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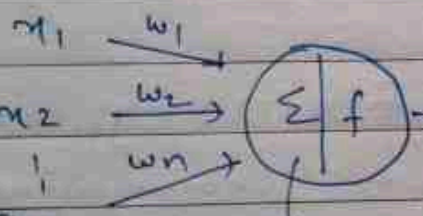
McCulloch - Pitts Neuron.

→ First mathematical model of biological neuron in 1943 by Warren Mc-Culloch & Walter Pitts
→ Also called Linear-threshold Gate model
→ Basic building block of neural n/w
→ Directed weight graph is used for connected neuron.
→ Two possible State of neuron → Active (1)
→ Silent (0)



Aggregates the weighted i/p into single numeric value
$\Sigma(x_1w_1 + x_2w_2 + x_3w_3 + \cdots x_nw_n)$ denoted → X.
f → produced the o/p using threshold (T) value.

$$o/p = 1 \text{ if } X > T$$
$$0 \text{ if } X < T$$

Bias / Threshold → It is the minimum value of weighted active i/p of neuron to fire.
If effective/weighted i/p > T then O/p is 1 else o/p is 0.

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i.e

o/p : f(x)

↳ $\sum w_i x_i \geq T$

function] $\theta(x) = 1$ if $x \geq 0$

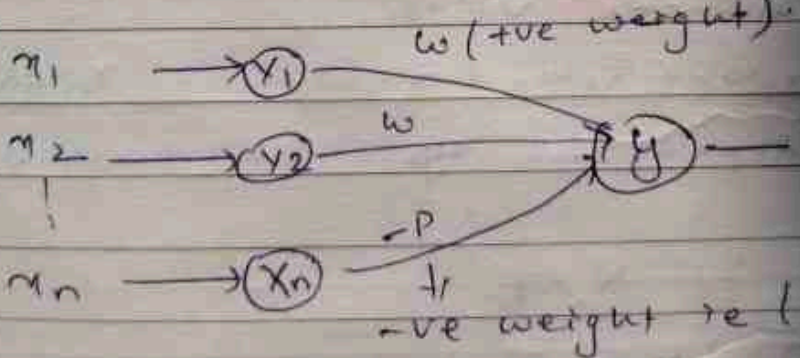
0.

What this model do

There is weighted i/p & o/p function Compared it with weighted i/p. If it is greater than threshold then o/p is 1 else the o/p is zero

Binary - neuron may fire (1) may not fire (0)

weight associated with communication link may be excitatory (positive) or inhibitory (-ve)



$$y_{in} = x_1 w_1 + x_2 w_2 + x_n w_n$$

$$y = f(y_{in}) = \begin{cases} 1 & \text{if } y_{in} \geq \theta \text{ threshold } (\theta) \\ 0 & \text{if } y_{in} < \theta \end{cases}$$

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To find threshold value

for inhibitory, threshold will be the activation function should satisfy the following function

$\theta > nw - p$

↓ → Inhibitory

Exhibitory.

for no particular training program.

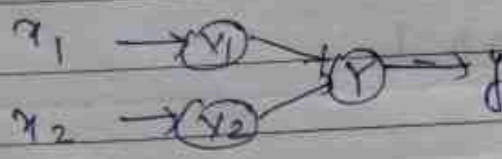
Ex of using Mc-Culloch Pitts neuron

Q. Implement AND NOT function using Mc-Culloch-Pitts neuron (Binary data)

x_1	x_2	y
0	0	0
0	1	0
1	0	1
1	1	0

o/p = 1 if 1st i/p is 1 & 2nd i/p is 0

Soln



Case-1 $w_1 = w_2 = 1$

$\theta \geq nw - p$

$\geq 2(1) - 0$

$\theta \geq 2$

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So $y_{in} = x_1 w_1 + x_2 w_2$

for i/p. $w_1 = w_2 = 1$

(0,0) $y_{in} = 0 \times 1 + 0 \times 1 = 0$

(0,1) $y_{in} = 0 \times 1 + 1 \times 1 = 1$

(1,0) $y_{in} = 1 \times 1 + 0 \times 1 = 1$

(1,1) $y_{in} = 1 \times 1 + 1 \times 1 = 2.$

This is not the i/p for AND-NOT function

Case-2 one weight is excitatory & other as inhibitory.

i.e $w_1 = 1 \quad w_2 = -1$

for i/p

(0,0) $y_{in} = 0 \times 1 + 0 \times -1 = 0$

(0,1) $y_{in} = 0 \times 1 + 1 \times -1 = -1$

(1,0) $y_{in} = 1 \times 1 + 0 \times -1 = 1$

(1,1) $y_{in} = 1 \times 1 + 1 \times -1 = 0$

It is possible to fire the neuron with i/p (1,0) only

for $w_1 = 1 \quad w_2 = -1$

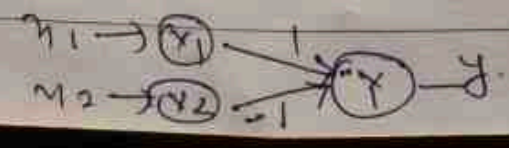
$\theta \geq nw - p$

$\geq 2(1) - 1$

$\boxed{\theta \geq 1}$

The o/p of Neuron Y can be written as

o/p $y = f(y_{in}) = \begin{cases} 1 & \text{if } y_{in} \geq 1 \\ 0 & \text{if } y_{in} < 1 \end{cases}$



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Linear Seperability

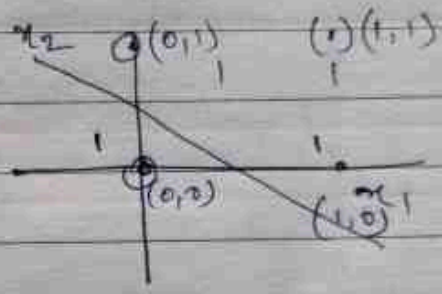
→ A decision line is drawn to seperate positive and negative response

- when two class that can be seperated by decision boundary they are said to be linear seperable problem.

Eg:

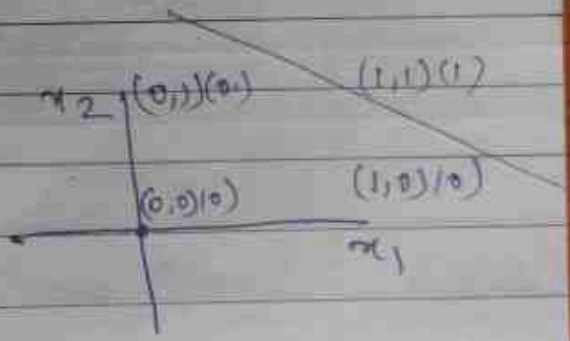
OR gate

x_1	x_2	OR
0	0	0
0	1	1
1	0	1
1	1	1



AND gate

x_1	x_2	o/p
0	0	0
0	1	0
1	0	0
1	1	1



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Hebb network

Algorithm

1) Initialize all weight & bias to zero
   $w_i = 0$ for $i = 1$ to n
2) for each i/p training vector & target vector o/p pair (s, t) perform step 3 to 6
3) Set activation for i/p unit i/p vector
   $x_i = s_i \quad (i = 1 \text{ to } n)$
   i/p unit ; i/p vector.
4) Set Activation for o/p unit with o/p neuron
   $y = t$
5) Adjust the weight by applying Hebb rule.
   $w_i(new) = w_i(old) + x_i y$ to $i = 1$ to n.
6) adjust bias.
   $b(new) = b(old)$

Eg. Hebb n/w to implement And using Hebb rule

Training data for AND fun.

x_1	x_2	bias	Target y
1	1	1	1
1	-1	1	-1
-1	1	1	-1
-1	-1	1	-1

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Initially the weight & bias to zero

$w_1 = w_2 = b = 0$

First input $[x_1\ x_2\ b] = [1\ 1\ 0]$ and target = 1

Setting the initial weight as old weight and applying the Hebb rule, we get

$w_i(new) = w_i(old) + \Delta w_i$

Change of weight

first find Δw_i

$\Delta w_i = x_i y$

i/p, target

$\Delta w_1 = x_1 y = 1 \times 1 = 1$

$\Delta w_2 = x_2 y = 1 \times 1 = 1$

$\Delta b = y = 1$

$w_1(new) = w_1(old) + \Delta w_1 = 0 + 1 = 1$

$w_2(new) = w_2(old) + \Delta w_2 = 0 + 1 = 1$

$b(new) = b(old) + \Delta b = 0 + 1 = 1$

Second i/p.

