CSEE5590/CS490-0004: AI for Cybersecurity

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Instructor

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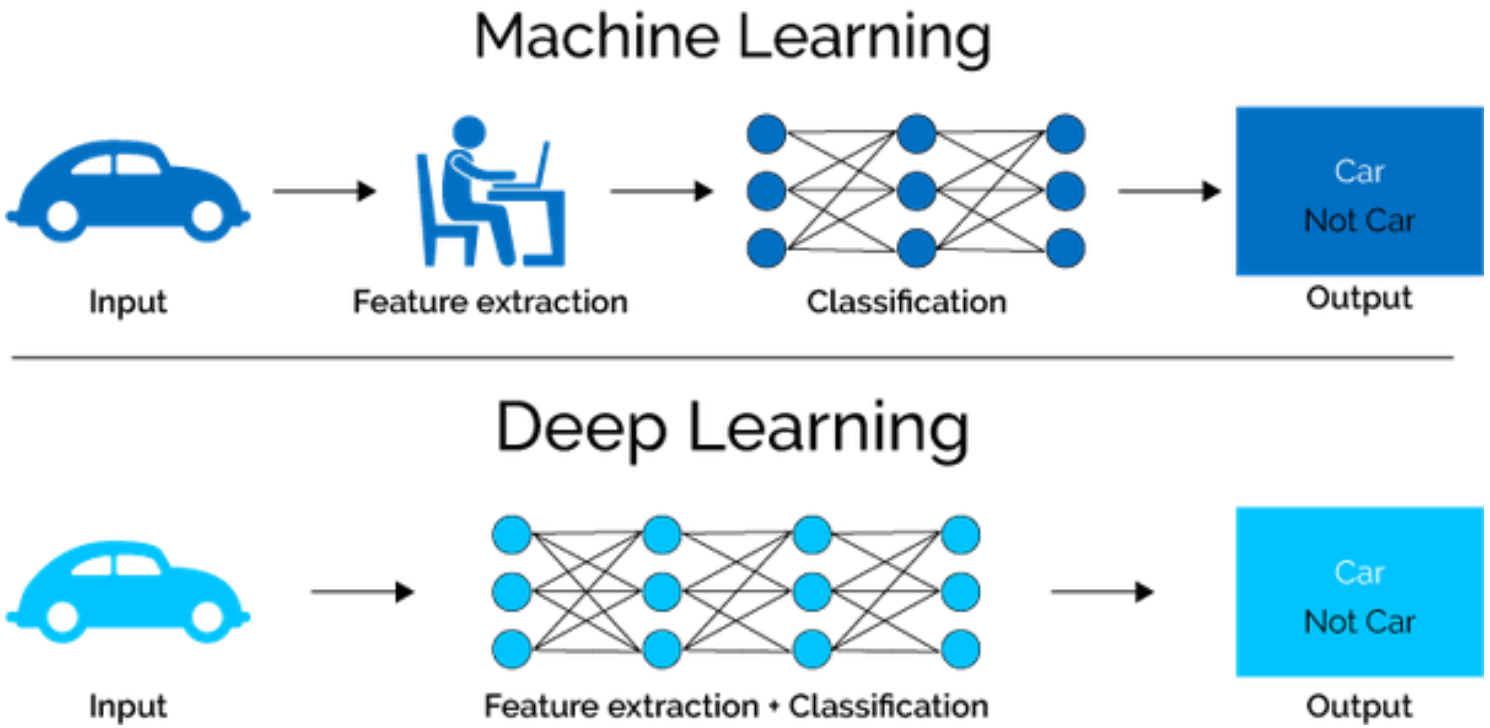
Course: AI for Cybersecurity

- AI, and specifically Deep Learning, has advanced the SOTA in an growing number of domains.
- Thus, there is a high demand to develop DL models, but the privacy and security of these models have been ignored for some extent.
- We study how to secure DL models and preserve data privacy when developing and implementing DL models.

What is Deep Learning?

