Black-Box Analysis:

From Theory to **Practice**

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Getting Started

- The libraries we will be using are implemented in C++ for efficiency reasons, but are exposed to python for ease of integration

- All libraries are available on Conda, they can be installed with

```
conda install meshplot
conda install igl
conda install wildmeshing
conda install polyfempy
```

Libraries Overview

Cross Platform: Windows, MacOSX, Linux

MeshPlot

Jupyter Tutorial

skoch9/meshplot
8 Stars · 2 Forks

meshplot

Home

Jupyter Tutorial

Docs

Visualizing Surfaces

We can visualize surfaces, their properties and additional debugging information through the `plot` function. Let's visualize the previously loaded triangle mesh:

```
mp.plot(v, f)
```

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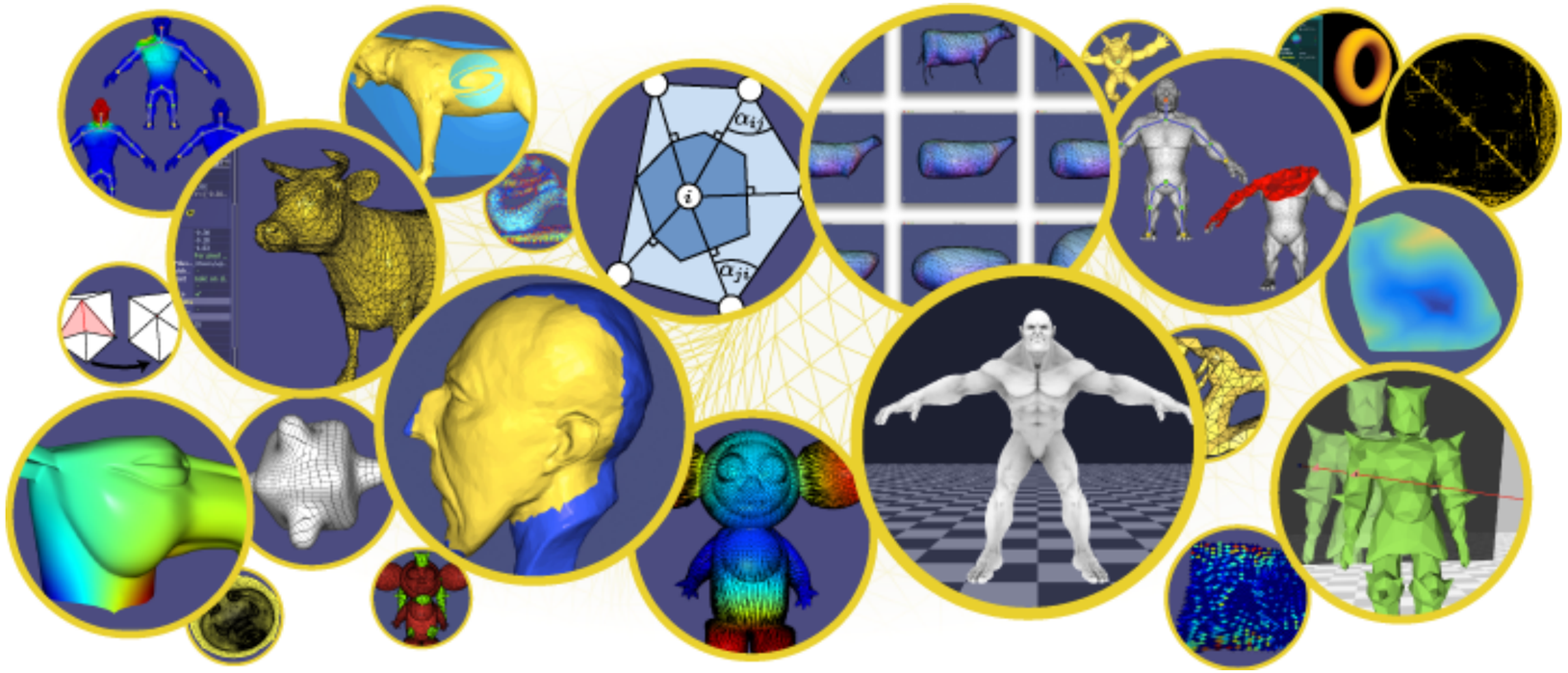
https://skoch9.github.io/meshplot/

Install with conda

Interactive Geometry Library (libigl)



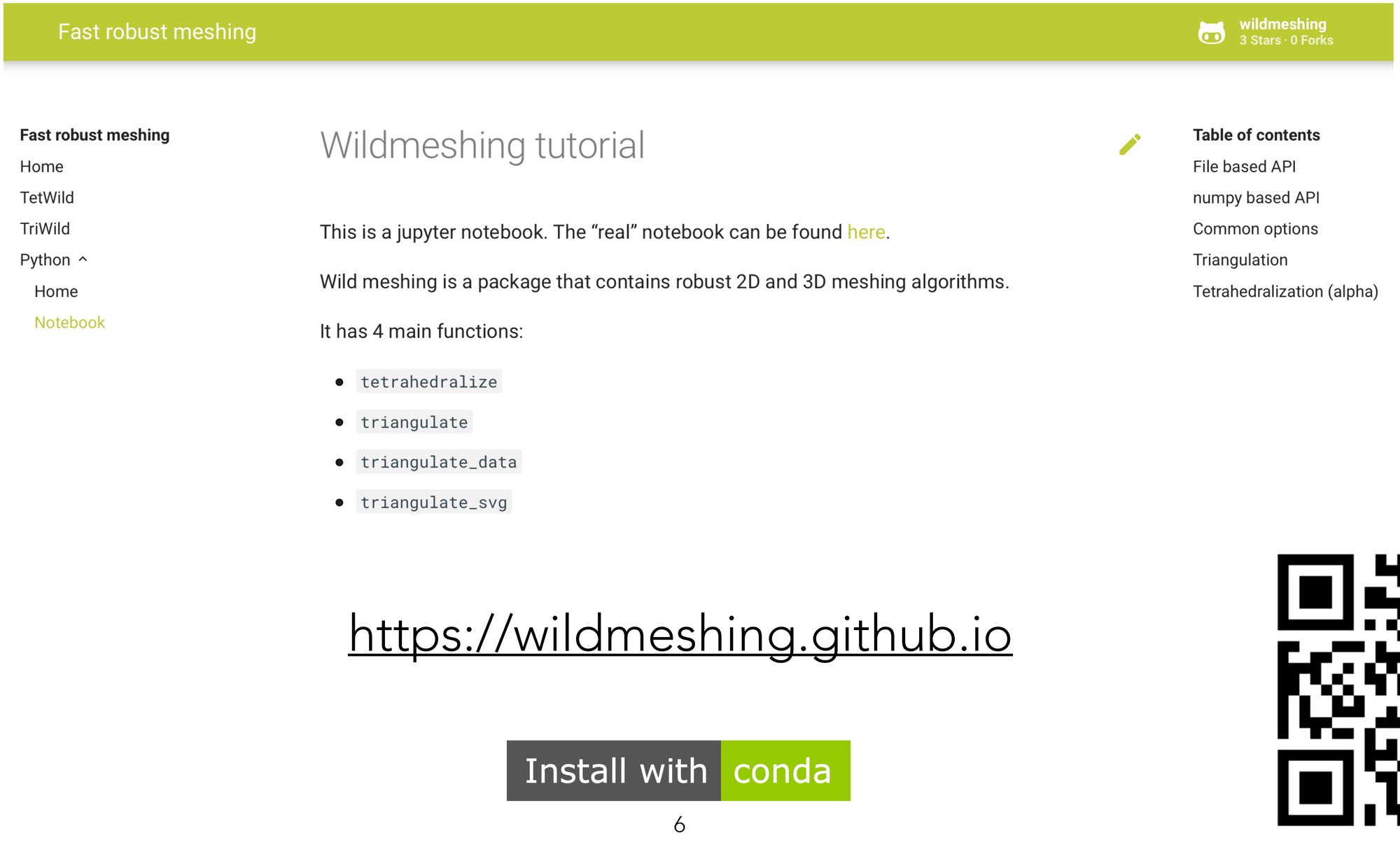
https://libigl.github.io

https://geometryprocessing.github.io/libigl-python-bindings/

Install with conda

downloads 2k total

Wild Meshing (TetWild and TriWild)



https://wildmeshing.github.io

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downloads 2k total

PolyFEM

Home | Search | polyfem/polyfem 22 Stars · 3 Forks

polyfem

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- Tutorial
- Documentation
- Python [alpha]
- Jupyter examples
- Python docs

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https://polyfem.github.io

Install with conda

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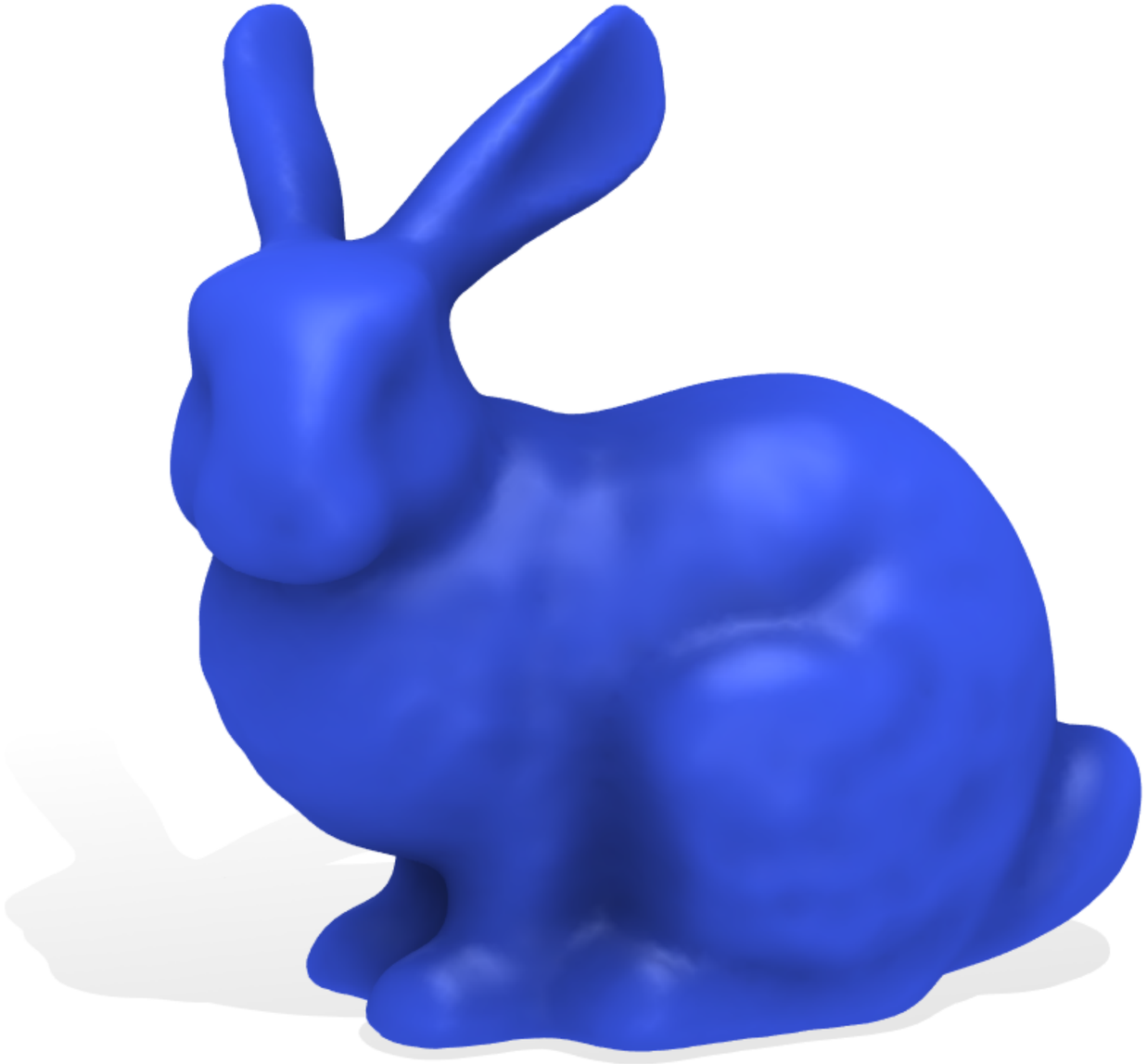
Data Structures (or lack thereof)

