VERIFICATION OF IDENTITY USING TRIPLET NETWORK

GROUP – 8
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PROBLEM STATEMENT

Given a dataset of biometric images (such as facial images, iris images, or handwritten text images), the goal is to train a deep learning model that can accurately verify the identity of individuals based on their biometric data.

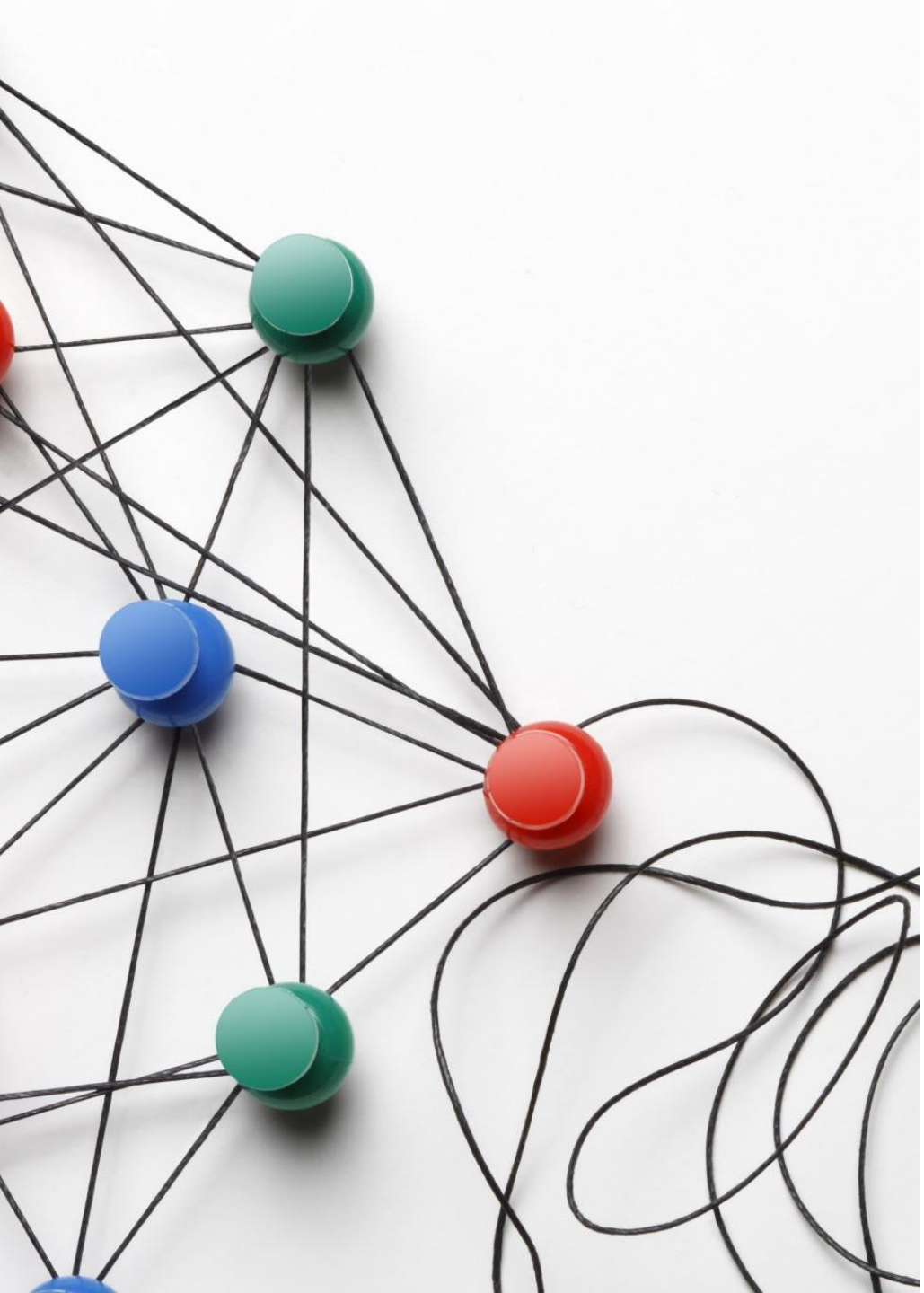
The model should be able to take an anchor image, a positive image of the same individual, and a negative image of a different individual, and determine if the anchor and positive images belong to the same individual.

