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Assignment 2

Graphics pipeline is a step-by-step process that converts vector graphic representations of objects into a raster image. In the beginning of computer graphics you were unable to program the pipeline, but the GPUs of today allow some control over the pipeline using what is called a shader program which is specialized set of instructions for manipulating and changing the data in a graphics pipeline.

The first step of the pipeline is setting up the data. It sets up its vertex shader and fragment shader and WebGL gives the shaders any data it needs. The second step is the execution of the vertex shader program on each vertex, usually matrix transformation matrix is used which determines the coordinates of triangles on the world. The third step is clipping which cuts off all the data that is outside of the field-of-view of the virtual camera. The fifth step is called viewport transform which maps the model data from normalized device coordinates, which is like a screen that is independent of display coordinate system, into a visible area on a screen defined in pixels. Step five is rasterizing which converts the geometric outlines of shapes and determines which pixels are inside the outlines of the shape, these pixels will also be colored in then. Step six is fragment shader which executes a fragment shader on each pixel which determines the color of the pixel. The last step is compositing, in this step the color of a pixel from the fragment shader is combined with the color of the pixel that is already assigned to the output draw buffer. This computed color will affect the final framebuffer’s pixel color at that location.

The first step is performed by the CPU from instructions specified in javascript code. The resto of the pipeline is performed by the GPU from shader program instructions. Sending data to the GPU is usually slow that is why the GPU does a lot of the steps and the so data is often sent once to the GPU and then used many times so new data does not need to be uploaded frequently from the CPU.

“Device Coordinate.” *Device Coordinate - an Overview | ScienceDirect Topics*, www.sciencedirect.com/topics/computer-science/device-coordinate.

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“1.3 - The 3D Graphics Pipeline¶.” *1.3 - The 3D Graphics Pipeline - Learn Computer Graphics Using WebGL*, runestone.academy/runestone/books/published/learnwebgl2/01\_the\_big\_picture/3\_3d\_graphics\_pipeline.html.