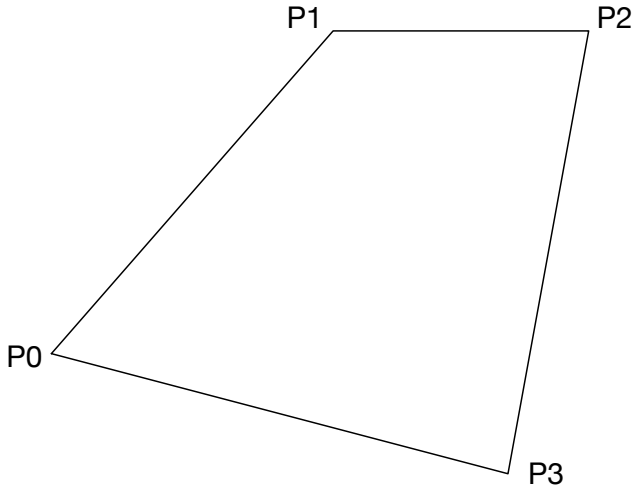


- And how to create them
  - And store them
  - And draw them



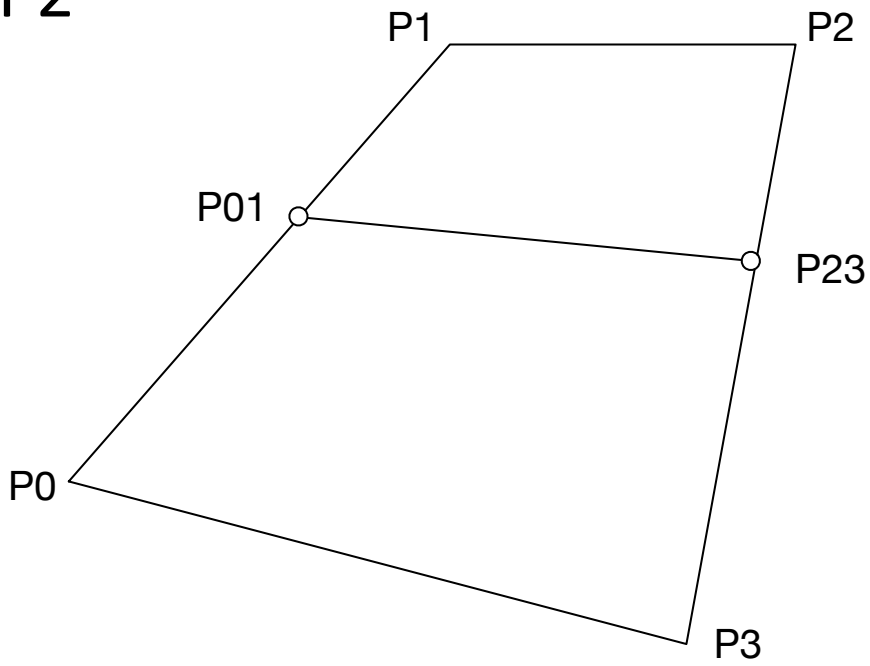
# Bilinear patch

- Blending of four 3D points
- Ruled surface
  - Swept out by sequence of lines



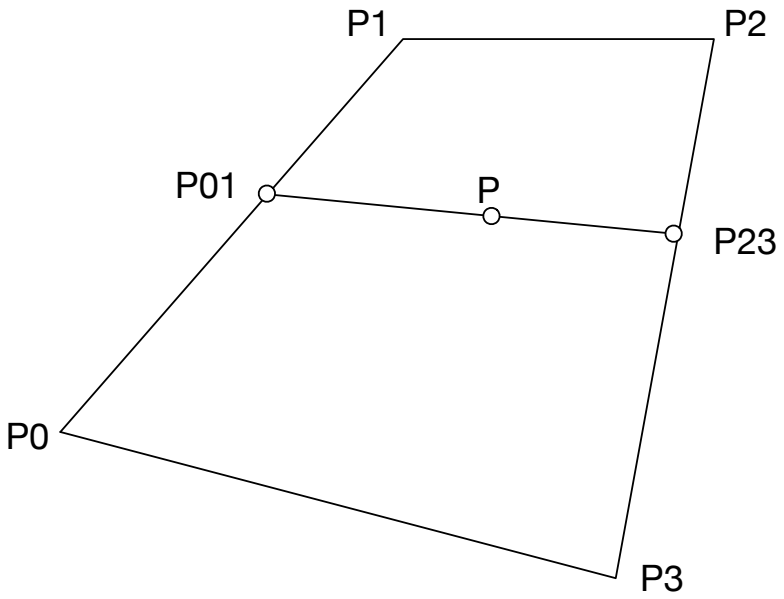

# Bilinear patch

- Blend simultaneously along two lines
- P01 = t(P1-P0) + P0
- P23 = t(P2-P3) + P2
- Same t in [0,1]



# Bilinear patch

- Blend simultaneously along two lines
