Surfaces of Revolution

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CSE 557
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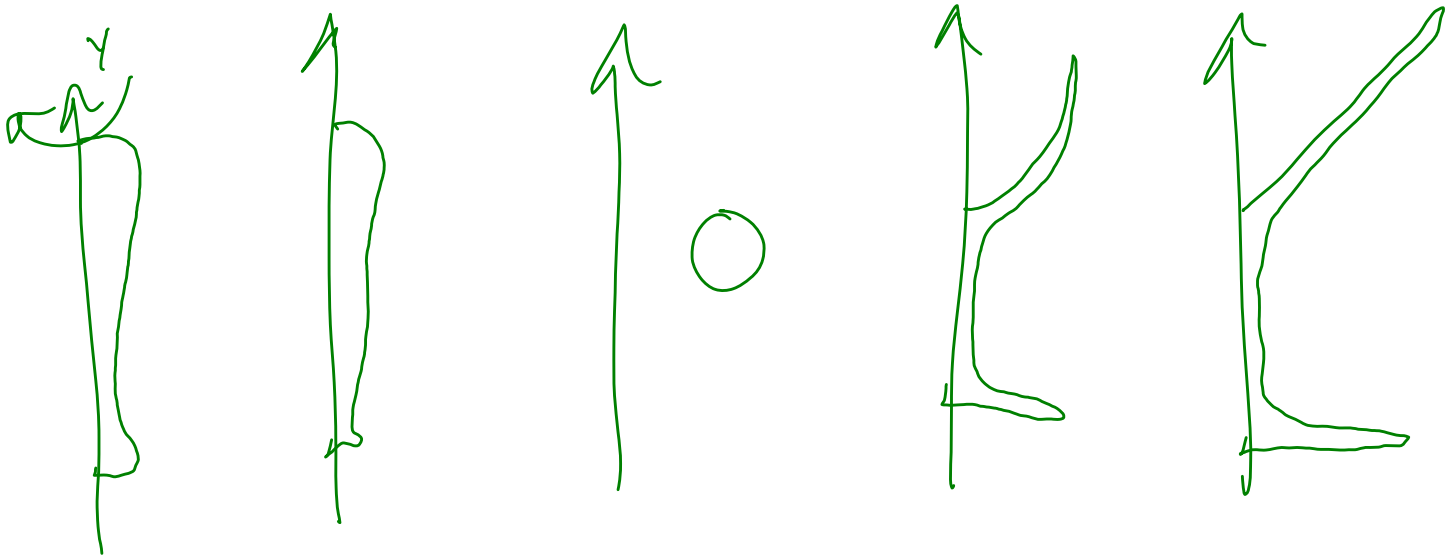
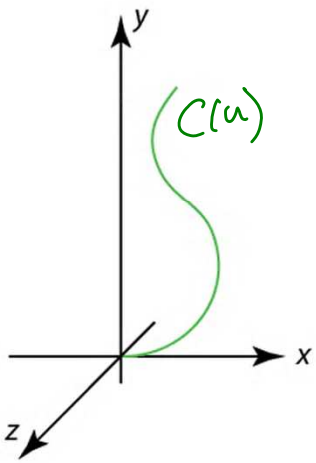
Surfaces of revolution

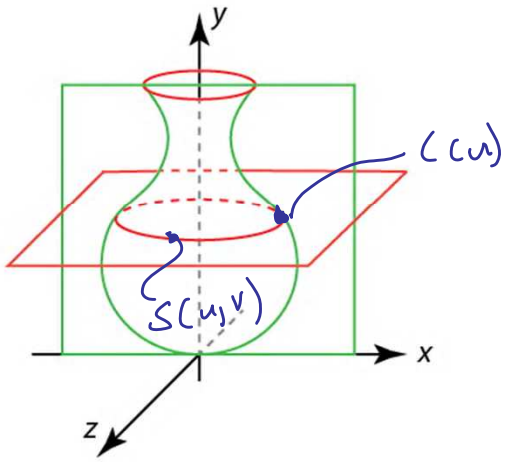


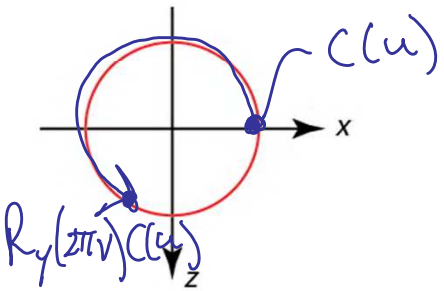
Idea: rotate a 2D **profile curve** around an axis.

What kinds of shapes can you model this way?