Acknowledgement: Alec Jacobson

Triangle meshes discretize surfaces…



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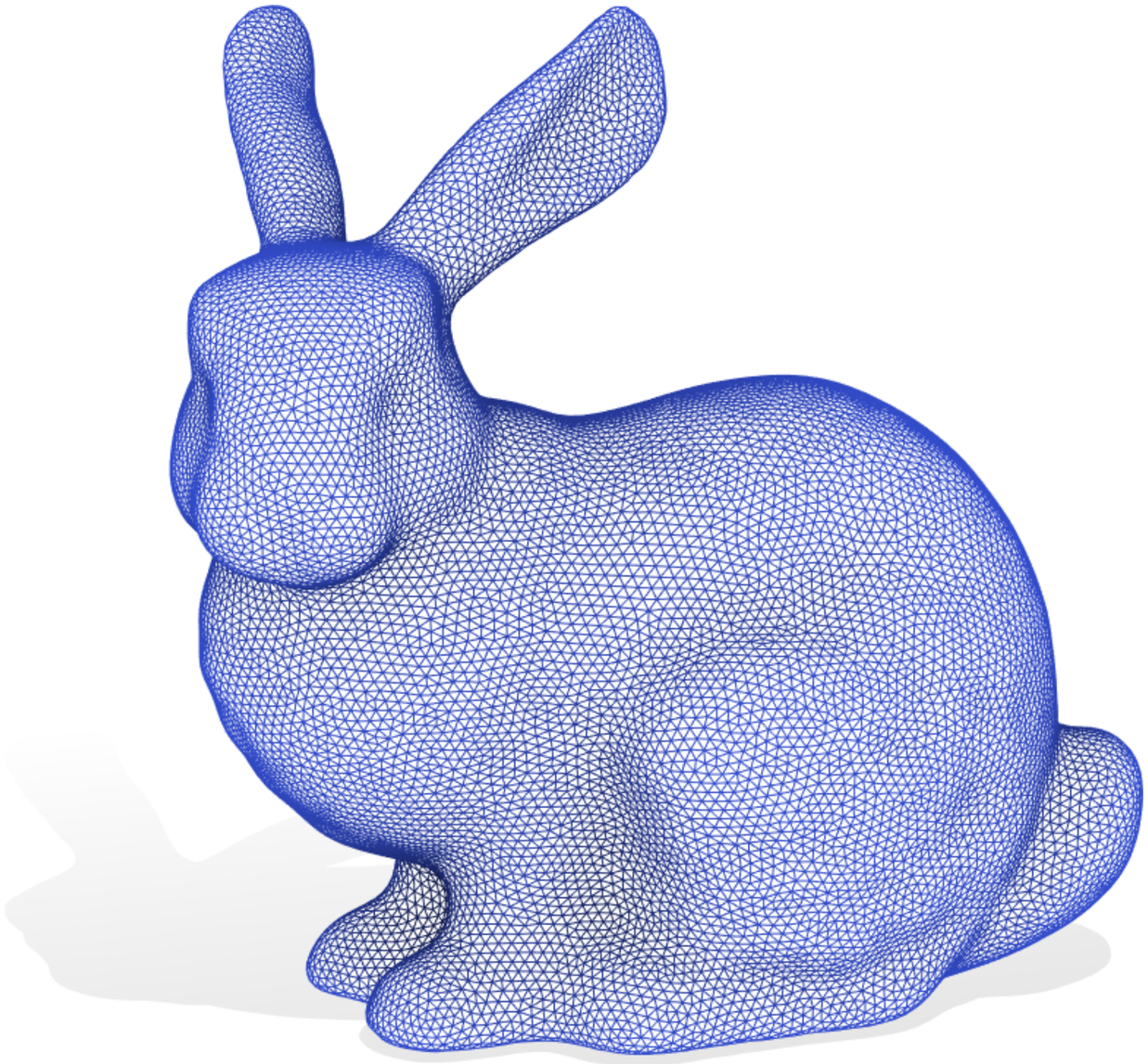

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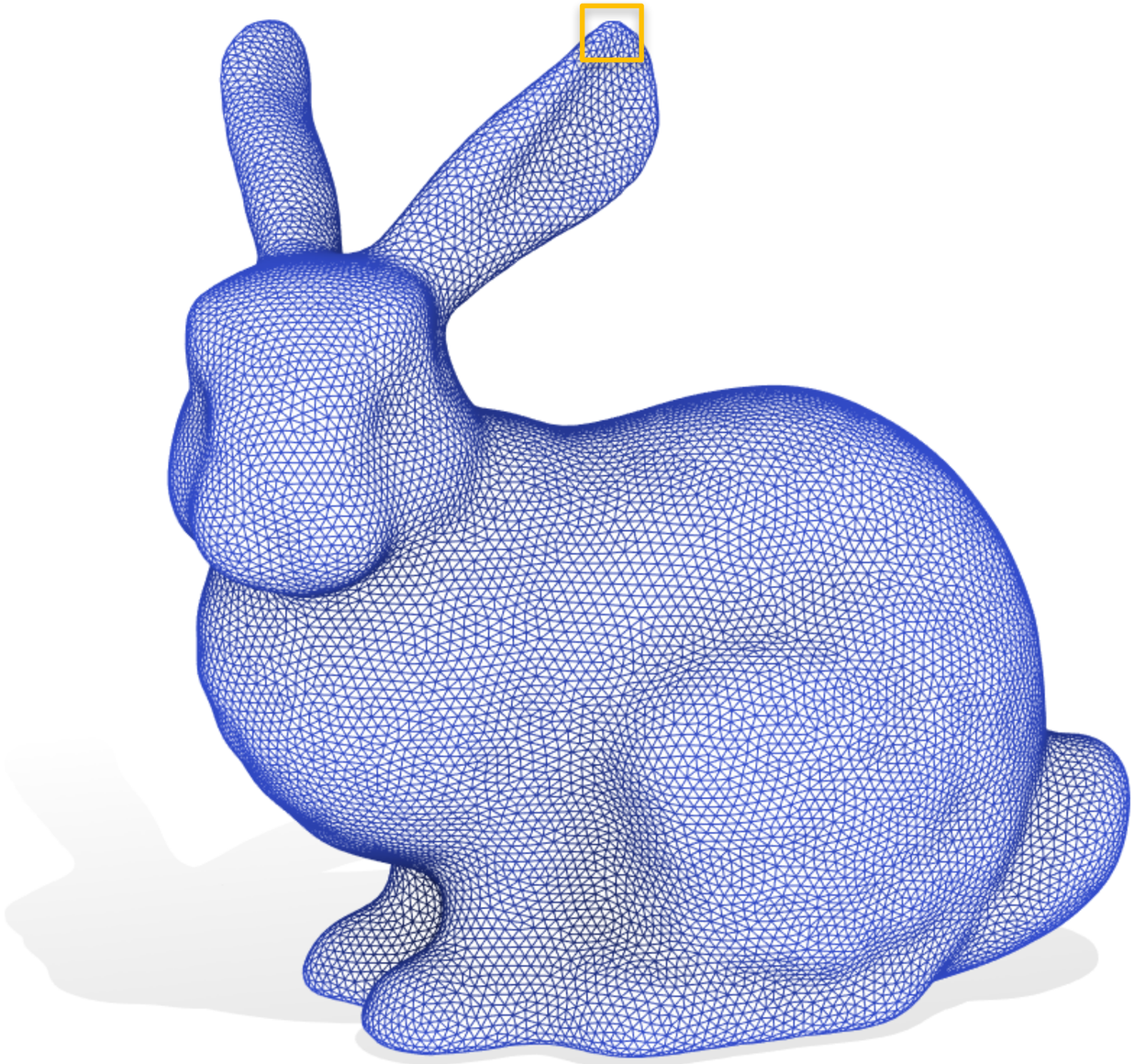

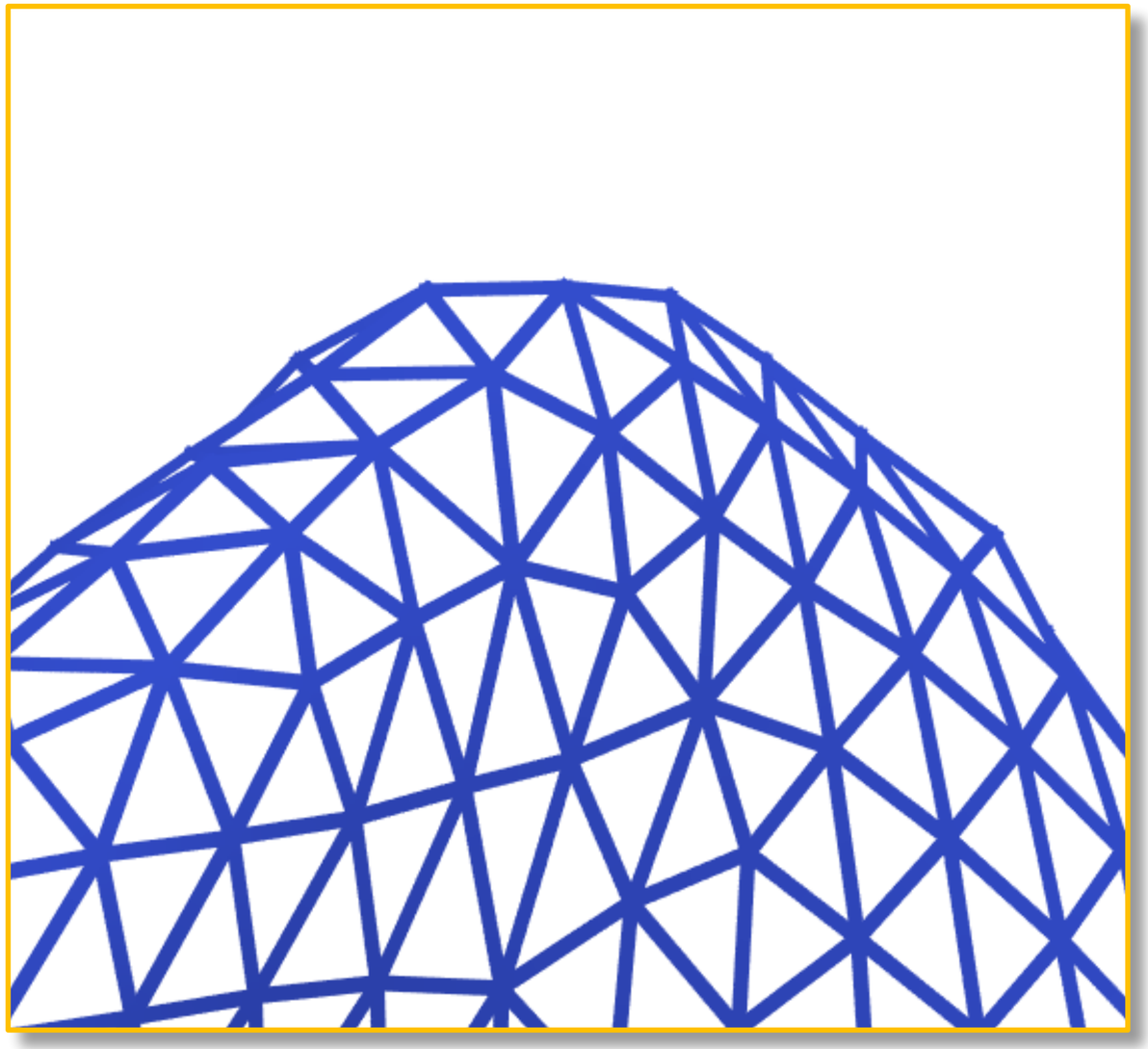

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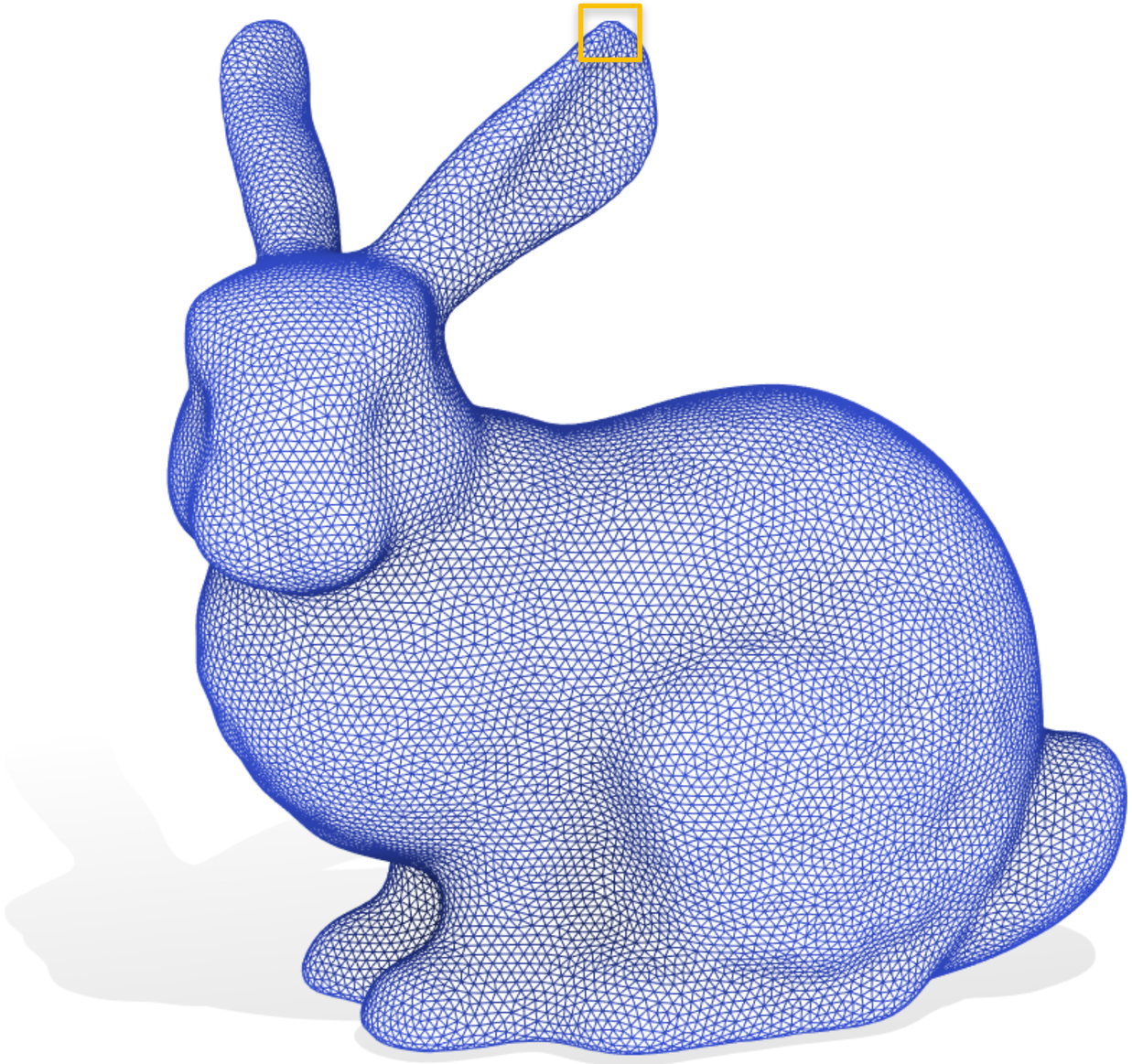

