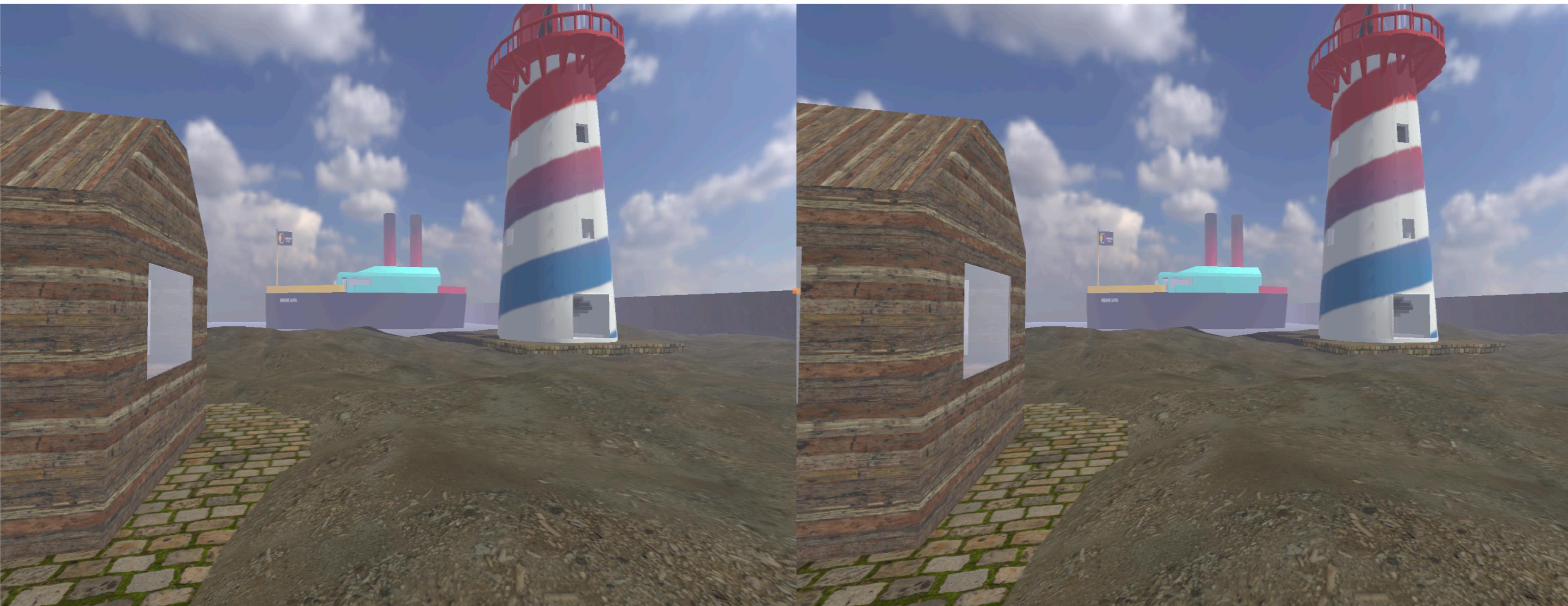


Virtual Reality in Pharo: Challenges and Demo



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Desromech E.I.R.L.



Talk Outline

- Massive Refactoring
- Rigid Body Physics Engine in Pharo
- Game Framework inspired in Unreal
- Level Editor
- VR Support and Challenges
- Demos

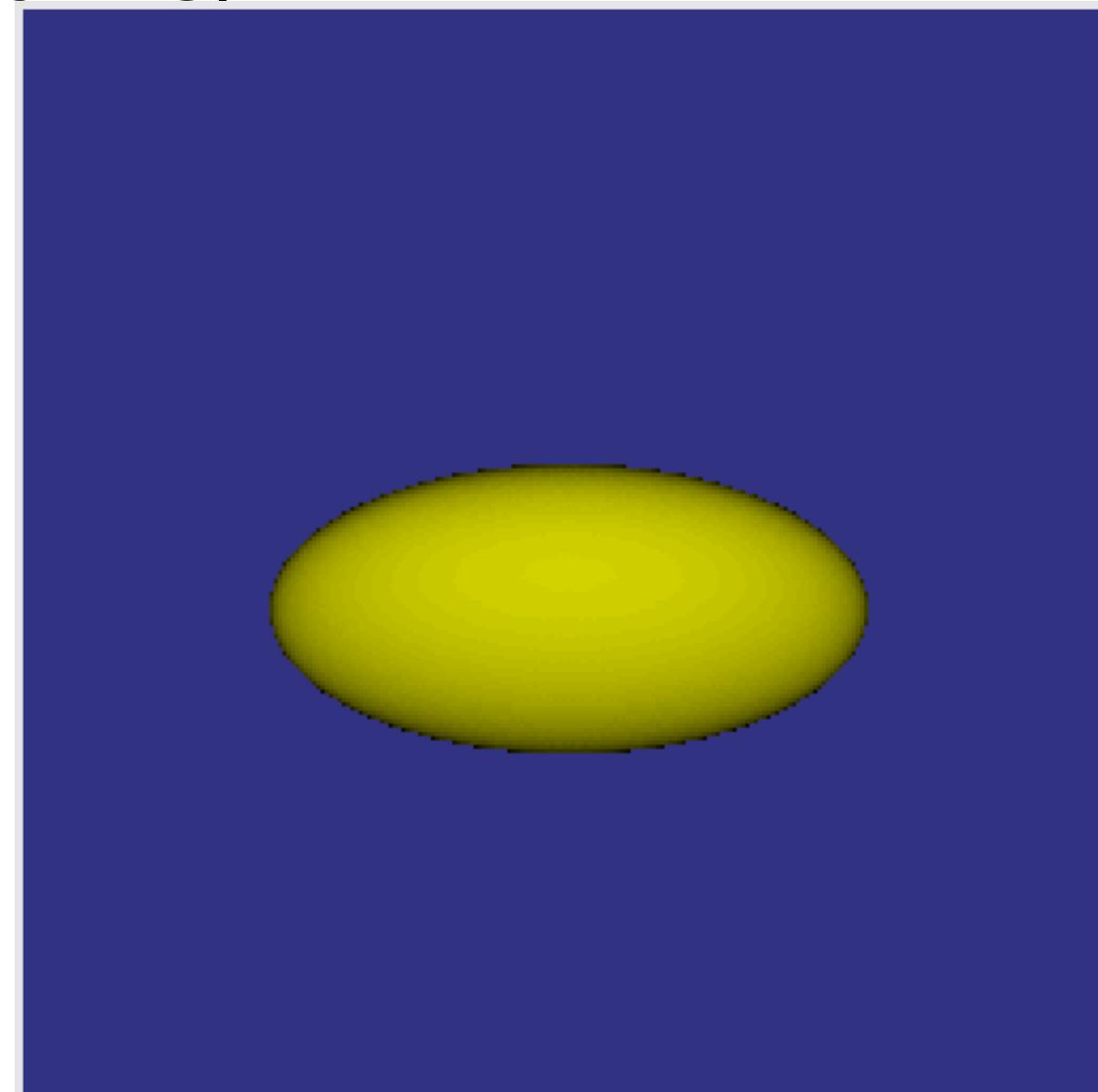
Massive Refactoring

- Focus on Scientific, Engineering and Prototyping Support
- Favor Flexibility vs Raw Speed (e.g. Physics in Pharo)
- Highly Modular Reimplementation
- Stricter Separation between Model and Presentation
 - Duplicates static Data between CPU and GPU (e.g textures, meshes)
 - Improves Stability across image sessions
- Separate Git Repos
- Reduce loading time if fewer repos and needed

