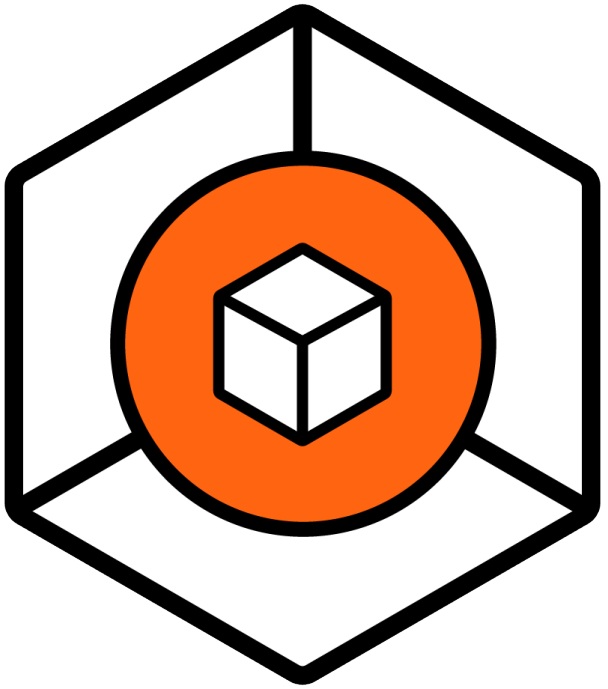
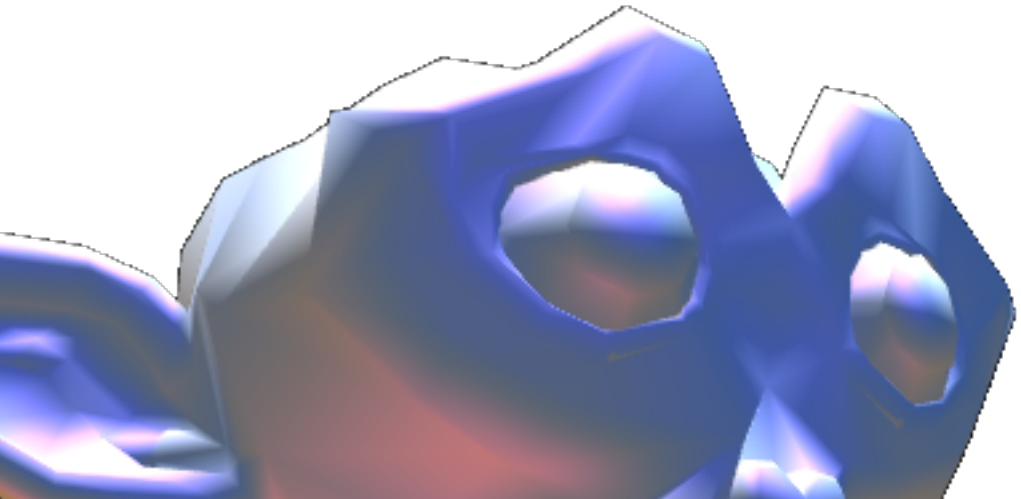


