Announcements

- Exam 2 this week - Covers Improper Integrals and Series
  - Cheat Sheet due Wednesday @ 8:00 am
  - Exam available Wednesday @ 8:00 am
  - Due Friday @ midnight
  - Same ground rules as for Exam 1

- "Normal" schedule for tutorials this week

- Let me know if you have any questions about courses for next semester

Basics of vectors

- If $\vec{\mathbf{a}} = \langle a_1, a_2 \rangle$ then the length of $\vec{\mathbf{a}}$ is $\|\vec{\mathbf{a}}\| = \sqrt{a_1^2 + a_2^2}$

- The unit vector pointing in the same direction as $\vec{\mathbf{a}}$ is

$$\vec{\mathbf{u}} = \frac{\vec{\mathbf{a}}}{\|\vec{\mathbf{a}}\|} = \frac{1}{\|\vec{\mathbf{a}}\|} \langle a_1, a_2 \rangle$$

- If $\vec{\mathbf{a}} = \langle a_1, a_2 \rangle$ and $\vec{\mathbf{b}} = \langle b_1, b_2 \rangle$, then the *dot product* is defined by

$$\vec{\mathbf{a}} \cdot \vec{\mathbf{b}} = a_1 \, b_1 + a_2 \, b_2$$

Let $\vec{v_1} = \langle 2, 3 \rangle, \quad \vec{v_2} \langle -6, 4 \rangle$

Key result

If θ is the angle between $\vec{a}$ and $\vec{b}$ then $\vec{a} \cdot \vec{b} = \|\vec{a}\| \, \|\vec{b}\| \cos(\theta)$

- Shows $\vec{a}$ and $\vec{b}$ are perpendicular if and only if $\vec{a} \cdot \vec{b} = 0$

- Allows us find angle between *any* two vectors: $\cos(\theta) = \dfrac{\vec{a} \cdot \vec{b}}{\|\vec{a}\| \, \|\vec{b}\|}$

- Also carries over to vectors in 3-space

Let $\vec{a} = \langle 2, -1 \rangle$ and $\vec{b} = \langle -1, 4 \rangle$

- Find $\vec{u_a}$, the unit vector in the same direction as $\vec{a}$

- Find $\vec{u_b}$

Let $\vec{a} = \langle 2, -1 \rangle$ and $\vec{b} = \langle -1, 4 \rangle$

- Find the angle between $\vec{a}$ and $\vec{b}$

- Find the angle between $\vec{u_a}$ and $\vec{u_b}$

Give two vectors perpendicular to $\vec{a}$

Let $\vec{a} = \langle 1, -3, 2 \rangle$ and $\vec{b} = \langle 3, 0, 1 \rangle$

- Find $\vec{u_a}$, the unit vector in the same direction as $\vec{a}$

- Find the angle between $\vec{a}$ and $\vec{b}$

- Find two vectors perpendicular to $\vec{a}$