



A first step towards the inference of geological topological operations

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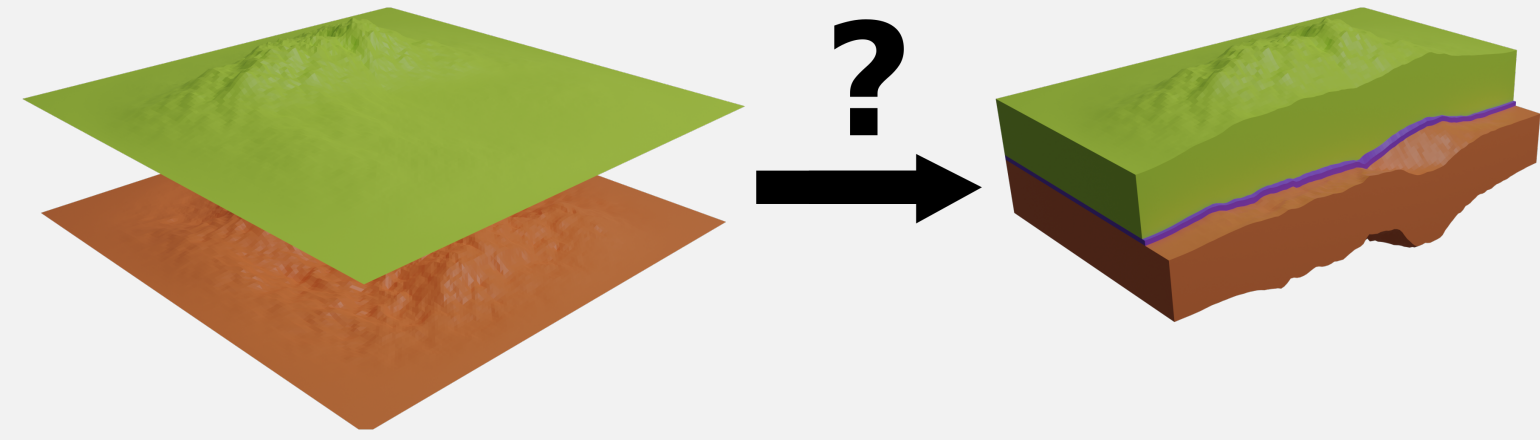
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1. Problematic and motivating context

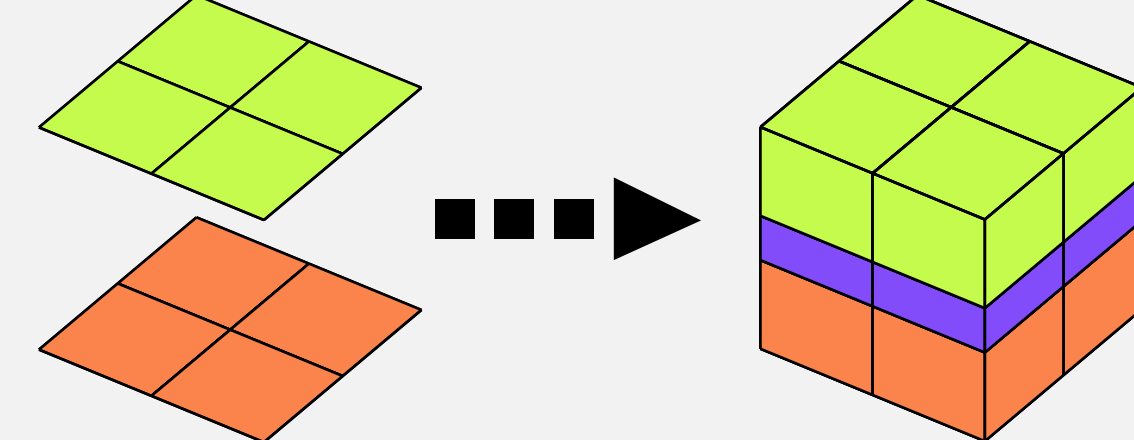
Question: How to obtain this operation ?



