Curved Surfaces
Not Free-form (concise description)
sphere / ellipsoid
cylinder
cone
Sampling
parameterizing

Semi-Free form
to generalize basic shapes

Surface of revolution
\( \rightarrow \) axis
\( \rightarrow \) 10 curve (or poly-line)
Cone and cylinder = special case
parameterize

Sweep / Generalized Cylinder
\[ \bigcirc \]
Sweep shape - 20, keep perpendicular
3D version
\( \Rightarrow \) bent tube
need full coordinate system if not a circle
varg shape of object
varg path
Constructive Geometry
- often w/ Solids
  Basic shapes (Primitives)
  Basic operations (union, subtract, difference)
  Complex operations (sweep)

important: Real objects are solids
Not all surfaces bound solids

Solid Modeling is hard - need to insure shape is always solid
not for graphics
Subdivision
4 pt scheme

\[
\begin{align*}
\bullet & \bullet \bullet \\
& \text{insert} \\
& - \frac{1}{16} \frac{9}{16} \frac{9}{16} \frac{1}{16}
\end{align*}
\]

interpolating - old points stay - stationary

do all round 1 pts

do all round 2 pts

Smooth $C^\alpha, \alpha < 2$ (?) \( \leq \) in the limit

Approximating
control points are not kept
- moved to a new place
- replaced

Corner cutting - Bezier construction

cut @ \( \frac{1}{4}, \frac{3}{4} \)
\( \frac{1}{2}, \frac{3}{2} \) also possible

Do 4 pt - but move old pt half way towards
midpoint of new neighbors