Math Library

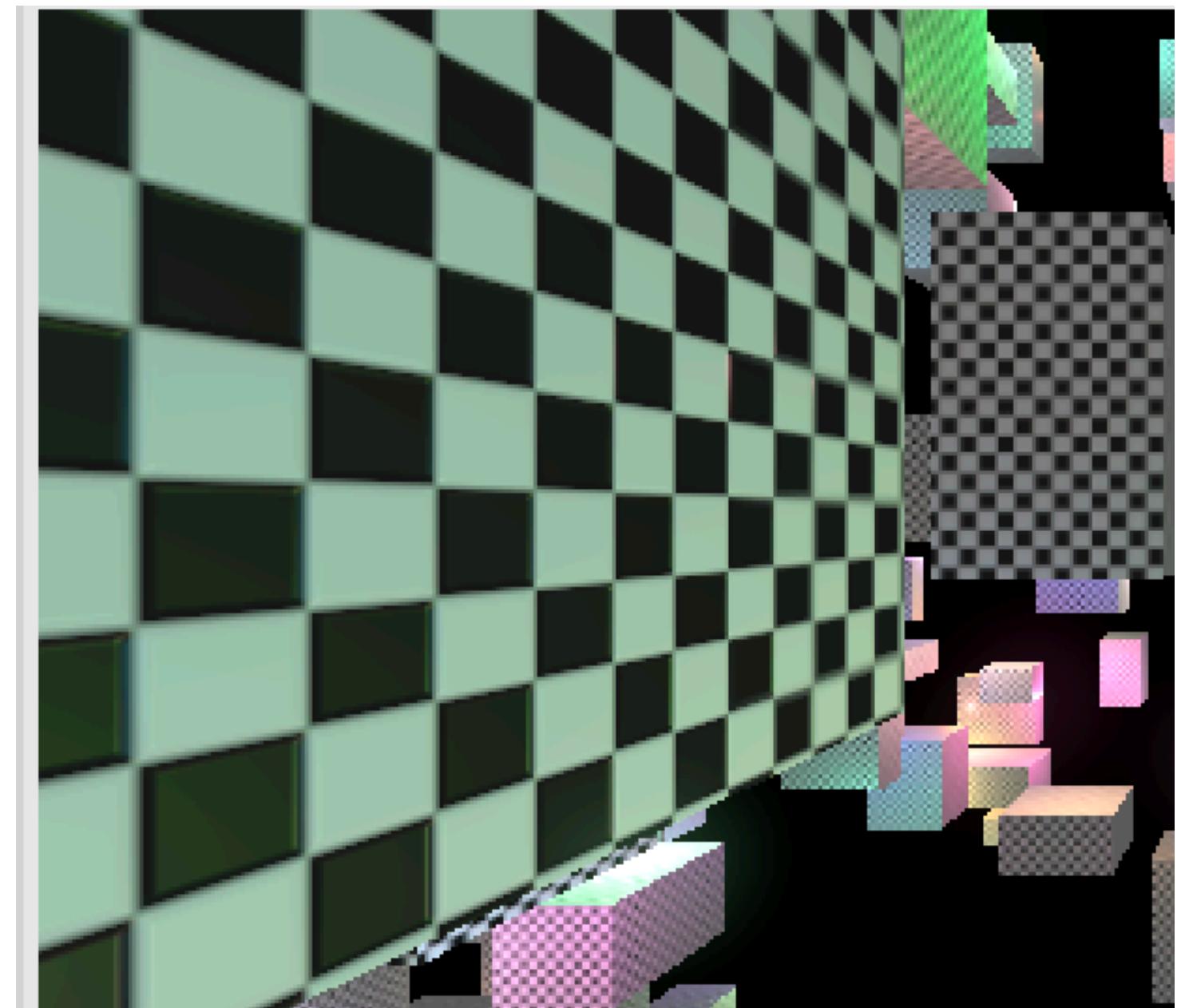
<https://github.com/desromech/woden-core-math>

- Linear Algebra math for 3D graphics (Vector, Matrix, Quaternion, Transforms)
- Collision Detection Algorithms
 - GJK Distance Function for Convex-Convex distance/intersection
 - GJK Sweep Test
 - Several analytical recasting methods
- Bounding volumes and spatial subdivision data structures
- Noise functions for procedural generation (value, gradient/perlin, voronoi)