$[x_1\ x_2\ b] = [1, -1, 1]$ and $y = -1$

The weight change here

$\Delta w_1 = x_1 y = 1 \times -1 = -1$

$\Delta w_2 = x_2 y = -1 \times -1 = 1$

$\Delta b = y = -1$

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$w_1(new) = w_1(old) + \Delta w_1 = 1 - 1 = 0$

$w_2(new) = w_2(old) + \Delta w_2 = 1 + 1 = 2$

$b(new) = b(old) + \Delta b = 1 - 1 = 0$

third i/p

$[-1, 1, 1]$ and $y = -1$

$\Delta w_1 = x_1 y = -1 \times -1 = +1$

$\Delta w_2 = 1 \times -1 = -1$

$\Delta b = y = -1$

$w_1(new) = w_1(old) + \Delta w_1 = 0 + 1 = 0$

$w_2(new) = w_2(old) + \Delta w_2 = 2 - 1 = 1$

$b(new) = b(old) + \Delta b = 0 - 1 = -1$

fourth i/p

$[-1 \quad -1 \quad 1]$ $\quad y = -1$

$\Delta w_1 = x_1 y = -1 \times -1 = 1$

$\Delta w_2 = x_2 y = -1 \times -1 = 1$

$\Delta b = y = -1$

$\Delta w_1(new) = w_1(old) + \Delta w_1 = 0 + 1 = 1$

$w_2(new) = w_2(old) + \Delta w_2 = 1 + 1 = 2$

$\Delta b(new) = b(old) + \Delta b = -1 - 1 = -2$

New weight calculated one.

x_1	x_2	b	Y	Δw_1	Δw_2	Δb	w_1	w_2	b
1	1	1	1	1	1	1	1	1	0
1	-1	1	-1	-1	1	-1	0	2	0
-1	1	1	-1	1	-1	-1	1	1	-1
-1	-1	1	-1	1	1	-1	2	2	-2

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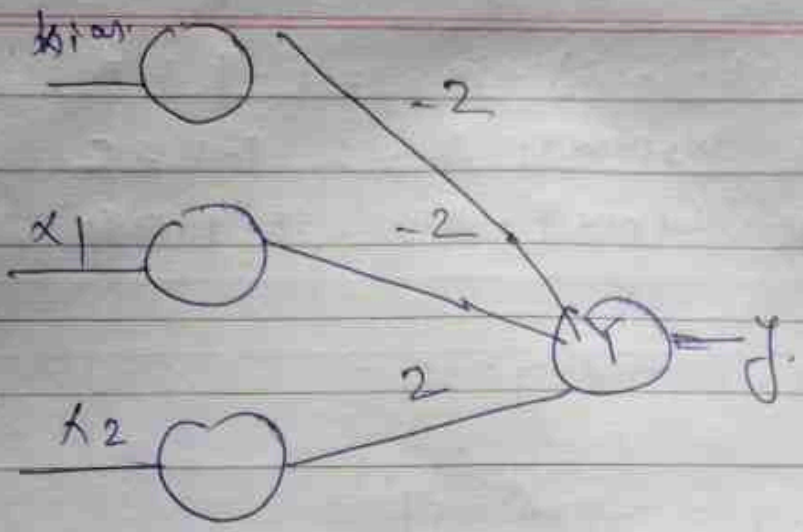
bias
-2
x_1
-2
y
2
x_2

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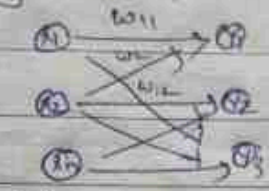
Models of artificial neural n/w

1) Single layer feed forward



Two layers only
i/p layer & o/p layers

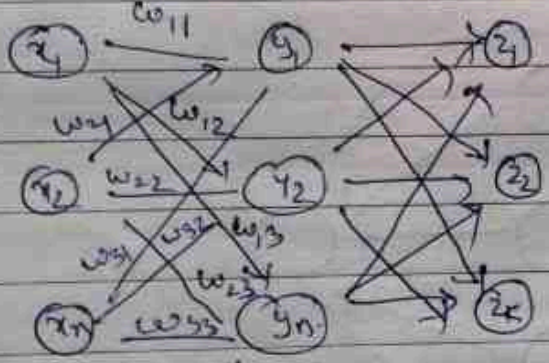
i/p layer

o/p layer

2) Multi layer feed forward n/w

There is hidden layer.

→ It become computationally more strong.



i/p layer

hidden layer

o/p layer

3) Multilayer Perceptron

3 or more layers are used to classify non-linearly separable data.

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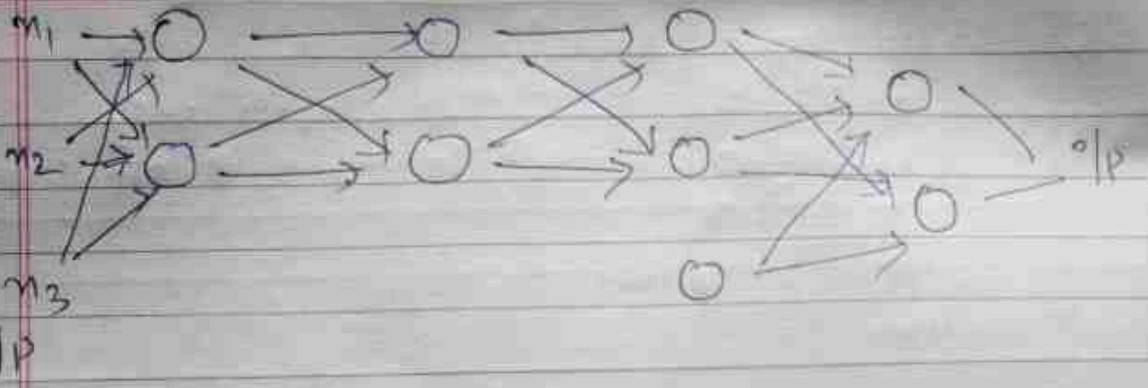
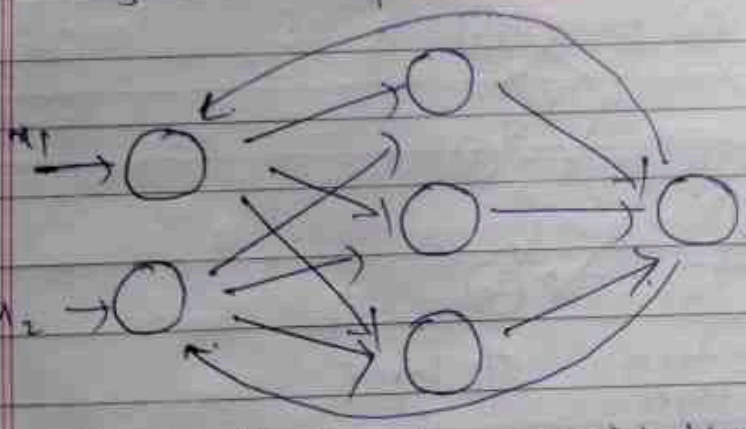


It is fully connected n/w that uses non linear activation functions

④ feedback ANN

feedback is given to i/p layers to adjust the parameters



A feedback is available toward the first layer so that ~~error~~ according to error parameters can be adjusted

It is used to minimize the error.

