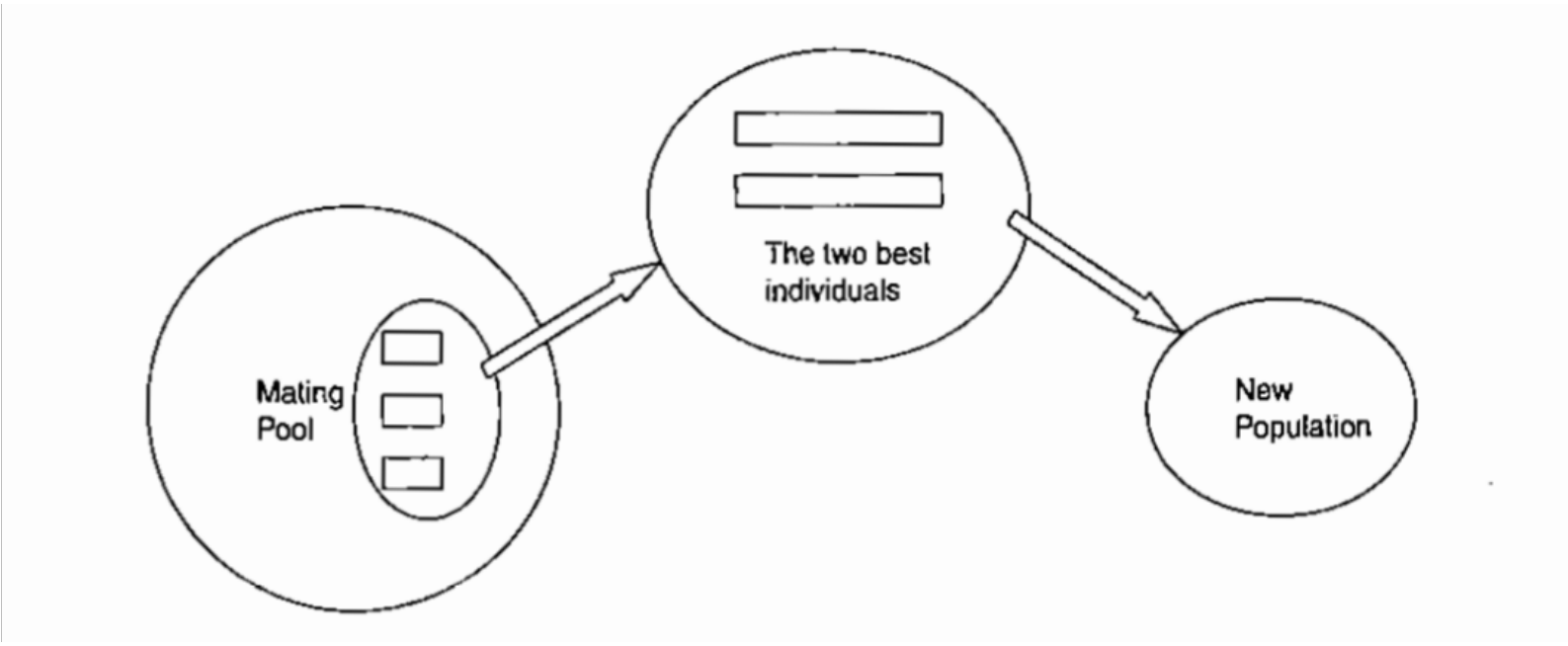
Selection

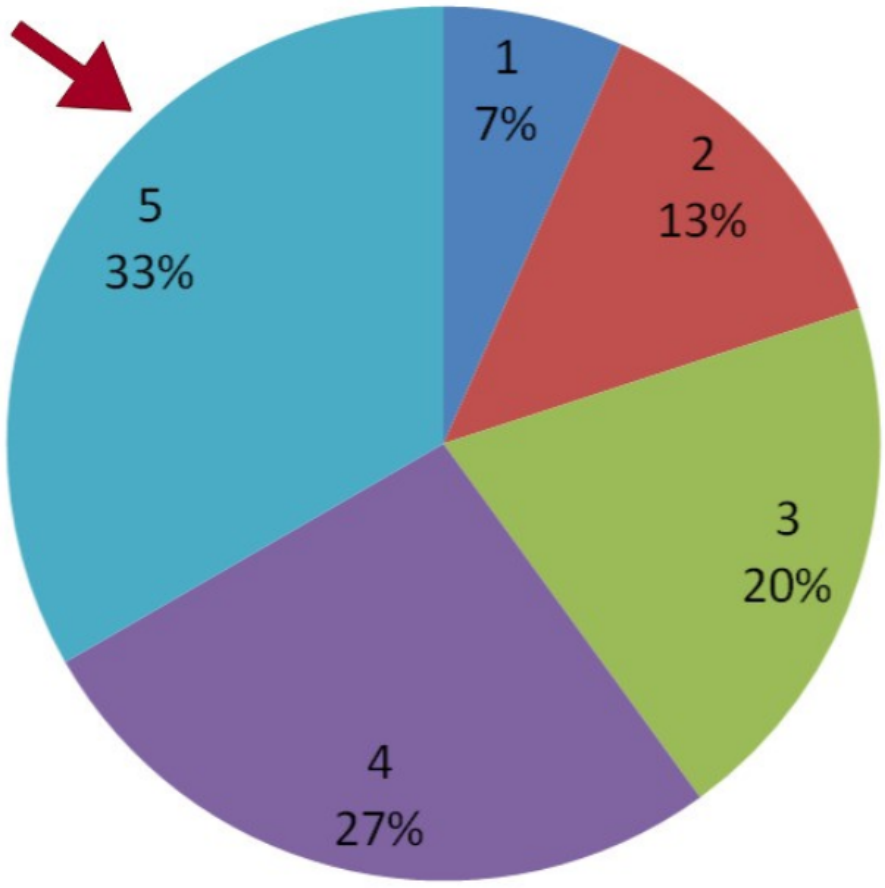
Selection is the process of choosing two parents from the population for crossing. After deciding on an encoding, the next step is to decide how to perform selection, i.e., how to choose individuals in the population that will create offspring for the next generation and how many offspring each will create. The purpose of selection is to emphasize fitter individuals in the population in hopes that their offspring have higher fitness. Chromosomes are selected from the initial population to be parents for reproduction. The problem is how to select these chromosomes. According to Darwin's theory of evolution the best ones survive to create new offspring. Figure 15-20 shows the basic selection process.

Selection is a method that randomly picks chromosomes out of the population according to their evaluation function. The higher the fitness function, the better chance that an individual will be selected. The selection pressure is defined as the degree to which the better individuals are favored. The higher the selection pressured, the more the better individuals are favored. This selection pressure drives the GA to improve the population fitness over successive generations.


Mating
Pool
The two best
individuals
New
Population

Roulette Wheel Selection

Selection in this method is proportionate to the fitness of an individual. Higher the fitness of an individual (better chromosomes), higher the chances of getting selected.



