

Multivariable Calculus

Day 1

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Introduction

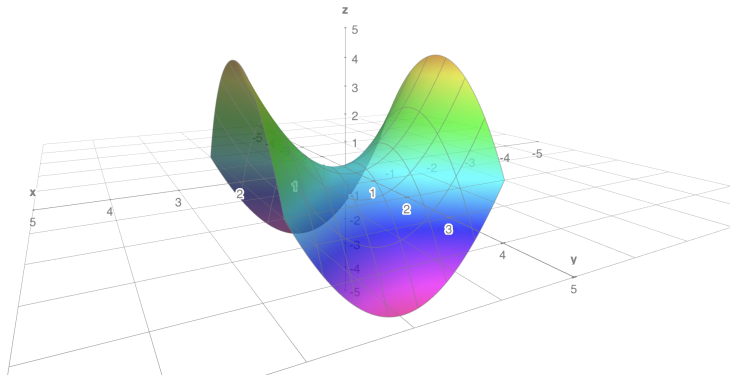
- Instructor: Truong-Son Van
- Time: T & Th, 9:45a-11:15a
- Office hours: M & W, 10a-11a (or by appointment)
- TA: TBD
- Discussion board: Piazza

- Logistics
- Getting started with linear algebra

Single variable vs. Multivariable

What's the point?

What do you think is the function that create this graph?



What's the point?

Life is a function with many variables

What's the point?

Life is a function with many variables



What will you learn?

`https://www.tsvan.xyz/MultiCalc/#core-content`

Assessment

- Homework (25%)
- Worksheets (15%)
- Midterm (15%)
- Final (30%)
- Project (15%)

DON'T CHEAT!!!

Final word on style

- Certain things in math have to be delivered while writing.
- So, sometimes I'll deliver my lectures by writing on the iPad / whiteboard.
- Slides/brief notes just contain key points.
- It is your responsibility to update your notes to include the details I speak in class.

Crash course in linear algebra

First, we need some language from linear algebra.

Definition

An n -dimensional Euclidean space \mathbb{R}^n is the Cartesian product of n Euclidean spaces \mathbb{R} .

Definition

An n -dimensional vector $\mathbf{v} \in \mathbb{R}^n$ is a tuple

$$\mathbf{v} = \langle v_1, \dots, v_n \rangle, \quad (1)$$

where $v_i \in \mathbb{R}$.

In dimensions less than or equal to 3, we represent a vector geometrically by an arrow, whose length represents the magnitude.

Examples

- Vector connecting two points $(1, 2)$ and $(4, 5)$ in \mathbb{R}^2
- Zero vector
- Unit vector

- Write the general formula for a vector that connects any two points A and B in \mathbb{R}^n .

Rules to manipulate vectors

Let $\mathbf{a}, \mathbf{b} \in \mathbb{R}^n$ and $c, d \in \mathbb{R}$. Then,

$$c(\mathbf{a} + \mathbf{b}) = \langle ca_1 + cb_1, \dots, ca_n + cb_n \rangle = c\mathbf{a} + c\mathbf{b},$$

and

$$(c + d)\mathbf{a} = c\mathbf{a} + d\mathbf{a}.$$

- Elementary vectors have the form

$$\mathbf{e}_i = \langle 0, \dots, 1, \dots, 0 \rangle.$$

Express a vector $\mathbf{u} \in \mathbb{R}^n$ in terms of these elementary vectors.

- In 3D,

$$\mathbf{e}_1 = \mathbf{i}, \quad \mathbf{e}_2 = \mathbf{j}, \quad \mathbf{e}_3 = \mathbf{k}.$$

Write the vector connecting $A(1, 2, 3)$ with $B(-10, -3, 5)$ in terms of elementary vectors.

Geometric meanings