Lecture 0

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Welcome

Blackboard Lecture notes, slides, "Echos", and grades. (Don't print out lecture notes in entirety as they will be supplemented throughout the semester.)

Attendance Not mandatory. Be respectful to those who choose to attend.

Math 1110 Easier. We are going to adjust grades. Stay with 1210 for better performance in 2nd and 3rd year.

Overview

1. Complex Numbers.
2. Vectors.
3. Lines, Planes, and Hyperplanes.
4. Matrix Algebra.

Complex Numbers

$$\mathbb{N} \subset \mathbb{Z} \subset \mathbb{Q} \subset \mathbb{R} \subset \mathbb{C} \subset \mathbb{H}.$$

The complex numbers arise because

$$f(x) = x^n + a_{n-1}x^{n-1} + \cdots + a_1 x + a_0$$

ought to have n solutions.

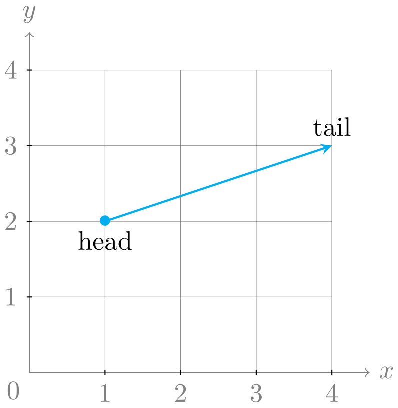
We will demonstrate that a number i with the property

$$\mathrm{i}^2 = -1$$

is sufficient to do this. However, we must adjust addition, multiplication, and division to accommodate i.

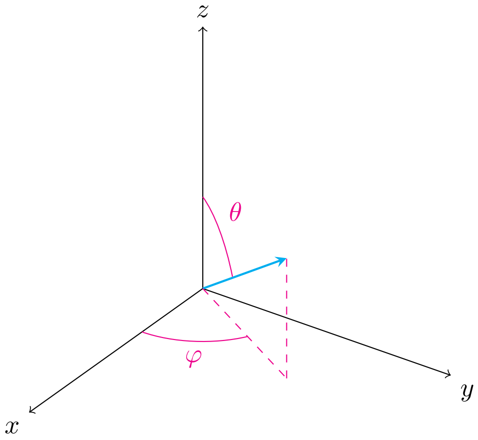
Vectors

Our efforts to generalize the complex numbers will fail so vectors will emerge as a type of concession. Vectors are quantities with direction and magnitude. They require their own arithmetic.



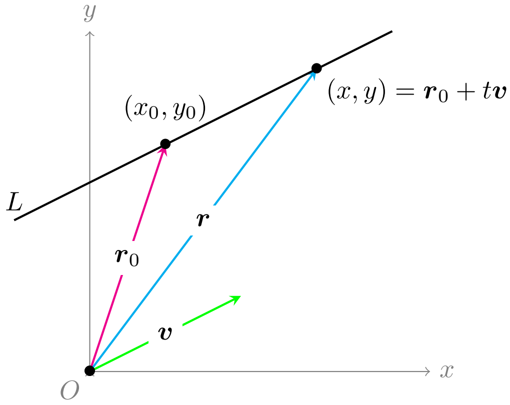
Vectors

We will learn to describe vectors using Cartesian coordinates as well.



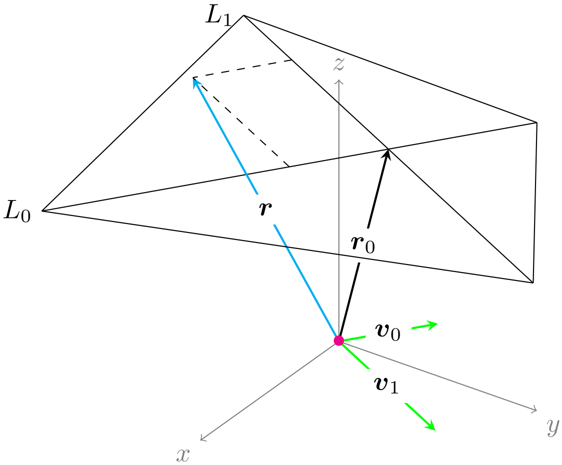
Lines, Planes, and Hyperplanes

We will use vectors to describe lines (which have infinite magnitude):



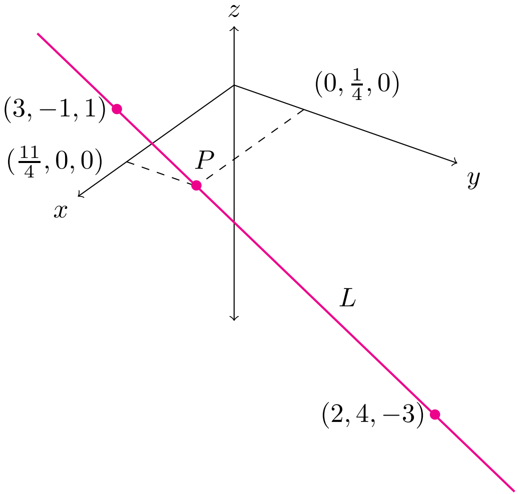
Lines, Planes, and Hyperplanes

We will use vectors to describe planes:



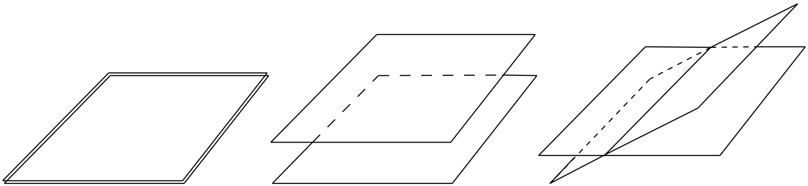
Lines, Planes, and Hyperplanes

And also figure out how to determine where a lines and planes intersect.



Lines, Planes, and Hyperplanes

And even where two planes meet.



Matrix Algebra

We will learn to solve a system of linear equations like

$$x + y + 2z = 9$$

$$2x + 4y - 3z = 1$$

$$3x + 6y - 5z = 0$$

by representing it as a matrix

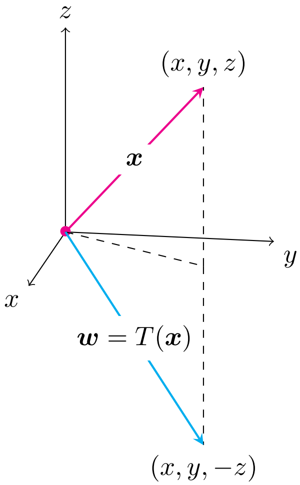
$$\begin{bmatrix} 1 & 1 & 2 & 9 \\ 2 & 4 & -3 & 1 \\ 3 & 6 & -5 & 0 \end{bmatrix}$$

and applying elementary row operations

$$\begin{bmatrix} 1 & 1 & 2 & 9 \\ 0 & 2 & -7 & -17 \\ 0 & 3 & -11 & -27 \end{bmatrix} \begin{array}{l} \\ \quad -3 \\ \mid 2 \quad + \end{array} = \begin{bmatrix} 1 & 1 & 2 & 9 \\ 0 & 2 & -7 & -17 \\ 0 & 0 & -1 & -3 \end{bmatrix} .$$

Matrix Algebra

We will learn (invertible) matrices define linear transformations in space like reflections:



$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} x \\ y \\ -z \end{bmatrix}$$

Let us begin...GL;HF.