4.) This rule does not hold for the dot product of two vectors. Let $\vec{u} = \langle 1, 1 \rangle$, $\vec{v_1} = \langle 2, 3 \rangle$, and $\vec{v_2} = \langle 3, 2 \rangle$, and consider $\vec{u} \cdot \vec{v_1}$ and $\vec{u} \cdot \vec{v_2}$:

$$\vec{u} \cdot \vec{v_1} = \langle 1, 1 \rangle \cdot \langle 2, 3 \rangle = 1 \cdot 2 + 1 \cdot 3 = 5$$

$$\vec{u} \cdot \vec{v_2} = \langle 1, 1 \rangle \cdot \langle 3, 2 \rangle = 1 \cdot 3 + 1 \cdot 2 = 5$$

Thus $\vec{u} \cdot \vec{v_1} = \vec{u} \cdot \vec{v_2}$, but $\vec{v_1} \neq \vec{v_2}$, thus the rule does not hold for all vectors. Q.E.D.