Project 3

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Main Idea

- Our idea was to train a neural network that (with given data) would be able to predict whether or not to admit any applicant to a school.

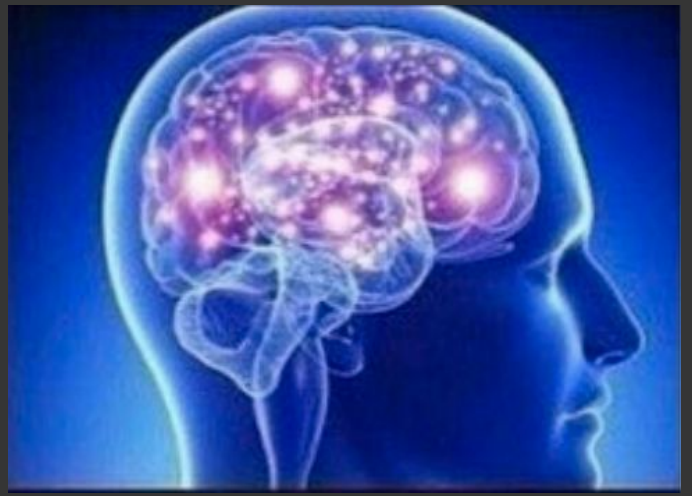
Intro

- Our project discusses concept of Neural Networks in order to develop a more efficient and fair admissions process.
- In order to begin discussing our topic, we must begin with explaining some major concepts that contributed to the computational concept of a neural network.
- Let’s begin at the root: Artificial Intelligence and Machine Learning.

Artificial Intelligence.

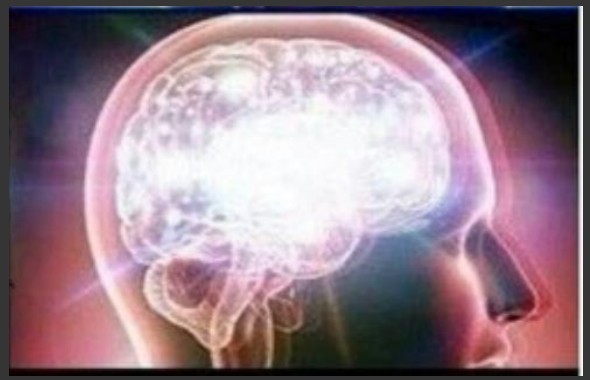
- A.I. is the development of computer systems that could do things which would normally need human intelligence [1].

- Examples of such tasks we are able to accomplish using A.I. concepts are speech recognition, decision making and visual perception.



Machine Learning.

- Machine learning is an application of A.I.
- Main idea is that if we give machines access to data, they can learn from this data themselves.
- Using Machine Learning algorithms, a computer program can access data and learn from it.
- The algorithm will then use the data to build a statistical model to make predictions from [2].

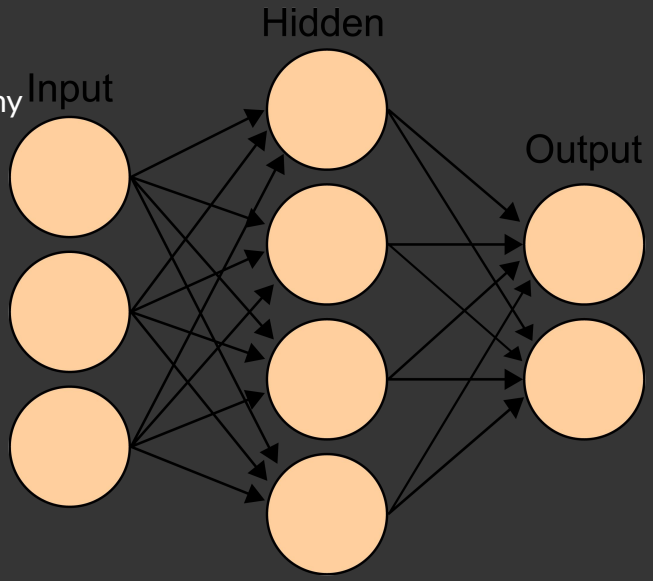


Neural Networks vs Machine Learning

- “A Neural Network is a computer system designed to work by classifying information in the same way a human brain does.” [3]
- In a machine learning algorithm, if a prediction is wrong, the adjustments are made using a concept called gradient descent.
- In a neural network, the program is able to make these adjustment using back propagation which incorporates gradient descent.[7]
  - Back prop is used here instead of gradient descent because back prop will step through the multiple layers of network.

Structure of Neural Network

- A neural network is structured with an input layer, output layer and as many hidden layers as the programmer wants. [4]
- Any amount of inputs are given and passed into the hidden layer.
- Each layer can have any amount of neurons, each performing a non-linear transformation on the data.[6]
- At the end, the output layer will produce an output.



