

Linear Algebra

- Introduction -

Jinsun Park

Visual Intelligence and Perception Lab., CSE, PNU

Orientation

Course Information

■ Engineering Linear Algebra (공학선형대수학)

- CB1501015-060
- 13:30 - 14:45 (Mon & Wed)
- 201-6516 (제6공학관 6516호)

■ Instructor

- Jinsun Park (박진선)
- [Visual Intelligence and Perception Lab. \(시각 지능 및 인지 연구실\)](#)

■ Textbook

■ Linear Algebra with Applications, Global Edition (10th Ed.)

Steven Leon and Lisette de Pillis
Pearson, 2021

■ 프로그래머를 위한 선형대수

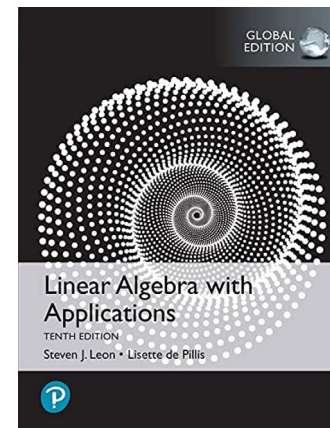
히라오카 카즈유키, 호리 겐
길벗, 2017

■ 머신 러닝을 위한 수학 with 파이썬, R

이원상
길벗, 2020

■ Course Materials

- Will be uploaded to the PLATO



Course Information

■ Grading Policy

Category	Ratio
Attendance	5%
Assignment (+ Quiz)	20%
Mid-Term Exam	35%
Final Exam	40%
Total	100%

■ Prerequisites

- Basic mathematics
 - Addition
 - Subtraction
 - Multiplication
 - Division

Syllabus

Week	Topic
1	Introduction
2	Systems of Linear Equations
3	Matrix Algebra
4	Determinant
5	Vector Spaces
6	Linear Independence
7	Linear Transformations
8	Mid-Term Exam
9	Orthogonality
10	Least Squares Problems
11	Orthogonalization Process
12	Eigenvalues and Eigenvectors
13	Diagonalization
14	Singular Value Decomposition
15	Final Exam

Introduction

What is Linear Algebra?



선형대수는 어떤 학문인가요?



선형대수는 벡터, 행렬 및 선형변환 등을 다루는 수학의 한 분야입니다. 선형대수는 대개 벡터 공간이나 선형 연립방정식의 해, 행렬 분해, 고유값 및 고유벡터, 행렬식, 행렬미분, 선형 회귀 및 최소자승법 등을 다룹니다. 이러한 개념들은 통계학, 물리학, 공학, 경제학, 컴퓨터 과학 등 다양한 분야에서 활용됩니다.

선형대수는 수학의 중요한 분야 중 하나로, 수학자들은 이를 활용하여 물리학, 공학, 경제학, 컴퓨터 과학 등에서 발생하는 문제들을 해결하는 데 사용합니다. 따라서 선형대수는 현대 과학 및 기술의 발전에 중요한 역할을 합니다.



좀 더 쉽게 설명 해 주세요.



선형대수는 수학의 한 분야로서, 다양한 분야에서 사용되는 벡터와 행렬을 다루는 학문입니다. 예를 들어, 우리가 일상 생활에서 많이 사용하는 그래프나 이미지는 행렬로 표현될 수 있습니다. 또한, 컴퓨터 프로그래밍에서도 많이 사용되며, 딥러닝과 같은 인공지능 분야에서도 중요한 역할을 합니다.

선형대수에서는 벡터와 행렬을 사용하여 다양한 계산을 수행합니다. 예를 들어, 두 벡터의 내적, 행렬의 곱셈, 역행렬 구하기 등이 있습니다. 이러한 계산을 통해, 데이터를 분석하거나, 시스템을 제어하거나, 문제를 해결하는 등의 다양한 분야에서 활용할 수 있습니다.

