3 Introduction to Graphics (rmk38)

You are provided with a 2D triangle mesh defined by a set of vertices $V[k] = (x_k, y_k, a_k)$ for $k = 1, \ldots, N$, and a triangle index table $T$ of dimension $M \times 3$, where $M$ is the number of triangles. $x_k$ and $y_k$ are the coordinates of vertex $k$ and $a_k$ is its scalar attribute. An example of such a triangle mesh is shown below.

(a) Write down the triangle index table of the mesh shown in the figure above. Ensure that all triangles are forward-facing. [4 marks]

(b) Write pseudocode for a function $a = \text{lookup}_a(x, y, V, T)$, which returns the value of the linearly interpolated attribute at the point $(x, y)$ when the point lies on the mesh and $-1$ otherwise. Use square brackets to index vertex ($V[i]$) and triangle ($T[i, j]$) tables. The pseudocode should include the formulas needed to compute the interpolated attribute value and to check whether the point is inside the triangles. [10 marks]

(c) Suppose that now vertices also include a depth, so that $V[k] = (x_k, y_k, z_k, a_k)$, and triangles overlap and occlude one another. How do you need to modify the pseudocode to return the attribute of the visible triangle that has the lowest $z$-value at a given point? Due to memory limitations, you cannot use the Z-buffer algorithm. [6 marks]