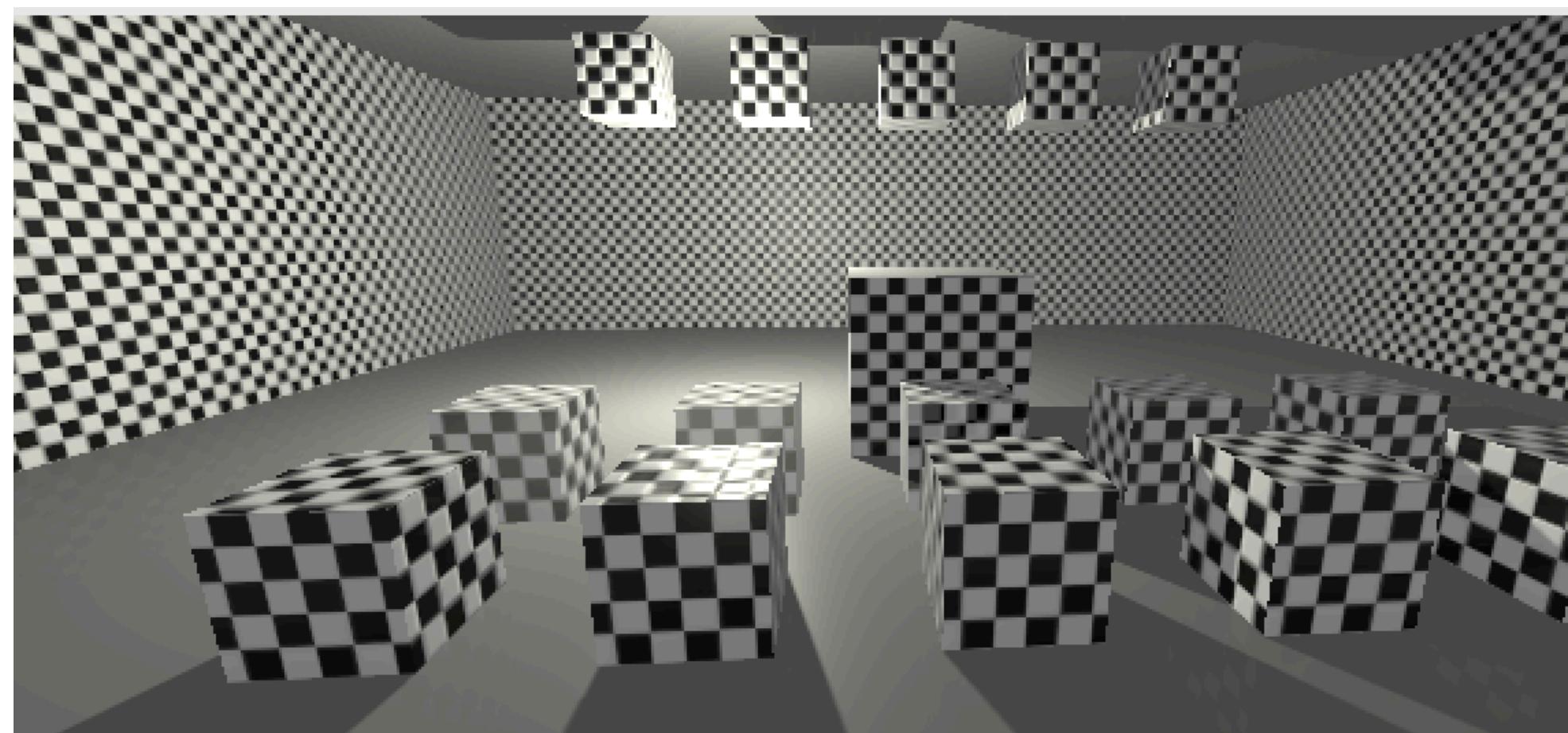
Scene Graph

- <https://github.com/desromech/woden-core-scene-graph>
- The Graphics Engine Core
- Focus on only displaying 3D scene
- Highly limited support for interactions
- Scenes are integrated with the inspector

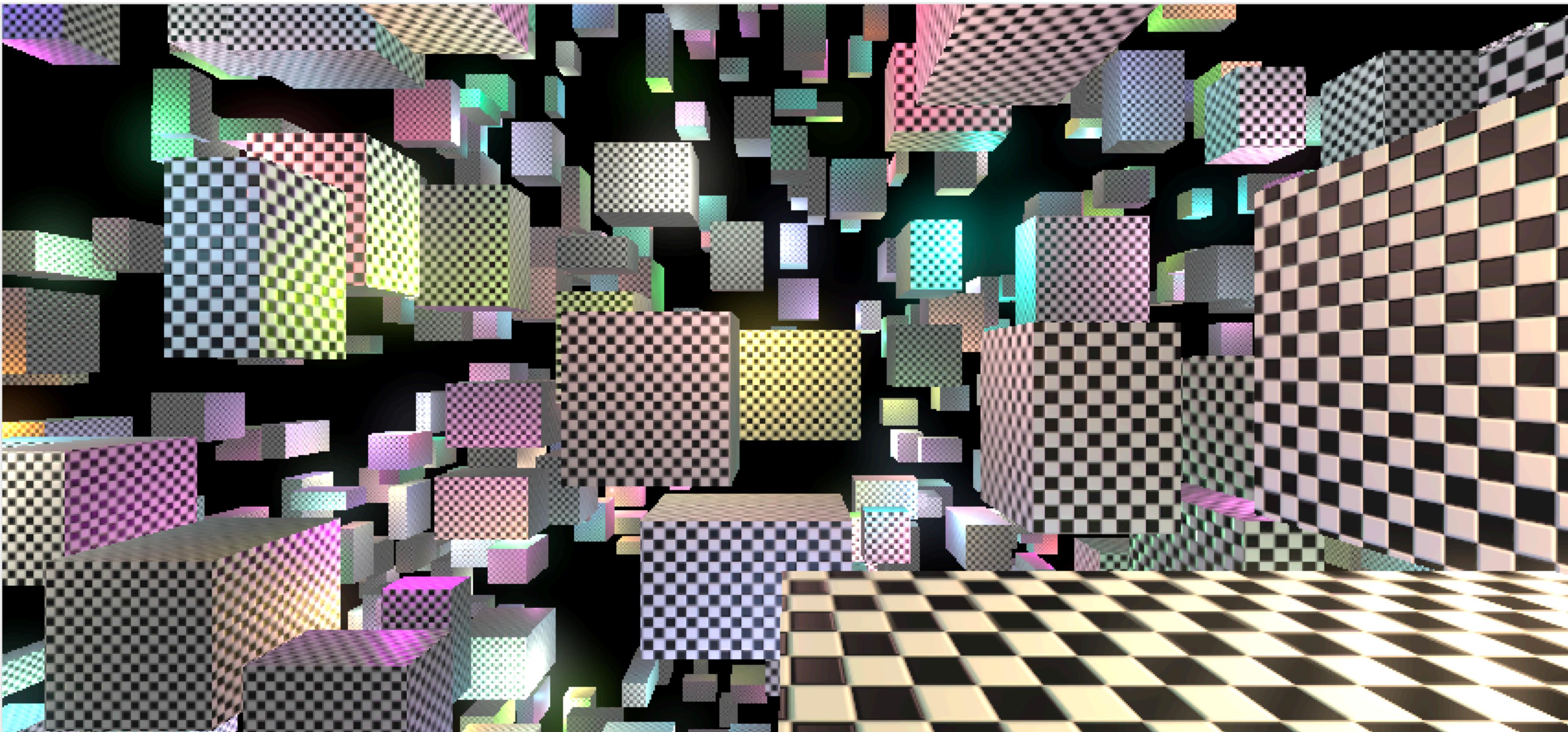


Scene Rendering Algorithm

- Base on Doom 2016 Algorithm (See Adrian Courrèges Article)
- Clustered Forward Rendering Algorithm
- Support for many non-shadow casting lights
- Good support for transparency
- AbstractGPU thin layer
 - Vulkan, Direct3D 12 and Metal