The Neuron and Forward Prop

- Each neuron performs a non-linear transformation on the data being passed through using forward propagation.
- In forward propagation, a summation is created by multiplying the data matrix by a matrix filled with weights. [5]
- Then it is passed through the second portion of the neuron called the activation function where the data is further manipulated and propagated on to next neuron.

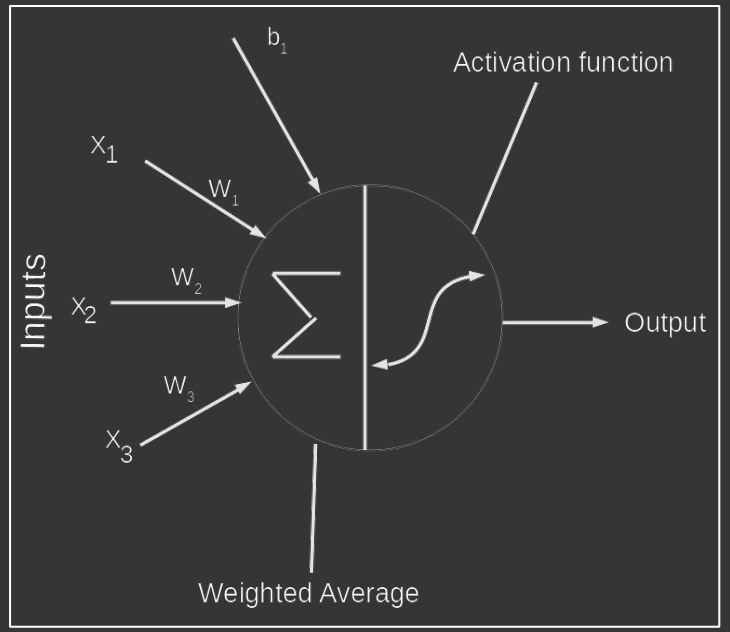
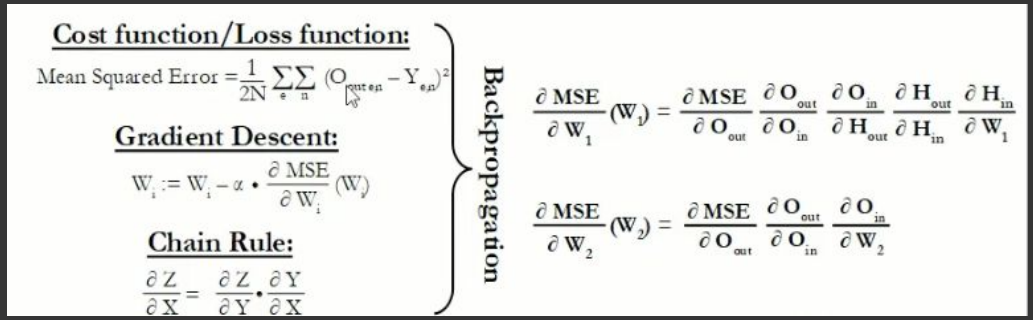


Image Source: [1]

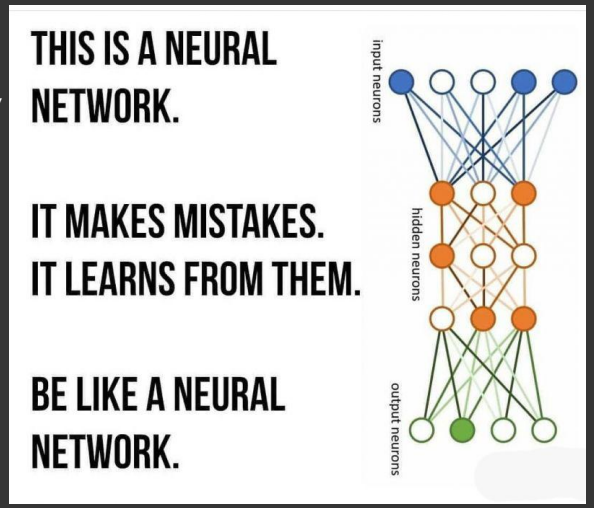
Back Propagation

- Back Propagation is what differs a neural network from other machine learning techniques.
- In back propagation, we step back in through the hidden layers after obtaining the output.
- We use the output to calculate an error value. Using this error value, we compose a calculation which will output a value to adjust our weights with.
- This calculation will involve concepts such as gradient descent, and Derivations. [5]
- Once the weights are adjusted in a layer, it will then continue to back propagate and update the weights in the previous layer.
- Back propagation will continue until we arrive at the input layer.



