

# Augmentation of Small Training Data Using GANs for Enhancing the Performance of Image Classification

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# Deep Learning



Sufficient  
Images

DCNNs



Training



High  
Performance

# Sufficient Images

How many images should we have to collect?

There may be no suitable **Labelled Images** for the classification tasks.

The data is hard to be collected.  
(Privacy, Confidentiality, Time, Cost)

Similarity

Diversity



# Methods

Developing a GAN Structure Suitable for Very Limited Training Data

GAN

Using **one original image** only overcomes the drawback of traditional GANs that need plenty of original images to generate high-quality images.

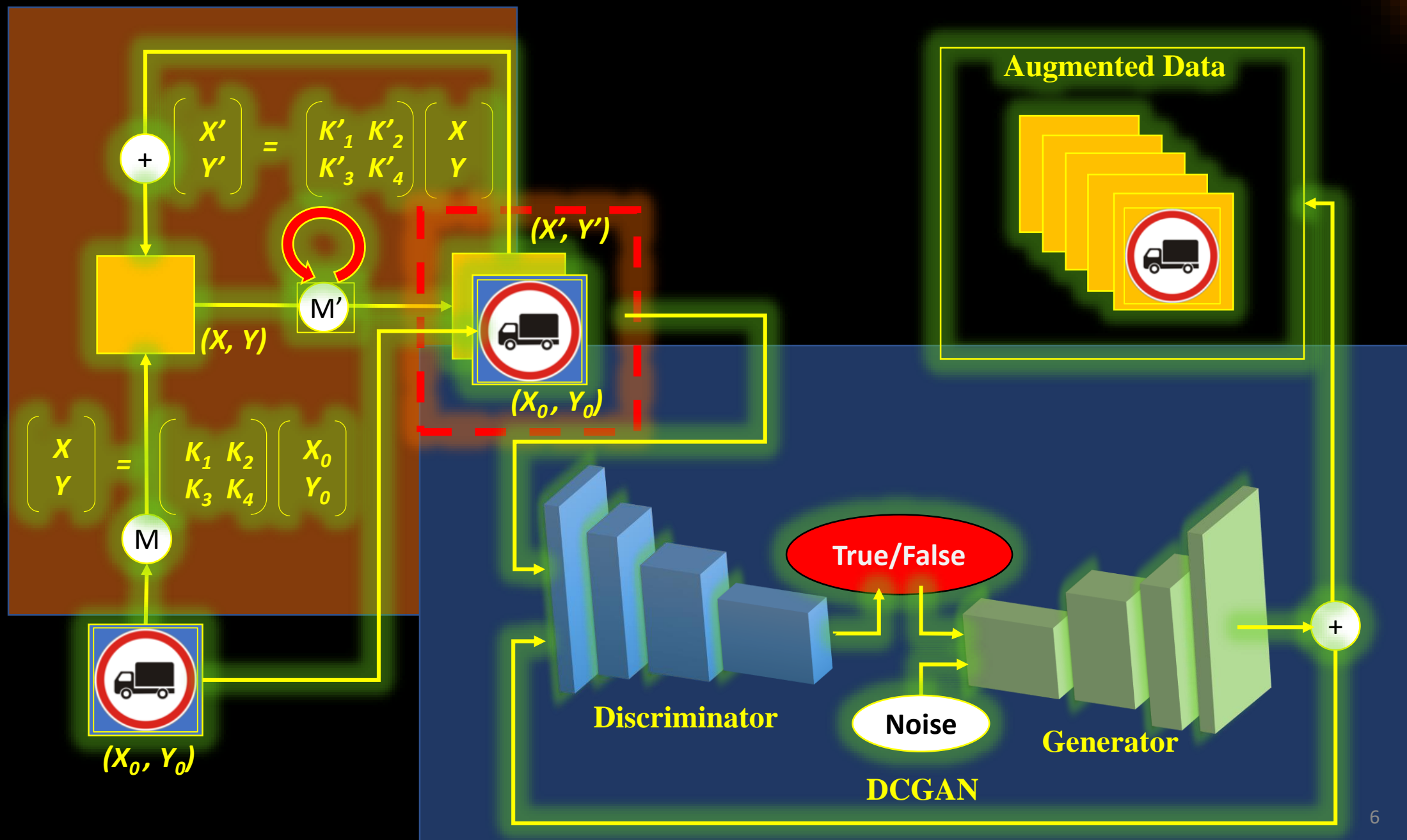
Similarity

Creating and Changing the Data Distribution

Transformation  
Matrices

**Two transformation matrices** are used to balance the quality and diversity of the images generated by GANs using a single original image only.

