CONSTRUCTIVE SOLID GEOMETRY

PROJECT PRESENTATION

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OVERVIEW

What is CSG?

How do we subtract objects?

How do we store these objects?

What does this look like in C++?

Results

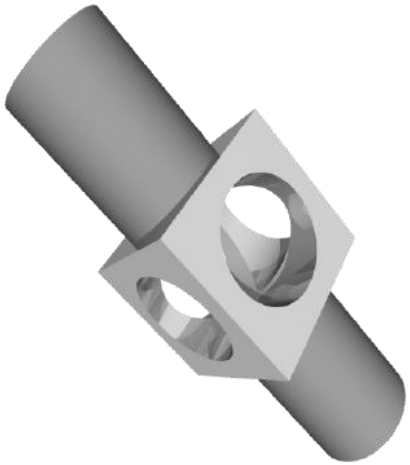
What is CSG?

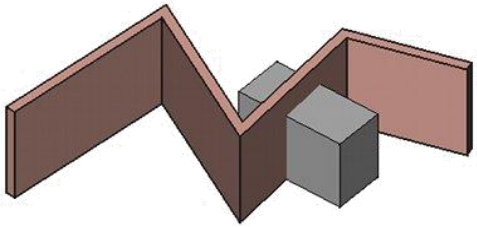
INTRODUCTION

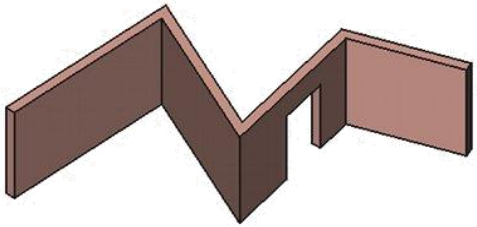
Usage

Constructive solid geometry (CSG) is used in solid modeling to combine objects with addition or subtraction

Used primarily in CAD modeling packages and video games





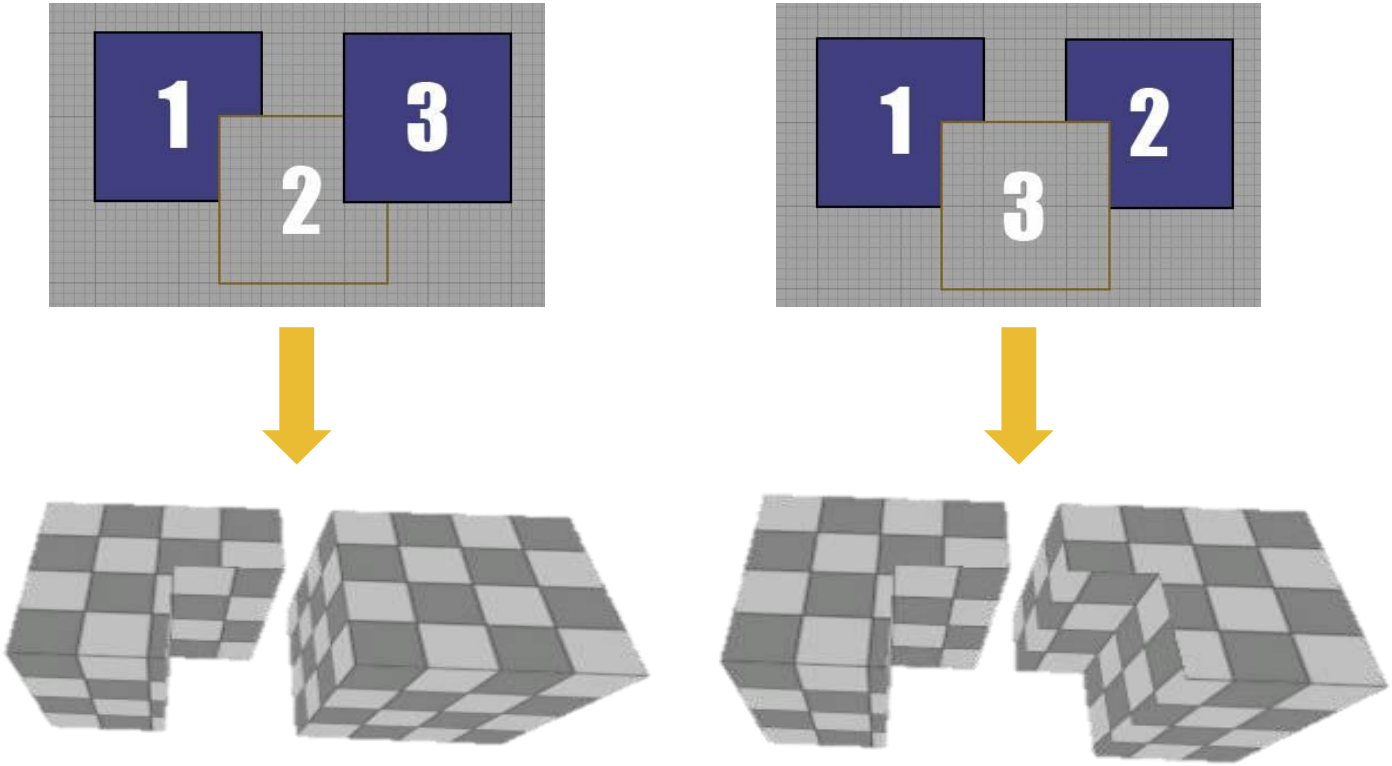


http://www.lems.brown.edu/vision/people/leymarie/Refs/CompGeom/Hoppe92/Hoppe92-CAD.gif

http://sourceforge.net/apps/mediawiki/free-cad/nfs/project/f/fr/free-cad/a/a3/Arch_Remove_example.jpg

