SELECTION

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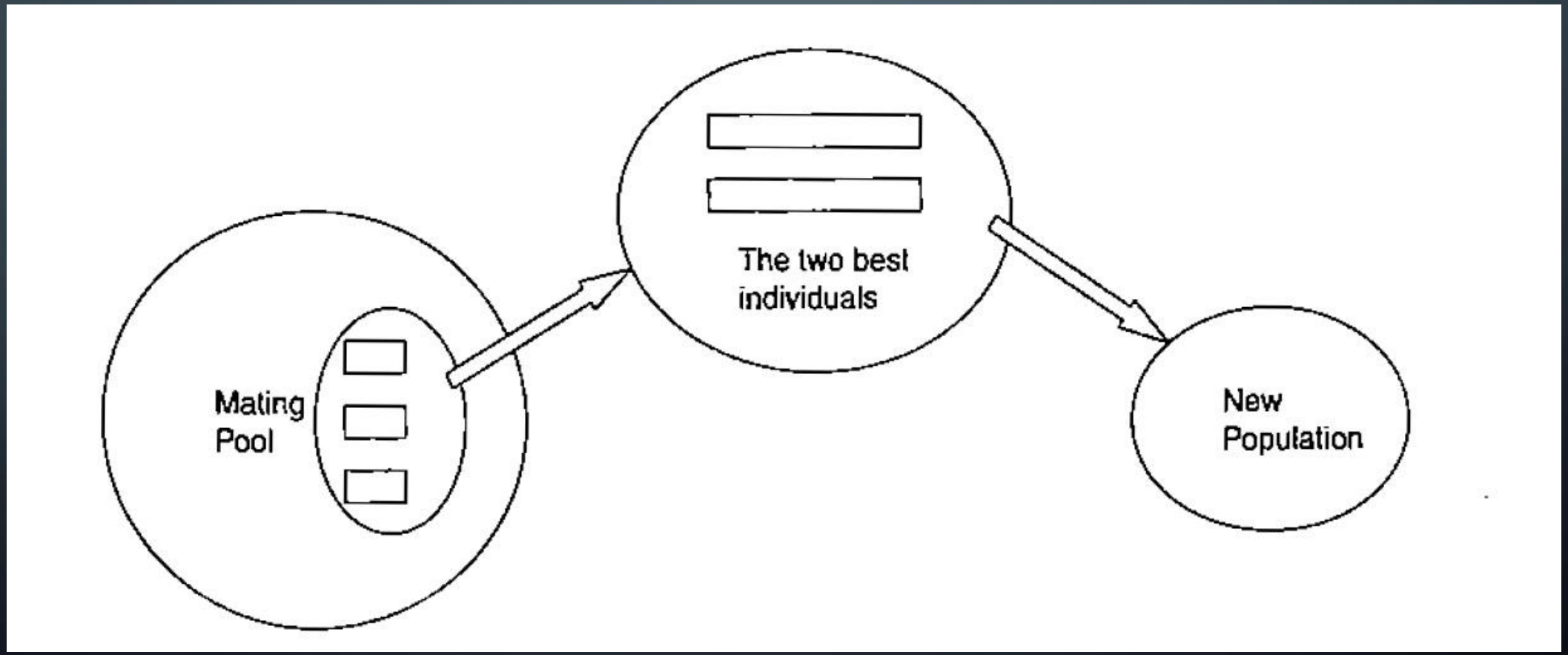
ROLL NO:27

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.
- 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.

SELECTION



SELECTION PRESSURE

- The selection pressure is defined as the degree to which the better individuals are favored.
- The higher the selection pressure, the more the better individuals are favored.
- This selection pressure drives the GA to improve the population fitness over successive generations.

CONVERGENCE RATE

- The convergence rate of GA is largely determined by the magnitude of the selection pressure, with higher selection pressures resulting in higher convergence rates.
- *GAs* should be able to identify optimal or nearly optimal solutions under a wide range of selection scheme pressure.
- However, if the selection pressure is too low, the convergence rate will be slow, and the GA will take unnecessarily longer to find the optimal solution.
- If the selection pressure is too high, there is an increased chance of the GA prematurely converging to an incorrect (sub-optimal) solution.

TYPES OF SELECTION

1. Proportionate – Based Selection

- This selection picks out individuals based upon their fitness values relative to the fitness of the other individuals in the population.

2. Ordinal – Based Selection

- This selection scheme selects individuals not upon their raw fitness, but upon their rank within the population.