Diversity

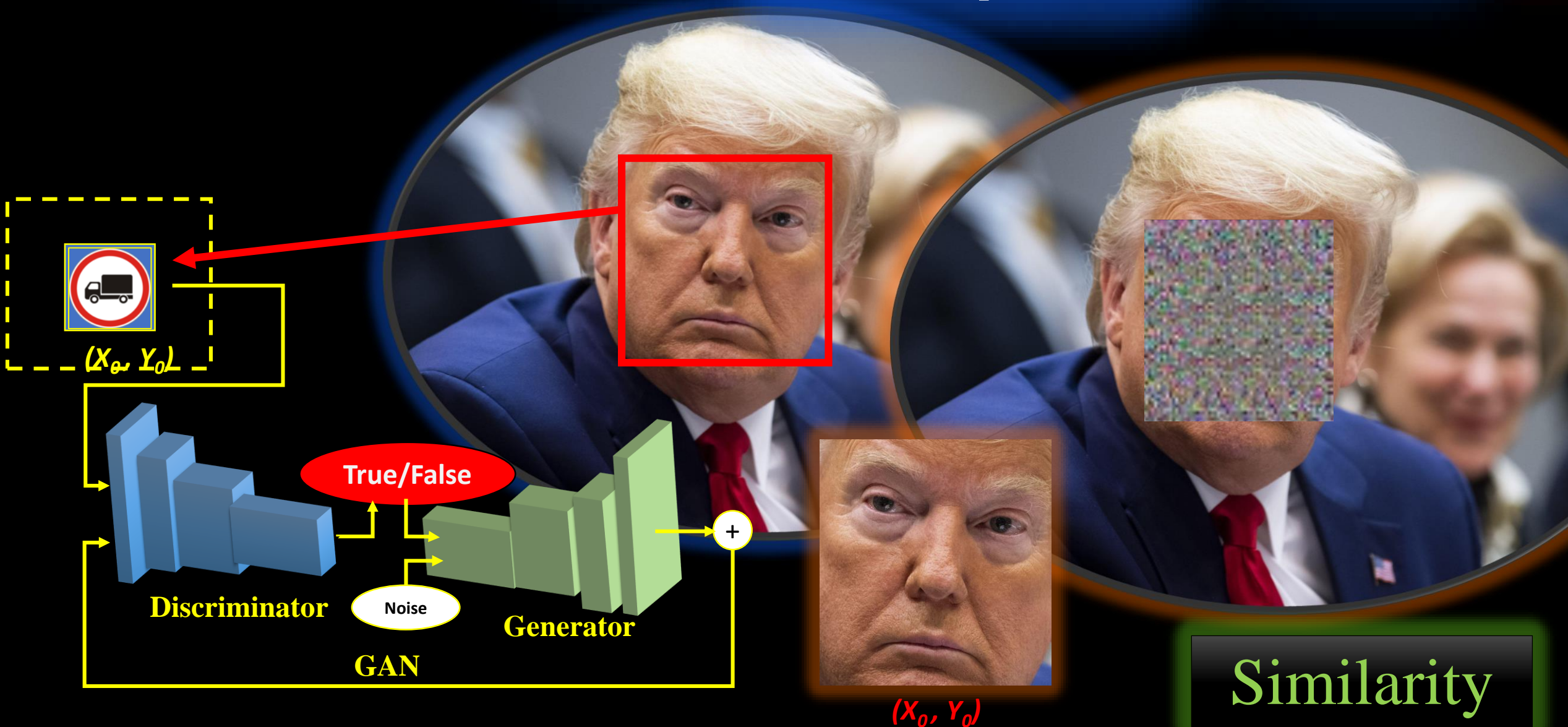


# Experiments

All of our experiments were conducted on a desktop computer with a processor of Intel Core i7-6700 (3.4GHz) and 16G RAM **without any GPUs**. The time spent is around **20 to 30 minutes** for generating **256,000 images of 64×64 pixels** from a single original image in **4,000 epochs** using the proposed GAN framework, which could be greatly reduced with GPU machines.