Before: 2 surfaces, 64516 faces, and 258064 vertices.

After: 48387 volumes, 290322 faces, and 2322576 vertices.

Intuition: It is a layering operation !



Before: 2 surfaces, 8 faces, and 32 vertices.

After: 12 volumes, 72 faces, and 288 vertices.

We offer to infer operations from a representative example.

Applicability: Should produce a valid operation.

Robustness: Should yield an operation usable in a broader context.

Simplicity: Should not require user knowledge of the data structure.

Time efficiency: Should infer in an acceptable amount of time.

Exploiting Jerboa's platform, we can use objects created in various software.

2. Topological structure

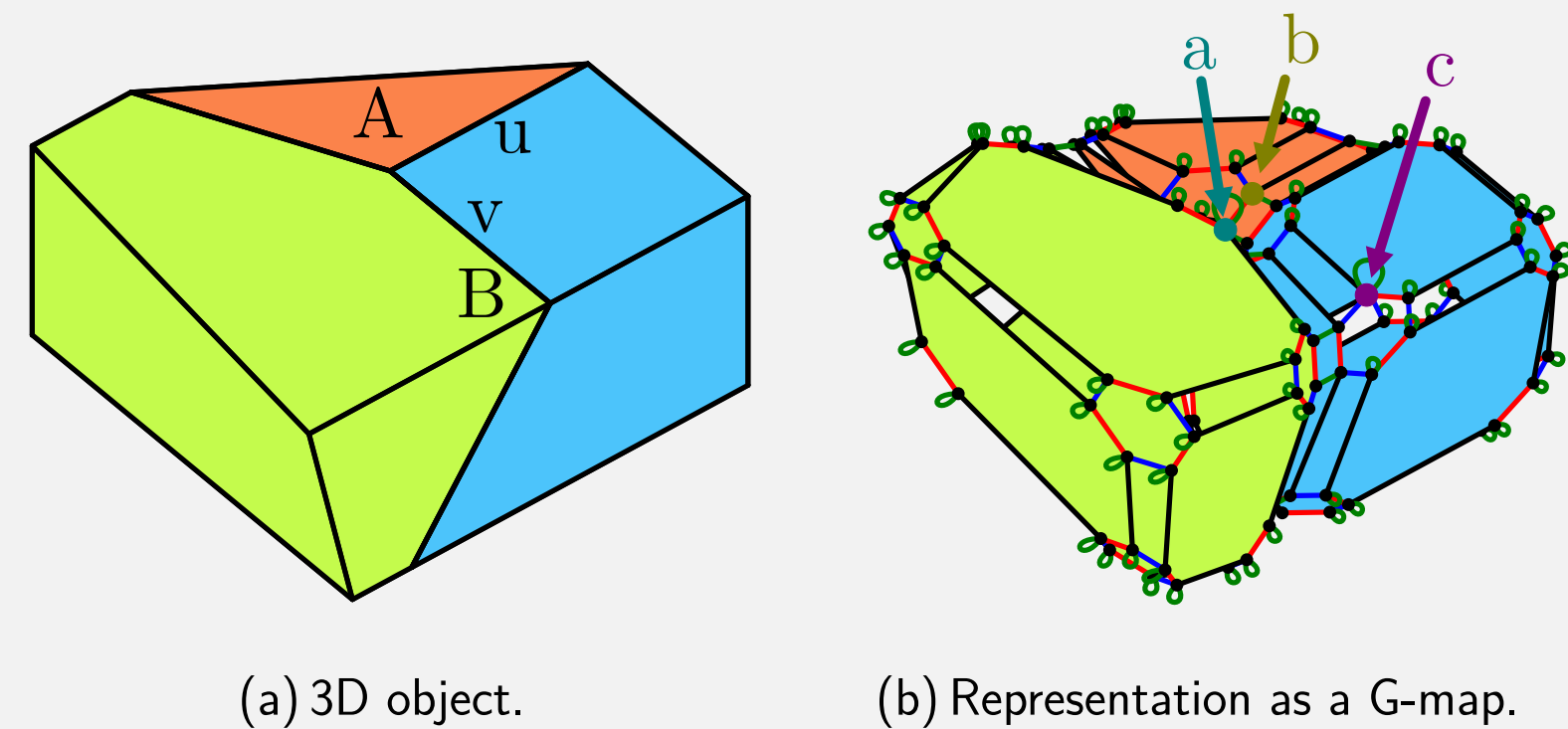


Figure 1: Generalized maps (G-maps) [DL14] as an arc-labeled graph encode the object's topological cells.

