2001 Paper 7 Question 9

Advanced Graphics and HCI

(*a*) The marching squares algorithm is a two-dimensional version of marching cubes – where you generate line segments in 2D rather than triangles in 3D. It could be used, for example, where you have a regular grid of height values and want to draw contours of constant height. Sketch an implementation of this two-dimensional marching squares algorithm. [6 marks]

(*b*) (*i*) Show how to find the first intersection between a ray and a finite-length, open-ended cone, centred at the origin, aligned along the x-axis, for which both ends of the finite-length are on the positive x-axis (i.e. $0 < x_{min} < x_{max}$). [6 marks]

(*ii*) Extend this to cope with a closed cone (i.e. the same cone, but with end caps). Take care to consider any special cases. [5 marks]

(*iii*) Extend this further to give the normal vector at the intersection point. [3 marks]