Chapter 10
Gene Expression Programming

Baddrud Zaman Laskar
NIT Silchar, India

Swanirbhar Majumder
NERIST, India

ABSTRACT

Gene expression programming (GEP) introduced by Candida Ferreira is a descendant of genetic algorithm (GA) and genetic programming (GP). It takes the advantage of both the optimization and search technique based on genetics and natural selection as GA and its programmatic Darwinian counterpart GP. It is gaining popularity because; it has to some extent eradicated the 'cons' of both while keeping in the 'pros'. It is still a new technique not much explored since its introduction in 2001. In this chapter both GA and GP is first discussed followed by the elaborate discussion of GEP. This is followed up by the discussion on research work done is different fields using GEP as a tool followed up by GEP architectures. Finally, here GEP has been used for detection of age from facial features as a soft computing based optimization problem using genetic operators.

1. INTRODUCTION

In 1950 and 1960 several scientists independently started studying evolutionary systems with this idea that it can be used as an optimization tools for engineers in future. Genetics is a biological process where a parent passes certain genes onto their children. Every child inherits genes from both of their biological parents and

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these genes inherit certain specific quality. Thus, genetics is study of heredity. Gene lies within a chromosome. This biological process leads to an idea of evolving a population of candidate solution to a given problem by the concepts of natural genetic variation and natural selection. Genetic algorithm was invented by John Holland and it was developed by his students and colleagues in the middle of 1960 and 1970. Holland's main focus is to design an algorithm to solve some unusual specific problem. Gradually he developed the ways in which natural adaptation can be imported into computer systems. Present day, a genetic algorithm (GA) is an optimization tool that mimics the process of natural selection, in the computer science field of artificial intelligence. Genetic programming (GP) is an extension of GA. GP began with an evolutionary algorithm, first used by Nilis Aall Barricelli, applied to evolutionary simulations in 1954. Tree-based genetic programming concept was first introduced by Nicheal L. Cramer but it is expanded by Koza (1992). Gene expression programming (GEP) was then first introduced by Ferreira (2001, 2002). It is related to both genetic algorithm and genetic programming. The chapter discuss in detail about GA, GP and how they lead to the development of genetic expression programming.

2. GENETIC ALGORITHM

Genetic algorithm is an optimization and search technique which is mainly based on the principles of genetics and natural selection. It is inspired by Darwin's theory of evolution. It starts with a set of solution (represented by chromosome) called initial population. Solution from one population is taken based on its fitness and is used to generate new population. The fitness function is defined over the genetic representation and measures the quality of represented solution. The fitness function is always dependent upon the problem specified. This gives a hope that new population will be far better than the old population. Thereby it can be concluded that GA can be a parallel mathematical algorithm that transforms a set of individual population with some fitness value into a whole new set of population with better fitness value associate with it. GA believes in the survival of the fittest. It is a search algorithm that mimics the natural process of evolution, where each individual can be an aspirant solution. Genetic algorithm is the larger class of evolutionary algorithm (EA), which generates optimized solutions for problems using techniques inspired by natural evolution, such as inheritance, mutation, selection, and crossover. GA allows a population composed of many individuals to evolve under specified selection rules to a state that maximizes the fitness. It can be applied in bioinformatics, phylogenetic, computational science, engineering, economics, chemistry, manufacturing, physics, mathematics, pharmacometrics, and other fields.