One Thousand Lights



Scene Graph Inspector

Playground

a WDScene

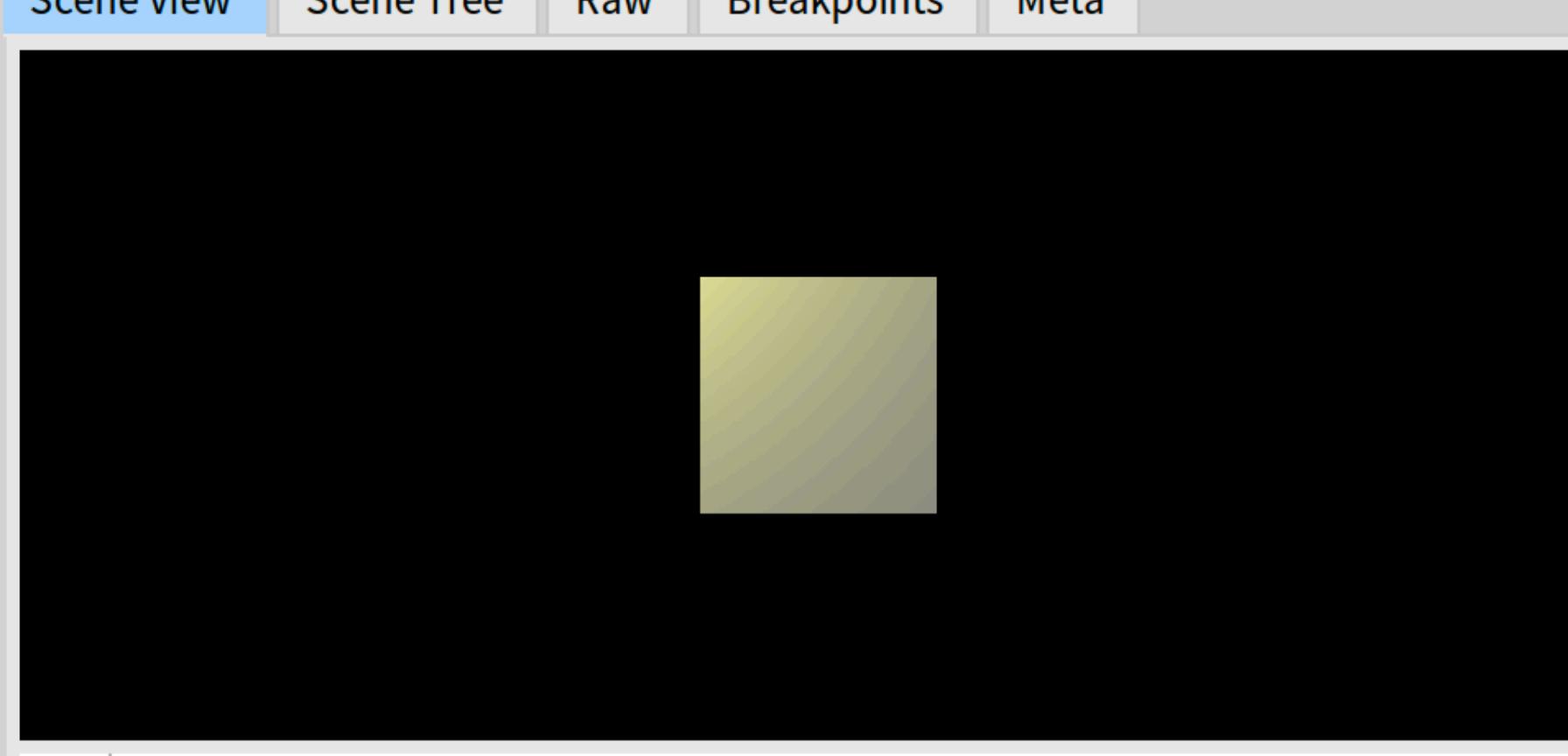
Scene View Scene Tree Raw Breakpoints Meta

```
1 WDScene new
2     add: (WDMeshBuilder new
3         addCubeWithWidth: 1.0 height: 1.0 depth: 1.0;
4         mesh);
5     add: ((WDPointLightSource new
6         color: (Vector3 x: 0.8 y: 0.8 z: 0.2);
7         intensity: 5.0;
8         influenceRadius: 4.0;
9         asSceneNode)
10        position: (Vector3 x: -1.5 y: 1.5 z: 1.6);
11        yourself);
12    yourself
```

