Vector Mathematics & Transformations

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Overview

- Abstract Intro
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- Frequently used Math
- Object Transformations
- Camera Transformations

"Mathematics is the *art* of solving problems"

(Prof. Dr. Fischer, 2003)

What else?

- A multipurpose toolkit
- Provides a huge set of concepts to solve problems
- It can only describe one particular aspect of a thing
- Abstract and ideal
- Real world ↔ Mathematical description

How does it work (basically)?

- By giving things a name!
- Means bind the properties you want to describe
- Then build systems with the symbols
- Replace the symbol by its 'content' to calculate

How does it work (really)?

- Take 3 numbers and give them a name:
  - A = 10, B = 20, C = 30
- They mean nothing if they are not associated
- Exaples:
  - size of a box, position in space, speed of 3 vehicles
- One aspect (real world) ↔ Mathematical description

What's the problem?

- Abbreviations, Greek Letters
- Mathematicians are lazy and want to save space
- Formulas became shorter and hard to grasp:

  $v = \Delta s / \Delta t$

  → speed = distance/time interval

  → average speed during the ride = distance of the ride / time needed for the ride

What can I do with it?

- Physics
  - simulation
- Measurement, Error correction
- Economy
  - Probability, game theory
- Geometry
  - Analytic geometry (that's what we use)
  - Computer graphics (yea!)

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- Numbers are concepts
- One essence of a statement:

  "*The moons of Jupiter.*" → 63 (moons)

- Gottlob Frege, *The Foundations of Arithmetic*

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- +−*/ are concepts as well:

  "*I have seen a moon of Jupiter explode, then I have seen another one explode.*"

  → 63 – 2 = 61 (moons)

What concepts do we need?

- Logic
- 1, 2, 3, (4)-D space
- Vectors
  - Arrow (direction + length)
  - Position
  - Color
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What concepts do we need?

- 4x4 Matrix
  - Transformations
- Matrix * Matrix → Combine transformation
- Matrix * Vector → Apply transformation to vector

Let's have a look

→ Patches