Assignment 2: Acceleration structure

Deadline	17:00 on December 18, 2020	**Student**	Carlo Bredius	4132955
Handed in on	December 18, 2020		Brian Janssen	5661154

1 Basic features

- Implementing a correct BVH over a large (>10k) set of input triangles or other primitives (2 pts);
- Implementing ray/scene intersection using this BVH (1 pt), achieving a performance improvement over brute force scene intersections in line with expectations (2 pts);
- Build the BVH using the Surface Area Heuristic (1 pt) and binning (1 pt) (see [1,4]).

2 Additional features

- Construct the BVH for a 2M triangle scene in less than 1 second (still using (binned) SAH; 1 pt)

2.1 Proof

The BVH construction is performed on an Intel(R) Core(TM) i7-6700K CPU @ 4.00 GHz (Figure 3). For timing we used the given Timer implementation as used in the template (1).

```
Constructing BVH...
Maximum number of nodes: 4036462
Used number of nodes: 1747171
Construction time: 473.473 ms.
```

Figure 1: Output for the construciton of the BVH around `nefertiti.obj`.

3 Controls

3.1 Keys

Key	Action
W D	Translate camera left and right
Q, E	Translate camera up and down
W, S	Translate camera forward and backward
F, R	Change field of view
Arrows keys	Rotate camera
Escape	Exit program

3.2 Scene configuration

Any `.obj` object can be loaded as an argument of the program. This file does not need to have computed normals as we computed them while loading in. This means that the file will be significantly reduced. There is the option to provide a material file and texture which will

automatically be read. If no arguments are given, the default scene will be loaded. However the BVH will only be build around triangles.

In `precomp.h` a new define is given named `USEBVH`, which does what the name suggests. To visualize this bvh, like the example in Figure 2, uncomment `#define VISUALIZEBVH` in the `precomp.h` file.

As default, the Surface Area Heuristic with binning (using 8 bins) is used. The number of bins can be changed in `precomp.h` under the define `BVHBINS`. When two bins are chosen, we have the equivalent to the median split, so the simpler function is used. When 0 bins is given, non-binned SAH is performed.

