

## Introduction

Genetic algorithm  $\xrightarrow{\text{as heuristic}}$  Search and optimization algo. based on the principles of evolution, which were first introduce by John Holland in 1970 [1]. It is a search based optimization technique based on the genetics of natural selection. The main focus of this paper is towards the comparative analysis on different selection technique & mutation along the genetic algorithm. Genetic algo  $\otimes$  used to find optimal or near-optimal soln to difficult problems which otherwise take a lifetime to solve.

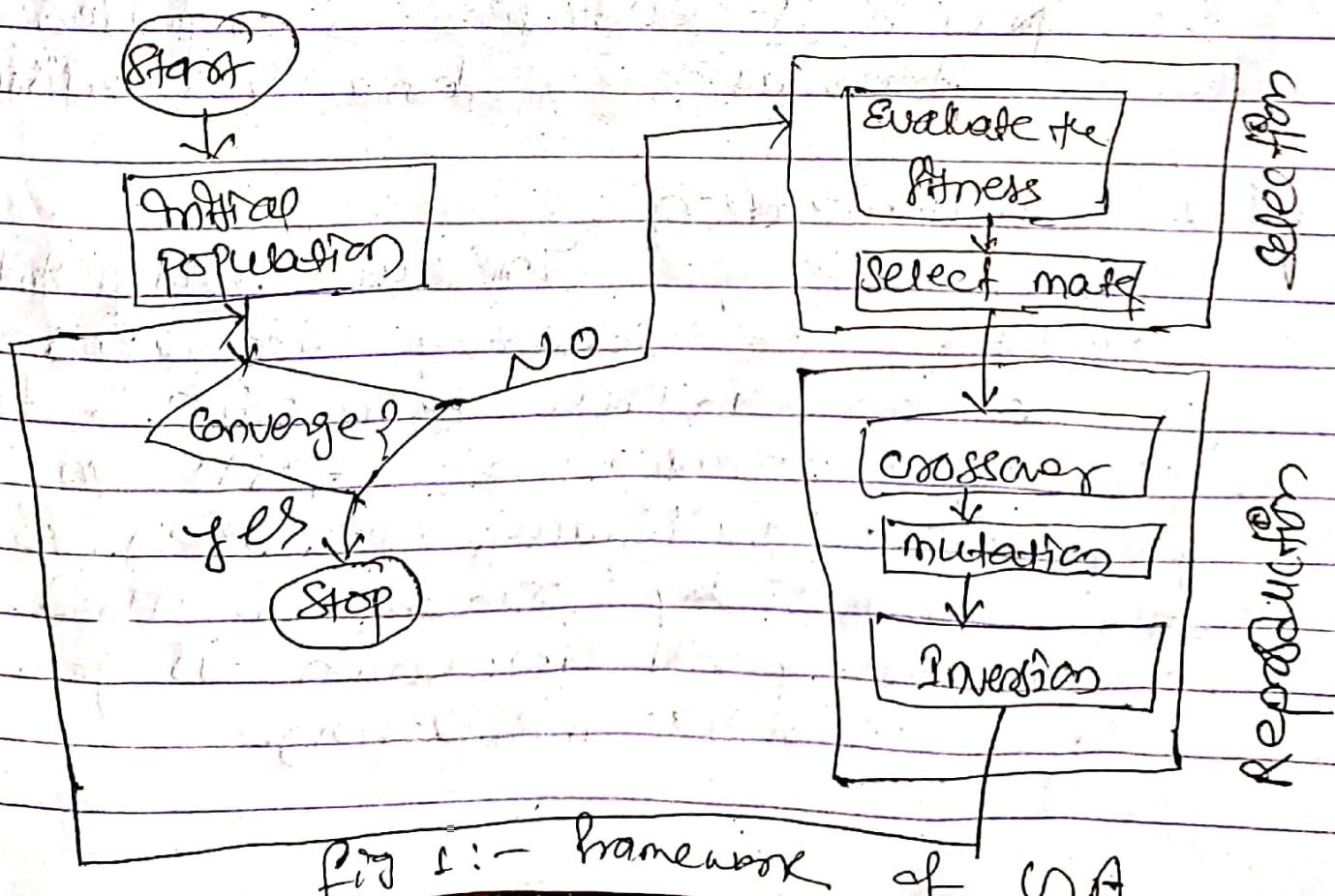


Fig 1 depicts the working of simple genetic algorithm. It starts with set of solutions called population. A. Evolution, presented by chromosome. fitness of each ~~generation~~ ~~chromosome~~ is evaluated, then the chromosome ~~chromosome~~ for the next generation will be selected according to fitness value. then ~~randomly~~ selected chromosomes mate & produces offspring. when producing offspring, crossover and mutation randomly occur [14]. Because of the chromosome of the higher ~~avg.~~ fitness value selected in every generation, offspring also have better fitness value than off's old generations. The process of evolution is repeated until the termination criteria is satisfied.

## 1.1 Initialization

Initially many individual solutions are randomly generated to form a initial population. the size of solution depends on the problem. traditionally, population is only initialized by random method but in recent years population is generated using Heuristic initialization.

## 1.2 Selection

Natural Selection is the main inspiration of this component for the GA algorithm [LS]. In selection process solutions are selected according to their fitness value. So, higher the fitness value, more the chance of selection. After the selection of solutions, these songs goes for mating & pairing produce a new offspring. Selection process is if songs have below than avg. fitness value the chances of for mating is less and if won't produce offspring. so, we have to select best selection method. Some of the selection methods are,

(i) Tournament

(ii)  Roulette

(iii) Ranked based

## 1.3 Reproduction

The next step is to generate a second generation population of songs from those selected through genetic operator.

for a new songs to be produced a

part of individual is selected. Then offspring by selection with then population new lineage is created by using mutation & crossover technique.

These process ultimately result in the next generation population of chromosome that is diff. from initial generations. Generally one fitness will have increase by this procedure.

#### 1.4 Termination

The evolution process continue until a termination condition has been reached. Common termination conditions are:

- A son found satisfy minimum criteria.
- fixed number of generations reached.
- Allocates badge.
- manual inspection

The main aim of this paper is to present the works of various selection technique, their pros & cons with their comparison. The remainder of this paper is organised as follows. The section 2 ~~gives~~ presents the previous work done by researchers to define various selection techniques. The section 3 ~~gives~~ presents different types of selection strategies like tournament selection, roulette wheel, ranked based selection. Section 4 shows the comparison between these selection techniques on the basis of several research papers. The conclusion & references are drawn in section 5 and 6.

Citation used

→ 11, 14, 15, 7, 19, 16, 10, 1, 20

## previous work on Selection techniques

As we discussed in previous section, GA is heuristic search & optimization algorithm technique used in computing to find exact or approximate solutions to optimisation and search problem. The selection of parent population is one of the major work in GA. many researcher has studied of GA considering diff selection technique. The performance of GA highly depend on the fitness value.

Pandey

~~et al [7]~~ compared ~~on~~ three selection techniques such as ranked based ~~selection~~, roulette wheel and tournament selection technique to evaluate the performance on travelling salesmen problem (TSP). It was found that ranked based selection perform well TSP problem. This is followed by tournament selection & roulette wheel selection.

Zhong et al [19] presented a comparative study of the selection techniques. For the study purpose, roulette wheel & tournament were considered. To conduct the experiment, seven different test function were considered & found that self based on tournament selection is more efficient in convergence than roulette wheel selection.

Champlin et al. [16] compared four selection techniques such as roulette wheel, stochastic universal sampling (SUS), tournament selection & Truncation selection to determine the performance of genetic sentences problem & proteinaceous filament problem. It was found that tournament selection perform ~~well~~ best for these two problems.

## Selection Strategies

Selection is the process of selecting parents which mate and recombine to create offspring for next generations. The Selection Phase determine which individuals are chosen for mating (reproduction) and how many offspring each selected individual produces. The main principle of selection strategy is "the better is an individual, the higher is it's chance of being parent." [20]. The primary objective of the selection operator is to emphasize the good solutions and eliminate the bad solutions in a population, while keeping the population size constant.