The objective is to outline the scope of identity verification using triplet networks, and to provide a clear understanding of the desired outcomes and requirements of the solution.

NEED FOR IDENTITY VERIFICATION USING TRIPLET NETWORK

- Identity verification is a critical task in various applications, including security systems, financial transactions, and access control.
- Traditional methods for identity verification, such as passwords and PINs, can be compromised, leading to unauthorized access or fraud.
- Triplet networks can be used for face recognition, person re-identification, and other tasks that require identifying unique features of an individual.
- By using a triplet network, we can compare an input image to two other images and determine if they belong to the same person or not.
- The motivation for working on the problem of identity verification using triplet networks is to develop a more secure and reliable method for verifying identity that can be used in various applications.

TRIPLET NETWORK



WHAT IS A TRIPLET NETWORK

- A triplet network is a type of neural network used for learning similarity between objects.
- It is commonly used for tasks like face recognition, image retrieval and object tracking.
- The main idea behind a triplet network is to learn a mapping function that can map inputs to feature space, where the distances between features can be used to measure the similarity between inputs.

FRAMEWORK OF TRIPLET NETWORK

The framework for identity verification using triplet networks typically involves three components: an anchor image, a positive image, and a negative image.

- The anchor image represents the person whose identity we want to verify.
- Positive image is another image of the same person.
- The negative image is an image of a different person.
- The primary goal of triplet networks is to learn a good representation of image data that can be used to compare and classify different images.
- The basic idea behind triplet networks is to learn a function that maps input data points into a lower-dimensional space (i.e., an embedding space) such that similar data points are close together in the embedding space, while dissimilar data points are far apart.

LAYERS OF TRIPLET NETWORK

1. CONVOLUTION LAYER

- In a triplet network, the convolutional layer is the layer that applies convolutional filters to the input images to extract features.
- The convolutional layer typically consists of a set of learnable filters, each of which is convolved with the input images to produce a set of feature maps.
- The output of the convolutional layer is then typically fed into a pooling layer, which down samples the feature maps, reducing their size while retaining their most important features.

2. MAX-POOLING LAYER

- In a triplet network, the max pooling layer is a layer that is often used after the convolutional layer to perform down sampling of the feature maps.
- Max pooling is used to reduce the spatial dimensions of the feature maps while retaining the most important information, which helps to reduce the computational complexity of the network and prevent overfitting.

