COMPUTER SCIENCE TRIPOS Part II – 2018 – Paper 7

2 Advanced Graphics (PAB)

(*a*) Given two signed distance field functions f and g, give the formula for their ...

(*i*) Union ($f \cup g$)

(*ii*) Intersection ($f \cap g$)

(*iii*) Difference ($f - g$)

[3 marks]

(*b*) Give clear definitions for the Virtual Reality industry's principles of *immersion* and *presence*. Compare the two concepts and explain the difference between them with examples demonstrating each. [5 marks]

(*c*) The *Doo-Sabin* subdivision scheme has kernel $(1/4)[\ldots, 0, 0, 1, 3, 3, 1, 0, 0, \ldots]$, defining a scheme in which each face is replaced by four new vertices.

(*i*) Give an expression for computing the position of a new vertex given the positions of the four old vertices of a face. [2 marks]

(*ii*) If the face does not have 4 vertices then you must weight each parent vertex differently to find the position of the child. Suggest possible weights for the vertices of faces with 3, 5, and n vertices, and justify your answer. [3 marks]

(*d*) There are several ray-tracing-friendly acceleration structures.

(*i*) Explain the *BSP tree* data structure. Explain how it is constructed and traversed. [3 marks]

(*ii*) Explain the *kd-tree* data structure. Explain how it is constructed and traversed. [3 marks]

(*iii*) Which of the two data structures is best-suited to ray-tracing a game of chess in real time? [1 mark]