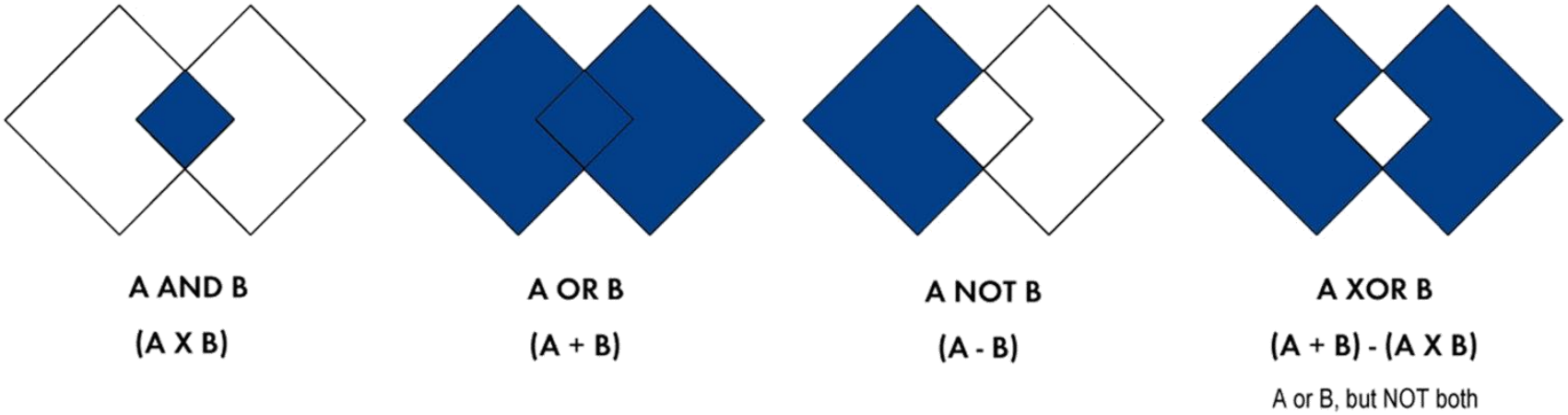
APPROACH

- Surfaces are added/subtracted to create the desired shape



http://waylon-art.com/LearningUnreal/UE3-03A-CSG.htm

BOOLEAN OPERATION

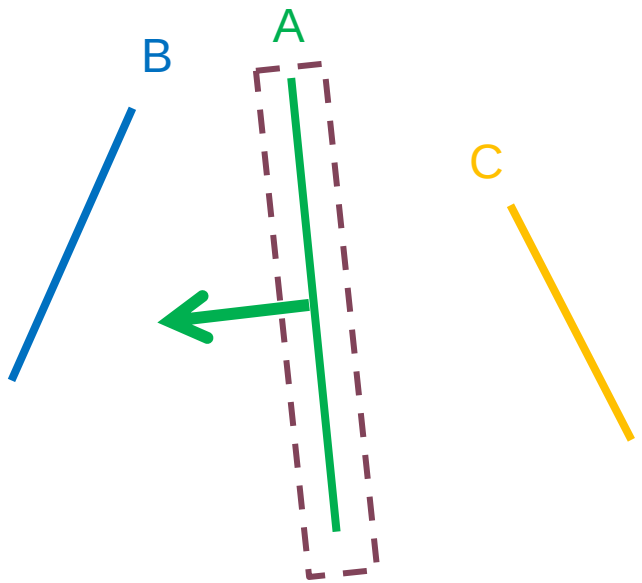


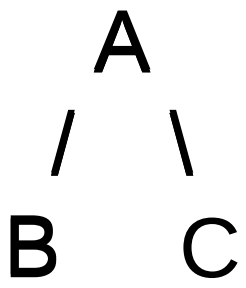
http://geoportal.icimod.org/UserFiles/Image/capacity%20building/elearning/Figure%207_1.jpg

How are these operations done?

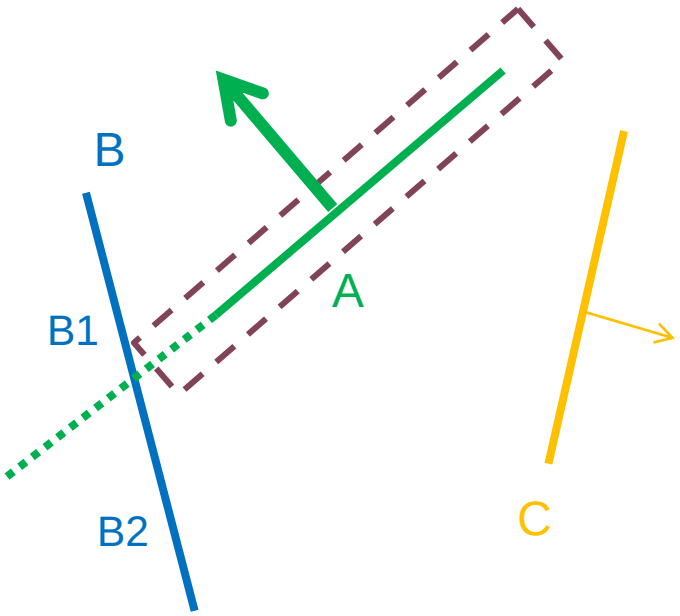
Before we answer that …How are they stored in memory?

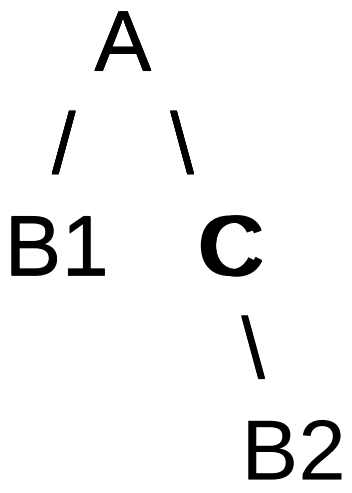
ALGORITHM – BSP TREE





ALGORITHM – BSP TREE





Now… How are the operations performed?

