HW05

MATH 102, WINTER 2018

DUE WEDNESDAY, FEB 12 NAME:

1. The methane molecule CH_4 is arranged as if the carbon atom were at the center of a regular tetrahedron with four hydrogen atoms at the vertices. If vertices are placed at $(0,0,0), (1,1,0), (1,0,1)$, and $(0,1,1)$—note that all six edges have length $\sqrt{2}$, so the tetrahedron is regular—what is the cosine of the angle between the rays going from the center $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ to the vertices? (The bond angle itself is about 109.5^o, an old friend of chemists.)

2. What matrix P projects every point in $\mathbb{R}^3$ onto the line of intersection of the planes $x + y + t = 0$ and $x - t = 0$?

3. If V is the subspace spanned by $(1,1,0,1)$ and $(0,0,1,0)$, find

   a) a basis for the orthogonal complement $V^\perp$.

   b) the projection matrix P onto V.

   c) the vector in V closest to the vector $\boldsymbol{b} = (0,1,0,-1)$ in $V^\perp$.

4. Find the best straight-line fit to the following measurements, and sketch your solution:

$$y = 2 \quad \text{at} \quad t = -1, \qquad y = 0 \quad \text{at} \quad t = 0,$$
$$y = -3 \quad \text{at} \quad t = 1, \qquad y = -5 \quad \text{at} \quad t = 2.$$