# First Day Introduction

## Math of Machine Learning

Department of Mathematics
University of Nebraska-Lincoln

# Math of Machine Learning

## What is Machine Learning?

- Wikipedia says, *"Machine learning (ML) is a field of study in artificial intelligence concerned with the development and study of statistical algorithms that can learn from data and generalize unseen data, and thus perform tasks without explicit instructions."*
- It has many applications such as:
    - Image classification
    - Speech recognition
    - Social media optimization: for example, friend suggestions in Facebook, music recommendation in YouTube
    - Predictive analytics: for example, the stock market, sports betting, etc.

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## How does a machine “learn”?

1. **A Decision Process**: In general, machine learning algorithms are used to make a prediction or classification. Based on some input data,  the algorithm will produce an estimate about a pattern in the data.

2. **An Error Function**: An error function evaluates the prediction of the model. If there are known examples, an error function can make a comparison to assess the accuracy of the model.

3. **A Model Optimization Process**: If the model can fit better to the data points in the training set, then weights are adjusted to reduce the discrepancy between the known example and the model estimate. The algorithm will repeat this iterative “evaluate and optimize” process, updating weights autonomously until a threshold of accuracy has been met.

# Math of Machine Learning

## What will we learn?

- Artificial Nearual Networks (ANN)
- Linear Algebra — mostly knowing how to multiply matrices will be enough
- Calculus — specifically, gradient descent (an algorithm for minimizing a function) and the chain rule for multivariable functions
- Programming — Python, Jupyter Notebooks, and TensorFlow (ML package for Python created by Google)

# Artificial Neural Network (ANN)

## Basic Structure

- Roughly speaking, an ***artificial neural network*** or simply a ***neural network*** is a biologically inspired programming architecture that enables a computer to “learn” from observational data.
- What is it actually?
    - A sequence of matrix operations (multiplication/addition) and applications of functions component-wise.