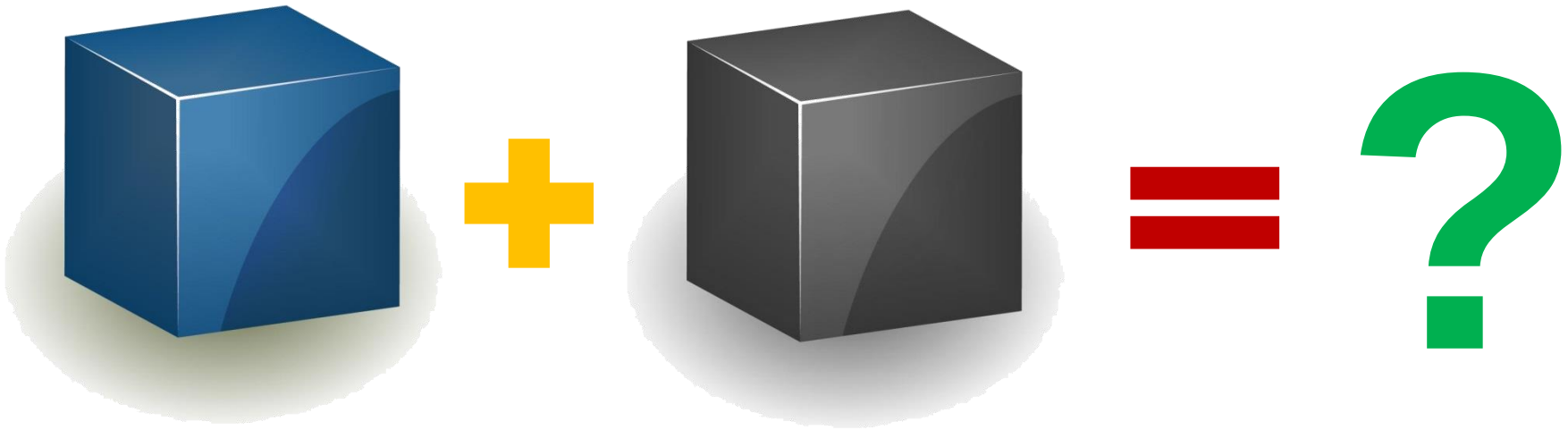
C++ Implementation

ALGORITHM – BSP TREE

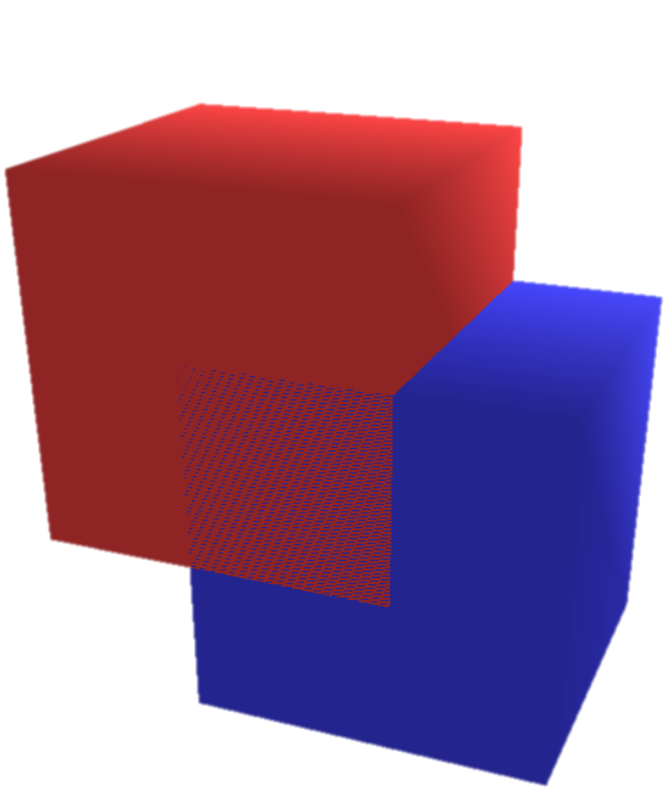
```
Struct BSP_tree
{
        BSP_tree * front;
        BSP_tree* back;
        BSP_tree* parent;
        Triangle triangle;
}
```

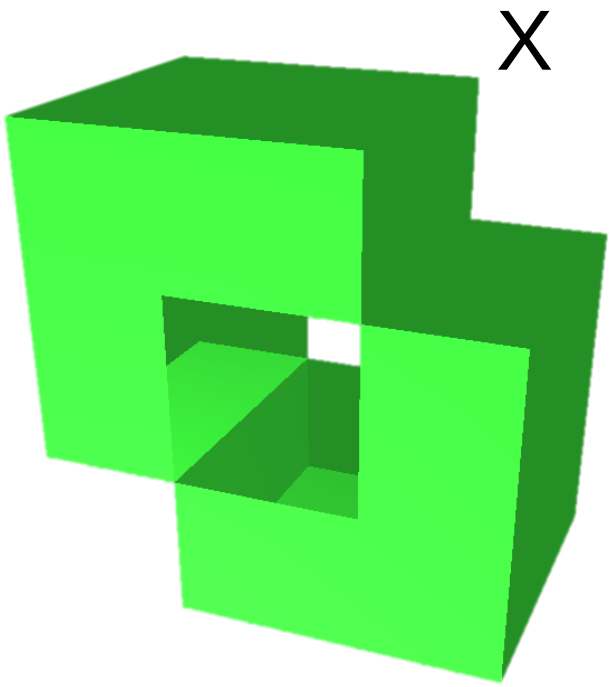
```
Triangle
{
        Vector3 vertices[3];
        Vector3 normal;
}
```