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Perception network

→ Perceptron unit is used to build ANN system
→ Perceptron takes a vector of real-valued i/p, calculates a linear combination of these i/p, then o/p 1 if the result is greater than some threshold and -1 otherwise.

Mathematically

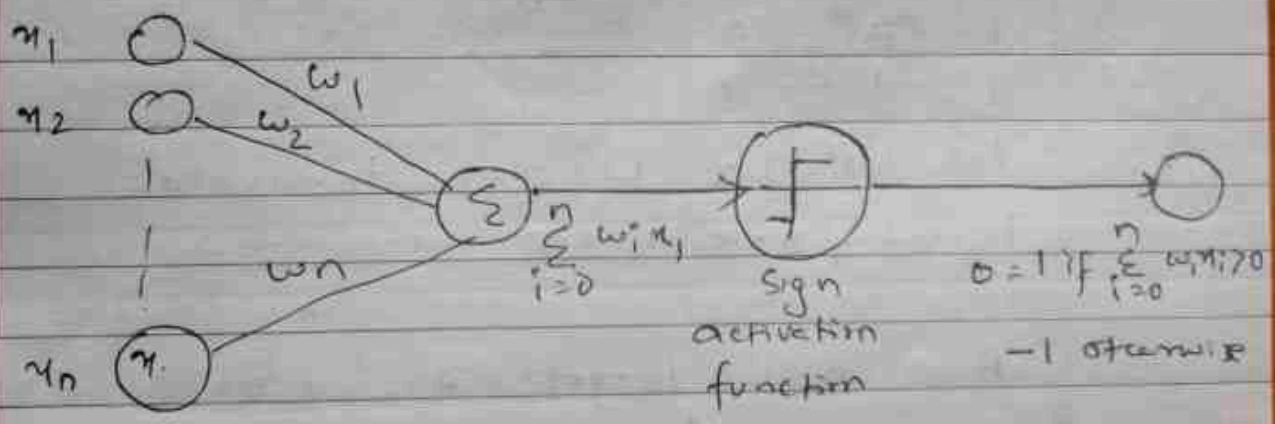
If given i/p and $x_1, x_2, x_3 \ldots x_n$

o/p and $o_1, o_2, o_3 \ldots o_n$

then computed by perceptron is

$$o(x_1 \ldots x_n) = \begin{cases} 1 & \text{if } w_0 + w_1 x_1 + w_2 x_2 + \ldots + w_n x_n > 0 \\ -1 & \text{otherwise} \end{cases}$$

w_i is real valued constant or weight that determines the contribution of i/p x_i to the perceptron o/p



The actual o/p is compared with target o/p if both target & actual o/p are same, these are final wt. otherwise go back and

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modify the weights (w_0, w_1 & w_2). Again the same process continue i.e first calculate the summation term, apply activation function and calculate the actual o/p. If the actual o/p is same as target these are final wt. otherwise go back and modify the wt.

How to learn the wt.

Ex – logical AND gate using perceptron wk

1) Truth table

A	B	A ∧ B
0	0	0
0	1	0
1	0	0
1	1	1

Let $w1 = 1.2$ $w2 = 0.6$ threshold = 1

learning rate $\eta = 0.5$

A = 0 B = 0 target = 0

$w_0 x_1 = 0 \times 1.2 + 0 \times 0.6 = 0$

not greater than threshold of 1 so o/p = 0.

The actual o/p calculate is zero and target is 0, because both are same. No need of wt updation

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2. A = 0 B = 1 target = 0

$w_1 x_1 = 0 \times 1.2 + 0.6 \times 1 = .6$

not greater than threshold 1, so o/p = 0

target = actual o/p, so no need of wt. modification

3) A = 1 B = 0 target = 0

$w_1 x_1 = 1 \times 1.2 + 0.6 \times 0 = 1.2$

o/p is greater than threshold of 1 so o/p = 1

target ≠ actual of, So wt need to be modified.

A/c to perceptron rule

$w_i = w_i + \eta(t-o)x_i$

$w1 = 1.2 + 0.5(0-1)1 = 0.7$

$w2 = 0.6 + 0.5(0-1)0 = 0.6$ } new modified w

Check from beginning:

A = 0 B = 0 target = 0

$w_1 x_1 = 0.7 \times 0 + 0.6 \times 0 = 0$

no need of wt. updation

A = 0 B = 1 target = 0

$w_1 x_1 = 0 \times 0.7 + 1 \times 0.6 = 0.6$

no need of wt. updation

3) A = 1, B = 0 target = 0

$w_1 x_1 = 1 \times 0.7 + 0 \times 0.6 = .7$

no need wt. updation

4) A = 1 B = 1 target = 1

$w_1 x_1 = 0.7 \times 1 + 0.6 \times 1 = 1.3$

w.1 > threshold (no wt. updation

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Adaptive Linear neuron (Adaline)

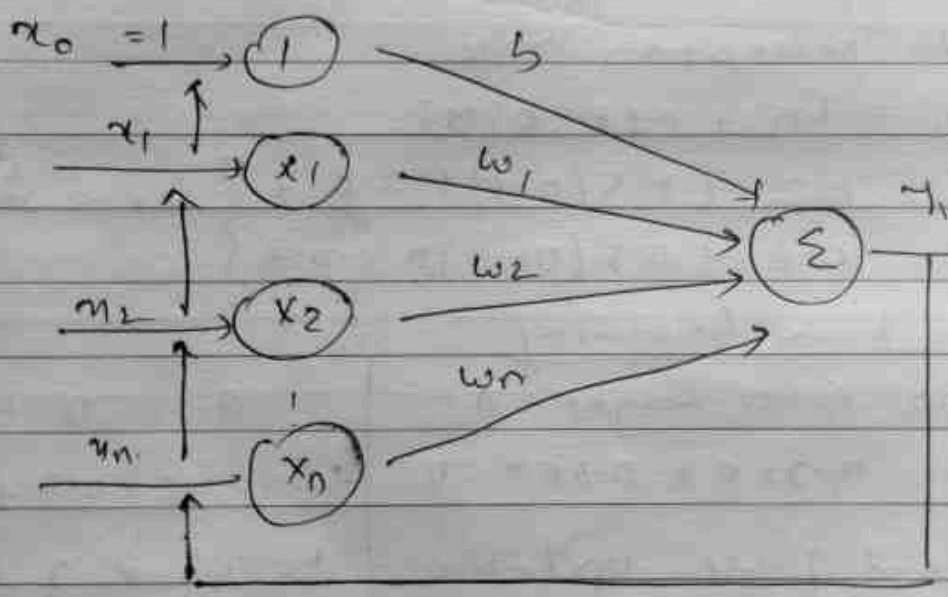
The units with linear activation function are called linear units

→ A n/w with a single linear unit is called adaptive linear neuron (Adaline)

– In adaptive linear neuron, the i/p & o/p relationship is linear

→ Adaline uses bipolar activation function for its i/p signal and its target o/p

$x_0 = 1$ bias



Weight updation

$w_i(new) = w_i(old) + \alpha (t - y_{in}) x_i$

$b(new) = b(old) + \alpha (t - y_{in})$.

