2000 Paper 9 Question 4

Advanced Graphics and HCI

(*a*) Show how you would calculate the first intersection point between an arbitrary ray and a finite length open cylinder of unit radius aligned along the x-axis. [Note: an open cylinder is one which has no end caps.]

Having calculated the intersection point, how would you calculate the normal vector? [7 marks]

(*b*) A non-rational B-spline has knot vector $[1, 2, 4, 7, 8, 10, 12]$. Derive the first of the third order (second degree) basis functions, $N_{1,3}(t)$, and graph it.

If this knot vector were used to draw a third order B-spline, how many control points would be required? [7 marks]

(*c*) Describe how an object built using constructive solid geometry (CSG) can be represented using a binary tree. Given the intersection points of a ray with each primitive in the tree, show how to calculate the first intersection point of the ray with the entire CSG object. [6 marks]