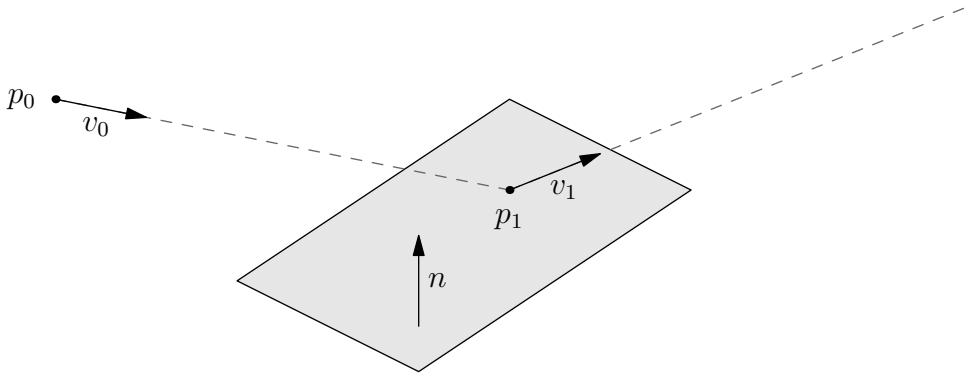
Exercises.

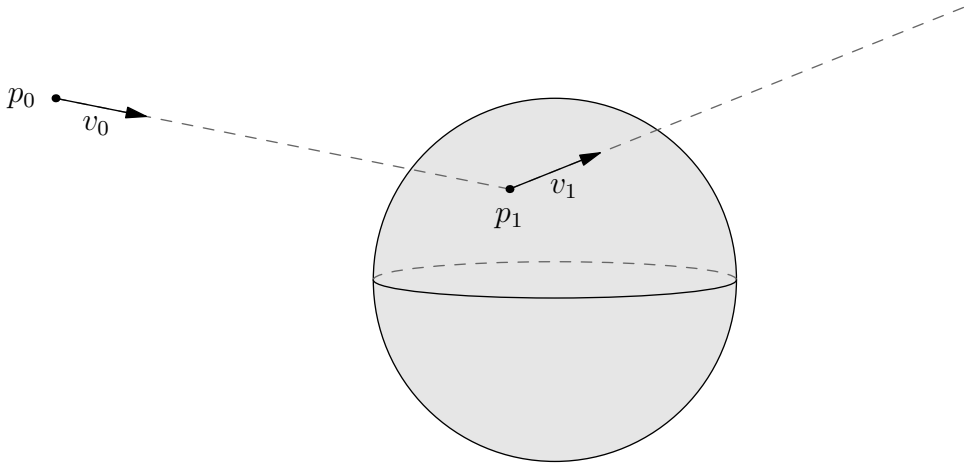
(1) Consider a plane $Q \subset \mathbb{R}^3$ passing through the origin and with normal vector $n \in \mathbb{R}^3$. That is,

$$Q = \{q \in \mathbb{R}^3 : q \bullet n = 0\}.$$

Also consider a ray of light starting from a point $p_0 \in \mathbb{R}^3$ and pointing in the direction of $v_0 \in \mathbb{R}^3$. Describe a step-by-step procedure (an algorithm) which determines whether or not the ray of light hits the plane. If the ray hits the plane, also determine the position p_1 and direction v_1 of the ray of light when it is reflected off of the plane.



(2) Consider a sphere of radius $r > 0$ centered at the origin in $\mathbb{R}^3$. As before, consider a ray of light starting from a point $p_0 \in \mathbb{R}^3$ and pointing in the direction of $v_0 \in \mathbb{R}^3$. Describe an algorithm which determines whether or not the ray of light hits the sphere. If the ray hits the sphere, also determine the position p_1 and direction v_1 of the ray of light when it is reflected off of the sphere.



(3) Consider a triangle with vertices $q_1, q_2, q_3 \in \mathbb{R}^3$. As before, consider a ray of light starting from a point $p_0 \in \mathbb{R}^3$ and pointing in the direction of $v_0 \in \mathbb{R}^3$. Describe an algorithm which determines whether or not the ray of light hits the triangle. If the ray hits the triangle, also determine the position p_1 and direction v_1 of the ray of light when it is reflected off of the triangle.