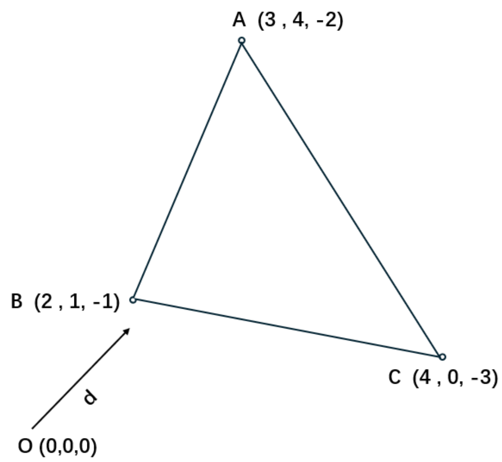
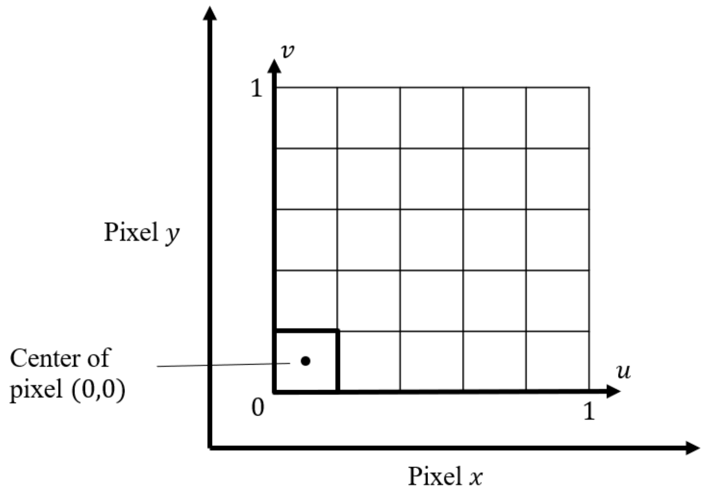
1. Consider the ray-triangle intersection during the ray-tracing process.

   (a) Suppose the generated ray has the origin of $\mathbf{O}(0,0,0)$ and the direction of $\mathbf{d}(12,9,-8)$. For a given triangle with vertices A, B and C whose positions are $(3,4,-2)$, $(2,1,-1)$ and $(4,0,-3)$ respectively, determine whether the ray hits the triangle. If it does, **calculate the intersection point and its barycentric coordinates regarding to this triangle.**

   (b) If the ray intersects the triangle, and there are texture coordinates attached to each vertex of this triangle. The texture coordinates of vertices A, B and C are $(0,0)$, $(1,0)$ and $(1,1)$, respectively. For the intersection point in question (a), **calculate the interpolated texture coordinates at the intersection point.**



(c) Suppose we want to map a grey-scale texture with a resolution of 5×5, as shown in the figure below, onto this triangle. The texture is described in a procedural way here: for any pixel (x, y) on the texture with $x \in [0,4]$ and $y \in [0,4]$, the grey-scale color of that pixel is defined as $c = x^2 + y^2$. **Using bilinear interpolation, determine the sampled grey-scale color from this texture at the intersection point in question (b).**



(a) The point in the plane P=$O + t \cdot d$, which can be written as $(\vec{BA} \times \vec{BC}) \cdot \vec{PA} = 0$,$x + z - 1 = 0, 12t - 8t - 1 = 0, t = \frac{1}{4}$,the intersection point is $(3, \frac{9}{4}, -2)$,then barycentric coordinates is $(\frac{2}{4}, \frac{1}{4}, \frac{1}{4})$

(b) the corresponding (u,v) can be easily calculated as $(\frac{1}{2}, \frac{1}{4})$

(c) Convert the texture coordinates $(\frac{1}{2}, \frac{1}{4})$ to pixel space yields pixel $(2, \frac{3}{4})$. Take the floor of this to get the bettom-left pixel of the four pixels used in bilinear interpolation: pixel $(2, 0)$, and the interpolation coordinates are $(0, \frac{3}{4})$.
So there is no need to interpolate along x direction. Interpolate along y direction: $(1 - \frac{3}{4}) * c(2,0) + \frac{3}{4} * c(2,1) = \frac{1}{4} * 4 + \frac{3}{4} * 5 = \frac{19}{4}$.