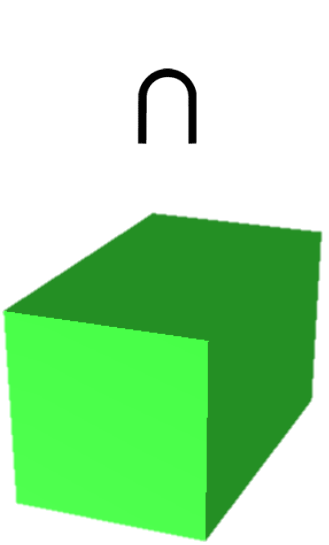
Results

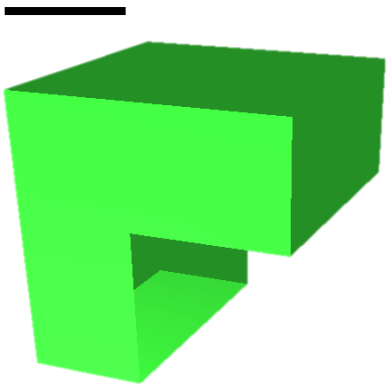


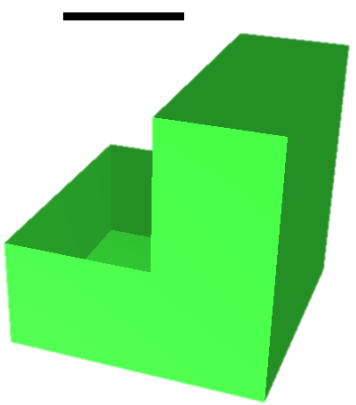
RESULTS – CUBE & CUBE

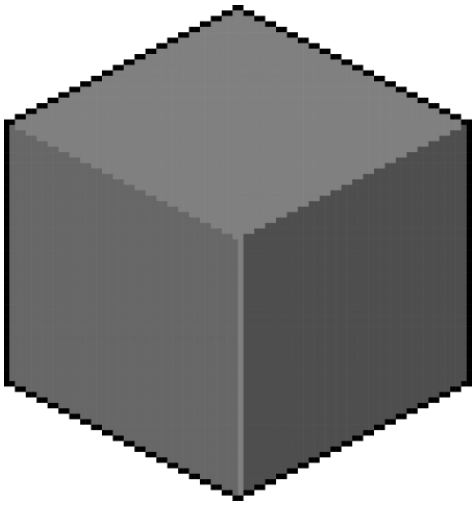


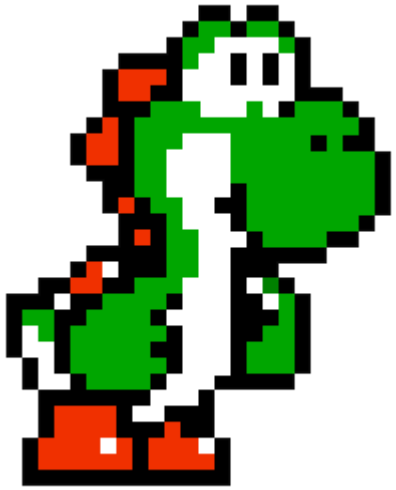












