

## Math 203 — Dot Product

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**Problem 1.** Find the angle between the following vectors. You can leave your answer in terms of  $\cos^{-1}$  but make note if any vectors are orthogonal (in which case the angle is  $\pi/2$ ).

- a.  $\langle 3, 1 \rangle$  and  $\langle -4, 3 \rangle$
- b.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- c.  $\langle 1, -8, 2 \rangle$  and  $\langle 0, 1, 4 \rangle$

**Problem 2.** Find the orthogonal projection of  $\langle 1, 1, 2 \rangle$  onto  $\langle 0, 1, 1 \rangle$ .

**Problem 3.** Consider the vectors  $\mathbf{v} = \langle 1, 5 \rangle$  and  $\mathbf{w} = \langle 4, 1 \rangle$ .

- a. Make a sketch  $\mathbf{v}$  and  $\mathbf{w}$  on the same set of axes.
- b. Make a sketch of the  $\text{proj}_{\mathbf{w}} \mathbf{v}$ .
- c. Make a sketch of the  $\text{proj}_{\mathbf{v}} \mathbf{w}$ .
- d. Find vectors  $\mathbf{p}$  and  $\mathbf{q}$  so that  $\mathbf{v} = \mathbf{p} + \mathbf{q}$  where  $\mathbf{p}$  is parallel to  $\mathbf{w}$  and  $\mathbf{q}$  is perpendicular to  $\mathbf{w}$ .
- e. Find vectors  $\mathbf{r}$  and  $\mathbf{s}$  so that  $\mathbf{w} = \mathbf{r} + \mathbf{s}$  where  $\mathbf{r}$  is parallel to  $\mathbf{v}$  and  $\mathbf{s}$  is perpendicular to  $\mathbf{v}$ .