TEAM NAME = TRANSFORMERS

Tutorial on GA **Date: 19.03.2025**

1. Given a population with the following fitness values: [2, 5, 1, 3]. Perform roulette wheel selection to determine which individual is chosen for i) r=0.5 ii)0.65 iii)r=0.85
2. A population consists of 4 individuals with fitness values **[4, 6, 3, 7]**. Perform roulette wheel selection twice, assuming random numbers r1=0.3 and r2=0.8 are generated.
3. Consider a population of four individuals represented by binary strings:
   Population: [1011, 1110, 0011, 1001]
   Fitness values: [4, 7, 2, 5]
   Perform the following steps : Let r1=0.4 , r2=0.8 :
   i)Roulette wheel selection to select **two parents**.
   ii)Perform **single-point crossover** at position 2.
   iii)Apply **mutation** by flipping the third digit of the offspring.
4. Consider a population of 6 individuals with fitness values **[10, 15, 5, 20, 8, 12]**.
   Population (binary): [1101, 1011, 0110, 1001, 1110, 0011]
   Perform the following steps: Let r1=0.5, r2=0.85
   i)Roulette wheel selection to pick two parents.
   ii)Apply **two-point crossover** at positions 2 and 4.
   iii)Introduce a mutation by flipping the first bit in both offspring.
5. **Population (binary):** [101, 111, 011] **Fitness values:** [6, 3, 7]
   Steps:
   Perform **roulette wheel selection** to select two parents Let r1=0.2, r2=0.7.
   Apply **single-point crossover** at position 2.
   Introduce a mutation by flipping the last bit of both offspring.
6. **Population (binary):** [1011, 1100, 0011, 1001, 1110, 0101] **Fitness values:** [4, 7, 2, 5, 6, 8]
   Steps:
   Perform **roulette wheel selection** to select two parents Let r1=0.55, r2=0.8..
   Perform **two-point crossover** at positions 2 and 4.
   Apply **mutation** by flipping the second and fourth bits in both offspring.
7. **Population (binary):** [1000, 1101, 1010, 0111, 0001, 1111, 0100, 0010]
   Fitness values: [3, 5, 8, 2, 6, 10, 7, 4]
   Steps:
   Perform **roulette wheel selection** to select **three parents(Assume r of your choice)**.
   Perform **three-way crossover** by mixing bits from all three parents.
   Apply **mutation** by flipping the third bit in all offspring.
   Generate offsprings for three generations analyse the role of selection, crossover, mutation

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Computational Intelligence Tut

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Group Name: Transformers.

Q1) fitness = $\overset{A}{[2}, \overset{B}{5}, \overset{C}{1}, \overset{D}{3}]$ total = 2+5+1+3 = 11

probability = $\left[\frac{2}{11}, \frac{5}{11}, \frac{1}{11}, \frac{3}{11}\right]$

$= \overset{A}{[0.1818}, \overset{B}{0.4545}, \overset{C}{0.0909}, \overset{D}{0.2727}]$

cummulative probability = $[0, 0.1818) \in A$

$[0.1818, 0.6363) \in B$

$[0.6363, 0.7272) \in C$

$[0.7272, 1) \in D$

for $r = 0.5$, select B

$r = 0.65$, select C

$r = 0.85$, select D

Q2) fitness = $\overset{A}{[4}, \overset{B}{6}, \overset{C}{3}, \overset{D}{7}]$ Total = 4+6+3+7 = 20

probability = $\left[\frac{4}{20}, \frac{6}{20}, \frac{3}{20}, \frac{7}{20}\right] = \overset{A}{[0.2}, \overset{B}{0.3}, \overset{C}{0.15}, \overset{D}{0.35}]$

cummulative probability

$[0, 0.2) \in A$

$[0.2, 0.5) \in B$

$[0.5, 0.65) \in C$

$[0.65, 1) \in D$

for $r1 = 0.3$ select B

$r2 = 0.8$ select D

Q3)

	A	B	C	D
fitness	4	7	2	5
string	1011	1110	0011	1001
probability	0.22	0.38	0.11	0.27
cum. prob	0.22	0.61	0.72	1.

- for $r1 = 0.4$ select B ie 1110
- i) $r2 = 0.8$ select D ie 1001

ii) → position 2

Parent 1 = 11 | 10

Parent 2 = 10 | 01

∴ Child 1 = 1101

child 2 = 1010

single point crossover

iii) 3rd digit mutation

∴ mutated child 1 = 1111

mutated child 2 = 1000

Q4)

	A	B	C	D	E	F
fitness	10	15	5	20	8	12
string	1101	1011	0110	1001	1110	0011
prob	0.1428	0.2142	0.0714	0.28	0.114	0.1714
cum prob	0.1428	0.35714	0.4285	0.7142	0.8285	1

i) for $r1 = 0.5$ select D ie 1001

for $r2 = 0.85$ select F ie 0011

ii)

	1	2	3	4
parent 1 =	1	0	0	1
parent 2 =	0	0	1	1

pos 2 pos 4

offspring 1 = 1011

offspring 2 = 0001

two point crossover

iii) first bit mutation

mutated offspring 1 = 0011

mutated offspring 2 = 1001

Q5)

	A	B	C
fitness	6	3	7
string	101	111	011
prob	0.375	0.1875	0.4375
cum prob	0.375	0.5625	1

∴ $r1 = 0.2$ Select A ie 101 ⟶ parent 1

∴ $r2 = 0.7$ Select C ie 011 ⟶ parent 2

Single point crossover

		1	2	3	
parent 1		1	0	1	offspring 1 = 101
parent 2		0	1	1	offspring 2 = 011

pos 2

Mutation on last bit

mutated offspring 1 = 100

mutated offspring 2 = 010