Grokking Artificial intelligence Algorithms
by Rishal Hurbans

Section 4 Advanced Evolutionary Algorithms

Alternative selection strategies

The roulette-selection wheel is good but there are problems with the vast differences in magnitude of fitness in the chromosome. This makes it biased towards individuals with high fitness, and may give those with undesirable fitness' a higher than intended chance of being chosen. This affects the diversity of population, a more diverse population gives a more optimal solution since it explores a broader range. One solution is to use Rank selection this works by "ranking individuals based on their fitness and then using each individual's rank as the value for calculating the size of its slice on the wheel." Then there is Tournament selection where the algorithm randomly chooses a set number of individuals from the population and places them in a group. This process is performed for a predetermined number of groups. The individual with the highest fitness score in each respective group is selected. The larger the group, the less diverse it is, because only one individual from each group is selected. As with rank selection, the actual fitness score of each individual is not the key factor in selecting individuals globally. Then there is Eltism selection which selects the best individuals of a population. This strategy retains the strongest and eliminates the risk that they willbe lost. This however means the population is not very diverse, leading to the population falling into local and not global best. The eltism method is often partnered with the previous mentioned methods, where the elite reproduce and the rest are populated using the other methods.

Real Value Encoding

When you consider the real world value (or when you are able to take more than 1, assuming these values are given) This encoding is used when potential solutions contain continuous values that cannot be encoded easily with binary encoding. Therefore it must be indicated how many of an item is being carried. Mutation and crossover is still possible with real value encoding, however mutation should be reviewed.

Arithmetic crossover involves an arithmetic operation to be computed by using each parent as variables in the expression. In boundary mutation, a gene randomly selected from a real-value encoded chromosome is set randomly to a lower bound value or upper bound value. Given 26 genes in a chromosome, a random index is selected, and the value is set to either a minimum value or a maximum value. . The minimum and maximum can be the same for all indexes or set uniquely for each index if knowledge of the problem informs the decision. This approach attempts to evaluate the impact of individual genes on the chromosome. In arithmetic mutation, a randomly selected gene in a real-value-encoded chromosome is changed by adding or subtracting a small numbers. These numbers could be decimals and fractions.

Order Encoding

_____To make things interesting, the refinery requires a steady rate of extraction, given the extraction time and the value of the item. It's assumed that the value of the refined material is more or less the same as the value of the item. The problem becomes an ordering problem. Order encoding, also known as permutation encoding, represents a chromosome as a sequence of elements. Order encoding usually requires all elements to be present in the chromosome, which implies that corrections might need to be made when performing crossover and mutation to ensure that no elements are missing or duplicated. Tree encoding represents a chromosome as a tree of elements. Tree encoding is versatile for representing potential solutions in which the hierarchy of elements is important and/or required. Tree encoding can even represent functions, which consist of a tree of expressions. As a result, tree encoding could be used to evolve program functions in which the function solves a specific problem. Tree crossover is similar to single-point crossover (chapter 4) in that a single point in the tree structure is selected and then the parts are exchanged and combined with copies of the parent individuals to create an offspring individual. In change node mutation, a randomly selected node in a tree-encoded chromosome is changed to a randomly selected valid object for that node. Given a tree representing an organization of items, we can change an item to another valid item.

Common types of evolutionary algorithms

Genetic programming follows a process similar to that of genetic algorithms but is used primarily to generate computer programs to solve problems. The process described in the previous section also applies here. tree-encoding method would work well here, because most computer programs are graphs consisting of nodes that indicate operations and processes. These trees of logic can be evolved, so the computer program will be evolved to solve a specific problem. Evolutionary programming is similar to genetic programming, but the potential solution is parameters for a predefined fixed computer program, not a generated computer program. If a program requires finely tuned inputs, and determining a good combination of inputs is difficult, a genetic algorithm can be used to evolve these inputs. The fitness of potential solutions in an evolutionary programming algorithm is determined by how well the fixed computer program performs based on the parameters encoded in an individual.

