FIRST TERM EXAMINATION, 2015

Q.1.a. what is meant by scan conversion? What are the four side effects of scan conversion with raster scan devices?

A. Scan conversion or scan rate converting is a video processing technique for changing the vertical/horizontal scan frequency of video signal for different purposes and applications.

Problems: Approximation of lines by a finite no. of pixels

a. Costly rounding of operations

b. Unnecessary floating point arithmetic

c. Error accumulation

Q.1.b. To draw a circle, it is sufficient to know the co-ordinates of an octant. Is this statement true, justify?

A. Yes, to draw a circle it is sufficient to know the co-ordinates of an octant symmetry as joining all the points of octant symmetry forms various arcs and on joining them a circle can be formed.

Q.1.c. What are the various types of parametric continuity conditions and why they are applied in curve drawing?

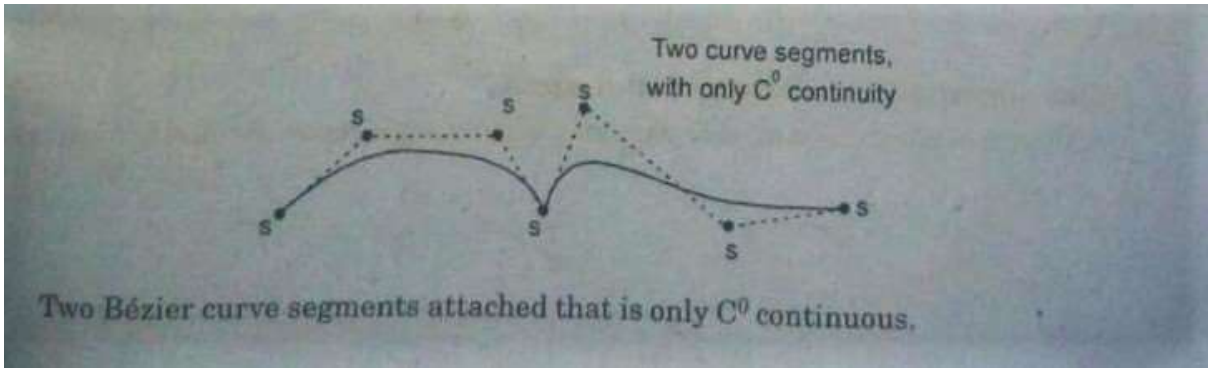
A. Parametric continuity is a concept applied to parametric curves describing the smoothness of the parameter's value with distance along the curve.

Definition: A curve can be said to have C^n continuity if $d^n s/dt^n$ is continuous of value throughout the curve.

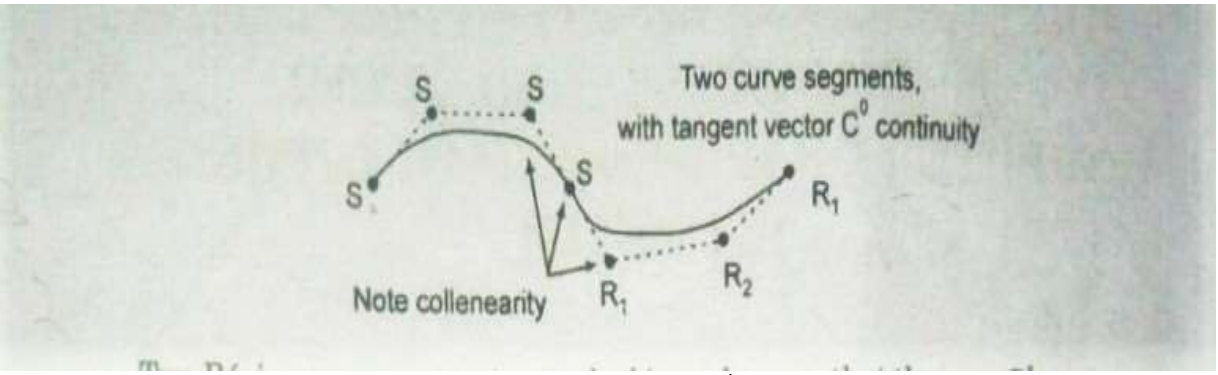
As an example of a practical application of this concept, a curve describing the motion of an object with a parameter of time, must have C^1 continuity for the object to have finite acceleration. For smoother motion, such as that of a camera's path while making a film, higher levels of parametric continuity are required.

