Two dimensional viewing pipeline

The two-dimensional (2D) viewing pipeline refers to the process of transforming two-dimensional geometric objects into a representation suitable for display on a computer screen or other output device. Here's an overview of the steps involved in the 2D viewing pipeline:

1. **Object Definitions**: Geometric objects are defined in a coordinate system. These objects can include points, lines, curves, and polygons.
2. **Modeling Transformation**: Any necessary transformations are applied to the objects in their local coordinate systems. These transformations include translation, rotation, scaling, and shearing. The result is the transformation of objects from their model space to a world space.
3. **Viewing Transformation**: The world space coordinates are transformed into a view space or camera space. This transformation simulates the position and orientation of a camera or viewer relative to the scene. It involves operations such as translation, rotation, and scaling.
4. **Clipping**: Objects or portions of objects that lie outside the view frustum (the volume representing the visible region of space) are clipped, removing them from further processing.
5. **Projection**: The view space coordinates are projected onto a two-dimensional plane known as the view plane or projection plane. This step determines how objects appear in the final image. Common projection techniques include orthographic projection and perspective projection.
6. **Window-to-Viewport Transformation**: The projected coordinates are mapped to device coordinates, which correspond to the actual pixels on the display screen. This transformation involves mapping the coordinates from a logical window (defined in normalized device coordinates) to the physical viewport (pixel coordinates).
7. **Scan Conversion**: The geometric primitives (points, lines, polygons) are converted into discrete pixels on the display screen. This process is known as scan conversion or rasterization. Algorithms such as Bresenham's line algorithm and polygon scan conversion algorithms are used for this purpose.
8. **Visibility Determination**: Objects or parts of objects may be occluded by others in the scene. Visibility determination algorithms are used to determine which objects or pixels are visible and should be displayed.
9. **Rendering**: Finally, the visible objects are rendered onto the display screen using appropriate rendering techniques. This may involve techniques such as flat shading, Gouraud shading, or Phong shading, depending on the desired visual effect.

By following these steps, the 2D viewing pipeline transforms geometric objects from their original coordinates to a final image suitable for display on a two-dimensional output device, such as a computer monitor or printer.