# Links and Contact

Feel free to contact me if you have any questions

- Youngsu Kim, youngsu.kim@csusb.edu
- https://www.csusb.edu/high-performance-computing
- (Server) https://csusb-jupyter.nrp-nautilus.io/

# High Performance Computing Program
# A Brief Introduction to Machine Learning

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High Performance Computing Faculty Fellow
Assistant Professor of Mathematics

11/30/2023

# Agenda

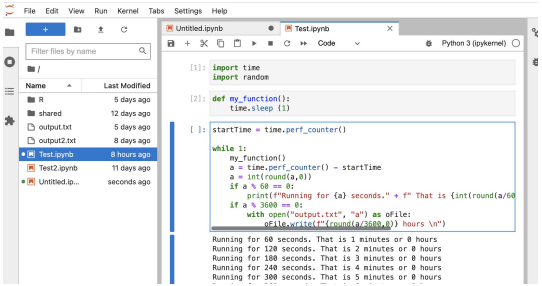
- ❏ High Performance Computing Program
- ❏ RStudio and JupyterLab on HPC
- ❏ Introduction to Machine Learning: linear regression and classification
- ❏ Demo of using GPU

# What Do HPC Program Offer?

- ❏ A gateway to HPC systems
- ❏ Test your software and project on HPC
- ❏ Provide training for faculty and students
- ❏ Guide you writing proposal regarding computing power specifications
- ❏ Consult the benefits of a project when run HPC

I am interested in working with faculty members who wants to explore or try out the HPC for current or future projects, especially from non-STEM disciplines

# HPCP Classroom and Workshop Support




Ready-to-go Platform for Python and RStudio

# RStudio/Python on HPC

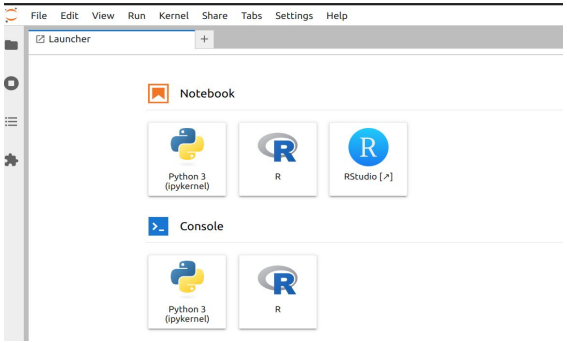
Connect to

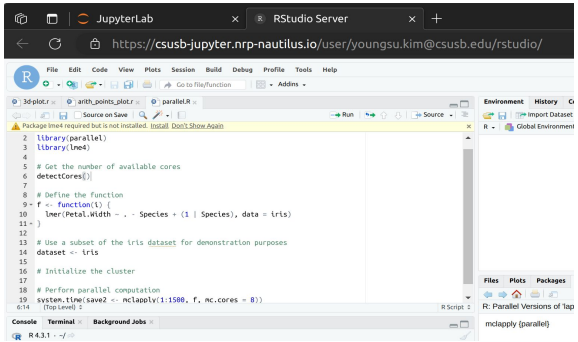
- https://csusb-jupyter.nrp-nautilus.io/ no registration required
- https://csusb-hpc.nrp-nautilus.io/ requires adding your account

Select “Stack RStudio.” After a few minutes, you will be prompted to the screen that contains a link to the RStudio

The rest is pretty much the same as the one on your PC.