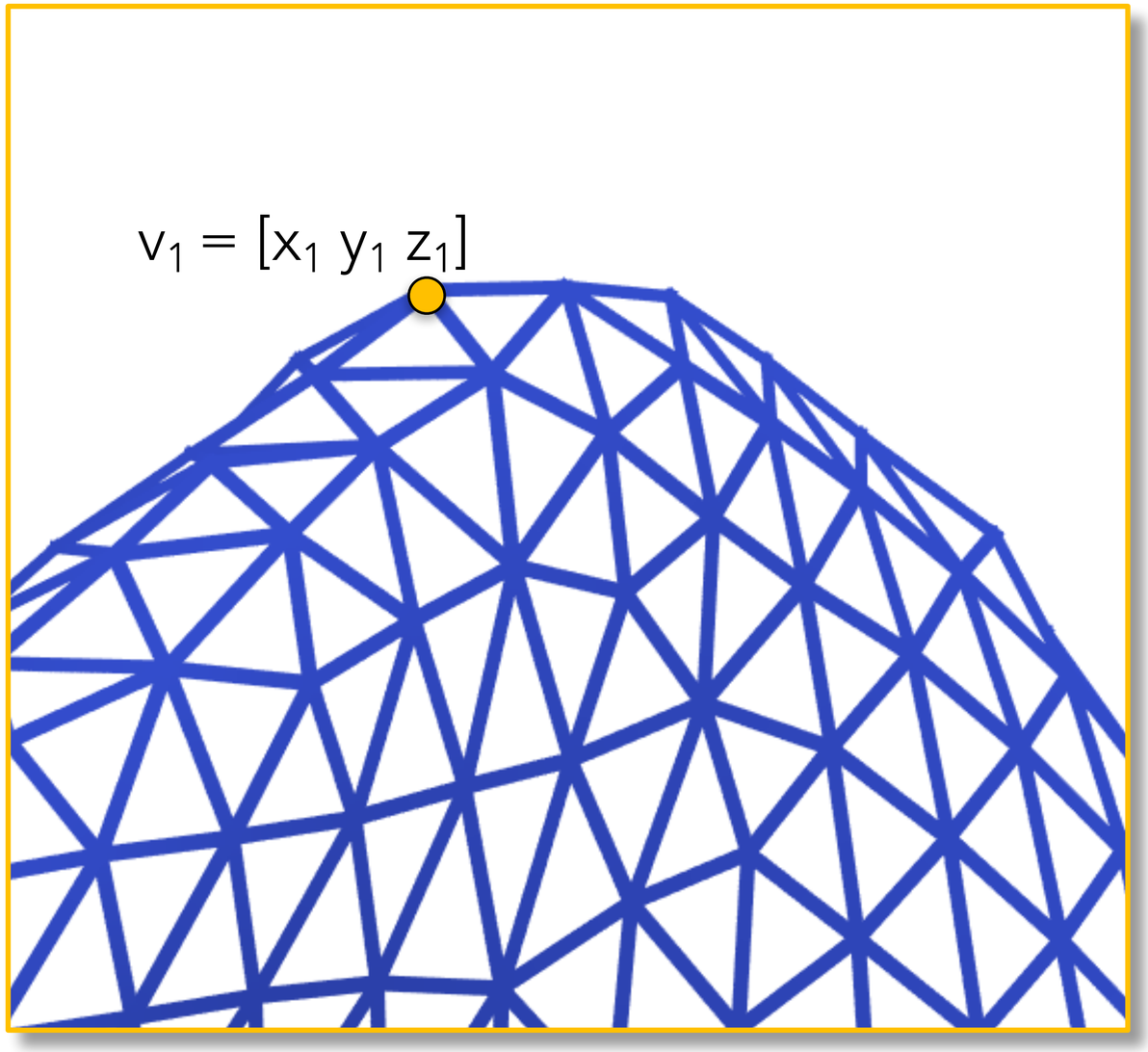

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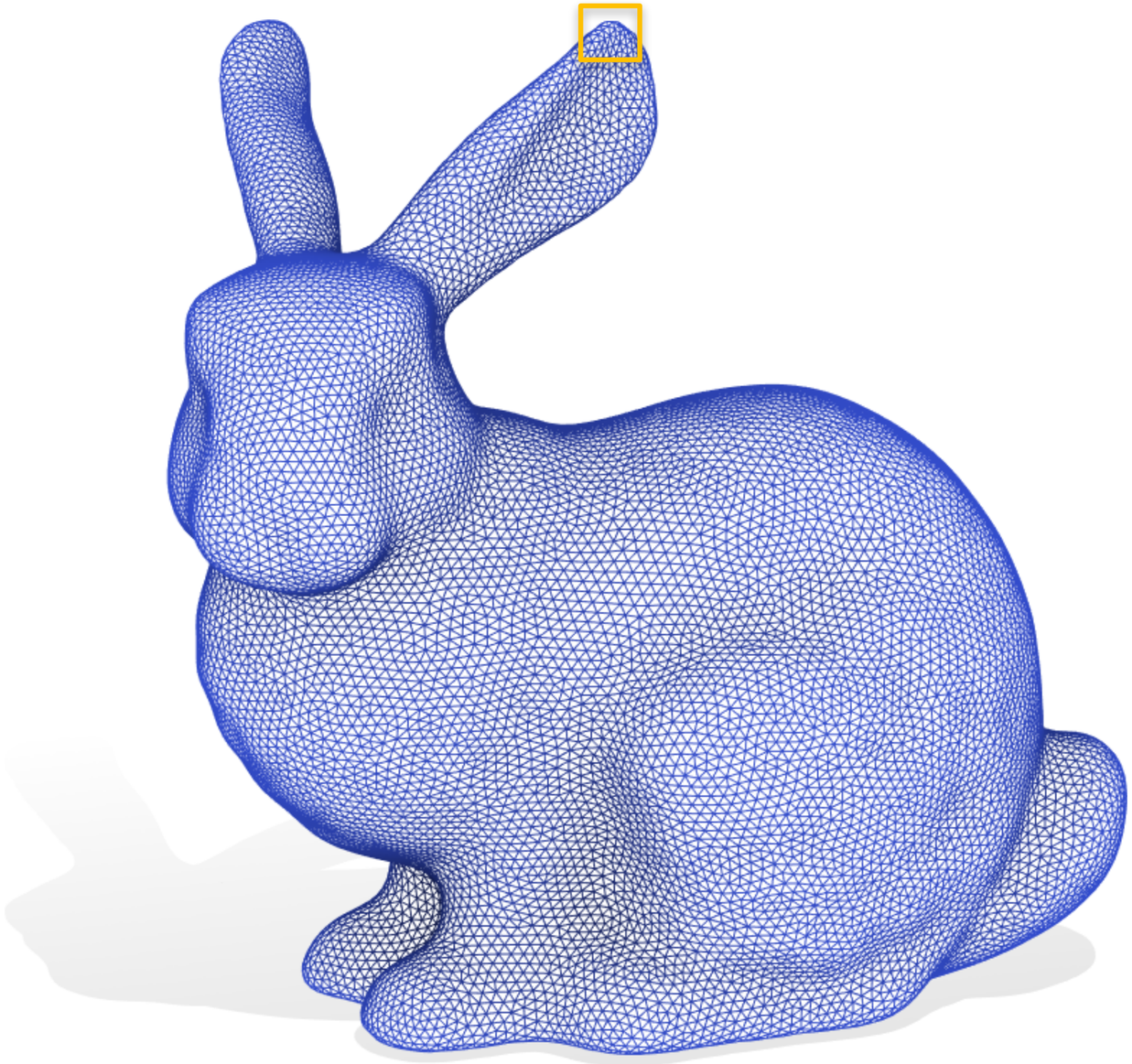

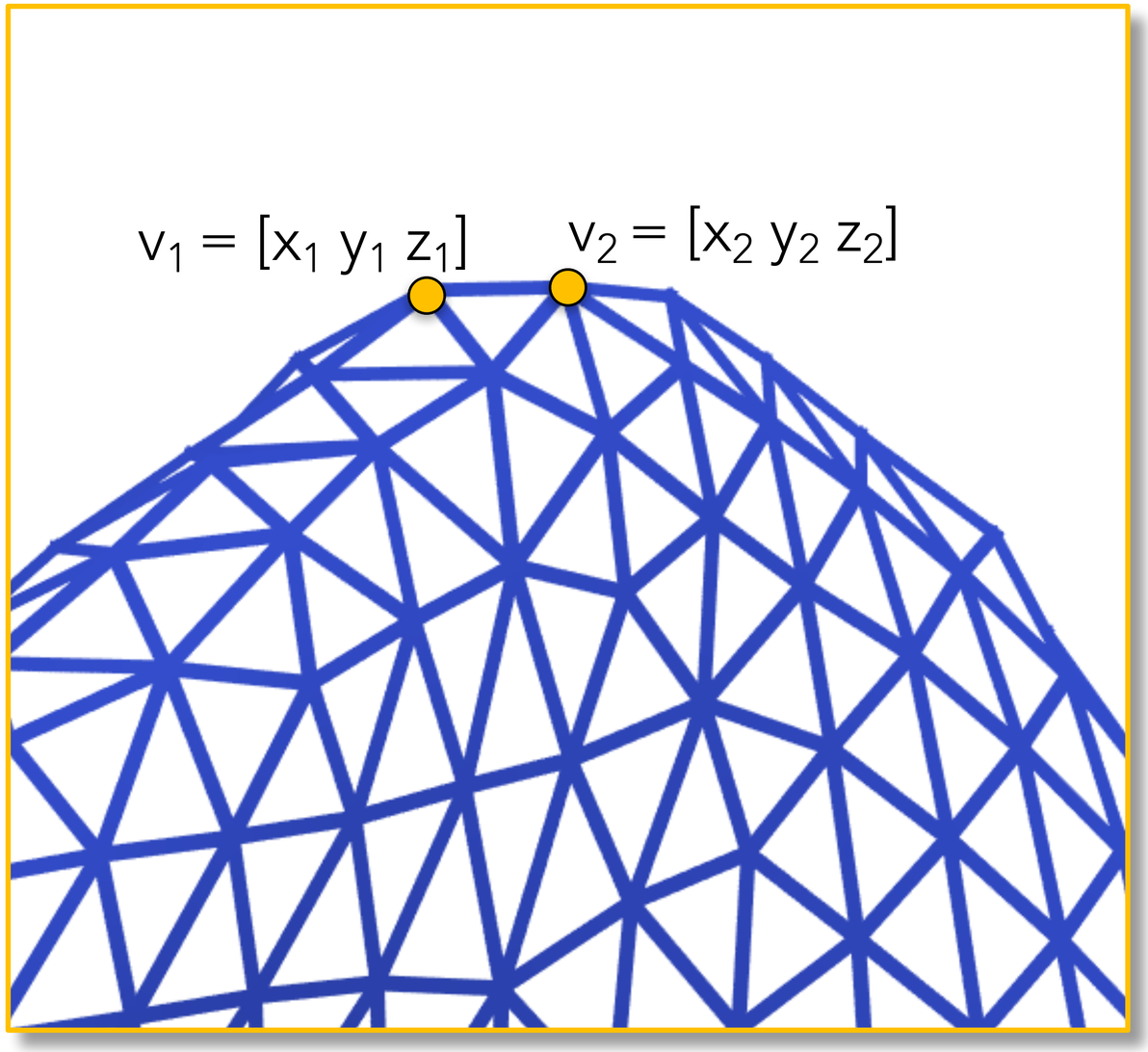

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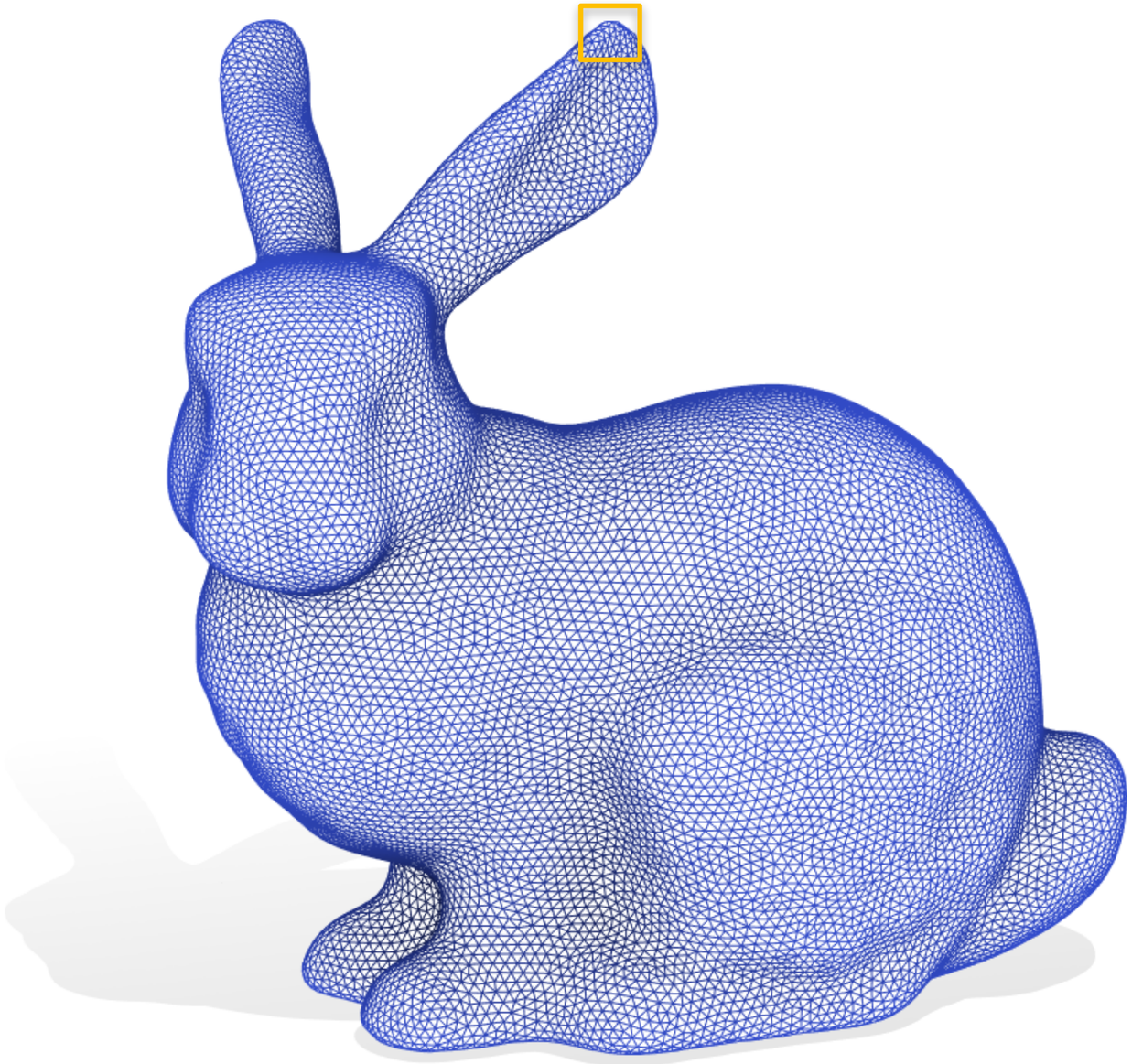