- P01 = tP1 + (1-t)P0
- P23 = tP3 + (1-t)P2
- Same t in [0,1]

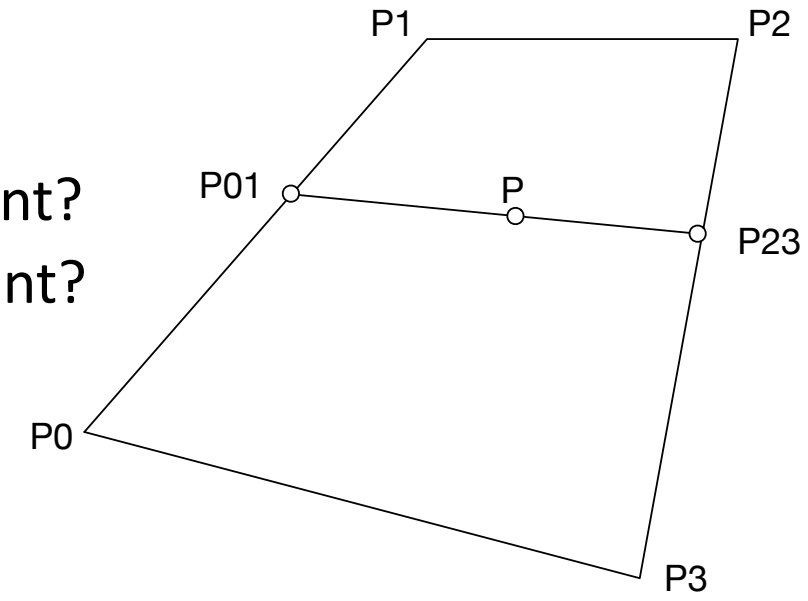



- Then blend between the two lines

- P = sP23 + (1-s)P01
- P = s(tP1 + (1-t)P0) + (1-s)(tP3 + (1-t)P2)

# Bilinear patch

- Questions
  - What order polynomial?
  - Convex combination?
  - What is drawn if t is constant?
  - What is drawn if s is constant?




- P = s(tP1 + (1-t)P0) + (1-s)(tP3 + (1-t)P2)