3. Modeling operations

We developed a dedicated tool with Jerboa's platform [BALGB14] supporting imports from common file formats.

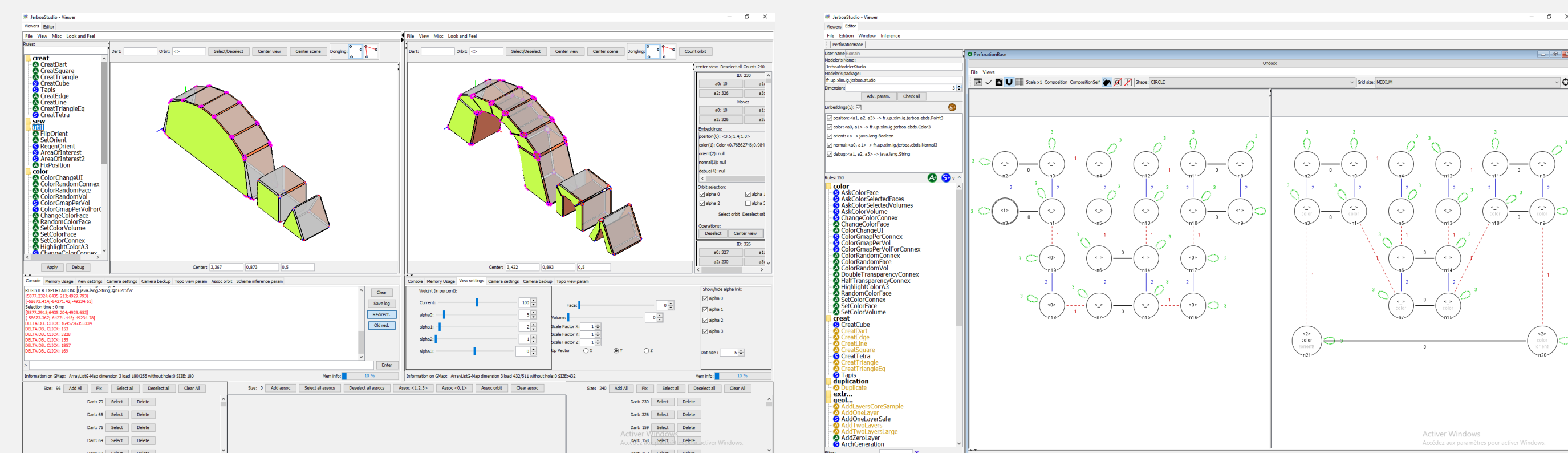


Figure 2: Viewer tab.

Figure 3: Editor tab.

The viewer tab (Fig. 2) contains both instances used for the inference. The editor tab (Fig. 3) allows visualizing the inferred operations and adding missing geometric computations.



Take a picture to
access the demo

[BALGB14] BELHAOUARI H., ARNOULD A., LE GALL P., BELLET T.:
Jerboa: A Graph Transformation Library for Topology-Based Geometric
Modeling.

In **Graph Transformation (ICGT)** (2014), Giese H., König B., (Eds.).

[DL14] DAMIAND G., LIENHARDT P.:
**Combinatorial Maps: Efficient Data Structures for Computer
Graphics and Image Processing.**
2014.

4. Method

We reverse the instantiation process by folding a graph that encodes the elements modified by the operation.