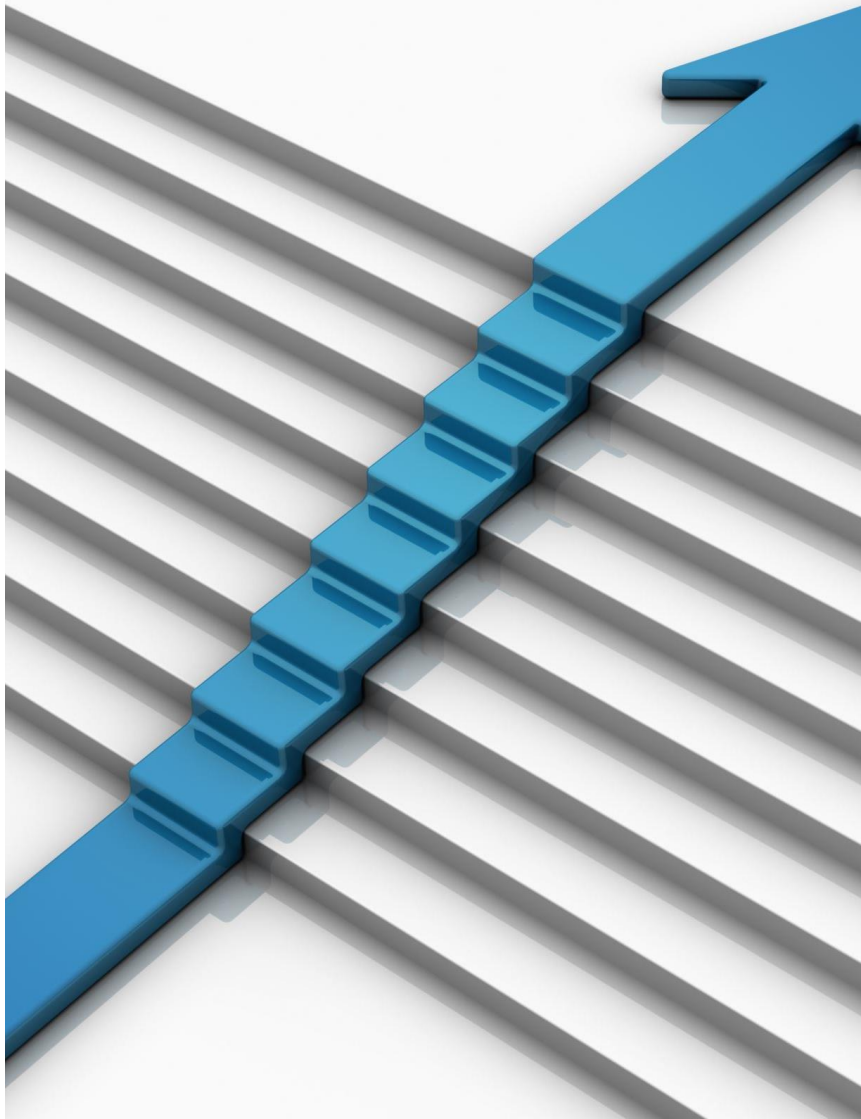
3. DENSE LAYER

- A dense layer is a layer that is used to learn a mapping between the feature vectors extracted from the input data by the convolutional and pooling layers and the metric space where similarity between data points is preserved.
- The dense layer is also sometimes called a fully connected layer, as each neuron in the layer is connected to every neuron in the previous layer.

TRIPLET LOSS

WHAT IS TRIPLET LOSS

- The triplet loss function computes the difference between the distance between the anchor and positive images and the distance between the anchor and negative images and penalizes the network if the difference is less than a margin value.
- The triplet loss is minimized during training to learn the optimal feature representation for image identification and retrieval.
- The Triplet Network is trained using a loss function called the Triplet Loss Function. This loss function is used to learn a distance metric between faces in an embedding space.
- A Triplet network is comprised of 3 instances of the same feed-forward network (with shared parameters). When fed with 3 samples, the network outputs 2 intermediate values - the L2 distances between the embedded representation of two of its inputs from the representation of the third.

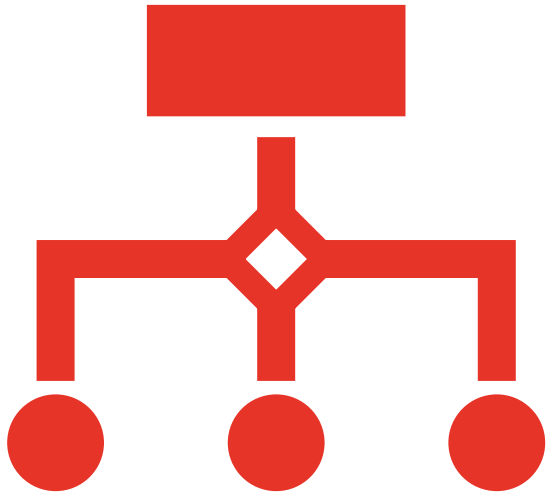


HOW DOES TRIPLET LOSS WORK ?

