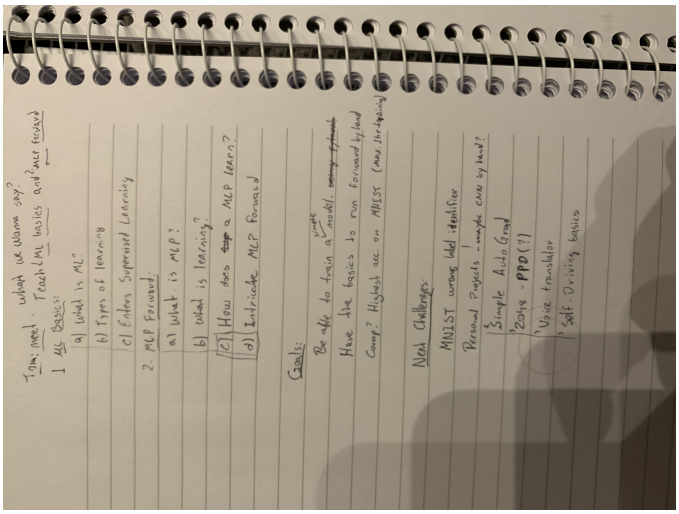
ML Intro Class

▼ Reference



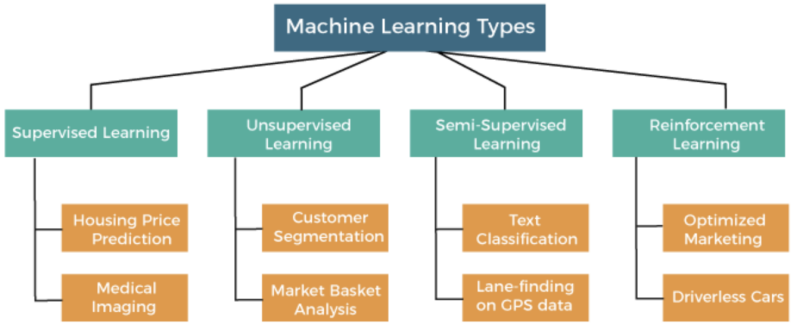
▼ What is ML

The act of receiving a correct output without explicitly programming it

Informal sketch of proof of convergence

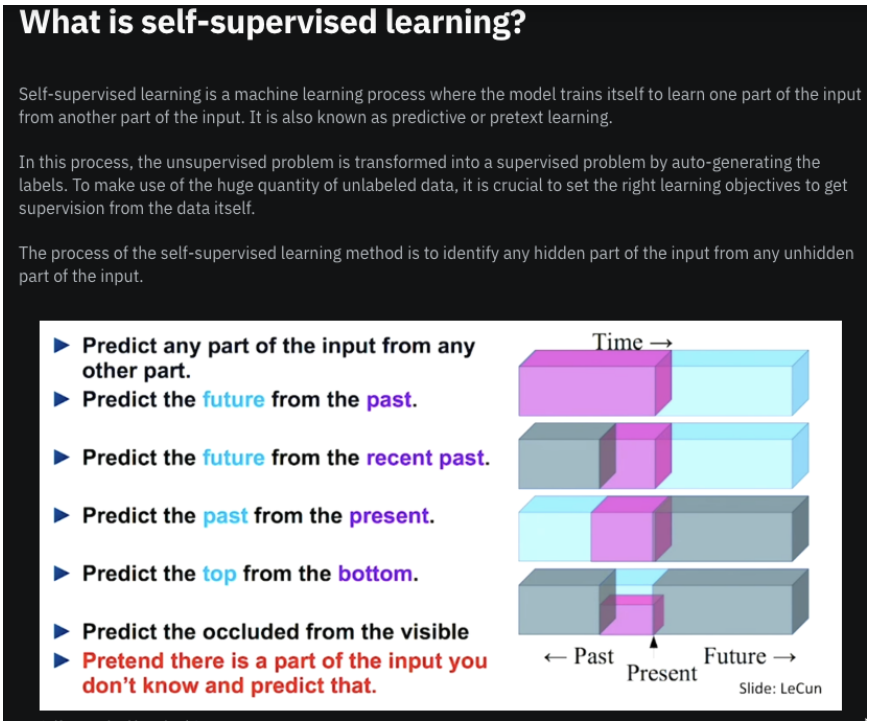
- Each time the perceptron makes a mistake, the current weight vector moves to decrease its squared distance from every weight vector in the “generously feasible” region.
- The squared distance decreases by at least the squared length of the input vector.
- So after a finite number of mistakes, the weight vector must lie in the feasible region if this region exists.

