Assignment #5: Find Geodesic Paths by Flipping Edges

USTC, 2024 Spring

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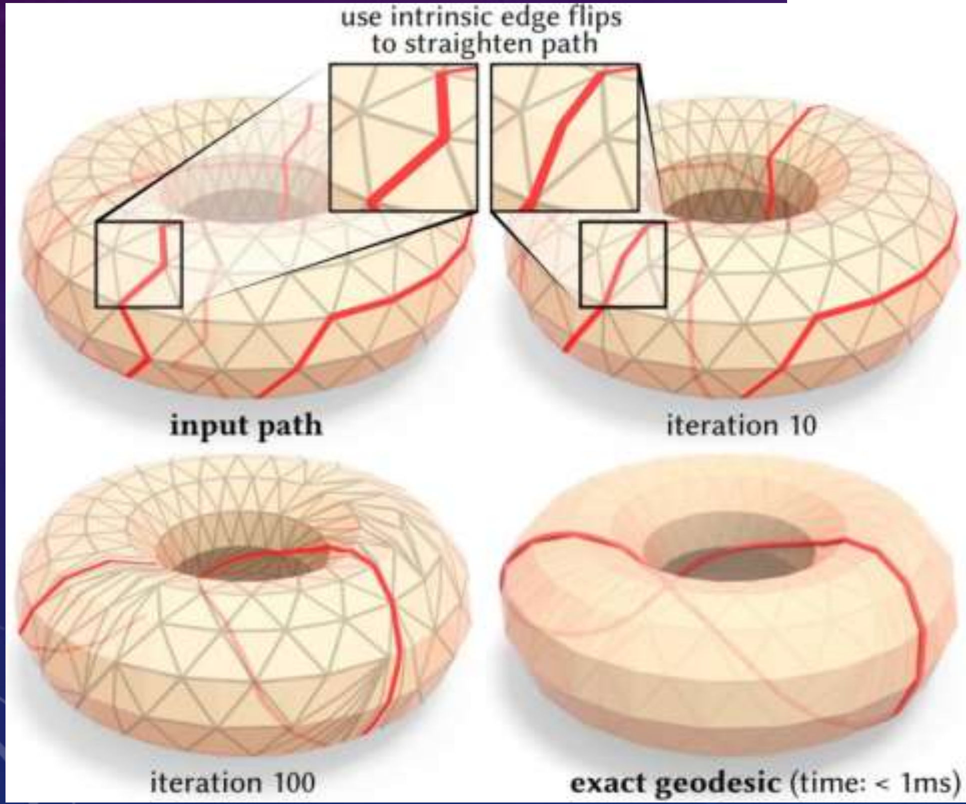
https://qingfang1208.github.io/

Implement algorithm in the following paper

You Can Find Geodesic Paths in Triangle Meshes by Just Flipping Edges

NICHOLAS SHARP and KEENAN CRANE, Carnegie Mellon University



uces a new approach to computing geodesics on polyhe- basic idea is to iteratively perform *edge flips*, in the same ic Delaunay flip algorithm. This process also produces a forming to the output geodesics, which is immediately ı geometry processing and numerical simulation. More OUT algorithm transforms a given sequence of edges into geodesic while avoiding self-crossings (formally: it finds a ıme *isotopy class*). The algorithm is guaranteed to termi- ımber of operations; practical runtimes are on the order nds, even for meshes with millions of triangles. The same applied to curves beyond simple paths, including closed orks, and multiply-covered curves. We explore how the tasks such as straightening cuts and segmentation bound- eodesic Bézier curves, extending the notion of *constrained lations (CDT)* to curved surfaces, and providing accurate ons for partial differential equations (PDEs). Evaluation tasets such as *Thingi10k* indicates that the method is both ıt, even for low-quality triangulations.