# Bilinear patch

- Questions
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  - Convex combination?
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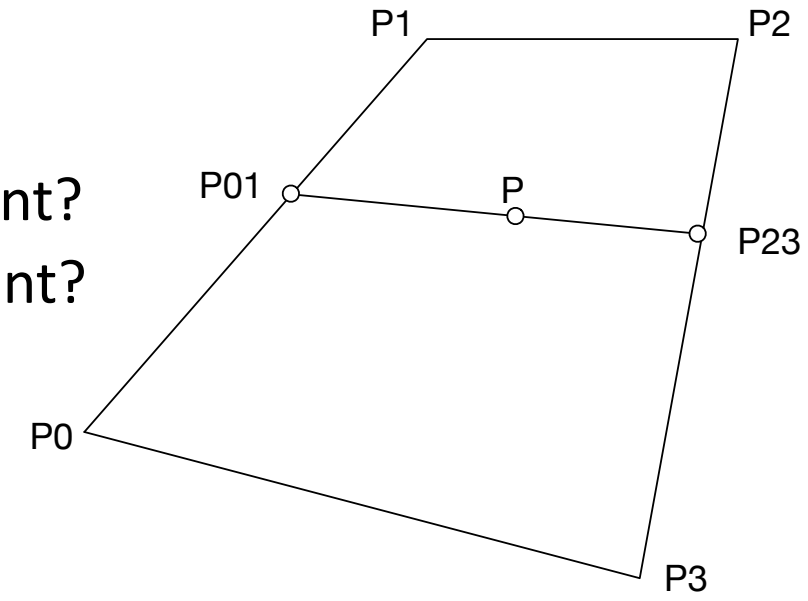
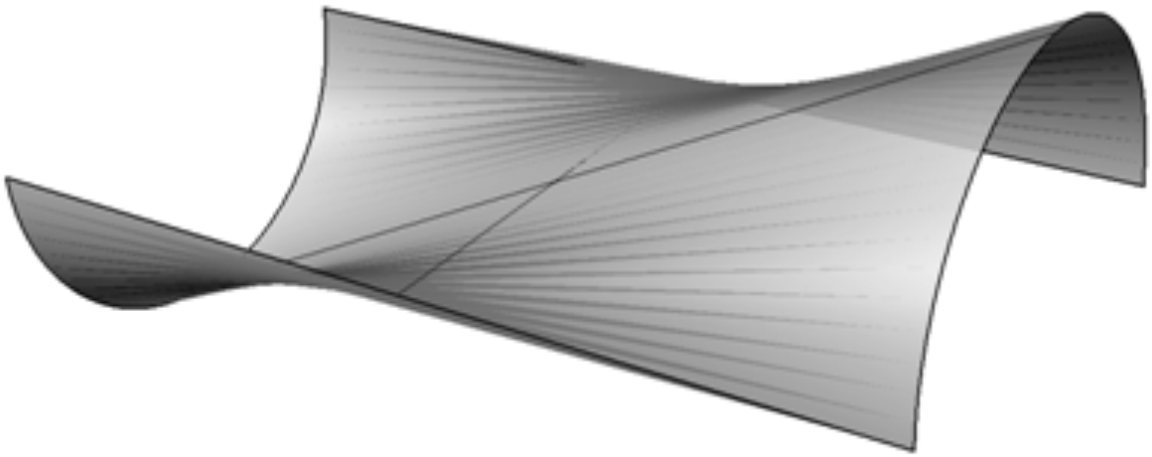



- P = s(tP1 + (1-t)P0) + (1-s)(tP3 + (1-t)P2)
- P = stP1 + s(1-t)P0 + (1-s)tP3 + (1-s)(1-t)P2