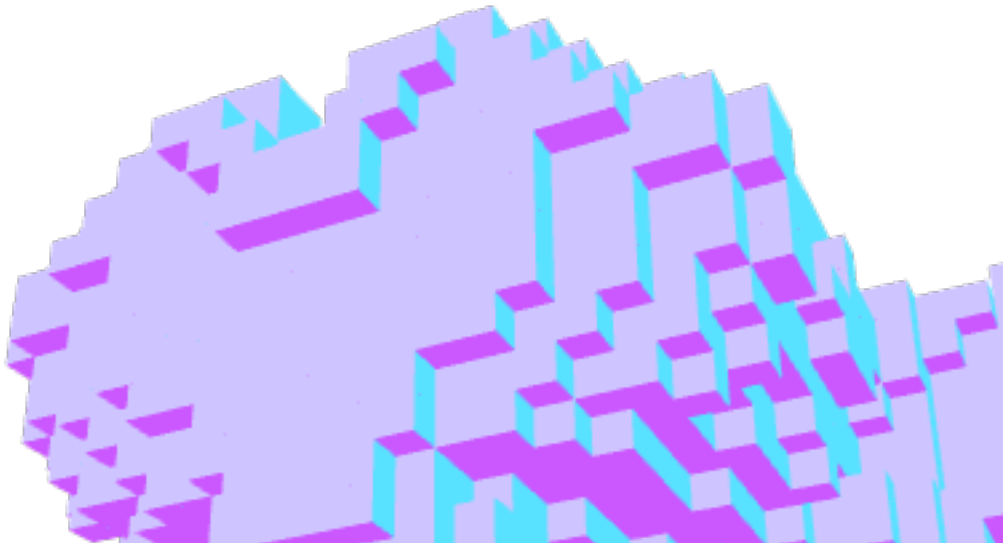
Research and Development about

Voxels
Octrees
Level Of Details

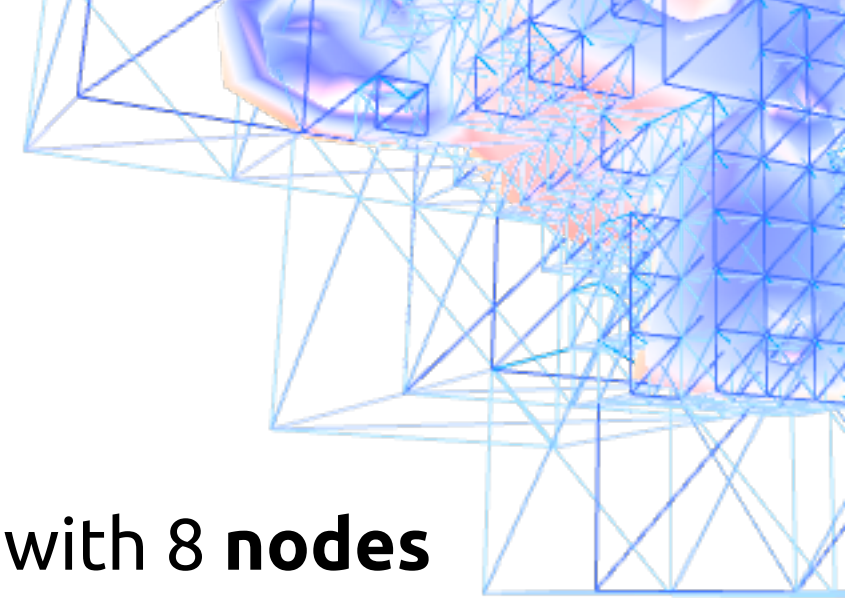
Definitions

- Model
  - 3D mesh made of **points** and **triangles**
- Voxel
  - Volume element
  - Unit cell of 3D grid
  - A **box**





