

The GAPic Package

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The elements in X_0 are called *vertices*, the elements in X_1 are called *edges* and the elements in X_2 are called *faces*.

Definition

Let (\prec, X_0, X_1, X_2) be a triangular complex.

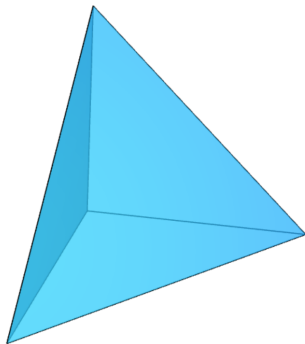
Then we call (\prec, X_0, X_1, X_2) *simplicial surface* if

- (i) $\forall e \in X_1 : |\{f \in X_2 \mid e \prec f\}| \leq 2$
- (ii) $\forall v \in X_0 : |\{f \in X_2 \mid v \prec f\}| < \infty$
- (iii) $\forall v \in X_0 : \text{there is an ordering of the } e_i, f_j \prec v \text{ such that}$

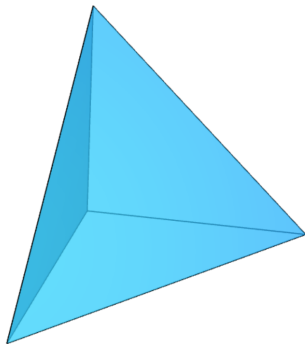
$$e_1 \prec f_1 \prec e_2 \prec f_2 \prec \cdots \prec f_{n-1} \prec e_n \prec f_n \prec e_1$$

the last condition is called the *umbrella condition*.

Example

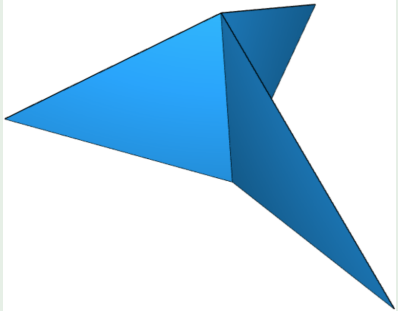
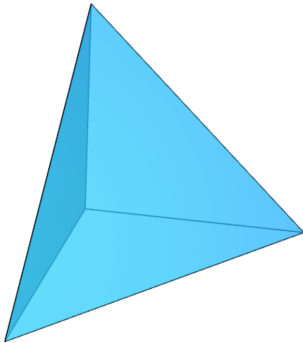


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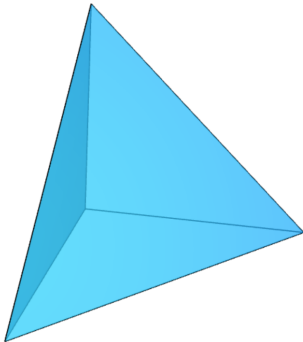
Simplicial Surface

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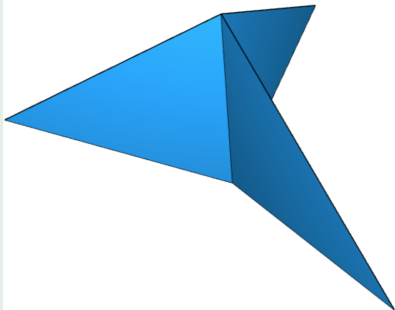


Simplicial Surface

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Triangular complex

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$$c : X_0 \rightarrow \mathbb{R}^3.$$

The image of $v \in X_0$ is called *coordinate of v* .

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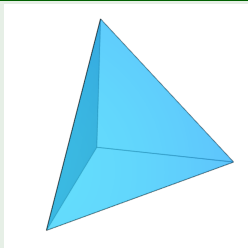
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Example



Is an embedded triangular complex.

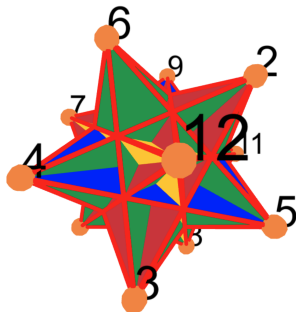
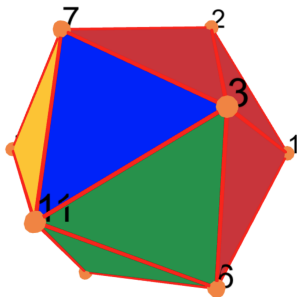
Simplicial Surfaces Package

- Has functionality for displaying surfaces
 - Generates a .html file
 - Uses three.js

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Example (Number 2.1 and 2.2 from [1])



Fachpraktikum

Was a project with the goal to improve the visualizations by adding shading/local lighting

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THREE.Geometry will be removed from core with r125

Discussion

geometry

**Mugen87** ✓

3 ✎ Jan '21

The upcoming release r125 will contain a major, potentially breaking change. The class `THREE.Geometry` will be no longer part of the core but moved to `jsm/deprecated/Geometry.js`. It will only be available as an ES6 module and not as a global script.

Goal

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Implement shading in the visualizations of the Simplicial Surface package.

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First Approach: Implement directly

→ Learn how the output is generated

Uses a class called `THREE.Geometry`

Workflow

But: In newer revisions of three.js shading is already implemented.
→ After some promising tests: Decided to rewrite the entire function.

Demo

We need to switch to the browser for this.
For one example we use [1]

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ToDo

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Advantages

- New security requirements of javascript and modern browsers: need to load the code from server → way smaller file sizes (for small examples 9kB vs. 539kB)
- More efficient Animations, faster loading, fewer memory (Demo in Browser)
- Also works for triangular complexes
→ Does not depend on incidence structure for visualization (Demo in Browser)

Future

- More functions in the GUI, e.g.
 - Turning the vertices on and off
 - Changing location of a vertex on the fly
- More options materials
e.g. Color dependent on the normal of the polygon
(Demo in browser)
- Intersection planes
(Demo in browser)

Thank You for your attention

Are there Questions?

- [1] Karl-Heinz Brakhage et al. *The icosahedra of edge length 1*. 2019. DOI: 10.48550/ARXIV.1903.08278. URL: <https://arxiv.org/abs/1903.08278>.