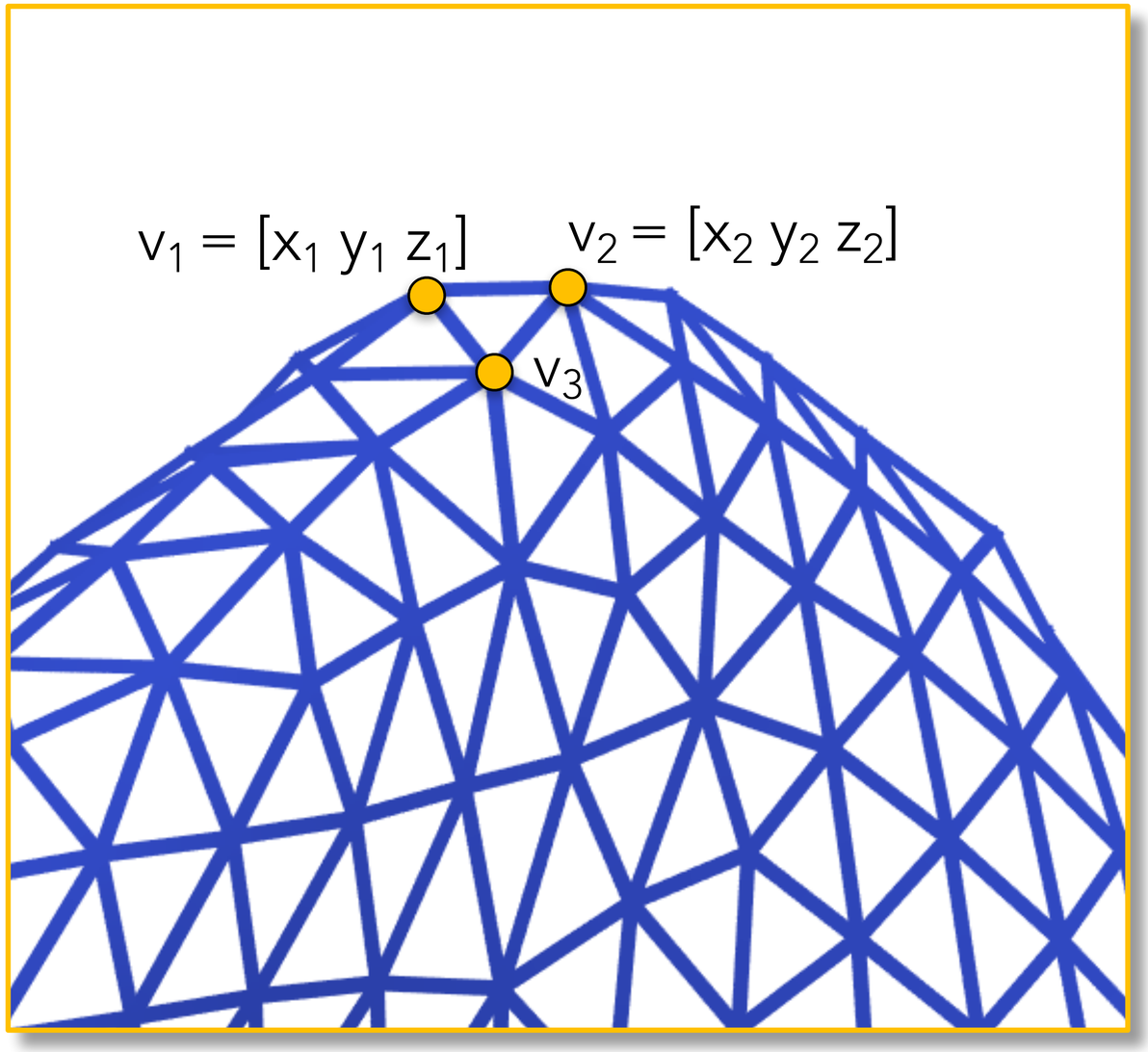

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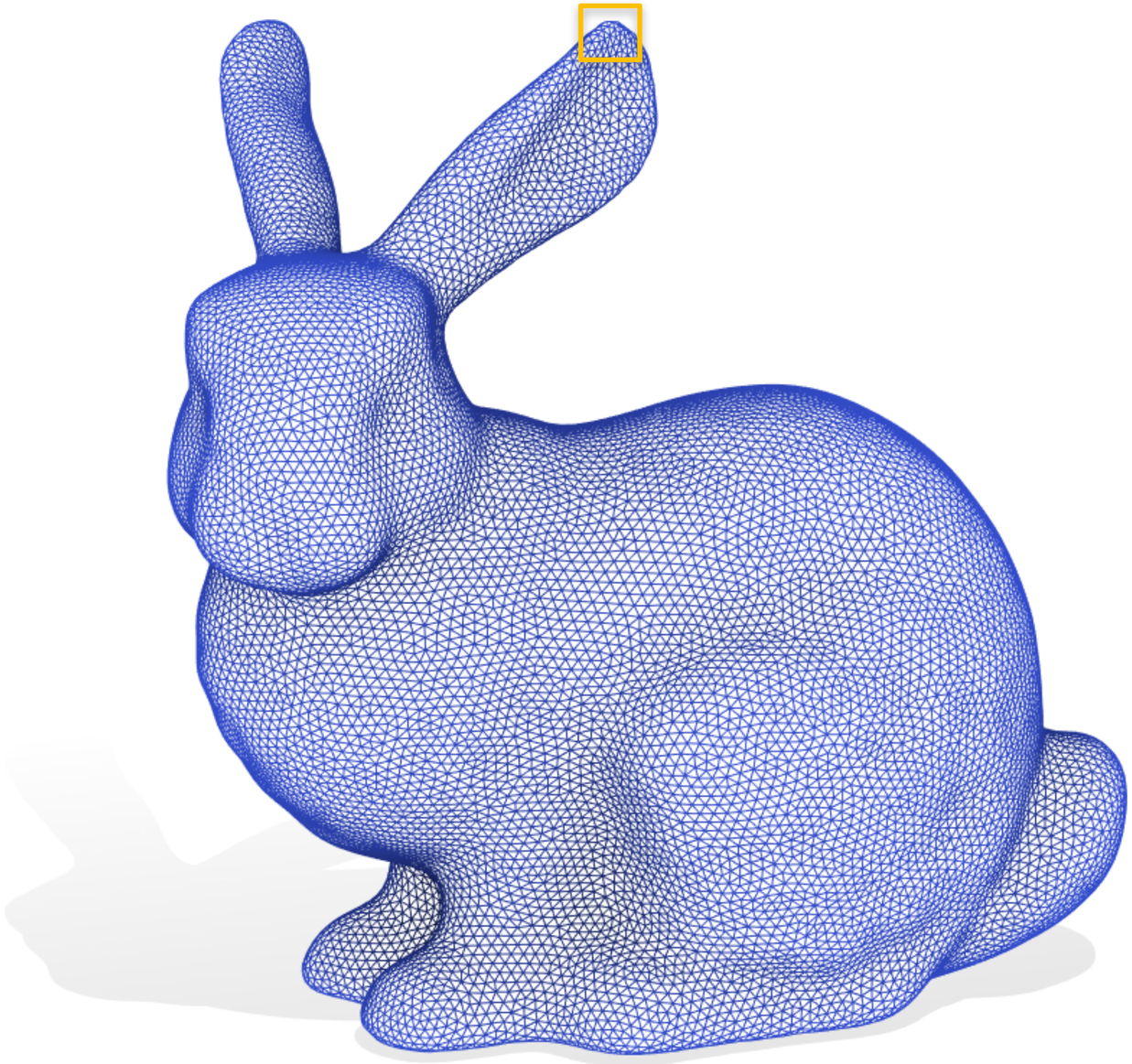
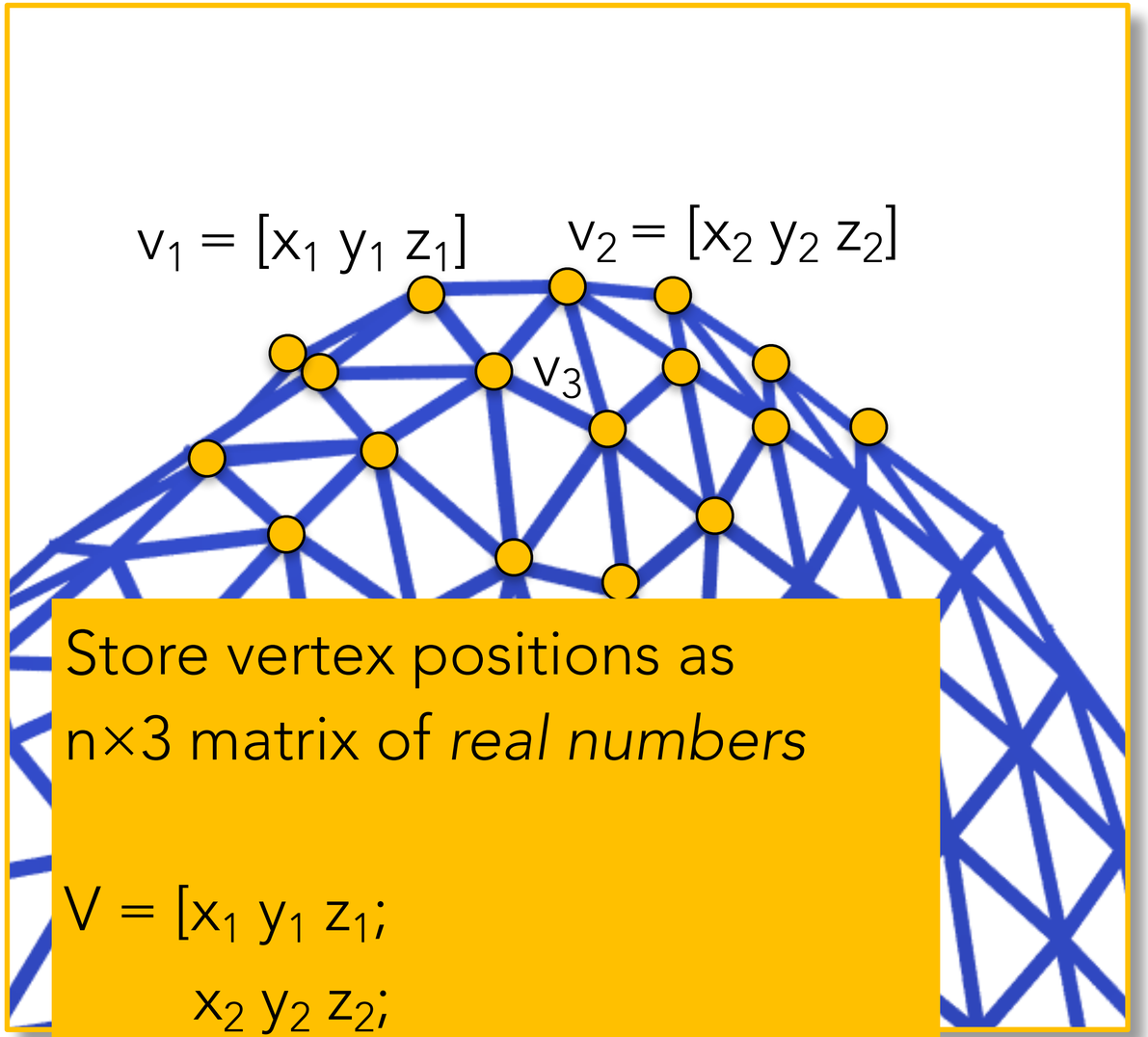
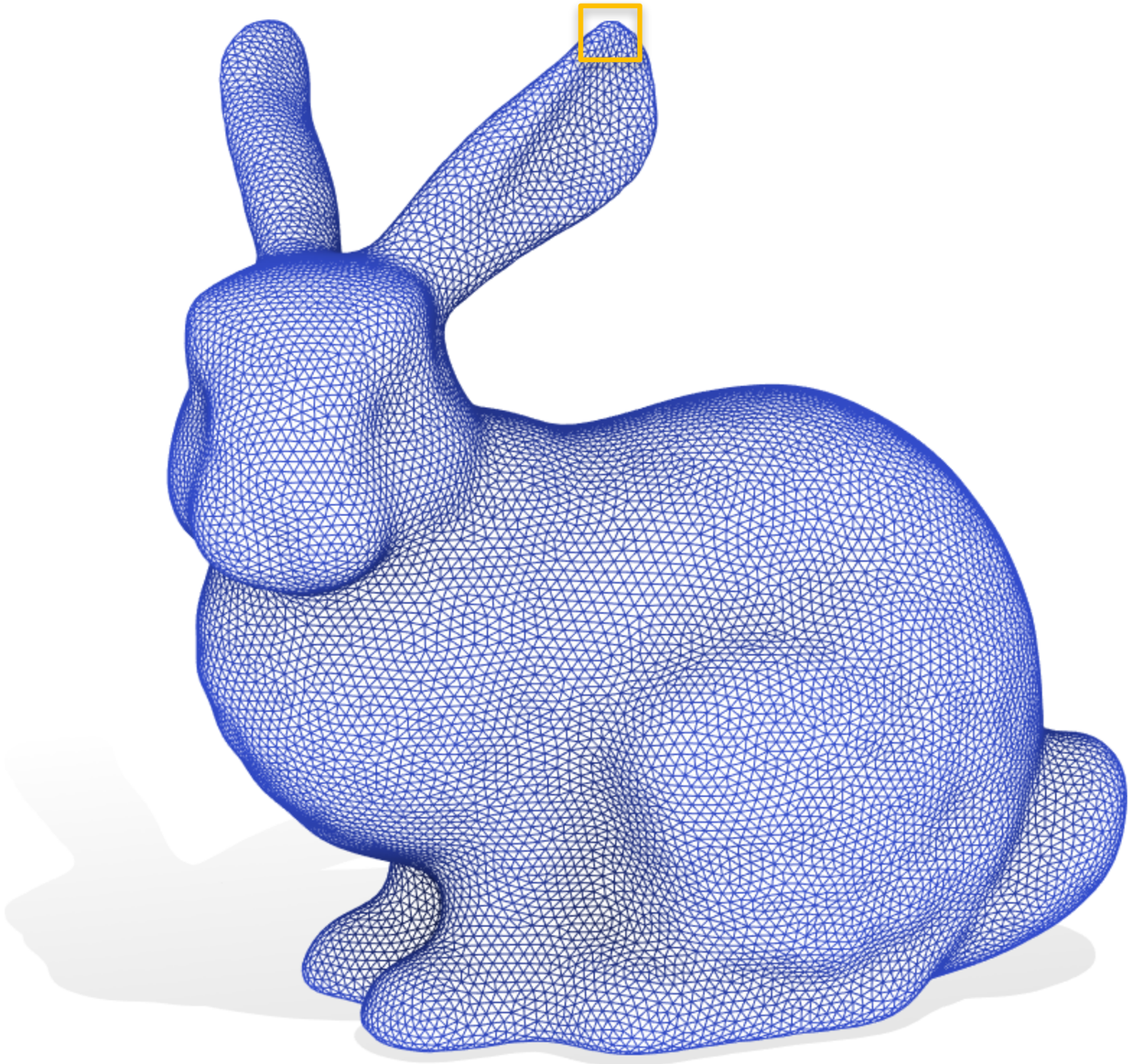


