

Primeiro Laboratório

Introdução ao three.js

Informações gerais

Horário de Dúvidas

Regra 1: todas as sessões serão feitas por Zoom

Regra 2: enviar e-mail informando o interesse na sessão de dúvidas com uma antecedência de 24h

Regra 3: se ninguém comparecer após os primeiros 15 minutos a sessão fica sem efeito.

Informações gerais

Os trabalhos são avaliados no turno em que o grupo está inscrito.

Cada trabalho de laboratório é entregue na mesma data e hora para todos os alunos às 23:59h da Sexta-Feira que antecede a semana da avaliação (o código será avaliado fora do período de aulas mas nas semanas das avaliações há discussão com cada grupo).

Informações gerais

As notas de laboratório obtidas no ano anterior podem ser aproveitadas no na corrente, desde que o aluno não se inscreva em nenhum turno de laboratório.

Caso o aluno se inscreva num turno do laboratório, as notas do ano anterior serão anuladas

Mapa das Aulas Laboratoriais

week (semester)	week (course)	course interruptions	calendar	school calendar	lab evaluations	scores	deadlines	lab class topics
10	1		09 May - 13 May	classes				Lab Structure, Lab Rules, and Lab Assessments Group matching Intro do Three.js - Hello 3D World! Project Support
11	2		16 May - 20 May	classes			20 May, 23h59	Pen and Paper Exercises Project Support
12	3	Dia do Técnico on Monday	23 May - 27 May	classes	Evaluation of Assignment A	4		Pen and Paper Exercises Project Support Project Discussions
13	4		30 May - 03 Jun	classes			03 June, 23h59	Pen and Paper Exercises Project Support
14	5	Public Holiday on Friday	06 Jun - 10 Jun	classes	Evaluation of Assignment B	3		Pen and Paper Exercises Project Support Project Discussions
15	6	Public Holidays on Monday and Thursday	13 Jun - 17 Jun	classes			17 June, 23h59	Pen and Paper Exercises Project Support
16	7		20 Jun - 24 Jun	classes	Evaluation of Assignment C	3		Pen and Paper Exercises Project Support Project Discussions

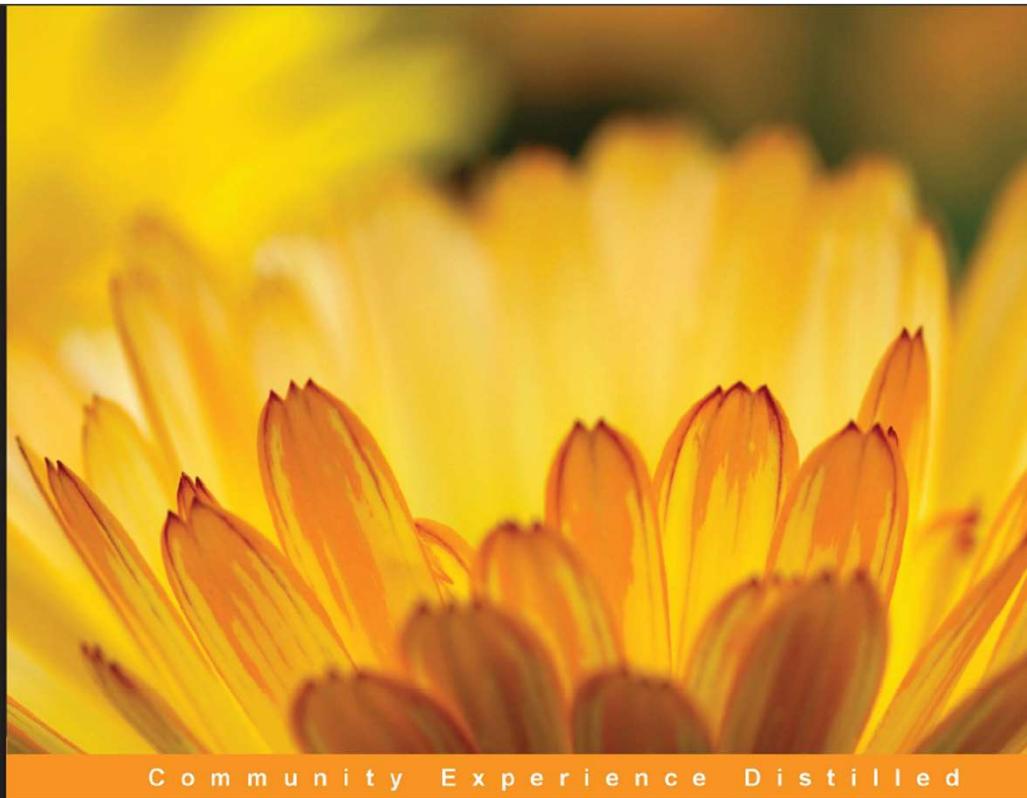
Laboratório #1

Introdução ao *Three.js*

Three.js

Biblioteca JavaScript

API Gráfica



Learning Three.js – the JavaScript 3D Library for WebGL

Second Edition

Create stunning 3D graphics in your browser using the Three.js
JavaScript library

Jos Dirksen

[PACKT] open source*

PUBLISHING

community experience distilled





Editor

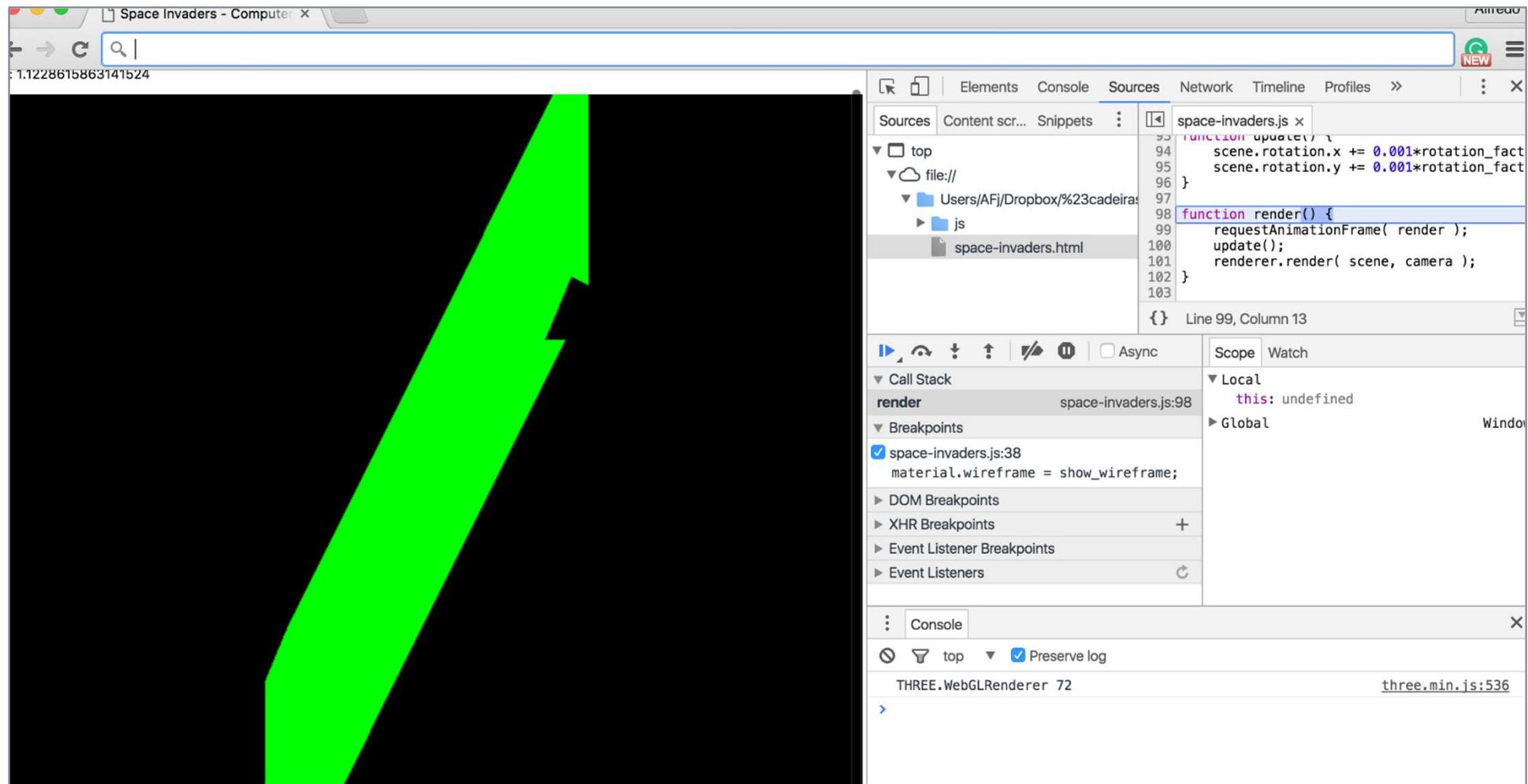
Visual Studio Code
(OS X, Windows, Linux)

Sublime Text Editor
(OS X, Windows, Linux)

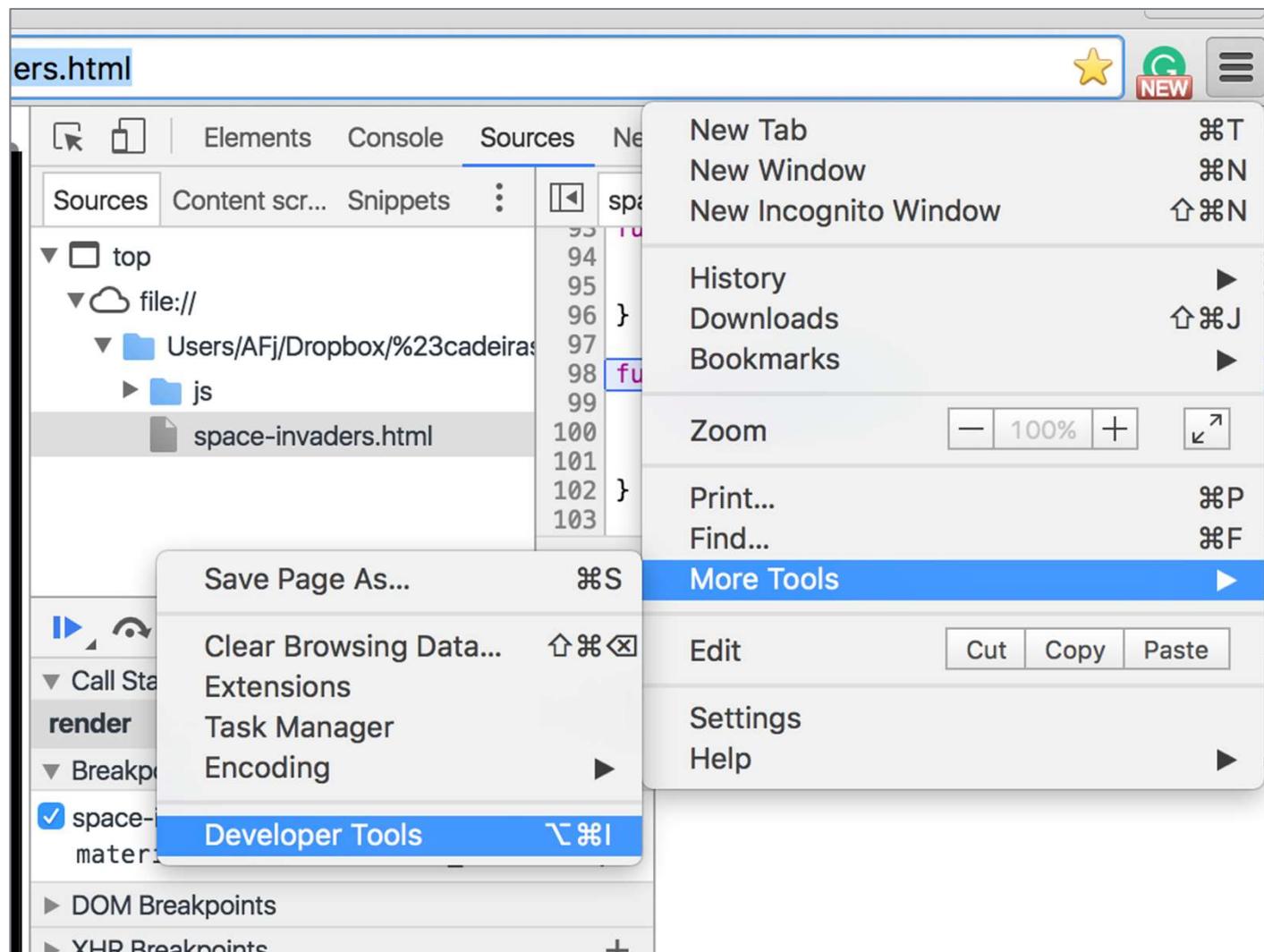
Atom
(OS X, Windows, Linux)

... ou outro da vossa preferência

Debugging



Debugging (em Chrome)



Obter o Three.js

descarregar **versão completa** da página oficial

<http://threejs.org/>

(não recomendado, a menos que estejam a pensar trabalhar offline)

