Symmetry

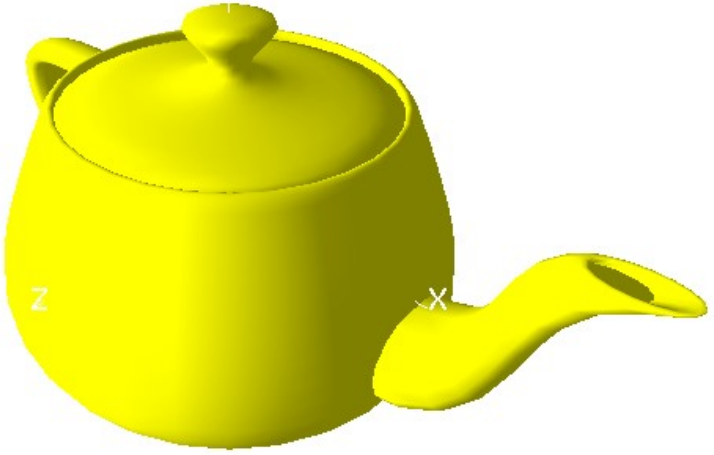
CSCI 4229/5229
Computer Graphics
Fall 2022

Symmetry is widespread.

- Bilateral (left-right) symmetry
  - Animals (at least externally)
  - Cars, airplanes, boats
  - Fractals
- Axis-symmetrical symmetry
  - Symmetric with respect to an axis
- Symmetry in rotation or translations

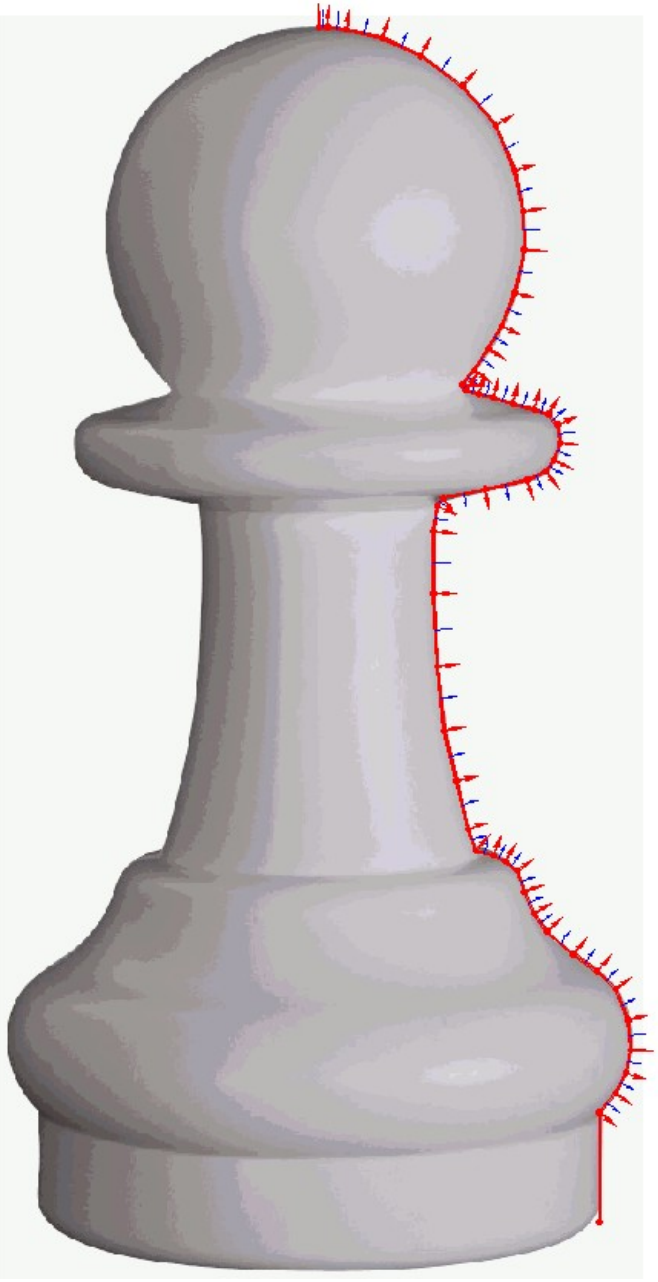
Advantages to symmetry

- You only need to figure out how to draw a fraction of the object
- Axis-symmetrical objects can be analyzed in 2D



Chess Pawn

- Axi-symmetric y-axis
- In 2D cross section
  - Digitize the outline
  - Compute normal for each facet (blue)
  - Compute average normal where facets join (red)
    - Gouraud average
- Rotate around y axis
  - $(\boldsymbol{x},\boldsymbol{y}) \Rightarrow (\boldsymbol{x}\cos\theta, \boldsymbol{y}, \boldsymbol{x}\sin\theta)$



Gouraud Averaging

- Calculate point to point vectors in 2D and normalize
  - (dx,dy)
- Rotate 90 degrees in 2D
  - (dx,dy) => (dy,-dx)
- Average and renormalize
  - First and last point are special cases
- Rotate around y axis
  - (gx,gy) => (gx cosθ , gy , gx sinθ)