2009 Paper 7 Question 2

Advanced Graphics

(*a*) State the Jordan curve theorem. [1 mark]

(*b*) Given point V and simple convex planar polygon $P=\{v_0, v_1, \ldots, v_{n-1}\}$ in $\mathbb{R}^3$, express:

(*i*) A test for whether V is coplanar with P. [1 mark]

(*ii*) A test for whether V lies *strictly inside* P. [2 marks]

(*iii*) A test for whether V lies *on the border* of P. [1 mark]

(*c*) (*i*) Describe an algorithm for ray-tracing a complex CSG (Constructive Solid Geometry) shape. How could your algorithm be represented by a state machine? [4 marks]

(*ii*) Identify *three* Boolean operations that your algorithm would support between primitives. [1 mark]

(*iii*) Would your algorithm perform ray-primitive intersections in local, eye, screen, or world co-ordinates? Why? [2 marks]

(*d*) (*i*) Show that the closed uniform B-Spline of degree 2 and with knot vector $\{0, 0, 0, 1, 1, 1\}$ is a quadratic Bézier curve. [6 marks]

(*ii*) Sketch the basis functions of the curve's coefficient polynomials. Accuracy is not critical. [2 marks]