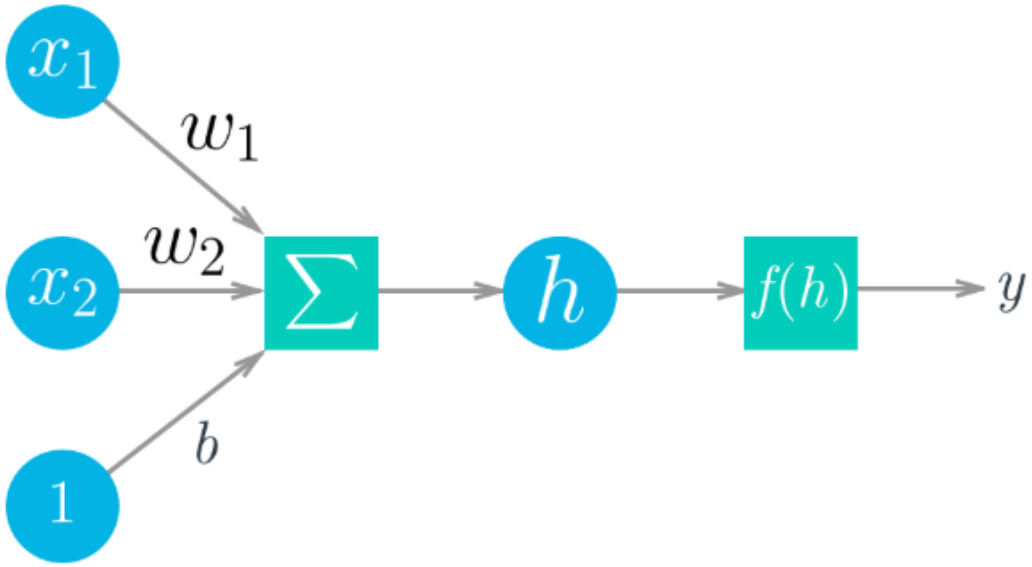
- A subfield of Machine Learning that can automatically detect the features/patterns of data without user intervention.



Neural Networks

Deep Learning is based on ***artificial neural networks*** which have been around in some form since the late 1950s.

The networks are built from individual parts approximating neurons, typically called units or simply "neurons."