1. ROULETTE WHEEL SELECTION

- The expected value of an individual is individual’s fitness divided by the actual fitness of the population.
- Each individual is assigned a slice of the Roulette wheel, the size of the slice being proportional to the individual's fitness.
- The wheel is spun *N* times, where *N* is the number of individuals in the population.
- On each spin, the individual under the wheel's marker is selected to be in the pool of parents for the next generation.

1. ROULETTE WHEEL SELECTION

- This method is implemented as follows:

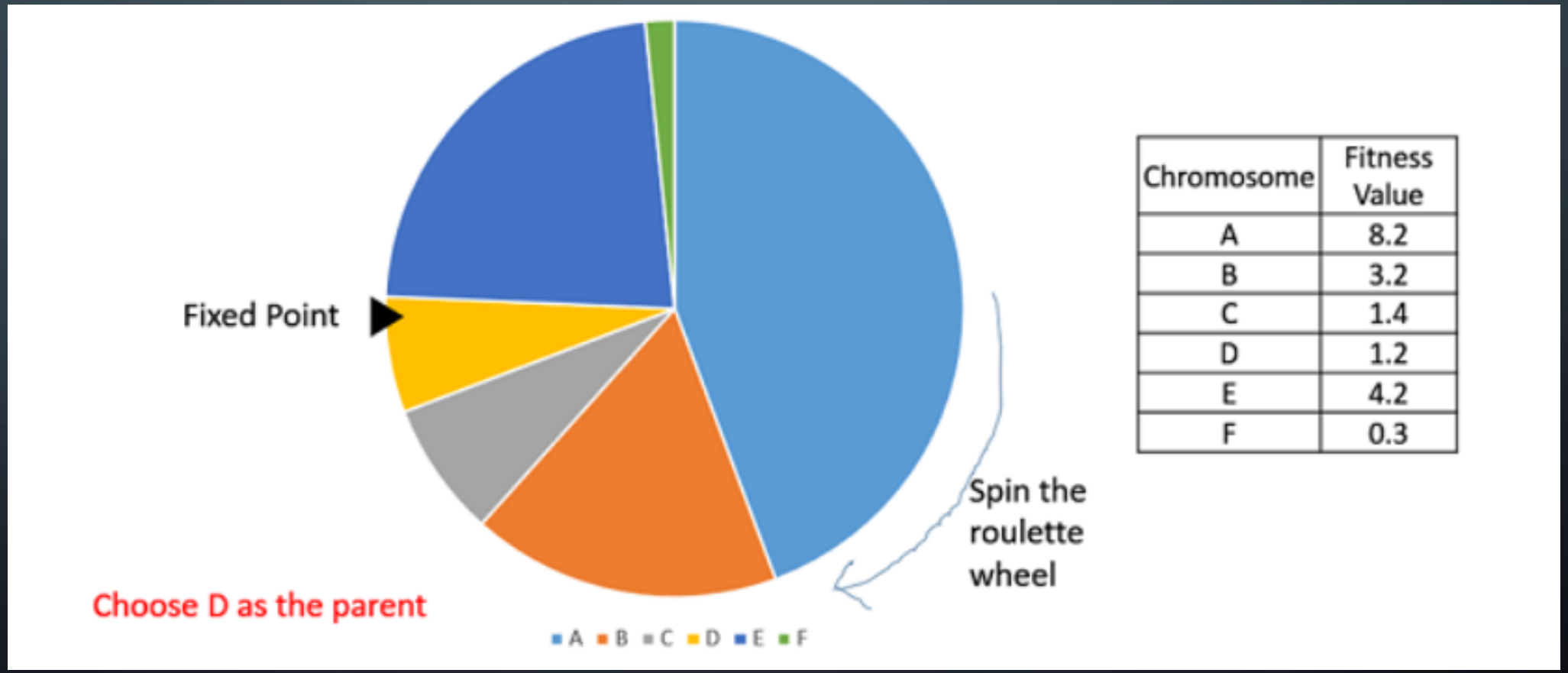
1. Sum the total expected value of the individuals in the population. Let it beT.

2. Repeat *N* times:

i. Choose a random integer *"r"* between 0 and *T.*

ii. Loop through the individuals in the population, summing the expected values, until the sum is greater than or equal to *"r."* The individual whose expected value puts the sum over this limit is the one selected.

1. ROULETTE WHEEL SELECTION



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

2. RANDOM SELECTION

- This technique randomly selects a parent from the population.
- In terms of disruption of genetic codes, random selection is a little more disruptive, on average, than Roulette wheel selection.

