MA153 Lesson 1

LESSON 1 - 3D and Vectors

Friday, 22 August, 2008

Outline

1. Admin
2. Last Class
3. 3D
   - Course Guide
   - Three Dimensional Example
   - Do Problem Help
4. INTRODUCTION TO VECTOR AND VECTOR OPERATIONS
   - Course Guide
   - Vectors
5. Look Forward
   - Course Guide

Admin

1. Schedule an interview - Use outlook!

Admin

2. Quiz Monday! Small quiz covering Fundamental Concepts. We will use SynchronEyes - Keep trying to get it working and your name instead of a number.

Admin

3. Homework 1 is due 2 September in class - The assignment is posted on the web site

Admin

4. Academic Integrity Briefing - Documentation of Written Work

Introduction to MA 153

Questions?

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Objectives

Three-Dimensional Coordinates (Stewart 12.1)

1. Understand the coordinate axes, coordinate planes, and right hand rule.
2. Determine the distance between points in three-dimensional space.
3. Determine an equation of a sphere.

This room in three dimensions

Think of this room as it is, Three Dimensional!

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Distance Formula in 3D:

$$|P_1P_2| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

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It is the set of all points (x, y) that satisfy the equation.

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What is the Equation of a Line?
It is the set of all points (x, y) that satisfy the equation.
The same is true in 3D it is the set of points (x, y, z) that satisfy an equation of a sphere or some other 3D object. So the equation of a sphere with a center $C(h, k, l)$ and radius r is:

$$(x - h)^2 + (y - k)^2 + (z - l)^2 = r^2$$

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Tossing a Grenade

1. One of your soldiers tosses a grenade from the second floor of a building at a position of $(8, 9, 10)$ (dimensions in yards) with his target an enemy hide site at the origin (0,0,0) across an intersection. The grenade's burst radius is 13 yards.

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2. Model the burst radius.

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4. If you move into a building across the street at the same height as your soldier are you safe?

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2. Model the burst radius.
3. Is your soldier a safe distance from the grenade
4. If you move into a building across the street at the same height as your soldier are you safe?
5. Now your radio doesn't work if you were to throw a rock back to your soldier how far would you have to throw it?

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Section 12.1/ 2, 5, 8, 10, 19, 33, 39

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Objectives

Vectors (12.2)

1. Determine the vector AB..... between two points.
2. Determine the length (magnitude) of a vector.
3. Determine the resultant of vector addition and scalar multiplication.
4. Understand scalar multiplication and how it relates to parallel vectors.
5. Understand the properties of vectors.
6. Determine the unit vector in a given direction.
7. Determine the resultant force of several forces.

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Vectors

1. Vectors have Magnitude and Direction

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2. Vectors are annotated a few ways:
   1. $\mathbf{a} = \langle a_1, a_2, a_3 \rangle$ the letter can be bold (hard to see on the chalk board or in hand writing)
   2. $\overrightarrow{a} = \langle a_1, a_2, a_3 \rangle$ an arrow over the letter (much easier for board and paper work)

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3. Vector Addition

Vectors

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3. Vector Addition
4. Scaler Multiplication

Vectors

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4. Scaler Multiplication
5. Components of Vectors

Vectors

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6. The vector $\overrightarrow{a} = \overrightarrow{AB}$

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6. The vector $\overrightarrow{a} = \overrightarrow{AB}$
7. Length or Magnitude of a vector

Vectors

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7. Length or Magnitude of a vector
8. Properties of Vectors

Unit Vectors

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2. Unit vectors are annotated by hand with a "hat" - $\hat{u}$
3. Common unit vectors are $\hat{i}, \hat{j}, \hat{k}$ describing the standard basis vector. Any vector multiplied by one of these unit vectors will result a vector pointing in the positive x, y, z direction.

Unit Vectors

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4. So vectors can also be described as $\overrightarrow{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$

Unit Vectors

1. A unit vector has direction but its magnitude is always 1
2. Unit vectors are annotated by hand with a “hat” - $\hat{u}$

5. A unit vector can be found by $\overrightarrow{u} = \frac{\overrightarrow{a}}{|\overrightarrow{a}|}$

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Dot Product (Stewart 12.3)

1. Understand the definition of the dot product.
2. Determine the dot product of two vectors using both the algebraic and geometric formulations of the dot product.
3. Determine the angle between two vectors.
4. Understand how the sign of $\overrightarrow{a} \cdot \overrightarrow{b}$ relates to the angle between $\overrightarrow{a}$ and $\overrightarrow{b}$.
5. Understand how the dot product relates to work.
6. Understand the concept of orthogonality.
7. Determine the scalar projection of $\overrightarrow{b}$ onto $\overrightarrow{a}$.
8. Determine the vector projection of $\overrightarrow{b}$ onto $\overrightarrow{a}$.

Questions?

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