(1) Roulette wheel Selection (Proportional Selection)

It is one of the traditional GA selection techniques. Chromosomes are selected based on their probabilities that are proportional to their fitness value. Its selecting principle is similar to Roulette wheel. The probability of selection of a sector in a roulette wheel is proportional to the magnitude

of the central angle of the sector [L]. In this technique, all the chromosome are placed on the roulette wheel according to their fitness value. The bigger the fitness value, the larger the segment is, i.e., roulette wheel is spinned. The individual corresponding to the segment on which roulette wheel stops are then selected. The process will continue until termination criteria is reached. The complexity of roulette wheel selection is  $O(n^2)$ . It can possibly miss the best individuals of a population. Individuals are selected with a probability that is directly proportional to their fitness values, i.e., an individual selection corresponds to a portion of a roulette wheel [LO].

chromosome	fitness value
A	8.2
B	3.2
C	1.9
D	1.2
E	4.2

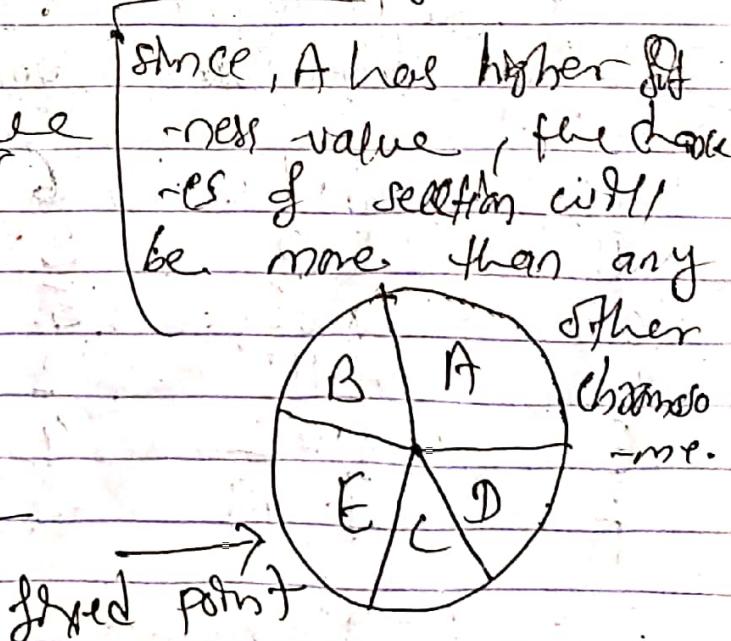


Fig: Roulette wheel selection.

## (ii) Ranked based selection

The roulette wheel will have a problem when the fitness value is negative and fitness value differ very much. If best fitness chromosome have fitness value 80%, it's circumference occupies 85% of roulette wheel, & other chromosomes have very few chances to be selected. In ranked based selection, individuals are first sorted according to their fitness value and then the ranks are assigned to them. Best individual get rank 0 and the worst one get rank 1. It is very useful when the individual in population have very close fitness value. with Complexity  $O(n \log n)$ .

chromosome      fitness value      rank

A	8.1	6
B	8.0	3
C	8.05	5
D	7.95	1
E	8.02	4
F	7.99	2

fixed point

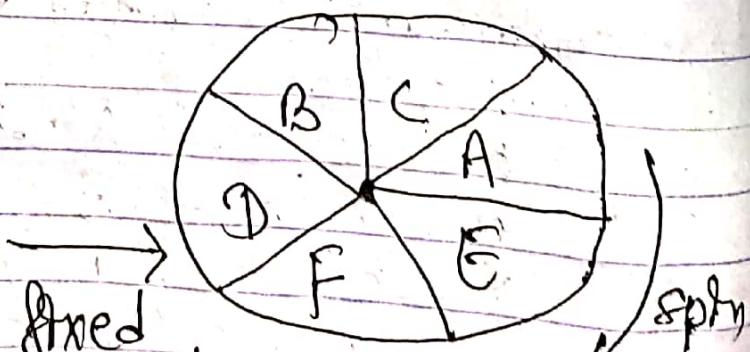


Fig 3:- Ranked based selection

### (ii) Tournament Selection

Tournament Selection

is one of the efficiency & easy selection technique in genetic algorithm.

In tournament selection 'n' random individual is chosen from the entire population. These individuals compete against each other. The individual with the highest fitness value wins and get selected for mating.