Training Data

- When training the neural network with our data, we obtain initial output values.
- Back propagation is then executed which allows for adjustments to the weights.
- In order to build a model, we must iterate through this process many times to improve our network's predictions.
- More data, along with more iterations allows for more efficient predictions.
- Learning rate



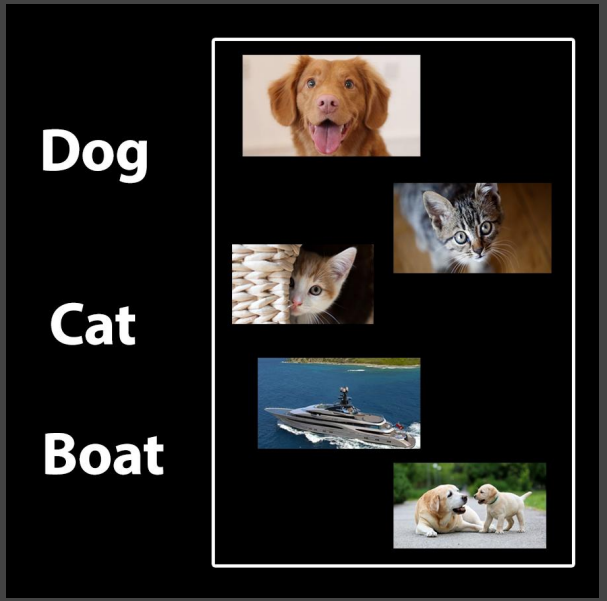
Checking Efficiency

- One way is to study the graph of the mean of your squared error.

- We can also verify the accuracy by comparing the known values to the output values of our neural network.

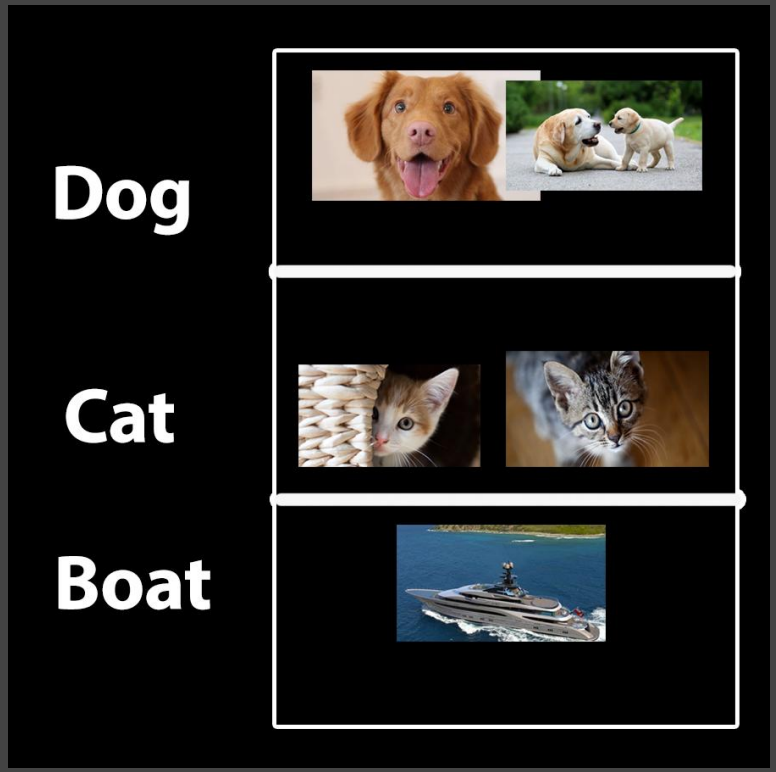
Example

- An example of a neural network that could identify images would be comprised of an initial dataset which includes a multitude of labeled pictures (pictures of cats, cars, boats, etc.)
- This data is fed into the neural network.



Example cont.

After training with the data and building a model, the neural network will be able to (with a certain degree of accuracy) determine what any one of the pictures are.



Applications of Neural Networks

- There are many innovations that we are familiar with that are comprised of neural networks
- Many social media platforms such as Facebook, Instagram and Pinterest make use of the neural network algorithm
- Other famous applications include voice-to-text, search suggestions and online check deposits. [8]

Our Project

- In our project, we will build a neural network that will efficiently predict the students that will be admitted into a school.
- We initially wanted to model it after the CSUN's admissions process but they did not reach out to us so we had to create mock data.

Dataset

- Because we had to create mock data, we needed to determine acceptance factors.
- A study was conducted regarding the current state of the college admissions process. [9]
- In the study they summarized the factors that various colleges base their acceptance on. From that we compiled this list of factors to take into account:
    - GPA
    - Class Rank (within their school)
    - SAT Score
    - Teacher Recommendation Score*
    - Extracurricular
    - College Interview
    - AP Classes

*we had to convert this from subjective to an objective variable.

