A Space-Themed Platformer

"Houston, We Had Problems"

-Logan Margo and Kieran Kim-Murphy

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Project Overview

01

Fall-Guys-esque platformer

02

Solar-System Hopper?

03

Procedural Planets!?!

(uh oh)

Technologies

Babylon.js

It’s like Three JS but the name is different

Vue.js

Handles pages and components

Vite.js

Build tool

Objectives

Learn new tech

- BabylonJS
- Vue and Vite

Scale

Assemble a larger-scale graphics project from the ground up.

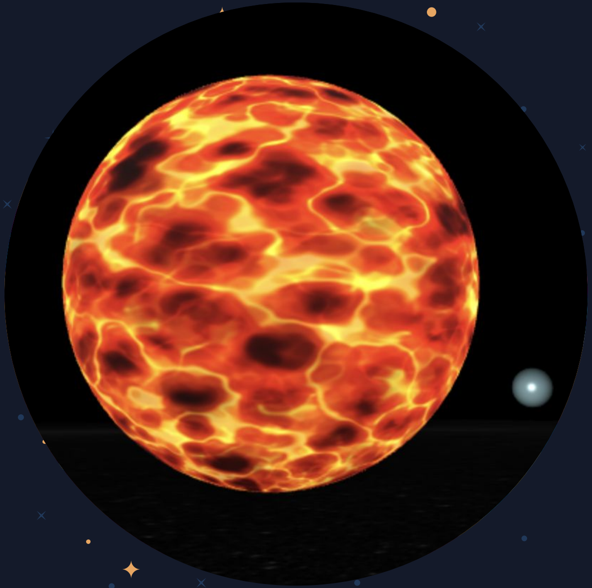
Space Themed

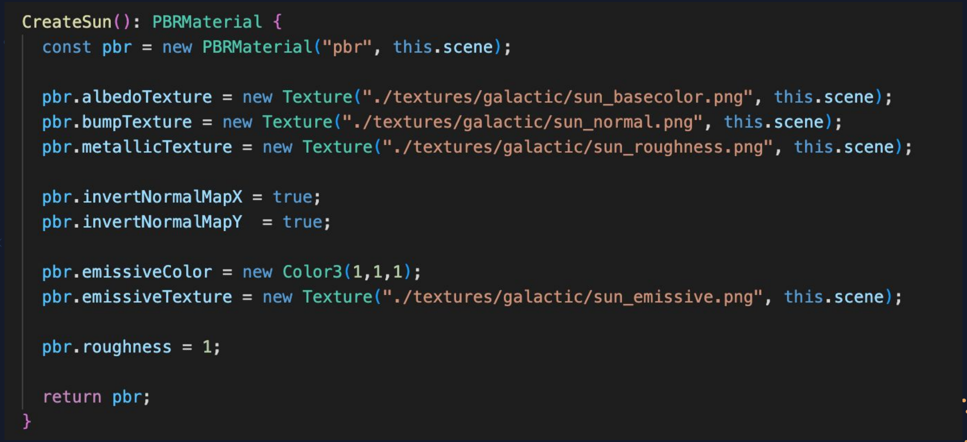
- Space is cool
- Lots of graphics opportunities

