Genetic Algorithm

→ Slow Algorithm

→ Difficult to find model chromosome & fitness function

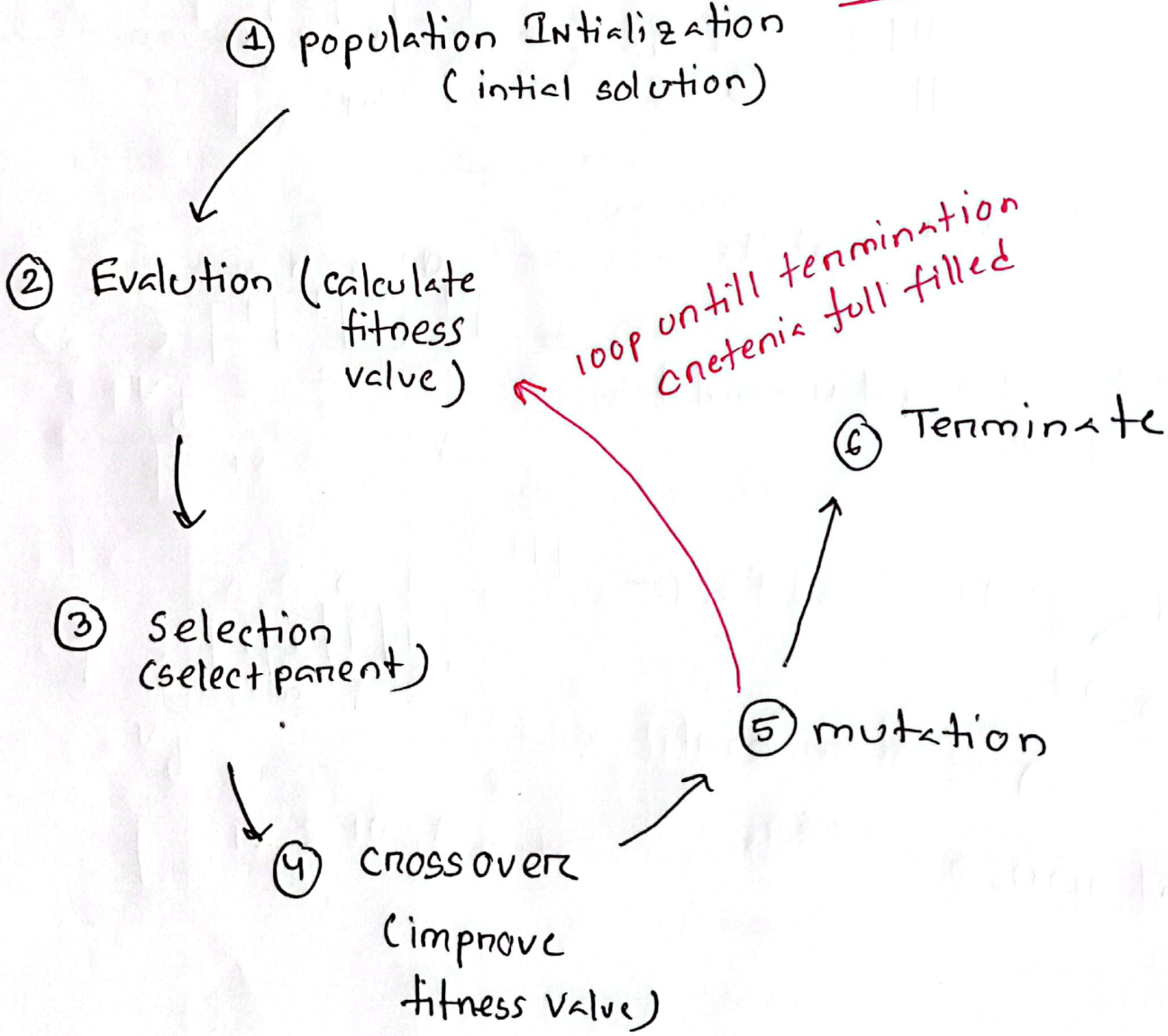
→ Random search Algorithm

→ easy to code

→ provides many soln

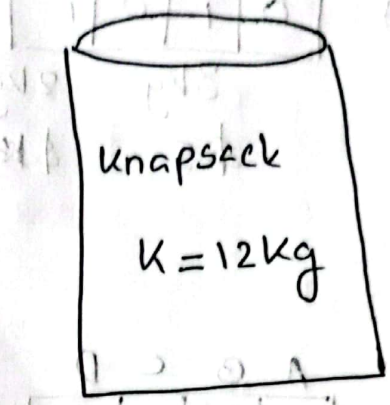
→ parallal processing

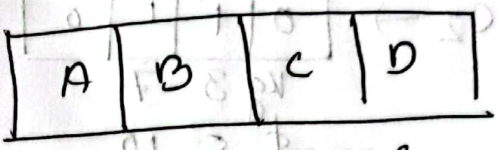
6 Steps



Q1 0-1 knapsack problem by Genetic Algorithm

Item	weight	Value
A	5kg	$12
B	8kg	$5
C	7kg	$10
D	2kg	$7





chromosome

$2^4 = 16$

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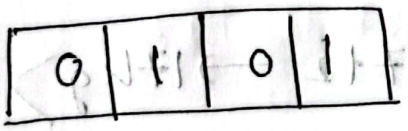
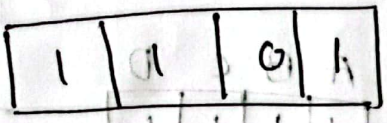
choosing random 1

0 → not selected item

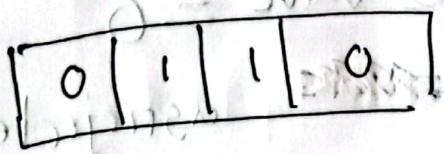
1 → selected item

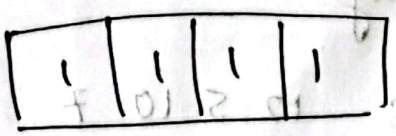
step:-1 population Inticlization

$C_1 \rightarrow$ 

$C_3 \rightarrow$ 

C_2

$C_3 \rightarrow$ 