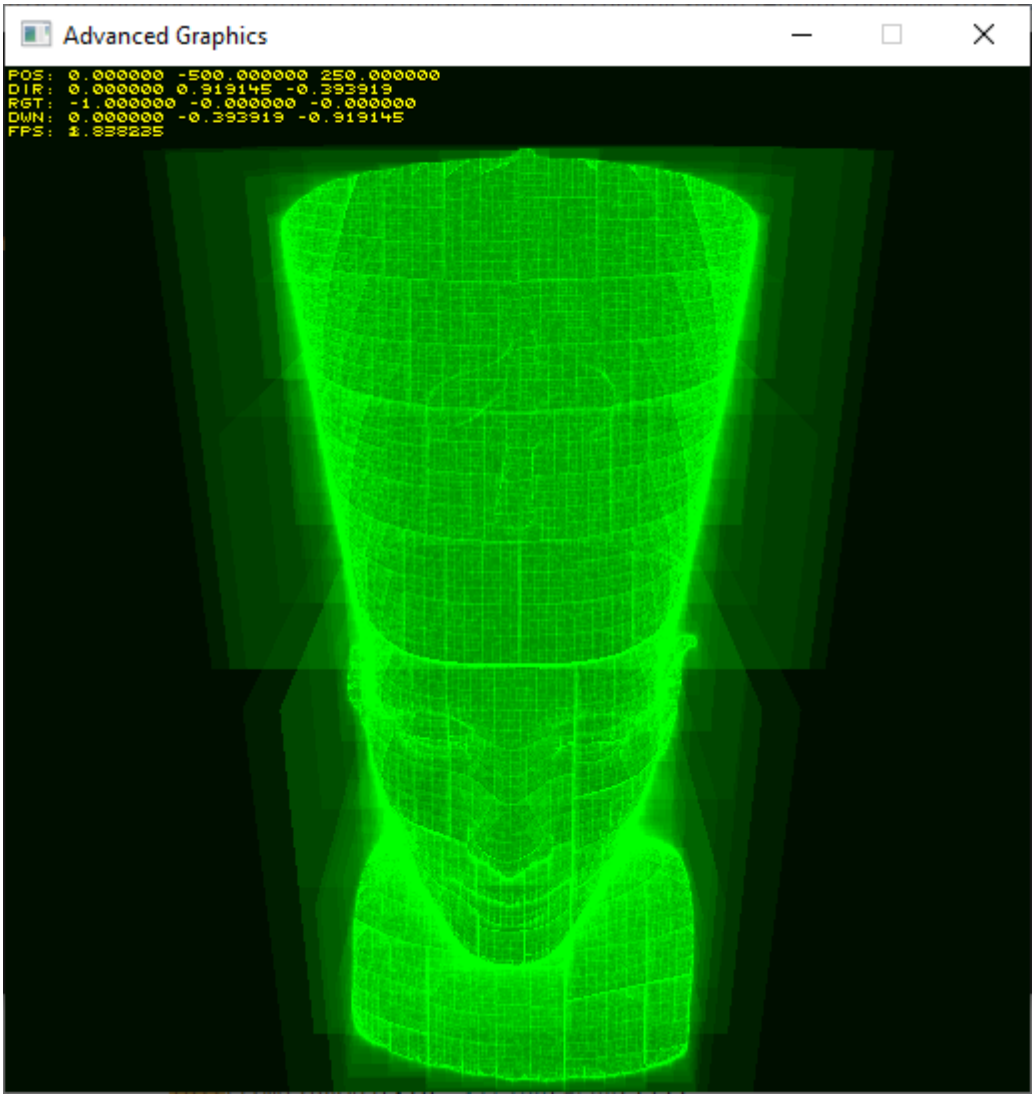

Figure 2: The Bounding Volume Hierarchy of Nefertiti.

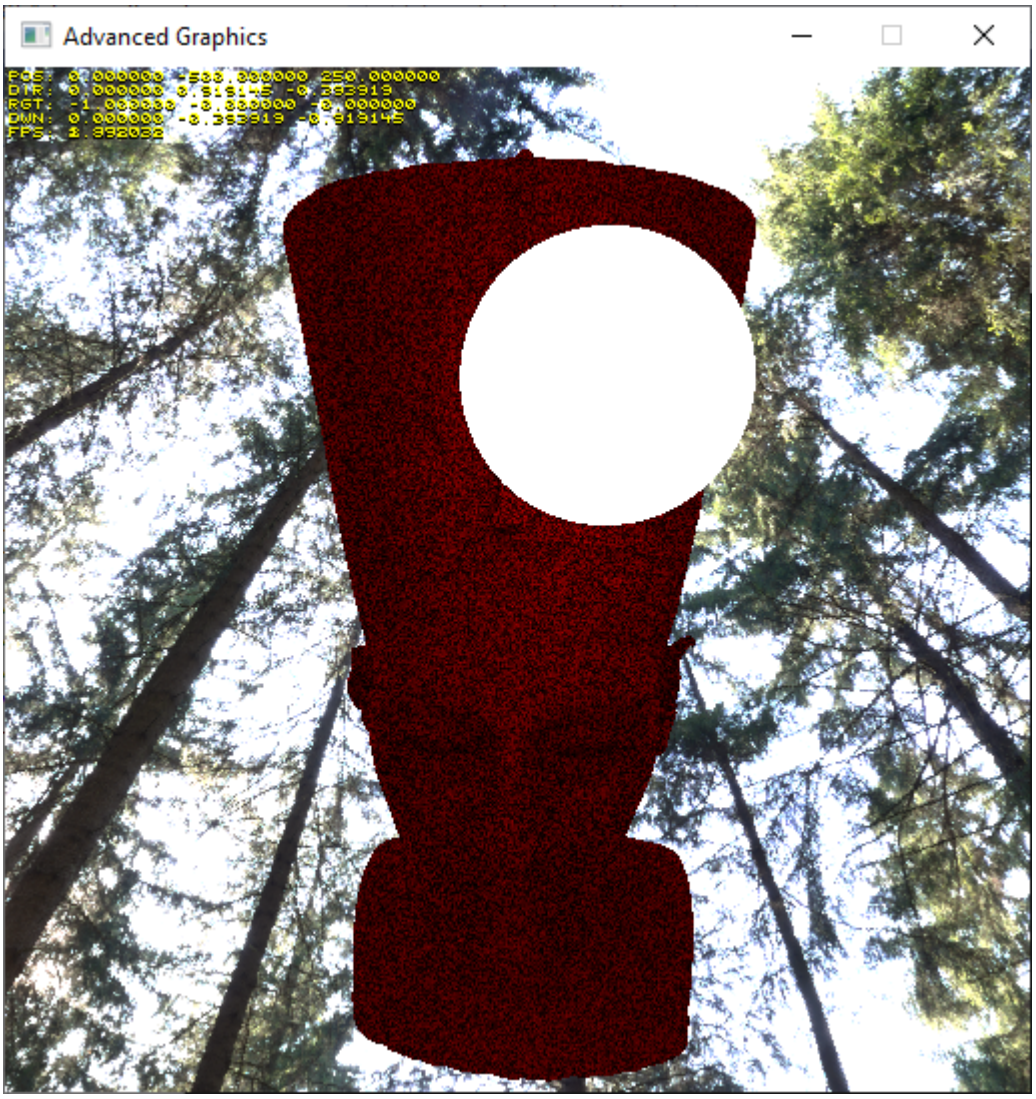

Figure 3: Rendering Nefertiti: a 2 million triangle mesh.