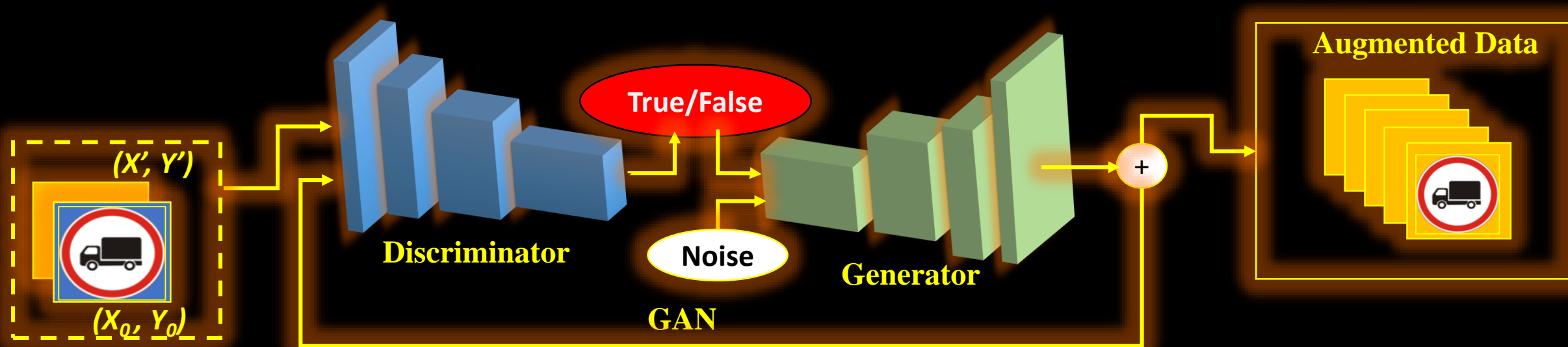


# Ex. 1: Generating Images from One Sample Only with The Proposed GAN





# Ex. 2: Generating Images from Two Different Samples with The Proposed GAN



$(X_o, Y_o)$

+



$(X', Y')$

=

Diversity



Augmented Data

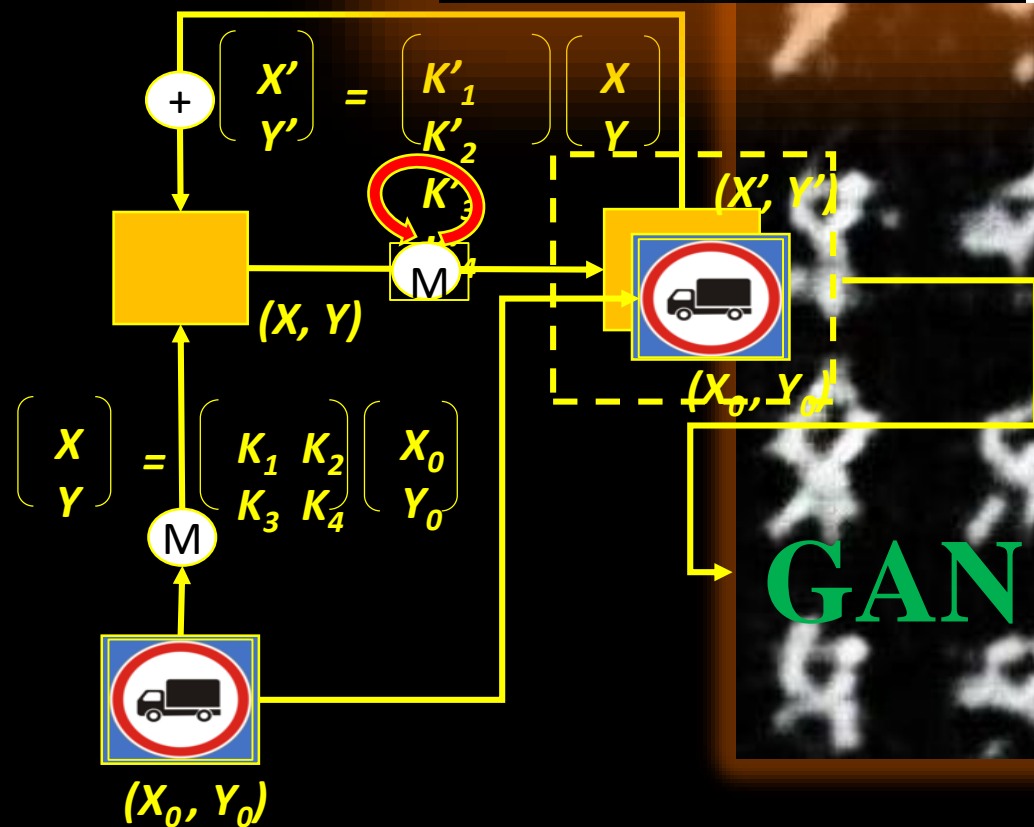
## Ex. 3

M

-Rotation:  $0^\circ$   
-Scaling: 1

M'

-Rotation:  $0-30^\circ$   