Unsupervised learning n/w

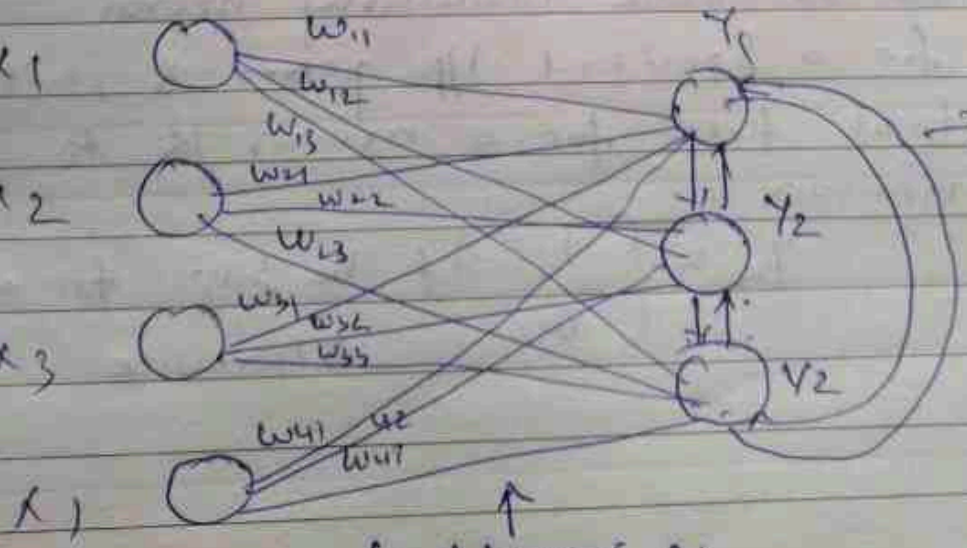
1) Competitive learning n/w

→ The o/p neurons of a neural n/w compete among themselves to become active (Find)
- In Hebbain learning, several o/p neurons may be active but in competitive only single o/p neuron is active at only one time.

→ This features helps to classify a set of i/p pattern.

Three basic elements of competitive learning

1) a set of neuron that are all the same. (except for synaptic weights)
2) Limit imposed on the strength of each neuron.
3) a mechanism that permits the neuron to compete -> a winner takes all



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Analogy:

All Student read all text book, Video, lecture but only one will be the topper.

Among Y_1 Y_2 Y_3 only one o/p will win topper always wants to be topper, so he inhibit other o/p Student by not saying them

Elements:

1) all i/p neuron x_1, x_2, x_3 & x_4 are same but weight are different

2) Limit imposed on each neuron.

Constraint can be.

$$\left.\begin{aligned} \sum_j w_{kj} &= 1 \quad \text{for all } k \\ \sum_j w_{kj}^2 &= 1 \quad \text{for all } k \end{aligned}\right\} \text{ Type of Constraint}$$

3rd elements

Q How to choose winning neuron

Ans for a Specified i/p pattern x, with induced local field for a neuron k to be winning neuron

$$y_k = \begin{cases} 1 & \text{if } v_k > v_j \text{ for all } j, j \neq k \\ 0 & \text{otherwise.} \end{cases}$$

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Membership function

$A = \{x, \mu(x)\}$

Let

$$\mu(x) = \frac{1}{1+x^2}$$

↓

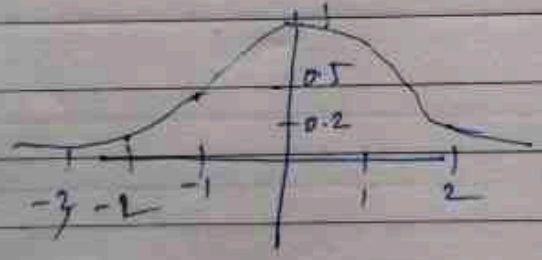
membership function.

e.g.

$A = \{$ Real no. close to zero $\}$

$= \{x, \mu(x)\}$ $x \in R$

$$\mu(x) = \frac{1}{1+x^2}$$



degree of membership

$f(-1) = .5$

$1 = .5$

$-2 = .2$

$+2 = .2$

1) Support set
2) Height of fuzzy set
3) Normalised & non-normalised fuzzy set

$\dot{q}: = \{(x_1, \mu(x_1)), (x_2, \mu(x_2)), (x_3, \mu(x_3)) + \cdots\}$

Another way to represent

$$A = \left\{ \frac{\mu(x_1)}{x_1} + \frac{\mu(x_2)}{x_2} + \frac{\mu(x_3)}{x_3} \cdots \right\}$$

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$$= \sum_{i=1}^{n} \frac{\mu(x_i)}{x_i}$$ for Discreate data.

$$\int \frac{\mu(x)}{x}$$ for Continous data

Support of fuzzy set :-

$\vec{A} = \{ (20, 0.0), (40, 0.0), (60, 0.8), (80, 0.9) \}$

$S(\vec{A}) = \{ x / \mu(x) > 0 \}$

Recorder Support set is all set for which the value are greater than 1
i.e all element for which $\mu(x) > 0$

$S(\vec{A}) = \{ x / \mu(x) > 0 \}$
$\{ 40, 60, 80 \}$

Height of fuzzy set :-

$$H(\vec{A}) = \mu_{max} = 0.9$$

Max. value of $\mu(x)$ is ht. of fuzzy set

Normalised set :-
If $\mu_{max} = 1$
i.e If height of $\mu(x) = 1$ then normalised.

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Lt Standaradard operation on fuzzy set

i) union
2) Complement
3) Intersection

i) α Cut set or α level set
ii) Equivalent fuzzy set.
iii) Sub-set of fuzzy set
iv) Standard operation on fuzzy set

α-cut set or α level set

If $\tilde{A}$ then α-cut set of $\tilde{A}$ is $\alpha \cdot \tilde{A}_\alpha$

$$\tilde{A}_\alpha = \{ x \in A \mid \mu(x) \geq \alpha \}$$

eg

$$\tilde{A} = \{ (10, 0.5) (20, 0.6) (30, 0.7) (40, .8) \}$$

then

$$\tilde{A}_{0.6} = \{20, 30, 40\}$$

up write value 0.6 value greater then 0.6.

equivalent fuzzy set

1
2
3
4
5

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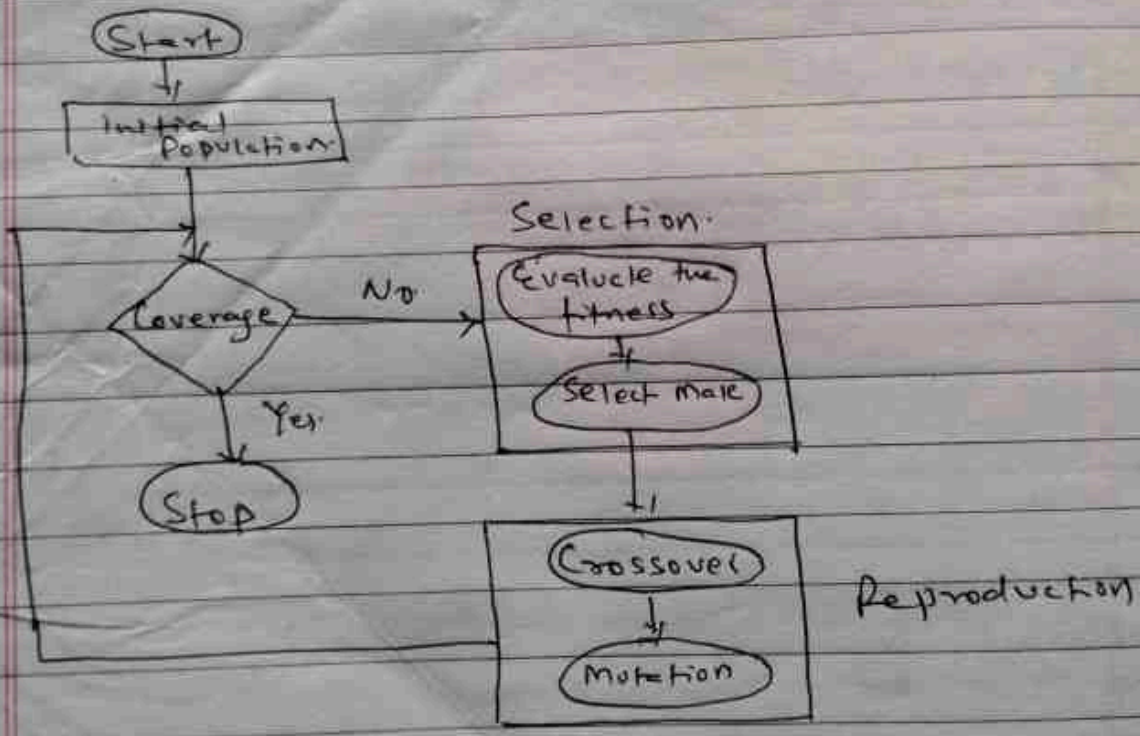
GA is adaptive-heuristic Search Algorithm
It is evolutionary Algorithms
Genetic & natural selection.
To Generate high-Quality Solution for optimization Problem

