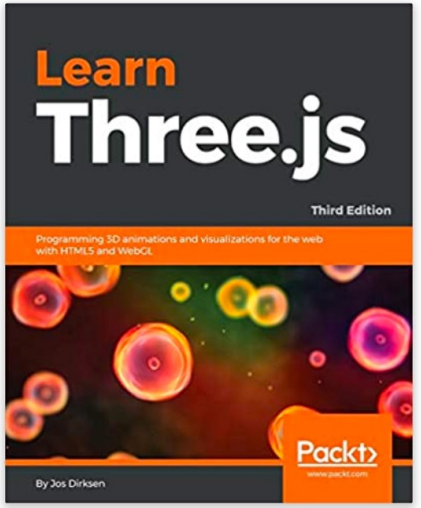
COMPUTER GRAPHICS



* Adapted from CISC 3326 lecture by Michael Mandel

PARAMETRIC LINES AND COLOR INTERPOLATION

Based on this CS 307 reading and this CS 307 lecture*

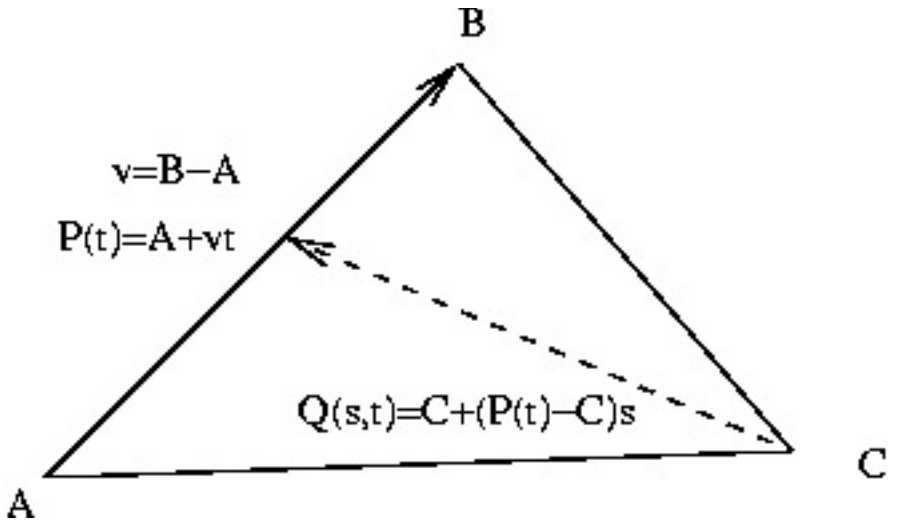
THREE.JS EXERCISES

COLOR INTERPOLATION AND GEOMETRY IN THREE.JS

Reminder: Parametric equation for a triangle

- Q(s,t) = C + (P(t) -C)s
- Q(s,t) = C + (P(t)s - Cs)
- Q(s,t) = [A(1-t) + B(t)]s + C(1-s)
- Q(s,t) = A(1-t)s + Bts + C(1-s)

- Lines to set up parametric equation of a triangle:

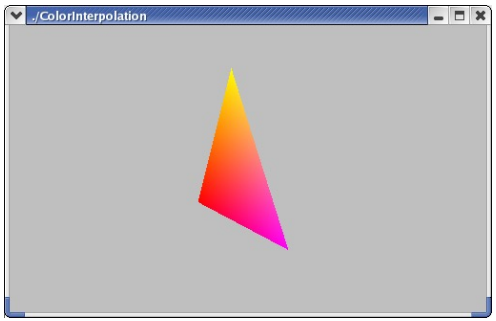


Color Interpolation in a Triangle

- If the colors of the vertices are different, OpenGL interpolates them for us
  - using the same equations that we used for calculating coordinates.