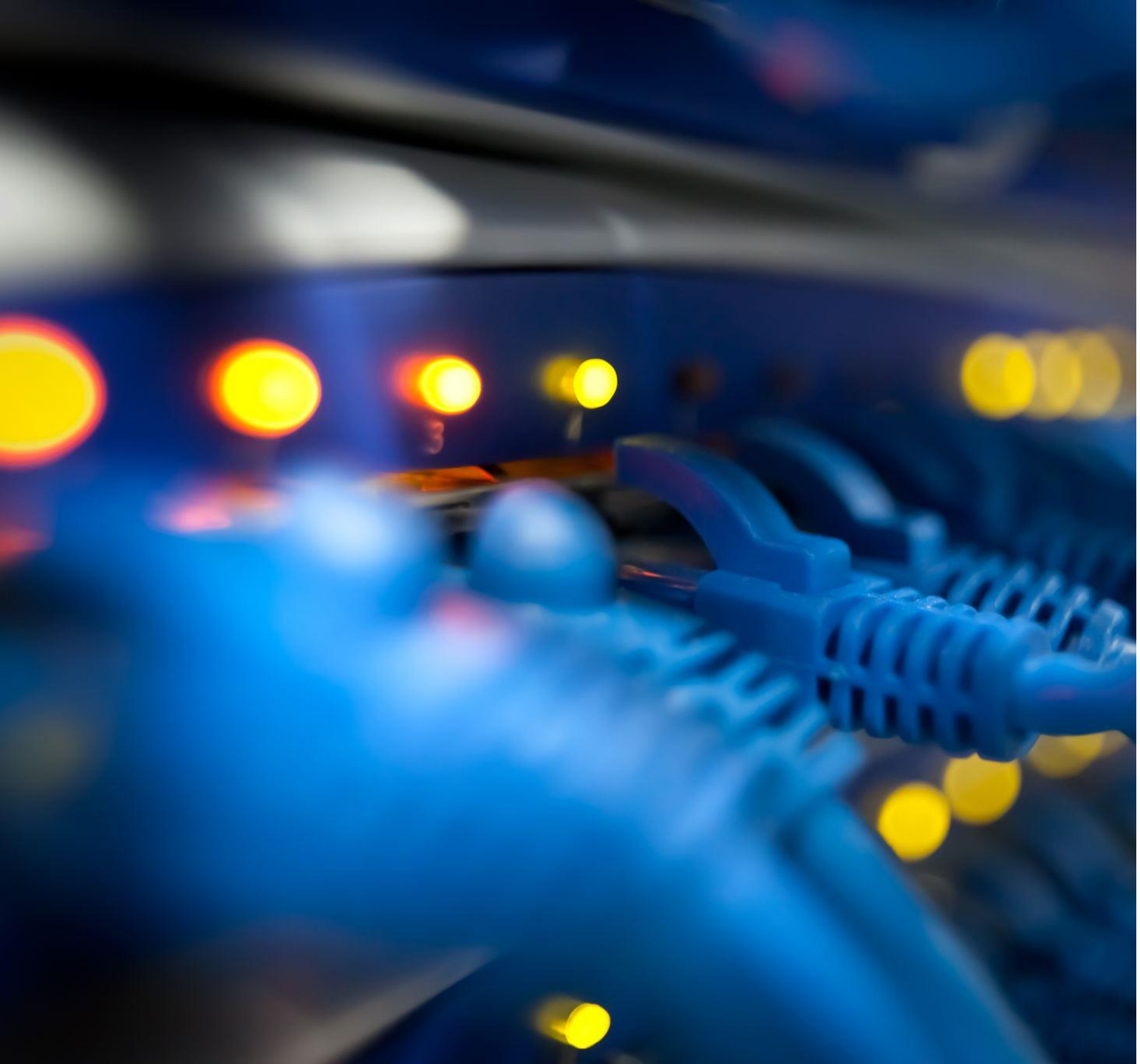
- Using the triplet loss function, which increases the distance between the anchor and positive embeddings and decreases the distance between the anchor and negative embeddings, the network is trained.
- The Triplet Loss Function minimizes the distance between an anchor image and a positive image (an image of the same person), while maximizing the distance between the anchor image and a negative image (an image of a different person).
- Input a triplet of samples (a, p, n), where a is the anchor sample, p is the positive sample of the same class as the anchor, and n is the negative sample of a different class.