# RStudio on HPC



# Python, TensorFlow, Machine Learning

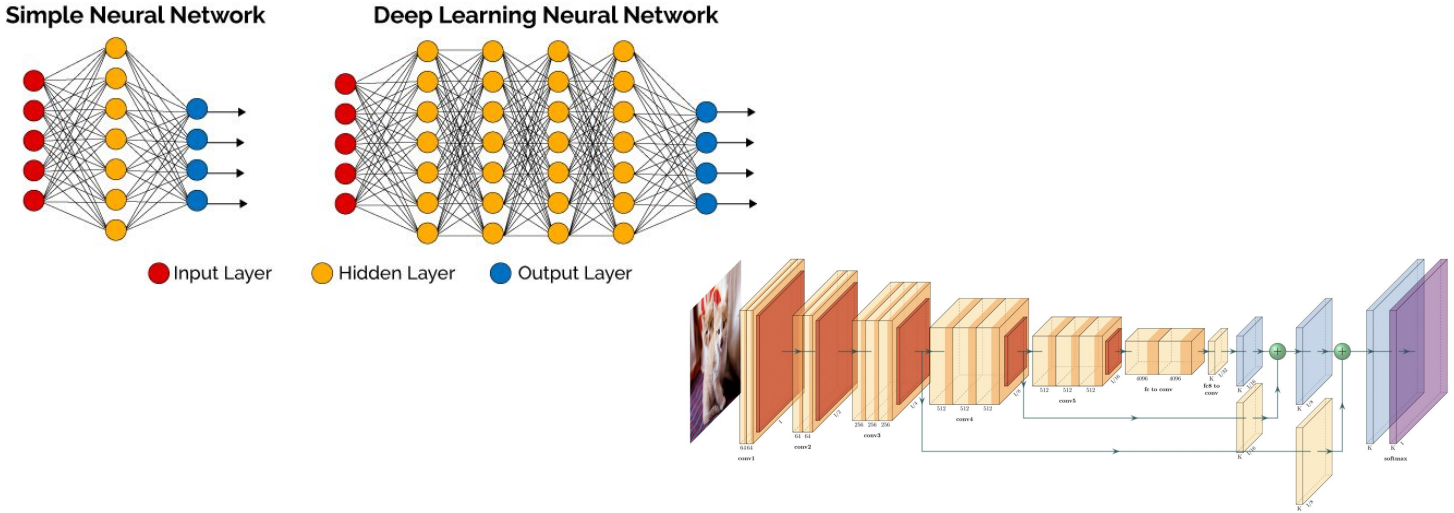
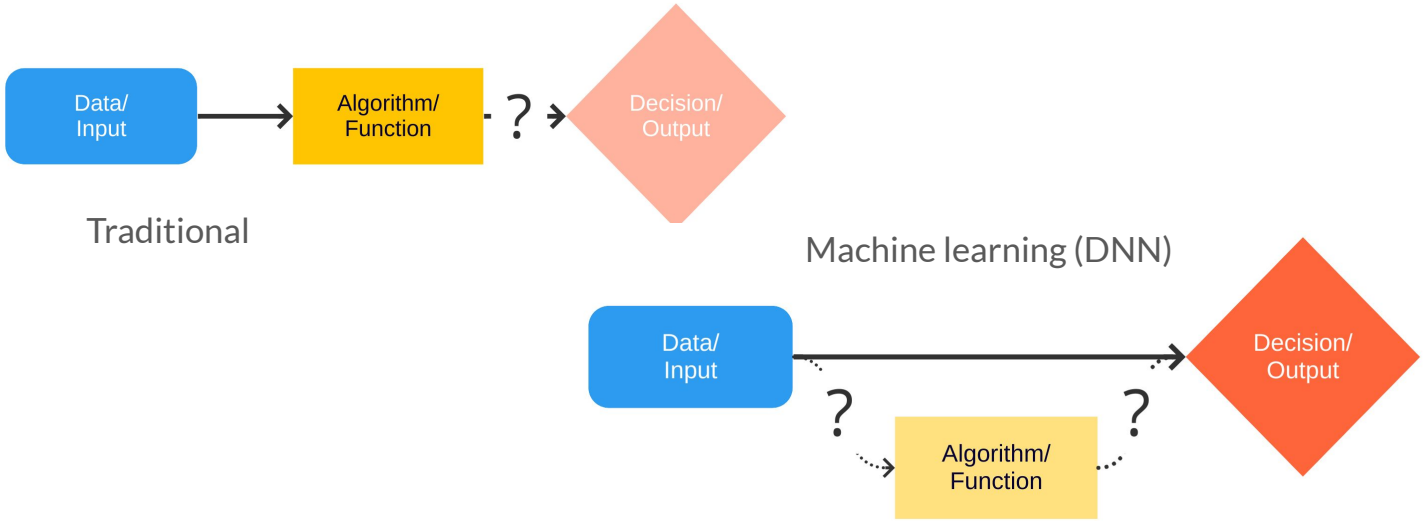



