1) You wish to approximate a curve. You are given four control points. You wish to roughly plot the Bezier spline generated with the following control points: control point 1 (0, 0, 0), control point 2 (5, 5, 0), control point 3 (10, 0, 0), control point 4 (20, 5, 0);

You need at least 10 points plotted to get a good idea of the shape of the spline generated with these control points. You decide to plot the parametric values

\[ u = 0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0 \] (every 10th)

Show all work (I expect that you will want to use a calculator, give me 2 significant figures: i.e. round to the nearest 100th.)

You may decide that it is easier to write a quick program to generate the coordinates. This is acceptable if you give me a printout of the \( (1-u)^3 \), \( 3u(1-u)^2 \), \( 3u^2 (1-u) \) and \( u^3 \) values along with the \( x, y, z \) coordinates each value of \( u \) generates.

5 points) Think about the convex-hull property of Bezier splines. All of the possible control points have a value of \( z = 0 \). Is it possible that \( z \) could be anything other than 0? If so, what could the value of \( z \) become?

30 points) Figure out the coordinates that should be graphed.

15 points) Correctly graph the spline (please connect the dots)

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Apply \( P(u) = (1-t)^3 P_1 + 3t(1-t)^2 P_2 + 3t^2(1-t) P_3 + t^3 P_4 \)

<table>
<thead>
<tr>
<th>( u )</th>
<th>( P(u) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(0, 0, 0)</td>
</tr>
<tr>
<td>0.1</td>
<td>(0.000, 1.000, 0.000)</td>
</tr>
<tr>
<td>0.2</td>
<td>(0.015, 1.221, 0.000)</td>
</tr>
<tr>
<td>0.3</td>
<td>(0.040, 1.924, 0.000)</td>
</tr>
<tr>
<td>0.4</td>
<td>(0.064, 2.344, 0.000)</td>
</tr>
<tr>
<td>0.5</td>
<td>(0.122, 2.478, 0.000)</td>
</tr>
<tr>
<td>0.6</td>
<td>(0.156, 2.500, 0.000)</td>
</tr>
<tr>
<td>0.7</td>
<td>(0.182, 2.500, 0.000)</td>
</tr>
<tr>
<td>0.8</td>
<td>(0.174, 3.040, 0.000)</td>
</tr>
<tr>
<td>0.9</td>
<td>(0.157, 3.760, 0.000)</td>
</tr>
<tr>
<td>1</td>
<td>(0, 0, 0)</td>
</tr>
</tbody>
</table>
2. We are given the same four control points. Except this time, we wish to interpolate a curve. We will use the Cardinal spline method to generate a curve.

Again: You decide to plot the parametric values
u=0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, and 1.0 (every 10th)

But you decide to visualize the difference between tension=0, and tension=1. Again, use a calculator. Report results to two significant figures. (Or you may wish to write a quick program to generate Cardinal Splines)

Show all work: After lightly tracing the spline in pencil, trace the spline in different color pens to indicate tension 0, and tension 1.

(15 points) Generate the curve using tension= 0.

(5 points) Plot the resulting coordinates.

(15 points) Generate the curve using tension= -1.

(5 points) Plot the resulting coordinates

(5 points) Plot the control points. Are all of them on the spline? Why?

(5 points) Do the two tension settings differ? If so WHY?

\[ P(u) = CAR_0, P_1 + CAR_1, P_2 + CAR_2, P_3 + CAR_3, P_4 \]

\[ CAR_0 = -Su^3 + 2Su^2 - Su \]

\[ CAR_1 = (2S - 5)u^3 + (S - 3)u^2 + 1 \]

\[ CAR_2 = (S - 2)u^3 + (3 - 2S)u^2 + Su \]

\[ CAR_3 = Su - Su^2 \]
2. We are given the same four control points. Except this time, we wish to interpolate a curve. We will use the Cardinal spline method to generate a curve.

Again: You decide to plot the parametric values
\[ u=0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, \text{ and } 1.0 \] (every 10\textsuperscript{th})

But you decide to visualize the difference between tension=0, and tension=1. Again, use a calculator. Report results to two significant figures. (Or you may wish to write a quick program to generate Cardinal Splines)

Show all work: After lightly tracing the spline in pencil, trace the spline in different color pens to indicate tension 0, and tension 1.

(15 points) Generate the curve using tension=0.
(5 points) Plot the resulting coordinates.
(15 points) Generate the curve using tension=-1.
(5 points) Plot the resulting coordinates
(5 points) Plot the control points. Are all of them on the spline? Why?
(5 points) Do the two tension settings differ? If so WHY?