Computing methodologies → Shape modeling.

ords and Phrases: geodesic, edge flip, triangulation

Format:
ıd Keenan Crane. 2020. You Can Find Geodesic Paths in y Just Flipping Edges. *ACM Trans. Graph.* 39, 6, Article 249 15 pages. https://doi.org/10.1145/3414685.3417839

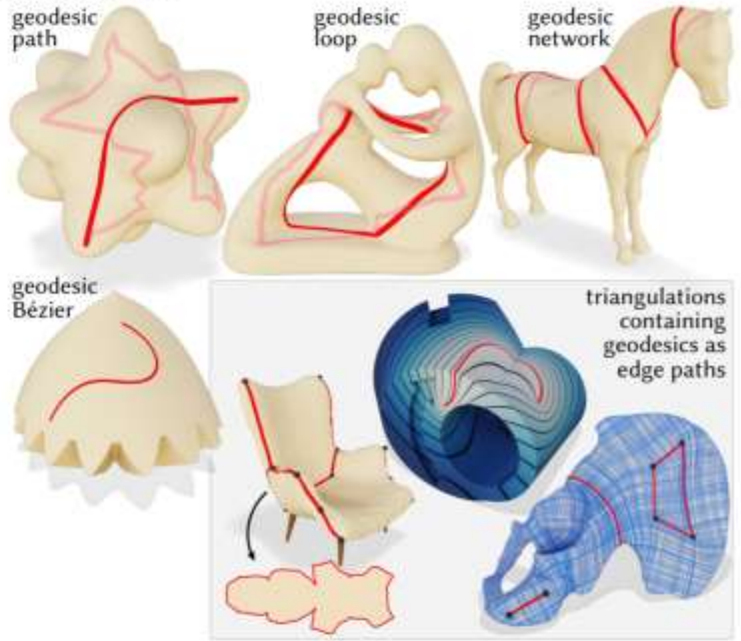
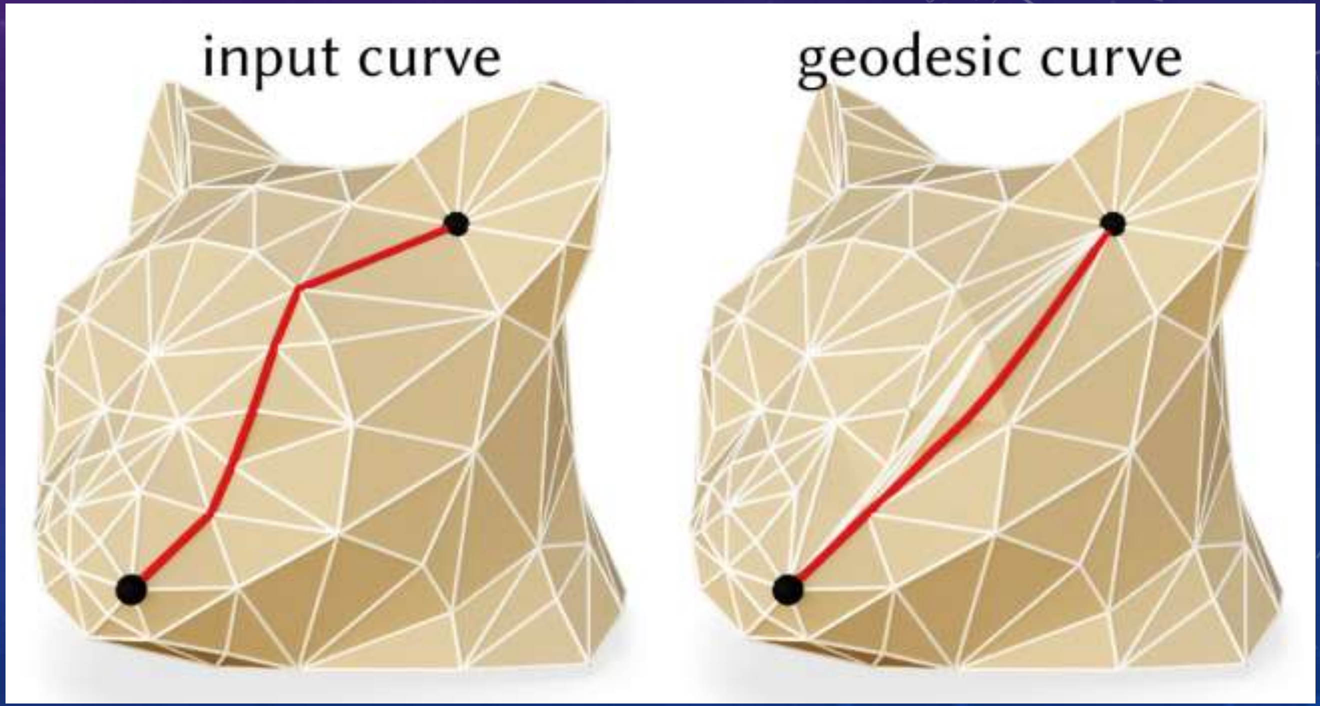