Image sources: https://cdn-images-1.medium.com/v2/resize:fit:800/1*5egrX--WuyrLA7gBEXdg5A.png https://github.com/HarisIqbal88/PlotNeuralNet

# Python, TensorFlow, Machine Learning


# Machine Learning?

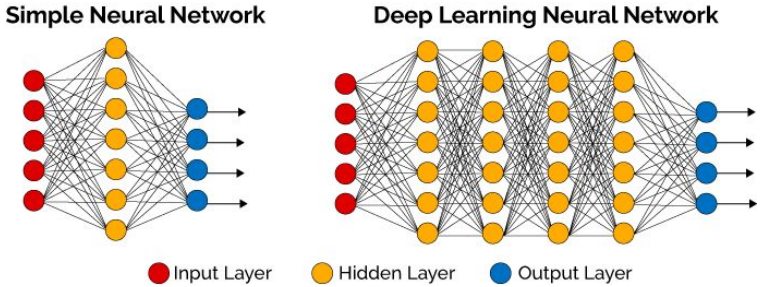



Made with miro.com

# Cats vs. Dogs; Hidden Driving Force in Machine Learning

Image source: https://www.kaggle.com/competitions/dogs-vs-cats/rules

# CNN/DNN (Convolutional/Deep Neural Network)



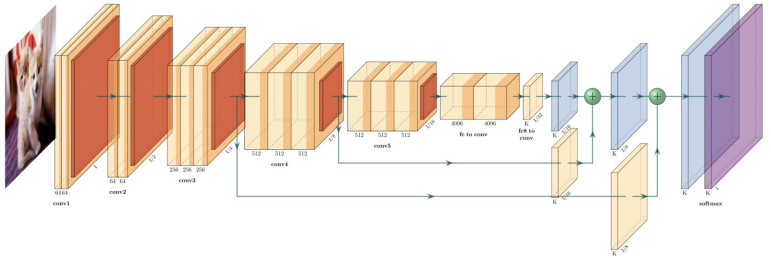
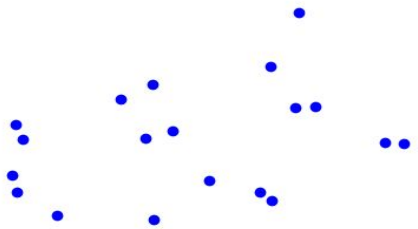



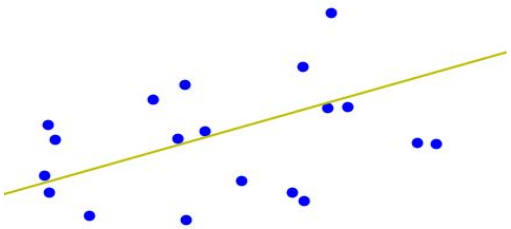
Image sources: https://cdn-images-1.medium.com/v2/resize:fit:800/1*5egrX--WuyrLA7gBEXdg5A.png https://github.com/HarisIqbal88/PlotNeuralNet