Concepts

Explore new concepts and algorithms

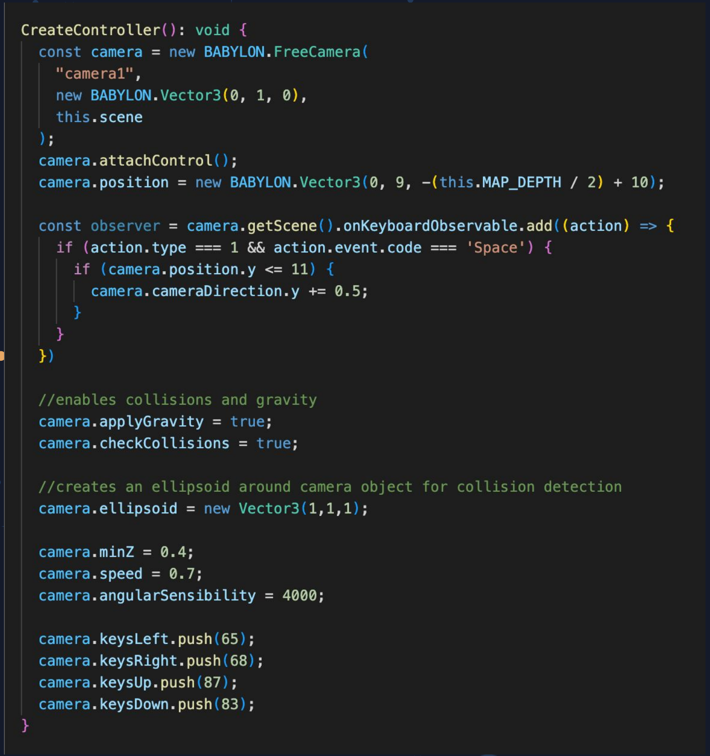
Emissive Textures





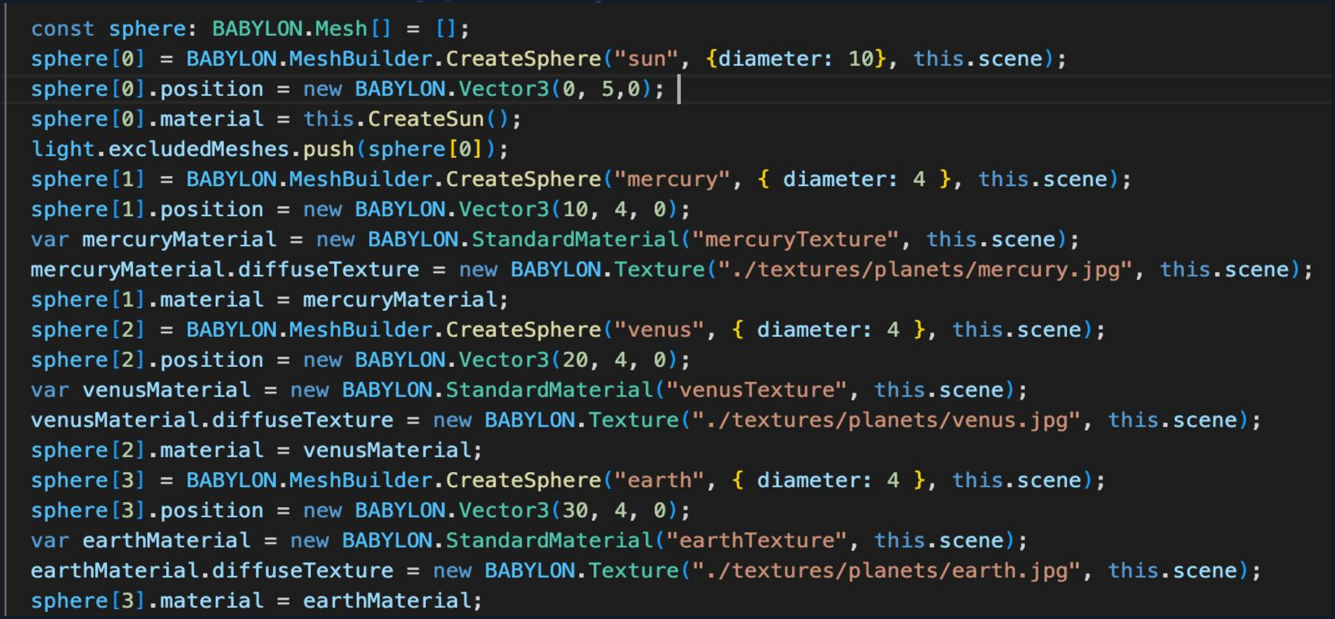
```
CreateSun(): PBRMaterial {
  const pbr = new PBRMaterial("pbr", this.scene);

  pbr.albedoTexture = new Texture("./textures/galactic/sun_basecolor.png", this.scene);
  pbr.bumpTexture = new Texture("./textures/galactic/sun_normal.png", this.scene);
  pbr.metallicTexture = new Texture("./textures/galactic/sun_roughness.png", this.scene);

  pbr.invertNormalMapX = true;
  pbr.invertNormalMapY  = true;

  pbr.emissiveColor = new Color3(1,1,1);
  pbr.emissiveTexture = new Texture("./textures/galactic/sun_emissive.png", this.scene);

  pbr.roughness = 1;

  return pbr;
}
```