Order of continuity:

Two curve segments, with only C^0 continuity.



Two Bezier curves attached that is only C^o continuous.



Two Bezier curve segments attached in a way that they are C^1 continuous. The various order of parametric continuity can be described as follows:

- C^1 : curves include discontinuities.
- C^0 : curves are joined
- C^1 : first derivatives are continuous
- C^2 : first and second derivatives are continuous
- C^n : first through nth derivatives are continuous

The term parametric continuity was introduced to distinguish it from geometric continuity (C^n) which removes restrictions on the speed with which the parameter traces the curve.

Q.1.d.Derive the rotation matrix for rotating an object through an angle of 45° degree about a line with end points A (0, 0, 0) and B (3, 4, 5).

A. Rotation about an arbitrary axis in space

Substituting for the respective angles we obtain the following matrices:

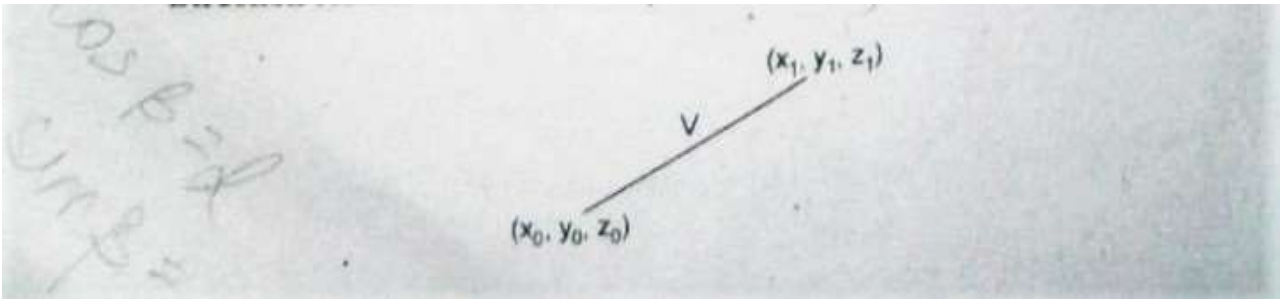
$[T] = [Tr][R_\alpha][R_\beta][R][R_\beta]^{-1}[R_\alpha]^{-1}[Tr]^{-1}$

$$[R_\alpha] = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\alpha & \sin\alpha & 0 \\ 0 & -\sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \frac{cx}{d} & \frac{cy}{d} & 0 \\ 0 & \frac{-cy}{d} & \frac{cx}{d} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$[R_\beta] = \begin{bmatrix} \cos(-\beta) & 0 & -\sin(-\beta) & 0 \\ 0 & 1 & 0 & 0 \\ \sin(-\beta) & 0 & \cos(-\beta) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} d & 0 & cx & 0 \\ 0 & 1 & 0 & 0 \\ -cx & 0 & d & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$[R] = \begin{bmatrix} cos\delta & sin\delta & 0 & 0 \\ -sin\delta & cos\delta & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Direction cosines of an arbitrary axis when two points on the line are known:



Here alpha is 45 degree and x0, y0, z0 and x1, y1, z1 are A (0, 0, 0) and B (3, 4, 5)

$$[V] = [(x_1 - x_0)(y_1 - y_0)(z_1 - z_0)]$$

$$[C_x\, C_y\, C_z] = \left[\frac{(x1 - x0)(y1 - y0)(z1 - z0)}{\sqrt{(x1 - x0) + (y1 - y0) + (z1 - z0)}}\right]$$

Q.2.a. Scan convert a line using Bresenham's line drawing algorithm from A (1, 1) to B (8, 5).

A.

$\Delta x = 8\text{-}1 = 7$

$\Delta y = 5\text{-}1 = 4$

$2\Delta x = 14$

$2\Delta y = 18$

$Po = 2\Delta y\text{-}\Delta x = 8\text{-}7 = 1$

$Pk > 0$ so next point is (2, 2)

$Pk+1 = Pk + 2\Delta y - 2\Delta x$

$P1 = -5 + 8 = 4$

And next point is (4, 3)

$P3 = 4 + 8 – 14 = -2$

Next point is (5, 3)

$P4 = -2 + 8 = 6$

Next point is (6, 4)

$P5 = 6 + 8 – 14 = 0$

Next point is (7, 5)

$P6 = 0 + 8 – 14 = -6$

Next point is (8, 5) stop.