-Scaling: 1-1.4



## Ex. 4

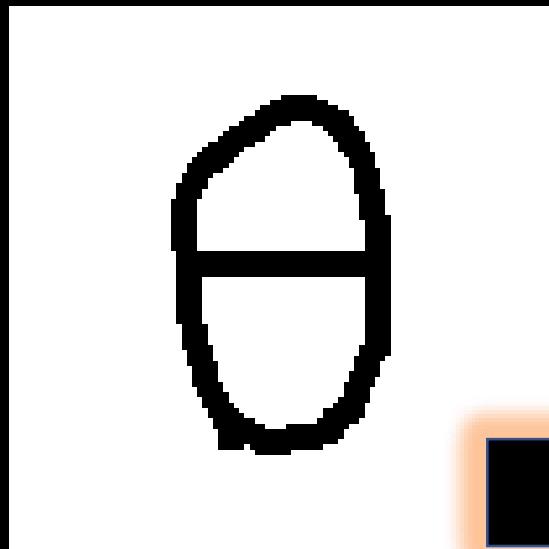
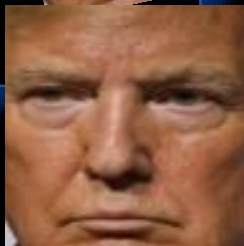
M

-Rotation:  $0^\circ$   
-Scaling: 1



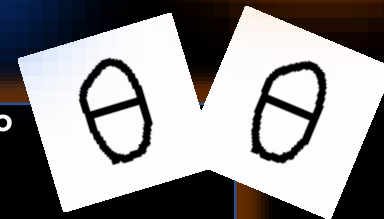
M'

-Rotation:  $15^\circ$   
-Scaling: 1.3



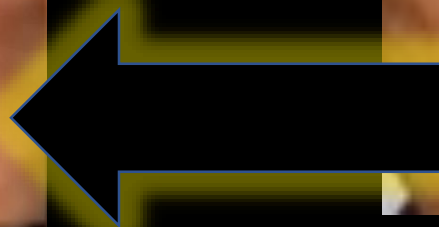
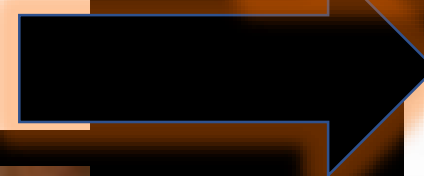
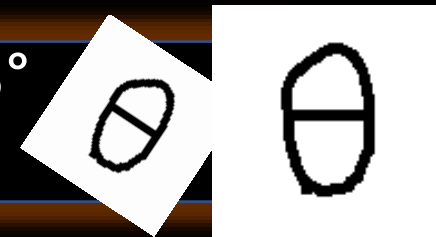
M