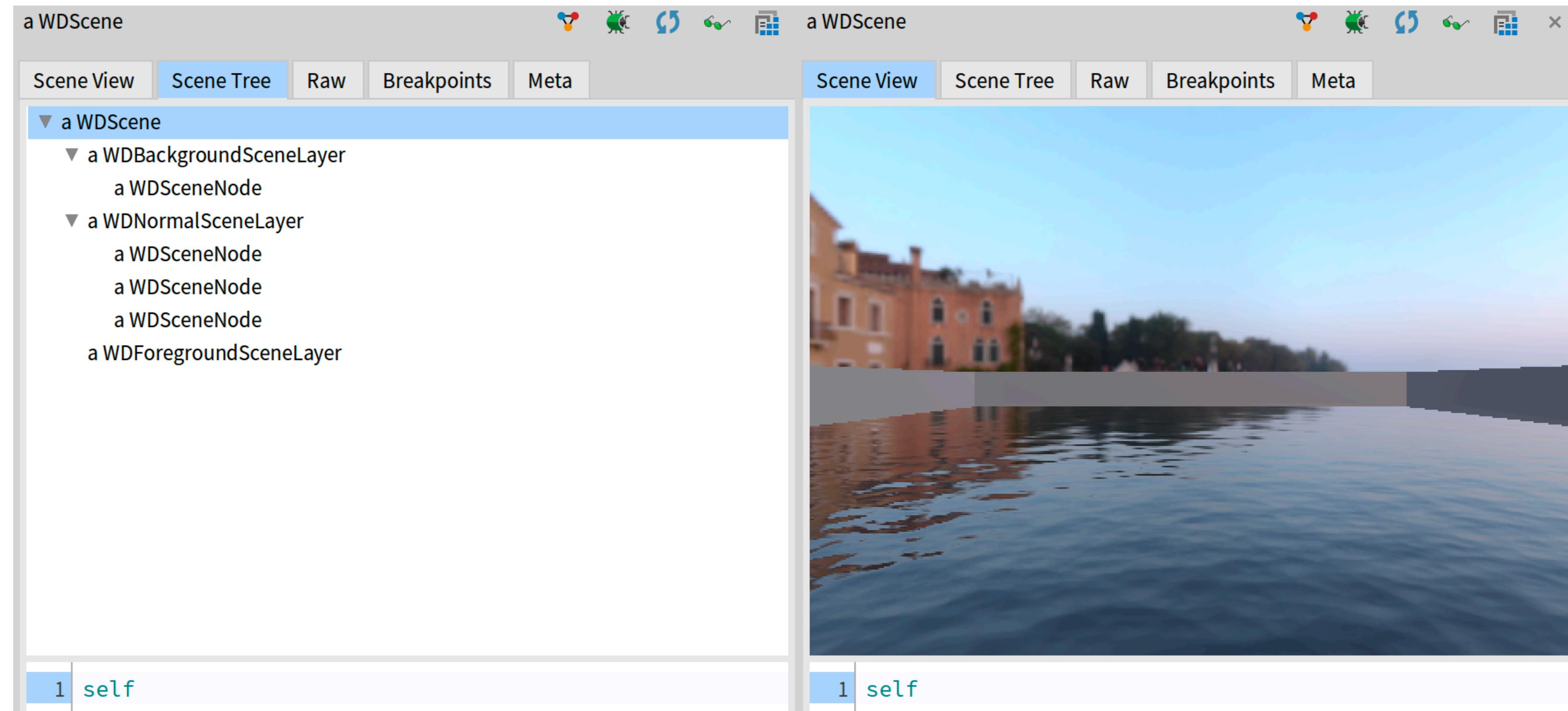
Line: 12:11

1 self

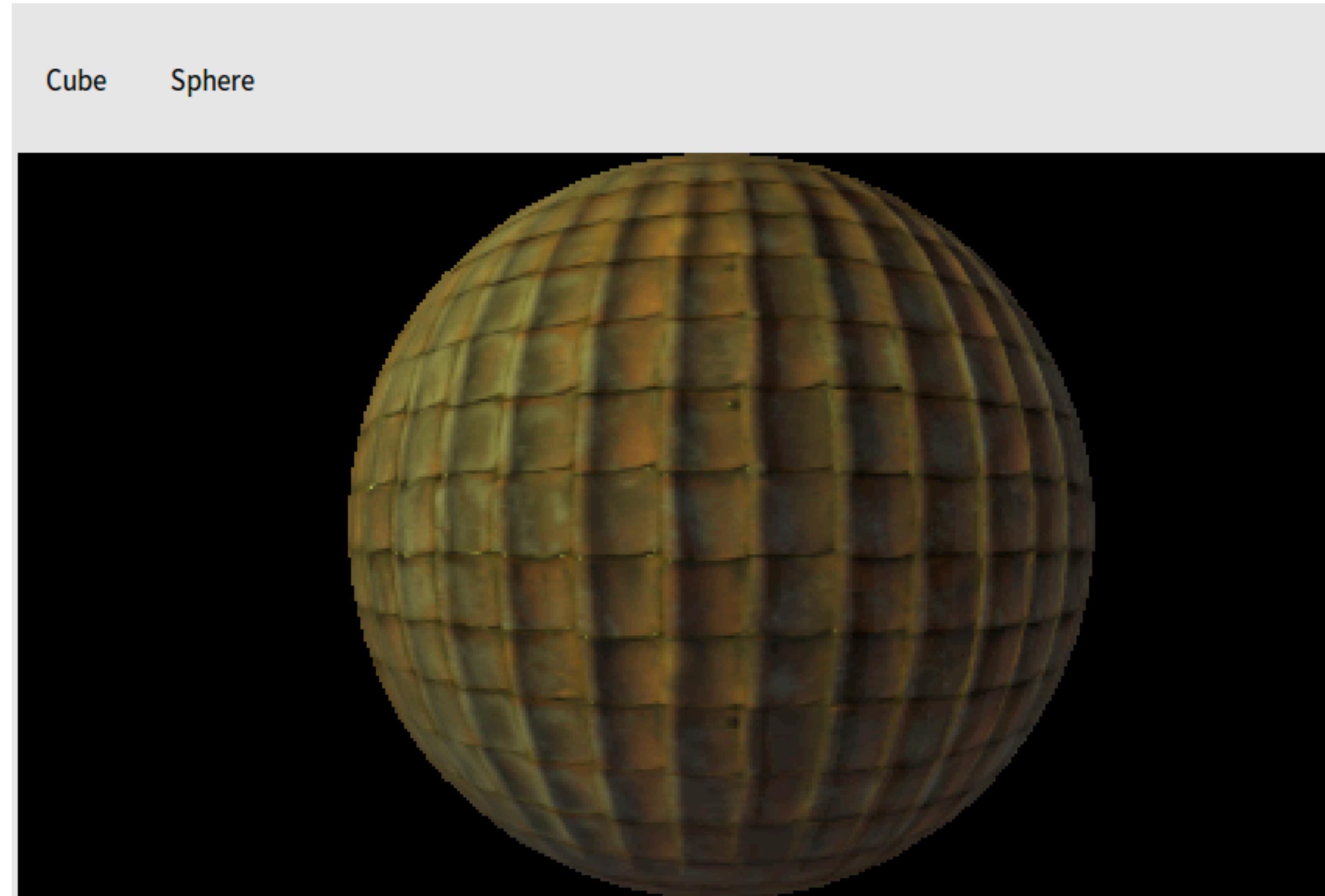
+L

A screenshot of the Scene Graph Inspector playground interface. The top bar includes tabs for 'Do it', 'Publish', 'Bindings', 'Versions', and 'Pages'. The title 'Playground' is at the top center, followed by 'a WDScene'. Below the title is a toolbar with icons for play, publish, and various scene components. The main area has tabs for 'Scene View', 'Scene Tree', 'Raw', 'Breakpoints', and 'Meta'. The 'Scene View' tab is active, showing a 3D perspective view of a scene. In the scene, there is a single cube centered at approximately (-1.5, 1.5, 1.6) and a point light source positioned at (-1.5, 1.5, 1.6) with a yellow glow. The bottom left shows the line number 'Line: 12:11' and the bottom right shows a small button labeled '+L'.