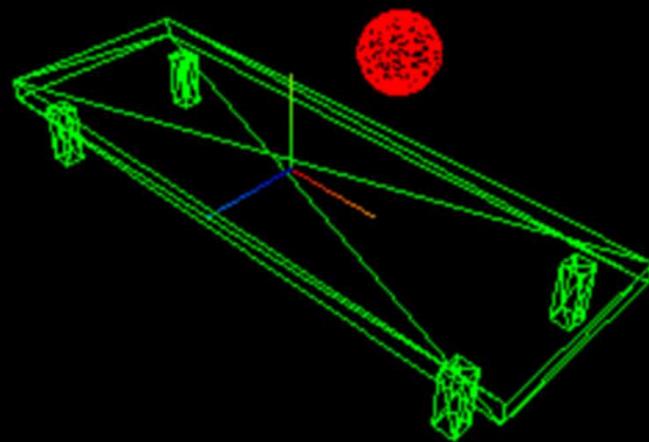
Obter o Three.js

descarregar **apenas um** ficheiro Javascript
three.js ou **three.min.js**

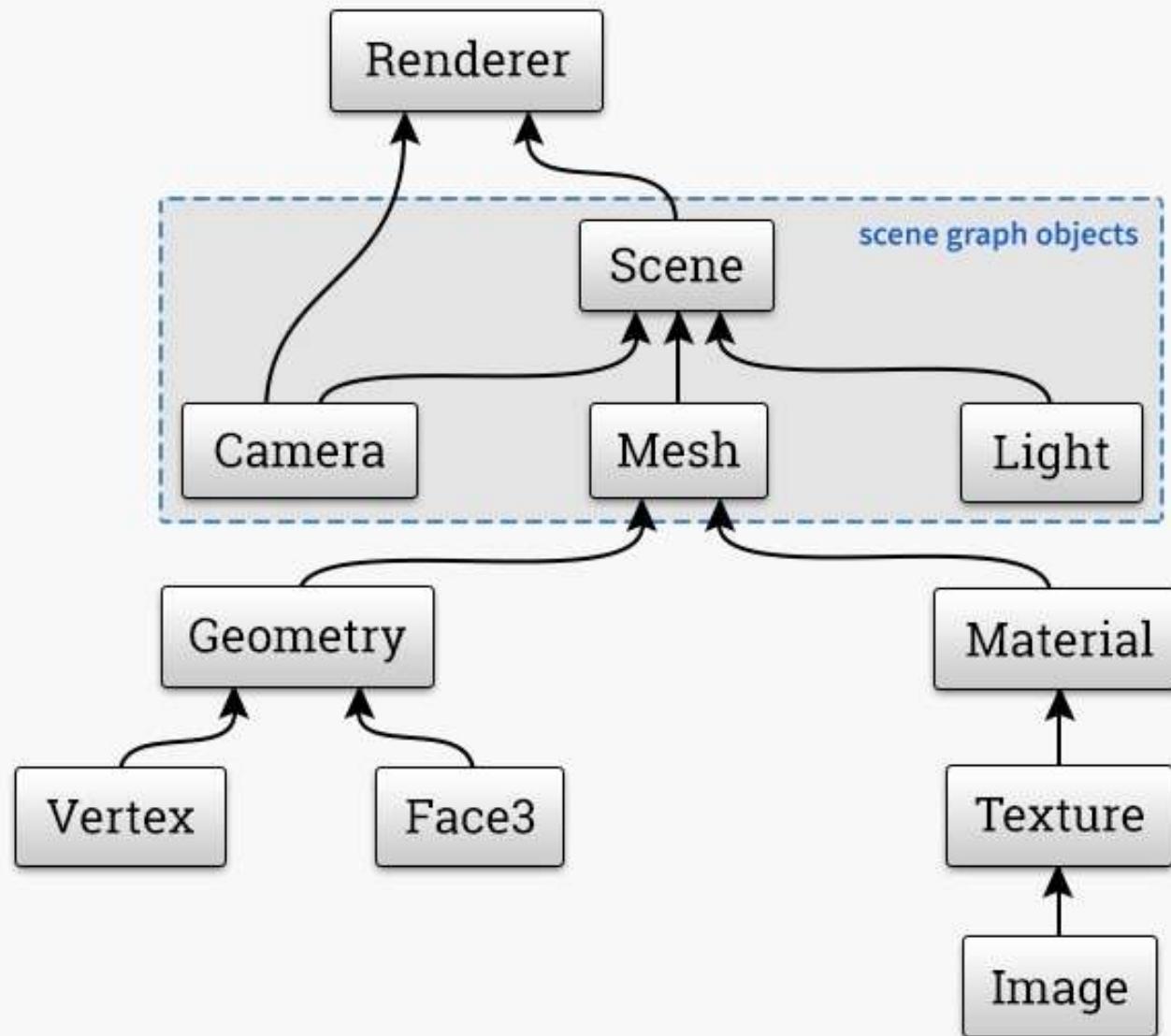
Laboratório #1

Criar a App

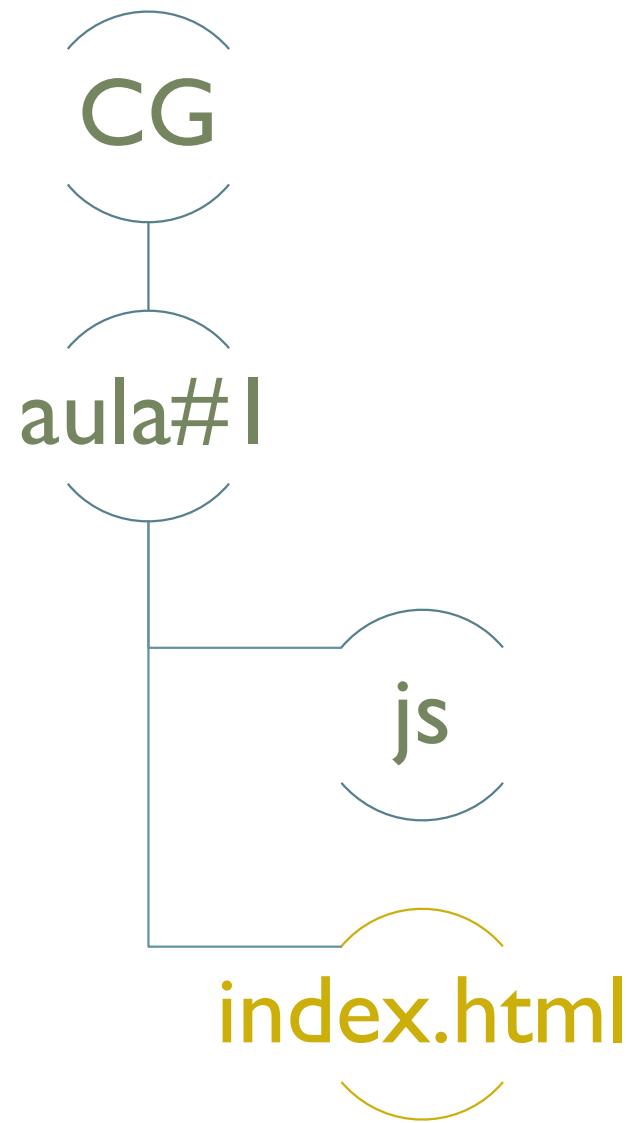
Criar a App...



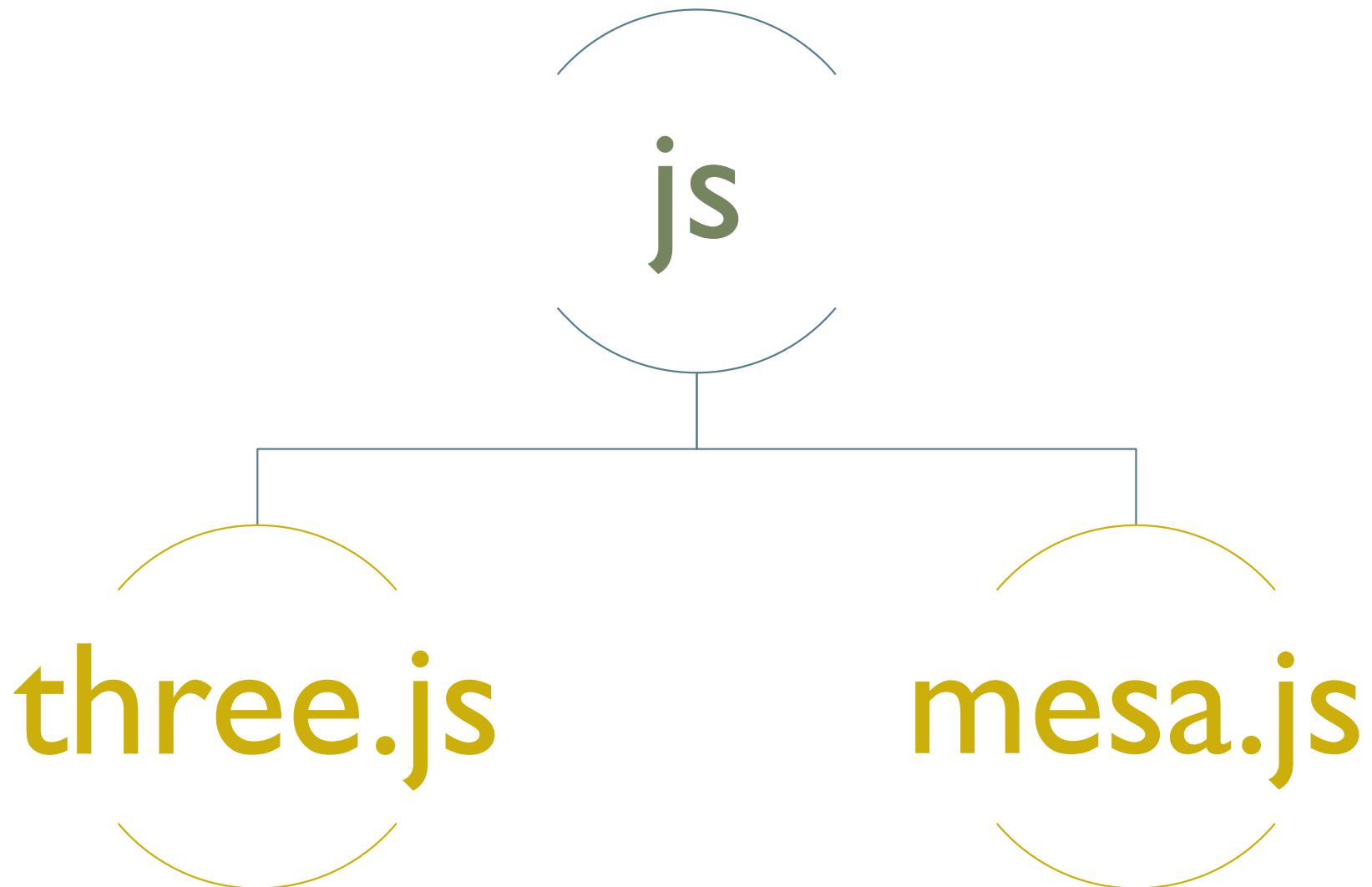
Scene Graph



Criar pastas e ficheiros



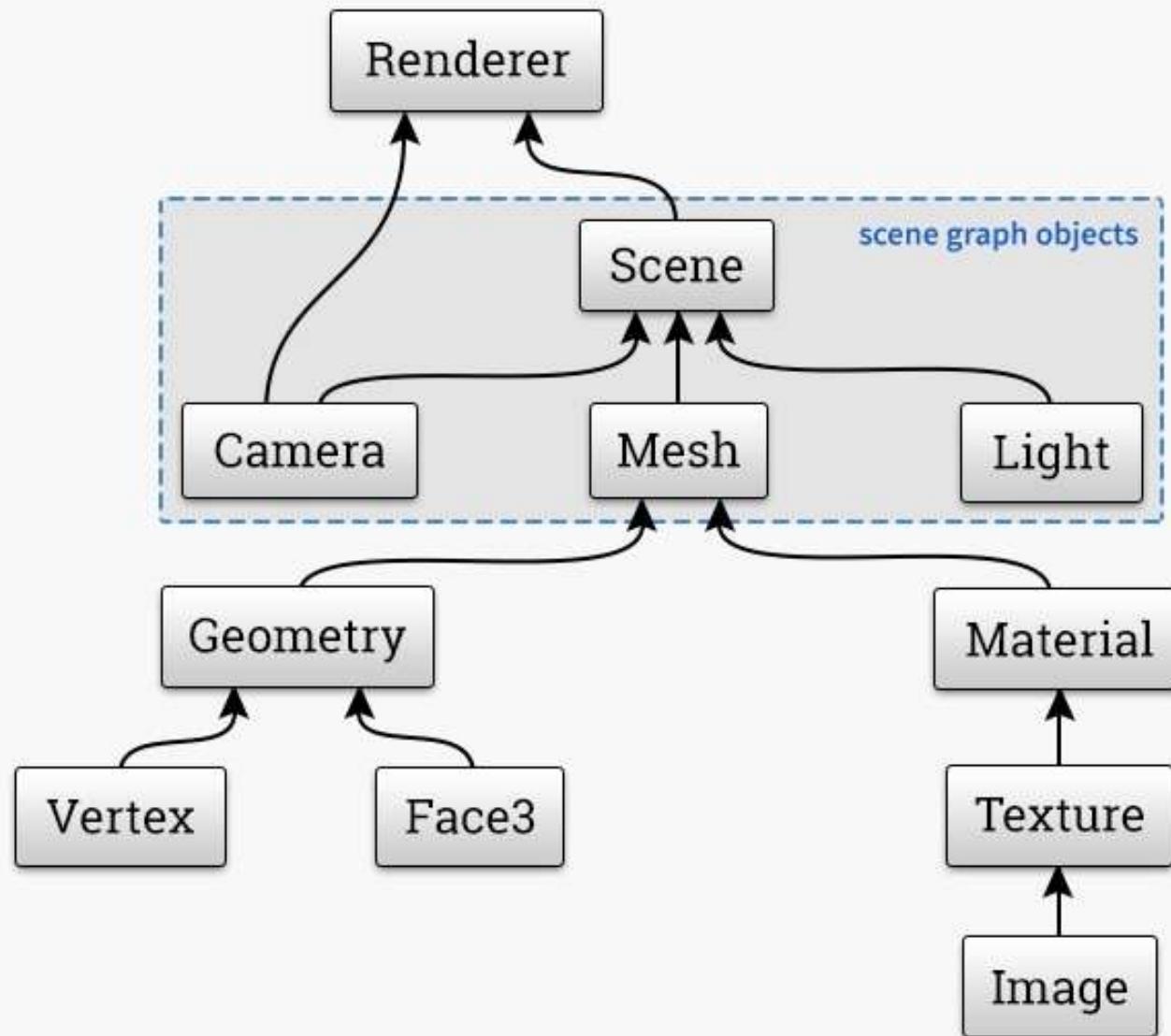
Criar pastas e ficheiros



index.html

```
1  <!doctype html>
2 ▼ <html>
3 ▼   <head>
4     <meta charset="utf-8">
5     <title>1&ordf; aula - CG@IST/UL</title>
6     <style>
7       body {
8         margin: 0px;
9         background-color: #fff;
10        overflow: hidden;
11      </style>
12      <script src="js/three.js"></script>
13      <script src="js/mesa.js"></script>
14    </head>
15 ▶    <body> ...
16    </body>
17
18
19
20  </html>
```

