Constant Area Coding Optimization using Genetic Algorithm

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2021/03399 2021/00199

# **Introduction:**

This report looks into the concepts of Constant Area Coding (CAC) compression and Genetic Algorithms (GA), and how GA can be applied to optimize CAC

# Constant Area Coding (CAC) Compression

## Overview

Constant Area Coding (CAC) is a data compression technique designed to encode data in such a way that the resultant encoded data has a fixed code length representing different values, which then leads to a constant area for each data segment represented by an allotted number of bits. This technique is particularly handy in scenarios where maintaining uniformity in the encoded data's length is crucial, such as in image or signal processing and compression. It is also popularly utilized in lossless binary image compression.

## How CAC Works

Data Segmentation: The input data is divided into segments of defined fixed lengths i.e. splitting the image into a number of blocks having a constant predefined of size P \* Q.

Encoding Scheme: Each segment is encoded using a predetermined coding scheme, ensuring that each encoded segment has the same area (or length).(Ex: 0 -> Black Block, 11-> White Block, 10 -> Mixed Block)

Uniform Distribution: By maintaining a constant area, CAC ensures that the distribution of encoded data remains uniform, which can be advantageous for certain types of data transmission and storage. It also gives rise to the possibilities of performing lossless compression due to the conformance of the resulting codes.

# Genetic Algorithms (GA)

## Overview

Genetic Algorithms (GA) are a class of optimization algorithms inspired by the principles of natural selection and genetics. They are used to find optimal or near-optimal solutions to complex problems through an iterative process of selection, crossover, and mutation.

## How GA Works

Initialization: Generate an initial random population of potential solutions.

Selection: Evaluate the fitness of each solution and select the fittest individuals for reproduction.

Crossover: Combine pairs of individuals (parents) to produce offspring by exchanging parts of their genetic information (Chromosomes).

Mutation: Introduce random changes to the offspring to maintain genetic diversity.

Iteration: Repeat the selection, crossover, and mutation steps for several generations until an optimal solution is found or a stopping criterion is met.

## CAC Optimization Using Genetic Algorithms

## Combining CAC and GA

Optimizing CAC using GA involves using the genetic algorithm to find the best P and Q values that maximize the data compression ratio while maintaining the uniformity of the encoded segments. This process involves defining a fitness function that evaluates the effectiveness of the encoding scheme and then using GA to evolve the encoding schemes over several generations.

## Steps in CAC Optimization Using GA

Representation: Encode potential solutions (Block sizes) as chromosomes.

Fitness Function: Define a fitness function that measures the compression ratio and checks the validity of the generated block size.

Initialization: Generate an initial population of block sizes randomly.

Selection: Select the best-performing block sizes based on the fitness function (Maximize Compression Ratio).

Crossover and Mutation: Apply crossover and mutation to create new offsprings that represent new block sizes.

Iteration: Repeat the process for multiple generations to steer the block sizes towards optimal solutions or near optimal solutions.

# Conclusion

By leveraging Genetic Algorithms to optimize Constant Area Coding, we can achieve highly efficient data compression while maintaining uniformity in encoded data segments. This combined approach enhances the performance of CAC in various applications, demonstrating the power of integrating optimization techniques with traditional compression methods.