Scene Graph Inspection



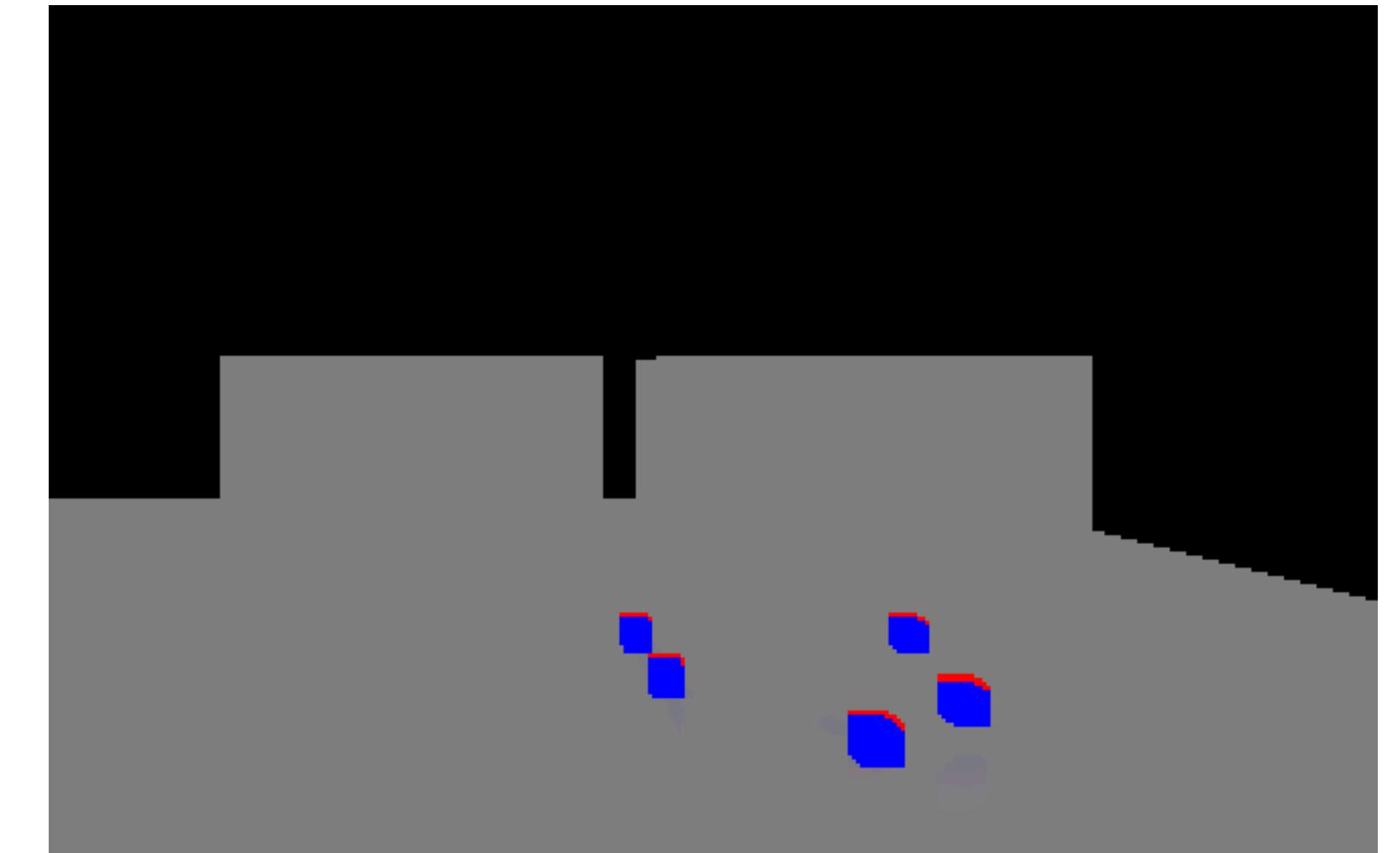
Material Preview Inspection



Rigid Body Physics

<https://github.com/desromech/woden-core-physics>

- Strong Inspiration on Bullet
- Completely implemented in Pharo
- Discrete Collision Detection
- Based on Millington book “Game Physics Engine Development”
- Bugs remain to be solved



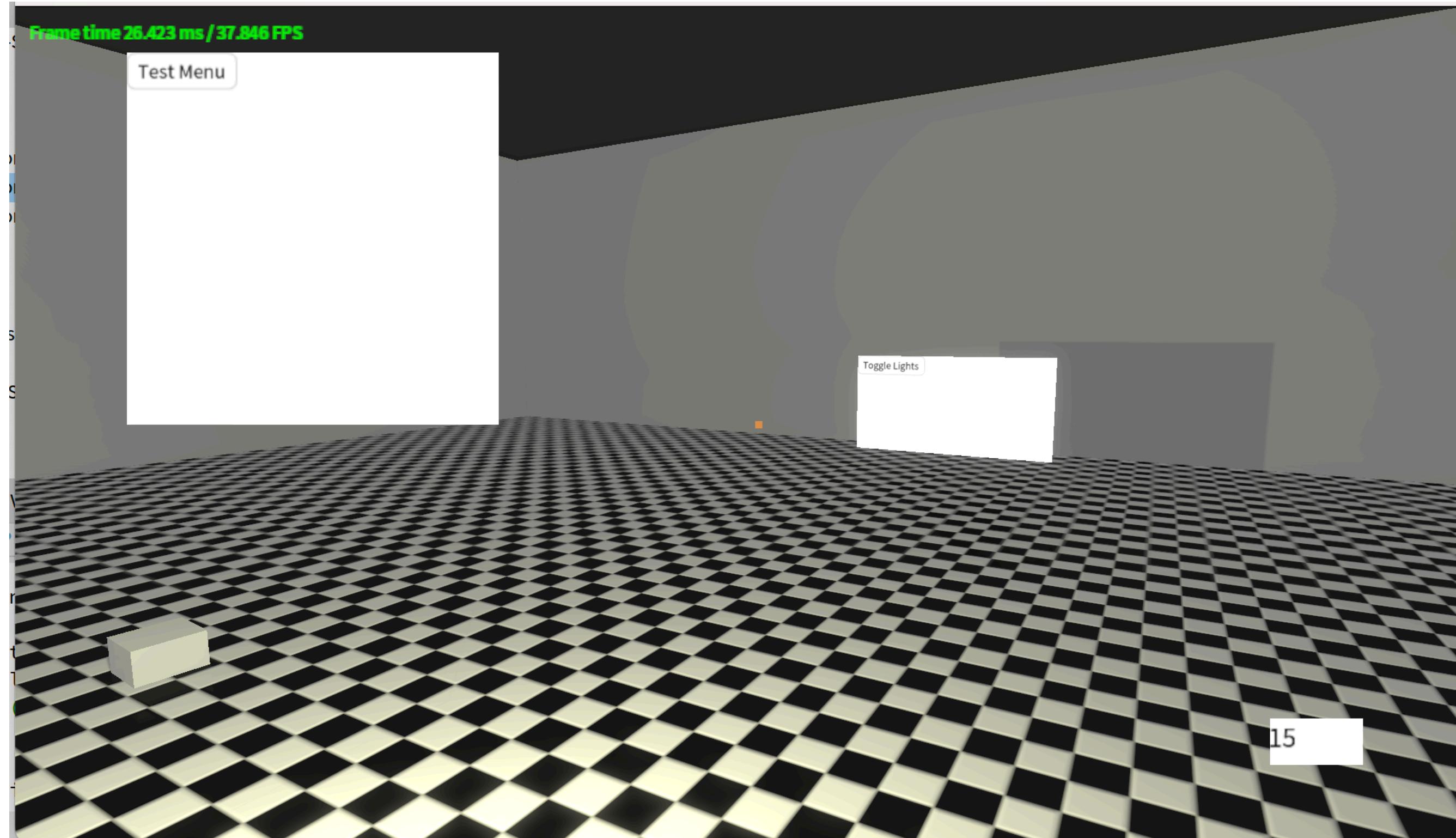
Game Framework

<https://github.com/desromech/woden-core-game-framework>

- Actor Model inspired on Unreal Game Framework
- Integrates different components
- For prototyping games, and highly interactive applications
- VR Interactions are implemented on this level