Scene Graph



mesa.js

```
1  /*global THREE*/
2
3  var camera, scene, renderer;
4
5 ► function render() { ... }
6
7
8 ► function init() { ... }
```

mesa.js

```
1  /*global THREE*/
2
3  var camera, scene, renderer;
4
5 ► function render() { ... }
9
10 ▼ function init() {
11     'use strict';
12
13     renderer = new THREE.WebGLRenderer({ antialias: true });
14
15     renderer.setSize(window.innerWidth, window.innerHeight);
16
17     document.body.appendChild(renderer.domElement);
18
19     render();
20 }
```

mesa.js

```
1  /*global THREE*/
2
3  var camera, scene, renderer;
4
5 ▶ function render() {
6      'use strict';
7      renderer.render(scene, camera);
8  }
9
10 ► function init() { [REDACTED]
```

index.html

```
1  <!doctype html>
2 ▼ <html>
3 ▼   <head>
4       <meta charset="utf-8">
5       <title>1&ordf; aula - CG@IST/UL</title>
6       <style>
7         body {
8           margin: 0px;
9           background-color: #fff;
10          overflow: hidden;
11        }
12        <script src="js/three.js"></script>
13        <script src="js/mesa.js"></script>
14      </head>
15 ▼   <body>
16     <script>
17       init();
18     </script>
19   </body>
20 </html>
```

Laboratório #1

Criar a cena

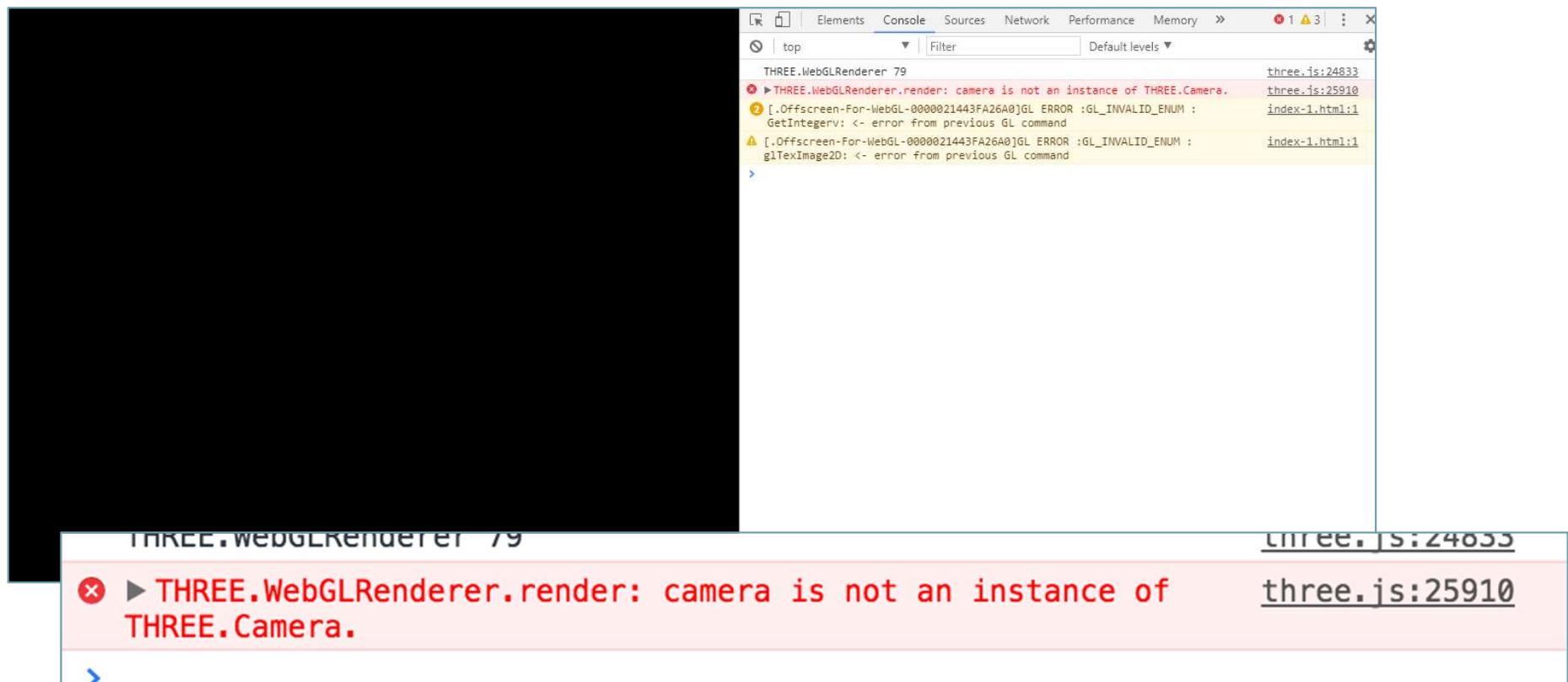
mesa.js

```
1  /*global THREE*/
2
3  var camera, scene, renderer;
4
5 ► function render() { ... }
9
10 ▼ function createScene() {
11     'use strict';
12
13     scene = new THREE.Scene();
14
15     scene.add(new THREE.AxisHelper(10));
16
17 }
18
19 ► function init() { ... }
```

mesa.js

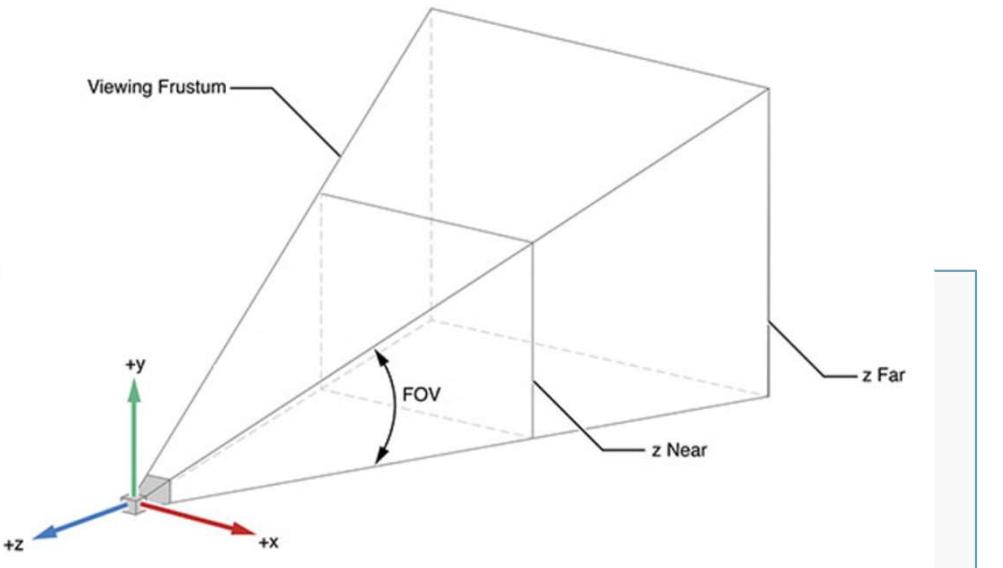
```
1  /*global THREE*/
2
3  var camera, scene, renderer;
4
5 ► function render() { ... }
9
10 ► function createScene() { ... }
18
19 ► function init() {
20     'use strict';
21
22     renderer = new THREE.WebGLRenderer();
23
24     renderer.setSize(window.innerWidth, window.innerHeight);
25
26     document.body.appendChild(renderer.domElement);
27
28     createScene();
29
30     render();
31 }
```

Ao executar a App...



mesa.js

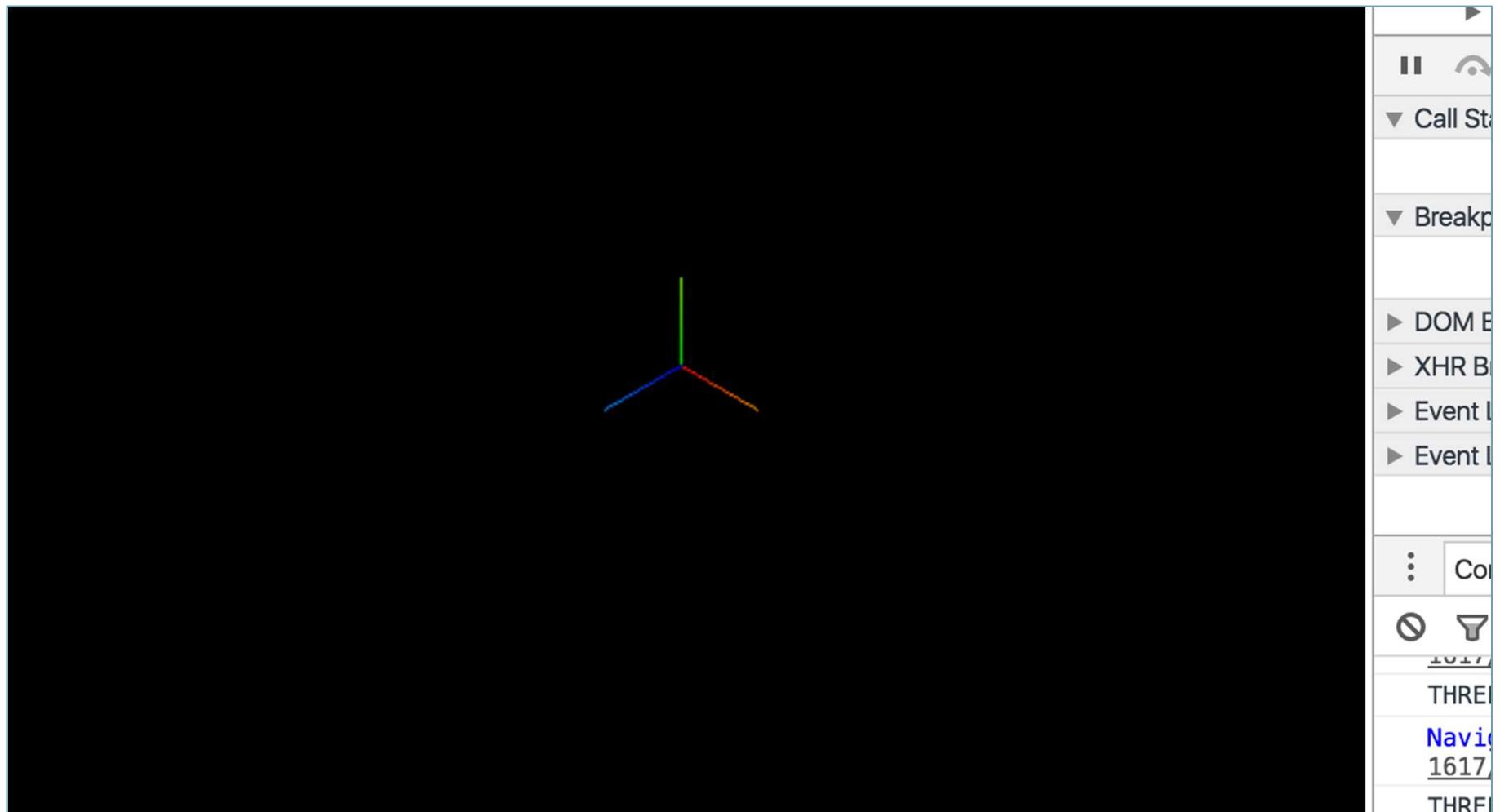
```
1  /*global THREE*/
2
3  var camera, scene, renderer;
4
5 ▶ function render() { ... }
9
10 ▼ function createCamera() {
11     'use strict';
12     camera = new THREE.PerspectiveCamera(70,
13                                         window.innerWidth / window.innerHeight,
14                                         1,
15                                         1000);
16     camera.position.x = 50;
17     camera.position.y = 50;
18     camera.position.z = 50;
19     camera.lookAt(scene.position);
20 }
21
22 ▶ function createScene() { ... }
30
31 ▶ function init() { ... }
```



mesa.js

```
1  /*global THREE*/
2
3  var camera, scene, renderer;
4
5 ► function render() { ... }
9
10 ► function createCamera() { ... }
21
22 ► function createScene() { ... }
30
31 ▼ function init() {
32     'use strict';
33
34     renderer = new THREE.WebGLRenderer();
35
36     renderer.setSize(window.innerWidth, window.innerHeight);
37
38     document.body.appendChild(renderer.domElement);
39
40     createScene();
41     createCamera();
42
43     render();
44 }
```