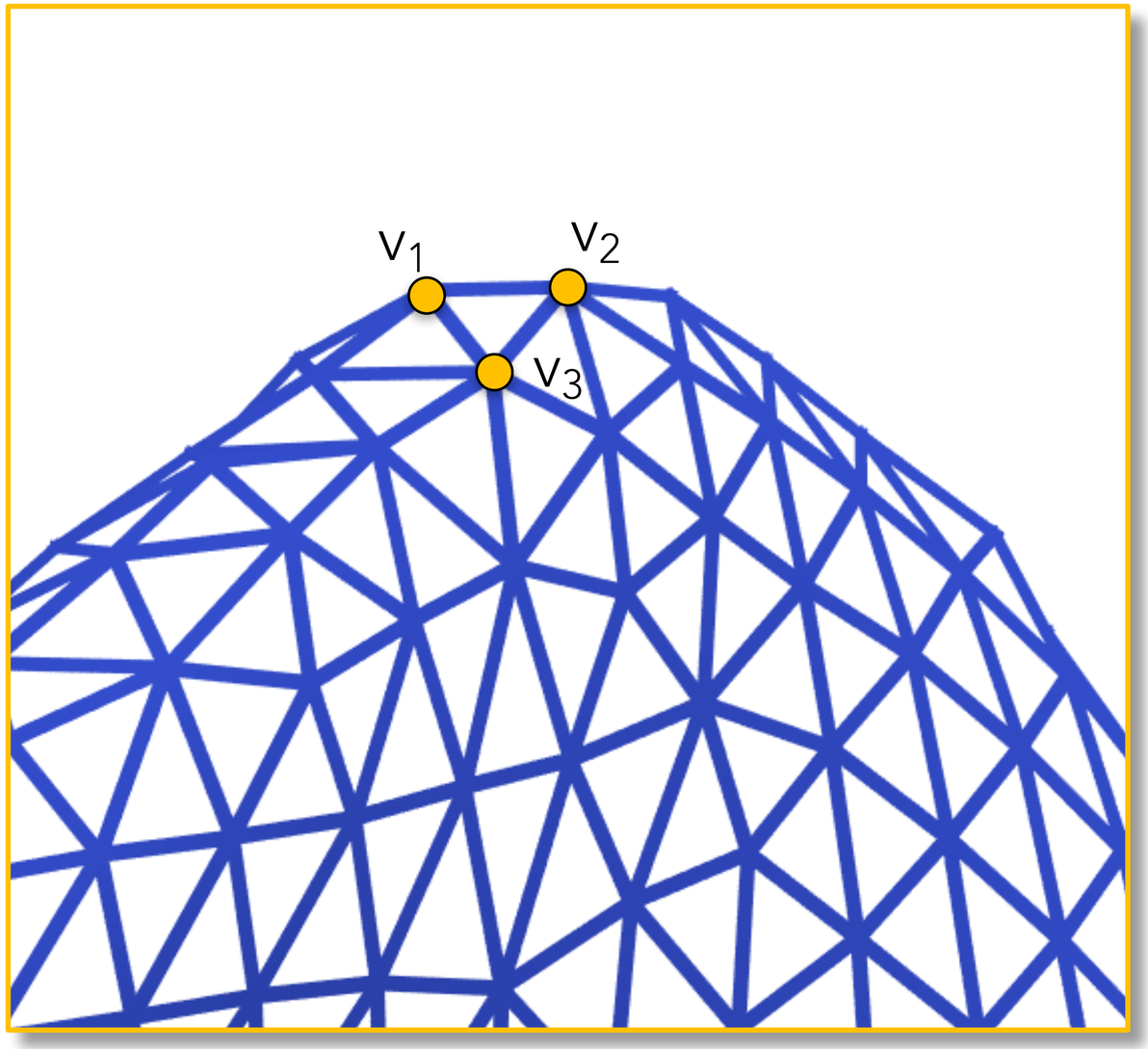


Store vertex positions as
n×3 matrix of *real numbers*

$V = [x_1\ y_1\ z_1;$
$x_2\ y_2\ z_2;$
…
$x_n\ y_n\ z_n]$

Triangle meshes discretize surfaces…





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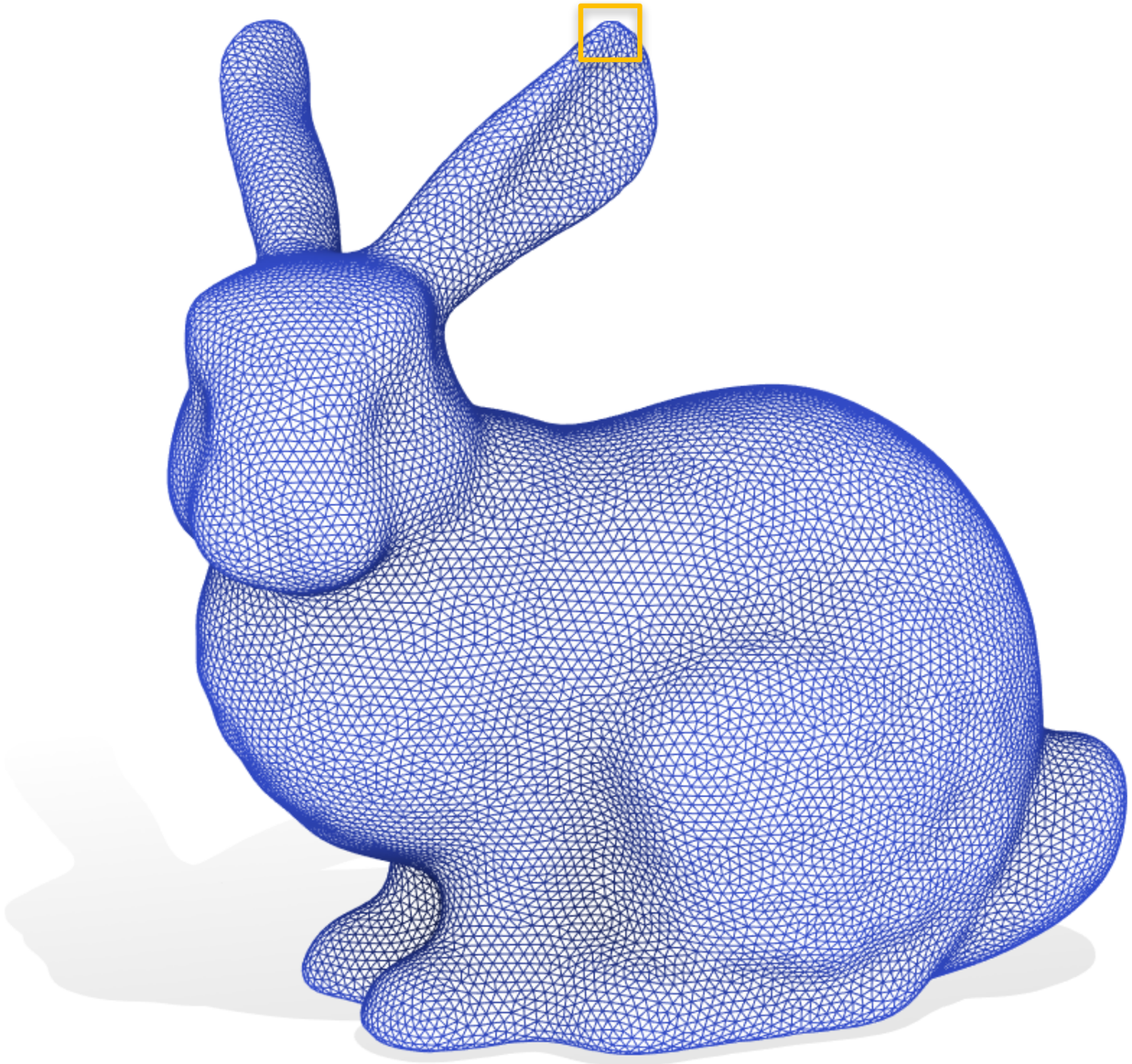