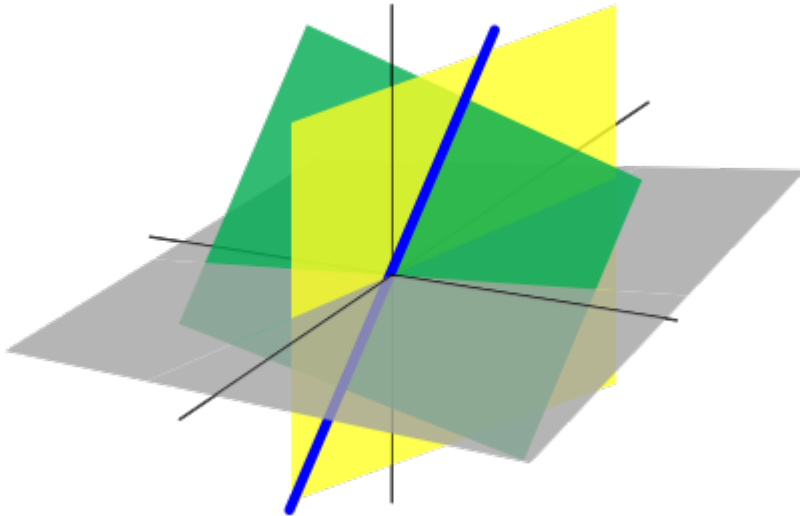
선형대수는 수학의 중요한 분야 중 하나이며, 다양한 분야에서 활용되는 것은 그 중요성을 보여줍니다. 하지만, 처음 접하는 사람들에게는 어려울 수 있습니다. 그러나 연습과 학습을 통해 선형대수를 이해하고 활용하는 것은 가능합니다.

What is Linear Algebra?

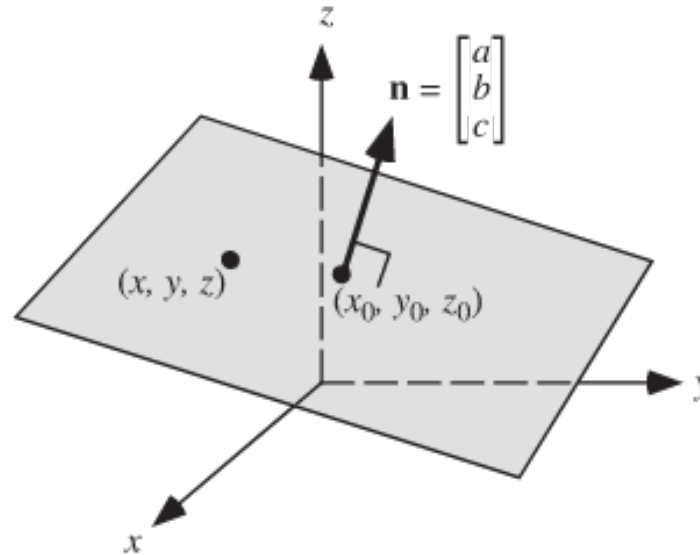
Linear + Algebra

Straight, Flat

대수(代數)



<https://ko.wikipedia.org/wiki/%EC%84%A0%ED%98%95%EB%8C%80%EC%88%98%ED%95%99>



<https://mathworld.wolfram.com/Plane.html>

$$\begin{cases} ax_1 + by_1 + cz_1 + d = 0 \\ ax_2 + by_2 + cz_2 + d = 0 \\ \vdots \\ ax_k + by_k + cz_k + d = 0 \end{cases}$$