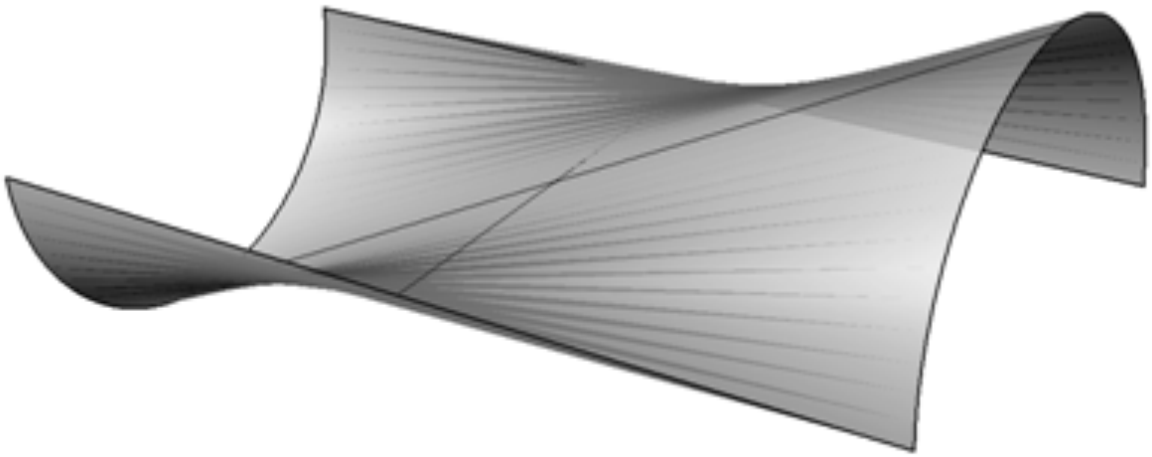
# Coons patch

- What's happening in this surface?



# Coons patch

- What's happening in this surface?

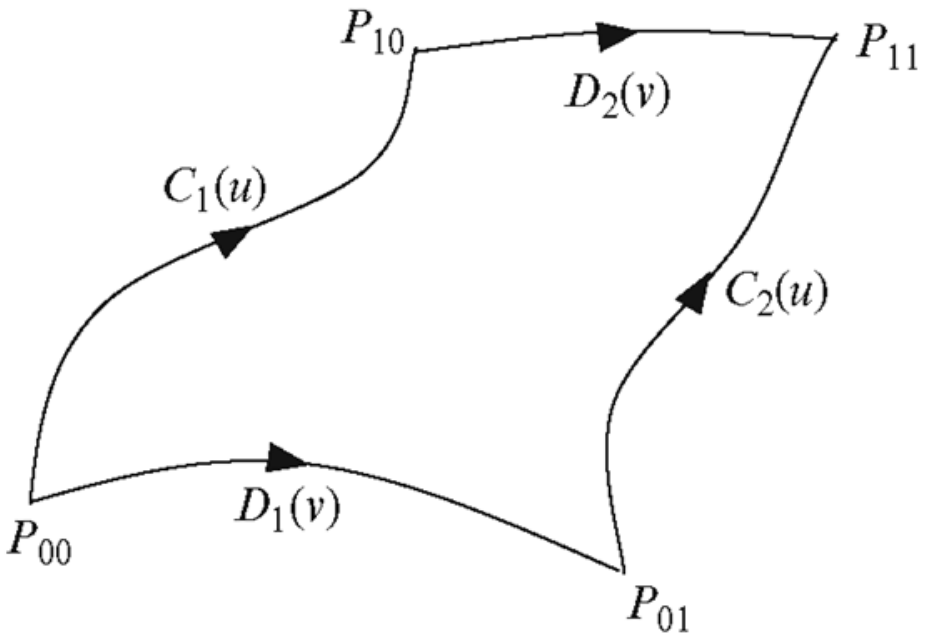


- Blending two arcs
  - Is this a ruled surface?