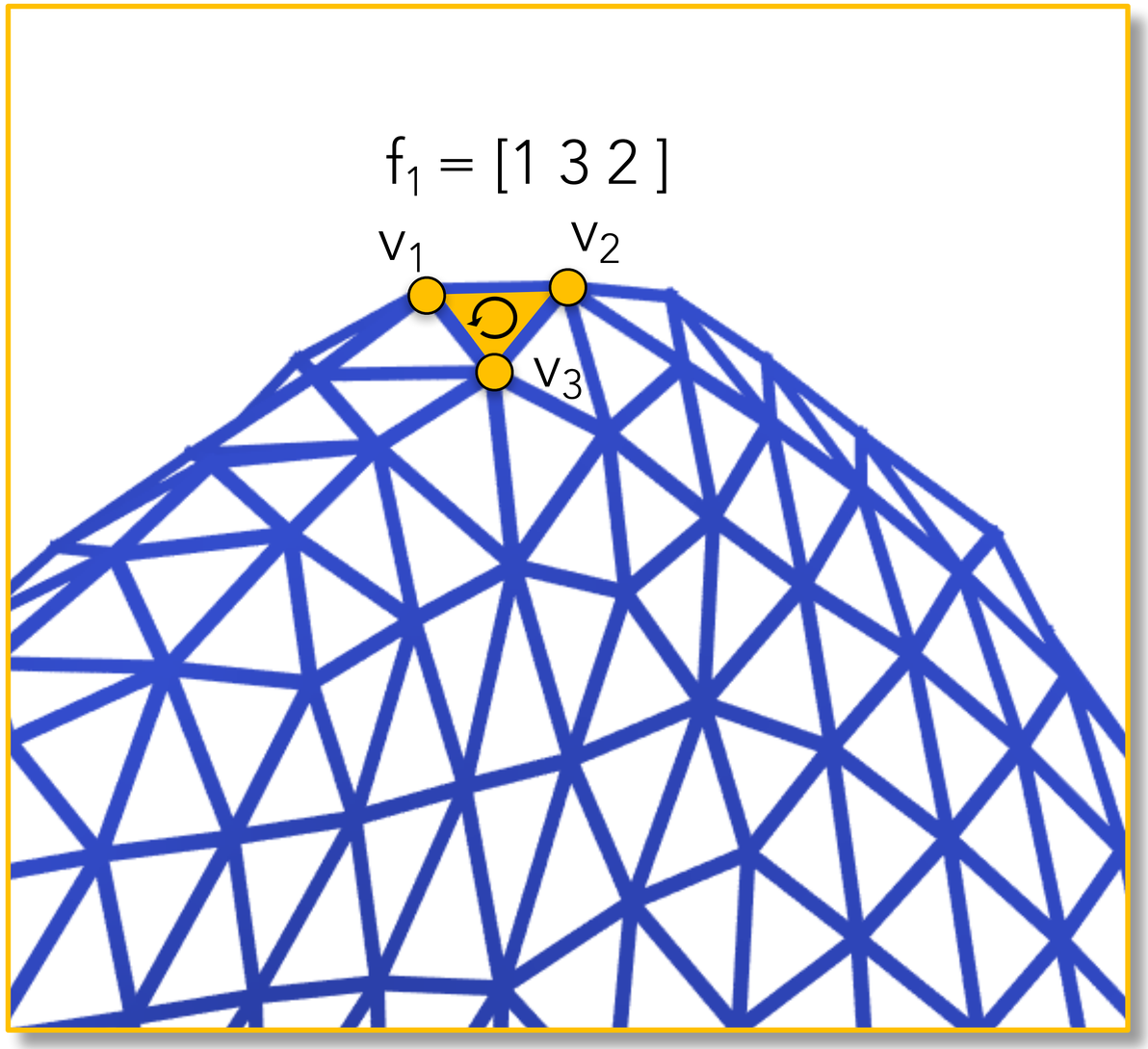

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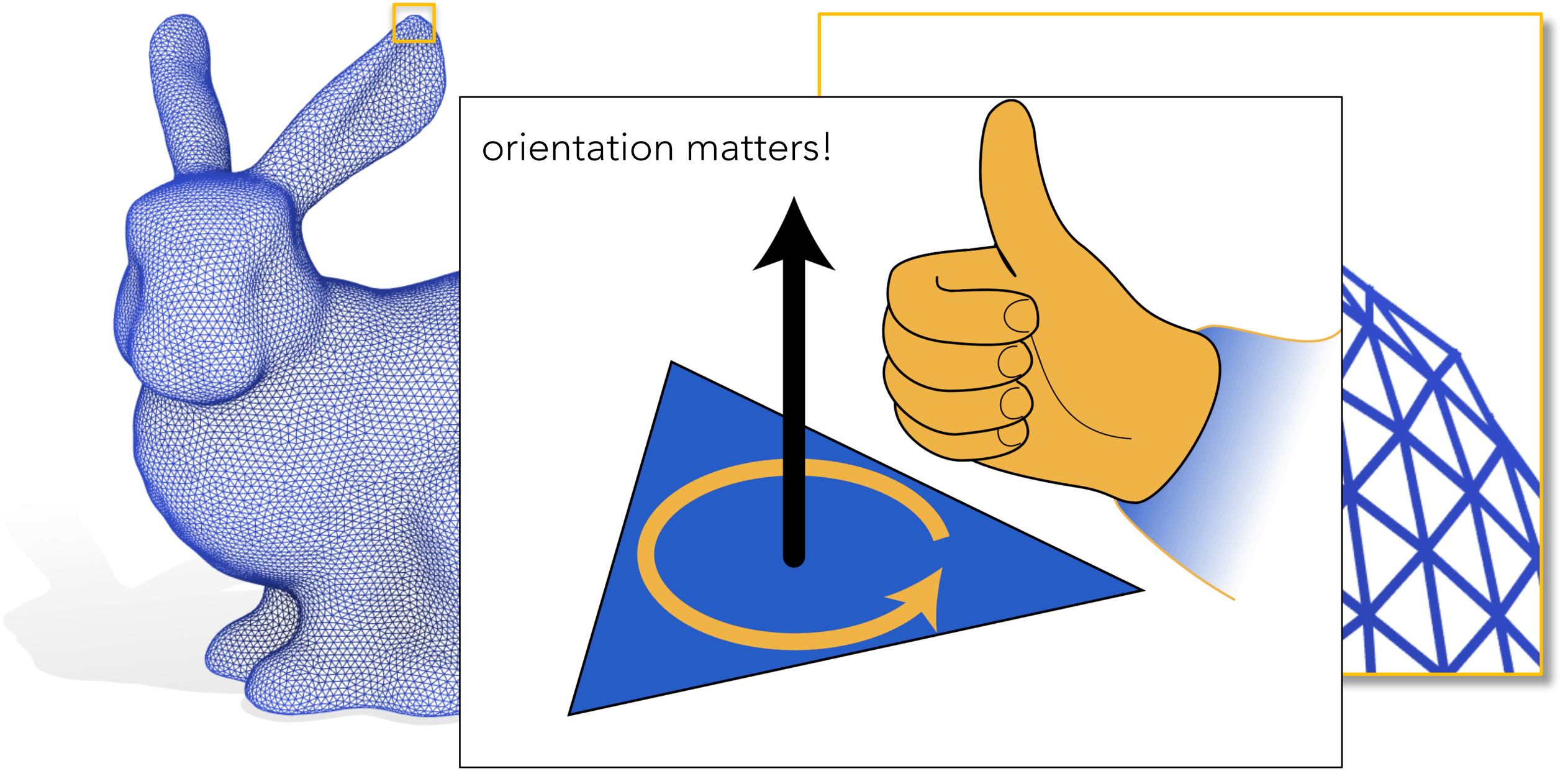

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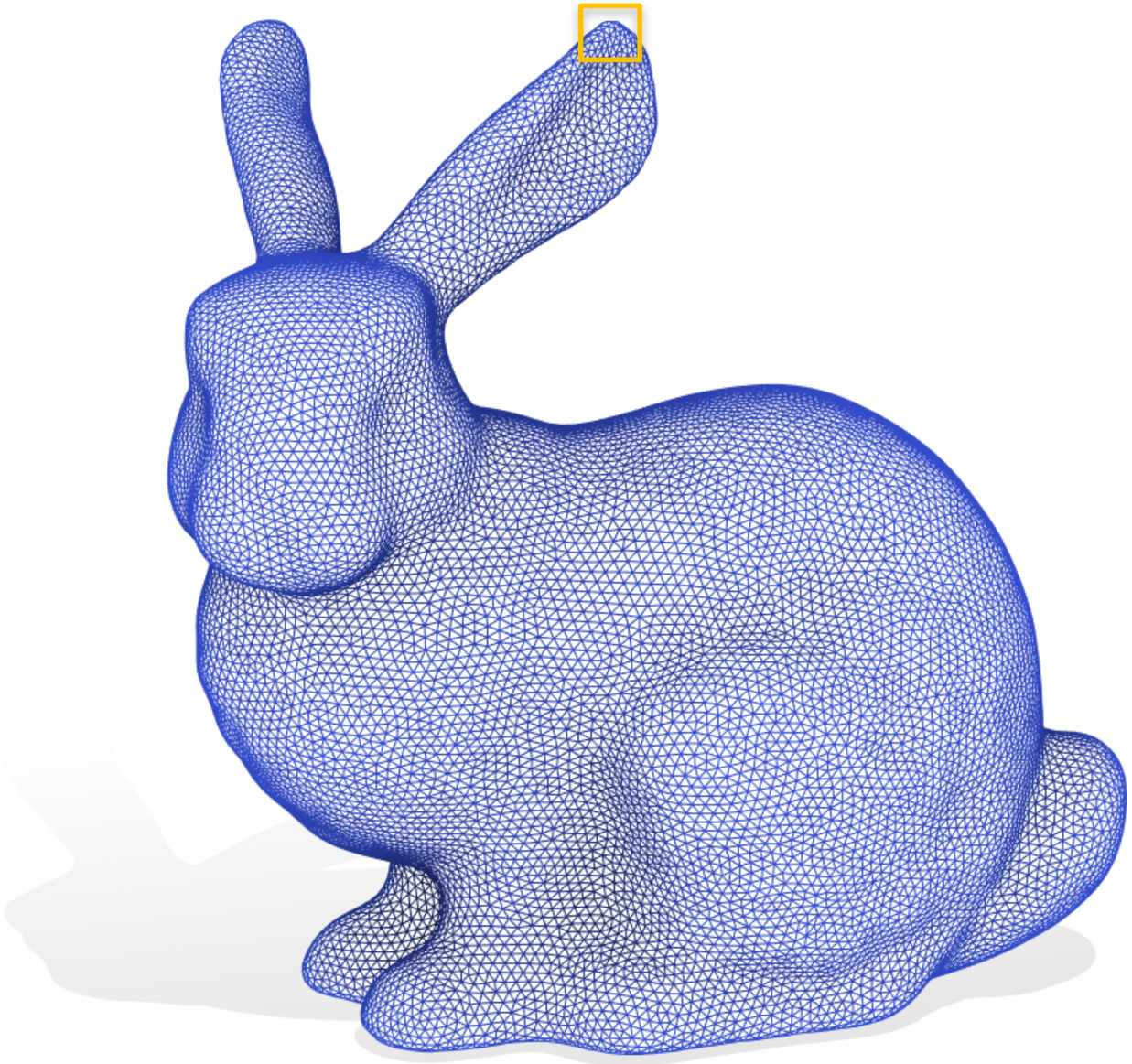

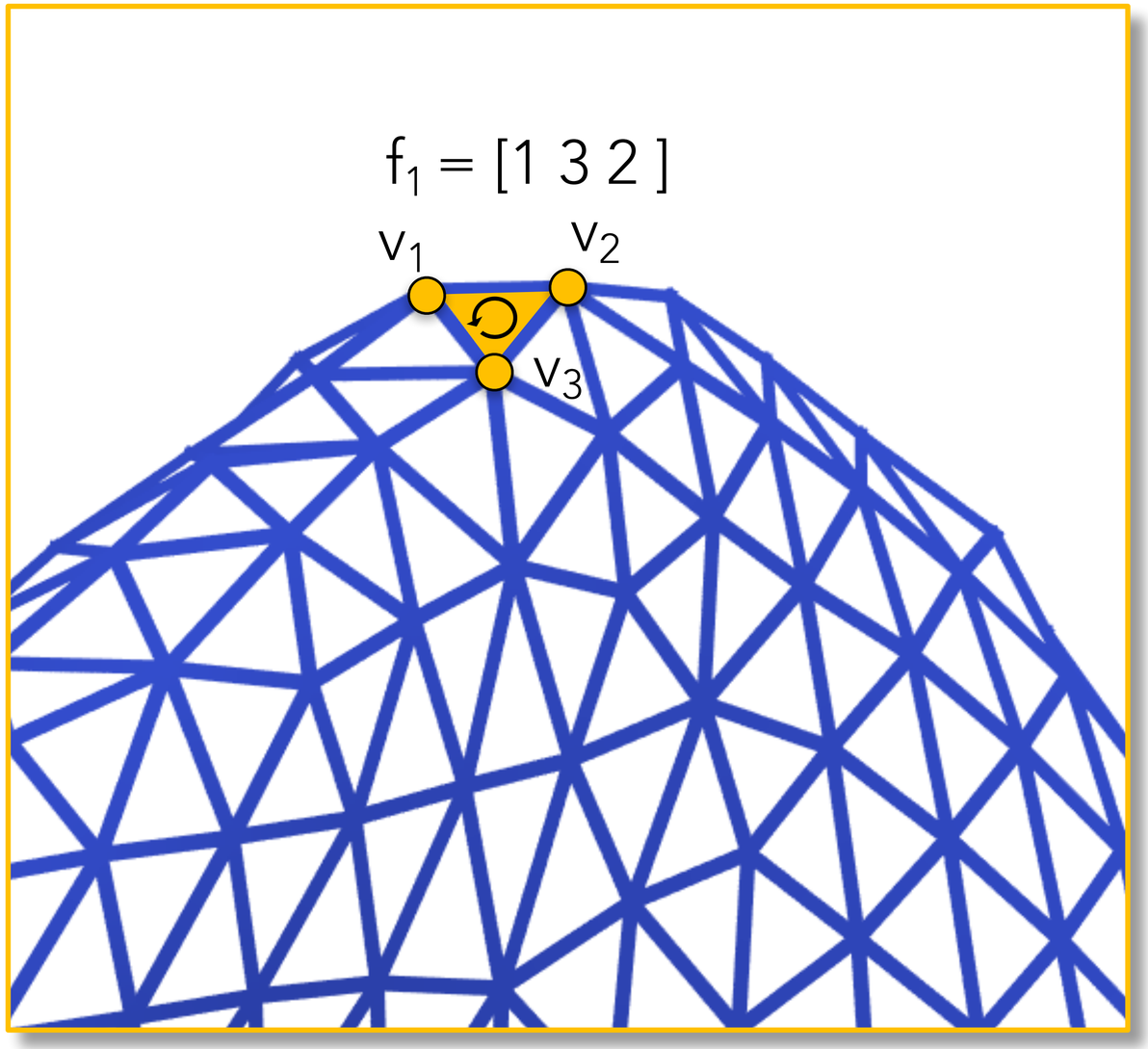

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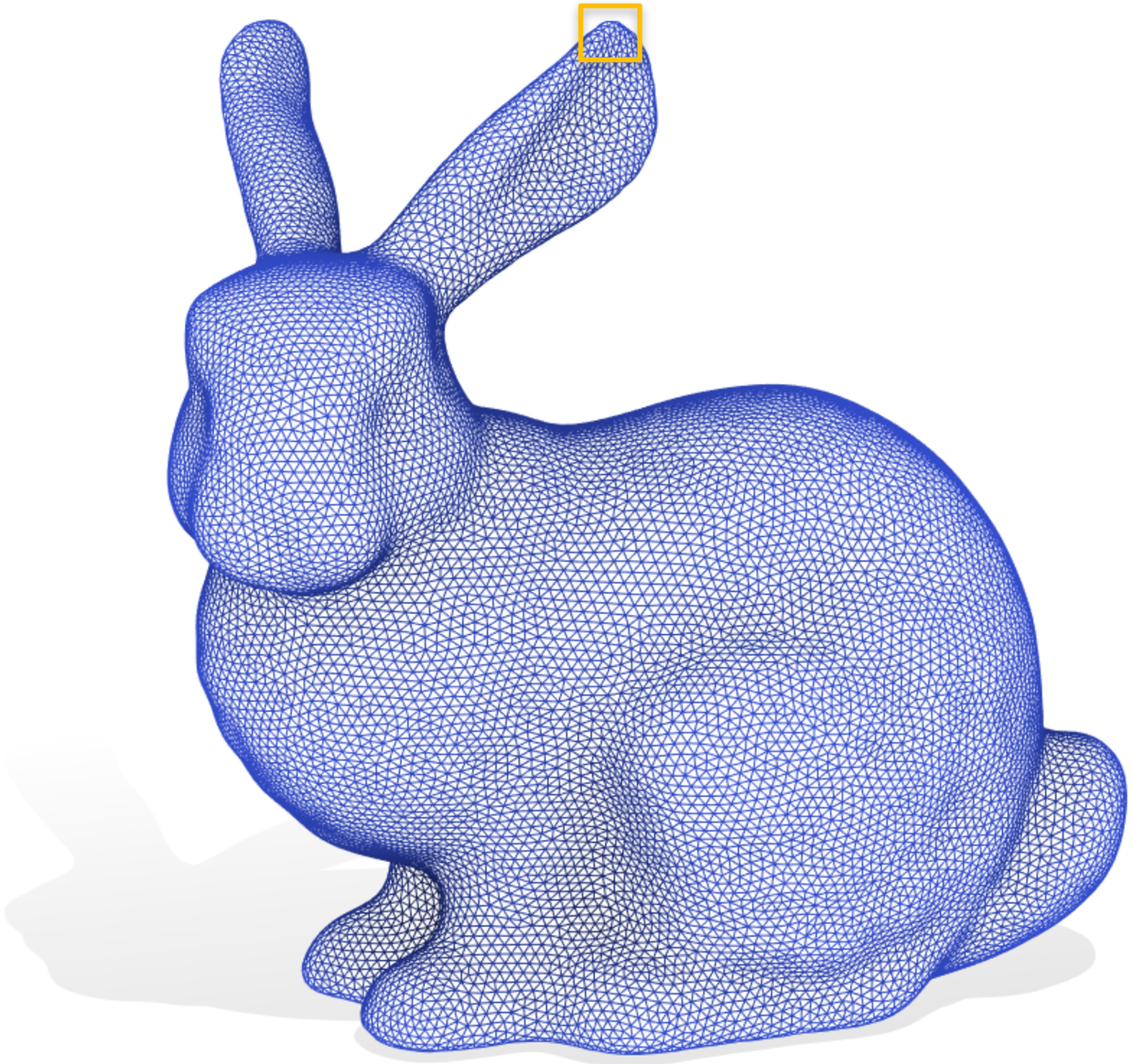