Fig. 1. We introduce an edge-flip based algorithm for computing geodesic paths, loops, and networks on triangle meshes. The algorithm also yields a triangulation containing these curves as edges, which can be used directly for subsequent geometry processing (*e.g.*, for cutting, or for solving PDEs).

Problem

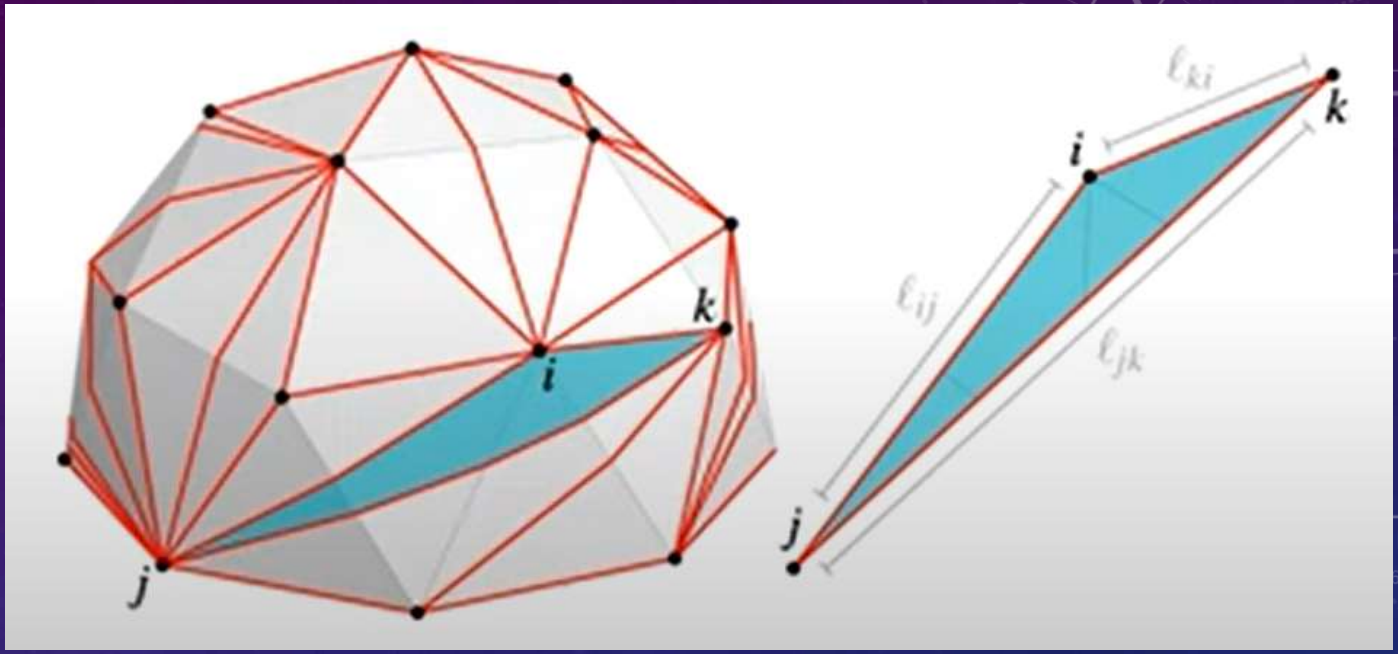
- Input: a path (or loop/network) on the surface of a mesh
- Output: an exact geodesic path (or loop/network)