# Linear Regression; Best Approximation by Line

Given a collection of points



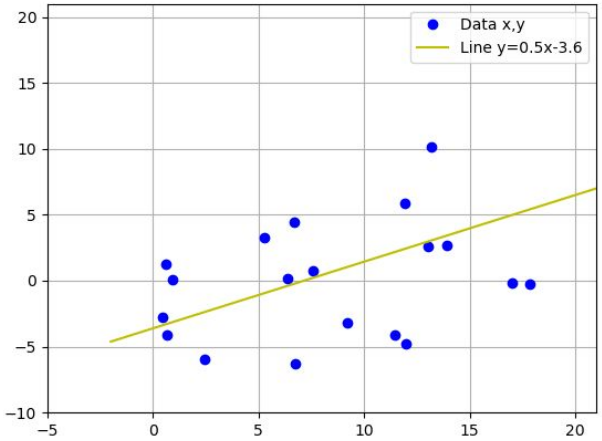
find the line that best approximates them



# Line

Line: y = **w***x + **b**

**x: input**
**y: output**
**w: slope; angle**
**b: y-int; ver. shift**



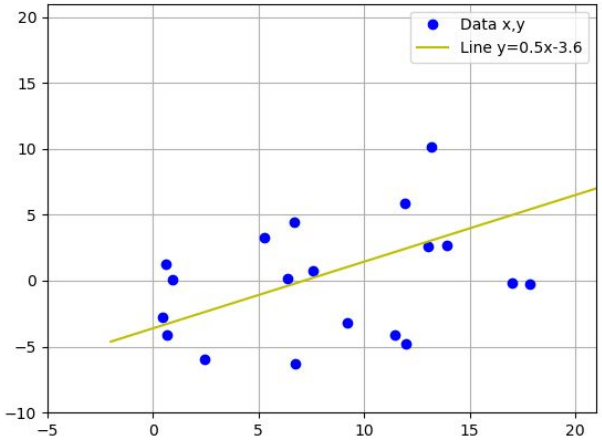
# Linear Regression Formula

$$w = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i-1}^{n}(x_i - \bar{x})^2}$$