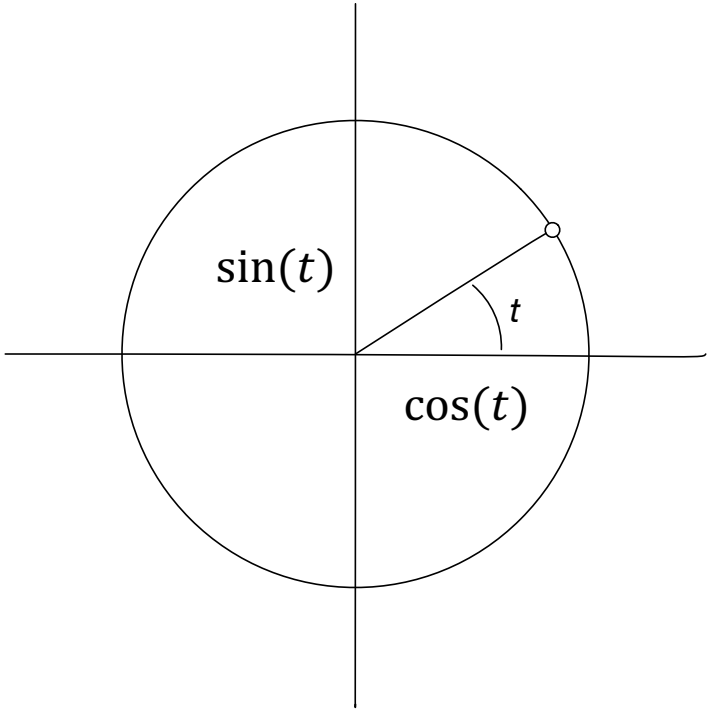
# Coons patch

- Blend four arbitrary curves

- Here C1, C2, D1, D2



# Circle with trig: review



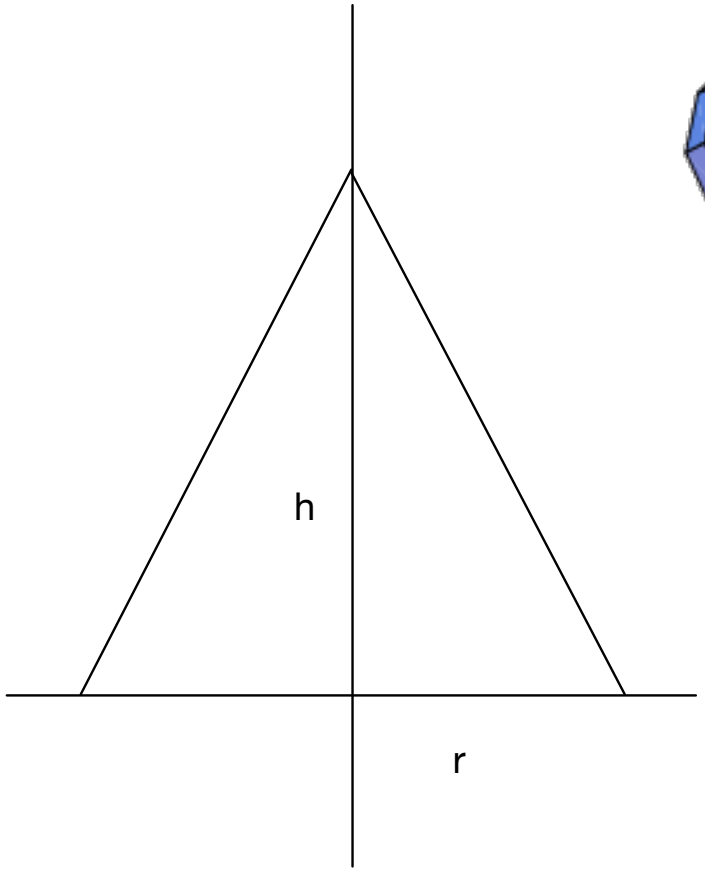

Parametric equation

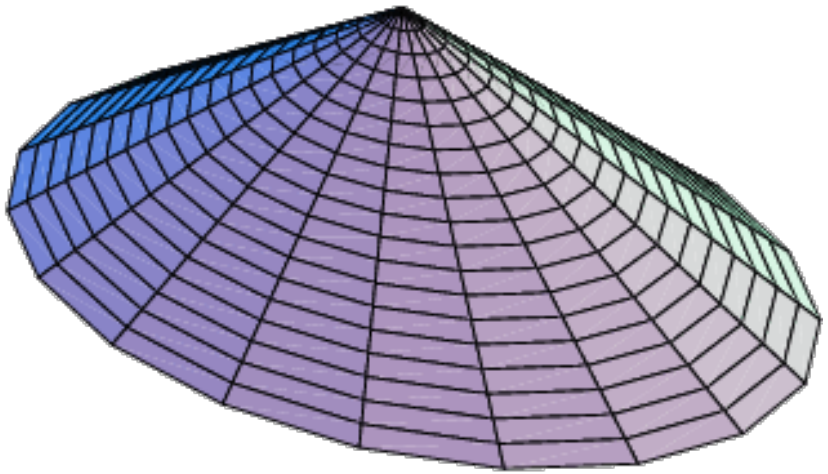
$$x = R\cos(t)$$

$$y = R\sin(t)$$

