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.

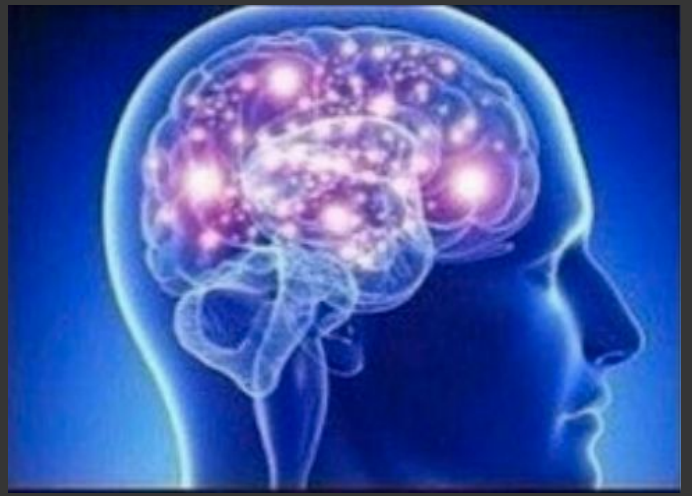
Intro

- 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.

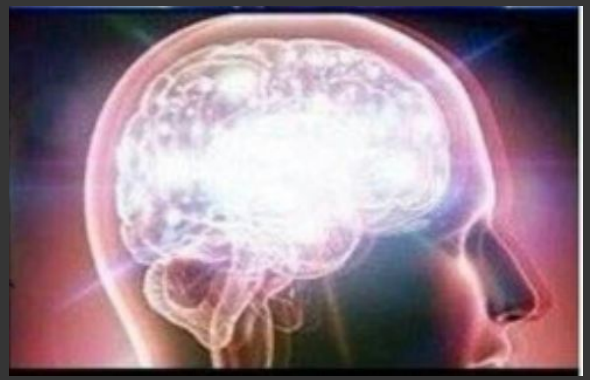
- A.I. is the development of computer systems that could do things which would normally need human intelligence [1].

- 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].

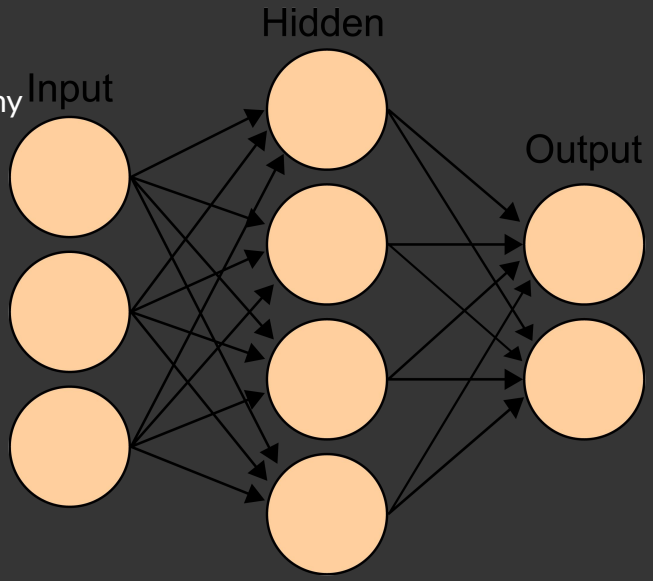


Neural Networks vs Machine Learning

- “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 for each matrix entry in the resultant matrix is created by multiplying the data matrix by a matrix filled with weights. [5]
- Then each entry within the resultant matrix 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.