Individual	Fitness
1	1.0
2	2.0
3	3.0
4	4.0
5	5.0

Roulette Wheel Selection

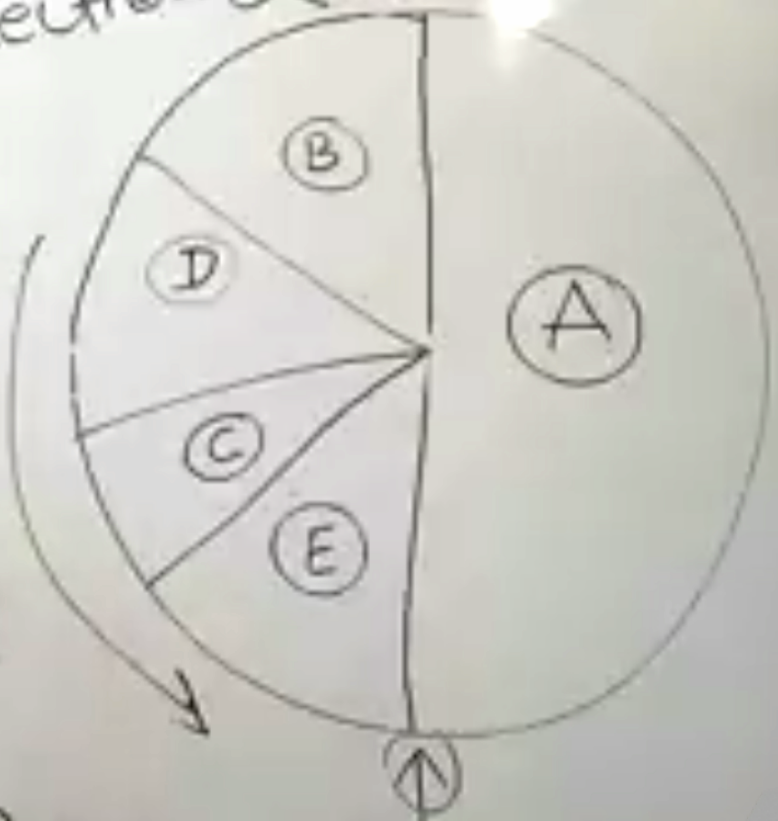
The principle of roulette selection follows a linear search through a roulette wheel with the slots in the wheel weighted in proportion to the individual chromosomes' fitness values. Then a marble is thrown there and selects the chromosome. Chromosome with bigger fitness will be selected more times.

It is clear that a fitter individual has a greater pie on the wheel and therefore a greater chance of landing in front of the fixed point/pointer when the wheel is rotated. Therefore, the probability of choosing an individual depends directly on its fitness.