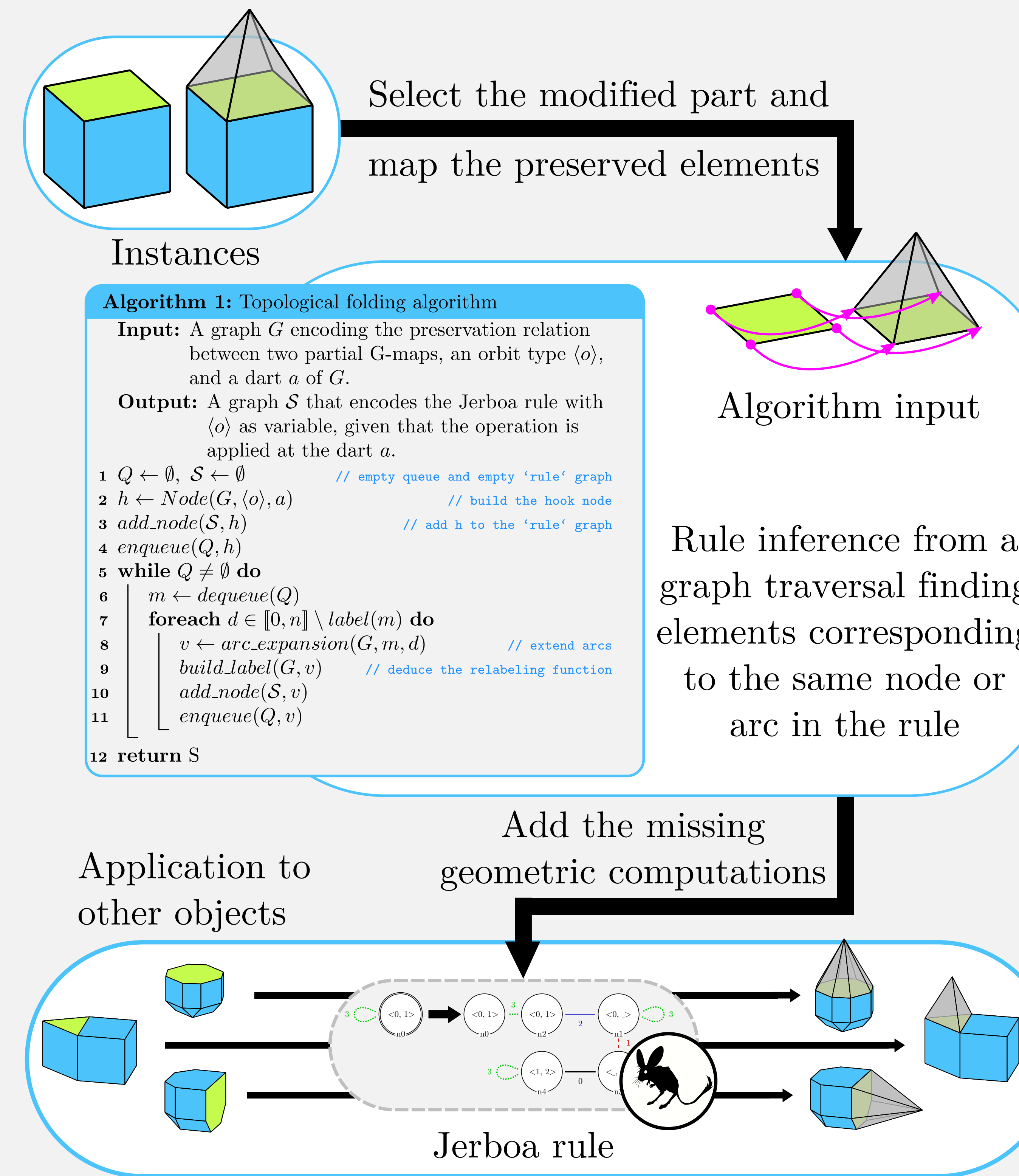


Figure 4: How to obtain a topological operation from an example.

5. Applications for procedural modeling (geology)

Layering: (a) no inter-layer, (b) one inter-layer, (c) two inter-layers, (d) six inter-layers and their inferred operations.