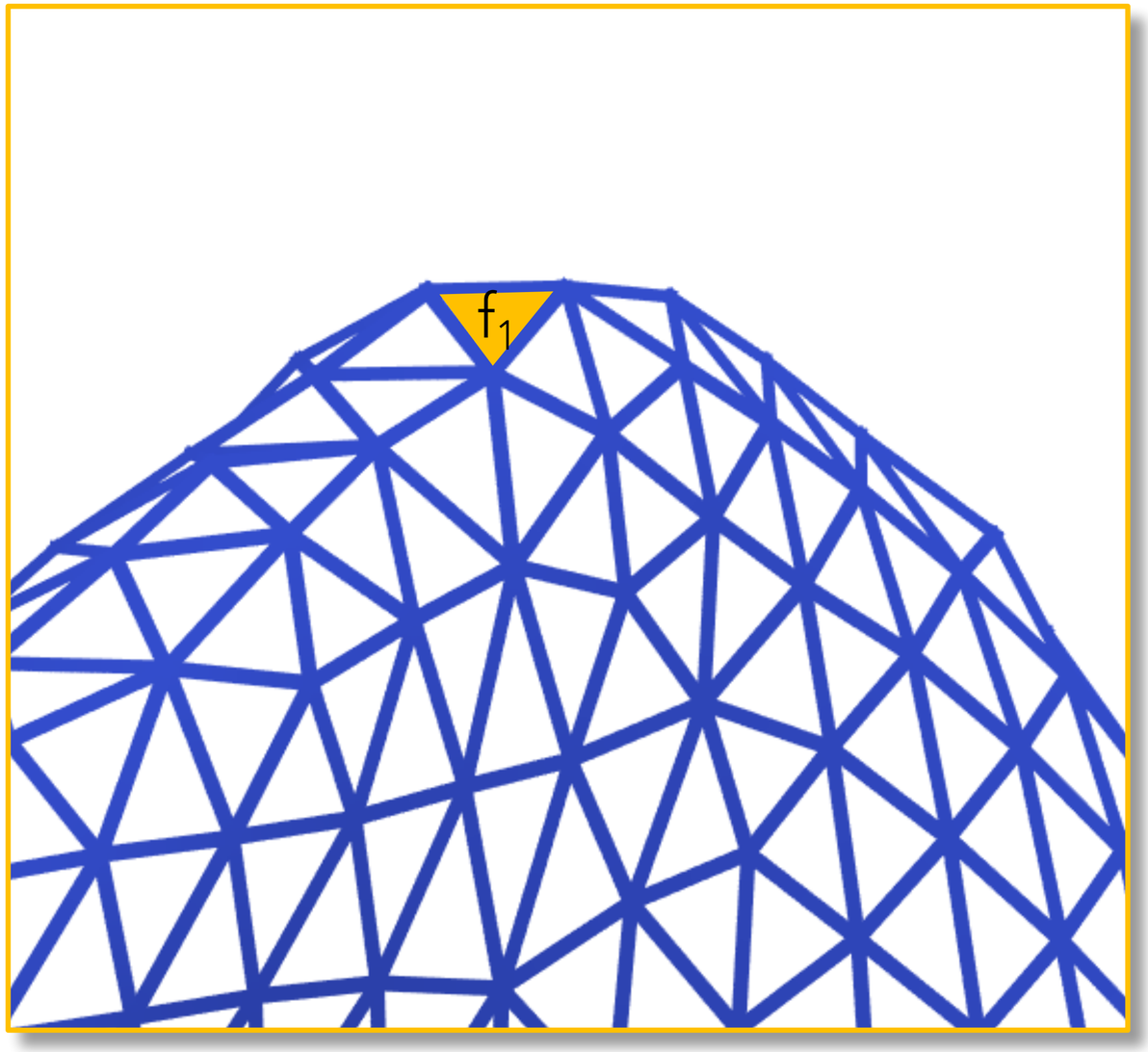

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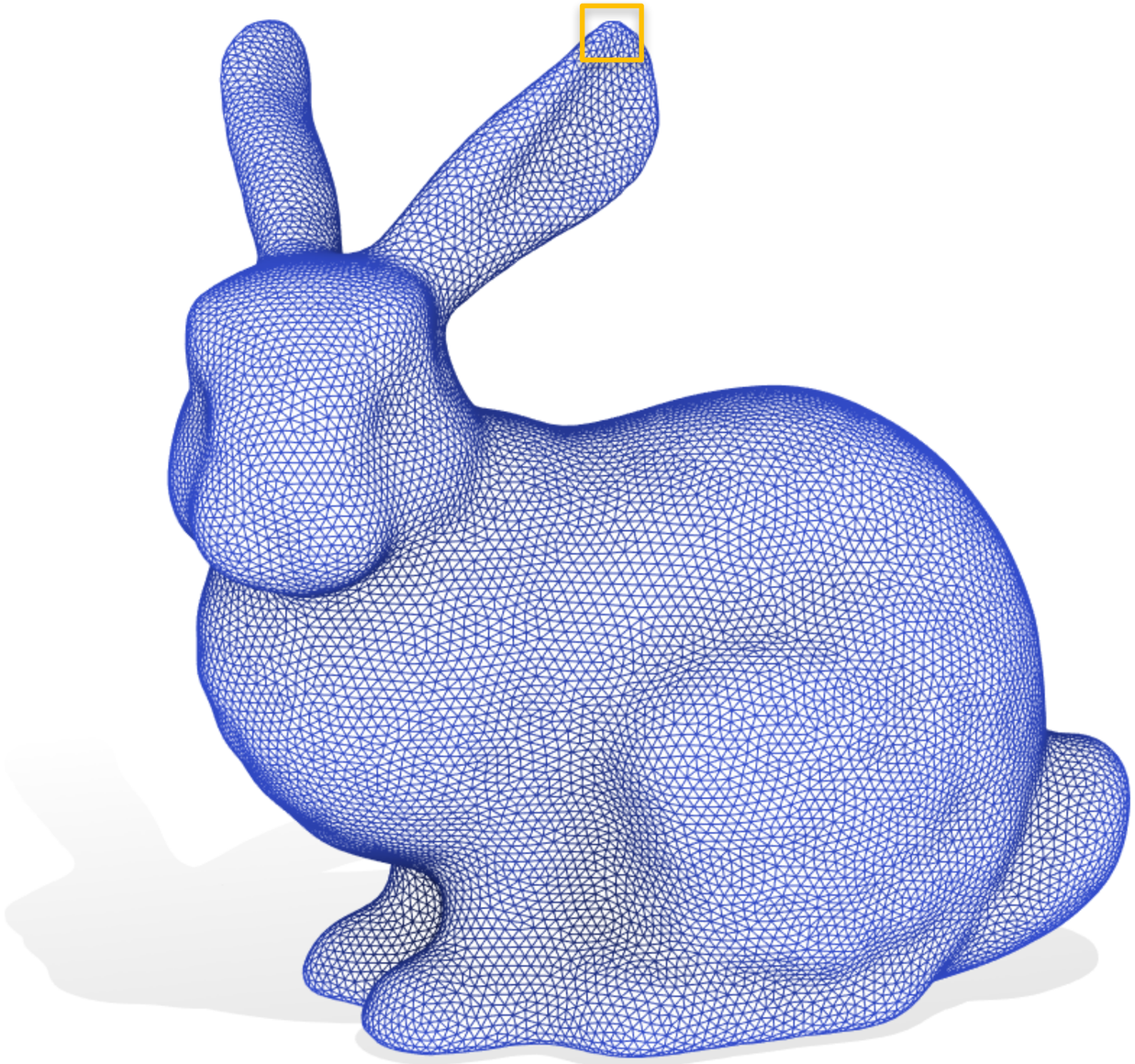

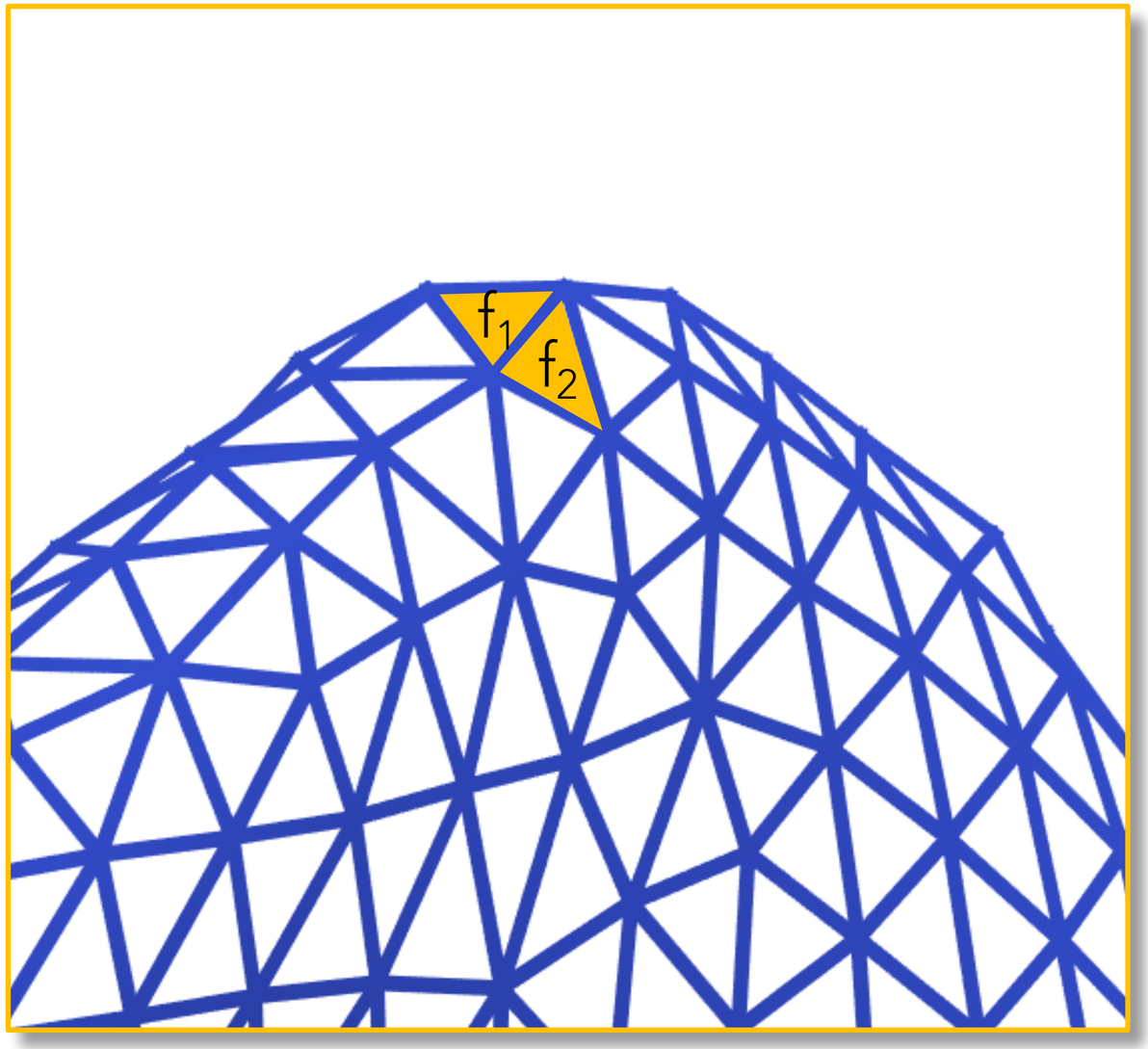

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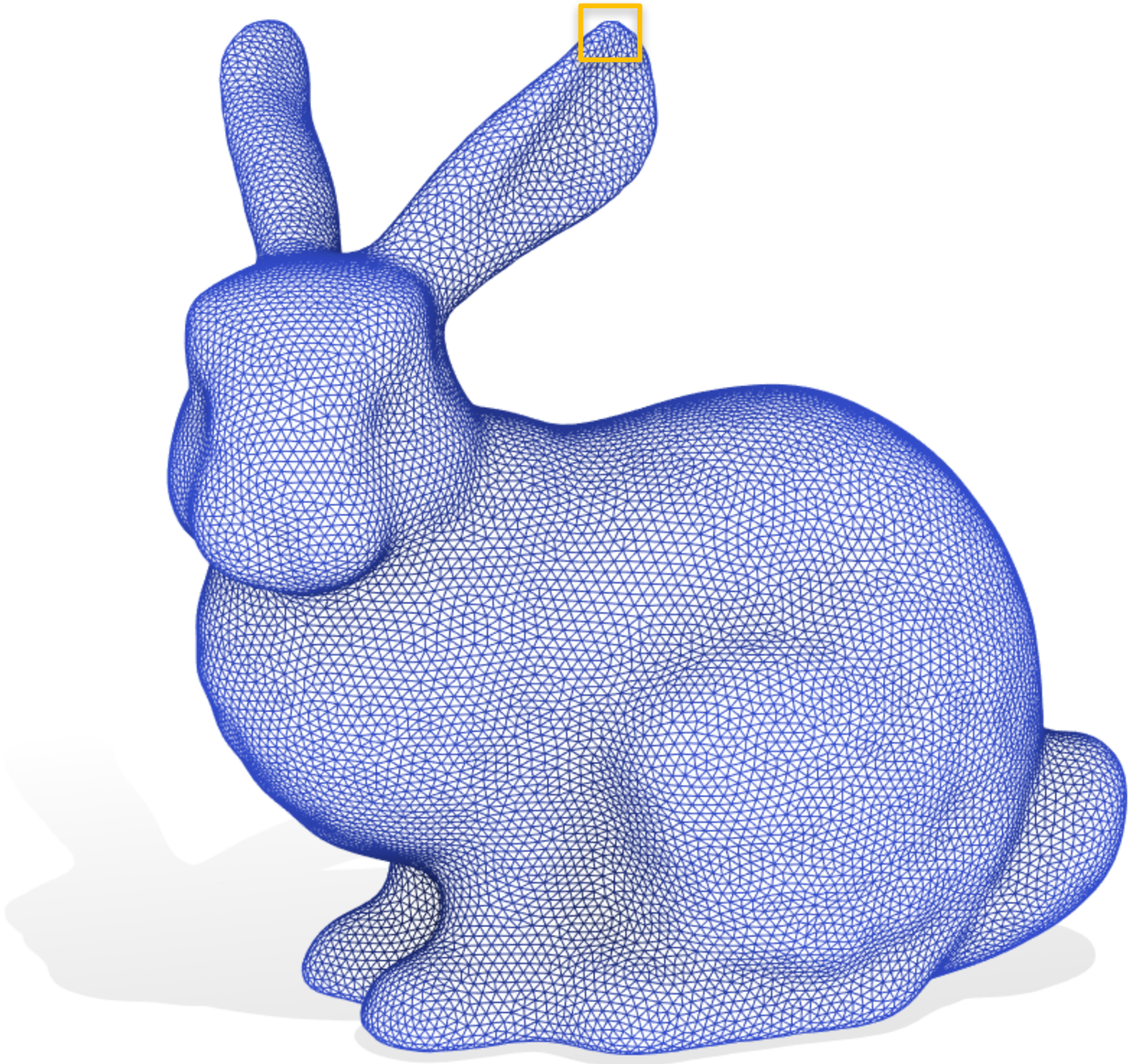