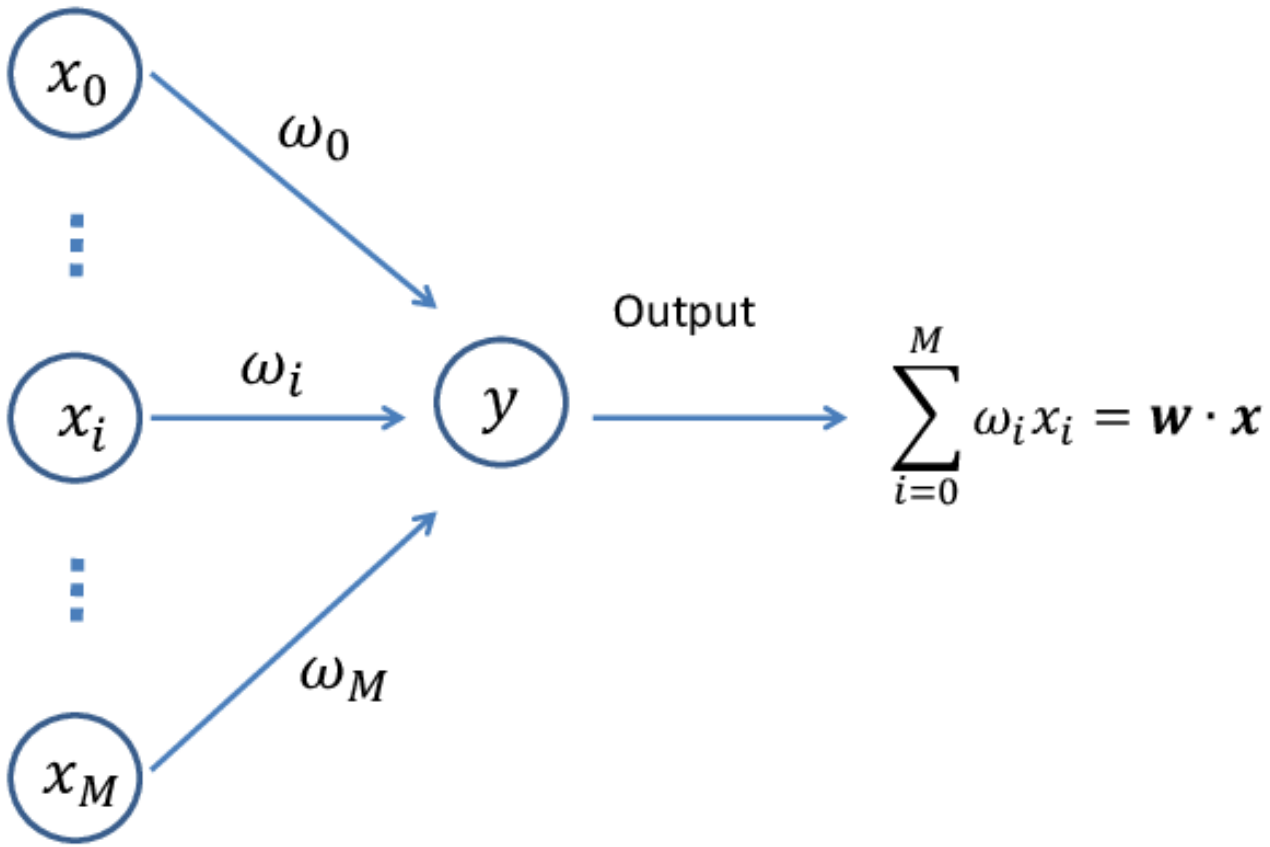


$$y = f(w_1 x_1 + w_2 x_2 + b)$$

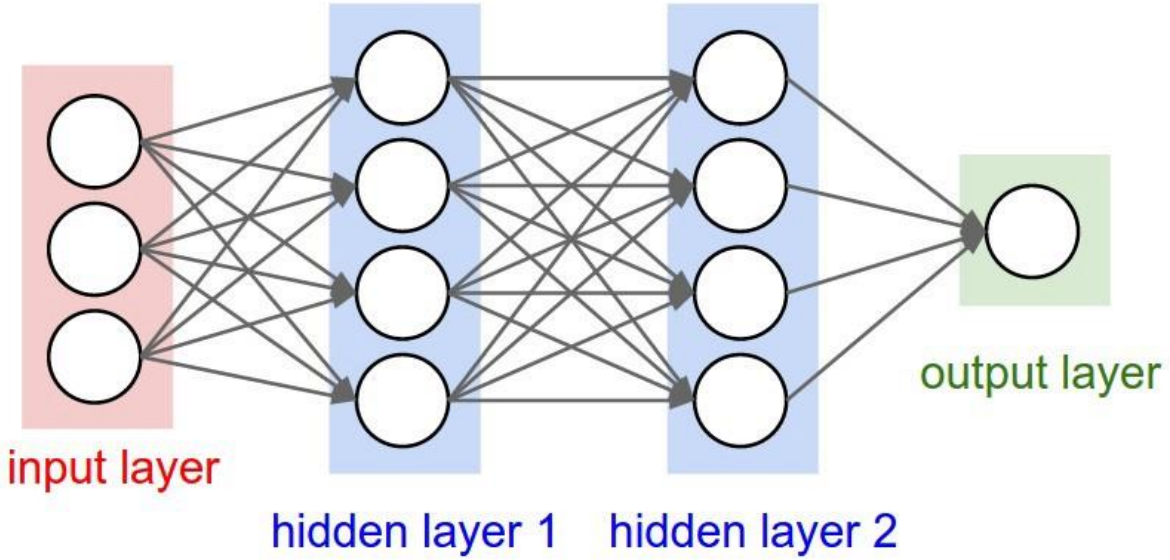
$$y = f\left(\sum_i w_i x_i + b\right)$$

Referece: https://classroom.udacity.com

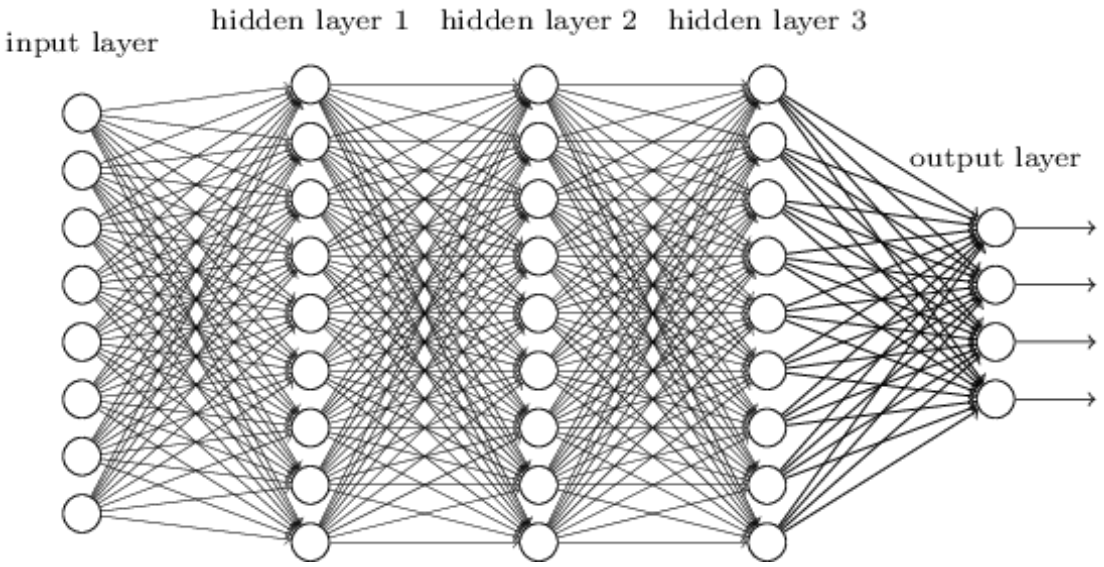
One-Layer Neural Network: How does it work?