First Person Camera Controls



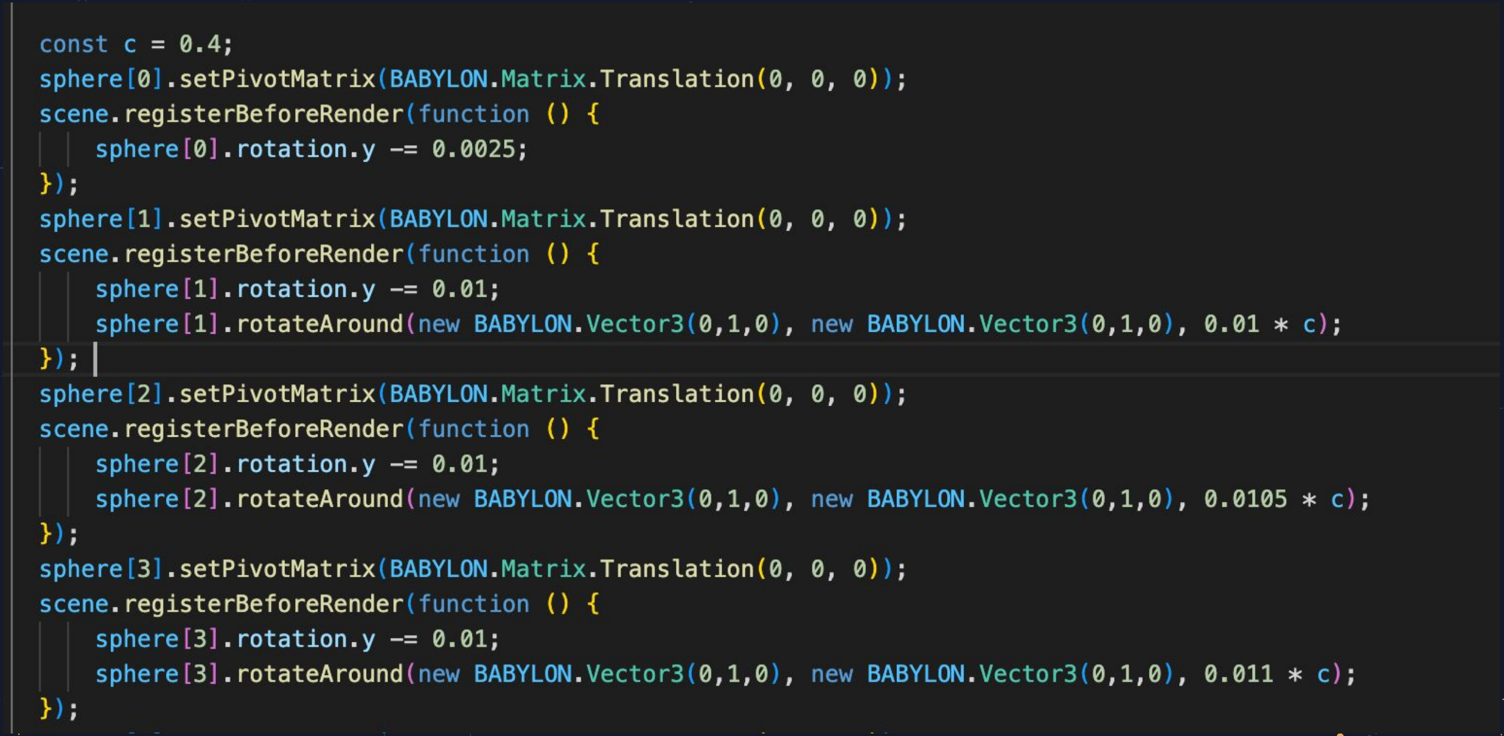
```
CreateController(): void {
  const camera = new BABYLON.FreeCamera(
    "camera1",
    new BABYLON.Vector3(0, 1, 0),
    this.scene
  );
  camera.attachControl();
  camera.position = new BABYLON.Vector3(0, 9, -(this.MAP_DEPTH / 2) + 10);

  const observer = camera.getScene().onKeyboardObservable.add((action) => {
    if (action.type === 1 && action.event.code === 'Space') {
      if (camera.position.y <= 11) {
        camera.cameraDirection.y += 0.5;
      }
    }
  })

  //enables collisions and gravity
  camera.applyGravity = true;
  camera.checkCollisions = true;

  //creates an ellipsoid around camera object for collision detection
  camera.ellipsoid = new Vector3(1,1,1);

  camera.minZ = 0.4;
  camera.speed = 0.7;
  camera.angularSensibility = 4000;

  camera.keysLeft.push(65);
  camera.keysRight.push(68);
  camera.keysUp.push(87);
  camera.keysDown.push(83);
}
```

