SCHOOL OF COMPUTING SCIENCE AND ENGINEERING

Program: B.Tech

Course Code: BTCS2401

Course Name: Computer Graphics

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Content:-

Introduction:-

Basic function:-

Properties:-

Advantages:-

Disadvantages:-

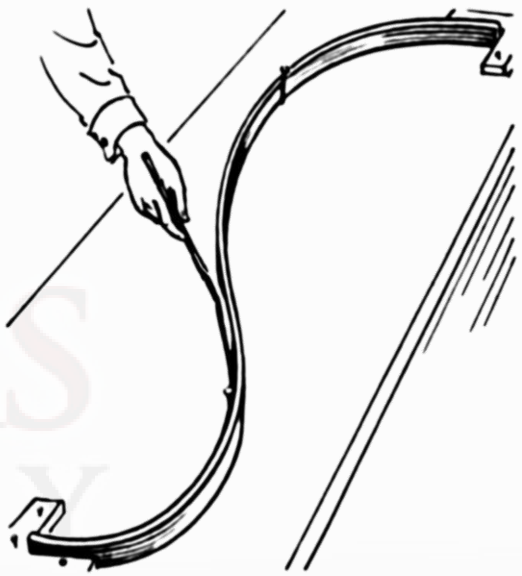
Example:-

Spline

- A long flexible strips of metal used by draftspersons to lay out the surfaces of airplanes, cars and ships.

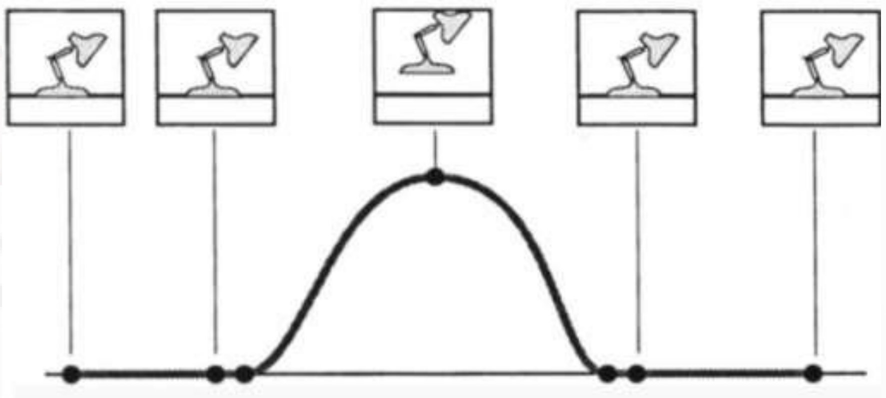
- Ducks weights attached to the splines were used to pull the spline in different directions.

- The metal splines had second order continuity.