$C_4 \rightarrow$ 

② Calculate fitness score

$C_1 \rightarrow$

A	B	C	D
0	1	0	1
	3kg		2kg
	$5		$7

→ 3+2 ⇒ 5kg < 12kg Accepted

→ fitness value = 5 + 7 = $12

$C_2 \rightarrow$

A	B	C	D
0	1	1	0
kg	3	7	
$	5	10	

→ 3+7 = 10kg < 12 Accepted

→ fitness value = 5+10 = $15

$C_3 \rightarrow$

A	B	C	D
1	1	0	1
kg	5	3	2
$	12	5	7

→ 5+3+2 = 10kg < 12 accepted

→ fitness value = 12+5+7 = $24

$C_4 \rightarrow$

A	B	C	D
1	1	1	1
kg	5	3	7	2
$	12	5	10	7

→ 5+3+7+2 → 17kg > 12 Reject

→ fitness value = 0

∴ as rejected

Parent Generation -1 (G1)

③ Selection Process

$$\text{probability of } i = P_i = \frac{f_i \text{ (fitness value } i)}{\Sigma f_i}$$

Chromosome	fitness value, f_i	$P_i = \frac{f_i}{\Sigma f_i}$
C_1 0101	$ 12	12/51 = .235
C_2 0110	$ 15	15/51 = .294 ✓
C_3 1101	$ 24	24/51 = .47 ✓
C_4 1111	$ 0	0/51 = 0
	Σf_i = $ 51	1