Solar Scene Implementation



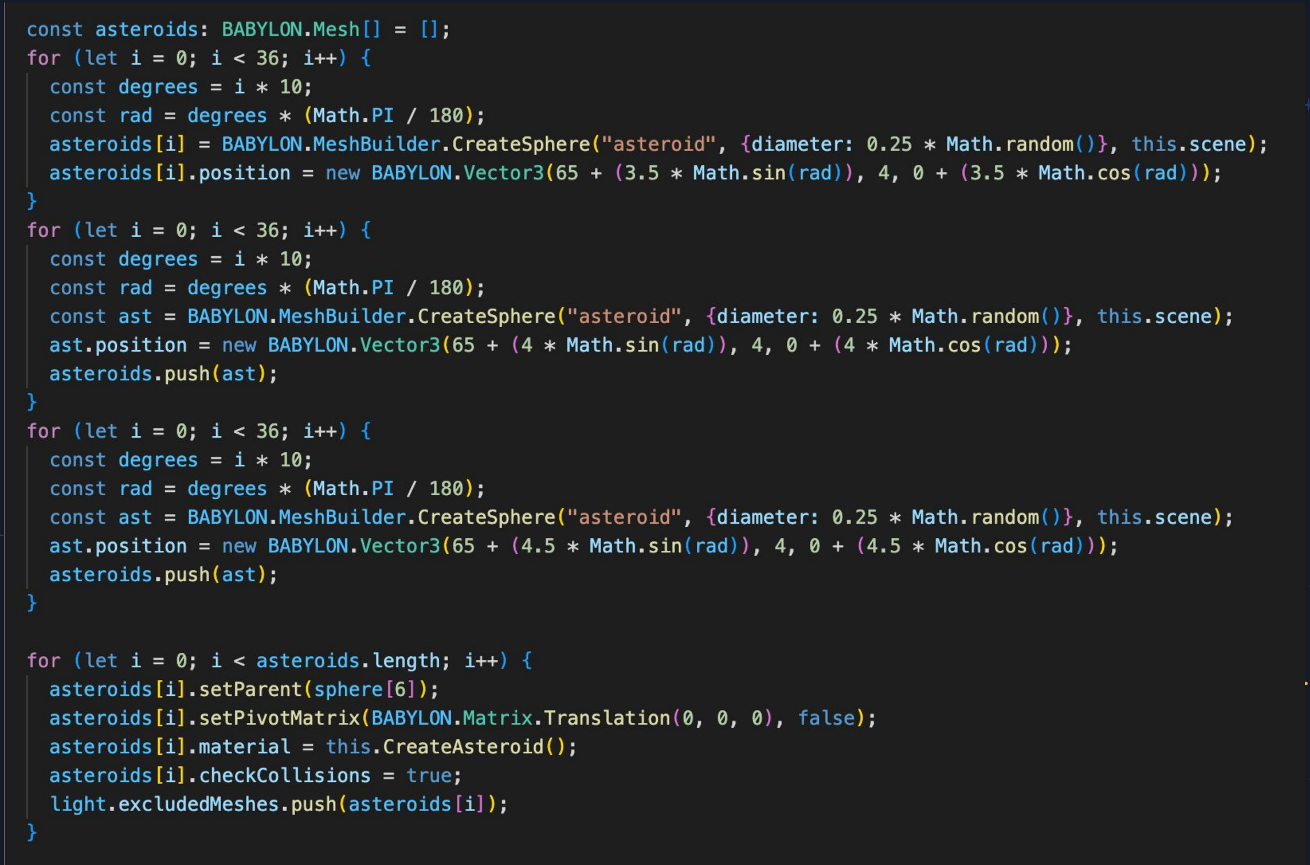
```
const sphere: BABYLON.Mesh[] = [];
sphere[0] = BABYLON.MeshBuilder.CreateSphere("sun", {diameter: 10}, this.scene);
sphere[0].position = new BABYLON.Vector3(0, 5,0);
sphere[0].material = this.CreateSun();
light.excludedMeshes.push(sphere[0]);
sphere[1] = BABYLON.MeshBuilder.CreateSphere("mercury", { diameter: 4 }, this.scene);
sphere[1].position = new BABYLON.Vector3(10, 4, 0);
var mercuryMaterial = new BABYLON.StandardMaterial("mercuryTexture", this.scene);
mercuryMaterial.diffuseTexture = new BABYLON.Texture("./textures/planets/mercury.jpg", this.scene);
sphere[1].material = mercuryMaterial;
sphere[2] = BABYLON.MeshBuilder.CreateSphere("venus", { diameter: 4 }, this.scene);
sphere[2].position = new BABYLON.Vector3(20, 4, 0);
var venusMaterial = new BABYLON.StandardMaterial("venusTexture", this.scene);
venusMaterial.diffuseTexture = new BABYLON.Texture("./textures/planets/venus.jpg", this.scene);
sphere[2].material = venusMaterial;
sphere[3] = BABYLON.MeshBuilder.CreateSphere("earth", { diameter: 4 }, this.scene);
sphere[3].position = new BABYLON.Vector3(30, 4, 0);
var earthMaterial = new BABYLON.StandardMaterial("earthTexture", this.scene);
earthMaterial.diffuseTexture = new BABYLON.Texture("./textures/planets/earth.jpg", this.scene);
sphere[3].material = earthMaterial;
```