▼ Types of ML



▼ <u>Self-Supervised</u> Learning

Is it part of semi-supervised learning? Nope



▼ Enters Supervised Learning

▼ The Process

1. Inputing **DATA** with respective labels (answers / truth values)

2. Through a **MODEL** that outputs a prediction
3. From prediction, get value for error of the prediction AKA: **LOSS**
4. **OPTIMIZE** adjustable parameters (weights) to improve performance on Loss
5. **TEST** your model performance on unseen data (test data)

▼ DATA

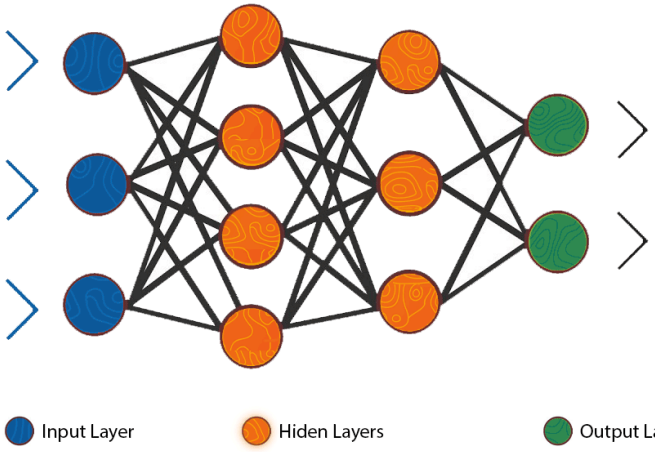
Get Data and Labels

Prepare data

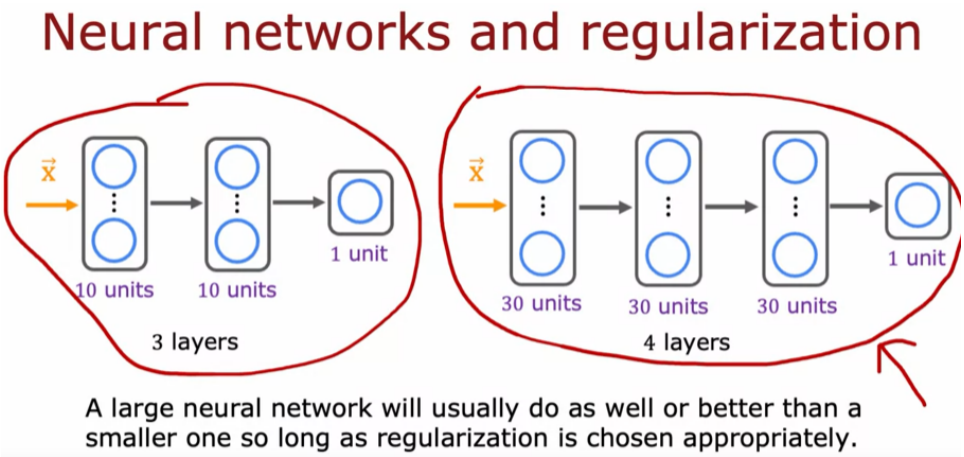
▼ MODEL (Structure)

▼ **Perceptron** (simplified model of biological neuron - initial goal binary classification): W * X + b

▼ **Multi Layer Perceptron (MLP)**: A fully connected multi-layer neural network



▼ **Deep Learning**: more than 2 hidden layers (nowadays way more than that)



▼ What do you have to choose

Output Layer + Layers: neurons, activation functions, other fancy shit

▼ LOSS

Depends on the type of problem you want to solve, there should be a selection (ChatGPT somewhat works) to check which one better fits your problem and data.

A function (good if its convex = differentiable) that outputs a value which considers the error for a given prediction, the closer the prediction to the truth, the better (lower loss).

▼ LOSS (COST) Functions

MSE, RMSE - Regression

Binary Cross Entropy - Classification (2 classes)

Cross Entropy - Classification (n classes)

Hinge Loss - Classification (2 classes)

KL Divergence - GAN's, Variational Autoencoder

▼ OPTIMIZE

This is how the *Learning* works.

Here lies the tasty BACKPROP - method introduced by Geoffrey Hinton in 1986, which resparked the interest in AI

▼ It consists in an algorithm that given a prediction and a loss function you can return a update to the parameters (weights) that improve the performance of the model on the training data.

```
def optm(pred, loss):
  do computations
  return updated_weights
```

▼ What do you have to do

```
optimizer = torch.optim.Adam(model.parameters(), lr=learning_rate)

optimizer.zero_grad()
loss.backward()
optimizer.step()
```

▼ **Optimization algorithms**

Gradient Descent

Momentum

RMSProp

ADAM

ADAGrad

▼ TEST

The goal is to see the model performance on the data, however, due to the high capabilities of deep learning, the model is able to “memorize” the training set, thus not performing on any other set of data. This is called OVERFITTING. To prevent this we separate a set of the data before even touching the model, called Test set.

A performance metric should be choosen and then tested on the test set (you only run Inference) - only run predictions, do not optimize.

The Famous forward Step

▼ For each Layer

Input - data at beggining

Weights - Learnable parameters

bias - Learnable parameters

Z = W * Input + bias

A = activation function (Z)

```
A = Layer(input, weight, bias, activation_function)
```

▼ Goals

Train a ML model (which dataset or which problem) - using PyTorch

Able to compute forward by hand

Competition? (problem/dataset) date? by hand?

▼ Next Challenges

MNIST wrong label identifier

Simple AutoGrad || CNN by hand (only forward)