If perform very good when the tournament size is limited (1 or 3). The larger the tournament size, the greater is the probability of loss diversity. Complexity is between  $O(n)$  &  $O(n^2)$ .

The process of Tournament selection

is shown below (fig:- 9)

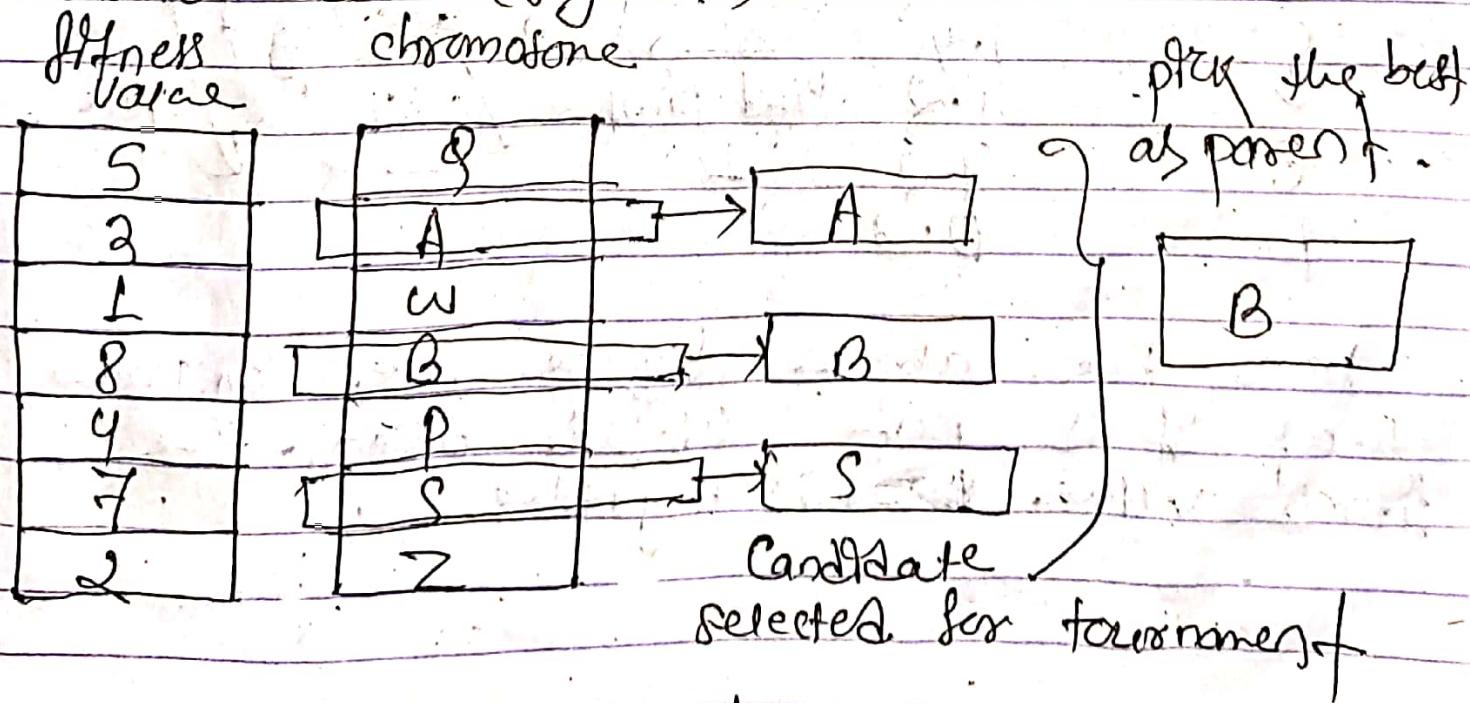


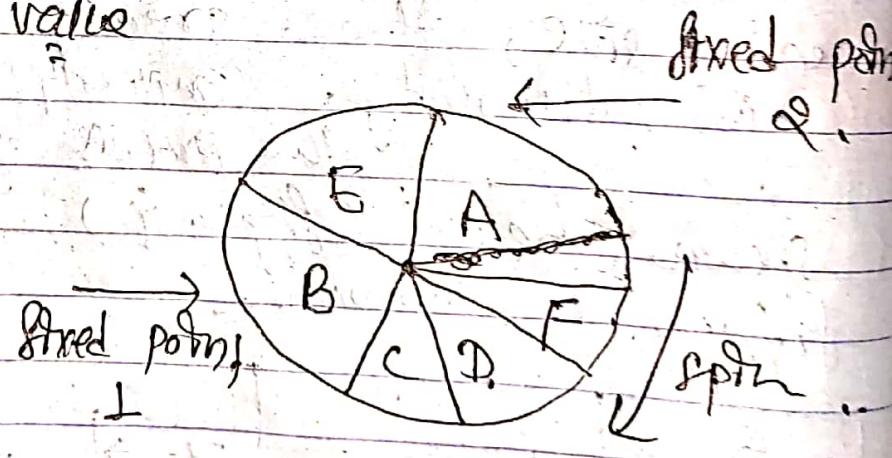
fig 4 :- Tournament Selection

## \* (iv) Stochastic universal Sampling (SUS)

Stochastic universal Sampling is very similar to roulette wheel selection, however instead of having just one fixed point, if have multiple fixed point as shown in the following images. therefore all the parent are selected in a single spin of wheel. Also, such a setup encourages the highly fit individuals to be chosen at least once. The complexity is  $O(n)$

chromosome      fitness value

A	8.2
B	3.2
C	1.4
D	1.2
E	4.2
F	0.3



From the above figure we can notice that if it is not useful when the fitness value ~~is~~ is negative.

(V)

## Truncation Selection

Truncation Selection is the final and most simple selection algorithm. In ~~Truncation~~ Selection, the ~~individuals~~ populations are sorted according to their fitness value and then drop the lower percentage. The pseudo code is as follows.

Truncation (population, truncation\_percent)

    Sort population by fitness

    Discard bottom percent of populations

    Add top percent to mating pool [16].

The time complexity of Truncation selection is dependent on the sorting population. Using a best sorting algorithm like merge sort or Heap sort ensure that the time complexity is  $O(n \log n)$ . Truncation selection is one of the fastest selection algorithms.

$$A = X + Y + Z$$

Ref. no (Citation)	Published year	Author	Factor considered for selection	Selection Technique	Observation
7	2016	Hari Mohan Pandey	Traveling Salesman Problem (10 sample)	Ranked based, Roulette wheel & Tournament	Ranked based Selection perform well
19	2005	Jinghua Zhang	Normal Test function	Roulette wheel & tournament	tournament selection is more efficient in convergence than roulette wheel.