Solar Scene Implementation



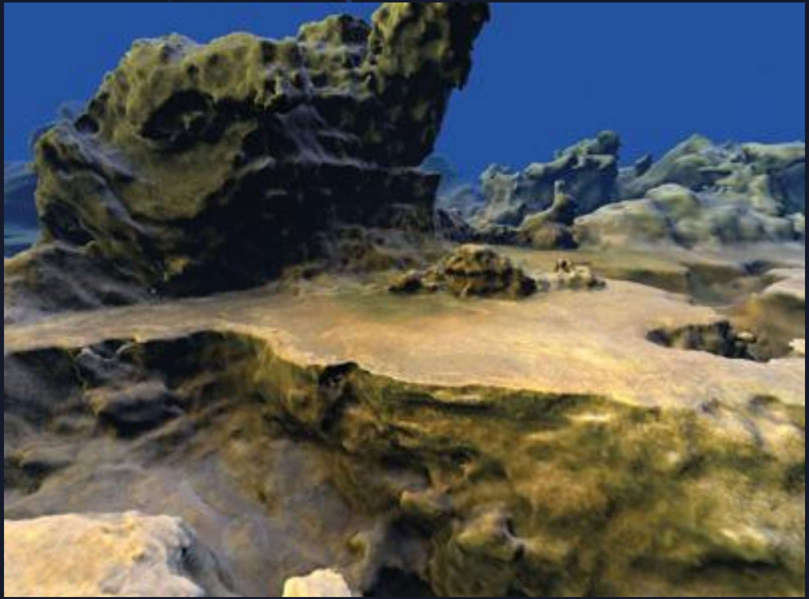
```
const c = 0.4;
sphere[0].setPivotMatrix(BABYLON.Matrix.Translation(0, 0, 0));
scene.registerBeforeRender(function () {
    sphere[0].rotation.y -= 0.0025;
});
sphere[1].setPivotMatrix(BABYLON.Matrix.Translation(0, 0, 0));
scene.registerBeforeRender(function () {
    sphere[1].rotation.y -= 0.01;
    sphere[1].rotateAround(new BABYLON.Vector3(0,1,0), new BABYLON.Vector3(0,1,0), 0.01 * c);
});
sphere[2].setPivotMatrix(BABYLON.Matrix.Translation(0, 0, 0));
scene.registerBeforeRender(function () {
    sphere[2].rotation.y -= 0.01;
    sphere[2].rotateAround(new BABYLON.Vector3(0,1,0), new BABYLON.Vector3(0,1,0), 0.0105 * c);
});
sphere[3].setPivotMatrix(BABYLON.Matrix.Translation(0, 0, 0));
scene.registerBeforeRender(function () {
    sphere[3].rotation.y -= 0.01;
    sphere[3].rotateAround(new BABYLON.Vector3(0,1,0), new BABYLON.Vector3(0,1,0), 0.011 * c);
});
```

Solar Scene Implementation



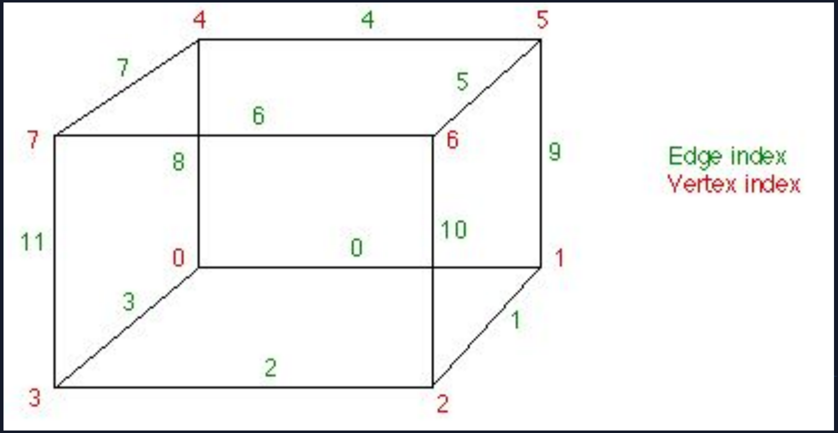
```
const asteroids: BABYLON.Mesh[] = [];
for (let i = 0; i < 36; i++) {
  const degrees = i * 10;
  const rad = degrees * (Math.PI / 180);
  asteroids[i] = BABYLON.MeshBuilder.CreateSphere("asteroid", {diameter: 0.25 * Math.random()}, this.scene);
  asteroids[i].position = new BABYLON.Vector3(65 + (3.5 * Math.sin(rad)), 4, 0 + (3.5 * Math.cos(rad)));
}
for (let i = 0; i < 36; i++) {
  const degrees = i * 10;
  const rad = degrees * (Math.PI / 180);
  const ast = BABYLON.MeshBuilder.CreateSphere("asteroid", {diameter: 0.25 * Math.random()}, this.scene);
  ast.position = new BABYLON.Vector3(65 + (4 * Math.sin(rad)), 4, 0 + (4 * Math.cos(rad)));
  asteroids.push(ast);
}
for (let i = 0; i < 36; i++) {
  const degrees = i * 10;
  const rad = degrees * (Math.PI / 180);
  const ast = BABYLON.MeshBuilder.CreateSphere("asteroid", {diameter: 0.25 * Math.random()}, this.scene);
  ast.position = new BABYLON.Vector3(65 + (4.5 * Math.sin(rad)), 4, 0 + (4.5 * Math.cos(rad)));
  asteroids.push(ast);
}

for (let i = 0; i < asteroids.length; i++) {
  asteroids[i].setParent(sphere[6]);
  asteroids[i].setPivotMatrix(BABYLON.Matrix.Translation(0, 0, 0), false);
  asteroids[i].material = this.CreateAsteroid();
  asteroids[i].checkCollisions = true;
  light.excludedMeshes.push(asteroids[i]);
}
```