G.A



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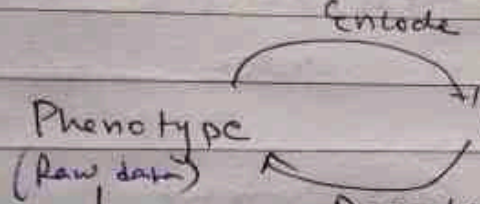
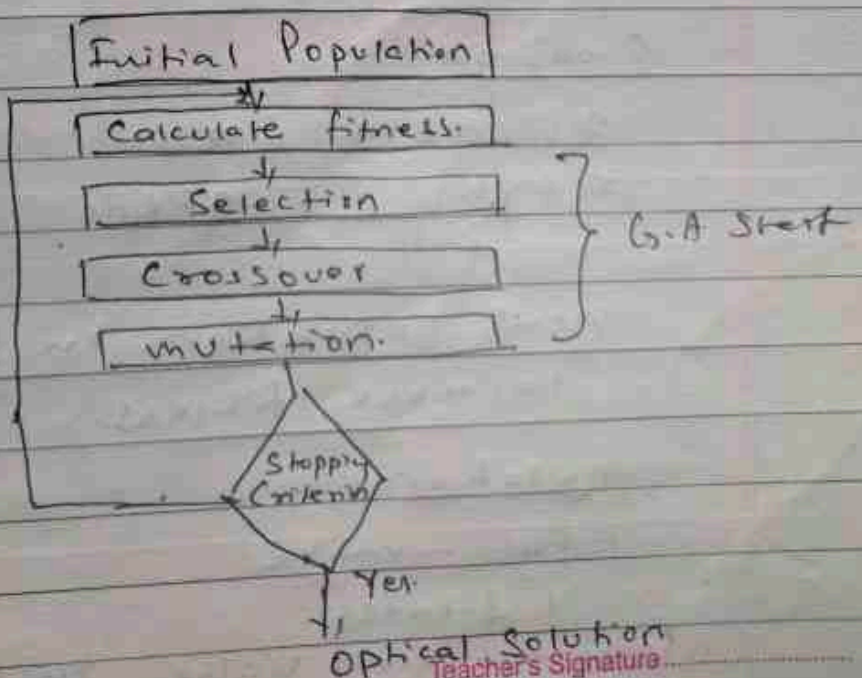
Genetic Algorithm

John Holland gave idea of G.A

→ It is abstraction of a biological evolution
→ Solve Complex Problem (like NP)
→ Focus on optimization
→ Population of possible solution for a given problem
→ From a group of individual (Chromozome), the best will Survive



Solution Space available
Rew Solution. encoded to Genotype.



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Initial population. -> Soln already available
Don't focus on one or two point.
Eg. Exit Poll -> Consider all population
eg young, old, daddy

Calculate fitness
eg Make we have to form from word take. So Accordly to fitness how among alphabet take is fit to form make
eg -> 3 fitness value
abcd -> 1 " value.

Selection of best parent.
Best parent have high fitness value.
Generally two parent is used

Cross-over
abcde aboni Swap policy.
efghi efede
swap

New population is generated to increase fitness.

Mutation
efgh - make
1 fitness
Generate such value that have fitness value better the previous.

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one fitness value highest is achieved. then stopping Criterion is induced.

eg

9kme
kame } both have highest fitness value.

Operators of GA

1) Mutation
2) Cross-over
3) Selection.

Mutation

It is the part of GA which is related to the 'exploration' of the search space. It has been observed that mutation is essential to the convergence of GA while crossover is not

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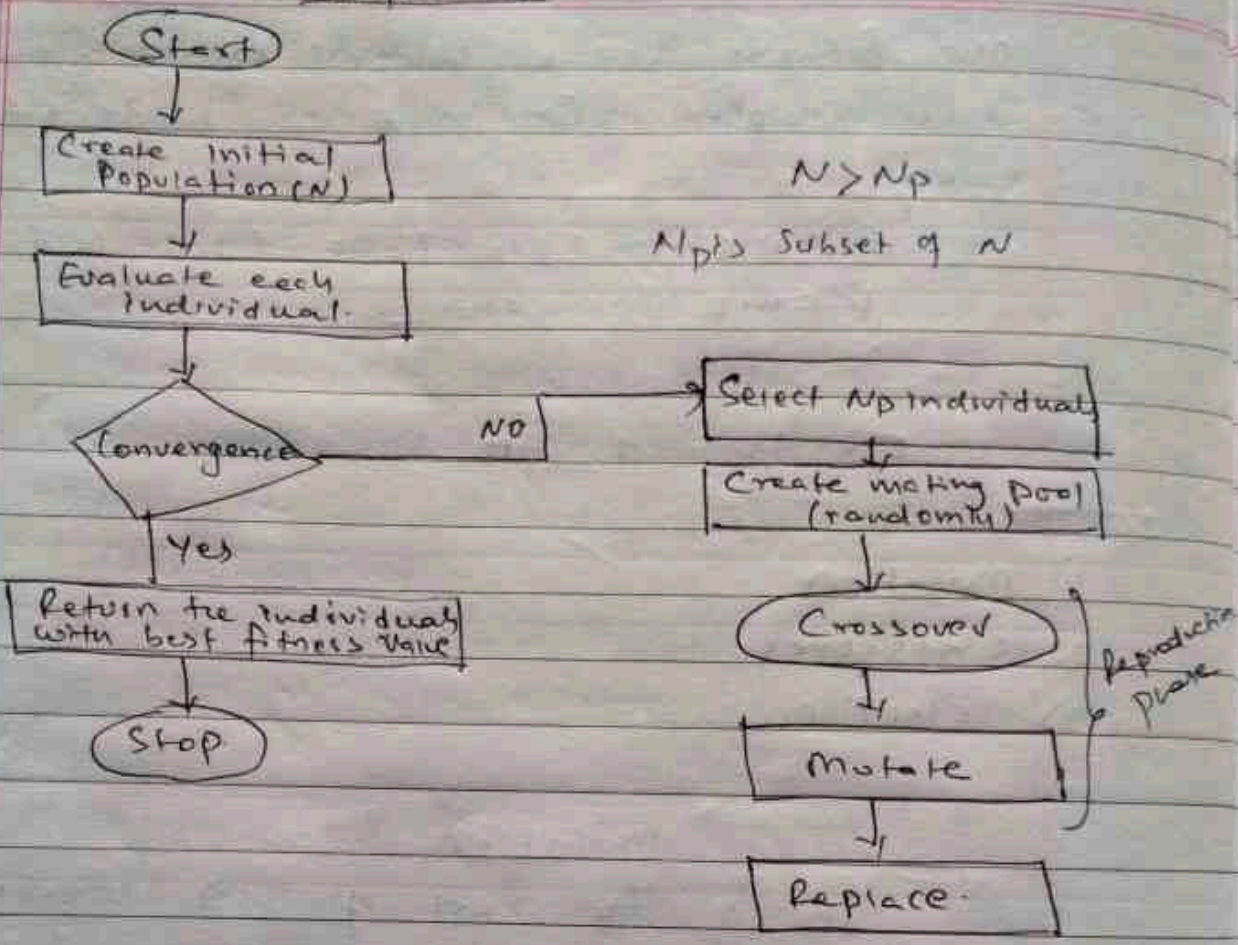
Simple GA