Linear Algebra Applications

Machine Learning

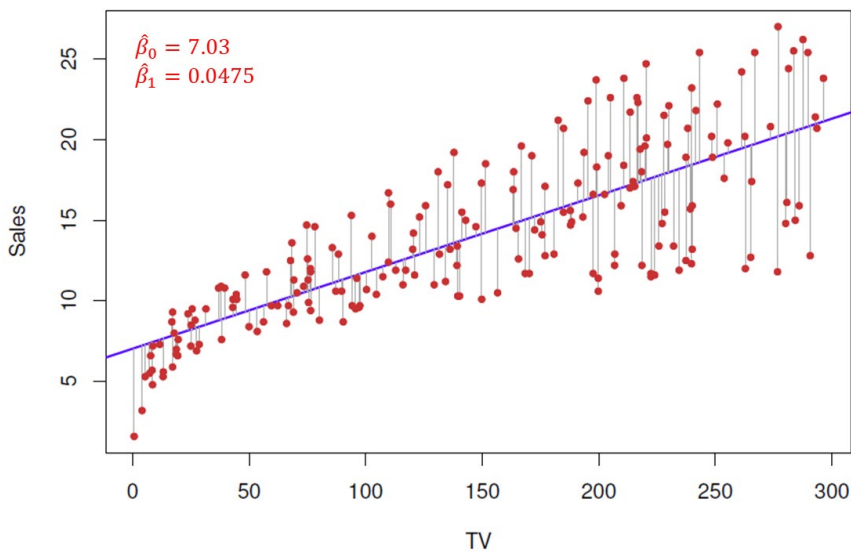
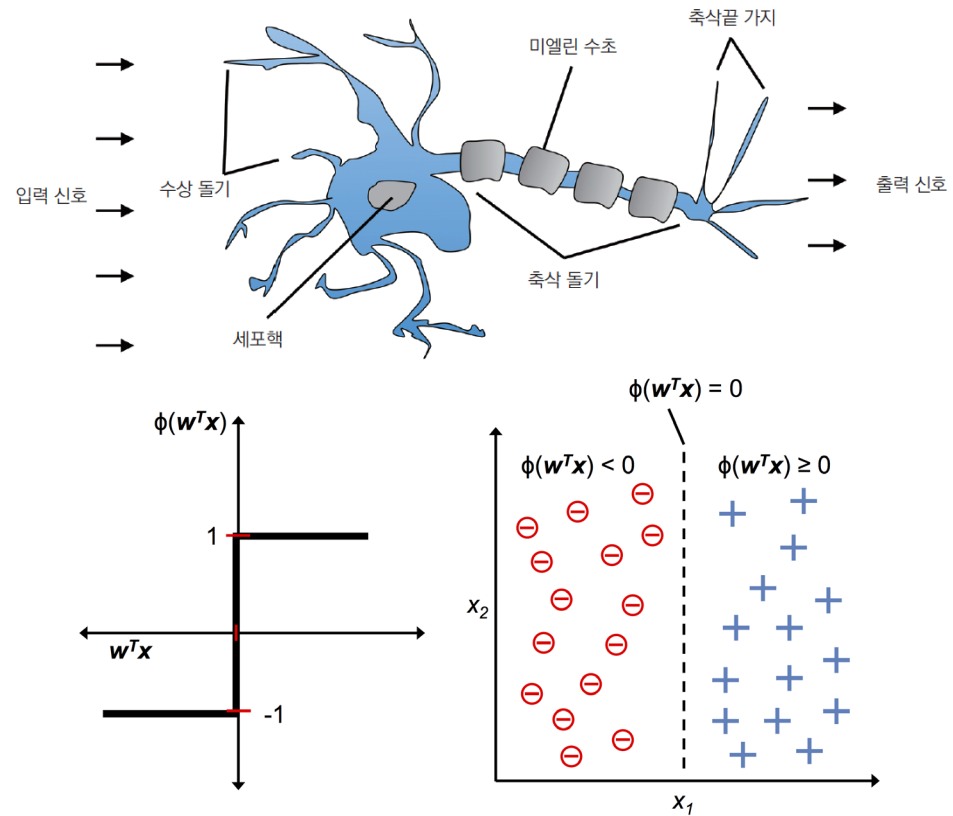


FIGURE 3.1. For the Advertising data, the least squares fit for the regression of sales onto TV is shown. The fit is found by minimizing the residual sum of squares. Each grey line segment represents a residual. In this case a linear fit captures the essence of the relationship, although it overestimates the trend in the left of the plot.