Terrain Generation



Source: Nvidia [2]

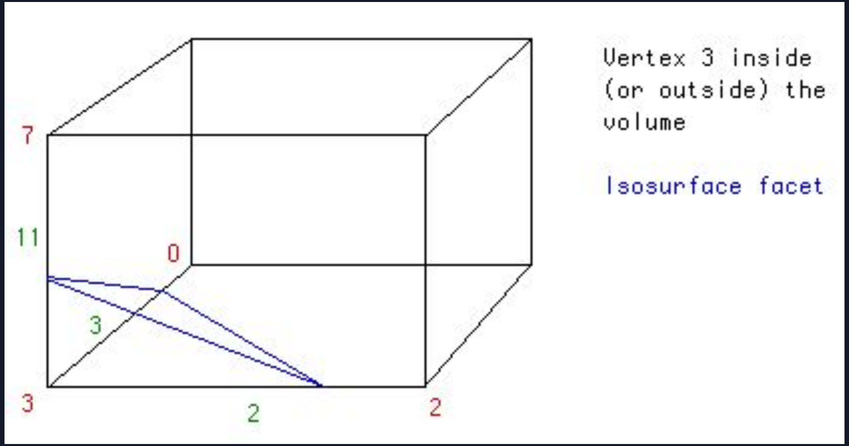
Marching Cubes



Source: Bourke [1]

$$f(x, y, z) \rightarrow value$$

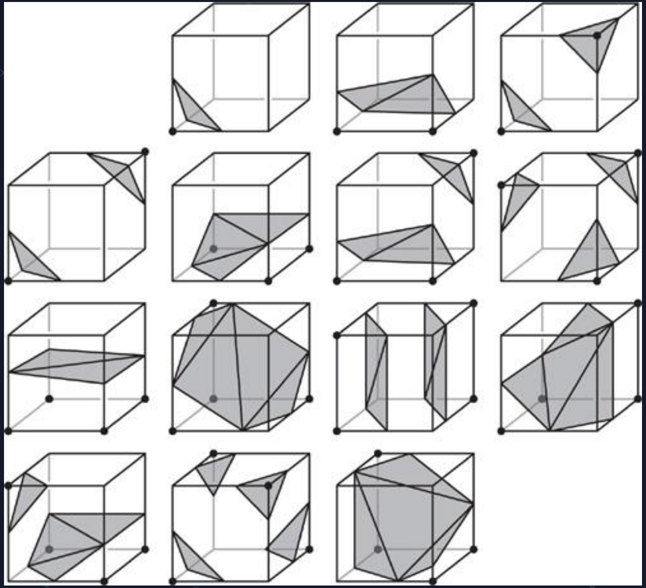
Marching Cubes



Source: Bourke [1]