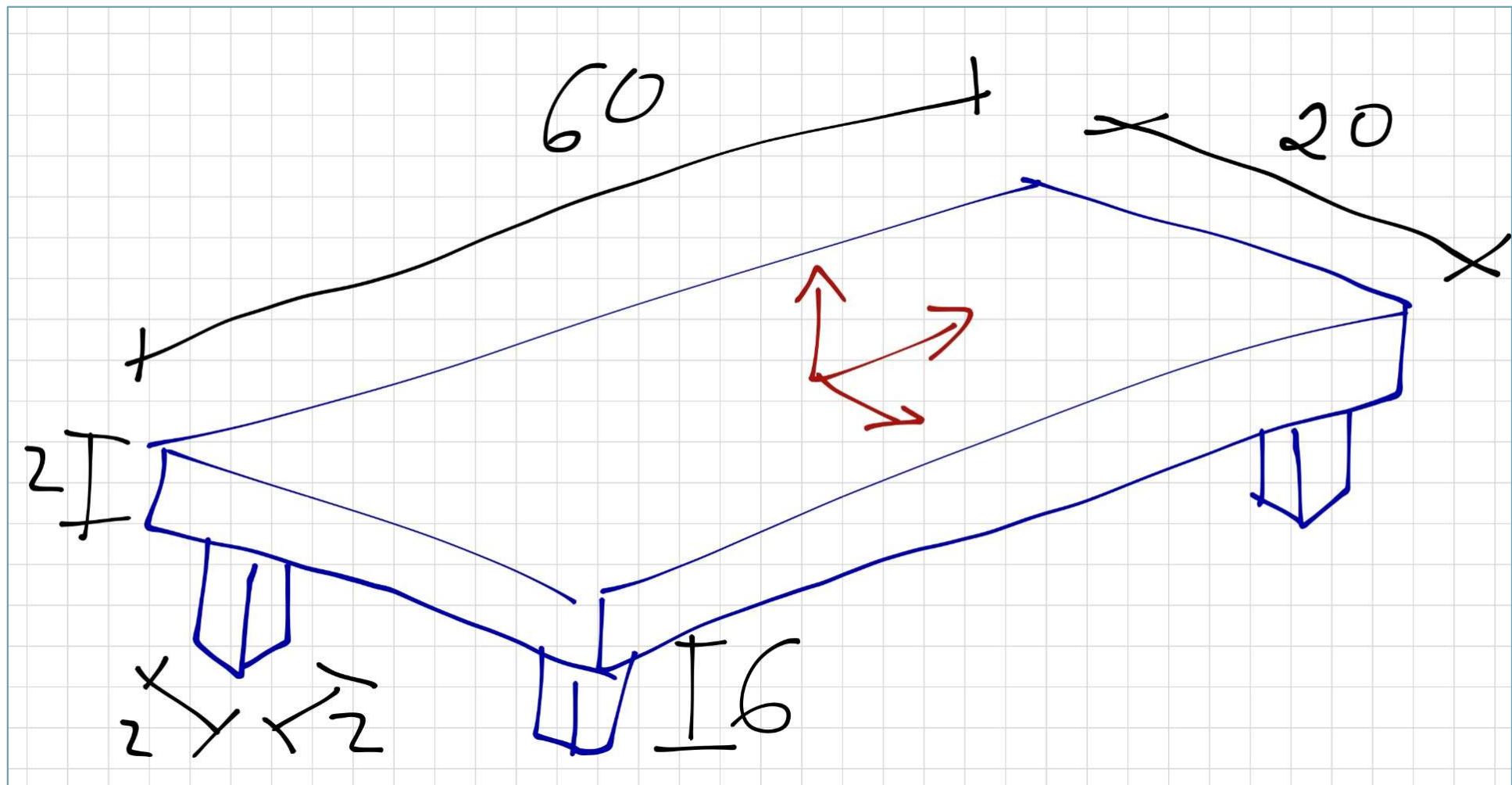
Ao executar a App...



mesa.js

```
1  /*global THREE*/
2
3  var camera, scene, renderer;
4
5  ▼ function createTable(x, y, z) {
6      'use strict';
7
8      var table = new THREE.Object3D();
9
10     material = new THREE.MeshBasicMaterial({ color: 0x00ff00, wireframe: true });
11
12     scene.add(table);
13
14     table.position.x = x;
15     table.position.y = y;
16     table.position.z = z;
17 }
18
19 ▶ function createCamera() { ... }
30
31 ▶ function createScene() { ... }
39
40 ▶ function render() { ... }
44
45 ▶ function init() { ... }
```

Geometria da Mesa



mesa.js

```
1  /*global THREE*/
2
3  var camera, scene, renderer;
4
5  ▶ function createTable(x, y, z) {
6      'use strict';
7
8      var table = new THREE.Object3D();
9
10     material = new THREE.MeshBasicMaterial({ color: 0x00ff00, wireframe: true });
11
12     addTableTop(table, 0, 0, 0);
13     addTableLeg(table, -25, -1, -8);
14     addTableLeg(table, -25, -1, 8);
15     addTableLeg(table, 25, -1, 8);
16     addTableLeg(table, 25, -1, -8);
17
18     scene.add(table);
19
20     table.position.x = x;
21     table.position.y = y;
22     table.position.z = z;
23 }
24
25 ▶ function createCamera() { ... }
26
27 ▶ function createScene() { ... }
28
29 ▶ function render() { ... }
30
31 ▶ function init() { ... }
```

mesa.js

```
1  /*global THREE*/
2
3  var camera, scene, renderer;
4
5  ▼ function addTableTop(obj, x, y, z) {
6      'use strict';
7      geometry = new THREE.CubeGeometry(60, 2, 20);
8      mesh = new THREE.Mesh(geometry, material);
9      mesh.position.set(x, y, z);
10
11      obj.add(mesh);
12  }
13
14 ► function createTable(x, y, z) { ... }
15
16 ► function createCamera() { ... }
17
18 ► function createScene() { ... }
19
20 ► function render() { ... }
21
22 ► function init() { ... }
```

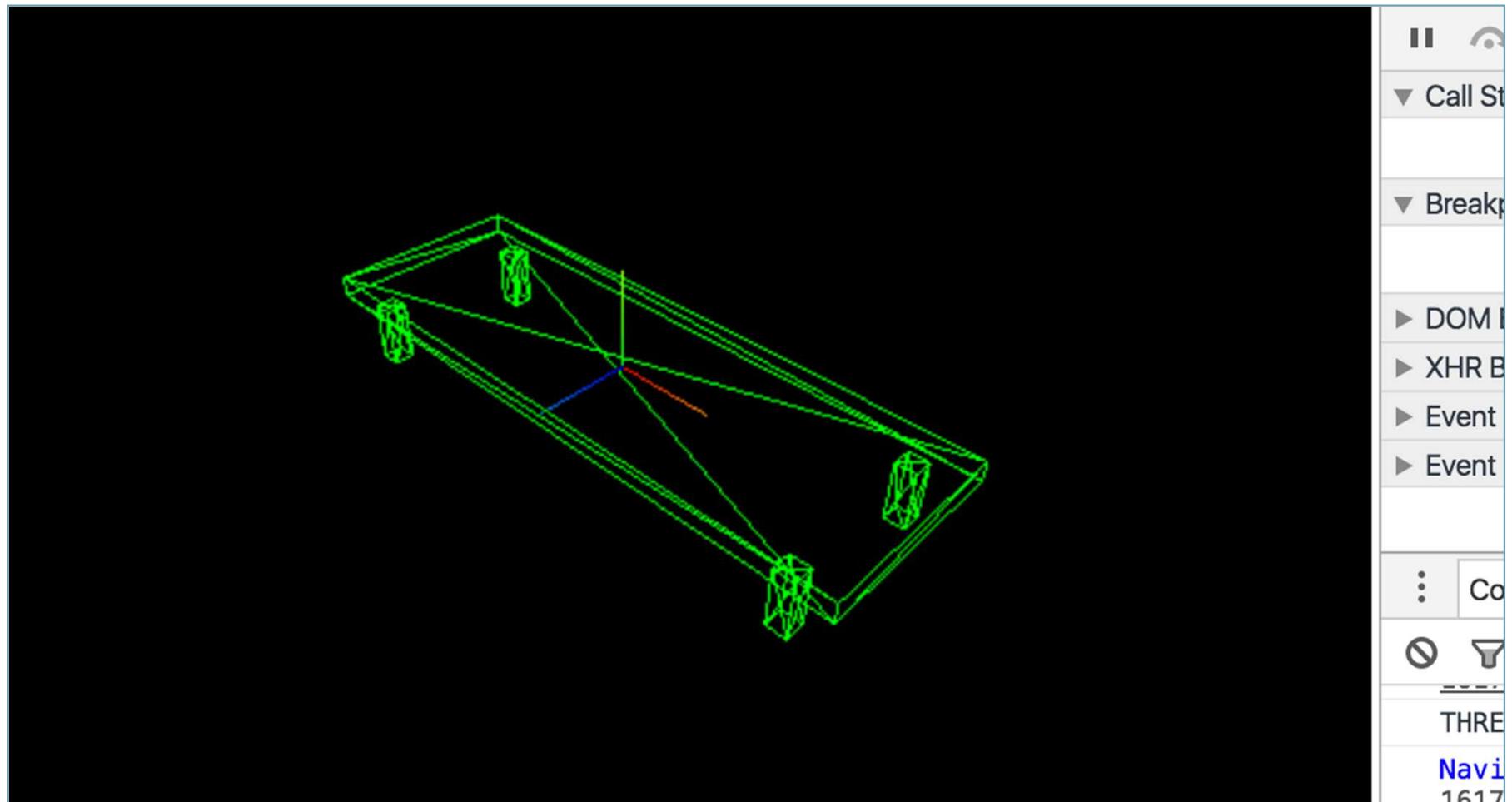
mesa.js

```
1  /*global THREE*/
2
3  var camera, scene, renderer;
4
5 ▼ function addTableLeg(obj, x, y, z) {
6      'use strict';
7
8      geometry = new THREE.CubeGeometry(2, 6, 2);
9      mesh = new THREE.Mesh(geometry, material);
10     mesh.position.set(x, y - 3, z);
11     obj.add(mesh);
12 }
13
14 ► function addTableTop(obj, x, y, z) { ... }
15
16 ► function createTable(x, y, z) { ... }
17
18 ► function createCamera() { ... }
19
20 ► function createScene() { ... }
21
22 ► function render() { ... }
23
24 ► function init() { ... }
```

mesa.js

```
1  /*global THREE*/
2
3  var camera, scene, renderer;
4
5  var geometry, material, mesh;
6
7 ► function addTableLeg(obj, x, y, z) { ... }
15
16 ► function addTableTop(obj, x, y, z) { ... }
24
25 ► function createTable(x, y, z) { ... }
44
45 ► function createCamera() { ... }
56
57 ▼ function createScene() {
58     'use strict';
59
60     scene = new THREE.Scene();
61
62     scene.add(new THREE.AxisHelper(10));
63
64     createTable(0, 0, 0);
65 }
66
67 ► function render() { ... }
71
72 ► function init() { ... }
```

Ao executar a App...