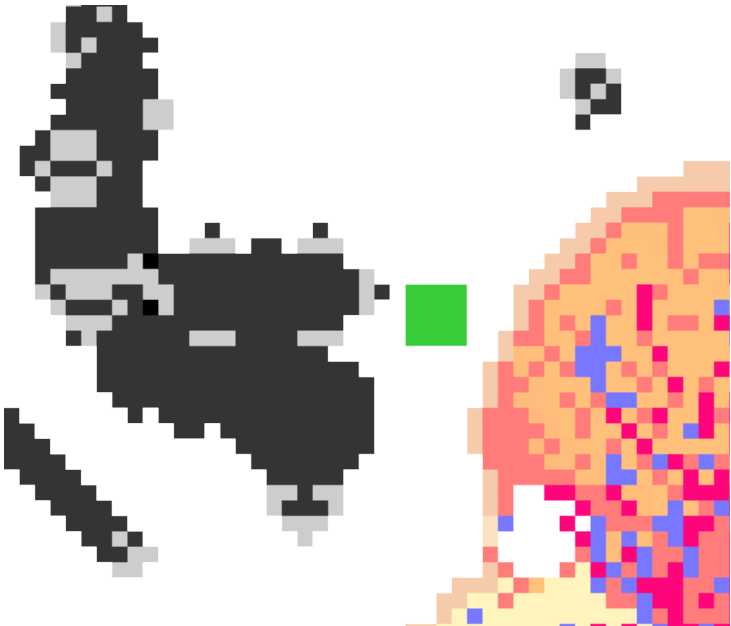
Definitions



- Octree
  - **Recursive** tree data structure with 8 **nodes**
  - Store **positions**, **dimensions** and **data**
  - An octree **leaf** is a node without **children** nodes
- Level Of Details
  - Amount of informations
- Bouding Box
  - Minimum and maximum points