$$f(x, y, z) \rightarrow value$$

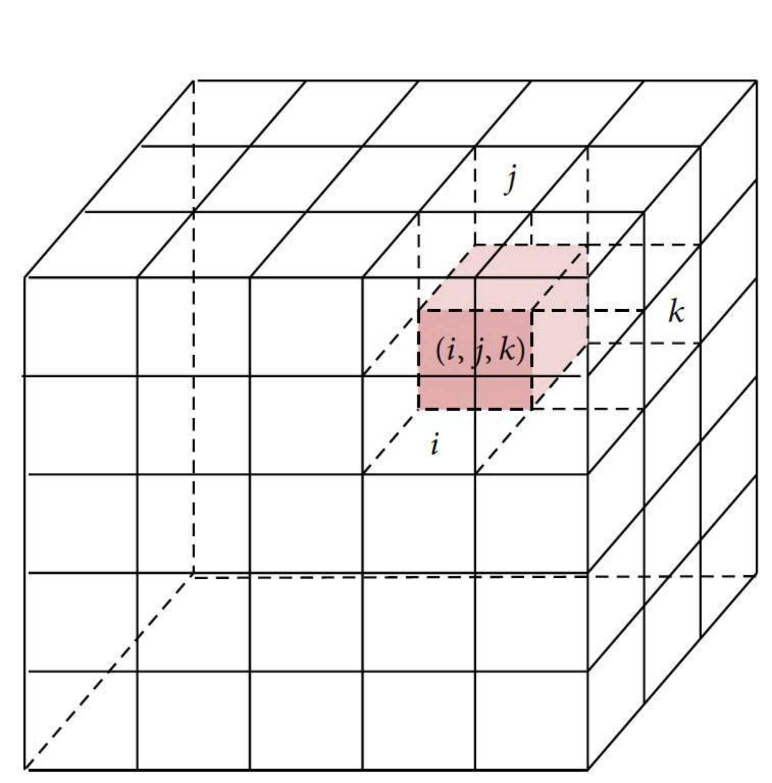
Marching Cubes



Source: Nvidia [2]

