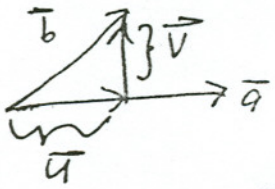
9. **(There is no partial credit for this problem. Make sure your answer is correct.)** Let $\vec{a} = \vec{i} + 2\vec{j} + 3\vec{k}$ and $\vec{b} = 1\vec{i} + 3\vec{j} + 7\vec{k}$. Find vectors $\vec{u}$ and $\vec{v}$ with $\vec{b} = \vec{u} + \vec{v}$, $\vec{u}$ parallel to $\vec{a}$, and $\vec{v}$ perpendicular to $\vec{a}$.



$\vec{u} = \text{proj}_{\vec{a}}\vec{b} = \frac{\vec{a}\cdot\vec{b}}{\vec{a}\cdot\vec{a}}\vec{a}$

$= \frac{1+6+21}{1+4+9}\vec{a} = \frac{28}{14}\vec{a} = 2\vec{a}$

$\vec{u} = 2\vec{i} + 4\vec{j} + 6\vec{k}$

$\vec{v} = \vec{b} - \vec{u} = (\vec{i} + 3\vec{j} + 7\vec{k}) - (2\vec{i} + 4\vec{j} + 6\vec{k})$

$\vec{v} = -\vec{i} - \vec{j} + \vec{k}$

10. Find the point on $3x + 5y + 2z = 57$ which is closest to $(1, 2, 3)$.

The line is $x = 1 + 3t$
$y = 2 + 5t$
$z = 3 + 2t$

The line hits the plane when

$3(1+3t) + 5(2+5t) + 2(3+2t) = 57$

$3 + 9t + 10 + 25t + 6 + 4t = 57$

$38t = 57 - 19$

$38t = 38$

$t = 1$

$(4, 7, 5)$