-Rotation:  $\pm 10^\circ$   
-Scaling: 1



M'

-Rotation:  $15^\circ$   
-Scaling: 1.3





## Real Images



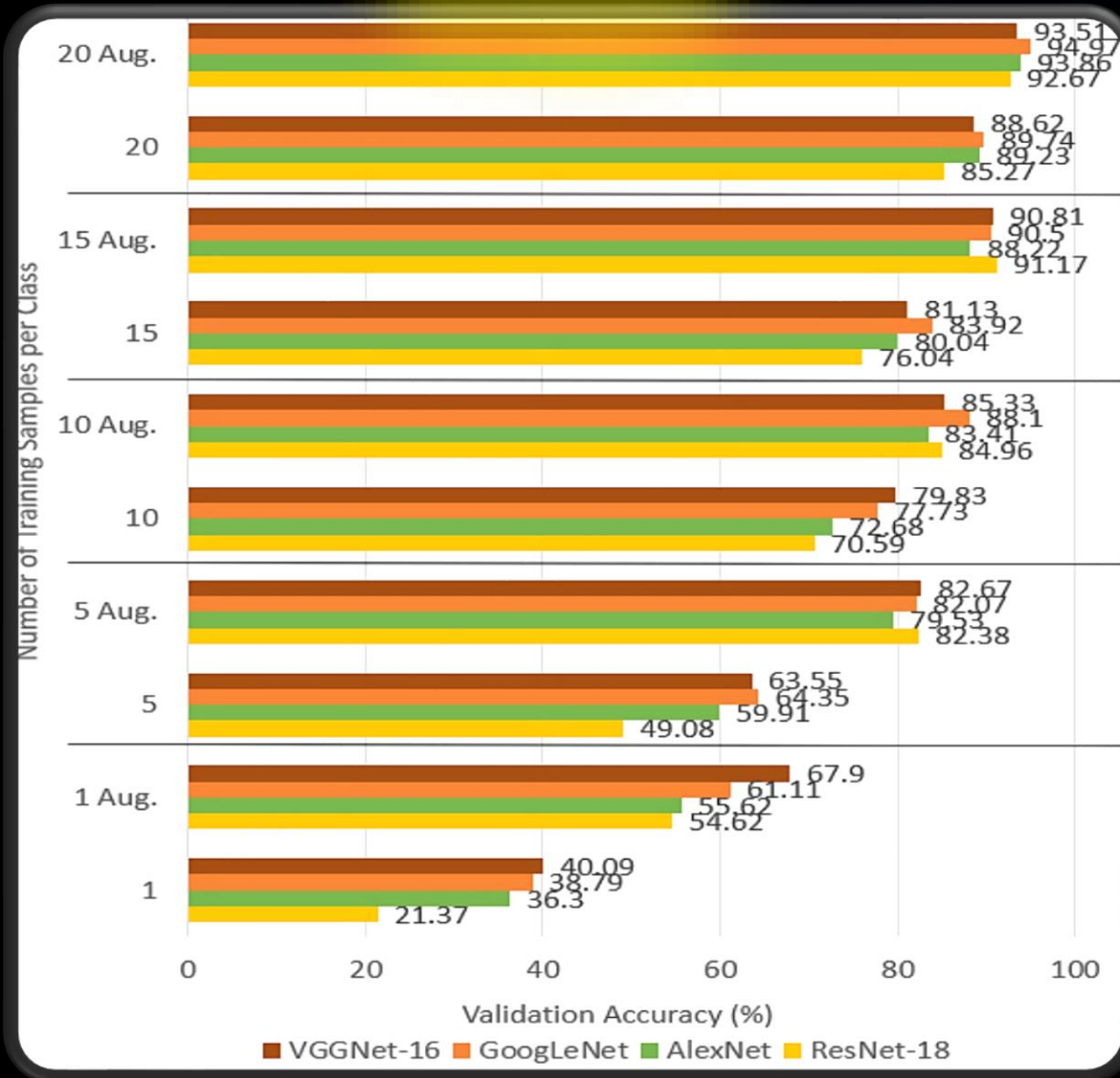