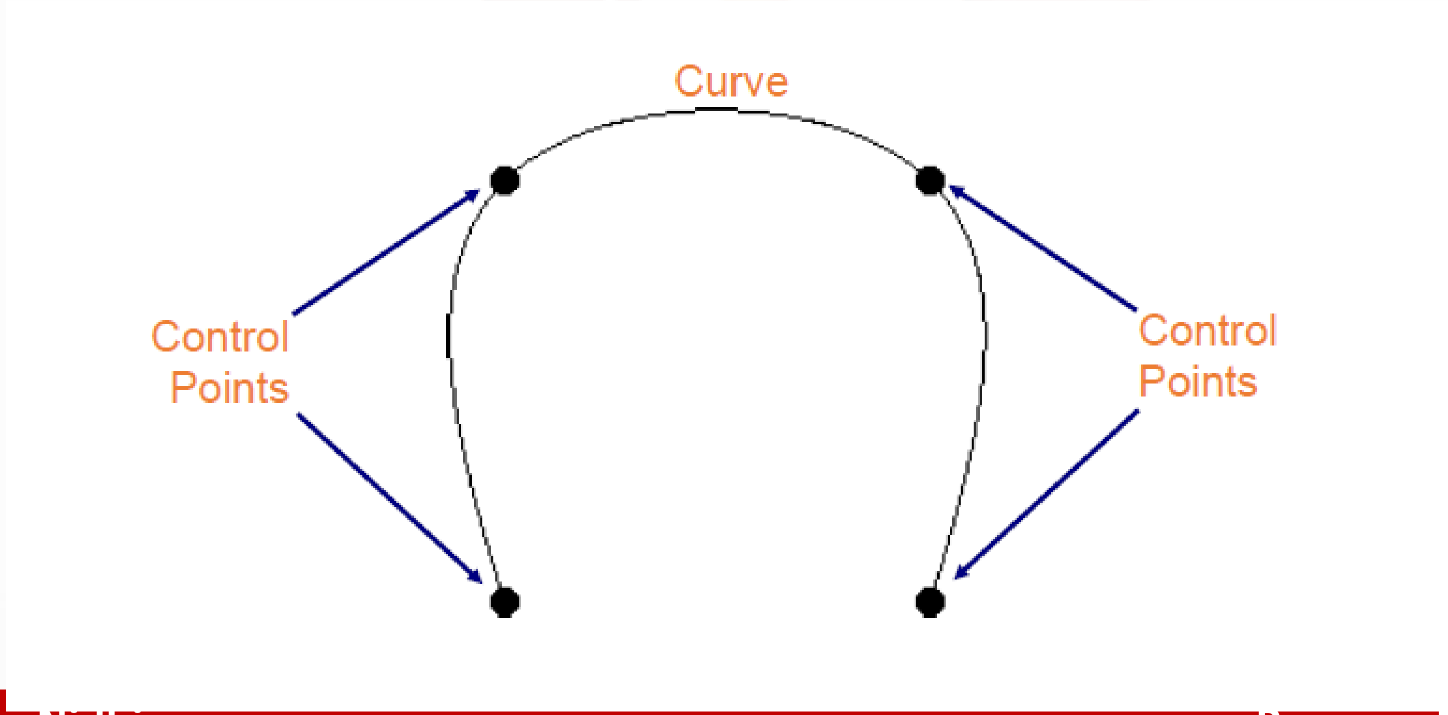
Spline Representations

- A spline is a smooth curve defined mathematically using a set of constraints
- Splines have many uses:
- 2D illustration
- Fonts
- 3D Modelling
- Animation

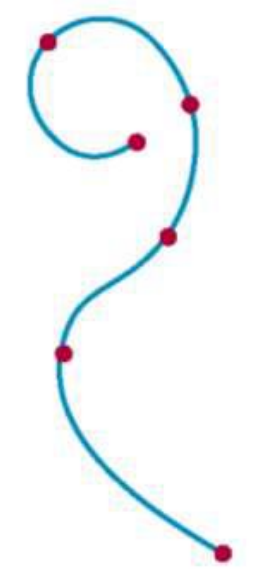


Big Idea

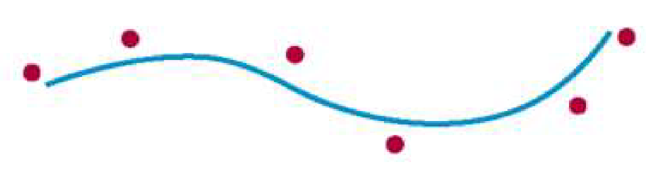
- User specifies control points
- Defines a smooth curve



Interpolation Vs Approximation



- A spline curve is specified using a set of **control points**
- There are two ways to fit a curve to these points:
- **Interpolation -** the curve passes through all of the control points
- **Approximation -** the curve does not pass through all of the control points
- Approximation for structure or shape
- Interpolation for animation



Spline Representation

- There are three equivalent methods for specifying a particular spline representation:
- We can state the set of boundary conditions that are imposed on the spline;
- We can state the matrix that characterizes the spline;
- We can state the set of blending functions

Boundary conditions

- Boundary conditions for this curve might be set,
- for example, on the endpoint coordinates $x(0)$ and x(l) and on the parametric first derivatives at the endpoints $x'(0)$ and x ' (1) .

- **Boundary conditions are sufficient to determine the values of the four coefficients ax, *bx,* cx, and *dx.***

Matrix Form

- we can obtain the matrix that characterizes this spline curve by first rewriting Eq as the matrix product

Variant 2:

$$\mathbf{P}(u) = \begin{pmatrix} u^3 & u^2 & u & 1 \end{pmatrix} \begin{pmatrix} M_{00} & M_{01} & M_{02} & M_{03} \\ M_{10} & M_{11} & M_{12} & M_{13} \\ M_{20} & M_{21} & M_{22} & M_{23} \\ M_{30} & M_{31} & M_{32} & M_{33} \end{pmatrix} \boxed{\begin{pmatrix} P_{0x} & P_{0y} & P_{0z} \\ P_{1x} & P_{1y} & P_{1z} \\ P_{2x} & P_{2y} & P_{2z} \\ P_{3x} & P_{3y} & P_{3z} \end{pmatrix}}$$

$$= \mathbf{U}\mathbf{M}_{\text{spline}} \begin{pmatrix} \mathbf{P}_0 \\ \mathbf{P}_1 \\ \mathbf{P}_2 \\ \mathbf{P}_3 \end{pmatrix} = \mathbf{U}\mathbf{M}_{\text{spline}}\mathbf{M}_{\text{geom}}$$

Control points or Control vectors

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Matrix $\mathbf{M}_{\text{spline}}$: 'translates' geometric info to coefficients

Blending functions

Variant 3:

$$\mathbf{P}(u) = B_0(u)\mathbf{P}_0 + B_1(u)\mathbf{P}_1 + B_2(u)\mathbf{P}_2 + B_3(u)\mathbf{P}_3$$

$$= \sum_{k=0}^{3} B_k(u)\mathbf{P}_k$$

with $B_k(u) = b_{k3}u^3 + b_{k2}u^2 + b_{k1}u + b_{k0}$ blending functions

References:-

- https://www.tutorialspoint.com/computer_graphics/computer_graphics_curves.htm
- http://www.inf.ed.ac.uk/teaching/courses/cg/lectures/lect14.pdf
- https://web.mit.edu/hyperbook/Patrikalakis-Maekawa-Cho/node17.html
- https://link.springer.com/chapter/10.1007%2F1-84628-108-3_11

Thank You