as C_4 has probability 0 . we removing it

choosing Highest probability cromose as parents

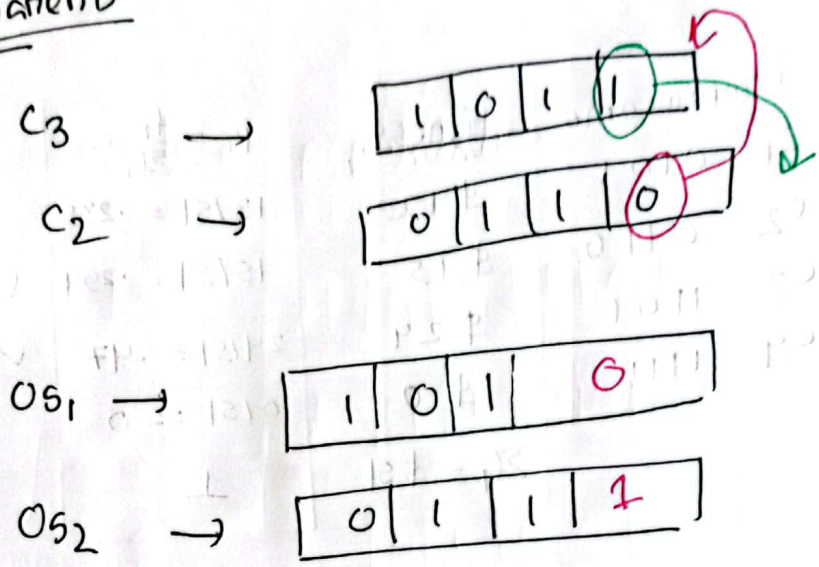
$P_1 \rightarrow$ | 1 | 0 | 1 | 1 | C_3

$P_2 \rightarrow$ | 0 | 1 | 1 | 0 | C_2

$P_3 \rightarrow$ | 0 | 1 | 0 | 1 | C_1

① Crossover

crossovening top 2 parents



Mating Pool	cross over point	offspring	weight	fitnes	Pi
1 0 1 1	2	1 0 1 0	12kg	$22	
0 1 1 0	2	0 1 1 1	12kg	~~$12~~	
1 0 1 1	0	1 0 1 1	10kg	$24	
0 1 1 0	0	0 1 1 0	10kg	15	

⑤ **Mutation** flip 1 to 0 or 0 to 1 for any offspring

Offspring	Mutation point	Update offspring	weight	fitness value
1010	3	1011	10kg	$24
0111	2	0101	5kg	$12
1011	1	0011	7kg	$10
0110	0	1110	15kg >12 not accepted	0

⑥ Termination:

Highest fitness value

= $24

weight = 10kg

Q-2 Maximize the function $f(x) = x^2$

x value range from 0 - 31

$2^5 = 32$

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Step - 1 Intialize popotalation

Decimal to Binary

13 → | 0 | 1 | 1 | 0 | 1 |

24 → | 1 | 1 | 0 | 0 | 0 |

8 → | 0 | 1 | 0 | 0 | 0 |

19 → | 1 | 0 | 0 | 1 | 1 |

Step - 2 calculating fitness

	fi
13	$13^2 = 169$
24	$24^2 = 576$
8	$8^2 = 64$
19	$19^2 = 361$

③ selecting parent :-

$p_i = f_i / \Sigma f_i$

	fi cromose	fitness	p_i
13	01101	169	.14
24	11000	576	.49
8	01000	64	.06
19	10011	361	.31

$\Sigma f_i =$

selecting parent

$P_1 = 11000 \quad (24)$

$P_2 = 10011 \quad (19)$

$P_3 = 01101 \quad (13)$

④ crossover

Mating Pool	cross over point	offspring	x value	fitness x^2
P_3 0110|1	3	0110|0	12	144
P_1 1100|0	3	1100|1	25	625
P_1 1|1000	1	1|0011	27	726
P_2 10|011	1	10|000	16	256

5. Mutation

offspring	Mutation point	update offsprings	X	fitness
01100	0	11100	28	784
11001	N/A	11001	25	625
11011	N/A	11011	27	729
10000	2	10100	18	324

6. Terminating

Highest fitness value

$= 784$

$\therefore X = 28$