## Synthetic Images



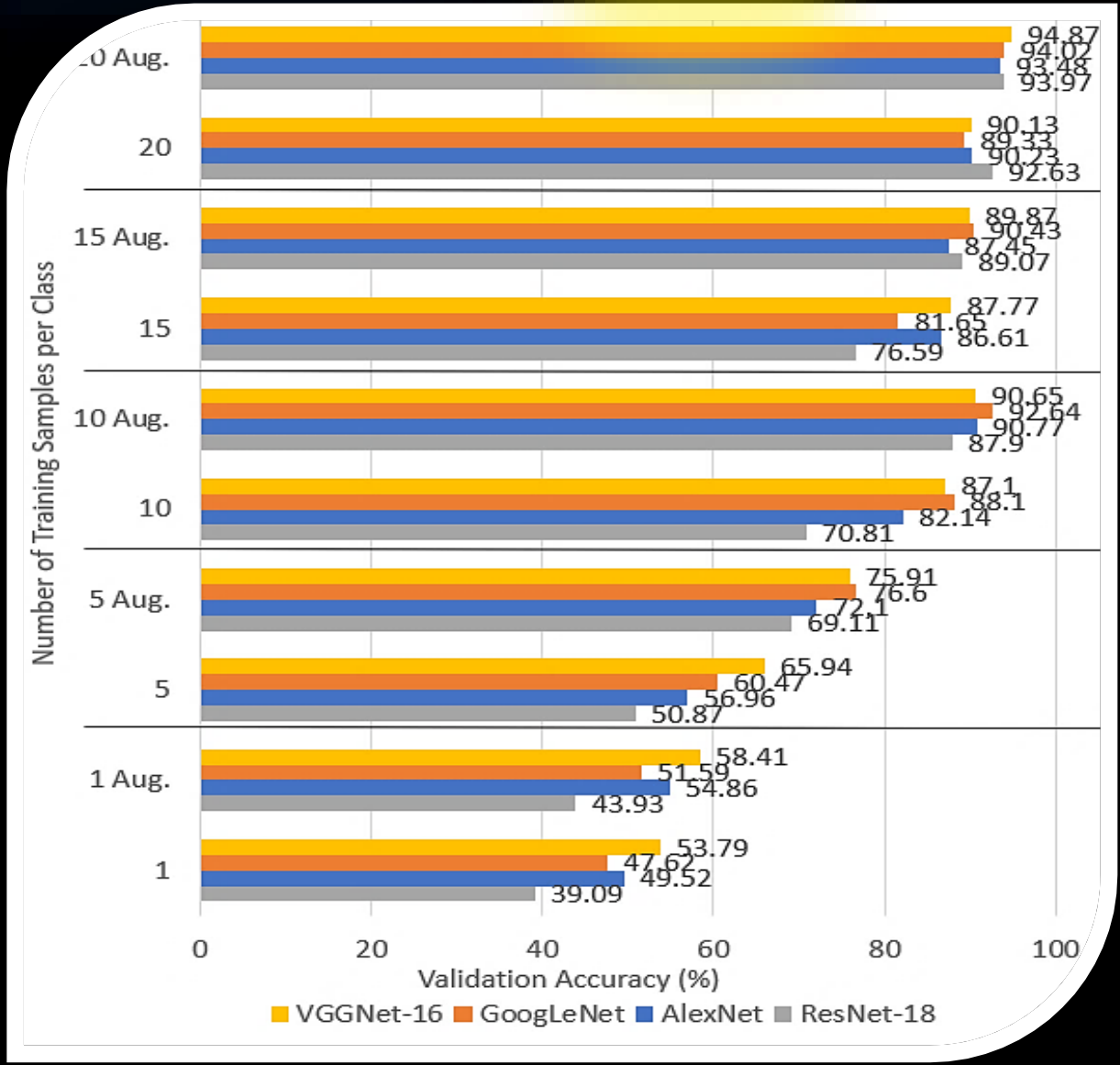
# Performance Evaluation

13

## MNIST



## RPS



Thanks for Your Attention