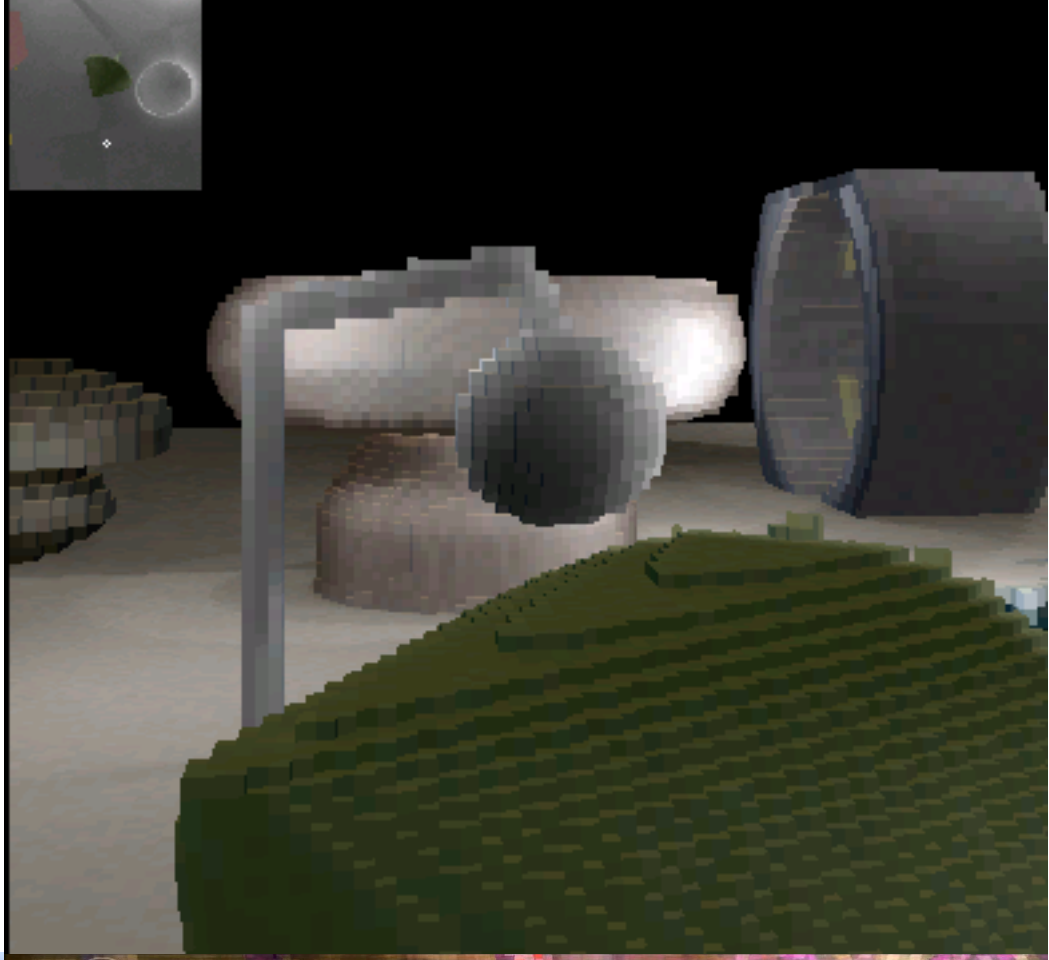
Project Description

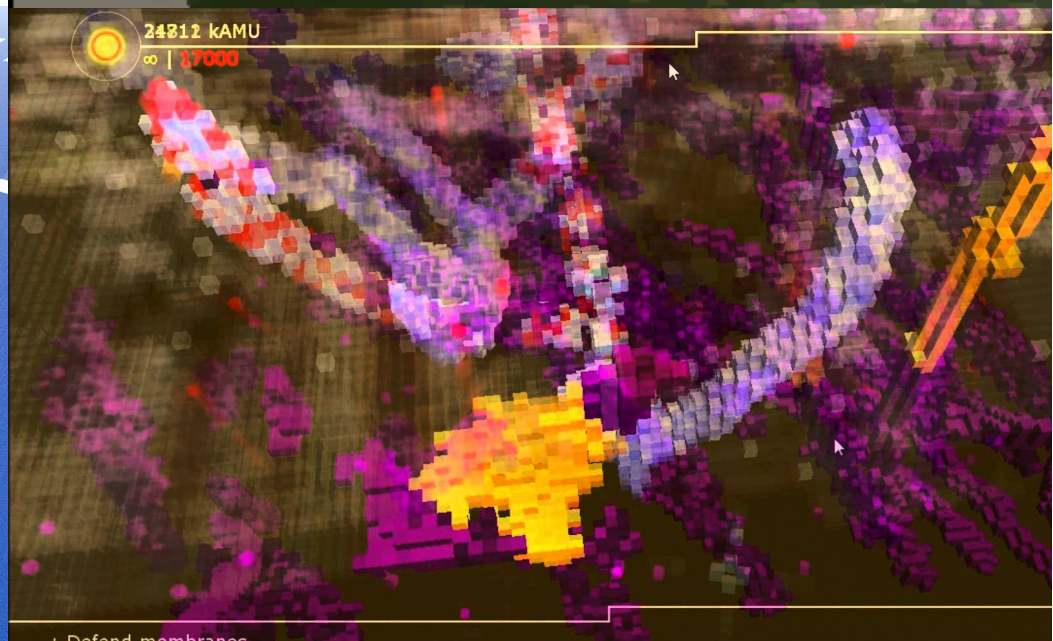
- Objectives
  - Create a **voxel world**
  - **Voxelize** a mesh
  - **Recursive** level of details
  - [Cellular automata]
  - [Game]