Game Framework

Bloc/Toplo in the Environment



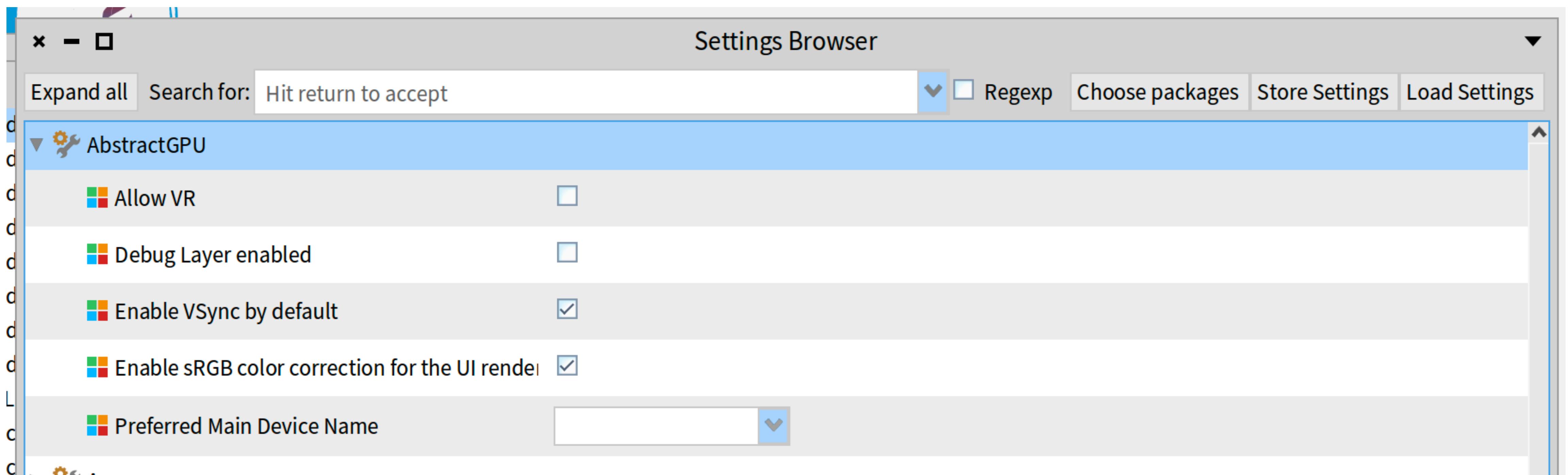
Level Editor

Level editor inspired on old Quake style BSP editor.