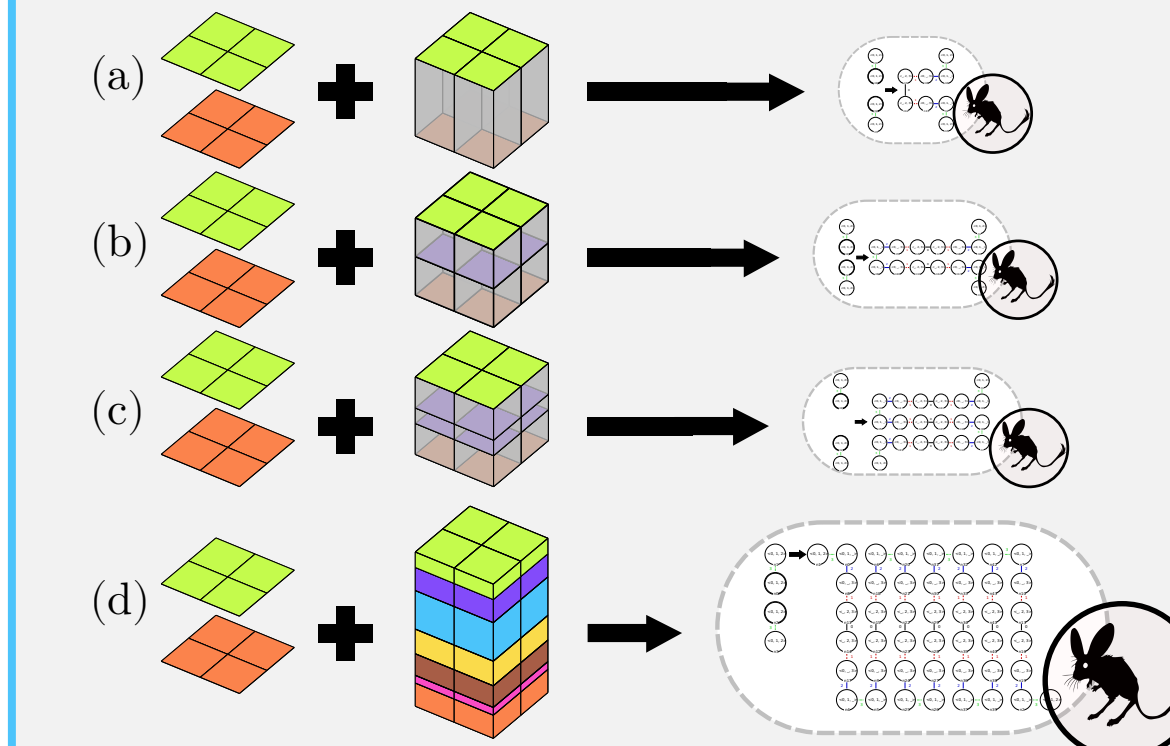


Figure 5: Layering inference.