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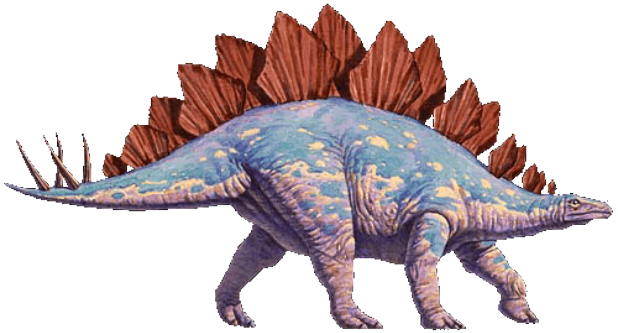

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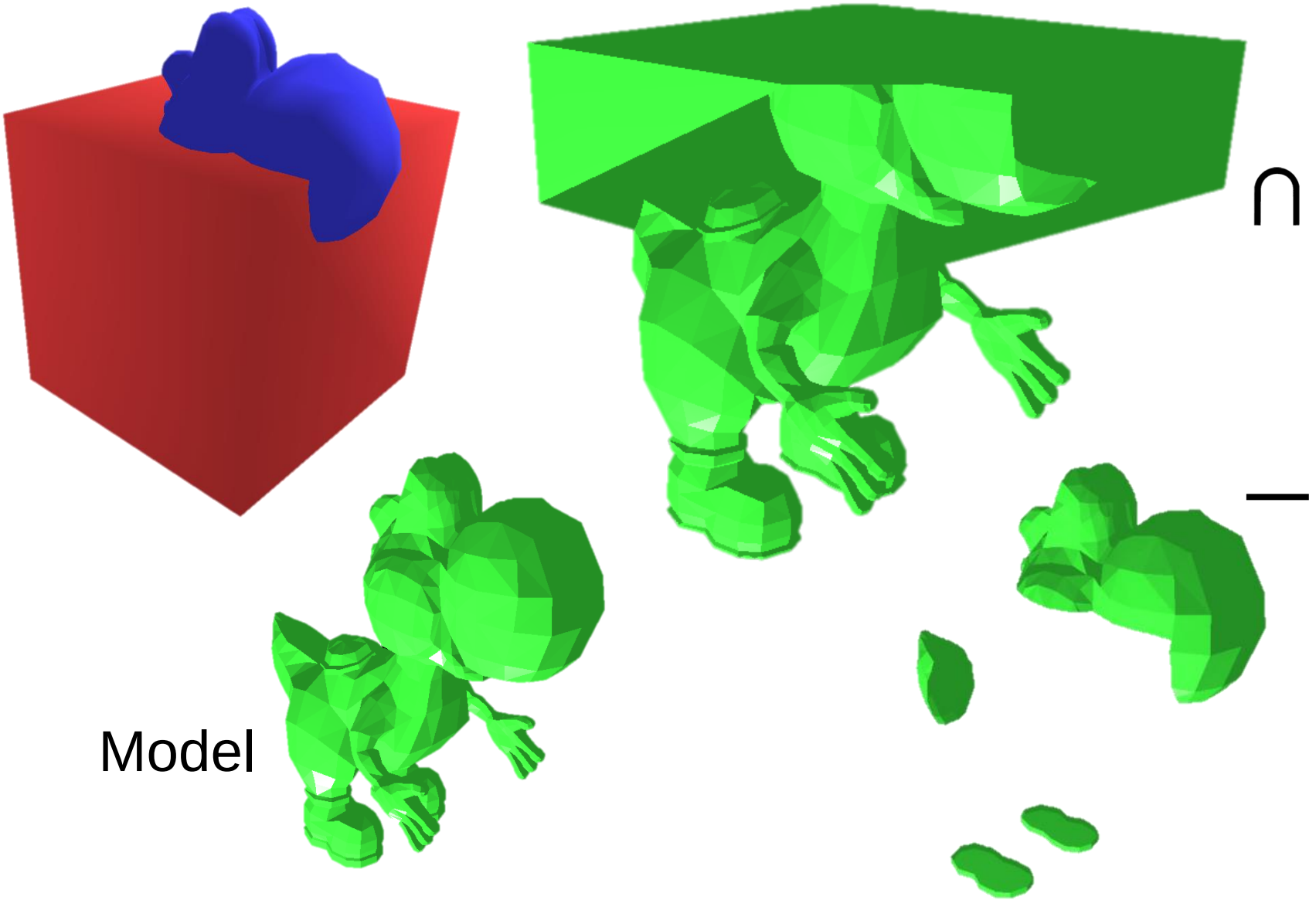
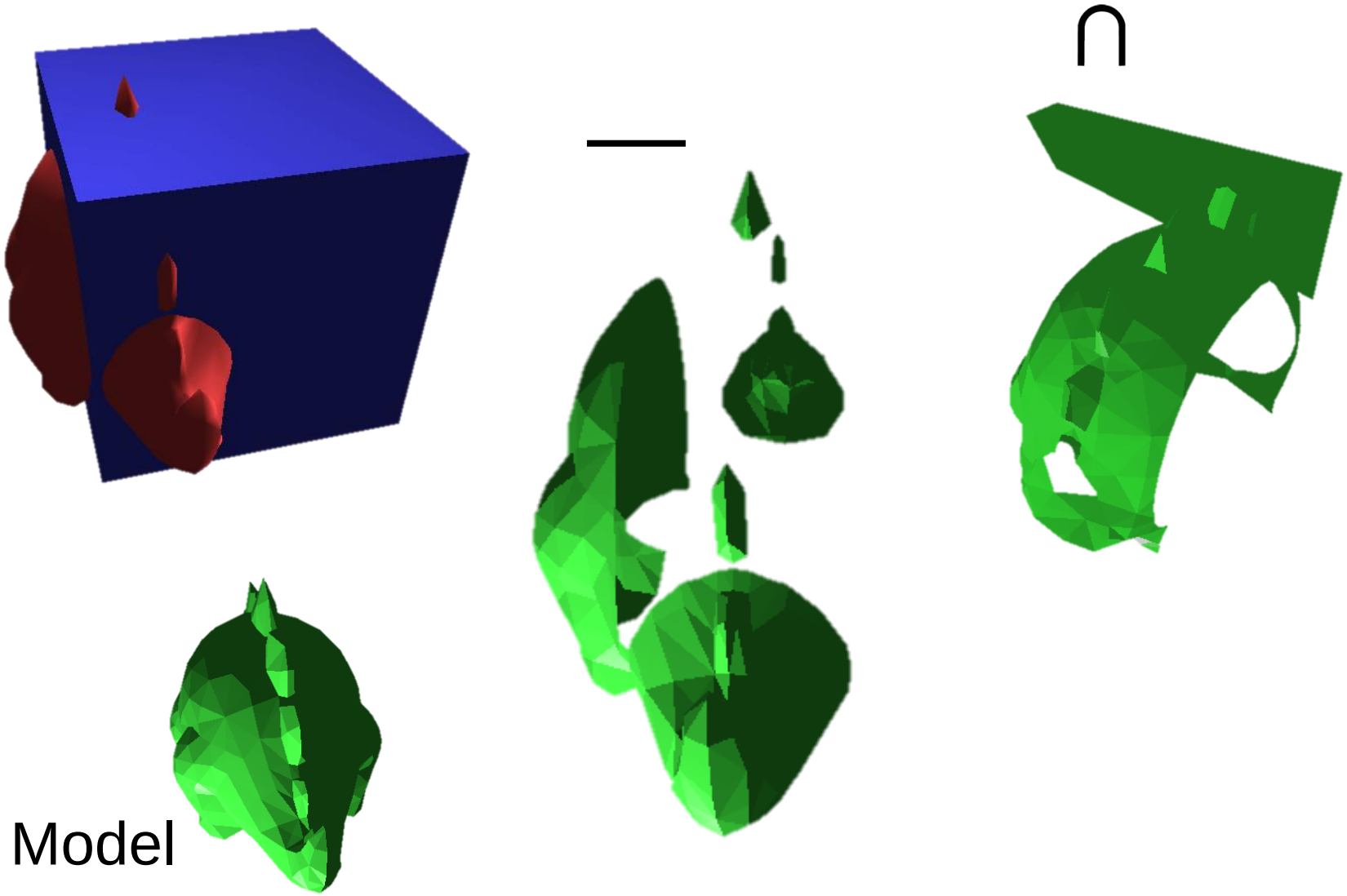
Wait…what's wrong
with your results?