GA Vs Traditional Algorithms

GA	TA
1) Genetics & natural Selection to solve optimization Prblm	Step by step produce to Solve a given problem
2) More advance	→ Not as advance
3) Use the field such as ML, AI	→ Used in field such as programming, mathematical
4) Probalistic Rules	→ Fully deterministic rules
5) Search on population of points	→ Search on a Single point

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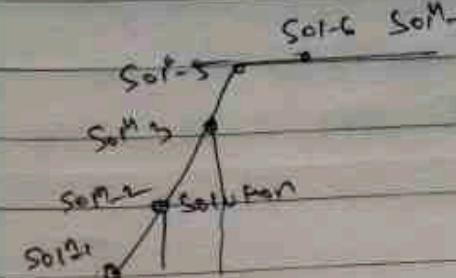
Convergence Criterion / Termination Condition
Convergence Test

1. Manual Checking
   It is tedious, time consuming
   Manual Checked
2) Solution found that satisfy objective Criterion
   eg. if threshold value is Satisfied.
   It is satisfy the Criterion. It is not not optimized value. It is applicable when Certain Criterion is achieved
3) Fixed no. of generation
   eg. 10 iteration will be perform. no. of iteration is increase, we are reaching toward global optimization, so we get to set no iteration
4) Budget limit Reached
   base on time available or available Space Criterion is fixed. So if Computation time is one hour then optimization is fixed for one hour.
5)



Soln 2 is more fitter the Soln 3
Sol 3 " Soln 2
after Soln-5, Soln-6, Soln-7 is equal. Then we have reached better Soln

6) Combination of above said Soln

Encoding:

Binary Encoding:

1st step Creating initial population. So Creating initial population Encoding is performed.

~~Binary Encoding~~

Individual is represented by Chromosome. It Contain Genes. materia in form of Genes. So Cromosome Contain Genes. Various Genes in one Chromosome

Binary Encoding

(a) Ex.

$f(x) = x^3$; $0 \leq x \leq 255$

- 8-bit

1 0 0 1 1 0 1 1		1 1 1 1 1 1 1 1
8-bit digit	155	255
	Chromosome	
	→ It can be a Solution	It can also be a Soln

Assigning Chromosome in form of string of bits is Encoding.

Population Contain Collection of possible Combination of 8-bits

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Ct-2

Binary Encoding

include one item or not called nap-sac problem

include - 1

not include - 0

(A) - } = 10 — = 5 } — = 100 cost

(B) } fan item — = 10 } profit — 150

(C) } — = 15 } — 200

m = 25 max is 25 called constraints

Chromose are

(A) (AB) (AC) (BC)

100 110 101 011

A = 100 Chromose.

↓ item-1 include → item-B included → item C-included

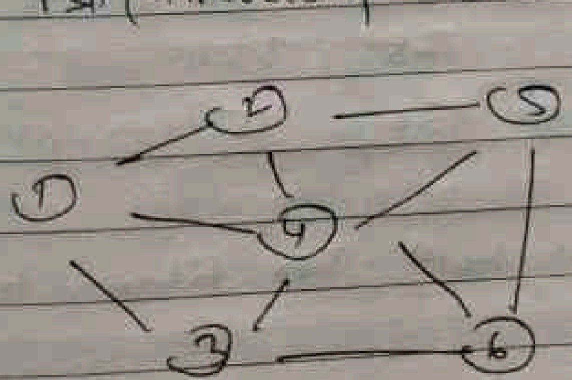
AB = 1 1 0

↓ item-a include → item-b included

fitness Evaluation

fitness function or objective function

TSP (Travelling Salesman Problem)



Ex-1

Let fitness vale & Ex Exa

Path-1 - 1 2 5 6 4 3 1 - (18)
2 - 1 2 5 4 6 3 1 - (20)
3 - 1 2 4 5 6 3 1 - (12)
4 - 1 2 5 6 3 4 1 - (17)

Objective function → Shortest path
Constraint → one visit to every city is Constraints

fitness function is one which has highest objective accomplishment
Path-3 is fittest if meet the objective

Ex-2 0 1 napsap

A - 5 100
B - 10 150 } profit
C = 15 200

M=25 (constrain)

		W/5	Profit P/100
A	= 1 0 0	-	
AB	= 1 1 0	15	250
AC	= 1 0 1	20	300
BC	= 0 1 1	25	350
ABC	= 1 1 1	30	450 → not a soln.

BC is the best soln. Its fitness test is highest

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Crossover (Binary Code GA)

P_1	0	1	1	0	1	0
P_2	1	1	0	1	0	0

P_1 & P_2 are Parent 1 & parent-2

Single Point Crossover

0	1	1	0	1	1	
1	1	0	1	0	0	

K-Single point

P_1 1st part P_2 nd part

P_2 1st part P_1 2nd part

O_1	0	1	0	1	0	0
O_2	1	1	1	0	1	0

→ Any Single point Cross-over

O_1 & O_2 are offspring

Reproduction phase

Two point Crossover

0	1	1	0	1	0	
1	1	0	1	0	0	

K_1-point K_2-point

1st part 2nd part 3rd part

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1st & 3rd part are extreme part. Write it as it is

O_1	0	1	0	1	1	0
O_2	1	1	1	0	0	0

Swipe 2nd part

Multipoint Crossover

0	1	1	0	1	0
1	1	0	1	0	0

Swipe k_3 k_4 Swipe k_2

alternat part Swape with each other.

1	1	0	1	1	0
0	1	1	0	0	0

Uniform Crossover

0	0	1	0	1	1
1	0	0	1	0	0

Does every bit is to be Swiped. So tossing is performed. On basis result swiping is decided. If it comes 1 then Swipe and if comes 0 then don't Swipe.

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Tossing result

0	0	1	0	1	1
1	0	0	1	0	0

TOSS 1 0 0 1 1 0 → Toss Result

1	0	1	1	0	1
0	0	0	0	1	0

Cross-over mask

0	0	1	0	1	1
1	0	0	1	0	0

→ Parent Chromosome

C-M. 0 1 0 1 1 0

Cross-over mask is randomly generated.

O_1	0	0	1	1	1	1
O_2	1	0	0	0	1	0

Rules for offspring 1

CM bit is 0 the parent bit-1 is copied to offspring

if CM is 0 the parent bit-2 is copied to offspring

For offspring-2 if 0 the Parent bit-2 is copied & if 1 Comes the Parent bit 1 is copied

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Mutation in GA

Off spring	0	1	1	0	0	1
MO (up)	0	1	0	0	0	1

It is used for more diversity

flipping of bit as per mutation Probability up decide if it is to be ~~must~~ flipped or not
If up = 0 Let it be as it is . not flipp
up = 1 flipped

Mutated Offspring } MO | 0 | 0 | 1 | D | D | ● |

~~AFO~~

2nd method

Off spring	0	1	1	0	0	1
MO	0	0	1	0	1	1

Randomly Select 2-bit from off spring and then replace each other.. * indicate two random bit and are flipped to get MO

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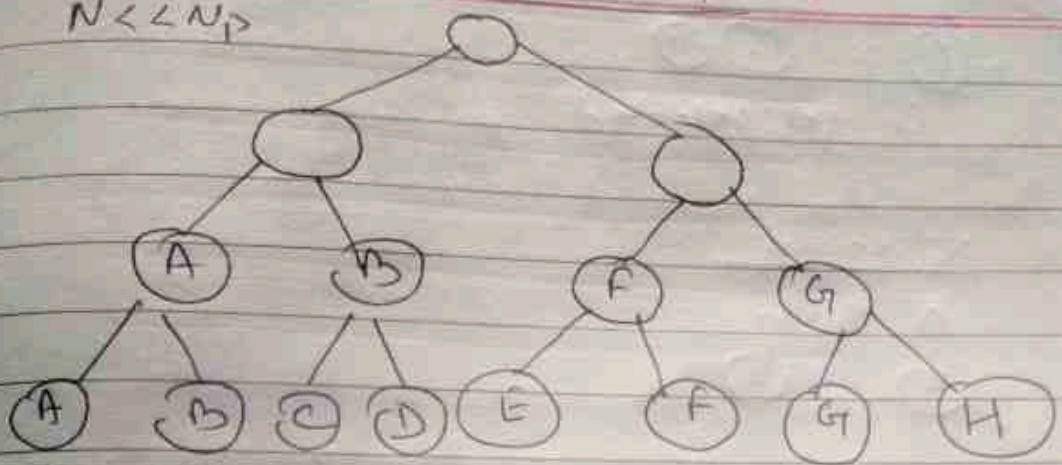
Tournament Conducted to find fittest parent.