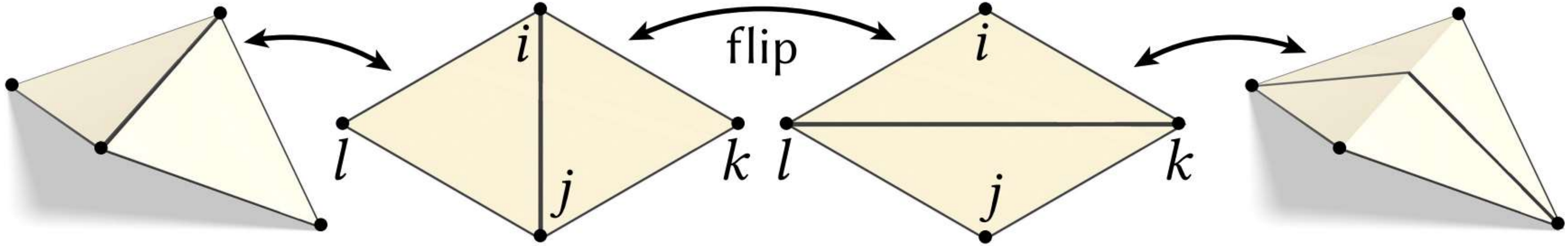


Intrinsic flip

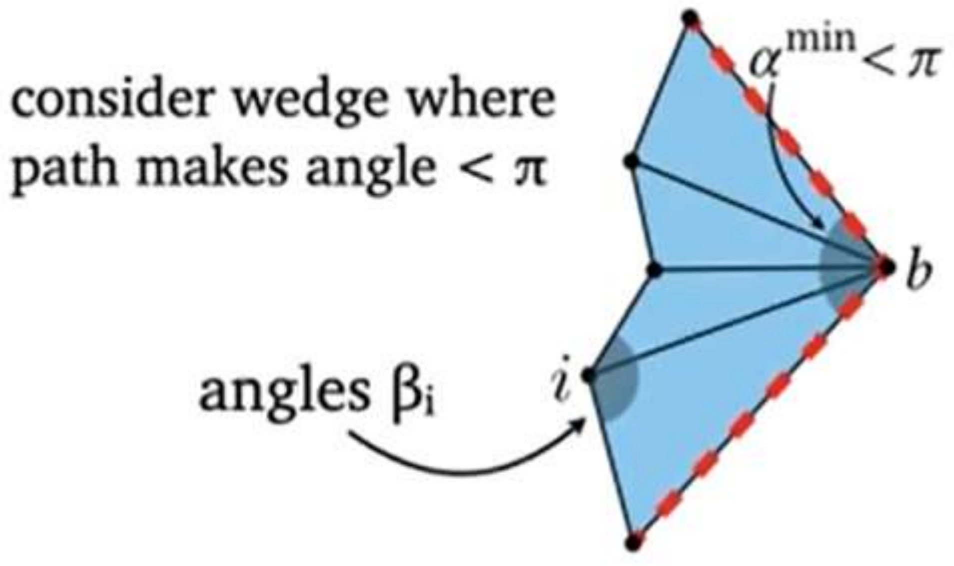
- Flip edges on a mesh

(unfolding)





