

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

$u=0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9,$  and  $1.0$  (every  $10^{\text{th}}$ )

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

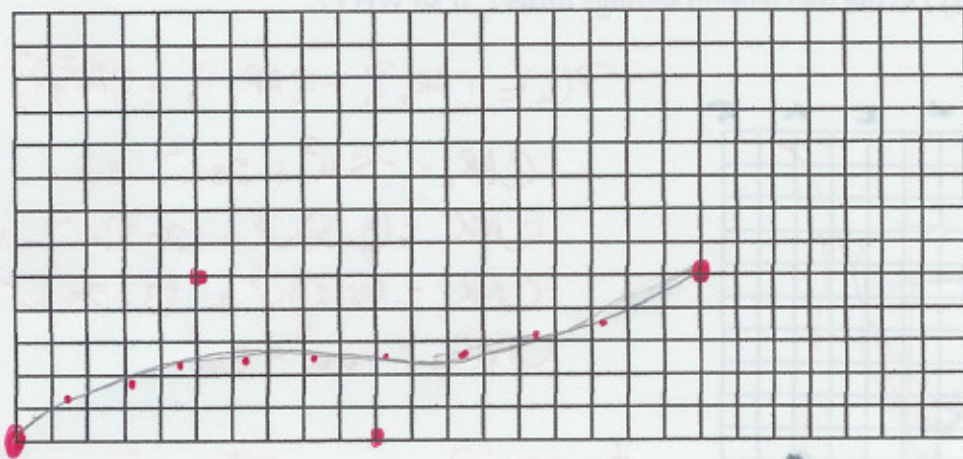
You may decide that it is easier to write a quick program to generate the coordinates.

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? No

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

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



$P(u)$

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

$u$	$P(u)$
0	0, 0, 0
.1	1.5, 1.22, 0
.2	3.04, 1.96, 0
.3	4.64, 2.34, 0
.4	6.32, 2.48, 0
.5	8.12, 2.5, 0
.6	10.08, 2.52, 0
.7	12.22, 2.66, 0
.8	14.56, 3.04, 0
.9	17.14, 3.78, 0
1	20.5, 0

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  $10^{\text{th}}$ )

But you decide to visualize the difference between  $\text{tension}=0$ , and  $\text{tension}=1$ . 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  $\text{tension}=0$ , and  $\text{tension}=1$ .

(15 points) Generate the curve using  $\text{tension}=0$ .  $S=1/2$

(5 points) Plot the resulting coordinates.

(15 points) Generate the curve using  $\text{tension}=-1$ .  $S=1$

(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?

$$S = \frac{1 - \text{tension}}{2}$$

$$P(u) = \text{CAR}_0 P_1 + \text{CAR}_1 P_2 + \text{CAR}_2 P_3 + \text{CAR}_3 P_4$$

$$\text{CAR}_0 = -Su^3 + 2Su^2 - Su$$

$$\text{CAR}_1 = (2-5)u^3 + (5-3)u^2 + 1$$

$$\text{CAR}_2 = (5-2)u^3 + (3-25)u^2 + Su$$

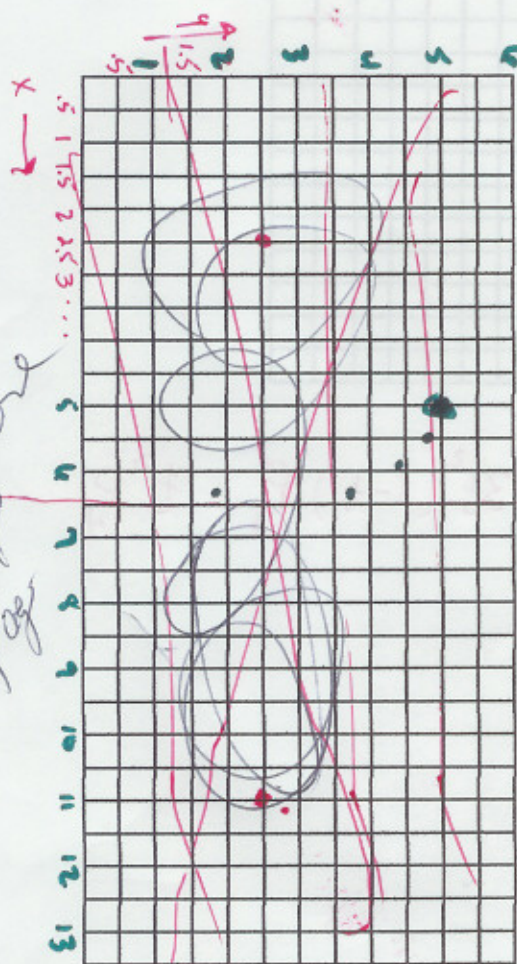
$$\text{CAR}_3 = Su^3 - Su^2$$

tension = 0

$u$	$P(u)$
0	5, 5, 0
.1	5.48, 4.86, 0
.2	5.92, 4.48, 0
.3	6.34, 3.92, 0
.4	6.76, 3.24, 0
.5	7.19, 2.50, 0
.6	7.64, 1.76, 0
.7	8.13, 1.08, 0
.8	8.68, 0.52, 0
.9	9.30, 0.14, 0
1	10, 0, 0

tension = -1

$u$	$P(u)$
0	5, 5, 0
.1	5.82, 4.86, 0
.2	6.32, 4.48, 0
.3	6.61, 3.92, 0
.4	6.76, 3.24, 0
.5	6.88, 2.50, 0
.6	7.04, 1.76, 0
.7	7.34, 1.08, 0
.8	7.88, 0.52, 0
.9	8.74, 0.14, 0
1	10, 0, 0



Key

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  $10^{\text{th}}$ )

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.

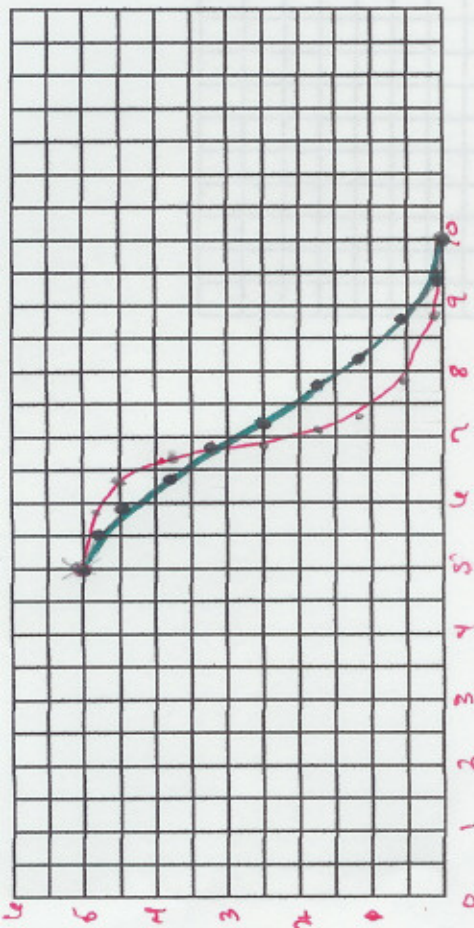
(5 points) Plot the resulting coordinates.

(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?



• = tension 0  
- = tension -1

X