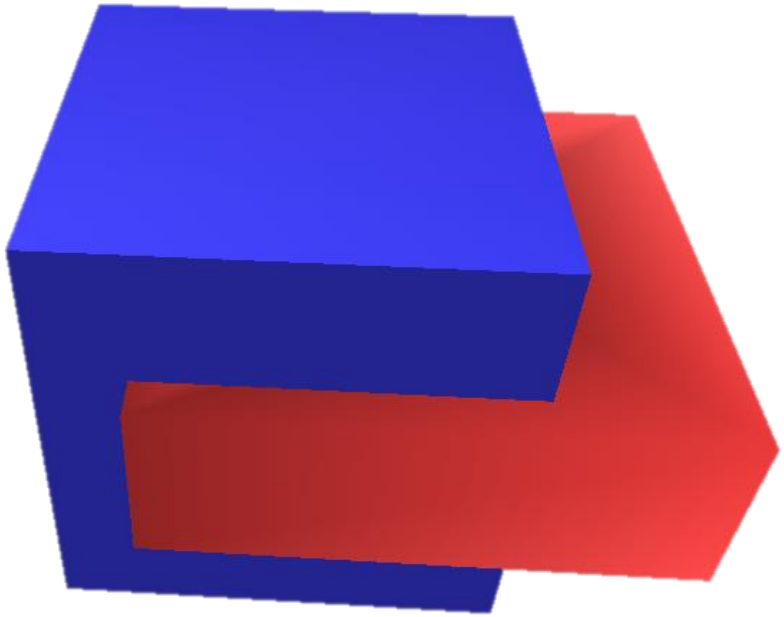
RESULTS – YOSHI & CUBE

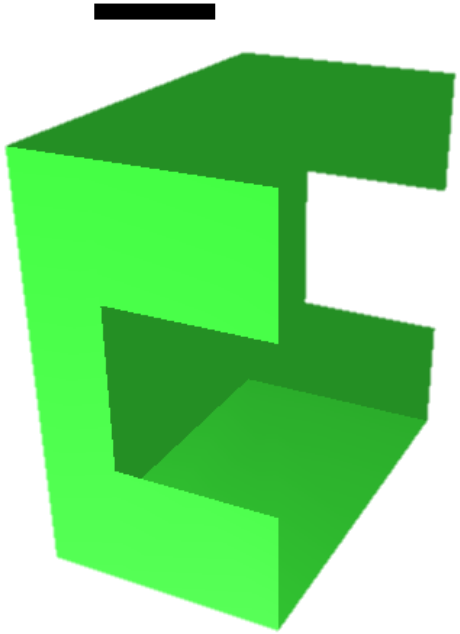


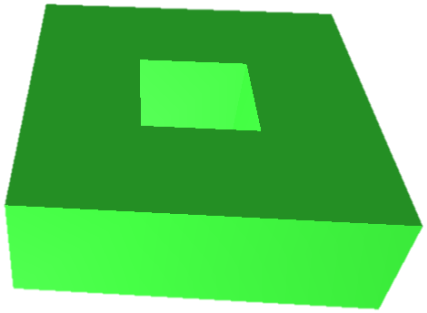
RESULTS – STEGOSAURUS & CUBE

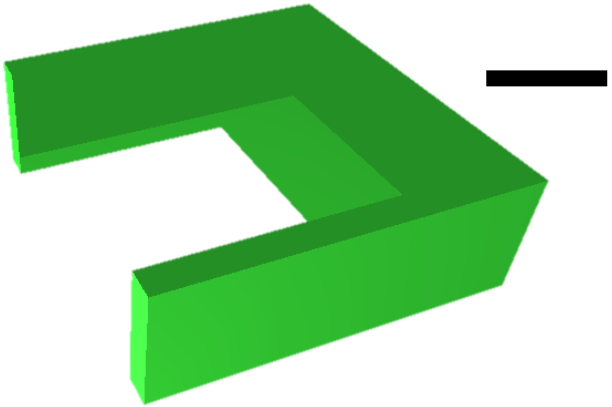


RESULTS – TORUS & CUBE



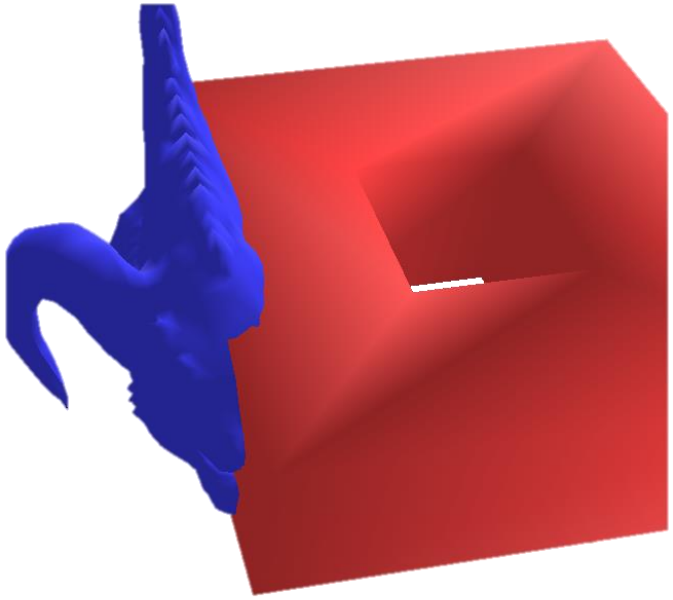




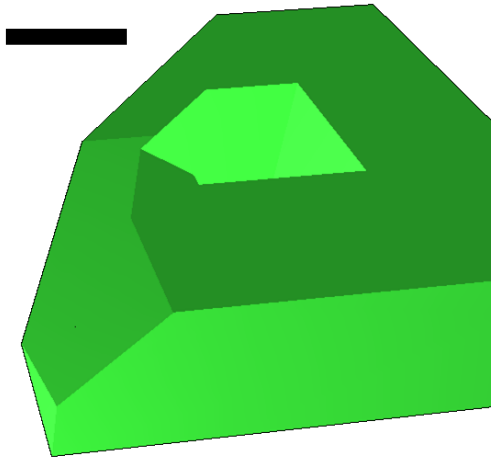


Model