References

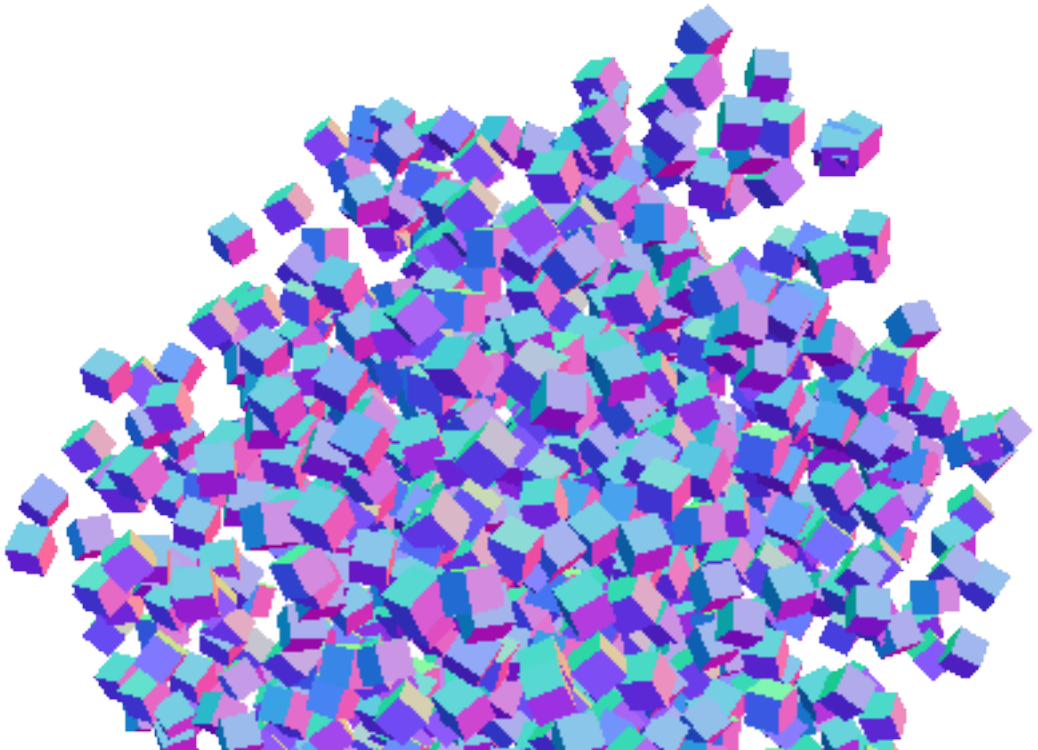
- Voxlap
- Minecraft
- Cell Emergence





Libraries

- WebGL ThreeJS
  - Universal Internet browser
  - Modern javascript framework
  - Easy to use examples



Routine Procedure

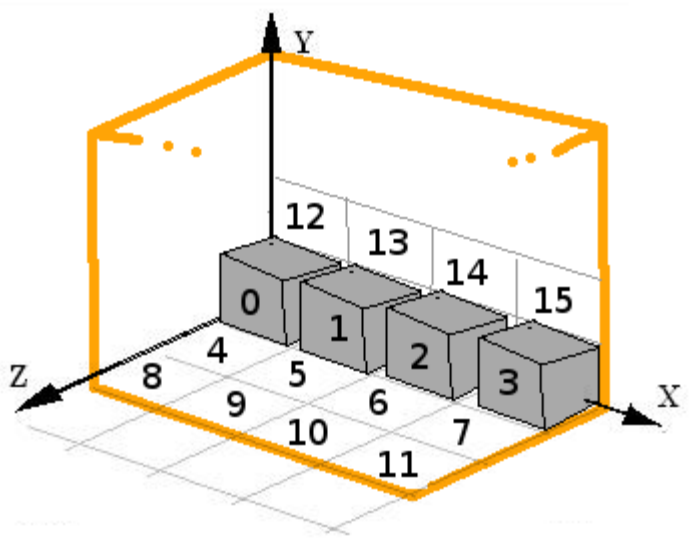
- Setup
  - Voxel **Engine**
  - Mesh **Voxelization**
  - Octree **Insertion**
- Update
  - Voxel **Raycasting**
  - Octree **Exploration**
  - Level Of Details **Localised**

Voxel Engine

- Voxel stored in **list** (size*size*size)
- **Unique** index from space position
- 3D position from voxel index
- 8 grids for each **octant**

```
// Get index from position
round ( x + y * (sizeX * sizeZ) + z * sizeX )

// Get position from index
x = index % sizeX
y = floor ( index / ( sizeX * sizeZ ) ) % sizeY
z = floor ( index / sizeX ) % sizeZ
```