Constructing surfaces of revolution







Given: A curve $C(u)$ in the xy-plane:

$$C(u) = \begin{bmatrix} c_x(u) \\ c_y(u) \\ 0 \\ 1 \end{bmatrix}$$

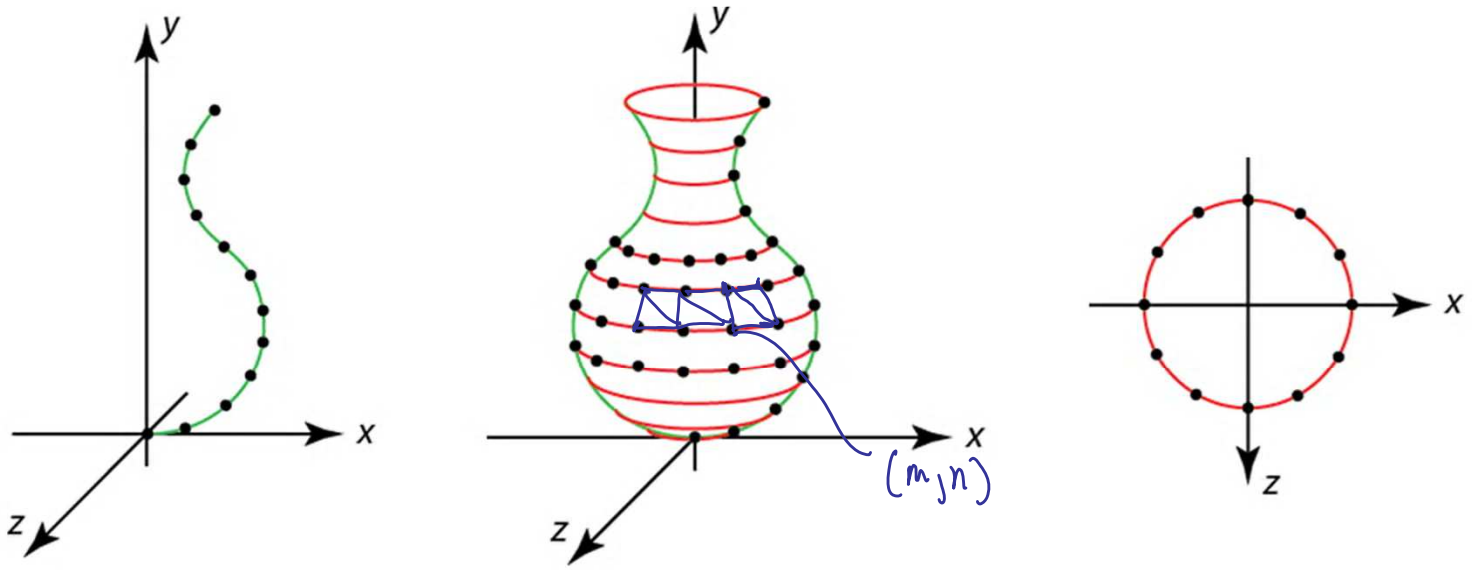
Let $R_y(\theta)$ be a rotation about the y-axis.

Find: A surface $S(u,v)$ which is $C(u)$ rotated about the y-axis, where $u, v \in [0, 1]$.

Solution: $S(u,v) = R_y(2\pi v)\,C(u)$

Constructing surfaces of revolution

We can sample in *u* and *v* to get a grid of points over the surface.



How would we turn this into a mesh of triangles?

How would we generate normals?

How would we assign texture coordinates?

Shading in OpenGL

The OpenGL lighting model allows you to associate different lighting colors according to material properties they will influence.

Thus, our original shading equation:

$$I = k_e + k_a I_{La} + \sum_j \frac{1}{a_j + b_j r_j + c_j r_j^2} I_{L,j} B_j \left[k_d \left(\mathbf{N} \cdot \mathbf{L}_j \right)_+ + k_s \left(\mathbf{N} \cdot \mathbf{H}_j \right)_+^{n_s} \right]$$

becomes:

$$I = k_e + k_a I_{La} + \sum_j \frac{1}{a_j + b_j r_j + c_j r_j^2} \left[k_a I_{La,j} + B_j \left\{ k_d I_{Ld,j} (\mathbf{N} \cdot \mathbf{L}_j)_+ + k_s I_{Ls,j} (\mathbf{N} \cdot \mathbf{H}_j)_+^{n_s} \right\} \right]$$

where you can have a global ambient light with intensity I_{La} in addition to having an ambient light intensity $I_{La,j}$ associated with each individual light, as well as separate diffuse and specular intensities, $I_{Ld,j}$ and $I_{Ls,j}$, repectively.