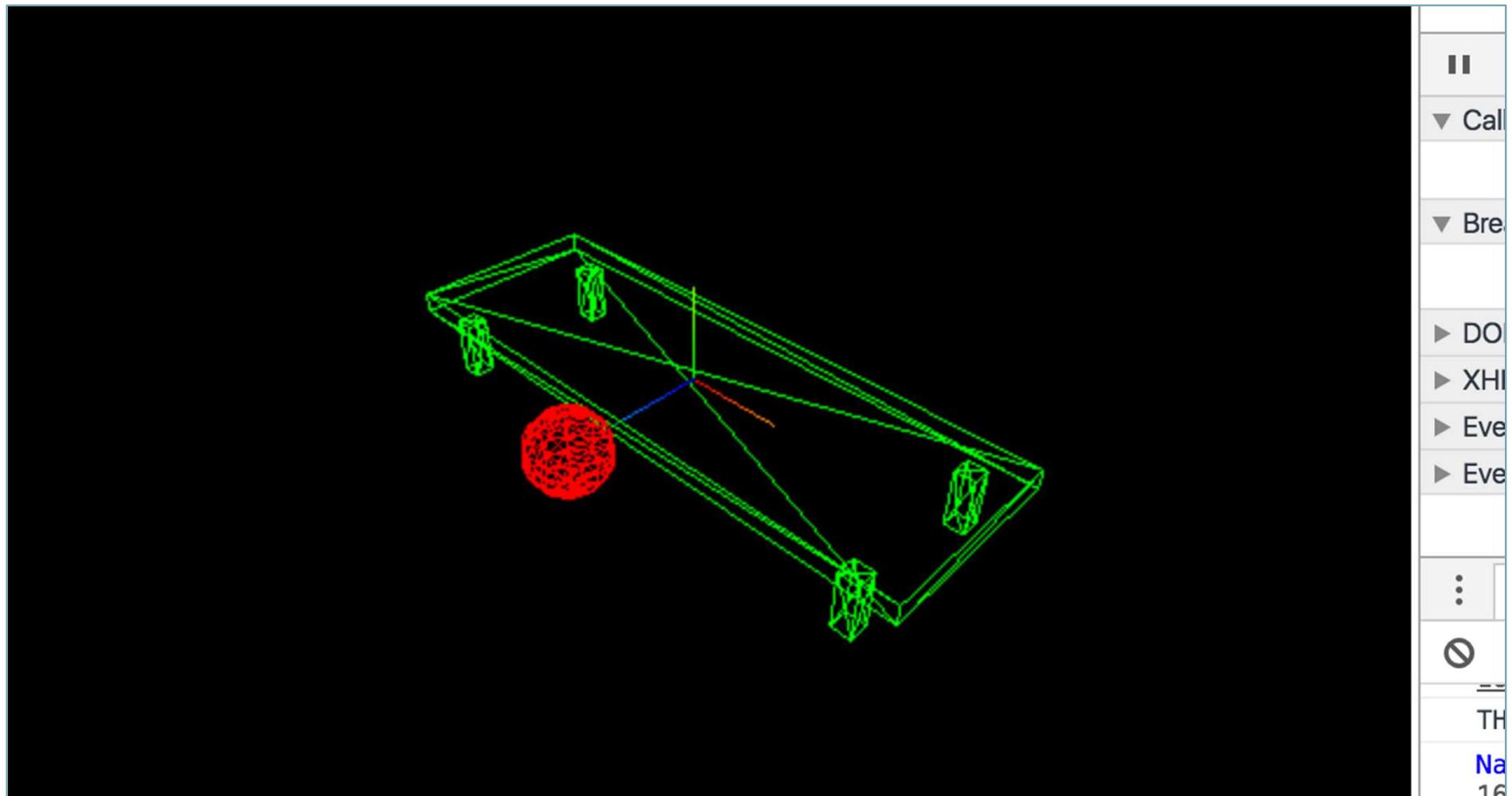
mesa.js

```
5  var geometry, material, mesh,
6
7  var ball;
8
9  ▼ function createBall(x, y, z) {
10    'use strict';
11
12    ball = new THREE.Object3D();
13    ball.userData = { jumping: true, step: 0 };
14
15    material = new THREE.MeshBasicMaterial({ color: 0xff0000, wireframe: true });
16    geometry = new THREE.SphereGeometry(4, 10, 10);
17    mesh = new THREE.Mesh(geometry, material);
18
19    ball.add(mesh);
20    ball.position.set(x, y, z);
21
22    scene.add(ball);
23  }
24
25 ▶ function addTableLeg(obj, x, y, z) { ... }
33
34 ▶ function addTableTop(obj, x, y, z) { ... }
42
43 ▶ function createTable(x, y, z) { ... }
```

mesa.js

```
    var ball;
8
9 ► function createBall(x, y, z) { ... }
24
25 ► function addTableLeg(obj, x, y, z) { ... }
33
34 ► function addTableTop(obj, x, y, z) { ... }
42
43 ► function createTable(x, y, z) { ... }
62
63 ► function createCamera() { ... }
74
75 ► function createScene() {
76     'use strict';
77
78     scene = new THREE.Scene();
79
80     scene.add(new THREE.AxisHelper(10));
81
82     createTable(0, 0, 0);
83     createBall(0, 0, 15);
84 }
85
86 ► function render() { ... }
```

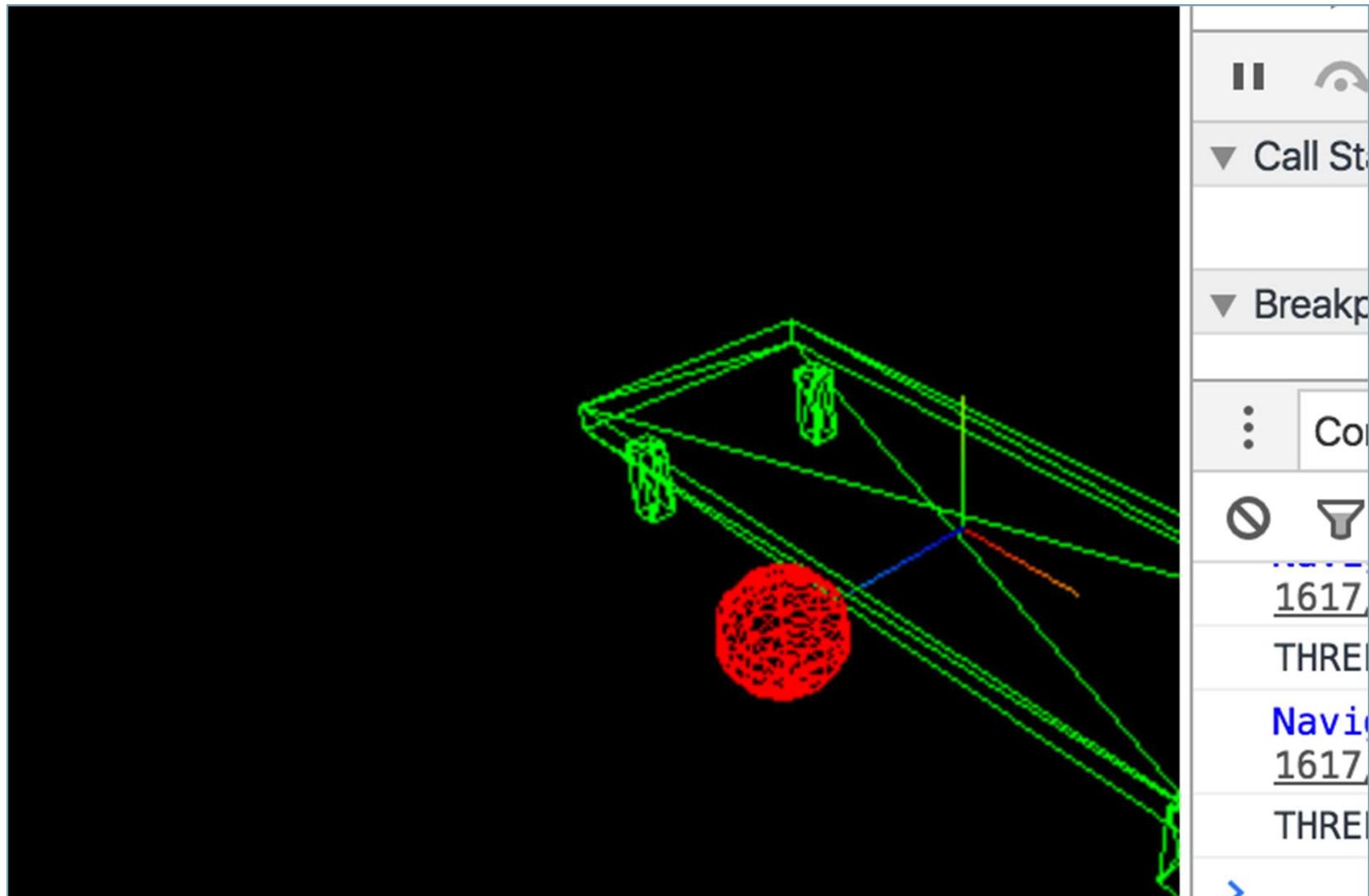
Ao executar a App...



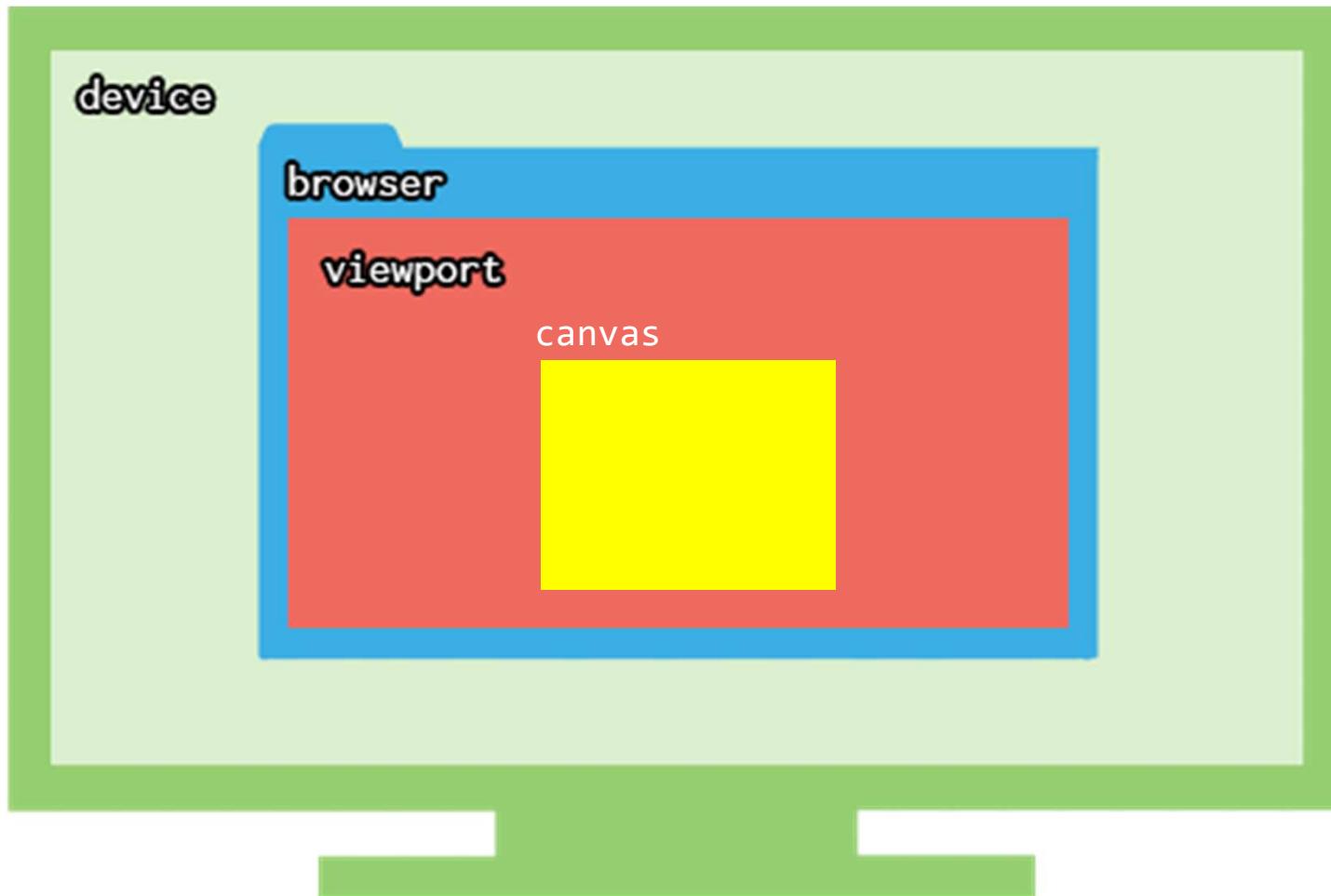
Laboratório #1

Redimensionar a janela

Ao redimensionar a janela...

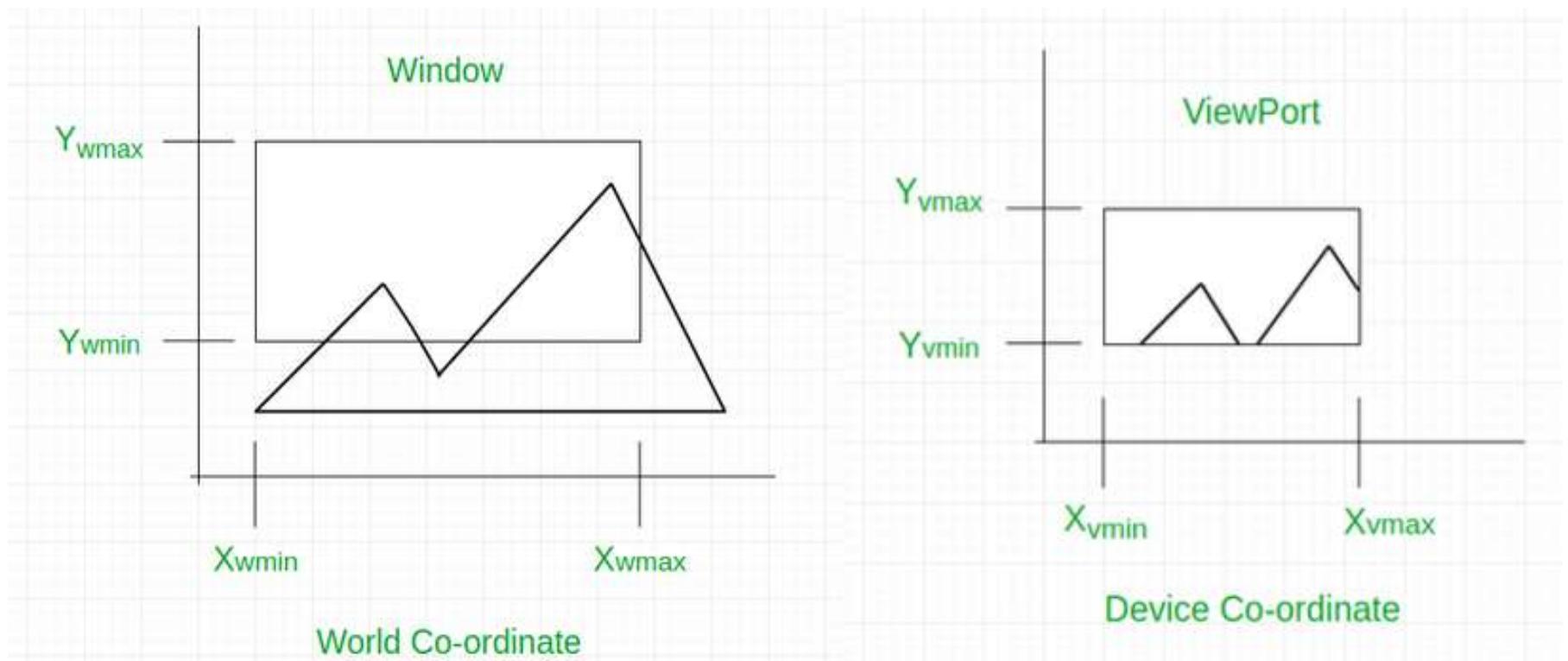


Ao redimensionar a janela...