Points are (1, 1), (2, 2), (3, 2), (4, 3), (5, 3), (6, 4), (7, 5) and (8, 5).

Q.2.b.Clip a line using Cohen-Sutherland algorithm where the window co-ordinates are (-3,1) and (2,6) and the line co –ordinates are A(1,5) and B(3,8) respectively.

A. Line segment AB points lies in (0000) AND (1010) = 0000

The outcode of B is 1010 i.e. it is outside the window. We push the first 1 to 0 by clipping the line against the line Ymax = 6.

Here $m = y2-y1/x2-x1 = 8 – 5/3 +1 = ¾$

And $y = 6$

$¾ = 6 – 5/x + 1 = 1/3$

So, the resulting interaction point is (1/3, 6) and it's outcode is 0000.

Q.3.a.Reflect the polygon whose vertices are A (-1, 0), B (0, -2), C (1, 0) and D (0, 2) about a horizontal line y = 2.

A. We can represent the given polygon by the homogenous coordinate matrix as:

$$V = [ABCD] = \begin{bmatrix} -1 & 0 & 1 \\ 0 & -2 & 1 \\ 1 & 0 & 1 \\ 0 & 2 & 1 \end{bmatrix}$$

a) The horizontal line y =2 has an intercept (0, 2) on y- axis and makes an angle of 0^0 degree with the axis. So m = 0 and c = 2. Thus, the reflection matrix.

$$ML = T – v. R – \theta. Mx. R\theta. T – v,$$

$$V=0I+2J$$

$$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 4 & 1 \end{bmatrix}$$

So the new coordinates A'B'C'D' of the reflected polygon ABCD can be found as:

$$[A'B'C'D'] = [ABCD]. ML$$

$$= \begin{bmatrix} -1 & 0 & 1 \\ 0 & -2 & 1 \\ 1 & 0 & 1 \\ 0 & 2 & 1 \end{bmatrix} . \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 4 & 1 \end{bmatrix} = \begin{bmatrix} -1 & 4 & 1 \\ 0 & 6 & 1 \\ 1 & 4 & 1 \\ 0 & 2 & 1 \end{bmatrix}$$

Thus, A' = (-1, 4), B' = (0, 6), C' = (1, 4) and D' = (0, 2)

b) the vertical line x = 2has no intercept on ty-axis and makes an angle of 90˚ with the x axis.

So,

$$M = \tan (90^\circ)$$

$= \infty$ and c = 0.

Thus, the reflection matrix ML = T-v.R- θ.My.R θ.T-v, where v = 2I

$$\begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 4 & 0 & 1 \end{bmatrix}$$

So the new coordinates A' B' C' D' of the reflected polygon ABCD can be found as:

$$[A'B'C'D'] = [ABCD].ML$$

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

Thus, A' = (5, 0), B' = (4, -2), C' = (3, 0) and D' = (4, 2)

Q.3.b.What are various types of multimedia authoring tools?

A. The integration of audio, video graphics and text on the desktop promises to fundamentally challenge the centuries – old model of the printed document as the basis for information exchange. Before this potential can be realised, however, systems must be devised that enables the production and presentation of complex, inter related media objects. These systems generically called multimedia authoring tools.

In this we consider the developing of multimedia authoring tools, examine the current state of the art , and then discuss a set of research challenges that need to be addressed before the full potential of multimedia output technology can be effectively utilised to share information.

TYPES OF AUTHORING TOOLS:

1. Card- or page- based tool
    - The elements are organised as pages of a book or a stack of cards
    - Card- or page- based authoring systems
    - Best used when the bulk of your contents consists of elements that can be viewed individually
    - The pages of a book or a card in a card file
    - Link these pages or cards into organised sequences.
    - Jump on command, to any page
    - Play sound elements and launch animations and digital videos.
2. Icon- based , event- driven tools
    - Multimedia elements and interaction cues (events) are organised objects in a structural framework k or process.
    - Simplify the organisation of your project
    - Display flow diagrams of activities along branching paths
3. Time- based tools
    - Elements and events are organised along a timeline with resolutions as high as or higher than $\frac{1}{30}$ seconds
    - Time- based tools
    - Best to use when you have a message with a beginning and an end

- Played back at a speed that you can set
- Other elements (such as audio events) are triggered at a given time or location in the sequence of events
- Jumps to any location in a sequence