Tournament Selection

N << Np



To select Np from N tournament is Conducted.

How tournament is Conducted

Randomly select any one without seeing the weightage

Ex Randomly select

from (A) 9 & (B) 8 → A got selected.

(C) 6 → get winner.

(F) 7 → get selected

(G) → get selected.

first round

Round-2

A - C Compared

9 6

A/9 - get select

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(F)-7 (G) (11)

G got selected

3rd round.

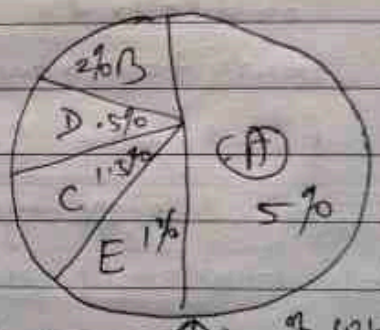
A & G.

(9) (11)

G11 is final winner. So G-11 is parent.

Roulette wheel Selection

C	F
(A)	5
(B)	2
(C)	0.5
(D)	1.5
(E)	1



fixed point → of wheel. Area is fitness value

fitness proprotionate Selection. i.e

Selection ∝ fitness

Population are A B C D E

fitness score 5 2 0.5 1.5 1 → 10

50% is occupied by A

Rotate the wheel. when it stop pointer will point the which area. That particular area is selected as parent.

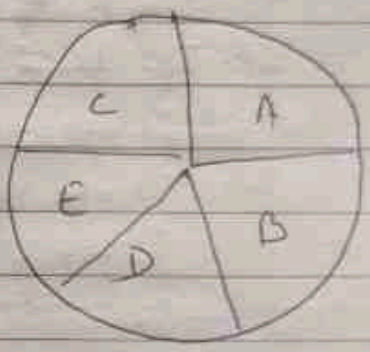
less Area has little changes to get selected

Teacher's Signature

Fitness & Area occupied & selection.

Rank-Based Selection

C	F		
A	5	5	33.33%
B	2	4	26.67%
C	0.5	1	6.6%
D	1.5	3	20%
E	1	2	13.33%
	10	15	



1st method

Travelling Salesman Problem

TSP and its state representation.

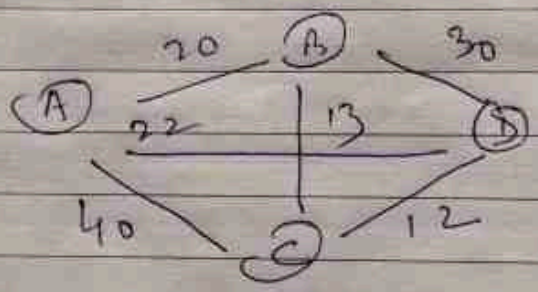
→ Salesman has list of cities, each of which must be visited once.

→ In list there are direct roads b/w. each pair of cities.

→ To find route, salesman should follow shortest possible round trip.

→ State is represented as pair of any two cities and distance between them

Ex.



A, B, C, D are cities.

Initial state space is A

└ {A(—20→ B), (A —40→ C), (A —22→ D)} one state

To find shortest possible path.

A —20→ B —13→ C —12→ D —22→ A = 67

A —20→ B —30→ D —12→ C —40→ A → 102

A → C → D → B → A → 105

A → D → B → C → A → ~~105~~

A → D → C → B → A — 67

A → C → B → D → A → 105

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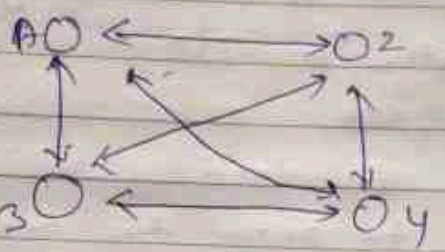
Shortest path is
ABCDA & ADCBA

2nd method

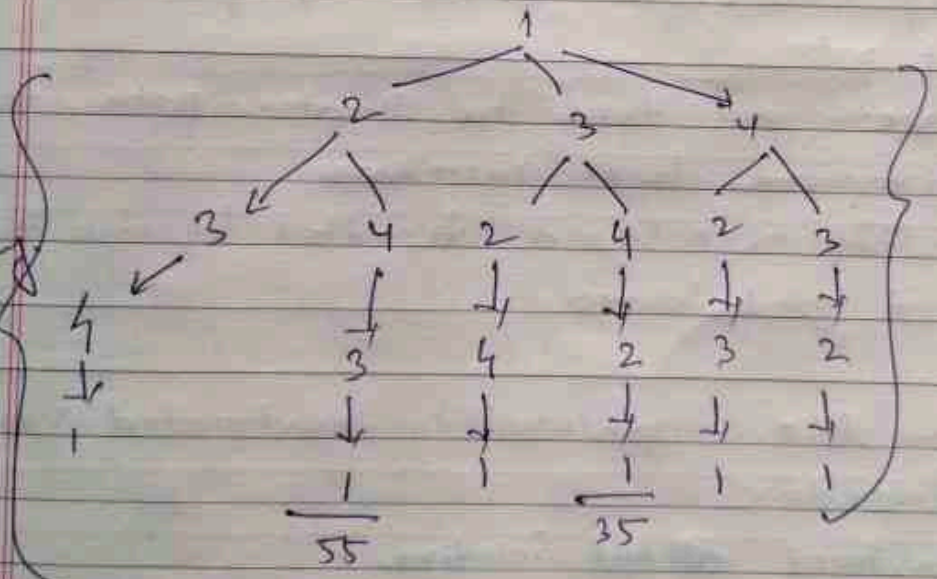
TSP



	1	2	3	4
1	0	10	15	20
2	5	0	25	10
3	15	30	0	5
4	15	10	20	0

Greedy method

1 → 10 → 2 → 10 → 4 → 20 → 3 → 15 → 1 → 55



Check for all posibility and take the least state route

(n-1) nodes are possible

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~~Dynamic Programming~~

Ant Colony optimization:

ACO is probalistic technique for solving computation problem which can be reduced to find good path through the graph. i.e finding Shortest path in TSP

* Ant Search for food.
* The Shorter the path the greater the pheromone left by an ant.
* The probability of taking a route is directly proportional to the level of pheromone on that path.
* As more ant take the shorter path, the pheromone level increases.

It is a liquid deposited by ant when they found good source.