16	2018	Ryan Chapman	Genetic Sentences problem	Roulette wheel, SUS, tournament & truncation	tournament selection is best.
16	2018	??	Positional dilemma	??	??
18	1991	Inayogji, J.C. Rawat, I.M.S	One Computer - 9DN, 29^n's of techniques, growth ratio, estimate	Roulette wheel, Ranked based, tournament	Roulette wheel selection is slower than method. Small growth ratio in tournament selection

## Comparison between different selection strategies

published years	Author	factor consider for selection	selection Technique	Observation
[20] 2013	Tarun. Varshney, Aishwary. Katiyar, pankaj. Sharma.	optimum & reliable route in wired net work.	Roulette wheel, Elitism, ranked based selection & tournament selection.	Tournament f. Rank selection are found to be <del>extreme</del> best in diff. situations and Tournament selection has the better convergence criteria.

$$20 \times 6 \\ = 120$$

## Abstract

This paper compare three different selection technique in genetic algorithm. Genetic algorithm are considered as a search process used in computing to find exact or approximate solution for optimization and search problem. While GA is heuristic procedure, they are not guaranteed to find the optimum, but they are able to find very good solutions for a wide range of problems. Identifying the appropriate selection technique is a critical step in genetic algorithm. The process of selection play important role in producing offspring (new generation). In selection operator individual are selected according to their fitness and choose those chromosomes in the population that will be allowed to reproduce, and on average fitter chromosome produce more offspring than the less fit ones. Therefore selection of population in each generation is very important. In this study we have been described different selection technique like roulette wheel, ranked based, sus, Truncation and Tournament selection.

Keywords Genetic Algorithm, Selection Techniques, Proportional roulette wheel selection, tournament selection, ranked based sel., Truncation selection, optimal sus.