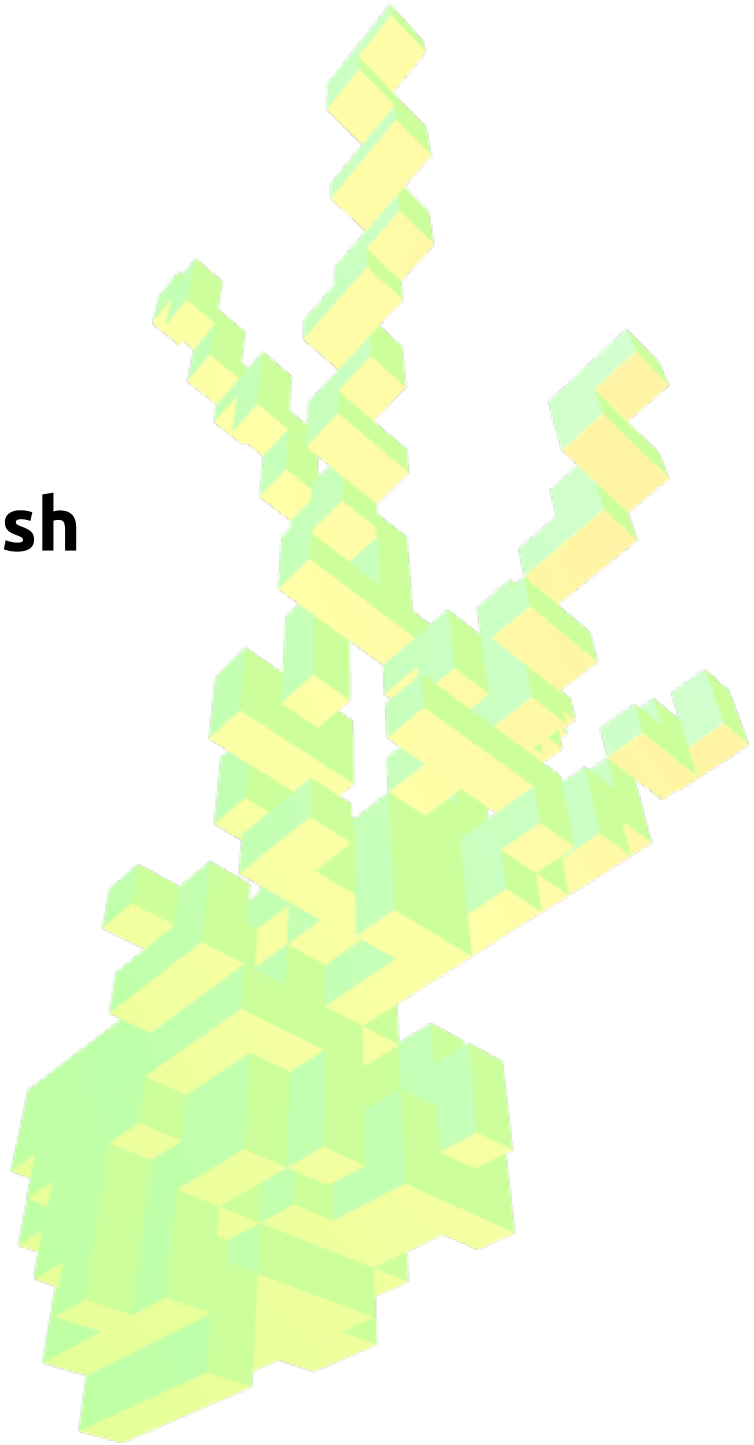


Voxel Display Optimisation

- Do not
  - Create numerous object to render
- Do
  - **Merge** geometries into one mesh
- Only one draw call to GPU