$$\sum_{i}^{N} \left[\|f(x_i^a) - f(x_i^p)\|_2^2 - \|f(x_i^a) - f(x_i^n)\|_2^2 + \alpha \right]$$

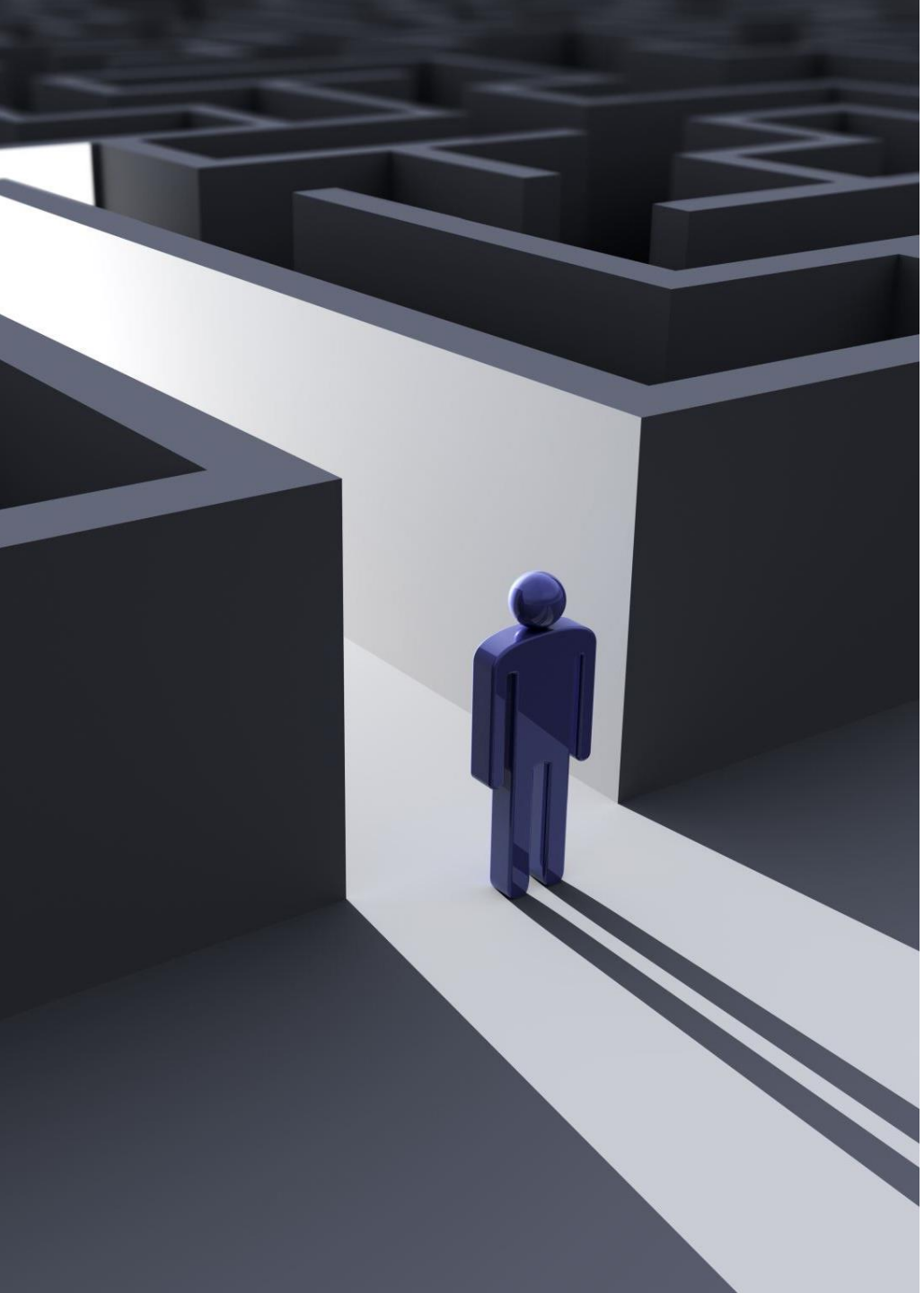
DATA PRE-PROCESSING



- It refers to the process of selecting triplets of images from a large dataset that are suitable for training the Triplet Network.
- The goal of triplet selection is to select triplets that are challenging for the Triplet Network to learn from.
- If the triplets are too easy, the Triplet Network may not learn the features necessary for accurate face recognition.
- On the other hand, if the triplets are too difficult, the Triplet Network may not be able to learn at all.



TRAINING A TRIPLET NETWORK

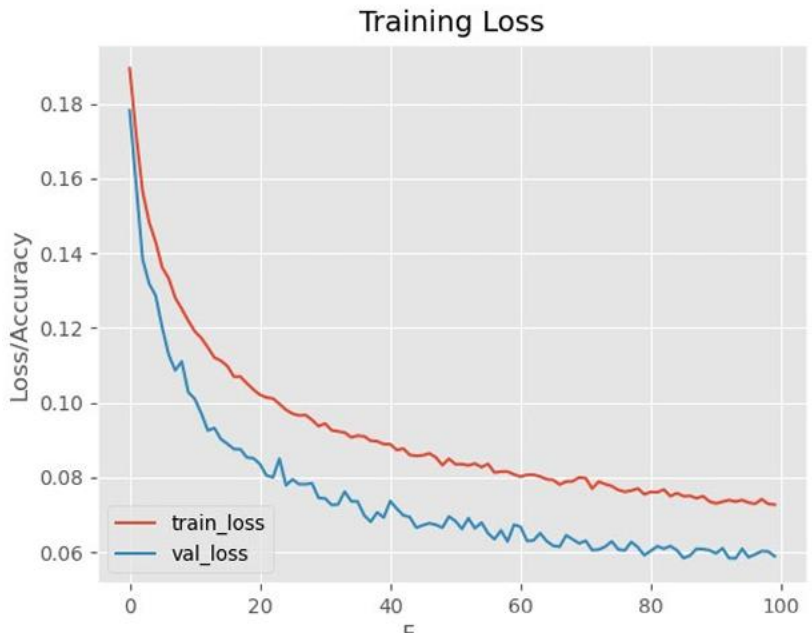


PROCESS USED FOR TRAINING THE NETWORK

- We are training a triplet network using the LFW dataset to verify the identity of a person given an image.
- In the Initial phase, we took an image of the person from the input dataset whose identity needs to be verified. This will be the anchor image and is used to generate a fixed dimensional embedding.
- For the next step, we selected another image of the same person. It will be taken as the positive image and is used to encourage the embeddings of the anchor and positive image to be close together.
- Now, we have selected an image of a different person which acts as a negative image.
- This is used to encourage the embeddings of the anchor image and negative image to be far apart.

RESULTS

1. TRIPLET LOSS



RESULTS

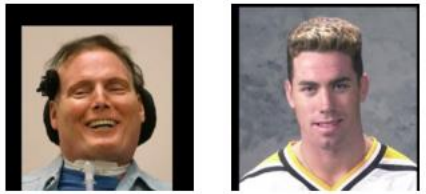
2. IDENTITY VERIFICATION WITH TRIPLET DISTANCE

Distance: 0.64

Distance: 0.67

Distance: 0.68

Distance: 0.79



Distance: 0.60

Distance: 0.29

Distance: 0.00

Distance: 0.36

THANK YOU