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]