Voxel Raycasting

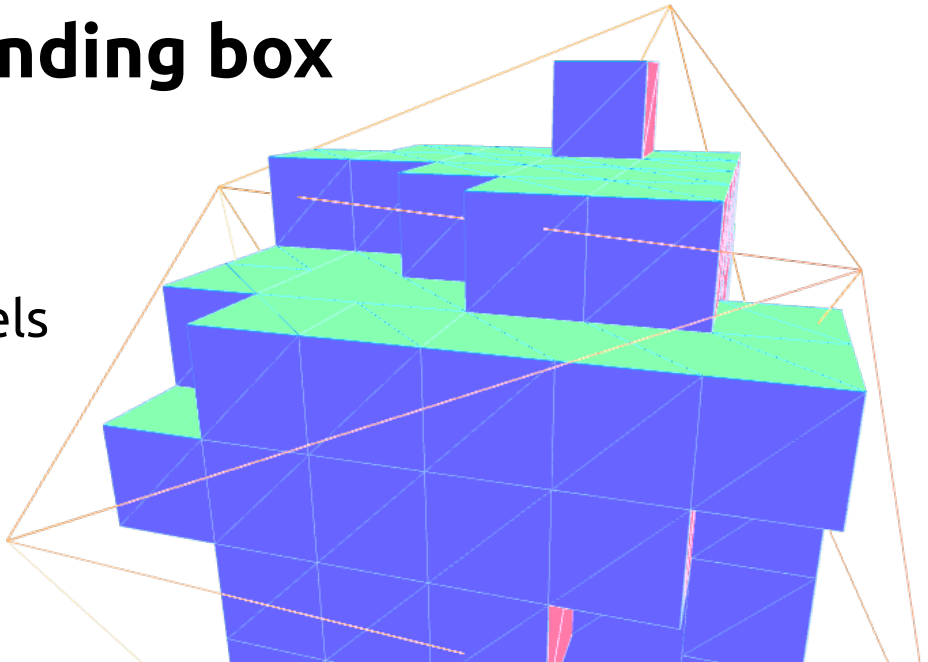
- **Picking** voxel
  - Test **raycast** on the **voxel mesh**
  - **Offset** with **face normal**
  - **Round** space position
- **Manipulate** voxel
  - Create
  - Clear



Mesh Voxelization

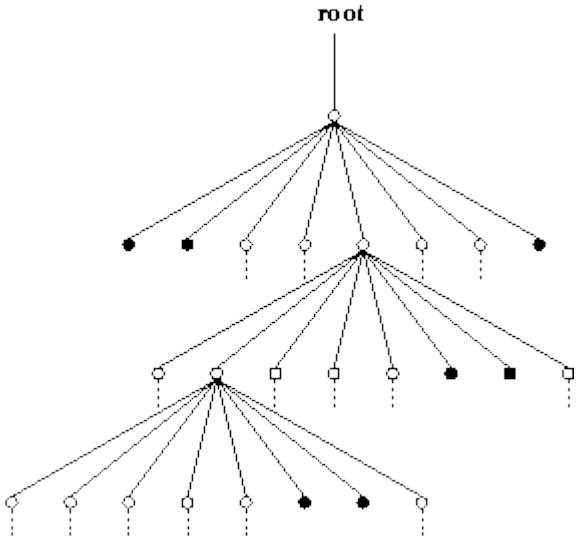
- Iterate **mesh triangles**
  - Iterate voxels in **triangle bounding box**
    - **Test overlapping** voxel / triangle

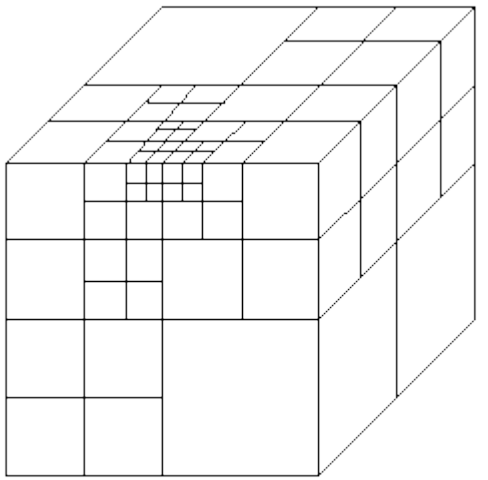
- Fill volume
  - Iterate voxels **slice of bounding box**
    - Iterate **voxels columns**
      - Test triangle normals
      - Fill column between two voxels