Jargão ‘Web Design’

Ao redimensionar a janela...



Jargão ‘Computer Graphics’

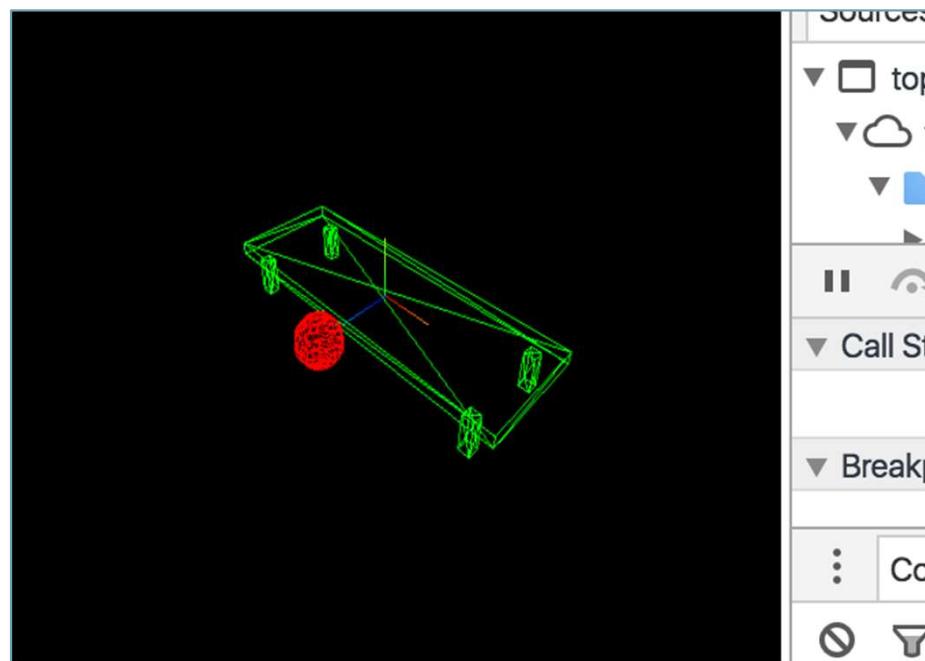
mesa.js

```
45 ▶ function createTable(x, y, z) { ... }
62
63 ▶ function createCamera() { ... }
74
75 ▶ function createScene() { ... }
85
86 ▶ function onResize() {
87     'use strict';
88
89     renderer.setSize(window.innerWidth, window.innerHeight);
90 }
91
92 ▶ function render() { ... }
96
97 ▶ function init() { ... }
```

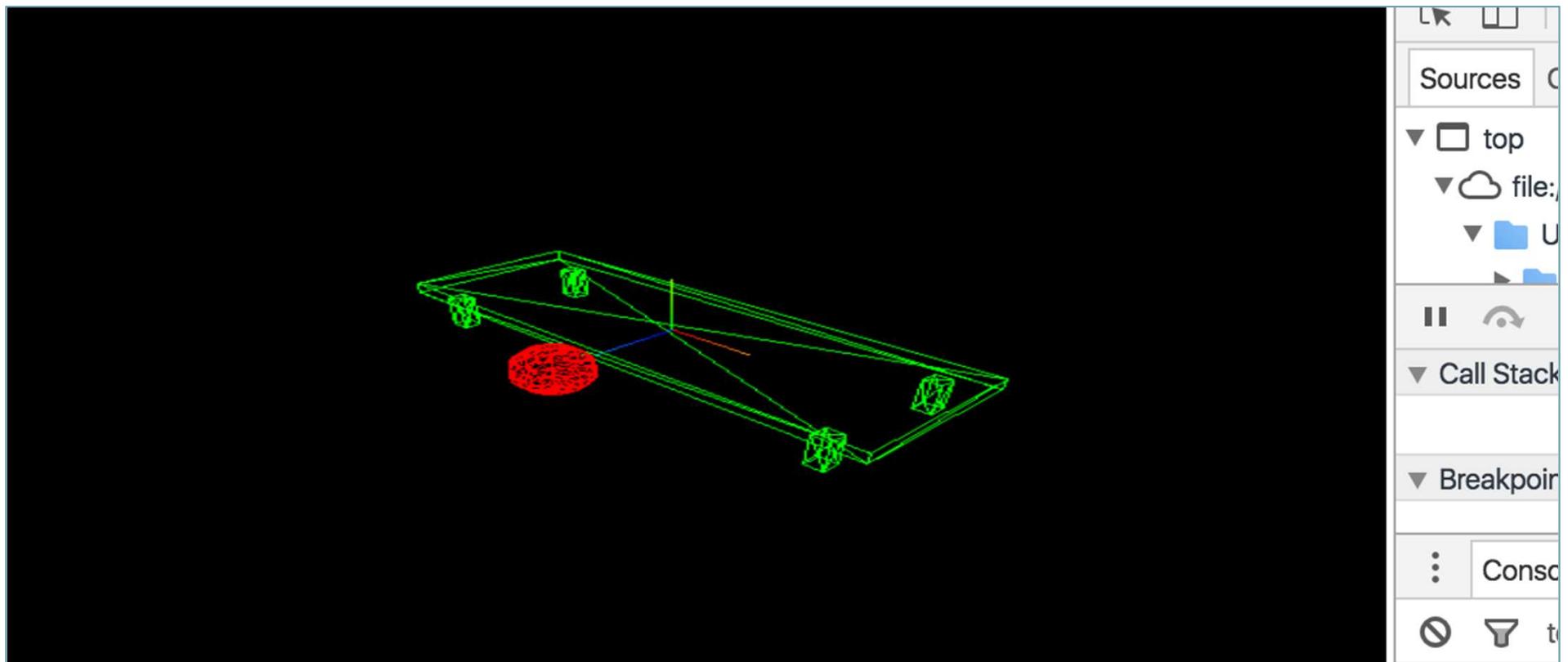
mesa.js

```
75 ▶ function createScene() { ... }
85
86 ▶ function onResize() { ... }
91
92 ▶ function render() { ... }
96
97 ▶ function init() {
98     'use strict';
99
100    renderer = new THREE.WebGLRenderer();
101
102    renderer.setSize(window.innerWidth, window.innerHeight);
103
104    document.body.appendChild(renderer.domElement);
105
106    createScene();
107    createCamera();
108
109    render();
110
111    window.addEventListener("resize", onResize);
112
113 }
```

Ao redimensionar a janela...



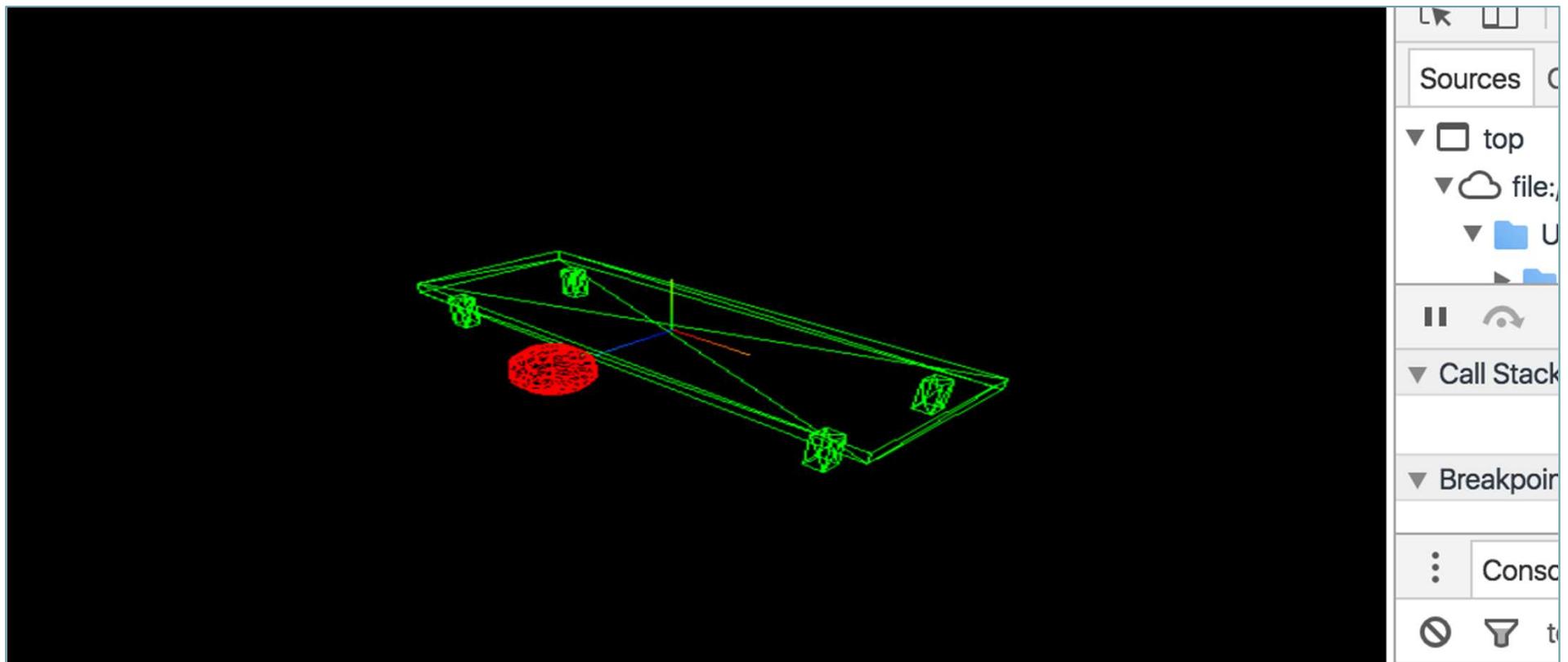
Ao redimensionar a janela...



mesa.js

```
65 ► function createCamera() { ... }
74
75 ► function createScene() { ... }
85
86 ► function render() { ... }
90
91 ▼ function onResize() {
92     'use strict';
93
94     renderer.setSize(window.innerWidth, window.innerHeight);
95
96 ▼     if (window.innerHeight > 0 && window.innerWidth > 0) {
97         camera.aspect = renderer.getSize().width / renderer.getSize().height;
98         camera.updateProjectionMatrix();
99     }
100    }
101
102 ► function init() { ... }
```

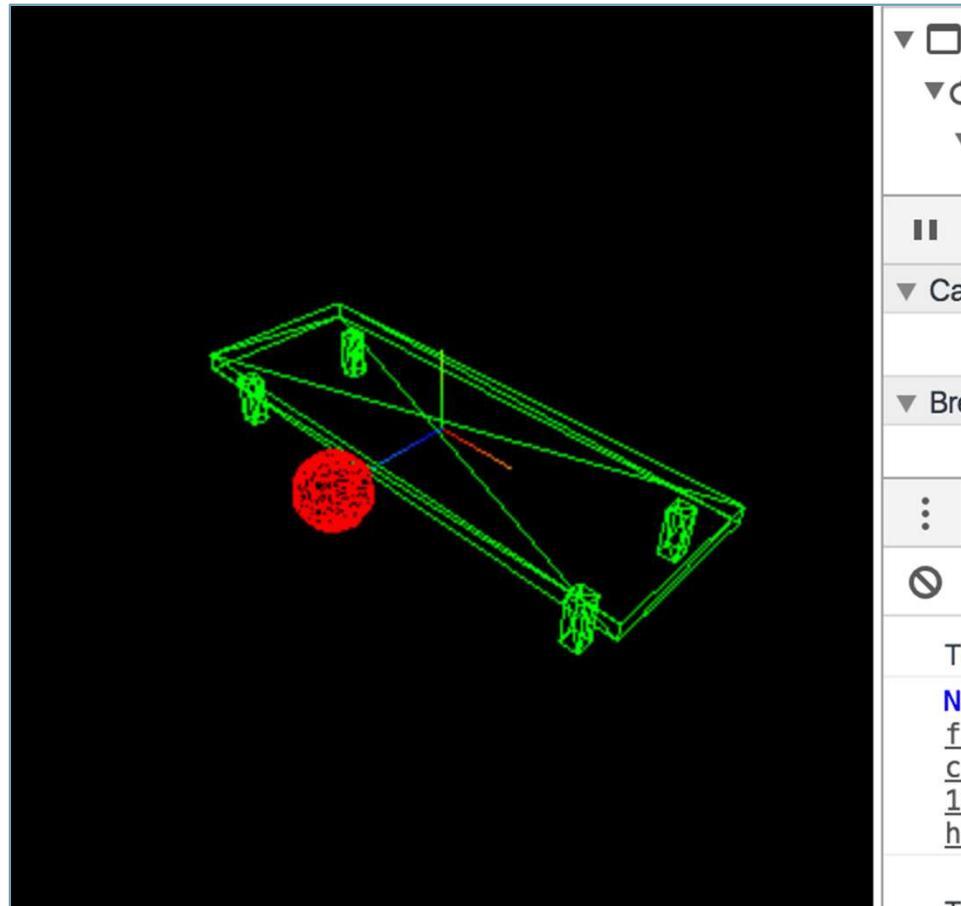
Ao redimensionar a janela...