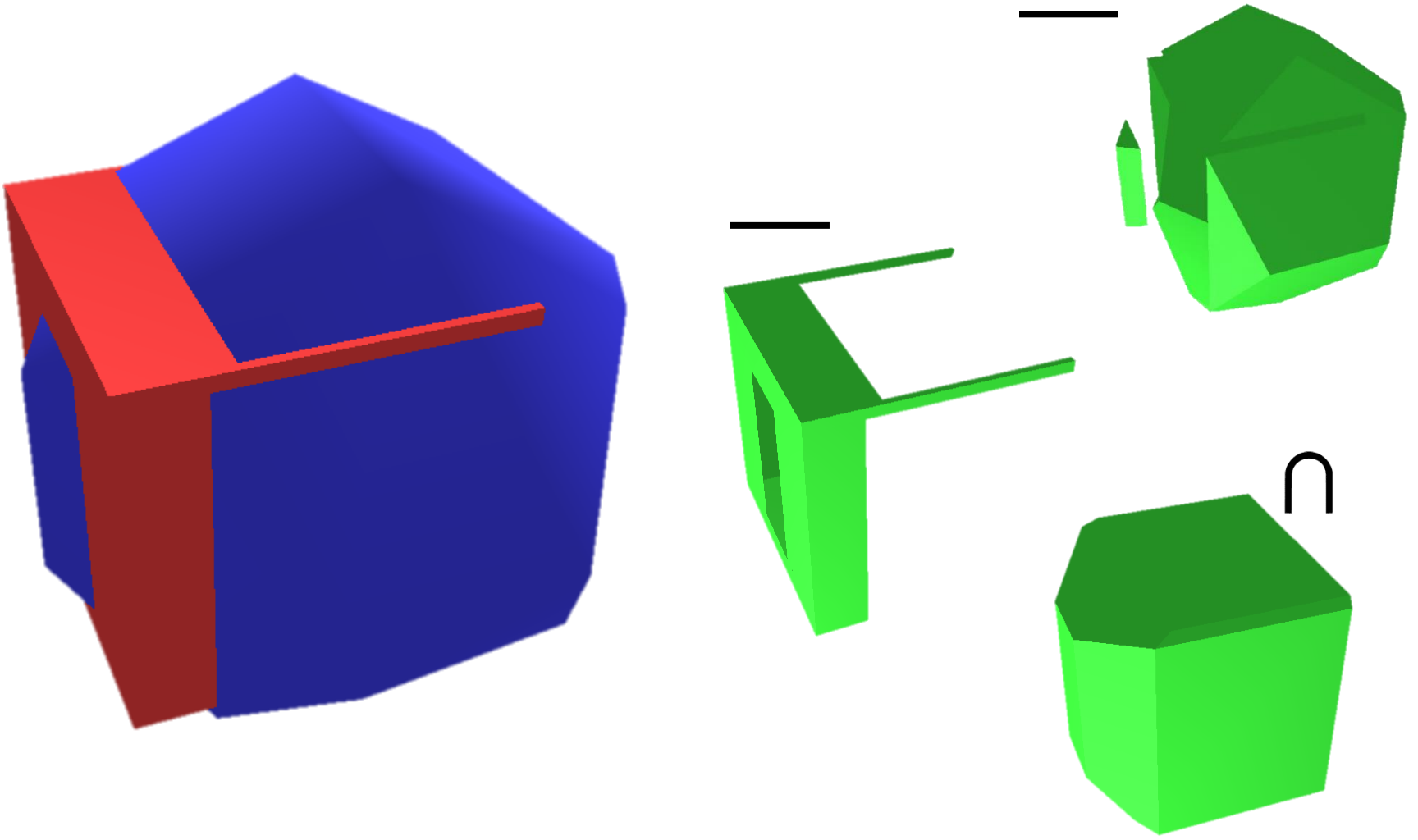
RESULTS – TORUS & DRAGON



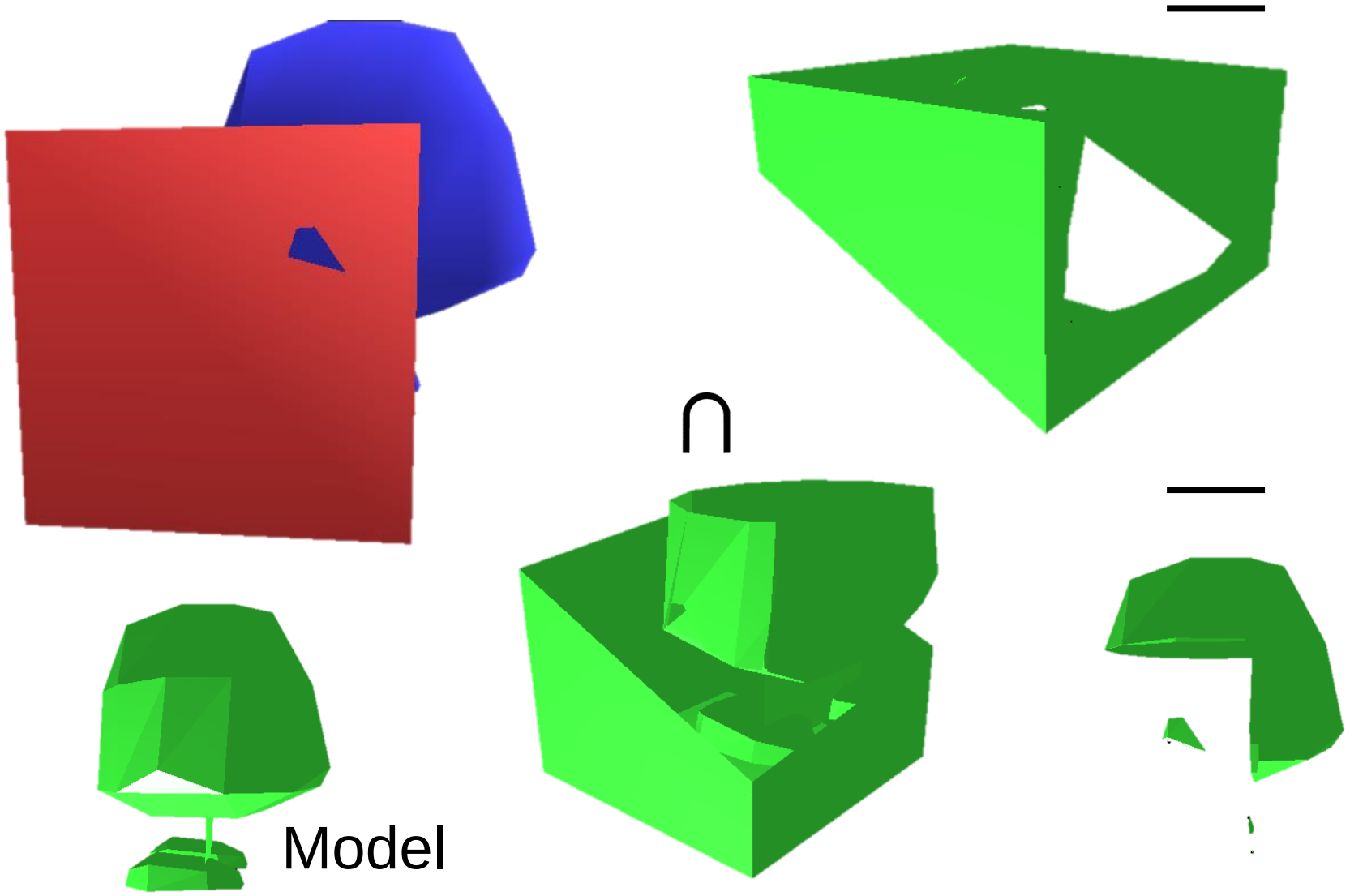
Model



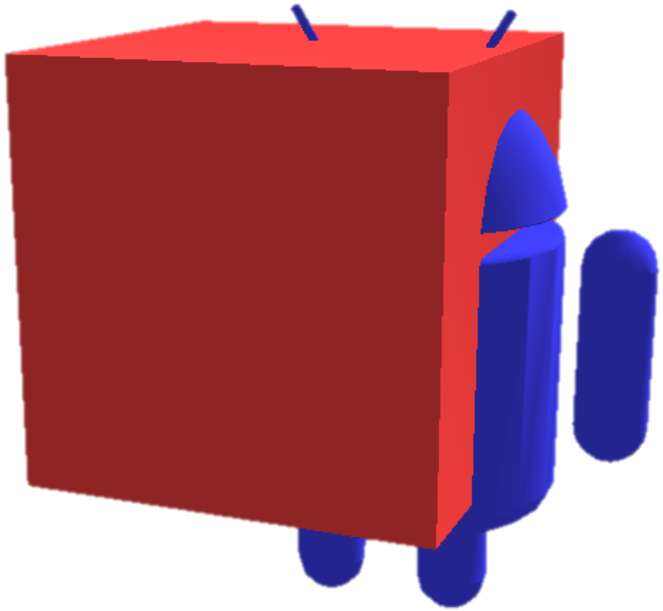
RESULTS – DODECAHEDRON & TABLE



RESULTS – GOOMA & CUBE



RESULTS – ANDROID & CUBE



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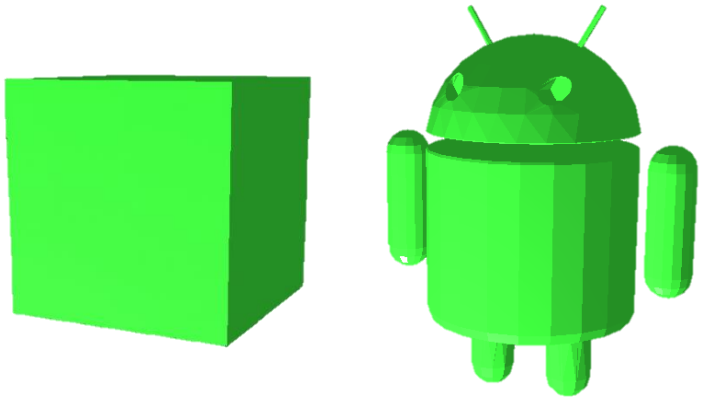