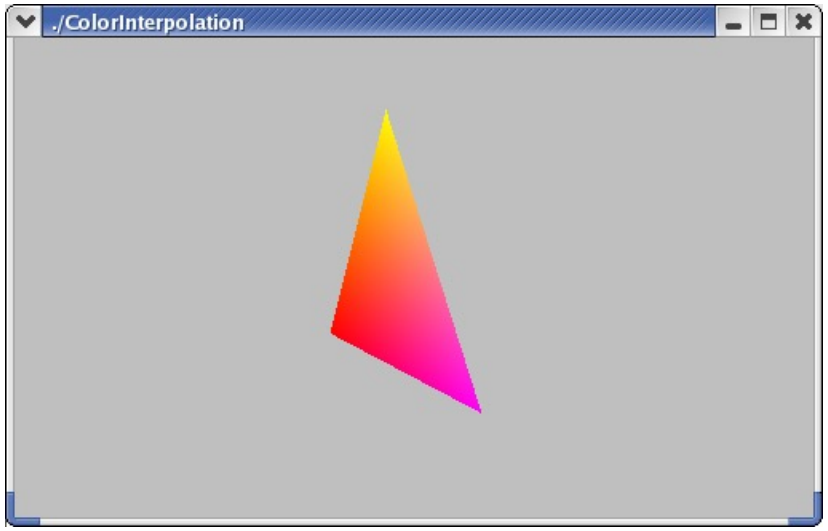
Color Interpolation in a Triangle

- Suppose A is red (1,0,0), B is magenta (1,0,1), and C is yellow (1,1,0)
- We can compute the color of the middle point, $Q(0.5,0.5)$, as:
  - Q(0.5,0.5) = A(0.25) + B(0.25) + C(0.5)
  - Q(0.5,0.5) = (1,0,0)(0.25) + (1,0,1) (0.25) + (1,1,0) (0.5)
  - Q(0.5,0.5) = (1, 0.5, 0.75)
- The triangle as a whole looks like this:



Color Interpolation in a Triangle

- The triangle as a whole looks like this:



- A triangle with smooth interpolation

Color Interpolation in Three.js

- To achieve interpolation in Three.js, you need to do the following:
  - Create a colors array, with as many entries as vertices in your mesh.
  - Set the colors array as the **vertexColors** property of the geometry
  - Using **THREE.MeshBasicMaterial**, set the **vertexColors** property to **THREE.VertexColors**

Example: Color Interpolation in Three.js

- The THREE.Geometry() object has a:
  - vertexColors property that is an array of colors
  - an array of THREE.Face3() objects
- Each THREE.Face3() object has a three-element array of colors
  - each is the color of the corresponding face vertex

Example: Color Interpolation in Three.js

- Using THREE.MeshBasicMaterial, we set the vertexColors property to THREE.VertexColors
  - The value of this property alerts Three.js that the vertices of a face could have different colors
    - The face is a triangle

Example: Color interpolation RGB triangle

- Triangle interpolation

Color interpolation RGB triangle

- Triangle interpolation on a square

Inconsistent color interpolation

- Inconsistent triangle interpolation on a square

Inconsistent color interpolation

- Notice that at the lower right we have:
  - vertex B, coordinates (1,0,0), color THREE.ColorKeywords.lime
  - vertex B2, coordinates (1,0,0), color THREE.ColorKeywords.blue

EXERCISES

Exercise 1

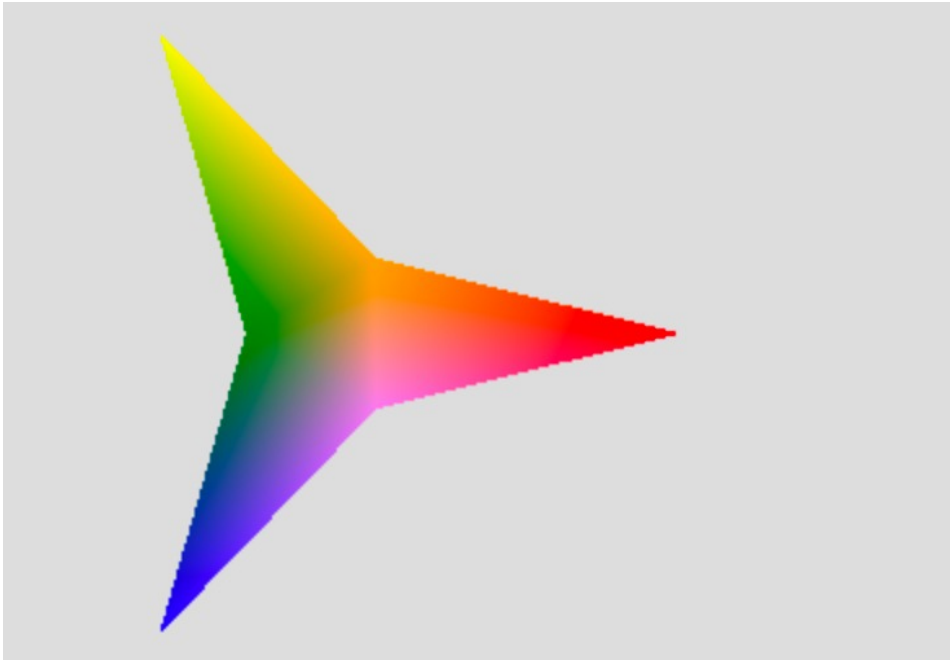
- Start from stars-start
  - pen contains a function starGeometry()
    - that creates and returns a Three.Geometry object for a three-pointed star.

