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Q.1 Describe the process and significance of the viewing Transformation Pipeline in 2D graphics

Ans The viewing transformation pipeline in 2D graphics in a series of steps involved in transformation 2D objects from their local coordinate system to the screen's coordinate system, making them visible on display

1. Model-to-world transformation.
   - Each object is defined in its local coordinate system, which is specific to the object.
   - This stage involves transforming the objects coordinates from its local system to the world coordinate system

2. World-to-Camera.
   - The world coordinate system is often centered at a specific point, which might not be the most convinient viewpoint.

3. Viewport Transformation:
   - The camera's coordinate system is typically in 3D, while the screen is 2D.
   - This stage projects the 3D coordinates from the camera's coordinate system onto the 2D plane

4. Clipping:
   - After ~~some~~ projection, some objects or parts of objects might be outside the viewport.

5. Normalisation:
   - The final coordinates after clipping might still be in a range that is not suitable for display device.

→ Correct Positiong
→ Visible Represent
→ Perspective Effects.
→ Efficient Rendering

Q2 Differentiate between Bezier curves and B-spline curves in terms of control and flexibility

Ans Bezier and B-spline curves are both parametric curves used in computer graphics and CAD for creating smooth of the continuous shapes.

Parameter	Beizer Curves	Bspline curves.
Control	• Beizer curves are defined by a set of control points. Each control point directly influences the shape of curve. Moving a control point will directly a ulter the curve's path.	• B-Spline curves are also defined by a set of control points, but the influence of each control point is not as direct as in Beizer curves. The shape of the curve is determined by a basic function that weights the contribution of each
Flexibility	Offer limited flexibility. The shape of curve is constrained by the control points. Adding or removing control points can be challenging, and the curve's shape can be difficult to manipulate.	B-spline curves offer greater flexibility than Beizer curves they can represent a wider range of shapes, including conics and free form curves. Adding or removing control points is easier and curve's shape can be manipulated more intuitively.

Q.3 Explain the Back-Face Detection method in visible surface determination.

Ans. Back-face detection is a simple and efficient method to determine which surfaces of a 3D object are visible to a viewer. Its based on principle that surfaces facing away from the viewer

How it works:

1. Calculate normal vectors: For each polygon, find its normal vector (a perpendicular unit vector).

2. Calculate view vectors: Determine the vector pointing from the viewer's eye to the polygon's center.

3. Calculate dot products: If the dot product of the normal and view vectors is positive, the polygon is facing the viewer and is potentially visible.

Limitations:

Back-face detection doesn't handle objects that overlap or penetrate each other.

Transparency, it doesn't handle transparent objects

Efficiency:

Back-face detection is a relatively fast algorithm, often used as a first pass to eliminate many invisible polygons before applying more complex methods.

Q.4 What is keyframing in animation, and how does interpolation help in creating smooth animations?

Ans Keyframing is a technique used in animation where specific points or posses along an ~~tto~~ animation timeline are defined as keyframes.

Interpolation is the process of calculating intermediate values between two known values. In animation it involves determining positions and orientations of an object at frames between keyframes

Interpolation is essential for creating smooth animations because.

1. It fills in the gaps: It creates frames between keyframes, making animation smooth
2. It avoids abrupt transitions: Prevents sudden jumps
3. It enhances realism: Creates more natural looking motion that is closer to how objects move in real world.