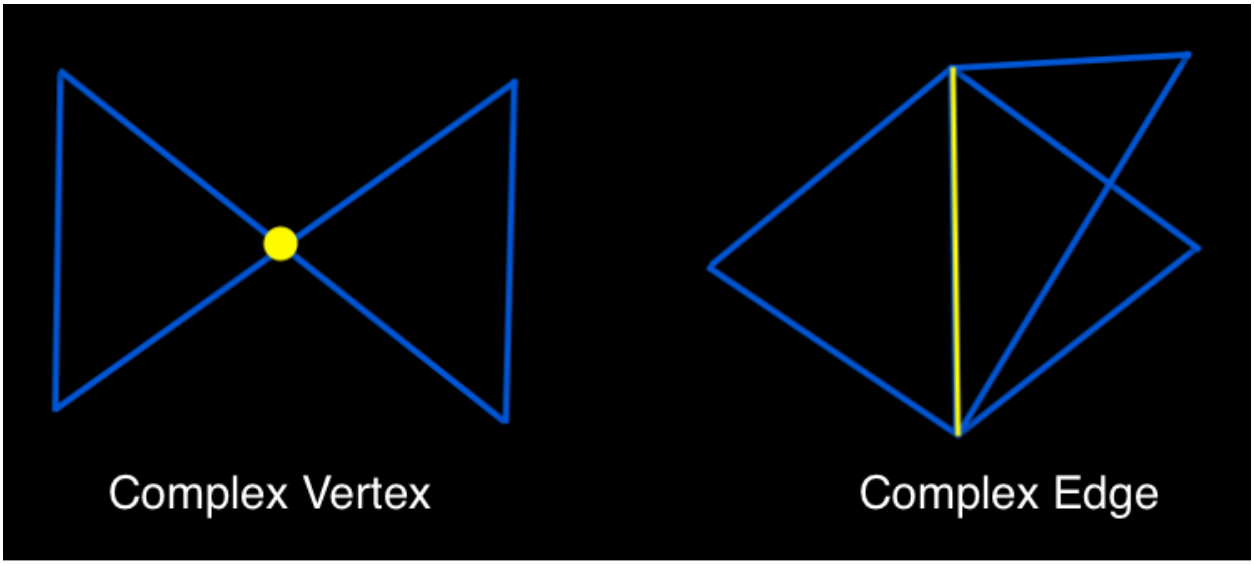
Model Repair

Model repair is the process of removing artifacts such as complex vertices and edges, inconsistent face orientations, gaps, overlaps and (self-)intersections from 3d models. Given the heterogeneous sources used today to create and collect models, repair algorithms attempt to resolve model inconsistencies and flaws by generating outputs suitable for further processing by downstream applications requiring geometrical and topological guarantees for their input.



Gueziec et al. proposed a surface-oriented method in [1] to remove complex vertices and edges from non-manifold input models. The method's output of a consistently oriented manifold mesh works efficiently and provides enough guarantees for its output to work with techniques such as compression, remeshing and smoothing. Gueziec et al.'s method has 5 steps:

1. Remove duplicate vertices and faces. Also remove any degenerate faces.

2. Identify complex vertices and edges. A complex vertex is one whose valency is not equal to the number of faces incident on it. An edge is complex if it is shared by more than 2 faces.

3. Cut the input mesh along the complex edges into separate manifold components. This involves segregating faces incident on complex vertices into components such that adjacent faces in a component only share a non-complex edge. For each component other than the first incident on a complex vertex, the vertex is duplicated and reassigned to the faces of that component.

4. Consistently orient each manifold component. This is achieved by building a spanning tree for each patch where two adjacent faces form an arc of the tree only if a consistent orientation is found across all shared edges, possibly after inverting

the orientation of one of the faces. As a result, the orientation of each face in the tree is consistent with the root face's orientation.

5. (Optional) Snap boundary edges. If the endpoints of two boundary edges are within a distance epsilon of each other, then they are stitched. If the components the edges belong to have inconsistent orientations, then the component with the smaller face count is flipped.

[1] Gueziec et al. Cutting and Stitching: Converting Sets of Polygons to Manifold Surfaces

Implementation: https://github.com/rohan-sawhney/model-repair