Linear Regression

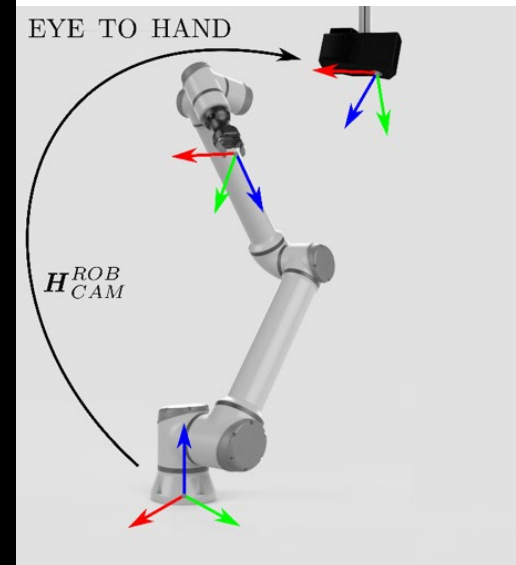


Perceptron

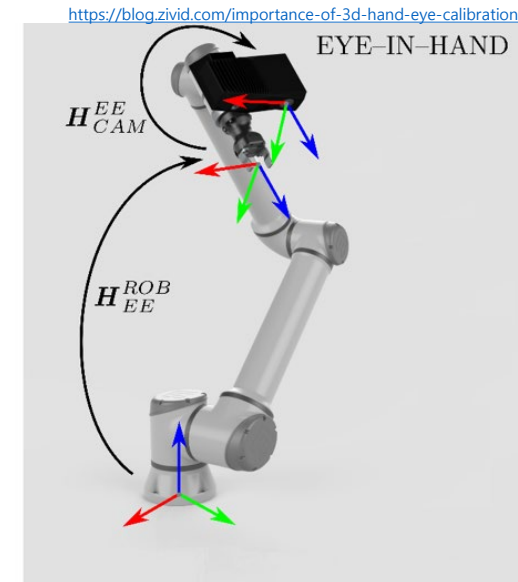
Linear Algebra Applications

- Robotics

<https://www.youtube.com/watch?v=ZAzeYPcTM78>



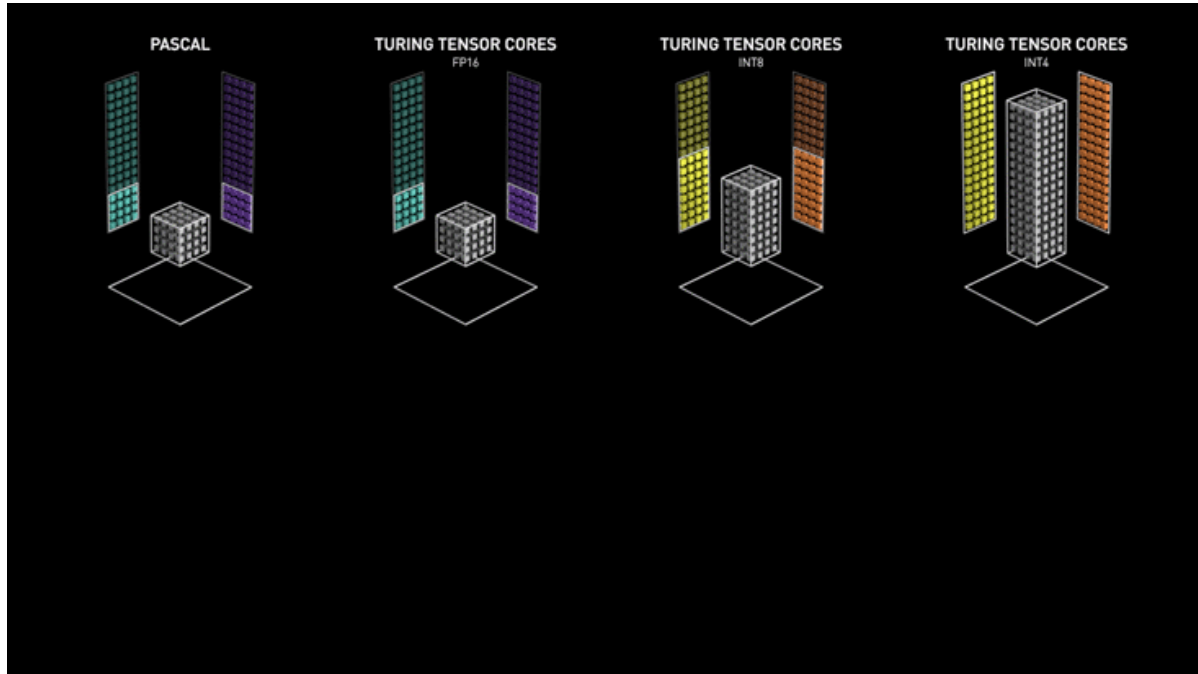
Robot Arm Grasping



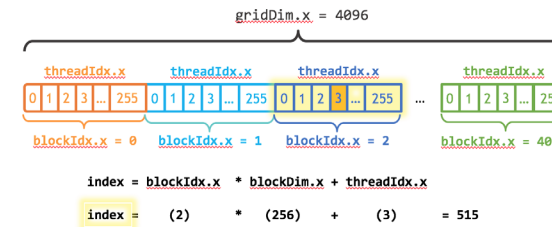
Hand-Eye Calibration

Linear Algebra Applications

■ NVIDIA CUDA



TRAINING AND INFERENCE	DESKTOP	DATACENTER AND CLOUD
	 DGX Station Titan V	 DGX-2 DGX-1 Tesla V100
INFERENCE AT THE EDGE	AUTONOMOUS MACHINES	AI SELF-DRIVING PLATFORM
	 Jetson TX2 Jetson TX1	 DRIVE Pegasus
NVIDIA DEEP LEARNING SDK and CUDA		



Software Intern, Linear Algebra Libraries - Summer 2023

NVIDIA · 샌타클래라, CA

풀타임 · 인턴

직원 10,001명 이상 · 컴퓨터하드웨어 제조

회원님을 다른 지원자 305명과 비교해 보세요. 프리미엄 무료 이용

채용공고 마감됨

채용공고 설명

NVIDIA's invention of the GPU in 1999 sparked the growth of the PC gaming market, redefined modern computer graphics, and revolutionized parallel computing. More recently, GPU deep learning ignited modern AI — the next era of computing — with the GPU acting as the brain of computers, robots, and self-driving cars that can perceive and understand the world. Today, we are increasingly known as "the AI computing company." We're looking to grow our company, and build our teams with the smartest people in the world. Join us at the forefront of technological advancement.