FlipOut subroutine



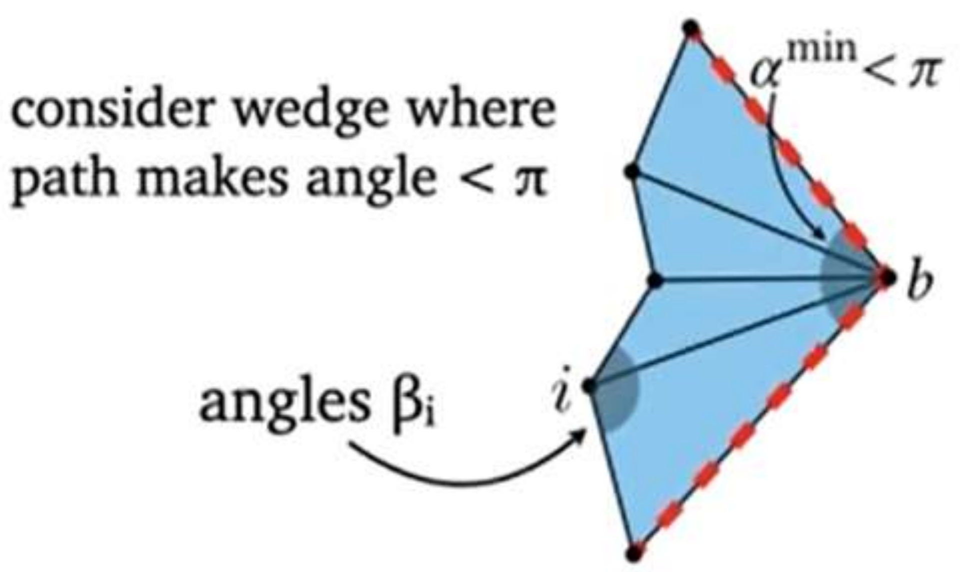
func **FlipOut()**

Input: path through vertices a,b,c

- while any $\beta_i < \pi$
  - flip first such edge *bi*

Output: shorter path along boundary

FlipOut subroutine



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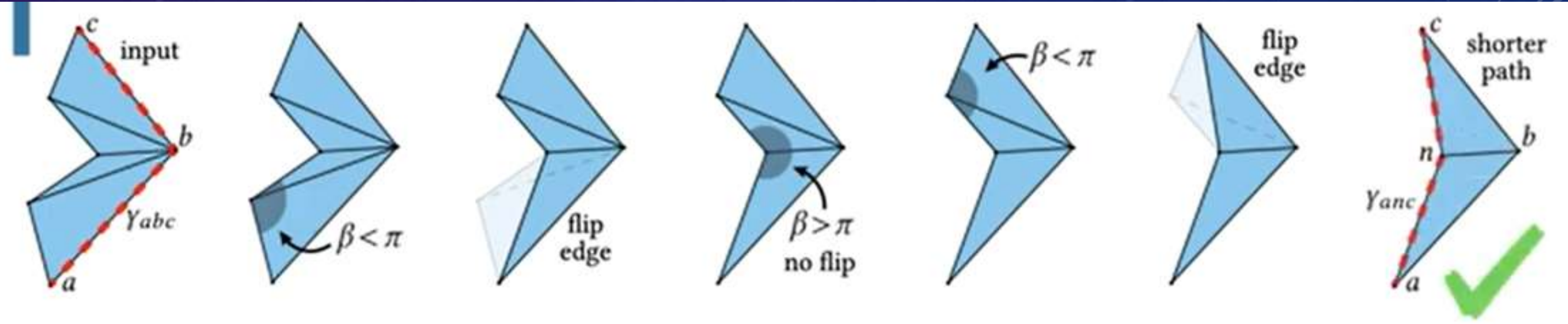
