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Solution: Computer Graphics and Virtual reality.

Q4 a Bezier Curve

$P0 = \{x_0, y_0\} = \{2, 2\}$ $P1 = \{x_1, y_1\} = \{0, 1\}$ $P2 = \{x_2, y_2\} = \{3, -1\}$ $P3 = \{x_3, y_3\} = \{4, 1\}$

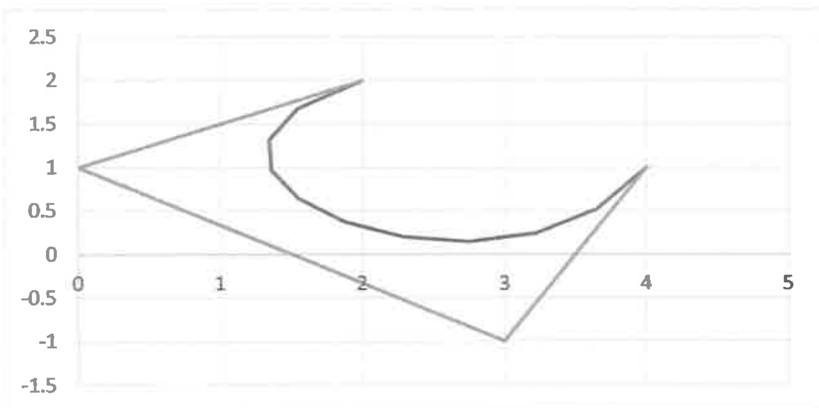
The formula can be expressed explicitly as follows:

$$P(u) = \sum_{k=0}^{n} \binom{n}{k} (1-u)^{n-k} u^k P_k \quad u \in R$$

$P_B = (1-u)^3 P_1 + 3u(1-u)^2 P_2 + 3u^2(1-u) P_3 + u^3 P_4$

with 0<= u <=1

u	X	Y
0	2	2
0.1	1.543	1.675
0.2	1.344	1.32
0.3	1.361	0.965
0.4	1.552	0.64
0.5	1.875	0.375
0.6	2.288	0.2
0.7	2.749	0.145
0.8	3.216	0.24
0.9	3.647	0.515
1	4	1



Q5 b Bresenham's Line Drawing Algorithm

P0 = (-10,15) p1=(-20,25)

Dx = |-20-(-10)| = 10

Dy = | 25-15| = 10

Sx=-1

Sy =1

P0 = 2Dy-Dx

= 10

If (P < 0)

P= P+ 2Dy Plot (x+Sx,y)

Else

P=P+2Dy-2Dx Plot (x+Sx,y+Sy)

k	Pk	X	Y
0	10	-10	15
1	10	-11	16
2	10	-12	17
3	10	-13	18
4	10	-14	19
5	10	-15	20
6	10	-16	21
7	10	-17	22
8	10	-18	23
9	10	-19	24
10	10	-20	25

Q5 a) A(1,2) B(3,4) C(5,2)

$$\therefore P = \begin{bmatrix} 1 & 3 & 5 \\ 2 & 4 & 2 \\ 1 & 1 & 1 \end{bmatrix}$$

i) Translate $T_x = 3$ $T_y = -2$

$$\begin{bmatrix} 1 & 0 & T_x \\ 0 & 1 & T_y \\ 0 & 0 & 1 \end{bmatrix}$$

$$\therefore P' = \begin{bmatrix} 1 & 0 & 3 \\ 0 & 1 & -2 \\ 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 3 & 5 \\ 2 & 4 & 2 \\ 1 & 1 & 1 \end{bmatrix} = \begin{bmatrix} 4 & 6 & 8 \\ 0 & 2 & 0 \\ 1 & 1 & 1 \end{bmatrix}$$

$\therefore$ A' = (4,0) B' = (6,2) C' = (8,0)

ii) Rotate $\theta = 30$

$$\begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$P' = \begin{bmatrix} 0.866 & -0.5 & 0 \\ 0.5 & 0.866 & 0 \\ 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 3 & 5 \\ 2 & 4 & 2 \\ 1 & 1 & 1 \end{bmatrix} \simeq \begin{bmatrix} 0 & 1 & 3 \\ 2 & 5 & 4 \\ 1 & 1 & 1 \end{bmatrix}$$

$\therefore$ A' = (0,2) B' = (1,5) C' = (3,4)

iii. Reflect abt Y

$$\begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$P' = \begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 3 & 5 \\ 2 & 4 & 2 \\ 1 & 1 & 1 \end{bmatrix} = \begin{bmatrix} -1 & -3 & -5 \\ 2 & 4 & 2 \\ 1 & 1 & 1 \end{bmatrix}$$

A' = (-1,2) B' = (-3,4) C' = (-5,2)

iv) Scaling $S_x = S_y = 2$

$$\begin{bmatrix} S_x & 0 & 0 \\ 0 & S_y & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$P' = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 3 & 5 \\ 2 & 4 & 2 \\ 1 & 1 & 1 \end{bmatrix} = \begin{bmatrix} 2 & 6 & 10 \\ 4 & 8 & 4 \\ 1 & 1 & 1 \end{bmatrix}$$

$\cdot$ A' = (2,4) B' = (6,8) C' = (10,4)

v). Reflect abt X = Y

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$P' = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 3 & 5 \\ 2 & 4 & 2 \\ 1 & 1 & 1 \end{bmatrix} = \begin{bmatrix} 2 & 4 & 2 \\ 1 & 3 & 5 \\ 1 & 1 & 1 \end{bmatrix}$$

A' = (2,1) B' = (4,3) C' = (2,5)