Oregon State University

CS 450/550 -- Fall Quarter 2020
Project #6
100 Points
Due: November 24

Geometric Modeling

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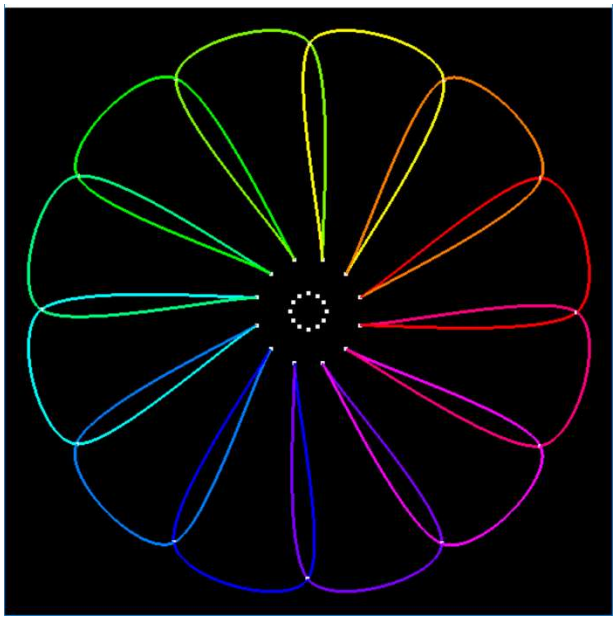

Introduction:
The goal of this project is to create an animated scene of Catmull-Rom curves.

1. It must be in 3D (i.e., Z cannot be constant).
2. You must have at least 5 curves.
3. Each curve can have any number of points defining it (>=6)
4. Pick a reasonable number of vertices for each sub-curve so that it looks smooth as t goes from 0. to 1.
5. The curves must somehow be "different" from each other. That could mean rotated, scaled, different points, etc. But, just translated is not good enough.

Requirements:

1. Create a scene of at least five 3D Catmull-Rom curves.
2. What the scene looks like is up to you. 10 of the 100 project points are given if you deliberately make it look like something at least somewhat recognizable.
3. How you color the scene is up to you. (It is helpful to us if each curve is a different color.)
4. How you animate the scene is up to you.
5. How many vertices you use to draw each sub-curve is up to you. (I.e., the Δt.) But, use enough to make the curves look smooth.
6. Animate each curve by changing the position of one (or more) points per curve based on the **Time** variable you have been using in the last couple of projects.
7. Be able to turn the drawing of the points on and off.
8. Enable the following keys:

'f'	Freeze/un-freeze the animation

Turn-in:
Use the Teach system to turn in your:

1. Your PDF report, describing what you did and where we can find your video.
2. Be sure your video makes it obvious that you are doing this in 3D!

3. .cpp file

A Possible Way to Organize the Data

```
struct Point
{
	float x0, y0, z0;	// initial coordinates
	float x,  y,  z;	// animated coordinates
};

struct Curve
{
	float r, g, b;
	Point *points;
	int count;
};

Curve Curves[NUMCURVES];		// if you are creating a pattern of curves
```

Reminder: the Catmull-Rom Sub-curve Equation is:

$$P(t) = 0.5 * \left[2 * P_1 + t * (-P_0 + P_2) + t^2(2 * P_0 - 5.* P_1 + 4P_2 - P_3) + t^3(-P_0 + 3P_1 - 3P_2 + P_3)\right]$$

$$0. \leq t \leq 1.$$

Rotating a Point an Angle about the X Axis Around a Center

```
void
RotateX( Point *p, float deg, float xc, float yc, float zc )
{
	float rad = deg * (M_PI/180.f);		// radians
	float x = p->x0 - xc;
	float y = p->y0 - yc;
	float z = p->z0 - zc;

	float xp = x;
	float yp = y*cos(rad) - z*sin(rad);
	float zp = y*sin(rad) + z*cos(rad);

	p->x = xp + xc;
	p->y = yp + yc;
	p->z = zp + zc;
}
```

Rotating a Point an Angle about the Y Axis Around a Center

```
void
RotateY( Point *p, float deg, float xc, float yc, float zc )
{
	float rad = deg * (M_PI/180.f);		// radians
	float x = p->x0 - xc;
	float y = p->y0 - yc;
	float z = p->z0 - zc;

	float xp =  x*cos(rad) + z*sin(rad);
	float yp =  y;
	float zp = -x*sin(rad) + z*cos(rad);
```

```
	p->x = xp + xc;
	p->y = yp + yc;
	p->z = zp + zc;
}
```

Rotating a Point an Angle about the Z Axis Around a Center

```
void
RotateZ( Point *p, float deg, float xc, float yc, float zc )
{
	float rad = deg * (M_PI/180.f);		// radians
	float x = p->x0 - xc;
	float y = p->y0 - yc;
	float z = p->z0 - zc;

	float xp = x*cos(rad) - y*sin(rad);
	float yp = x*sin(rad) + y*cos(rad);
	float zp = z;

	p->x = xp + xc;
	p->y = yp + yc;
	p->z = zp + zc;
}
```

How Did Jane Graphics Get That Nice Color Progression?

She used the hue-saturation-value color scale and the **HsvRgb( )** function that is included in your sample code. As long as you are using angles to locate points, you can use that same angle to assign a hue and then turn it into an RGB. See the HSV slide of the *Getting Started* notes.

Grading:

Item	Points
Draw at least 5 3D curves	40
Animate those 3D curves	30
Turn the curves on and off	10
Turn the points on and off	10
Make the scene look somewhat recognizable	10
Potential Total	100

Be sure it is obvious from your video that the curves pass through their points (except the first and the last)!