Bézier Matrix

The cubic form is the most popular $X(t) = t^T M_B q$ (M_B is the Bézier matrix)

With *n=4* and *r=0,1,2,3* *we get:*

$$X(t) = \begin{bmatrix} t^3 & t^2 & t & 1 \end{bmatrix} \begin{bmatrix} -1 & 3 & -3 & 1 \\ 3 & -6 & 3 & 0 \\ -3 & 3 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} q_0 \\ q_1 \\ q_2 \\ q_3 \end{bmatrix}$$

Similarly for Y(t) and Z(t)

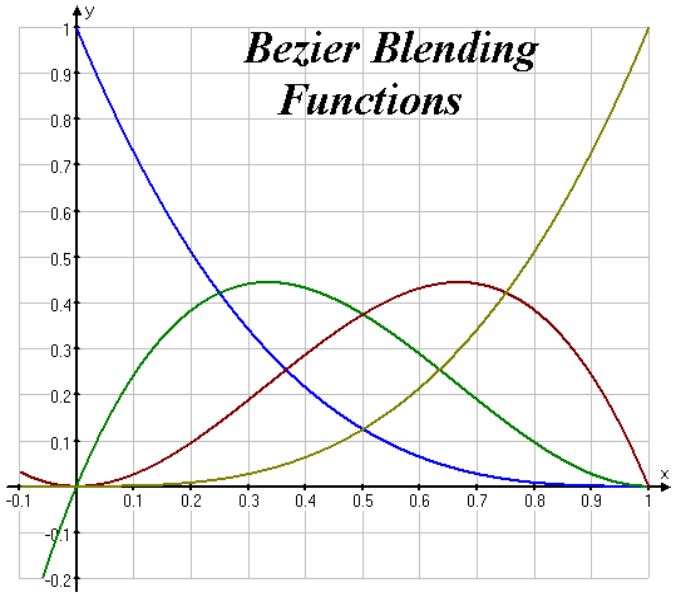
Bézier blending functions

This is how they look –

The functions sum to 1 at any point along the curve.

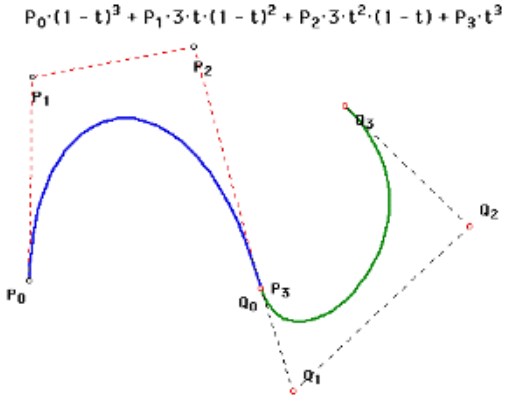
Endpoints have full weight

The weights of each function is clear and the labels show the control



Joining Bezier Curves

- G^1 continuity is provided at the endpoint when $P_2 - P_3 = k\,(Q_1 - Q_0)$
- if $k=1$, C^1 continuity is obtained



Questions

1.For a cubic Bezier curve, carry a similar matrix formulation to a cubic spline.

2. Derive the cubic spline equations.

3. Given a point Q and a parametric curve in the Cartesian space, find the closest point P on the curve to Q.
Hint: Find P such that (Q - P) is perpendicular to the tangent vector.

4. Explain the engineering application of cubic splines.

5. Derive the condition for C0 and C1 continuity in a cubic Bezier composite surface of two patches.

6. What are the types of surfaces that CAD/CAM systems use?

7.What is meant by coon surface?

8. What do you understand by the form element method of geometric construction?

9.Specify the applications of this method of modeling in comparison to that of the variant type.

10 What are the limitations in utilizing the sweep method for geometric construction?

Lecture No 28 Topic: 3D Geometry

- Three dimension system has three axis x, y, z. The orientation of a 3D coordinate system is of two types. Right-handed system and left-handed system.
- In the right -handed system thumb of right- hand points to positive z-direction and left- hand system thumb point to negative two directions. Following figure show right-hand orientation of the cube.