Important Figures

Genetic Algorithm

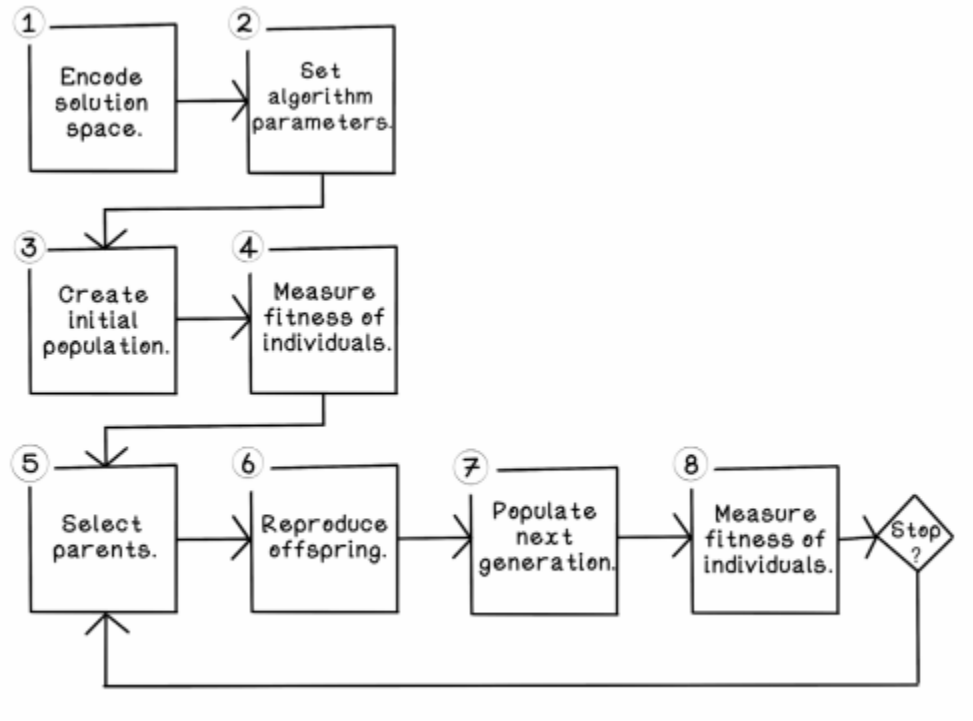

Figure 5.1 Genetic algorithm life cycle

Rank Selection

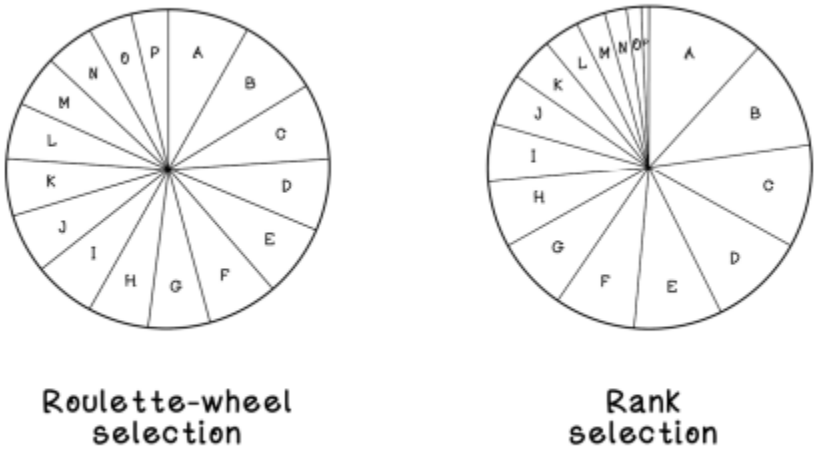

Figure 5.4 Roulette-wheel selection vs. rank selection