The ACO Algorithm is constructed using three Procedure

1) Construct Ant Solution
2) update pheromones
3) Daemon Actions

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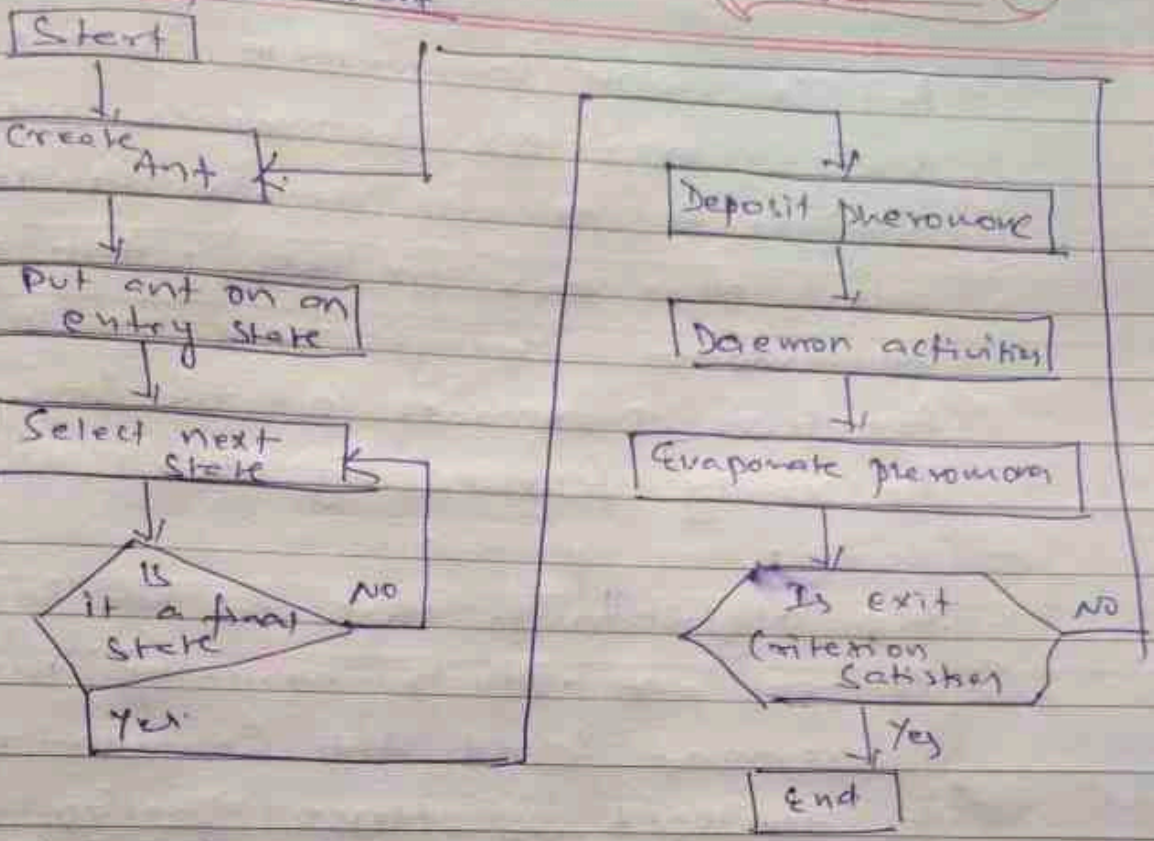
flow chart



→ Applying Ant Colony optimization to TSP

Step-1 Initialize Important Parameters.

Population Size = 04

Max. Iterations = 10

Pheromone Evaporation rate = 0.05

Artificial pheromone = 0.0453

Alpha = 1

Beta = 1

Q = 1

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→ Ant Can easily Communicate with each other using pheromones. Pheromones are Chemical Signal. Ant release pheromones in Danger (to alert other ants for help). Ant detect pheromones through their mobile entering Ant leave pharmones on the soil., that Can be easily followed by other ant

=

ACO algorithm is inspired by Social behaviour of real ant. It is basically inspired by pheromone based Ant Communication. ACO is developed by Marco Dorigo in 1922. This technique is used to find optimal path ACO is used for Routing and load balancing problems. for eg TSP. ACO Can be Continous optimization problem

→ Ants Communicate with each other Indirectly using a Chemical known as pheromone. With the help of pheromone signal, ant Can easily find Shortest path between Nest/ Colony and food.

Teacher's Signature

→ Ant ~~are~~ explore area Randomly
→ They release chemical ~~are~~ called pheromone when ant find food source they choose the way have strong pheromone

→ A group of Ant's forging in the environment for food randomly. Forger will marks trail on the way using pheromones while going back ~~to~~ to the colony, ~~forger will marks trail on the way using pheromones~~ when food source is finished. No new way are mark by returning ant

Case-1 All ants are in nest. There is no pheromone mark on the ground
② Forging start → 50% ant take shortest path & 50% take longest path.
③ Pheromone mark on the shorter path have strong pheromone signal. Probability of this path selected by other ant increased

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ACO algorithm

1) Initialize Aco parameter
2) Ant Solution Construction
3) Position each ant in to starting node
4) Each ant will select next node by applying state transition rule
5) Repeat unit ant build the best solution, then compute the fitness value.
6) update best solution
7) Apply offline pheromone update
8) Display best result

Particle Swarm optimization

350	1350	10793
719	6147	fuel - 1500
520	61	Time 4000
580	950	16293
	1226	+ 6000
	150	22293
	909	

Teacher's Signature

Travelling Salesman Problem

Process of patent filing:

First Prohibitional date filing

2-kind of application → Provisional date
→ non-provisional dat

Provisional → we want to protect the priority date because we have just developed the concept and need some time to work on that concept & idea. It is just to protect the idea and priority date

2nd Non-provisional or Complete Specificate → filed when Invention is complete.

→ within 12-month of filing provisional application go for non-provisional applicato

→ 18-month from provisional application patent publish

→ 48-month to file request for examination. They will ~~file~~ Examined. They will come with few objection or clarification. They will submit first examination report, which will be given to you. I need to take action.

→ If not examination they will call for patent hearing. If still not satisfied patent not granting.

→ for Speed

Teacher's Signature

Date
Page

Trade-mark

→ Brand → 1958 (Trade & Merchandise Marks Act)
Brand name and brand mark.
Brand —Register→ Trade mark.

→ It is any mark, name or symbol (or their combination) that let us identify the goods made by any individual, company, organisation etc.

Conventional	Non-Conventional
mark, label, logo, package	→ Sound mark IPL music
Shape of goods	→ Special taste.
	→ Dynamic mark.
	Smell

(Patent) used for inventions

→ Scientific inventions.
→ Industrial application.
non obvious.
new-inventio
} Condition

Act 1970 Sec-3 &4 { not patented → Scientific principle, method of agriculture, horticulture method of ~~treatment~~, traditional knowledge, atomic energy inventio

original literary work
Dramatic work
Musical work
Artistic work
} ~~valid for 60 years after death of author~~
60 counted from next Calendar year.

→ Cinematograph
Sound.
Posthumous publication (published after author death)
Anonymous and pseudonymous publication (pen name)

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Type of IPR

1. Copyright → 60 years valid. Counted after death of author.
   - Book, music, movie, software, writing, photograph, audio, video, sculpture, architectural work, artististic work, literary work.
2. Trade mark
3. patent → 20 years right
4. Geographical Indication
5. Design
6. Plant Variety
7. Semiconductor IC layout Design

1957 → Copyright Act (Right to not copy) (effective from 1958)

Right include

→ Right to copy (reproduce) a work

→ Right to create derivative work based on it

→ Right to distribute copy of the work to the public

→ Right to publicly display or perform the work

What is protected

Literary work → Pamphlet Brochure, Novel, Books, Poem, Song Lyrics, Computer program

Artistic work → Drawing, painting, Architectural Drawing, Tech. Drawing, Map, logos

Dramatic work → Dance, mimes, Screenplay, Musical work, Sound, Recording, Cinematographic

11 8 2 1 8

1983
1984
92
93

fi— 1 → 8 → 2, 11 8.

Act Amended on 1983, 1984, 1992, 1994, 2012

→ Work of govt & work of international organisation

Type of IPR → 60 years valid. Counted after death of author.

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② Trademark - artistic work, literary work.
③ patent → 20 years right
④ Geographical Indicate
⑤ Design
⑥ Plant Variety
⑦ Semiconductor IC layout Design

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→ work of govt & work of International organisation