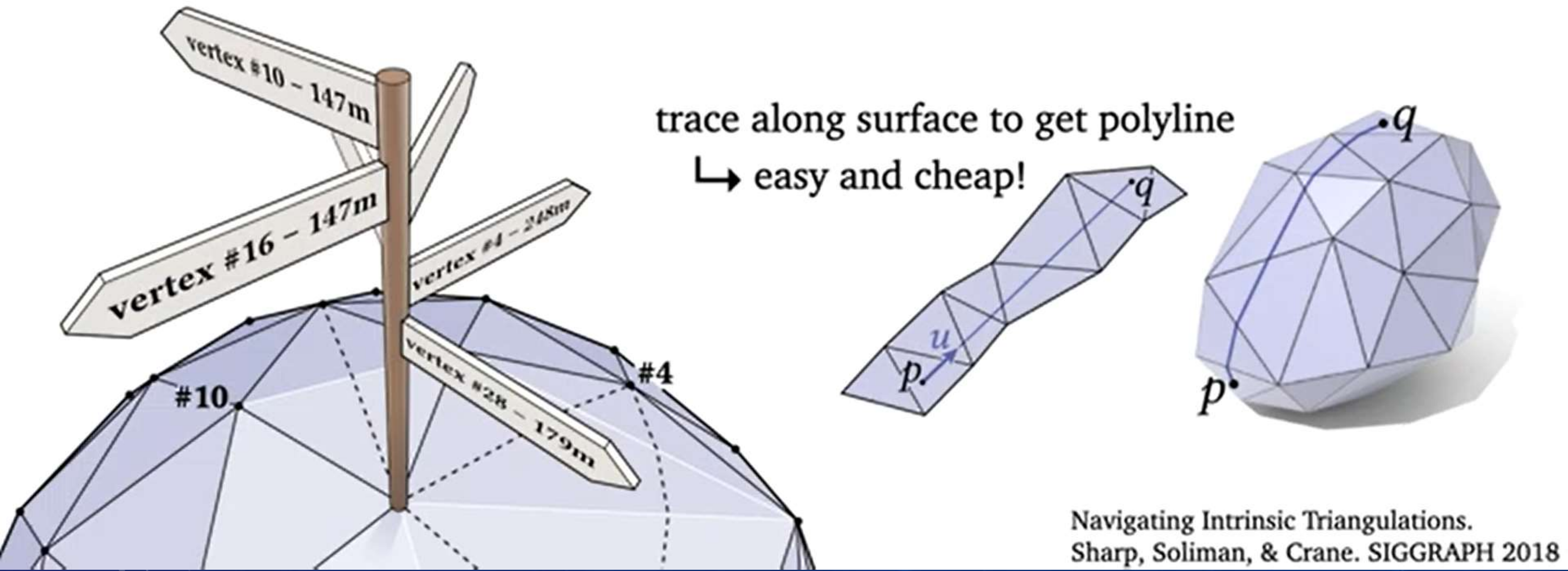
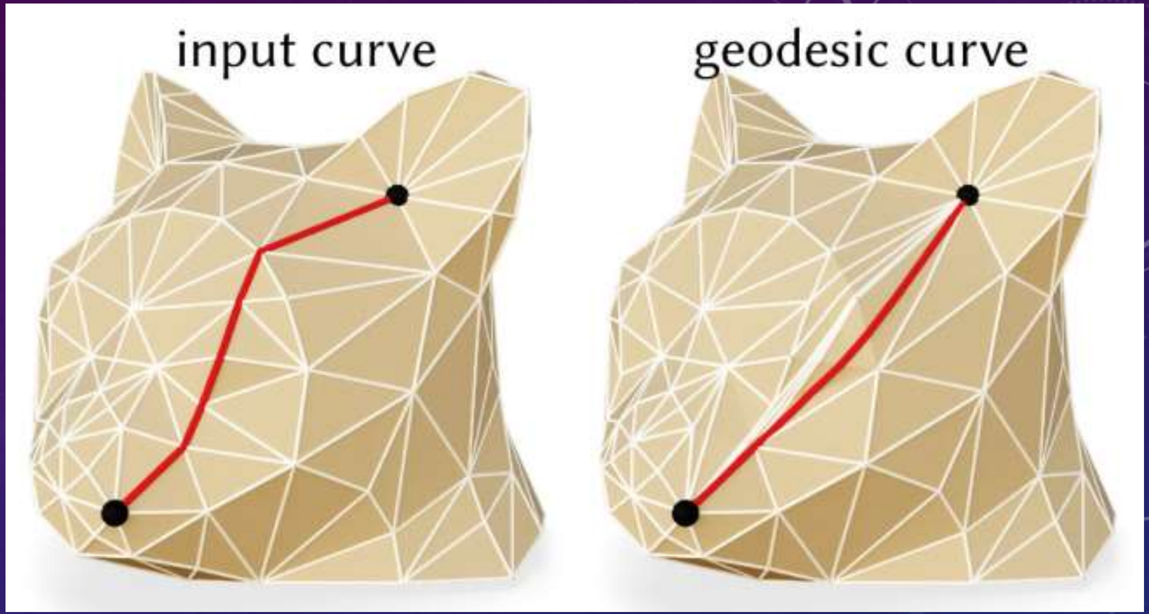


Implementation details



Assignment requirements



- Input : any two point on the mesh
- Alg:
  - Find the shortest edges' path by Dijkstra's algorithm
  - Change the path to geodesic path by flipping edges.
- Email: ID_name_homework#5.zip
- Deadline: 2024.05.01, 23:59