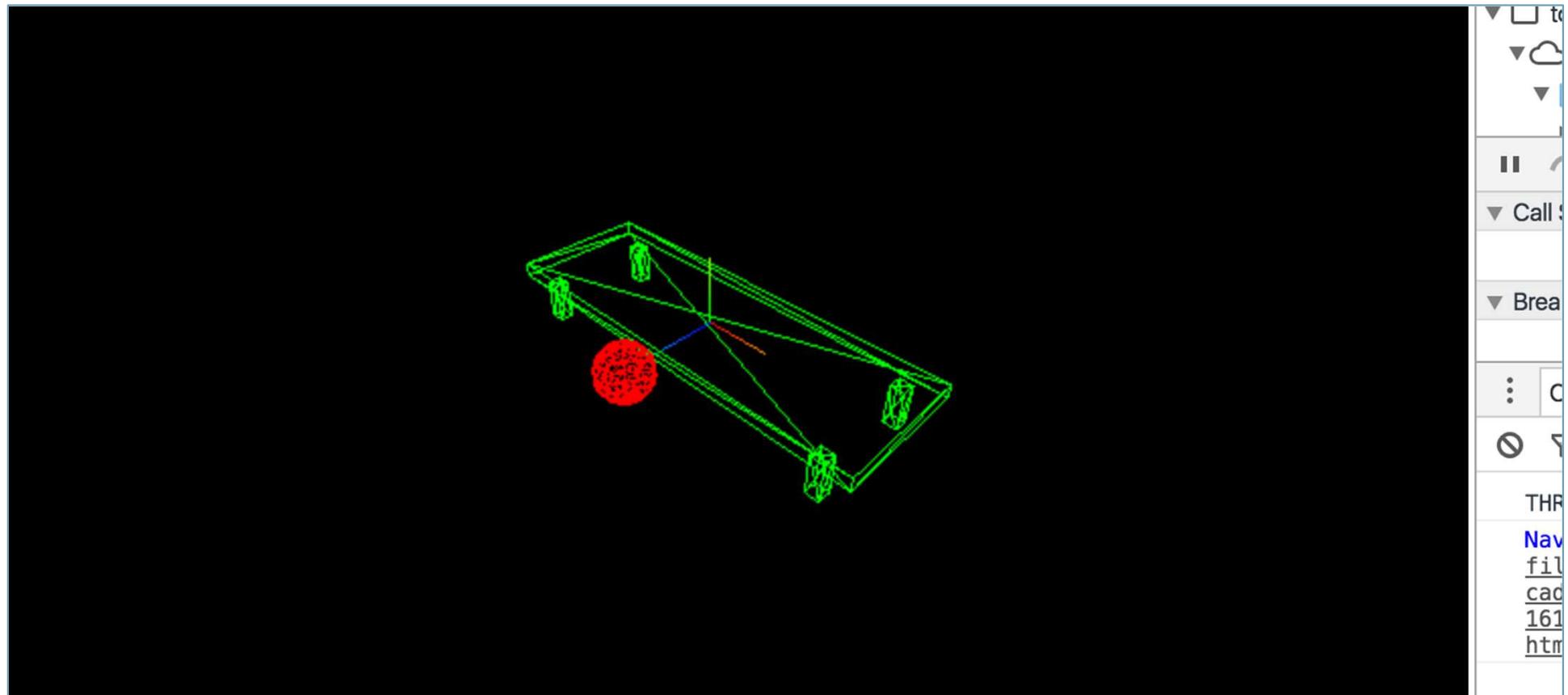
mesa.js

```
75 ▶ function createScene() { ... }
85
86 ▶ function render() { ... }
90
91 ▶ function onResize() {
92     'use strict';
93
94     renderer.setSize(window.innerWidth, window.innerHeight);
95
96 ▶     if (window.innerHeight > 0 && window.innerWidth > 0) {
97         camera.aspect = renderer.getSize().width / renderer.getSize().height;
98         camera.updateProjectionMatrix();
99     }
100
101     render();
102 }
103
104 ▶ function init() { ... }
```

Ao redimensionar a janela...



Ao redimensionar a janela...



Laboratório #1

Interacção

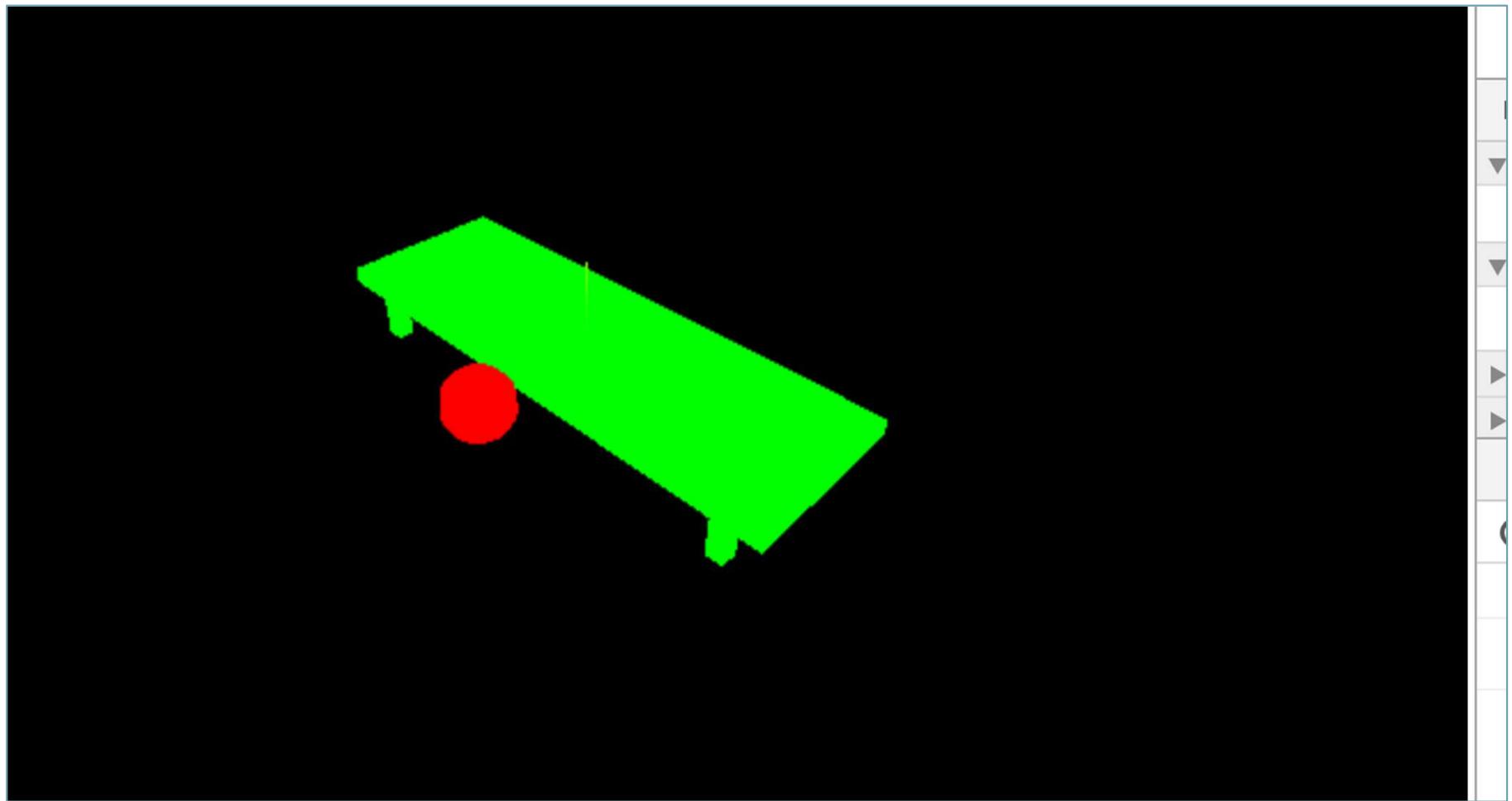
mesa.js

```
75 ► function createScene() { ... }
85
86 ► function render() { ... }
90
91 ► function onResize() { ... }
103
104 ► function init() {
105     'use strict';
106
107     renderer = new THREE.WebGLRenderer();
108
109     renderer.setSize(window.innerWidth, window.innerHeight);
110
111     document.body.appendChild(renderer.domElement);
112
113     createScene();
114     createCamera();
115
116     render();
117
118     window.addEventListener("resize", onResize);
119     window.addEventListener("keydown", onKeyDown);
120 }
```

mesa.js

```
75 ► FUNCTION createscene() { ... }
85
86 ► function render() { ... }
90
91 ► function onResize() { ... }
103
104 ▼ function onKeyDown(e) {
105     'use strict';
106
107 ▼     switch (e.keyCode) {
108         case 65: //A
109         case 97: //a
110 ▼             scene.traverse(function (node) {
111                 if (node instanceof THREE.Mesh) {
112                     node.material.wireframe = !node.material.wireframe;
113                 }
114             });
115             break;
116         }
117
118         render();
119     }
120
121 ► function init() { ... }
```

Ao executar a App...



mesa.js

```
91 ► function onResize() { ... }
103
104 ▼ function onKeyDown(e) {
105     'use strict';
106
107 ▼     switch (e.keyCode) {
108         case 65: //A
109         case 97: //a
110     ▼         scene.traverse(function (node) {
111         ▼             if (node instanceof THREE.Mesh) {
112                 node.material.wireframe = !node.material.wireframe;
113             }
114         });
115         break;
116         case 83: //S
117         case 115: //s
118             ball.userData.jumping = !ball.userData.jumping;
119             break;
120         }
121
122         render();
123     }
124
125 ► function init() { ... }
```

mesa.js

```
91 ► function onResize() { ... }
103
104 ▼ function onKeyDown(e) {
105     'use strict';
106
107 ▼     switch (e.keyCode) {
108         case 65: //A
109         case 97: //a
110             scene.traverse(function (node) {
111                 if (node instanceof THREE.Mesh) {
112                     node.material.wireframe = !node.material.wireframe;
113                 }
114             });
115             break;
116         case 83: //S
117         case 115: //s
118             ball.userData.jumping = !ball.userData.jumping;
119             break;
120     }
121
122     render();
123 }
124
125 ► function init() { ... }
```

```
7   var ball;
8
9 ▼ function createBall(x, y, z) {
10    'use strict';
11
12    ball = new THREE.Object3D();
13    ball.userData = { jumping: true, step: 0 };
14
15    material = new THREE.MeshBasicMaterial({ col...
```