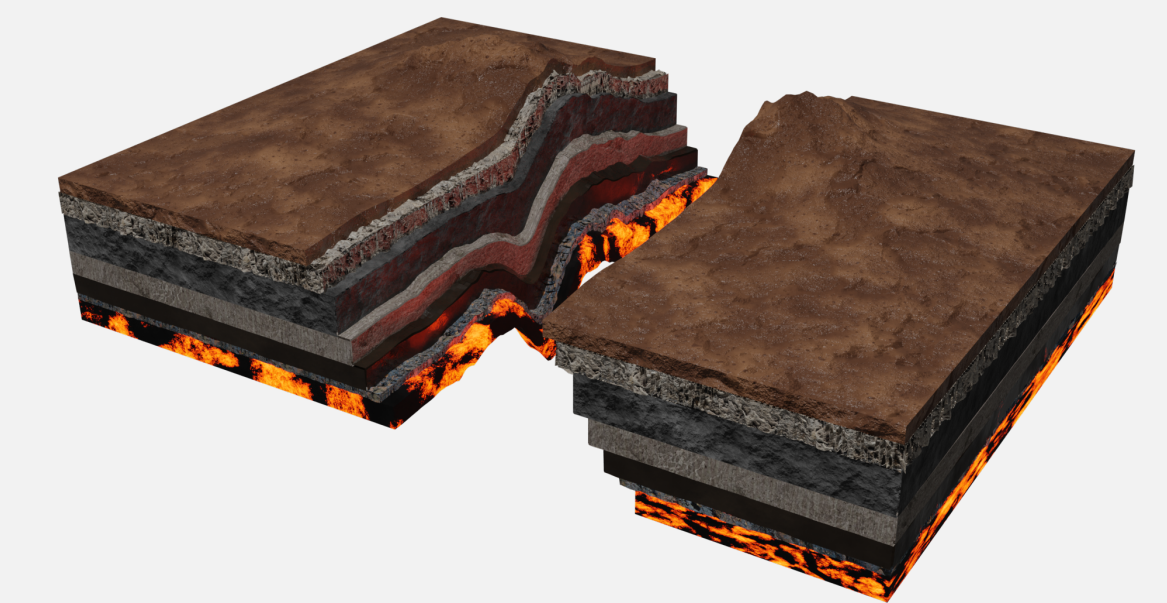


Figure 6: Final rendered subsoil.

Arch generation: (a) three-step and (b) one-step procedure by removing the base of a prism, and (c) two-step procedure by hole perforation.

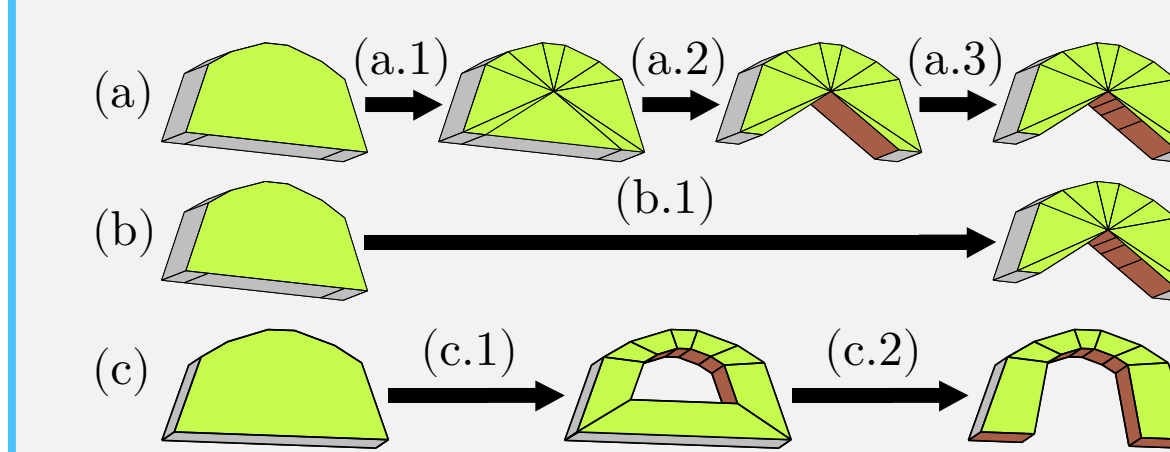


Figure 7: Arch generation inference.



Figure 8: Rendered arches in water.

The operations presented here are part of a larger procedural workflow and were obtained through our inference mechanism. We can either refine the generation by inferring simpler operations (line (a)) or realize a single step generation with the threat of inferring an operation that completely fixes the topology (line (b)).

6. Results and conclusion

Inference time:

Time in ms for the inference of the operations from applications of section 5.

Operation	Figure 5				Figure 7				
	a	b	c	d	a.1	a.2	a.3	b.1	c.1
Time (ms)	3	4	4	4	2	5	2	28	4

Limitations:

- The operation should modify a connected part of the object for the algorithm to work.
- When the algorithm does not find regularities, it produces an operation tailored to the instance given as input (e.g. operation (b) from Fig. 7).

Conclusion:

We infer any constructive or destructive topological operations from their description on a representative example (facilitated by the regularity of generalized maps and the genericity of graph-based rules).