We are looking for software engineering interns for our cuSPARSE and cuSOLVER team which are a key part of high-performance computing and deep learning software stacks. The main purpose of these libraries is to provide the fastest computing primitives for sparse and dense **linear algebra**, like Cholesky decomposition and sparse matrix products among many others. We see strong interest in optimization of such key functionalities from various industrial and research organizations - from Gaming and Machine Learning to autonomous driving and chip modeling. Some of these kernels spend several milliseconds while others involve hundreds of GPUs and spend hours. All of them need to be optimized for current and future GPUs that involve mathematical changes of algorithms. Does the idea of being at the heart of these projects and apply your knowledge to develop and optimize algorithms which make an impact around world excite you? If yes, then come and join our team!

During your internship, you will work with senior software engineers in the libraries team who will provide mentorship and guide you in developing highly optimized algorithms. Projects will involve implementing new numerical algorithms, defining APIs, analyzing performance, finding appropriate solutions for difficult numerical corner cases, and other general software engineering work.

What You'll Be Doing

- Prototype and develop numerical algorithms for high-performance math libraries in the areas of dense and sparse **linear algebra** for single node and multi GPU clusters
- Analyze the performance of GPU or CPU implementations and find opportunities for improvements.
- Collaborate with team members to understand software use cases and requirements

- 강력한 병렬처리를 통해 딥러닝 학습을 유한한 시간 안에 가능하게 함
- 다수의 Tensor Core를 통한 병렬 처리 실시