VR Support

- VR Support Disabled by Default. Enabled via the Allow VR option

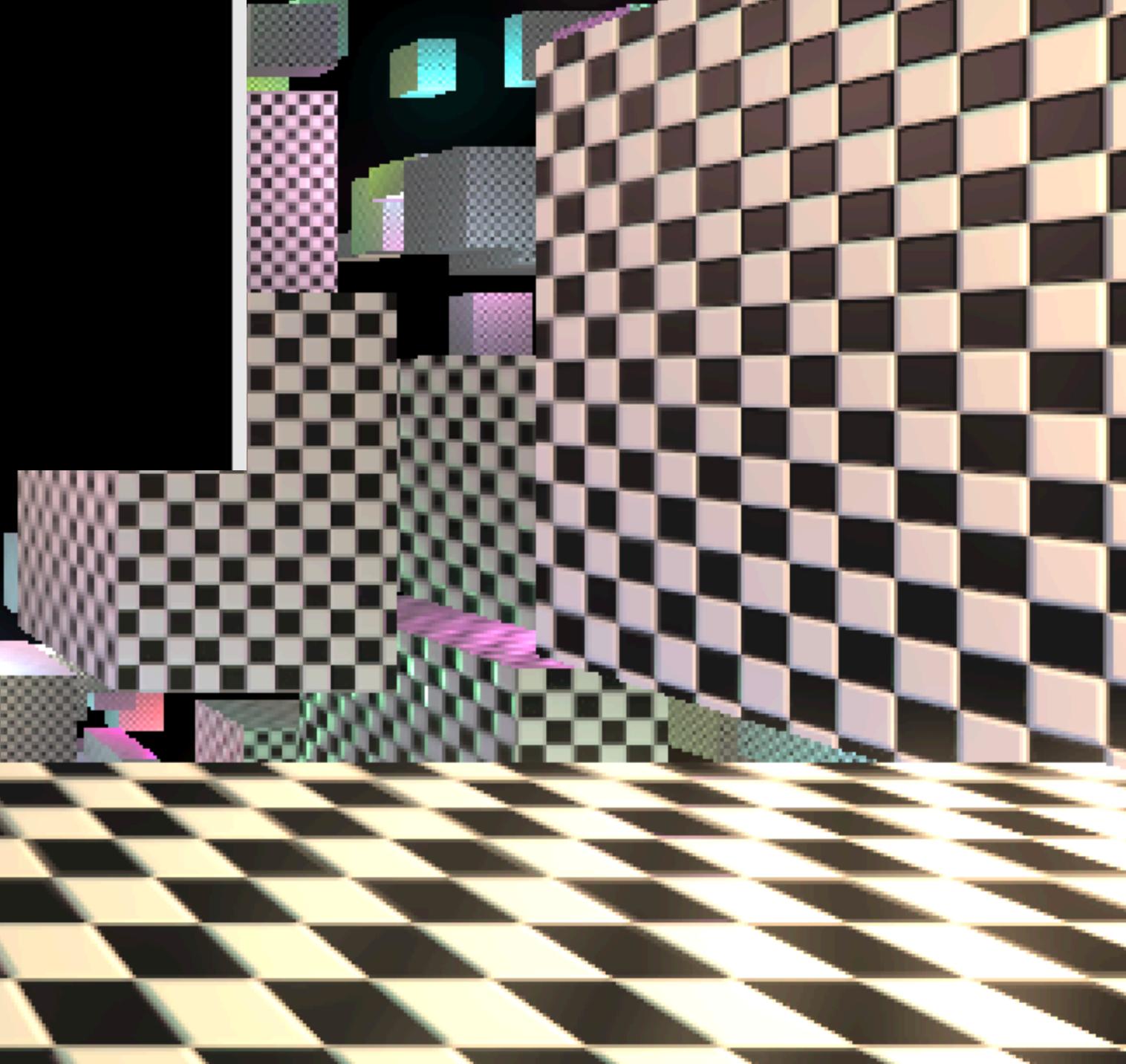
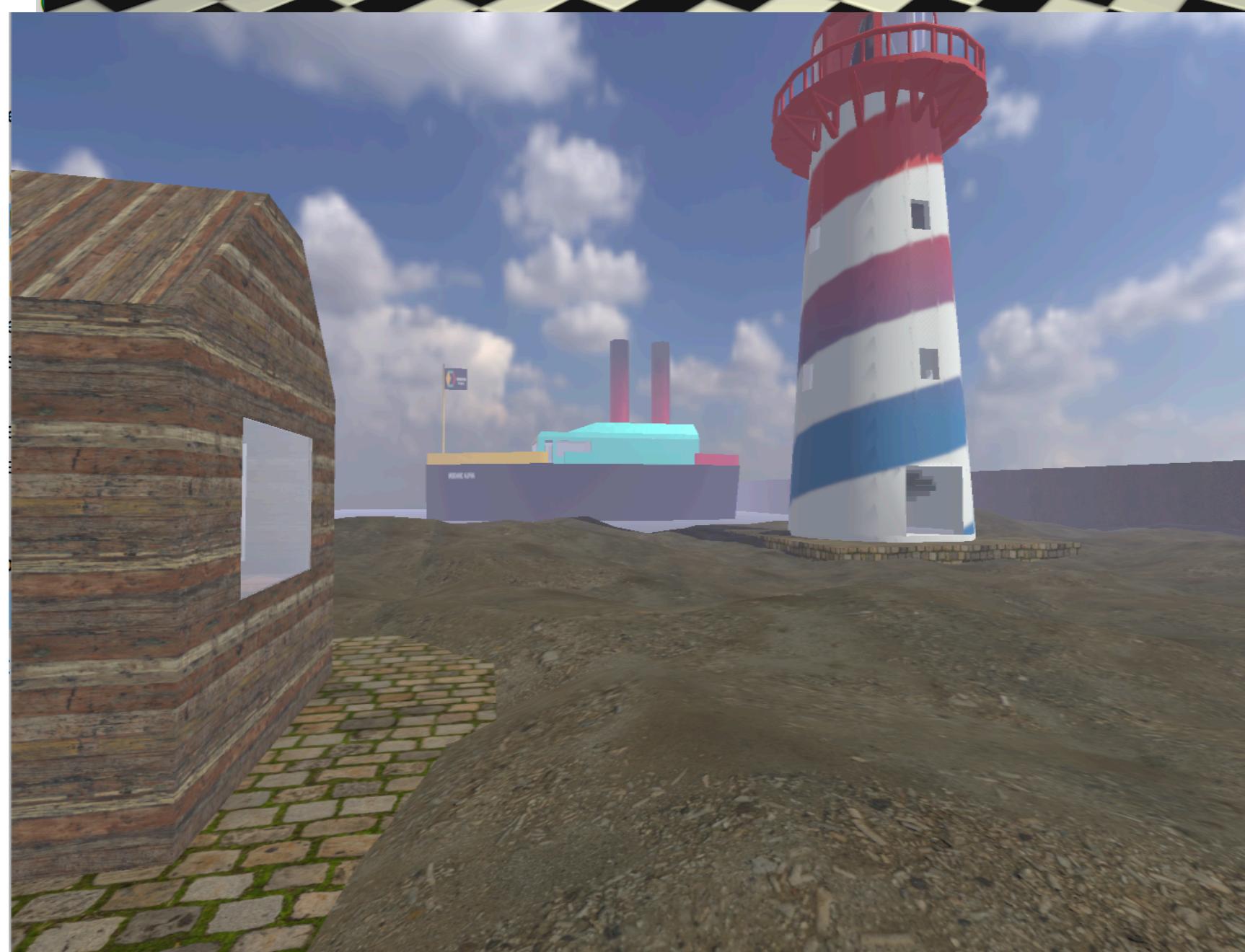
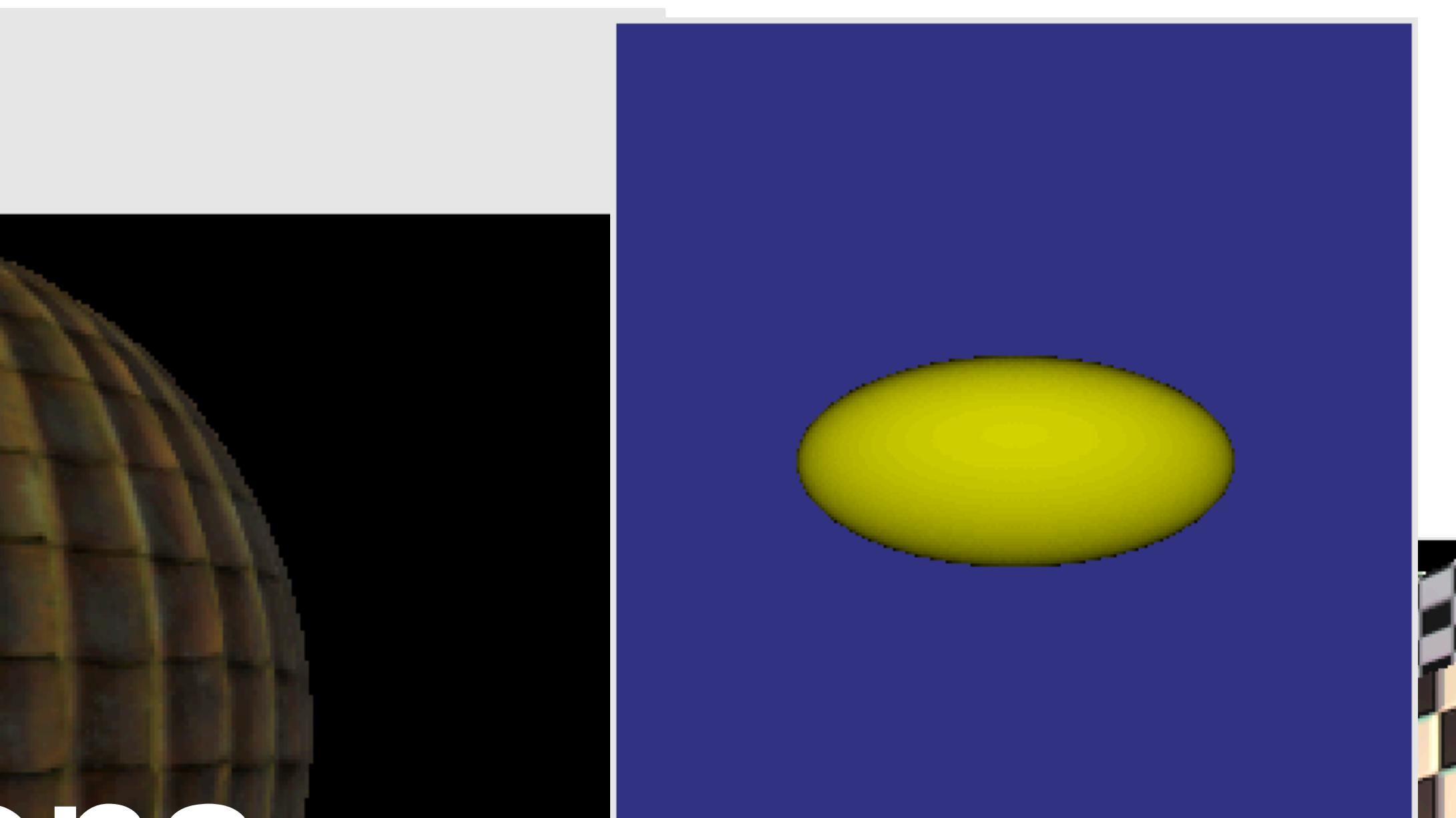


VR Challenges

- Performance Constraints
 - Stereoscopic rendering
 - Higher FPS to avoid motion sickness
- Modeling 3D Interactions
 - Actual 3D cursors
 - Picking and handling objects physically



Demo Time!!



Questions