How Computer Renders 3d Graphics

Jan 28, 2022 Yujing Tang

The process of computer rendering 3d space is quite similar to drawing from imagination on a piece of paper. Compute needs to figure out what to draw and draw at a high frame rate in response to the user input.

An array of Vertex Coordinates that describes the geomtry of a 3D object

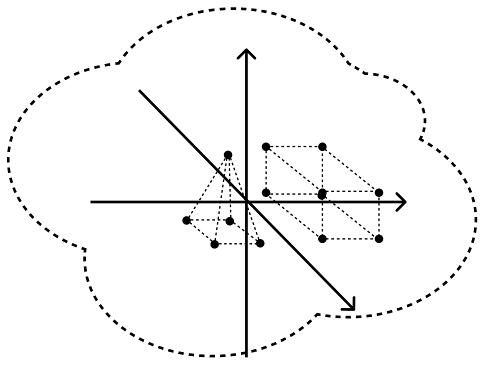
```
v 0.073049 0.860247
1.270917
v 0.073049 -1.139753
1.270917
v 0.073049 0.860247
3.270917
v 0.073049 -1.139753
3.270917
v -1.926951 0.860247
1.270917
v -1.926951 -1.139753
1.270917
v -1.926951 0.860247
3.270917
v -1.926951 -1.139753
3.270917
vt 0.625000 0.500000
vt 0.875000 0.500000
vt 0.875000 0.750000
vt 0.625000 0.750000
vt 0.375000 0.750000
vt 0.625000 1.000000
vt 0.375000 1.000000
vt 0.375000 0.000000
vt 0.625000 0.000000
vt 0.625000 0.250000
vt 0.375000 0.250000
vt 0.125000 0.500000
vt 0.375000 0.500000
vt 0.125000 0.750000
vn 0.0000 1.0000 0.0000
vn 0.0000 0.0000 1.0000
vn -1.0000 0.0000 0.0000
vn 0.0000 -1.0000 0.0000
vn 1.0000 0.0000 0.0000
vn 0.0000 0.0000 -1.0000
.....
```

Input →

Determine Shape, Position, Perspective

Model Transform

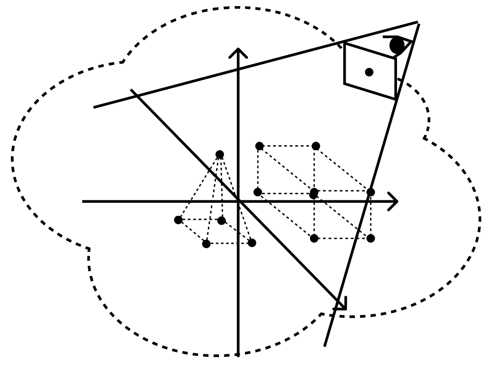
Objects are placed in an imaginary space as points called “vertices”



Vertex coordinates are transformed in relative to the world origin

View Transform

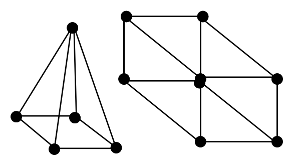
Set up a camere in this imaginary space and that’s where we are going observe the space



Vertex coordinates are transformed relative to the camera position

Primitive Assembly

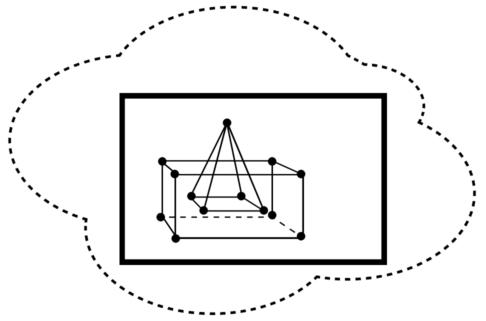
Vertices are connected to form faces that describe the geometry



Vertex coordinates Sequence is turned into face sequence

Projection transform

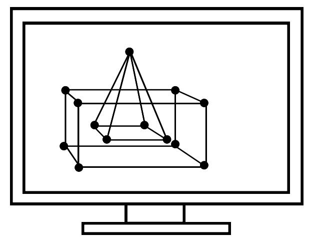
Use this camera position to view the objects



Vertex coordinates are transformed in perspective view

Viewport Transform

Map this camera onto our computer display



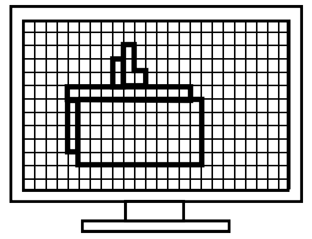
Vertex coordinates are transformed into Screen Space Pixel coordinates

→

Determine Color

Rasterize

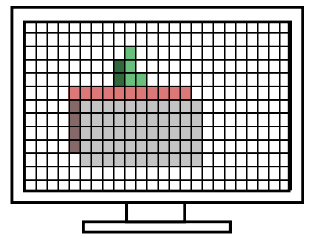
Determine what area on the screen to fill and how to fill each segment. Each segment is called “Fragment”



Pixel coordinates are grouped into fragment, ready to be colored

Fragment Processing

Each fragment is colored accordingly



RGB value is assigned to each pixel on the display

Output ↓

Screen Display

User