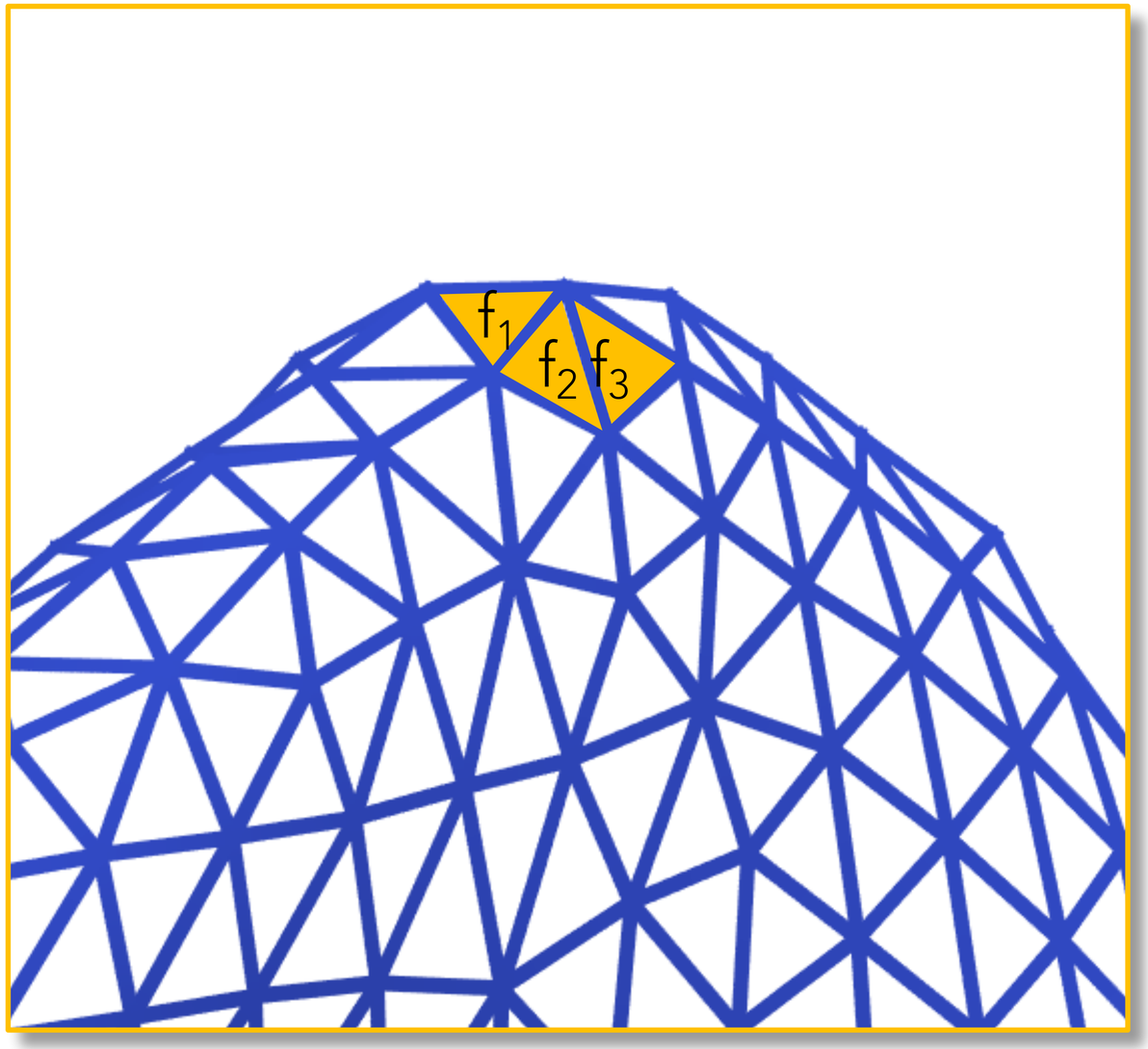

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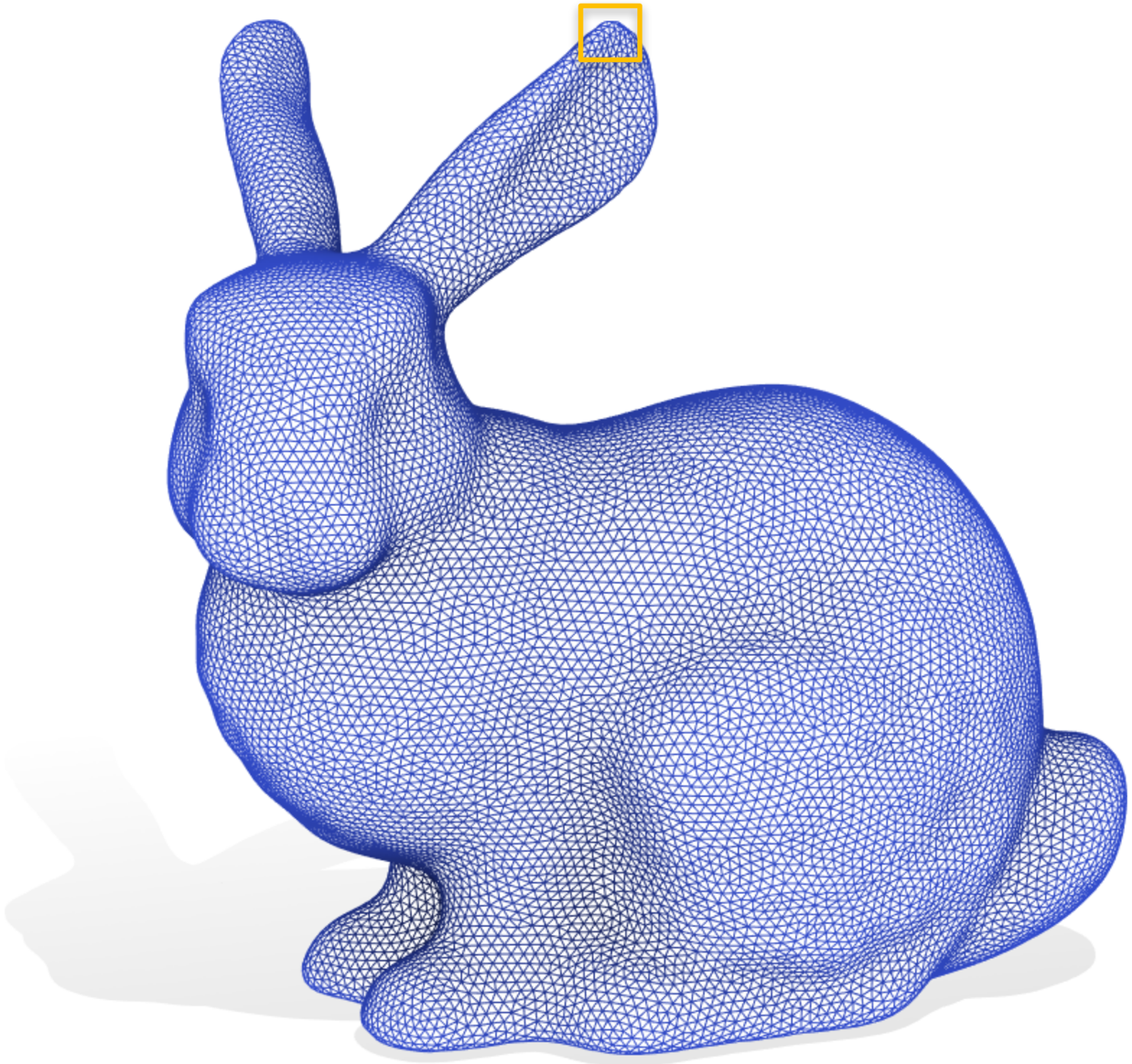

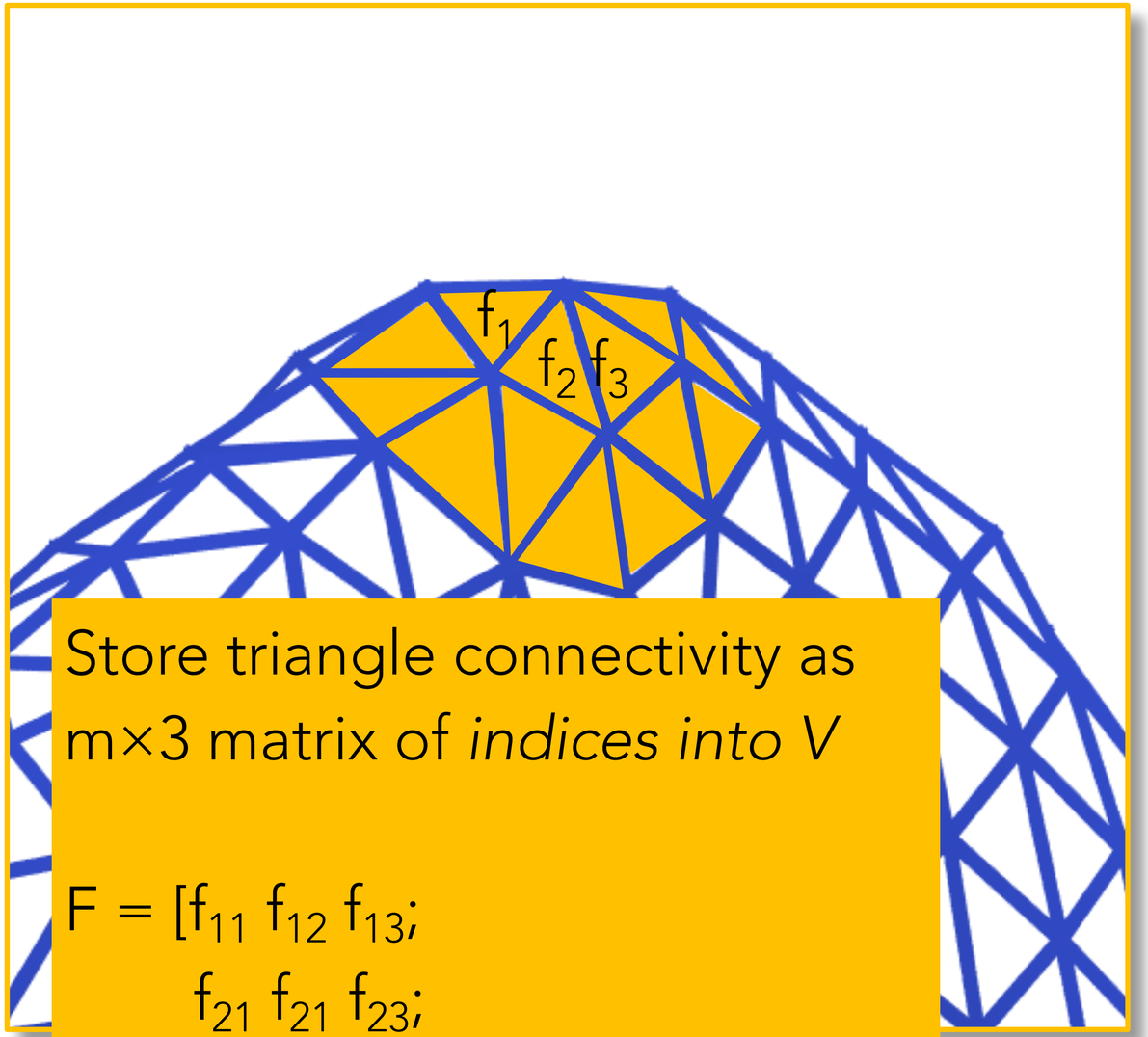

Store triangle connectivity as m×3 matrix of *indices into V*

$$F = \begin{bmatrix} f_{11} & f_{12} & f_{13} \\ f_{21} & f_{21} & f_{23} \\ \dots & & \\ f_{n1} & f_{n2} & f_{n3} \end{bmatrix}$$

Why RAW matrices?

- Memory efficient and cache friendly
- Indices are simpler to debug than pointers
- Trivially copied and serialized
- **Interchangeable** with other libraries: **numpy**, pyTorch, Tensorflow, Scipy, MATLAB, OpenCV

Getting Started

https://geometryprocessing.github.io/geometric-computing-python/

Closing Remarks

Roadmap

- We are developing this infrastructure to support our own research, we hope to reach a wide coverage of **wildmeshing** and **libigl** within the next 6 months

- **Polyfem** is in development, and new features will be exposed to python as they are added to the C++ version

- We are working on a physically-based rendering module for **meshplot**

Please let us know if you use it!

- Please cite the course notes in your papers if you use any of these python libraries.
- If you want to contribute, PRs are very welcome!
- For questions/suggestions/complaints please open issues on the corresponding GitHub repo

Black-Box Analysis:

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Teseo Schneider

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