The General Architecture of a Deep Neural Network



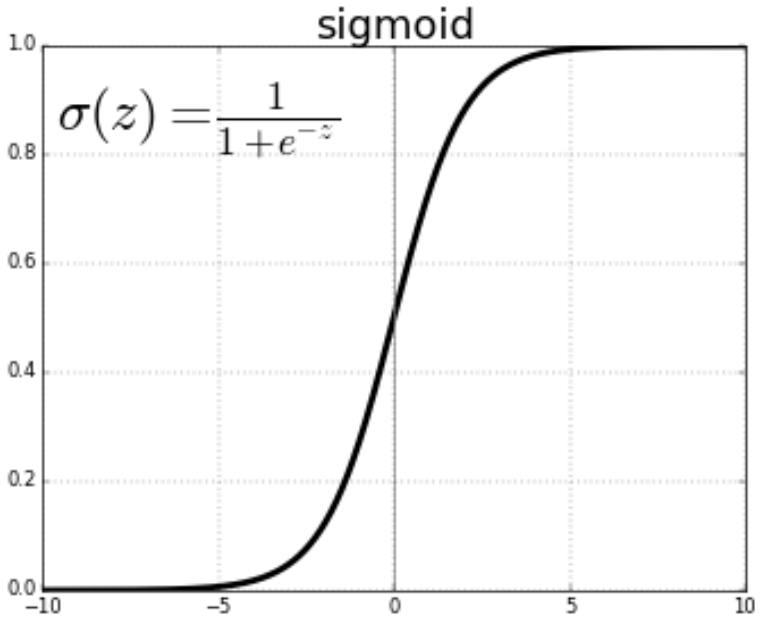
More hidden layers for more complicated tasks (NLP, Computer Vision, etc.)

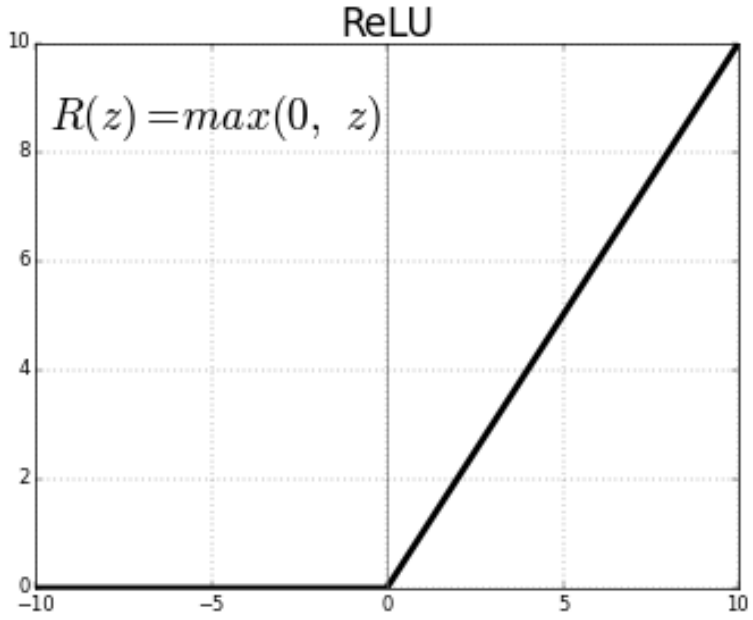


Activation Functions

Used to break the linearity of the matrix computations by compressing the network values between 0 and 1 or -1 and 1.

- ReLU
- Sigmoid
- Tanh
- Softmax





More on Deep Neural Networks

Do not worry about these concepts, we will study them in more details as the course progress (top-down appraoch):

- A loss function (e.g., mean square error)
- Backpropagation
- Stochastic Gradient Descent
- Hyperparameters
- …and others

Google Colaboratory

- Google Colab is an online Notebook service with that provides a GPU for up to 12 hours per session for free.
- You only need to create a Google account (gmail) and access the GC from your Google Drive.
- Here's the formal "getting-Started" tutorial from Google:

https://colab.research.google.com/notebooks/welcome.ipynb

- We will run this step-by-step in the class

Introduction to PyTorch

What is PyTorch?