Sample of Data

- 100 students in our dataset: 80 to train with and 20 to test accuracy after.

STUDENT	GPA (1-4)	Class Rank (1-300)	SAT scores	Recommendation	Extra Curricular (0 - 8)	College Interview (1-10	Advanced Placement (1-40)	Outcome
1	1.80	262	510	2	5	2	0	0
2	1.24	257	704	2	0	2	1	0
3	1.35	253	732	1	1	3	0	0
4	3.60	34	1345	5	7	8	8	1
5	1.53	246	760	2	5	5	0	0
6	1.70	243	804	2	1	2	0	0
7	2.89	120	1150	4	3	4	3	1
8	2.50	219	900	3	0	5	1	0
9	1.91	206	859	1	7	7	0	0
10	3.40	50	1387	5	1	9	10	1

Explanation of Process

- Our network is structured as follows
  - Input layer = 7 Variables
  - Hidden Layer = 1 layer, 4 Neurons
  - Output layer = 1 output
- In the activation portion of forward propagation, we decided to use the relu function in the hidden portion and the sigmoid function to produce the output.
- The relu function will produce a value that is either zero if negative or just the positive value if positive
- The sigmoid will produce a value between 0 and 1

$$R(z) = max(0,\ z)$$

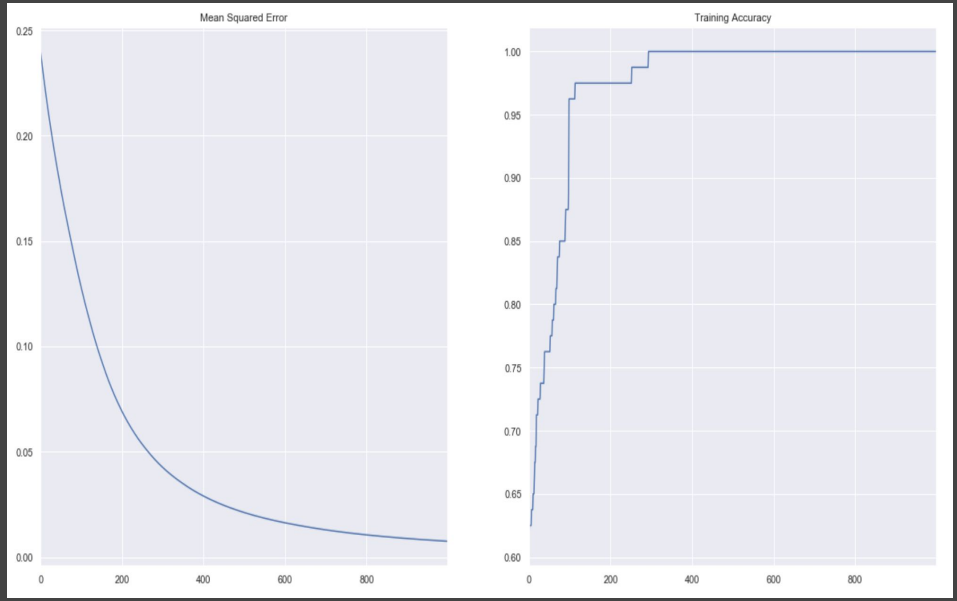
$$S(x) = \frac{1}{1 + e^{-x}}$$

Neural Network Build

- We implemented the neural network using Python
  - Python libraries that we used are numpy, pandas and sci-kit learn
- To run our Python code, we used Jupyter Notebooks so we can run each block of code individually

Results of Training set

- We passed the 80 instances into the neural network and ran the process of training it 1000 times.
- Since accuracy hits 1.0, that means our test set must have a 100% accuracy of prediction.



Results of Test Set

- After passing in our 20 instances in the test dataset, we acquired this result:

```
Accuracy: 1.0
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- Just as predicted with our accuracy in the training model, our model can predict 100% of data passed into it.

Contributions

- We used a machine learning algorithm to learn how to do the job of admitting students to a University using similar factors to the admissions process of CSUN.

- Using a neural network, instead of people, we remove the bias and corruption that has taken place.

Why Neural Network?

- Neural Networks are efficient without taking a toll on our computing power.

- Neural Networks adapt to using more data quite easily because of back propagation.

Limitations

- Mock (inaccurate) data

- Changing variables from subjective to objective
  - Would have more efficient if we received guidance from admissions.
  - I.e. teacher recommendation score, interview score

Future Possibilities

Having a neural network could help standardize the admissions process for colleges & universities all over the world as well as creating a more efficient application process for students.

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Questions?

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