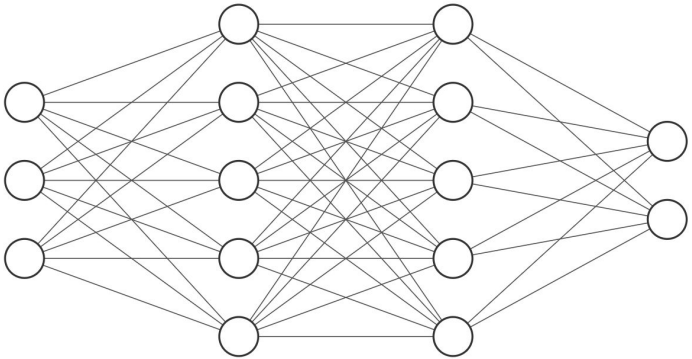
$$b = \bar{y} - w\bar{x}$$

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

$$\bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i$$



# Linear Regression in Neural Networks



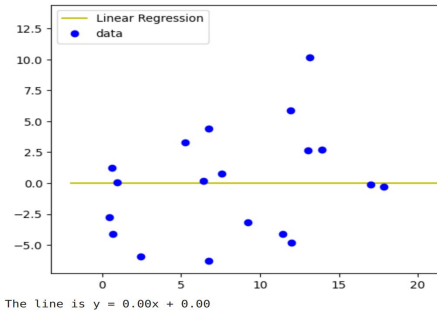

Simple Linear Regression

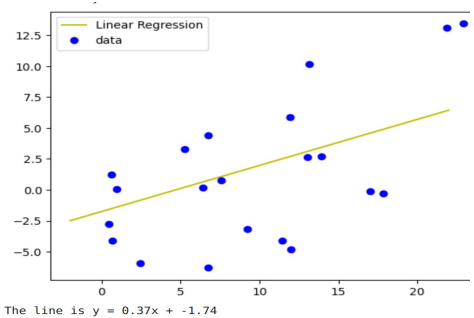
# Linear Regression in Neural Networks

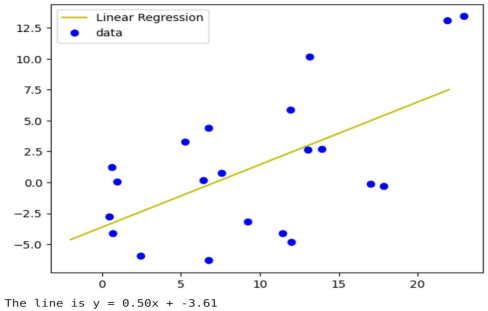
Goal: Fit a line (determine w & b in y = wx + b) that best approximates the given points in the following steps.

- ❏ Minimize L, the loss/error by
- ❏ Optimizing L using calculus
- ❏ Gradient descent

# Linear Regression with Simple Neural Network

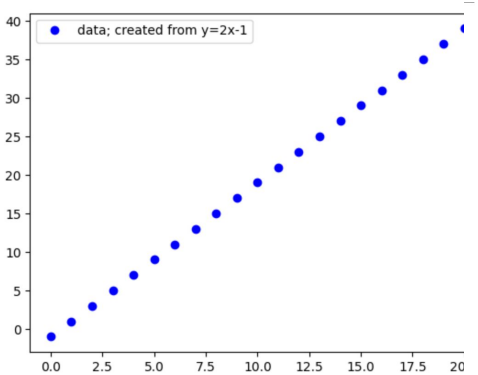


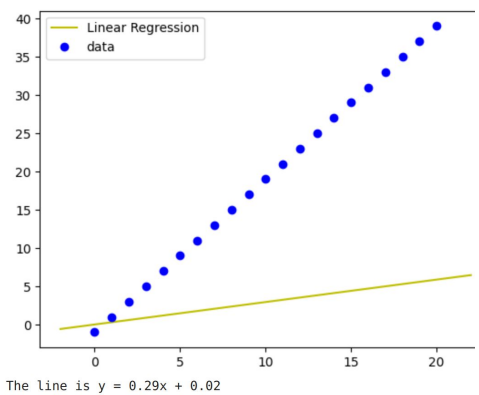



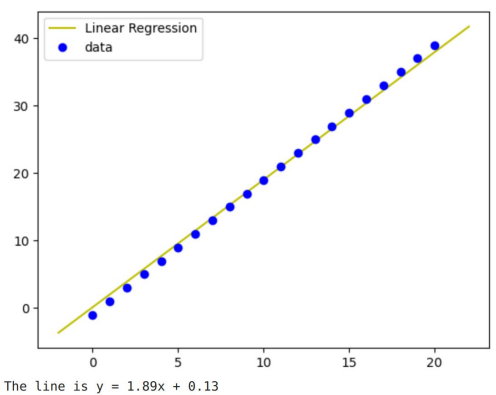




https://colab.research.google.com/drive/10nzTmJeZ9F1RzwkHg12ROZYe47dTWMUS?usp=sharing

# Linear Regression Hands-on Example




https://colab.research.google.com/drive/1fy0FGKoGfjFxdfp1agUKlRsj5YL16RfX?usp=sharing

# Seek to Support More Projects

- Machine-learning
- Scientific Computing
- Actively Seeking for Additional Projects from non-STEM Disciplines
  - Data Collection
  - Large Language Models such as ChapGPT
  - Image hosting
- Student Oriented Projects

# Questions & Thank you!

Feel free to contact us if you have any questions

- Youngsu Kim, youngsu.kim@csusb.edu
- https://www.csusb.edu/high-performance-computing

# HPC Team at CSUSB

- **Gerard Au** Chief Technologies Officer
- **Dr. Bradford Owen** Interim AVP of Faculty Development/Chief Academic Technologies Officer
- **Dr. Dung Vu** HPC consultant, Analyst/Programmer
- **Dr. Youngsu Kim** HPC Faculty Fellow, Assistant Professor of Mathematics

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