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Selected Problem Set 6

1. Suppose we have a ray starting at point $\vec{e}=(2,2,2)^T$ in direction $\vec{d}=(-1,-1,-1)^T$. Find the value of t at which this ray intersects the sphere of radius one centered at the origin.

   Pose $a=\|\vec{d}\|^2$, $b=\vec{e}\cdot\vec{d}$, $c=\|\vec{e}\|^2-1$ *and proceed to solve for variable* t *as* $at^2+2bt+c=0$ *as* $t_0=\frac{-b}{a}\pm\frac{\sqrt{b^2-ac}}{a}=2\pm\frac{\sqrt{3}}{3}$

2. Find the 3D coordinates of the intersection point from the previous question.

   Put the smallest value of t *in the equation of the ray to obtain* $(2,2,2)+\left(2-\frac{\sqrt{3}}{3}\right)(-1,-1,-1)=\frac{\sqrt{3}}{3}(1,1,1)$

3. Why do we find two intersections, and not just one?

   Simply because the ray enters and exits the sphere, thus creating two intersections.

4. Form the equation of a Bezier curve with points $p_1=(0,0)^T$, $p_2=(2,2)^T$, $p_3=(4,-2)^T$, $p_4=(6,0)^T$.

   As per the notes: $p(t)=(1-t)^3 p_1+3(1-t)^2 t\, p_2+3(1-t)t^2 p_3+t^3 p_4$

5. What are the coordinates of the point on this curve when $t=0.5$?

   Replace t *with 0.5 in the preceding formula to obtain* $p(t)=(3,0)$.