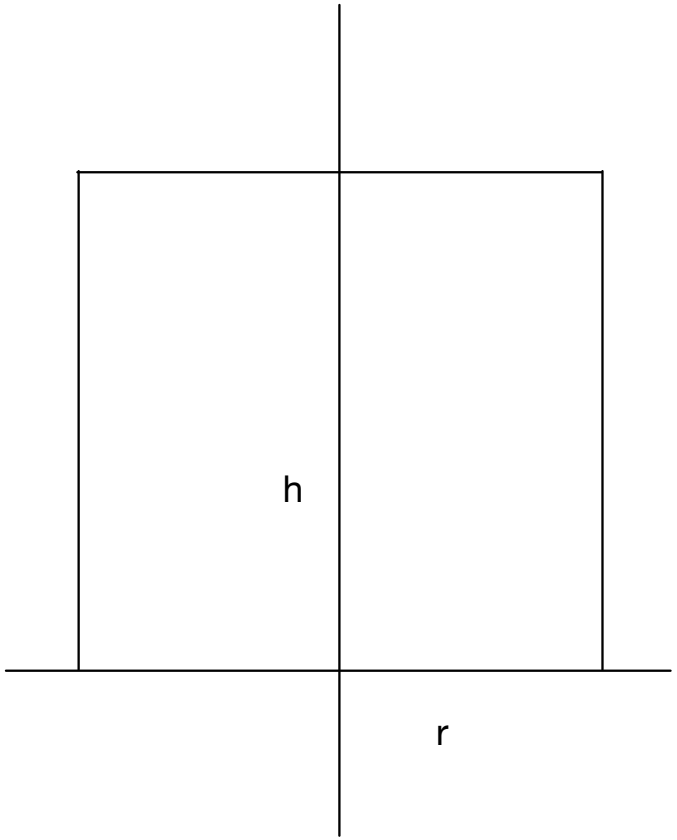
$$0 \leq t \leq ??$$

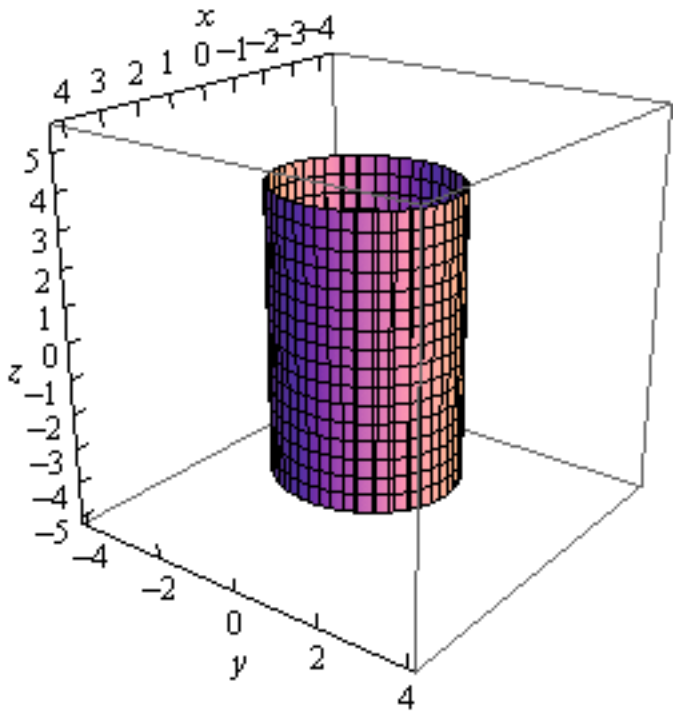
# Parametric cone



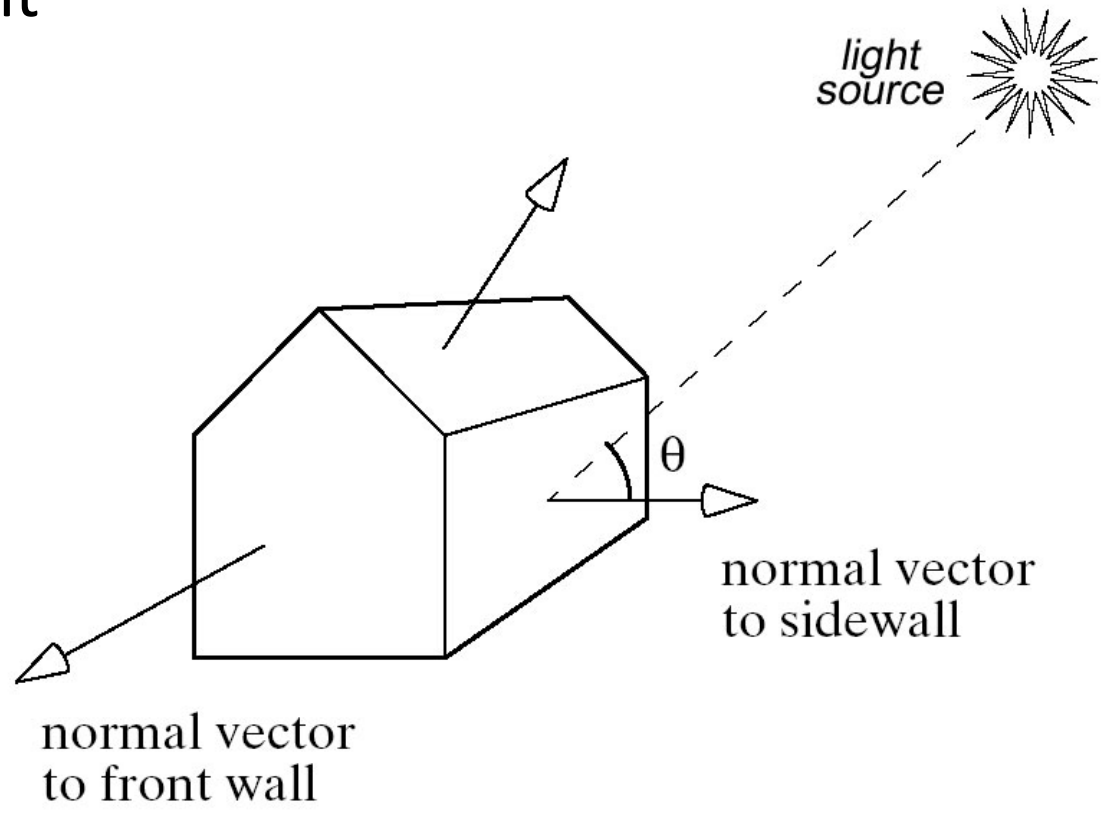
# Parametric cylinder



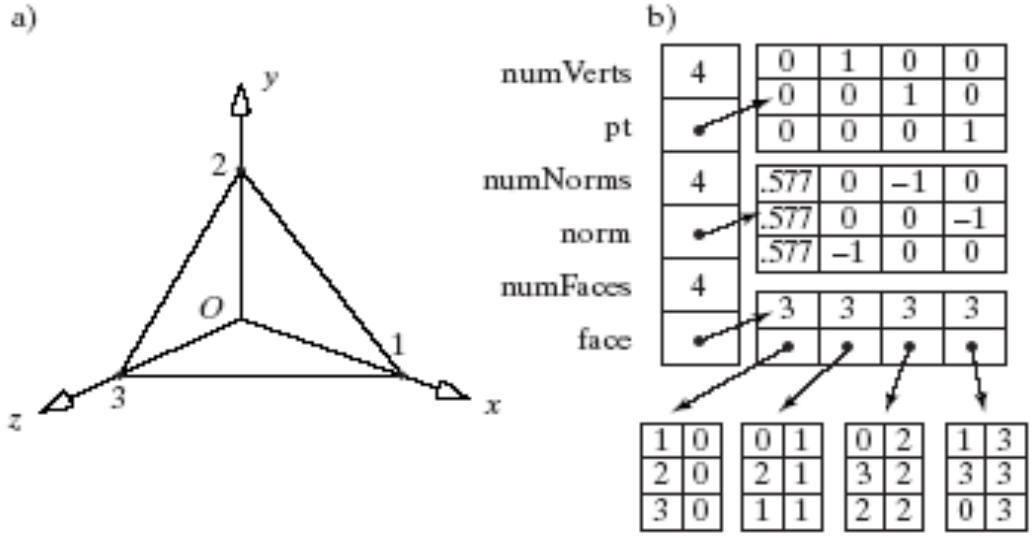