Octree Insertion

- **Insert** point in **root node**
  - Node **have children** nodes
    - **Insert** point in **child node**
  - Already **have a point**
    - **Split** node (create children)
    - **Insert** previous point in **child node**
    - **Insert** new point in **child node**
  - Have **no point** stored
    - **Store** point in **current node**





Octree Exploration

- Algo
- Modes

Local Level Of Details

Generate Depth

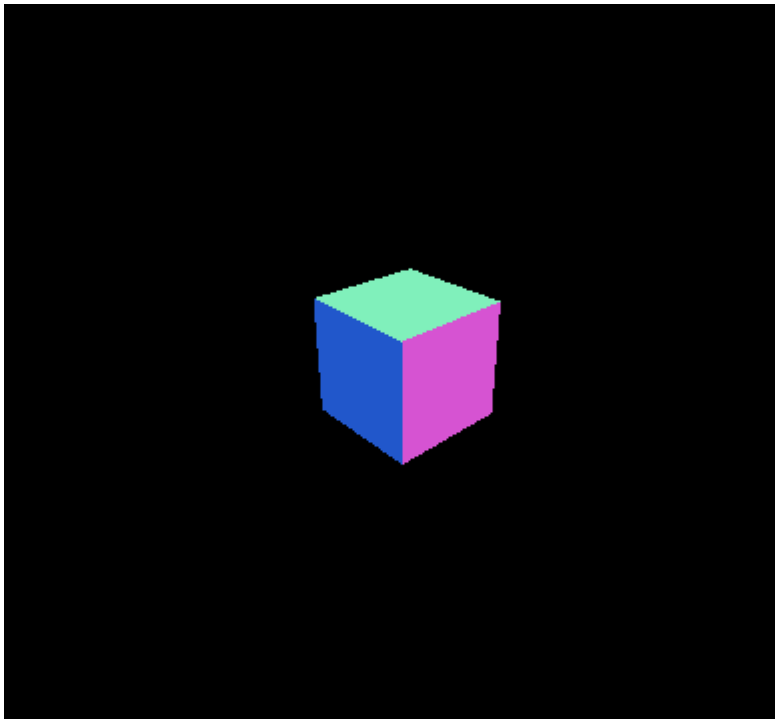
Interface

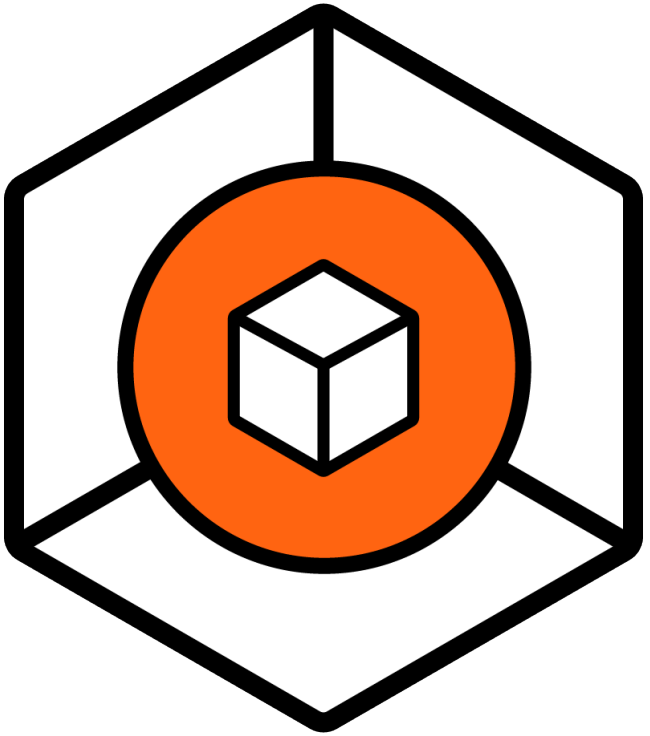
- Controls
- Parameters

Debriefing

- Futur engine
- Cellular automata
- Game

Preview





PLAY