Roulette wheel

C	F	
A	5	50%
B	2	20%
C	05	5%
D	15	15%
E	1	10%
	10	

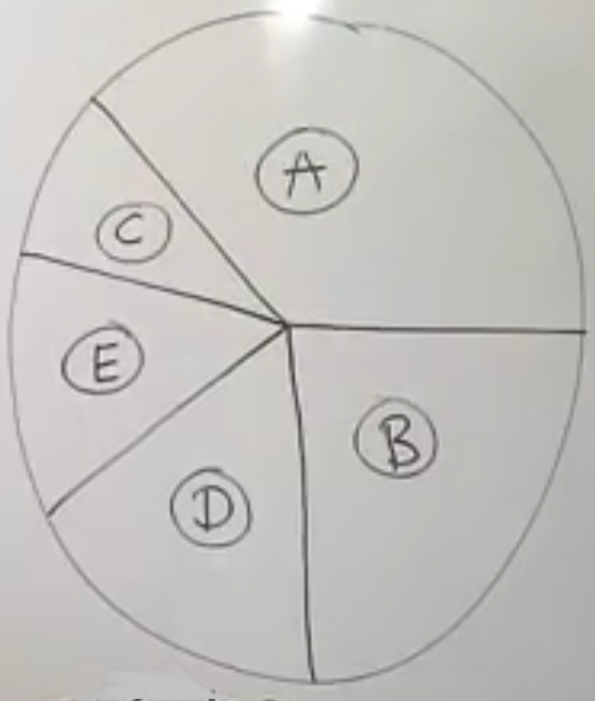
Selection ∝ Fitness



Fitness ∝ Area ∝ selection

Rank Based Selection

C	F		
A	5	5	= 33.33%
B	2	4	= 26.67%
C	0.5	1	= 6.67%
D	1.5	3	= 20%
E	1	2	= 13.33%
		15	

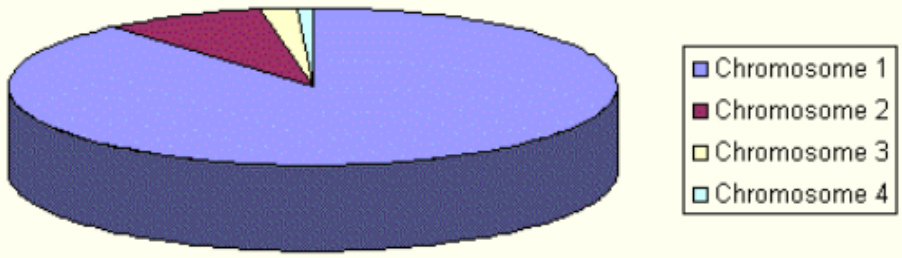


Rank Selection

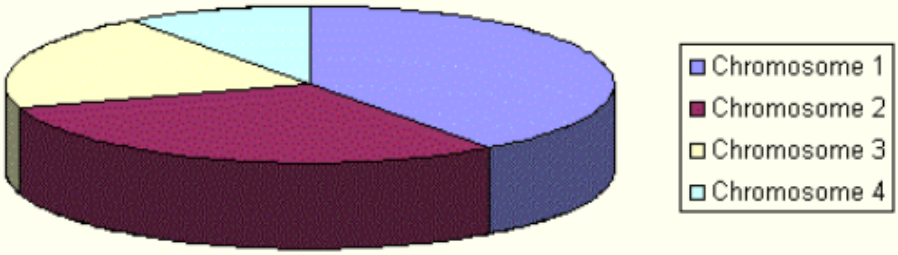
The previous selection will have problems when the fitnesses differs very much. For example, if the best chromosome fitness is 90% of all the roulette wheel then the other chromosomes will have very few chances to be selected.

Rank selection first ranks the population and then every chromosome receives fitness from this ranking. The worst will have fitness ***1***, second worst ***2*** etc. and the best will have fitness ***N*** (number of chromosomes in population).

You can see in following picture, how the situation changes after changing fitness to order number.



Situation before ranking (graph of fitnesses)



Situation after ranking (graph of order numbers)

After this all the chromosomes have a chance to be selected. But this method can lead to slower convergence, because the best chromosomes do not differ so much from other ones.

Steady-State Selection

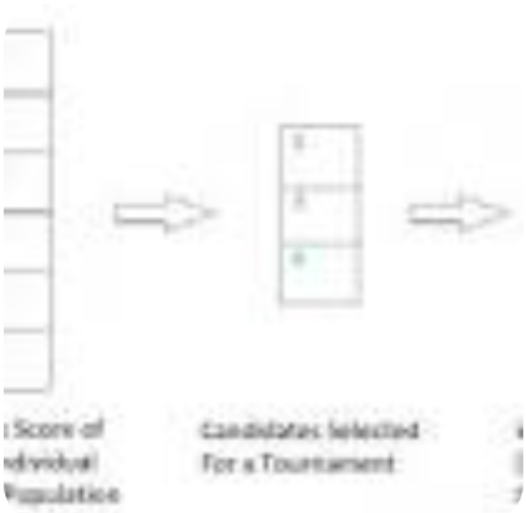
This is not particular method of selecting parents. Main idea of this selection is that big part of chromosomes should survive to next generation.

GA then works in a following way. In every generation are selected a few (good - with high fitness) chromosomes for creating a new offspring. Then some (bad - with low fitness) chromosomes are removed and the new offspring is placed in their place. The rest of population survives to new generation.

Tournament selection

Tournament selection is a method of selecting an individual from a population of individuals in a genetic algorithm. Tournament selection involves running several "tournaments" among a few individuals chosen at random from the population. The winner of each tournament is selected for crossover.

Tournament Selection is a **Selection Strategy used for selecting the fittest candidates from the current generation in a Genetic Algorithm**.



These selected candidates are then passed on to the next generation. In a K-way tournament selection, we select k-individuals and run a tournament among them.

Chromosome #	C_1	C_2	C_3	C_4	C_5	C_6	C_7
Fitness value	10	1	8	6	9	4	7

Tournament size= 3

Randomly 3 chromosomes are selected

Chromosome #	C_2	C_6	C_7
Fitness value	1	4	7

Chromosome with best Fitness is selected

Winner Chromosome #	C_7
Fitness value	7