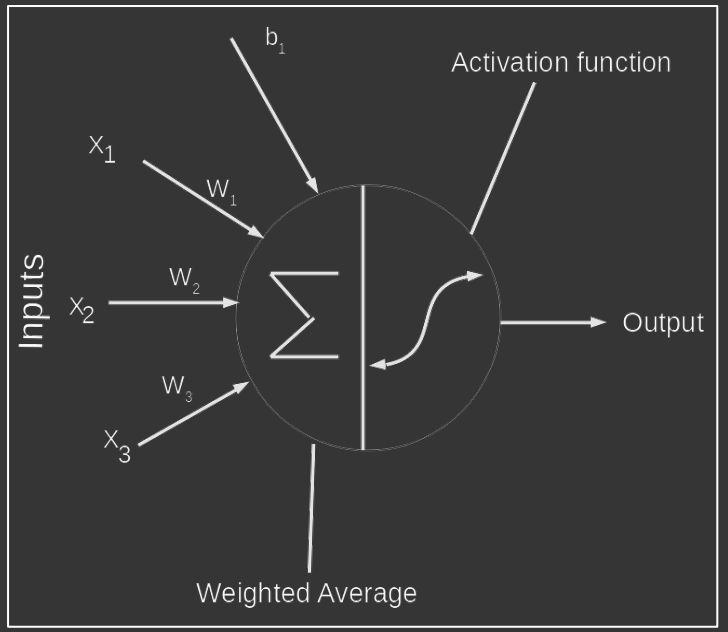
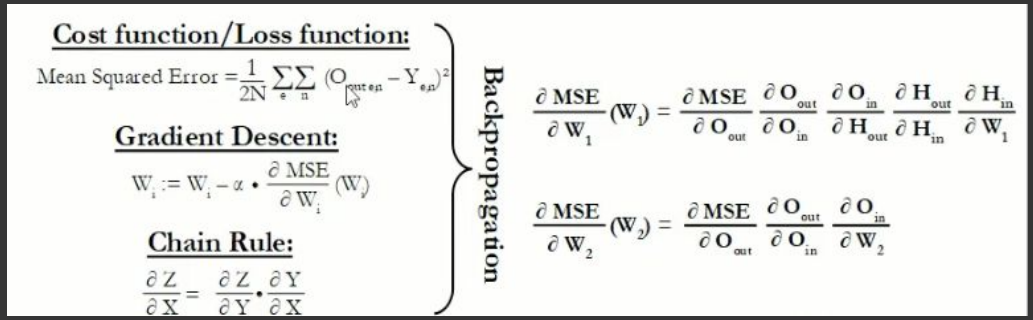


Image Source: [1]

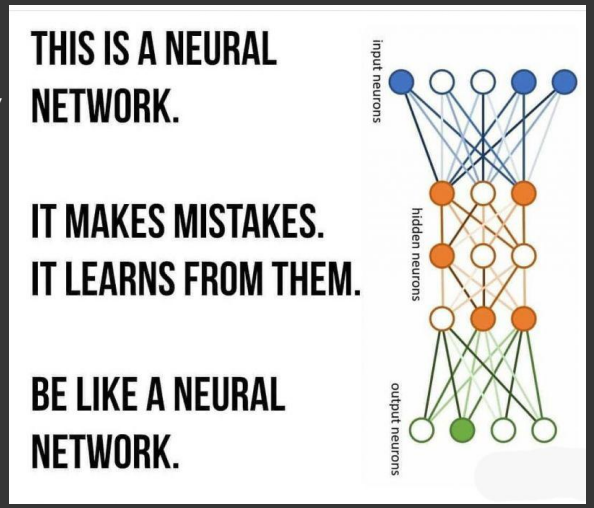
Back Propagation

- 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



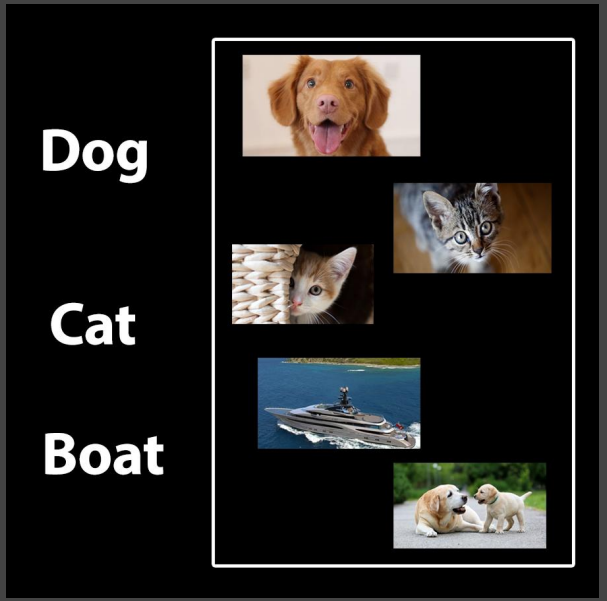
Checking Efficiency

- 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.