starGeometry function

```
function starGeometry (size) {
  var starGeom = new THREE.Geometry();
  var angle;
  var lens = [size, size/4];
  for (var i = 0; i < 6; i++) {
     angle = i*(Math.PI/3);
     len = lens[i % 2];
     starGeom.vertices.push(new THREE.Vector3(len*Math.cos(angle),
len*Math.sin(angle)));
  }
  starGeom.faces.push(new THREE.Face3(0,1,5));
  starGeom.faces.push(new THREE.Face3(1,2,3));
  starGeom.faces.push(new THREE.Face3(3,4,5));
  starGeom.faces.push(new THREE.Face3(1,3,5));
  return starGeom;
}
```

starGeometry function

- How does the geometry work?



starGeometry function

- Triangle Vertices

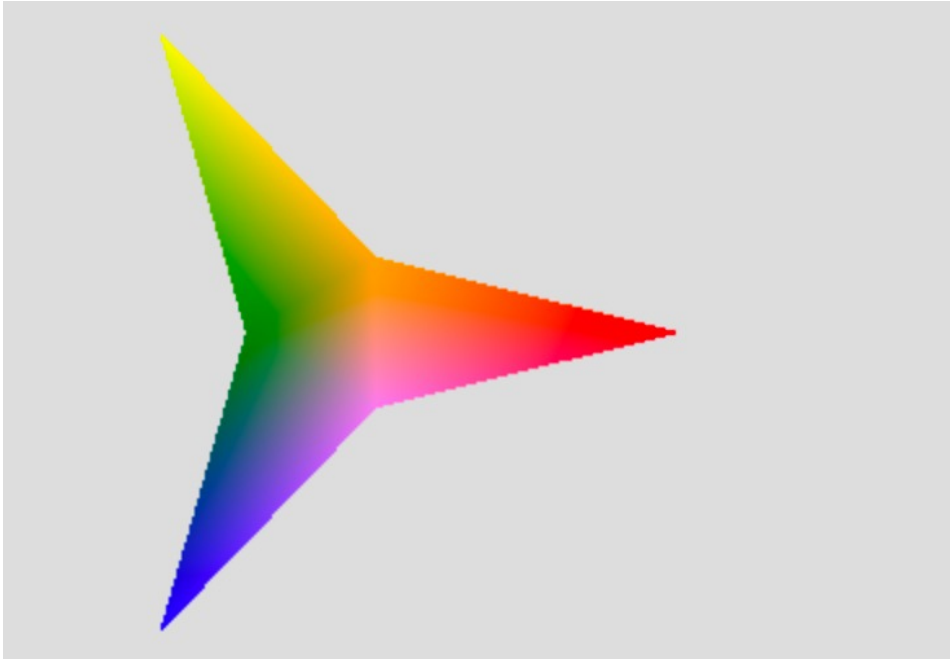
- Adding triangles

Exercise 1

- Exercise: Modify this code to create a star that uses color interpolation of the triangular faces
  - and adds it to the scene.

Exercise: Colorful Stars

- Your result might look like this:



Exercise: Colorful Stars

- Suggestions:
  - The starting code includes an array of THREE.Color objects named colors
    - You can change the colors to whatever you want!
      - Colors array is defined in the starter lab
  - Create the material for the star using THREE.MeshBasicMaterial:
    - add a second property to the input object
      - in addition to the vertexColors property
    - Property should tell Three.js to render both sides of the triangular faces:
      - side: THREE.DoubleSide

Exercise 2: Add stars to the scene

- Add six additional stars to the scene that each have a uniform color
  - placed around the central star
- Something like this:

Exercise: Add stars to the scene

- Suggestions:
  - Think about how this can be done with a loop
  - Use the same array of colors that you used for the central star
  - Recall that position.set() can be used to place a mesh at a desired location
  - Remember to adjust the bounding box supplied to TW.cameraSetup() to see the additional stars

Exercise: Add stars to the scene

- Suggestions:
  - Inside a loop, your may want to include code similar to:

```
for (i = 0; i < 6; i++) {
…
    angle = i*(Math.PI/3);
    x = 1.5*size*Math.cos(angle);
    y = 1.5*size*Math.sin(angle);
    starMesh.position.set(x,y,0);
    …
}
```

Questions?