Model

RESULTS – WEREWOLF & CUBE

Model

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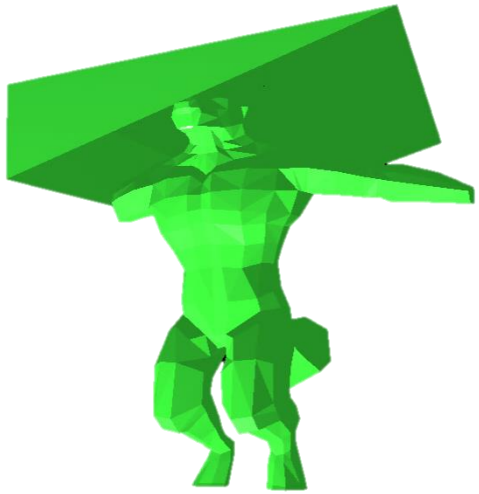

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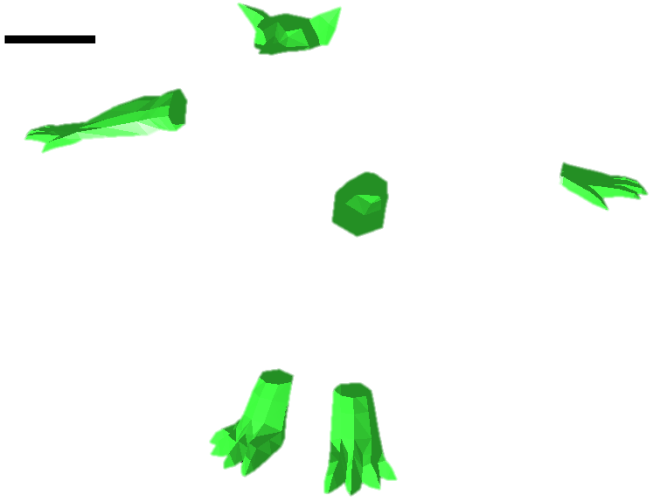
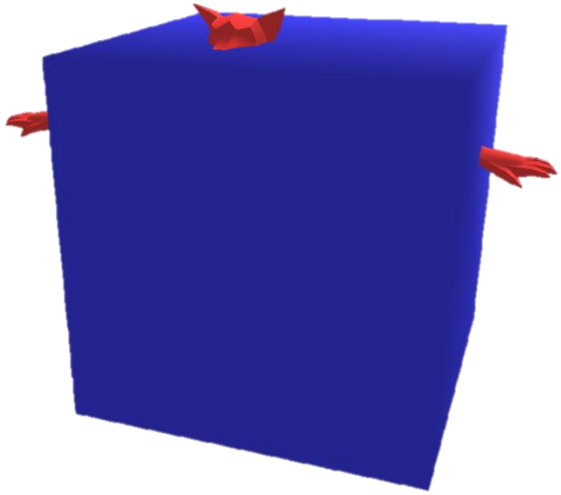
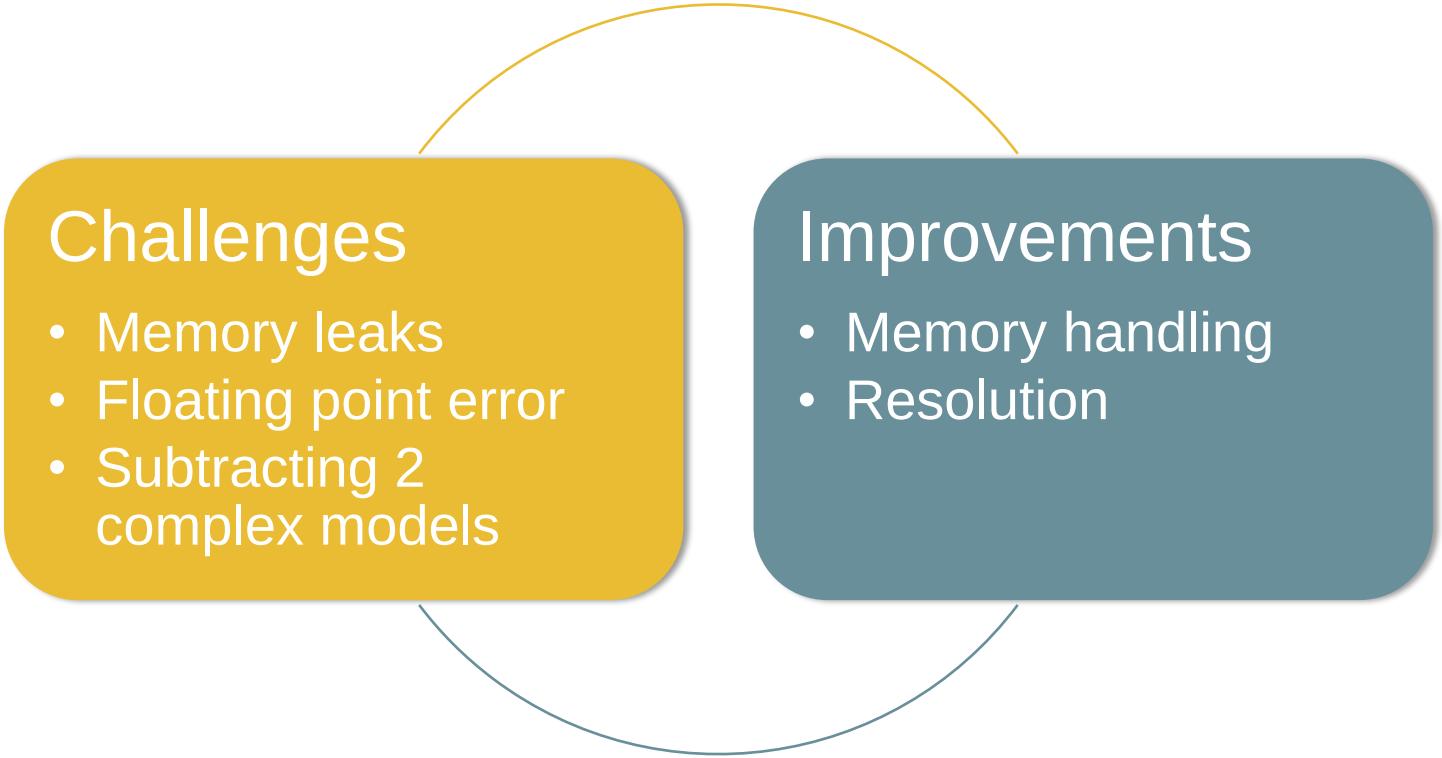




DISCUSSION


Challenges
• Memory leaks
• Floating point error
• Subtracting 2 complex models
Improvements
• Memory handling
• Resolution

REFERENCES

B. Naylor, J. Amanatides and W. Thibault, "Merging BSP Trees Yields Polyhedral Set Operations", *Proc. Siggraph '90, Computer Graphics* 24(4), August 1990, pp 115-124.

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Q & A

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