# Genetic Convolutional Neural Network

Ashish Sethi (MT18024), Kshitij Srivastava (MT18099) and Vishal (MT18019)

CSE M.Tech IIITD

## Motivation

In recent times, **CNNs** have emerged as the go-to technique for image classification problems. However, they rely highly on their architecture, which needs to be hand crafted by a personnel having expertise in both, CNN and the respective problem. This makes it difficult for researchers who have no expertise in CNNs, to explore their full potential. We will try to implement an already proposed algorithm, which is capable of discovering a potentially good architecture for a CNN best suitable for image classification tasks.[1, 2]

## Problem Statement

- Designing a pool of CNNs and choosing the best one.
- Modelling the problem as a search problem in a large search space to be solved using genetic algorithms.

## Objectives

- Encoding CNNs as a binary string.
- Creating a pool of CNN architectures.
- To find best CNN model for Classification task using genetic algorithm.
- Modify CNN architecture to find best accuracy in classification task.

## Literature Review

**L. Xie** and **A. Yuille** in their paper proposed an encoding method to represent netork components as fixed length binary strings. At each stage, the height, width and depth of data cube is same. Each string act as a chromosome and genetic operations like selection, mutation etc are applied on the string.
For evaluation the fitness function is defined as the recognising accuracy on CIFAR 10. A binary string is converted to a CNN and evaluation is done using the same. From the generated network strings they selected the best chromosomes for next generation and repeated the process until convergence. It took them 50 generations to achieve 76.58 % accuracy.[2]

## Our Approach

- Initialize a random binary string which represents the network.
- Use genetic operations to create more strings.
- Convert this string to a CNN and evaluate it on CIFAR 10 dataset.
- Fitness function for GA is recognition accuracy of the network.
- Select best chromosomes (binary encoded string) and repeat until convergence.

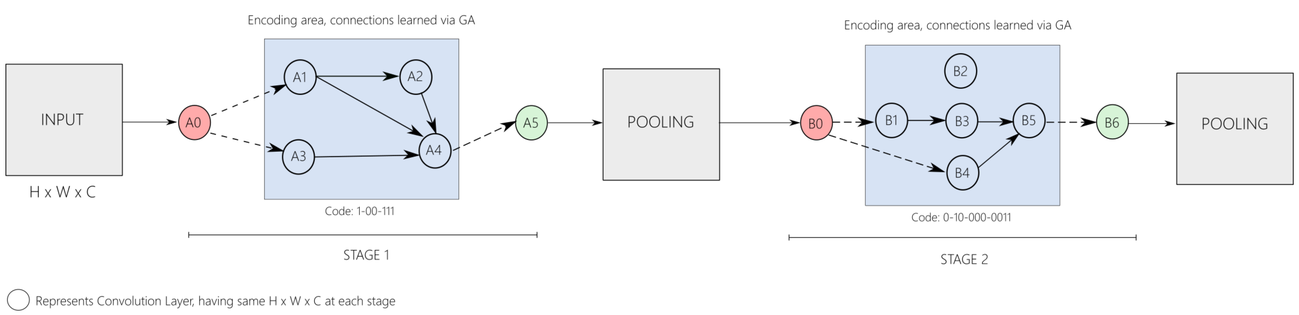


Figure 1: Sample Architecture of Genetic CNN

## Milestones

- For mid evaluation, we are aiming to finish till the coding phase for our project.
- Comparison and consolidation of results are parts of Phase - 2.

## Experiments

- **Peer competitors**- In order to compare our proposed algorithm and other state of the art algorithms, we will train both type models on same dataset and will check on the basis of accuracy and error rate.
- **Benchmark Datasets**- For all the experiments we will use CIFAR-10 dataset to train the peer competitors model and our proposed model because this dataset is very challenging in terms of image complexity and widely used for classification.

## Evaluation metrics

- Fitness function.
- Accuracy %on test dataset.
- Number of parameters required in CNN architecture.
- Error rate.
- Assistance - manual, semi manual, automatic.

## Role of every individual

| | Ashish | Kshitij | vishal |
|---|---|---|---|
| Literature Review | | | |
| Problem Statement Definition | | | |
| Mathematical Model | | | |
| Algorithm Designing | | | |
| Coding | | | |
| Comparison of Results | | | |
| Consolidated Results | | | |

## References

[1] Yanan Sun, Bing Xue, Mengjie Zhang, and Gary G Yen.
Automatically designing cnn architectures using genetic algorithm for image classification.
*arXiv preprint arXiv:1808.03818*, 2018.

[2] Lingxi Xie and Alan L. Yuille.
Genetic CNN.
*CoRR*, abs/1703.01513, 2017.