PyTorch Locally:

- To install ***PyTorch*** Locally, follow the instructions here: https://pytorch.org/get-started/locally/
- You should be able to manage Virtual Environment on your own system. I recommend using ***Conda***. Follow the instructions here: https://conda.io/en/latest/
- Install ***NumPy*** and ***Jupyter Notebooks*** (should be easy to install from within conda –if not already installed with the package)

Introduction to PyTorch

If you do not have a local GPU, I recommend using Google Colaboratory.
https://colab.research.google.com/notebooks/welcome.ipynb

If you would like to use other paid services, check:

- AWS: https://docs.aws.amazon.com/dlami/latest/devguide/gpu.html
- GCP: https://cloud.google.com/gpu/
- FolydHub: https://www.floydhub.com/

Introduction to PyTorch

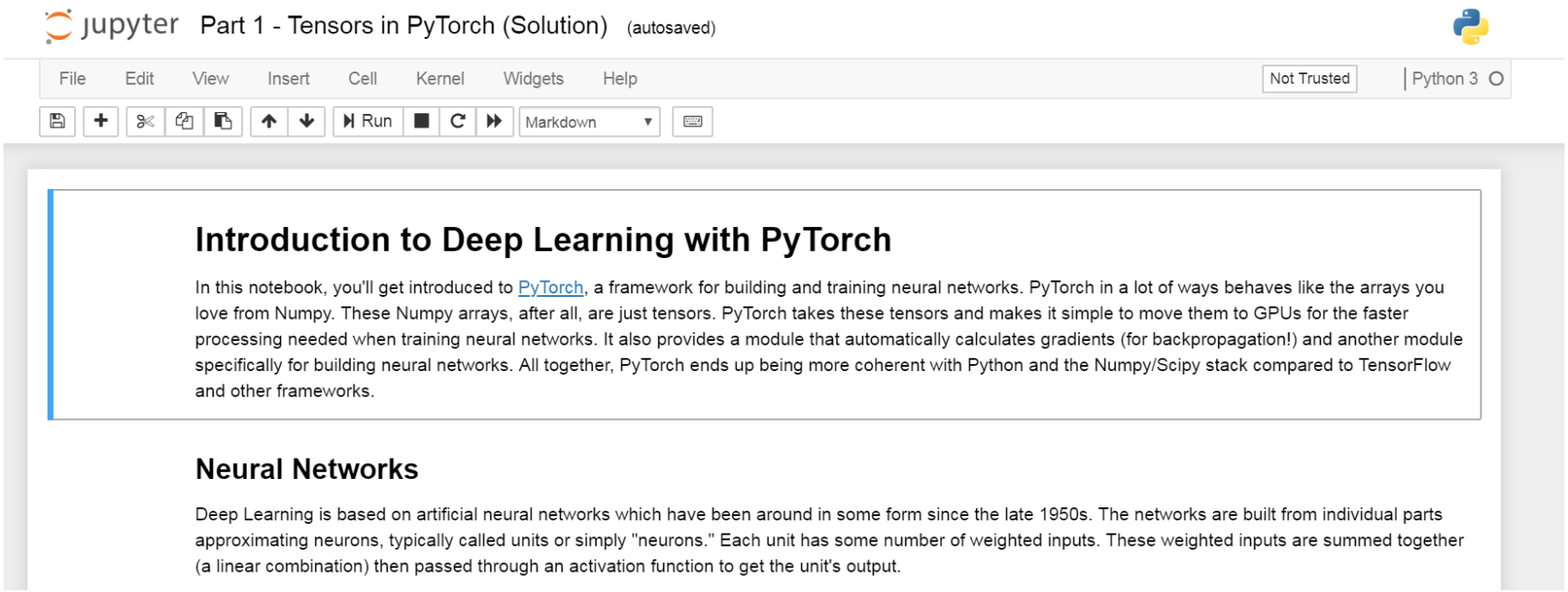
- The best resource to start learning PyTorch, is to learning by example from the following Notebooks on GitHub (these are used for teaching a Deep Learning Nanodegree in Udacity). Following is a modified version to fit our classroom.
- Clone the following repository (It includes more teaching materials and ICP 1):

https://app.box.com/file/469880222759

Building a Deep Neural Network (DNN) from scratch:

Notebook1:

deep-learning-v2-pytorch >> intro-to-PyTorch >> Part1 (tensors in PyTorch)



ICP1 (Exercise Part1 + Part2)

Part 1: Build a DNN using Tensors

Part2: Build a DNN using PyTorch nn module and download the MNIST dataset