3. RANK SELECTION

- Rank Selection ranks the population and every chromosome receives fitness from the ranking.
- The worst has fitness 1 and the best has fitness *N.*
- In effect, potential parents are selected and a tournament is held to decide which of the individuals will be the parent.
- There are many ways this can be achieved and two suggestions are:

1. Select a pair of individuals at random. Generate a random number *R* between 0 and 1. If *R* <r use the first individual *as* a parent. If the *R* 2: *r* then use the second individual as the parent. This is repeated to select the second parent. The value of *r* is a parameter to this method.

3. RANK SELECTION

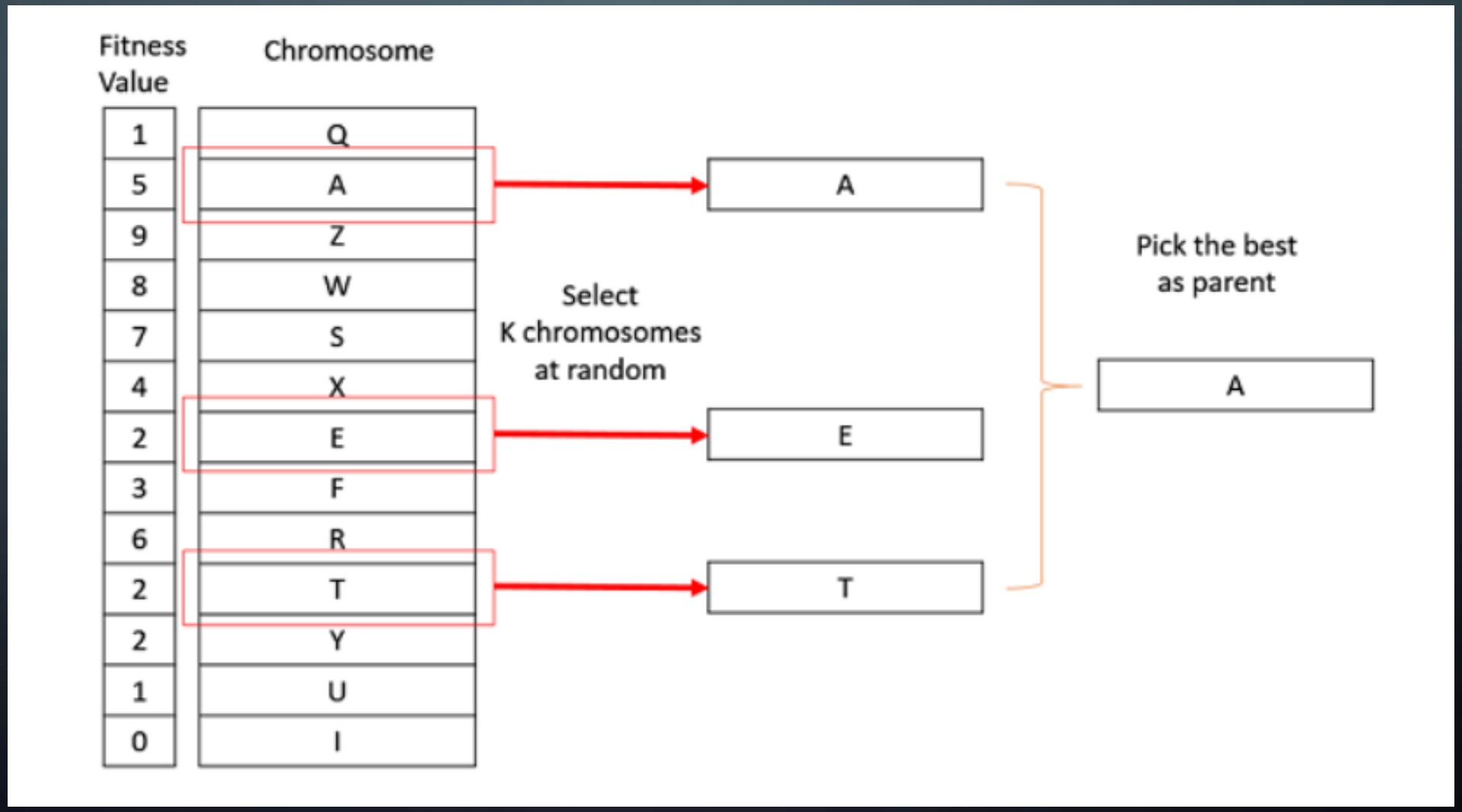
2. Select two individuals at random. The individual with the highest evaluation becomes the parent. Repeat to find a second parent.

