

Assignment 1
CPSC589/689 Modeling for Computer Graphics
Due Date: Oct. 9, 2011
Total Marks: 100 + 20 bonus

1. (20 marks) Consider a cubic Bezier curve $Q_3(u)$ with the control points $\{P_0, P_1, P_2, P_3\}$. (Show all calculations.)

- Find the tangent of the curve at $u = 0$, $u = \frac{1}{2}$, and $u = 1$.
- Find the normal vector of the curve at $u = 0$, $u = \frac{1}{2}$ and $u = 1$.
- Show that the output of deCasteljau algorithm, P_0^3 , is the same as $Q_3(u)$.

2. (15 marks) $S(u)$ is defined as:

$$S(u) = \begin{cases} a + 2.5u + bu^2 + cu^3, & u \geq 0; \\ 5 + du, & u < 0. \end{cases}$$

Determine a , b , c and d such that $S(u)$ becomes a 3^{rd} -degree spline function.

3. (15 marks) Consider the knot sequence, $\{0, 0, 0, \frac{1}{4}, \frac{1}{2}, \frac{3}{4}, 1, 1, 1\}$, and the control vertices $\{P_0, P_1, \dots, P_m\}$, for a B-spline curve of order 3:

- what is m ?
- what is the parameter range?
- how many segments does the curve have?

4. (50 marks and 20 bonus) Write a program to draw a helix with :

- user control of the radius and number of cycles.
- user control of viewing angle and scale.
- an option to visualize the tangent vectors (see ellipse example in the slides).

(Bonus) Use one or more helix curves combined with simple primitives such as spheres and any rendering technique that you know to produce an interesting object such as DNA.