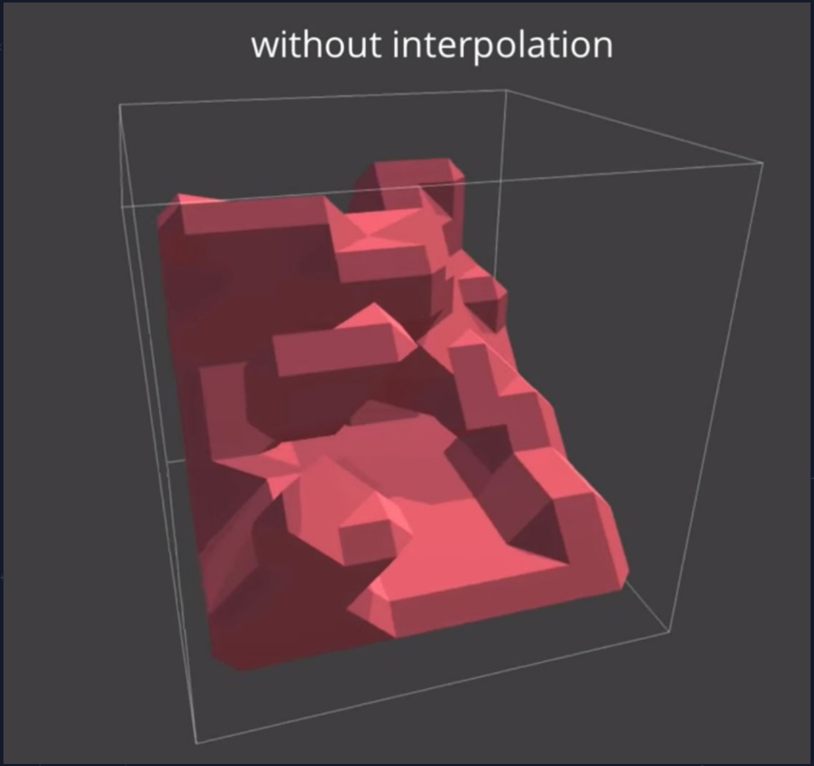
$$f(x, y, z) \rightarrow value$$

Marching Cubes



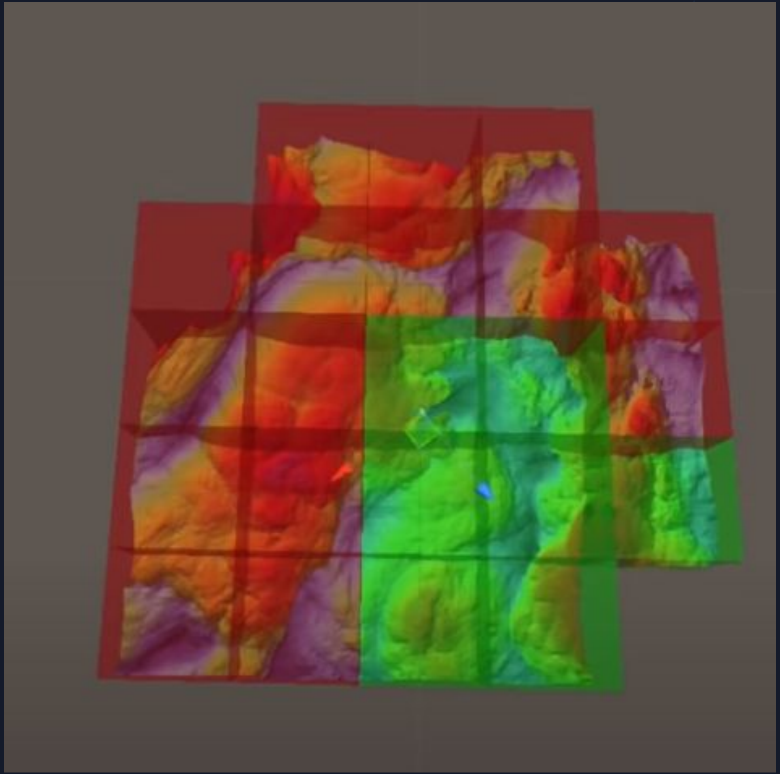
Source: Kruger [6]

Marching Cubes



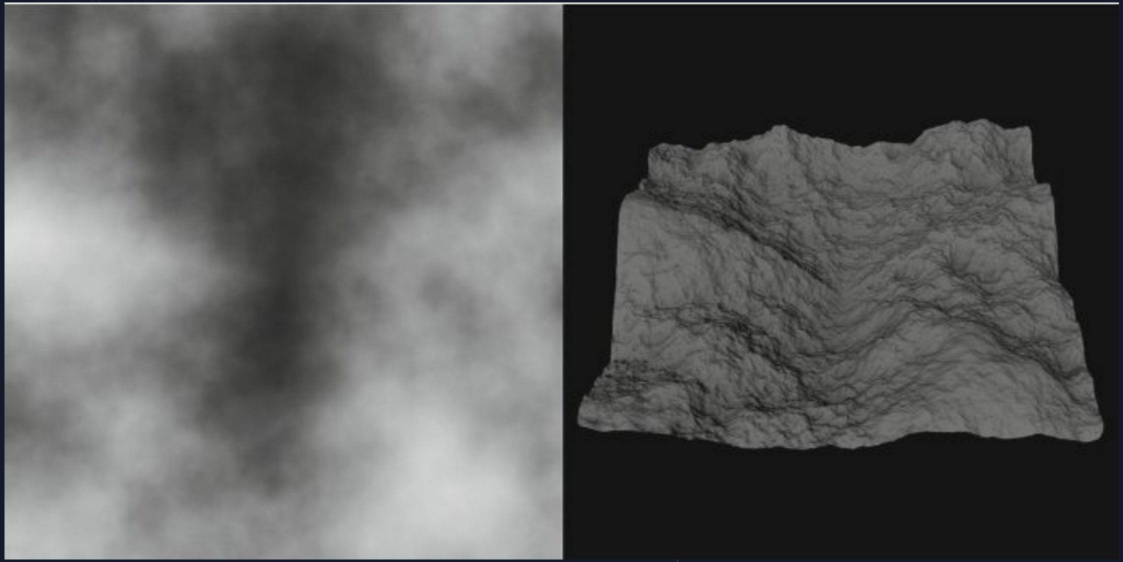
Source: Lague [4]

Marching Cubes



Source: Lague [4]

Marching Cubes



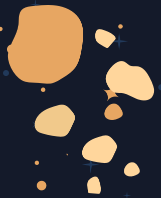
Source: Eck and Lamers [7]

$$f(x, y, z) \to value$$

Demo

Recap!

What we learned



Thank you!

Questions?

Project Sources

[1] Paul Bourke. 1995. Polygonising a scalar field. Blog. “http://paulbourke.net/geometry/polygonise/” Accessed May, 2022.

[2] Ryan Geiss. Generating Complex Procedural Terrains Using the GPU. Blog. “https://developer.nvidia.com/gpugems/gpugems3/part-i-geometry/chapter-1-generating-complex-procedural-terrains-using-gpu” Accessed May, 2022.

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[4] Sebastian Lague. 2019. Coding Adventure: Marching Cubes. Video. “https://www.youtube.com/watch?v=M3iI2l0ltbE” Accessed May, 2022.

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[6] Berti Kruger. 2020. Forum. “https://discourse.vtk.org/t/vtkmarchingcubes-vtkdiscretemarchingcubes-does-not-produce-a-closed-mesh-surface/4312” Accessed May, 2022.

[7] Wim Eck and Maarten Lamers. Biological Content Generation: Evolving Game Terrains Through Living Organisms. 2015. Book.