CS4620 Fall 2011
HW4 - Curves and Animation

Due: Nov 22 2011

1 B-Spline and Bezier Curves

Consider the B-spline to Bezier conversion algorithm covered in Lecture 28, Slide 20 (Boehms conversion). Prove that the corresponding Bezier curves rendered, in fact, are the same as the originally intended B-spline curve.

We will simplify this problem, by not worrying about the end cases. Further, in the slide, we create 3 new Bezier curves; you will only derive the equivalence of the middle Bezier curve (shown by the thick green curve in the figure, reproduced here for your convenience).

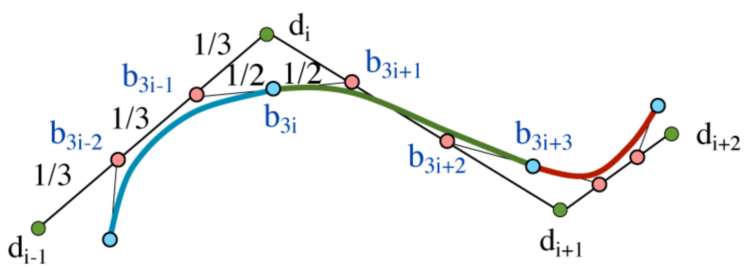


Figure 1: Bspline to Bezier conversion.

Hint: to solve this problem you will need to do the following. Derive the Bezier points, b, for the green curve in terms of the associated B-spline points, d. Given the matrices of Bezier and Bspline curves prove that the green curve is the "right" curve.

2 Quaternions

2.1

Let $q_0 = \frac{1}{2} + \frac{\sqrt{3}}{2}\mathbf{k}$. What rotation does q_0 represent? That is, q_0 represents the rotation around which vector and by what angle?

2.2

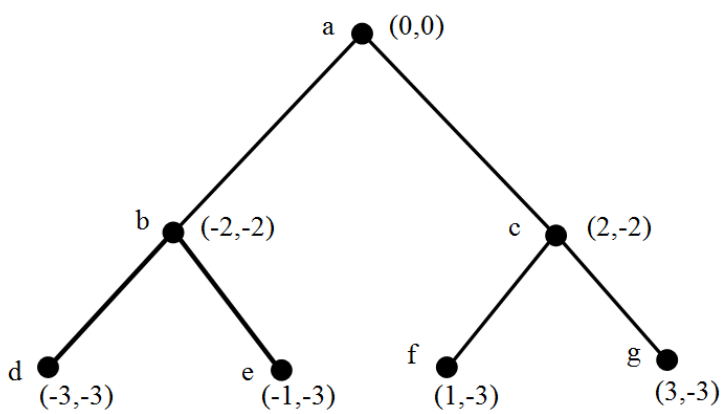
Let $q_1 = \frac{\sqrt{3}}{2} + \frac{1}{2}\mathbf{k}$. Compute $\mathrm{slerp}(q_0, q_1, 0.5)$.

2.3

Let q be a unit quaternion. Show that q and $-q$ represent the same rotation.

3 Forward Kinematics

Consider the following articulated rigid body in its rest pose. Here, a is the



root joint. All the positions are *world positions* of the joints/end effectors. They are not relative positions to the joints'/end effectors' parents.

Draw the rigid body when it is in the following pose:

$$\theta_a = 45^\circ, \theta_b = -45^\circ, \theta_c = 45^\circ.$$

Also, specify the positions of all the joints and end effectors.