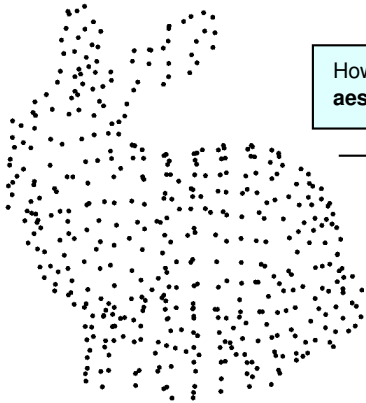# Intrinsic Shape of Point Clouds
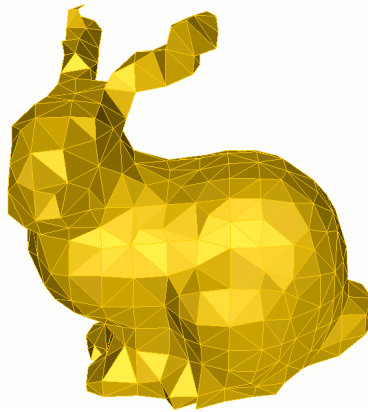
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Problem Definition
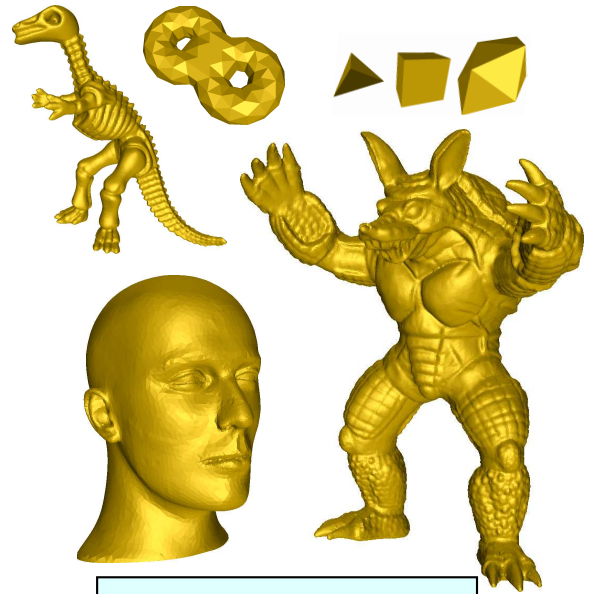find manifold surface which interpolaties an unorganized point set, using just coordinate data
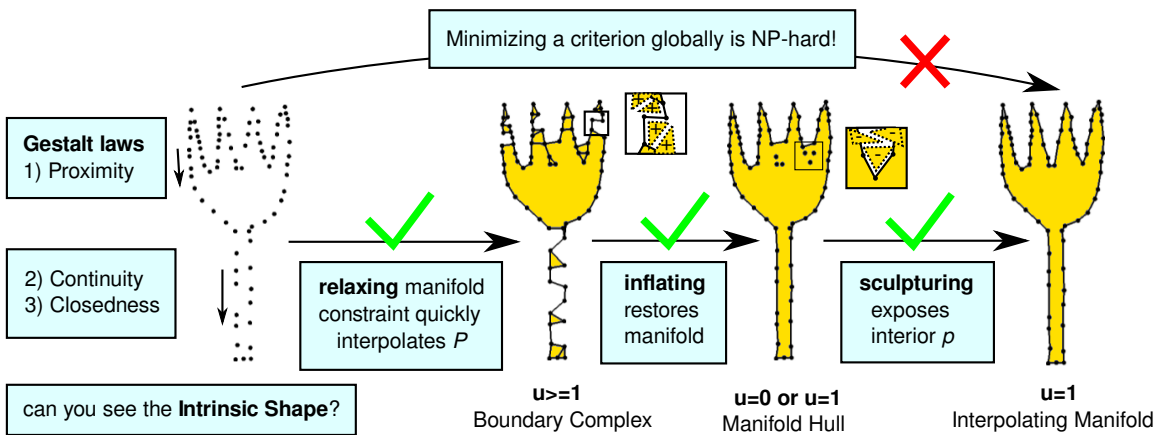
How to extract **aesthetic** shape?

Challenge: non-dense, non-uniform point spacing

Minimize surface curvature **globally**
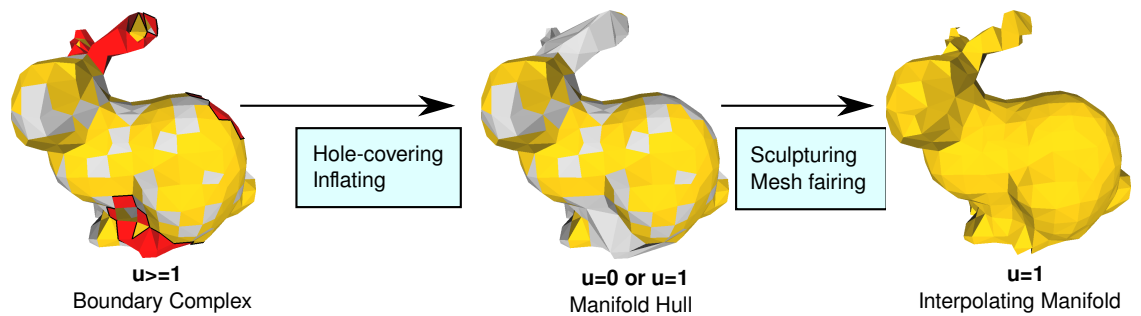
Minimizing a criterion globally is NP-hard!

2D Concept
Construct surface in steps
Vary topological constraint
u = umbrella count at *p* in hull

umbrella = incident edge-pair
-> minimize boundary length

Boundary Complex is sub-set of Delaunay Triangulation

Gestalt laws
1) Proximity

2) Continuity
3) Closedness

can you see the **Intrinsic Shape**?

relaxing manifold constraint quickly interpolates *P*

inflating restores manifold

sculpturing exposes interior *p*

u>=1
Boundary Complex

u=0 or u=1
Manifold Hull

u=1
Interpolating Manifold

3D Extension
umbrella = closed triangle fan
-> minimize surface curvature

Grey: tetrahedra
Yellow: triangles

Black: hole-boundaries
Red: inside hole-boundaries

Hole-covering
Inflating

Sculpturing
Mesh fairing

u>=1
Boundary Complex

u=0 or u=1
Manifold Hull

u=1
Interpolating Manifold

TightCocone [Dey03]
is best previous method fails for non-dense, non-uniformly spaced point sets

Our Method
much improved quality
competitive run-time
O(n log n) complexity