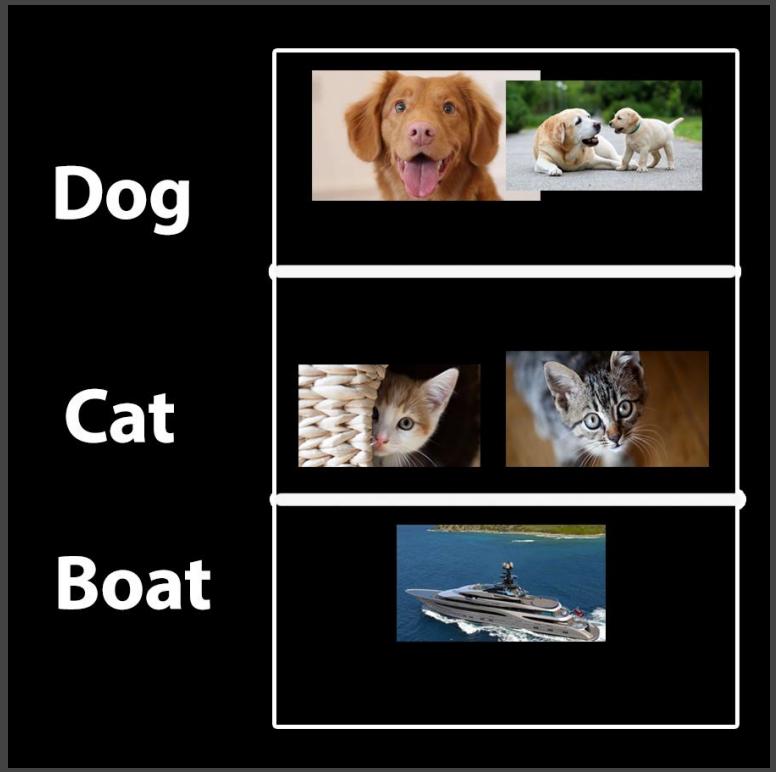
Example

- 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

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

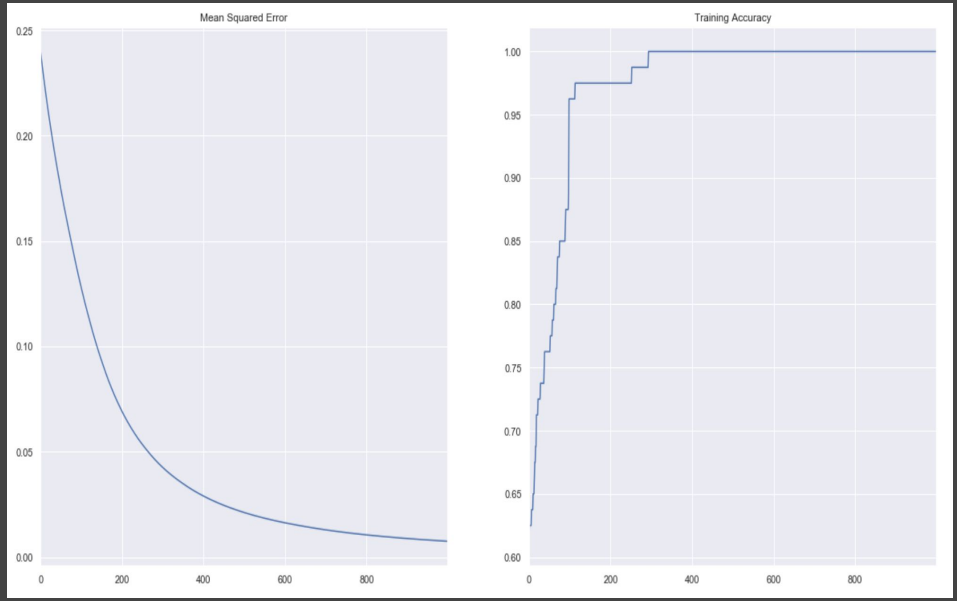
$$S(x) = \frac{1}{1 + e^{-x}}$$

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 the Jupyter Notebooks IDE 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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