Drawing on the Web
CSCI-UA 380

WebGL
Drawing in 3D with Three.js
We experience the world in three dimensions and, increasingly, screen-based media is rendered in 3D.

3D graphics have been around since the 1960s but required advanced computers with special software.

Today, 3D processing hardware is integrated with virtually every new computer and mobile device.

Moreover, software for rendering 3D is now ubiquitous: the web browser.
3D Graphics

Coordinate System

3D graphic data is represented in a Cartesian coordinate system.

In addition to “x” and “y” values, an additional “z” value describes depth.

The primary difference between 2D Canvas (and CSS) coordinates and WebGL is that “y” starts at the bottom of the window, increasing to the top.

This distinction stems from historical convention of WebGL being y-up and HTML being y-down.
3D Graphics

Mesh

The most common way to draw 3D graphics is with a mesh.

A mesh is composed of one or more polygon shapes, constructed of vertices \((x, y, z)\), defining coordinate positions in space.

The polygons most often used in meshes are triangles and rectangles.

3D meshes are often referred to as “models”.
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Image source:
wikipedia.org/wiki/File:Dolphin_triangle_mesh.png
**3D Graphics**

**Material**

Material is generally used to describe the surface attributes of a mesh. This can be as simple as a solid color or more complex, such as a shiny, reflective surface. Surface information can also be applied using bitmap images to create textures.

*Programming 3D Applications with HTML5 and WebGL*  
Tony Parisi
3D Graphics

Light

Light defines how a surface is illuminated.
Without a light source, it is difficult to perceive 3D attributes such as depth.
3D graphics can have one or more light sources in a given scene.
3D Graphics

Camera

3D scenes require a point of view from which to experience them.

The “camera” defines where, relative to the scene, a viewer is positioned.

Additional camera properties include field of view, which defines perspective.

The final 3D image is rendered into a 2D “viewport”—the window or canvas.
3D Graphics

Shader

Your computer’s graphics hardware understands vertices and textures, but that’s about it.

Other aspects of a 3D scene—material, light, cameras—need to be interpreted.

A “shader” is the part of your program that gets the pixels for a mesh onto the screen.

Shaders are very powerful but we will rely on a JavaScript library for this part.
WebGL

WebGL is the standard 3D graphics API for the Web, initiated by Mozilla engineer, Vladimir Vukićević, in 2006.

It allows developers to utilize the power of a computer’s 3D rendering hardware from within the browser, using JavaScript.

WebGL is supported in all current, major, desktop browsers; increasingly, WebGL is also supported in mobile browsers.

WebGL is a low-level drawing API.
Three.js is a JavaScript toolkit for WebGL that provides higher-level access to the API.

It was initially released via GitHub in 2010 by Ricardo Cabello, also known as “Mr.doob” and is actively maintained with additional three.js authors.

Three.js is governed with an MIT free software license for use and reuse within diverse types of projects.

threejs.org