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

4. TOURNAMENT SELECTION

- Unlike, the Roulette wheel selection, the tournament selection strategy provides selective pressure by holding a tournament competition among *Nu* individuals.
- The best individual from the tournament is the one with the highest fitness, who is the winner of *Nu.*
- Tournament competitions and the winner are then inserted into the mating pool. The tournament competition is repeated until the mating pool for generating new offspring is filled.
- The mating pool comprising the tournament winner has higher average population fitness.
- The fitness difference provides the selection pressure, which drives GA to improve the fitness of the succeeding genes.
- This method is more efficient and leads to an optimal solution.

4. TOURNAMENT SELECTION



5. BOLTZMANN SELECTION

- In Boltzmann selection, a continuously varying temperature controls the rate of selection according to a preset schedule.
- The temperature starts out high, which means that the selection pressure is low.
- The temperature is gradually lowered, which gradually increases the selection pressure, thereby allowing the GA to narrow in more closely to the best part of the search space while maintaining the appropriate degree of diversity.

5. BOLTZMANN SELECTION

- A logarithmically decreasing temperature is found useful for convergence without getting stuck to a local minima state.
- However, it takes time to cool down the system to the equilibrium state.
- Let *fmax* be the fitness of the currently available best suing.
- If the next string has fitness *f(Xi)* such that *f(Xi)*> *fmax,* then the new string is selected.

5. BOLTZMANN SELECTION

- Otherwise it is selected with Bolt/Mann probability

  $P = exp[- \{fmax – f(Xi)\} / T]$

  where $T=T0(1 – \alpha)^k$ & $k=(1 + 100 * g / G)$; g is the current generation temperature; G the maximum value of g. The value of α can be chosen from range [0,1] & that of T0 from range [5,100].

  The final state is reached when computation approaches 0 value of T.

- The probability that the best string is selected and introduced into the mating pool is very high.

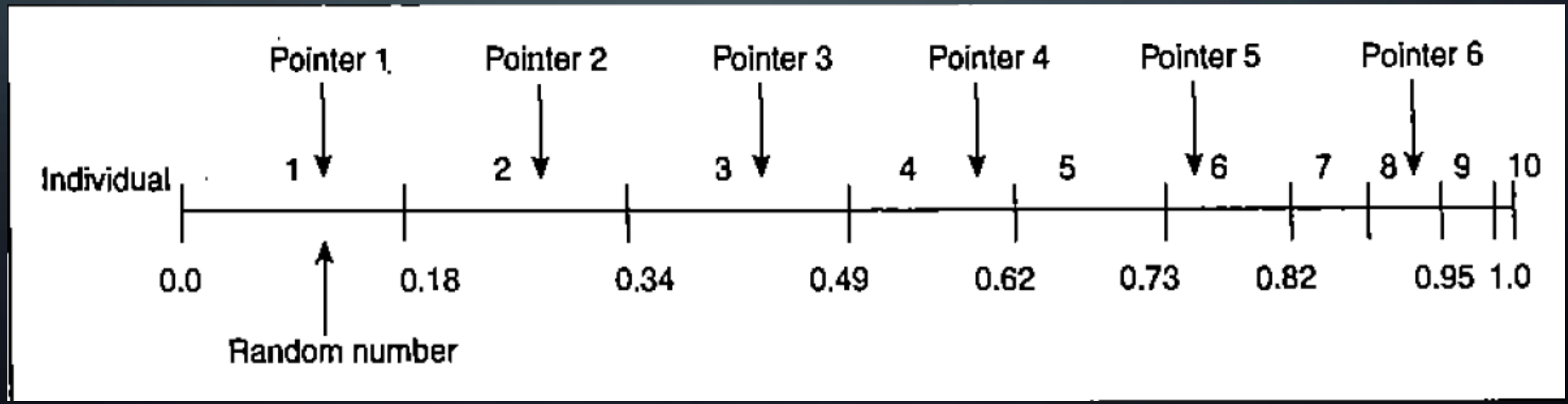
6. STOCHASTIC UNIVERSAL SAMPLING

- The individuals are mapped to continuous segments of a line, such that each individual's segment is equal in size to its fitness exactly as in Roulette wheel selection.
- Here equally spaced pointers are placed over the line, as many as there are individuals to be selected.
- Consider *NPointer* the number of individuals to be selected, then the distance between the pointers are *1/NPointer* and the position of the first pointer is given by a randomly generated number in the range [0, 1*/NPointer].*
- For 6 individuals to be selected, the distance between the pointers is 1/6 = 0.167.

6. STOCHASTIC UNIVERSAL SAMPLING

- Sample of 1 random number in the range [0, 0.167]: 0.1.
- After selection the mating population consists of the individuals,

  1,2,3,4,6,8



THANK YOU