# Rendering faces: need location and normal

- Need distance and orientation relative to lights to compute reflected light



# Polygonal mesh

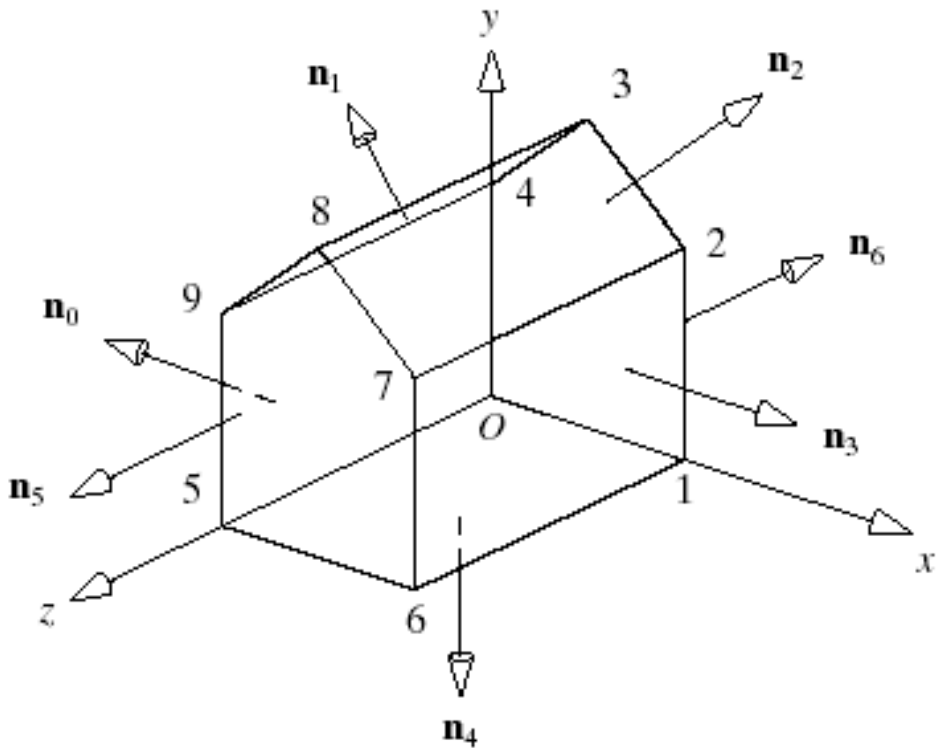
- Simplest mesh: tetrahedron
- Indexed mesh representation
  - Vertex list
  - Normal list
  - Face list




- Non-indexed representation
  - List of faces with repeated vertices

# Polygonal mesh

- Hill's barn
- 10 vertices
- 7 faces
- 7 normals



# File formats

- STL
  - https://en.wikipedia.org/wiki/STL_(file_format)
- OBJ
  - https://en.wikipedia.org/wiki/Wavefront_.obj_file
- Many others