

Math 19. Lecture 8

Vectors

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1 The General Equation

We can write the system

$$\begin{aligned}\frac{dx}{dt} &= f(x, y) \\ \frac{dy}{dt} &= g(x, y)\end{aligned}$$

as

$$\frac{d\mathbf{v}}{dt} = \mathbf{F},$$

where

$$\mathbf{v}(t) = \begin{pmatrix} x(t) \\ y(t) \end{pmatrix} \text{ and } \mathbf{F}(x, y) = \begin{pmatrix} f(x, y) \\ g(x, y) \end{pmatrix}.$$

2 Definition of Vectors

A *vector* is a pair of numbers

$$\begin{pmatrix} a \\ b \end{pmatrix}.$$

The numbers a and b are called *components*.

3 Vectors as Functions

We can talk about vector functions such as

$$\mathbf{v}(t) = \begin{pmatrix} x(t) \\ y(t) \end{pmatrix}.$$

We can integrate and differentiate such functions by integrating and differentiating their components.

4 Functions of Vectors

We can think of of $f(x, y)$ as $f(\mathbf{v})$.

5 Operations with Vectors

- *Adding Vectors.*
- *Scalar Multiplication.*
- *The Dot Product Measures Lengths and Angles.*

6 Vectors with Three Components

Homework

- Chapter 7. Part 1: Exercise 1; Part 2: Exercises 1, 2, 3, 4, 5, 6; pp. 125–126.

Reading and References

- C. Taubes. *Modeling Differential Equations in Biology*. Prentice Hall, Upper Saddle River, NJ, 2001. Chapter 7.