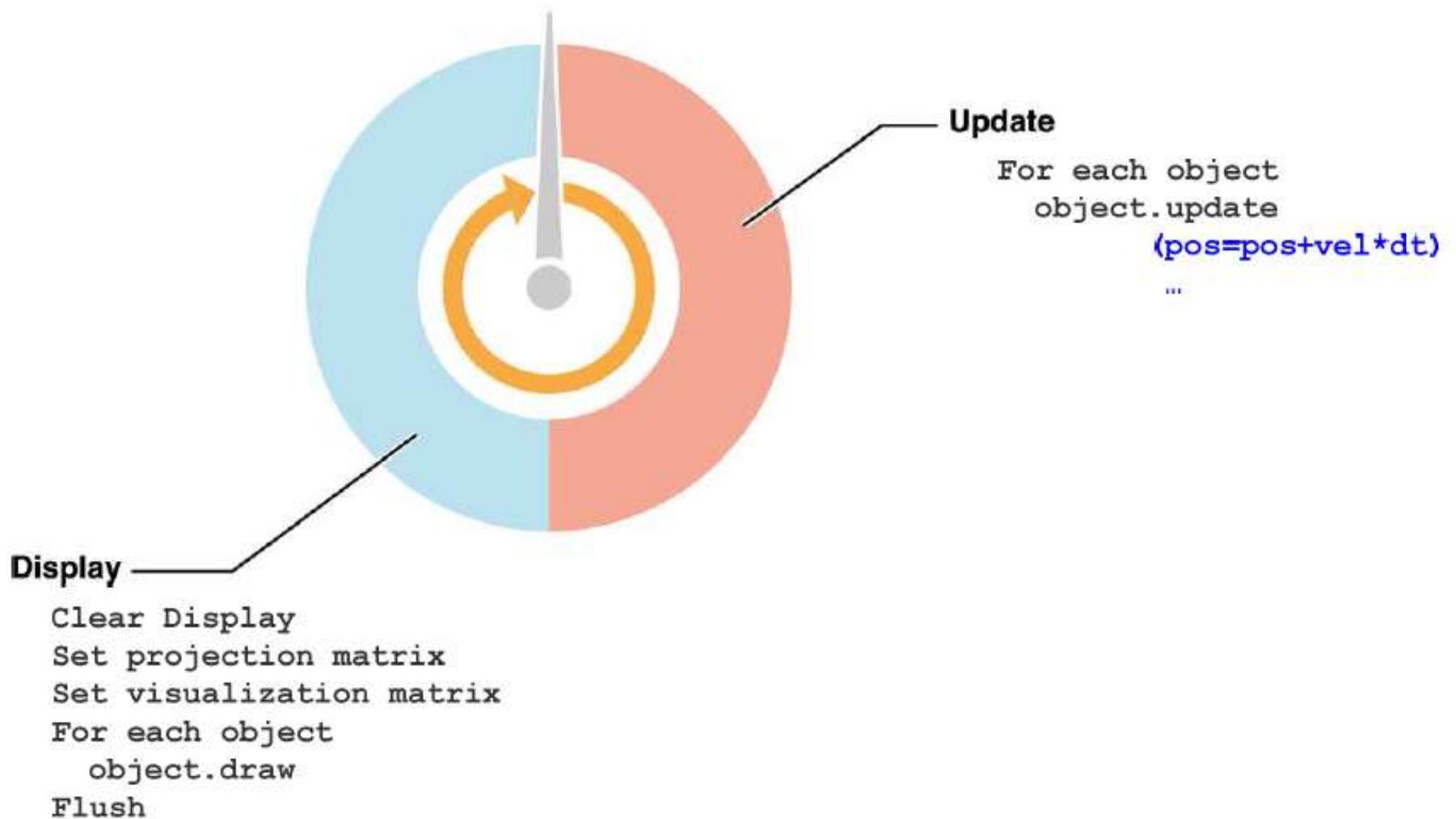
mesa.js

```
91 ► function onResize() { ... }
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104 ▼ function onKeyDown(e) {
105     'use strict';
106
107 ▼     switch (e.keyCode) {
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109         case 97: //a
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111             ▼                 if (node instanceof THREE.Mesh) {
112                     node.material.wireframe = !node.material.wireframe;
113                 }
114             });
115             break;
116         case 83: //S
117         case 115: //s
118             ball.userData.jumping = !ball.userData.jumping;
119             break;
120         }
121
122         render();
123     }
124
125 ► function init() { ... }
```

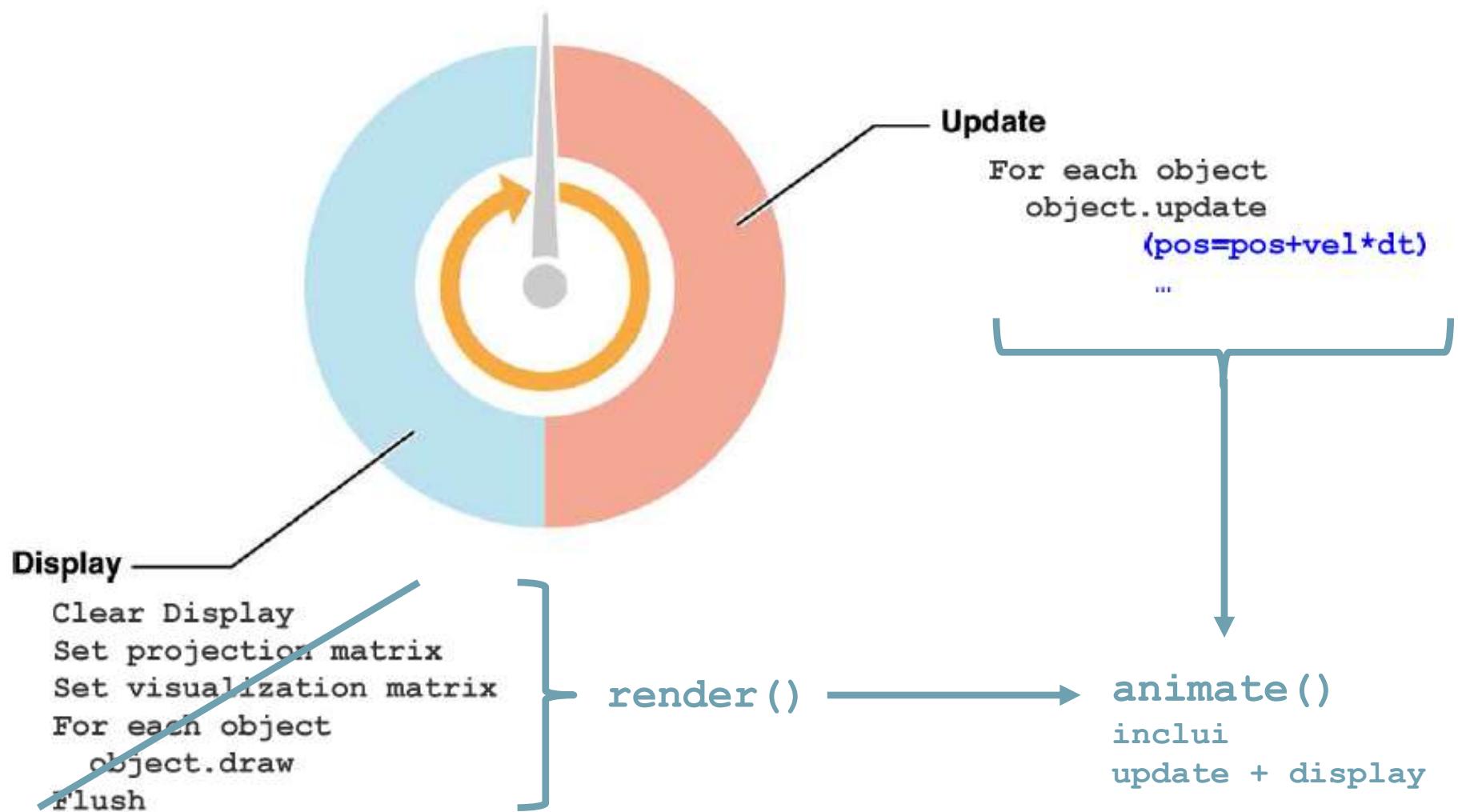
Laboratório #1

Animação

Ciclo Update/Display



Ciclo Update/Display



mesa.js

```
104 ► function onKeyDown(e) { ... }
124
125 ▼ function animate() {
126     'use strict';
127
128 ▼     if (ball.userData.jumping) {
129         ball.userData.step += 0.04;
130         ball.position.y = Math.abs(30 * (Math.sin(ball.userData.step)));
131         ball.position.z = 15 * (Math.cos(ball.userData.step));
132     }
133     render();
134
135     requestAnimationFrame(animate);
136 }
137
138 ► function init() { ... }
```

mesa.html

```
1  <!doctype html>
2 ▼ <html>
3 ▼   <head>
4     <meta charset="utf-8">
5     <title>1&ordf; aula - CG@IST/UL</title>
6     <style>
7       body {
8         margin: 0px;
9         background-color: #fff;
10        overflow: hidden;
11      }
12      </style>
13      <script src="js/three.js"></script>
14      <script src="js/mesa.js"></script>
15   </head>
16   <body>
17     <script>
18       init();
19       animate()
20     </script>
21   </body>
22 </html>
```

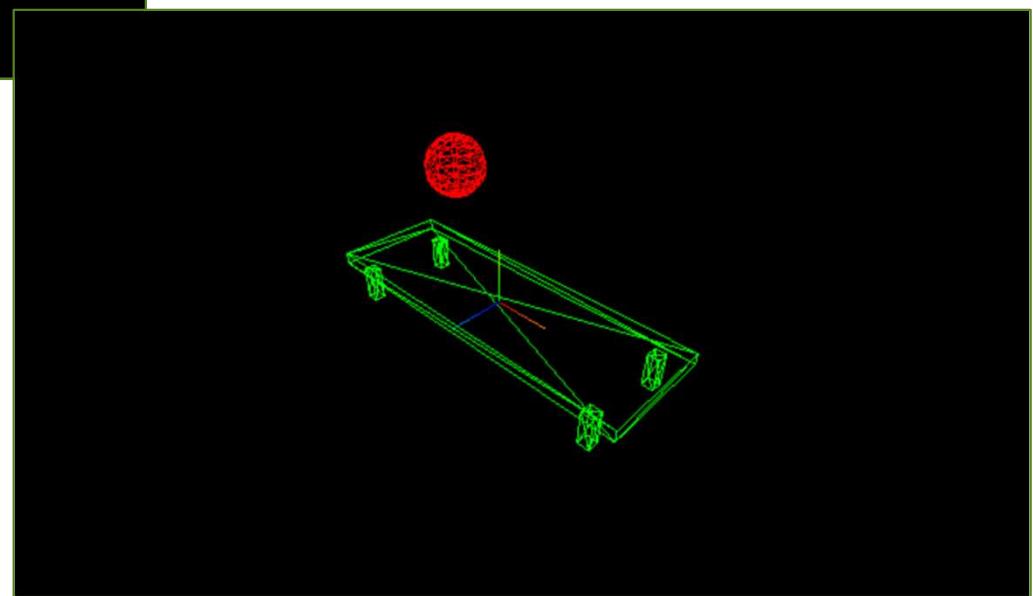
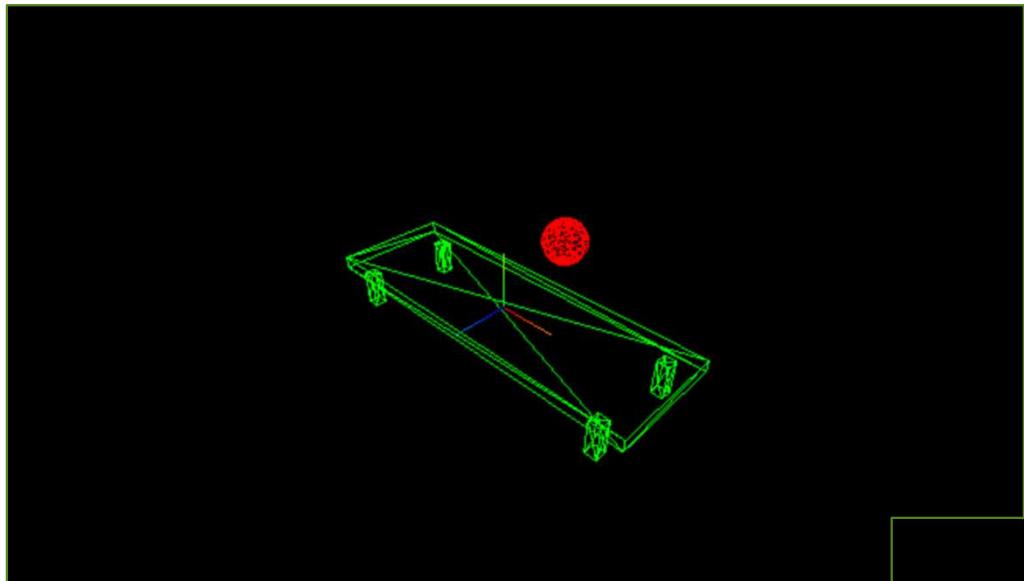
mesa.js

```
90
91 ▼ function onResize() {
92     'use strict';
93
94     renderer.setSize(window.innerWidth, window.innerHeight);
95
96 ▼     if (window.innerHeight > 0 && window.innerWidth > 0) {
97         camera.aspect = renderer.getSize().width / renderer.getSize().height;
98         camera.updateProjectionMatrix();
99     }
100
101     render();
102 }
103
104 ▼ function onKeyDown(e) {
105     'use strict';
106
107 ▼     switch (e.keyCode) {
108         case 65: //A
109         case 97: //a
110             scene.traverse(function (node) {
111                 if (node instanceof THREE.Mesh) {
112                     node.material.wireframe = !node.material.wireframe;
113                 }
114             });
115             break;
116         case 83: //S
117         case 115: //s
118             ball.userData.jumping = !ball.userData.jumping;
119             break;
120     }
121
122     render();
123 }
124
125 ► function animate() { ... }
```

mesa.js

```
91 ▼ function onResize() {
92     'use strict';
93
94     renderer.setSize(window.innerWidth, window.innerHeight);
95
96 ▼     if (window.innerHeight > 0 && window.innerWidth > 0) {
97         camera.aspect = renderer.getSize().width / renderer.getSize().height;
98         camera.updateProjectionMatrix();
99     }
100 }
101
102 ▼ function onKeyDown(e) {
103     'use strict';
104
105     switch (e.keyCode) {
106         case 65: //A
107         case 97: //a
108             scene.traverse(function (node) {
109                 if (node instanceof THREE.Mesh) {
110                     node.material.wireframe = !node.material.wireframe;
111                 }
112             });
113             break;
114         case 83: //S
115         case 115: //s
116             ball.userData.jumping = !ball.userData.jumping;
117             break;
118     }
119 }
120
121 ► function animate() { [...]
```

Ao executar a App...



Nota Importante

Este exemplo tem, propositadamente, vários erros e segue opções de codificação incorrectas.

A sua utilização nos trabalhos dará origem a penalização na avaliação.

É suposto os alunos serem capazes de identificar e ultrapassar estas situações.

E agora...

