

44

seems
OK over
2 present
function

UNIT-IV Genetic Algorithm

Introduction

- They belong to Evolutionary Alg.

- Adaptive heuristic Search Algorithm.

- 1) W.r.t No of parameters
- 2) " " " Amount of data
- 3) It Can Change according to Environment.

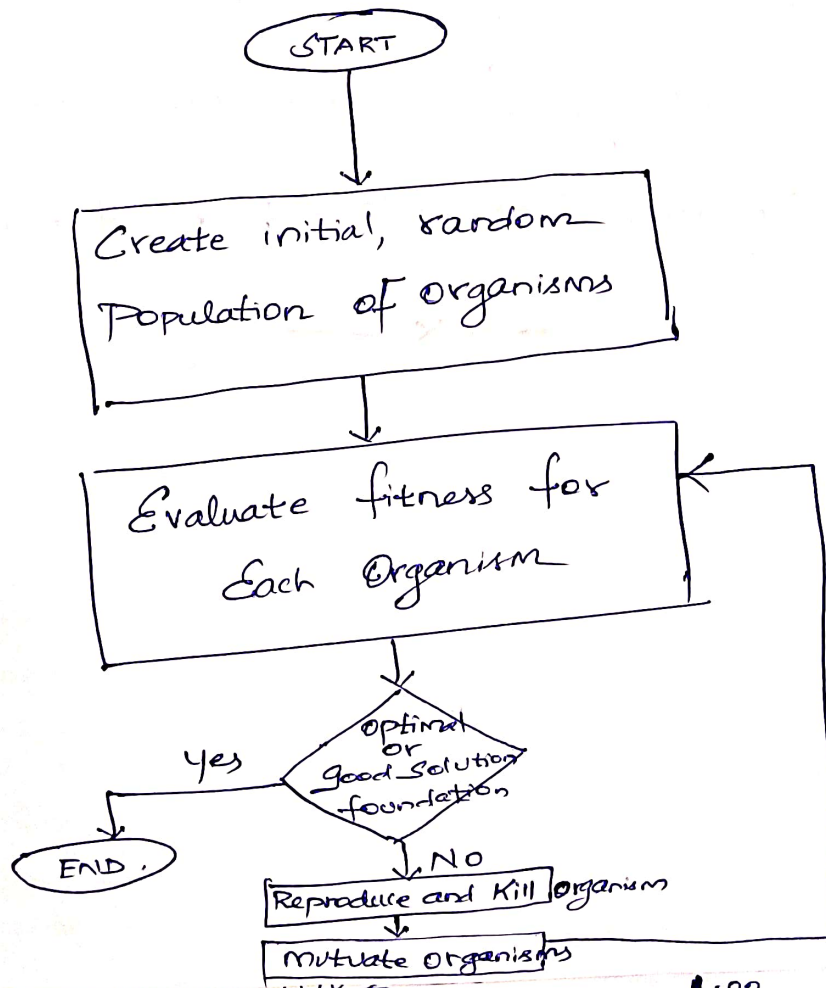
It use practical Methods

- Based on genetics and Natural Selection.

- Used to generate high Quality Solution for an (part).

Optimisation Problem.

flowchart:



9).

late

7

531

f.

125

125

1028

125

are
all
w).

8.00

4.00

Operations of Genetic Algorithm:-

- mainly discussing
- ✓ 1) Selection - All the samples Selected (6). Samples.
↓
2 Parents for cross over.
Select 2 Parents.
 - ✓ 2) cross Over - Two most fittest parent / reproduction
 - ✓ 3) mutation - Make some changes in the gene
 - 4) Encoding

An illustrative Example of Genetic Algorithm.

Ex:- $f(x) = x^2$, maximize the fn with x in interval $[0, 31]$

- 1) Generate initial population at random (from flowchart).
Called genotypes.

* Random Number represent in Binary. N=4
 $01101 (13), 11000 (24), 01000 (8), 10011 (19).$

- 2) Calculate fitness With the help of fn from Q/A Calculator
 $f(x) = x^2$

$13^2 = 169, 24^2 \rightarrow 576, 8^2 \rightarrow 64, 19^2 \rightarrow 361.$

- 3) Select any 2 Parents based on fitness.

$$P_i = F_i \mid \sum_{j=1}^N F_j$$

					W.K.T <u>N=4</u>
No	Population	x value	$F(x) = x^2$	P_i	Expected Count $N \times p$
1	01101	13	169	$169/1170 = 0.14$	0.56
2	11000	24	576	$576/1170 = 0.49$	1.97 ← High value
3	01000	8	64	$64/1170 = 0.06$	0.22 → Low value (replace row)
4	10011	19	361	$361/1170 = 0.31$	1.23
			<u>1170</u>	<u>1.00</u>	<u>4.00</u>

Selection :-

* In Selection, which One to Select which One is highest 1.97.

* In order to do the Cross Over single parent is Not Enough we require two parent.

Genetic Operator's

Cross over :-

- Can be either One point | 2 point | n-point.

Ex : One point

$$\begin{array}{c} 10011101 \\ \quad \quad \quad \downarrow \\ 10110101 \end{array} \Rightarrow \begin{array}{c} 10001011 \\ 10111101 \end{array}$$

No	Initial	Cross over point	After cross over	x	f(x) = x ²
1	01101	4	01100	12	low 144
2	11000	4	11001	25	625
3	11000	2	11011	27	High value 729
4	10011	2	10000	16	256
Depends Cross Over Point Initial making.					Low 1754
					Cross over value
					So it is good way.

Mutation :-

Applied to Each child after crossover

No	After crossover	After mutation	x	f(x) = x ²
1	01100	① 1100	26	676
2	11001	11001	25	625
3	11011	11011	27	729
4	10000	10①00	18	324
Total				2354

Each and Every time sum is increased, Which means Our Algorithm going in Correct way.

— x — x —

Genetic Programming :-

* It is a Extension of genetic Algorithms

— Main Idea → Represent a Computer Program as Tree

— Where used means, When Solution is not known in Advance.

(ex) Prediction Not available

(All Operations are same as genetic Alg),

Selection, Crossover, mutation,

Ex:- Plastic Can Collecting Robot Navigation.

if (east = Can & North = empty)

Then move east

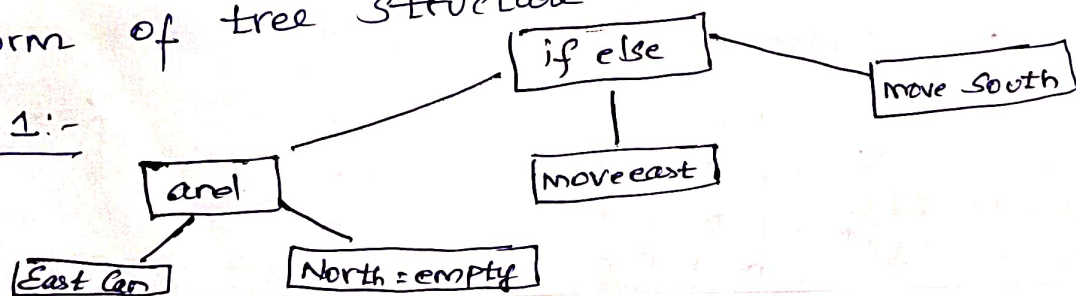
else move South.

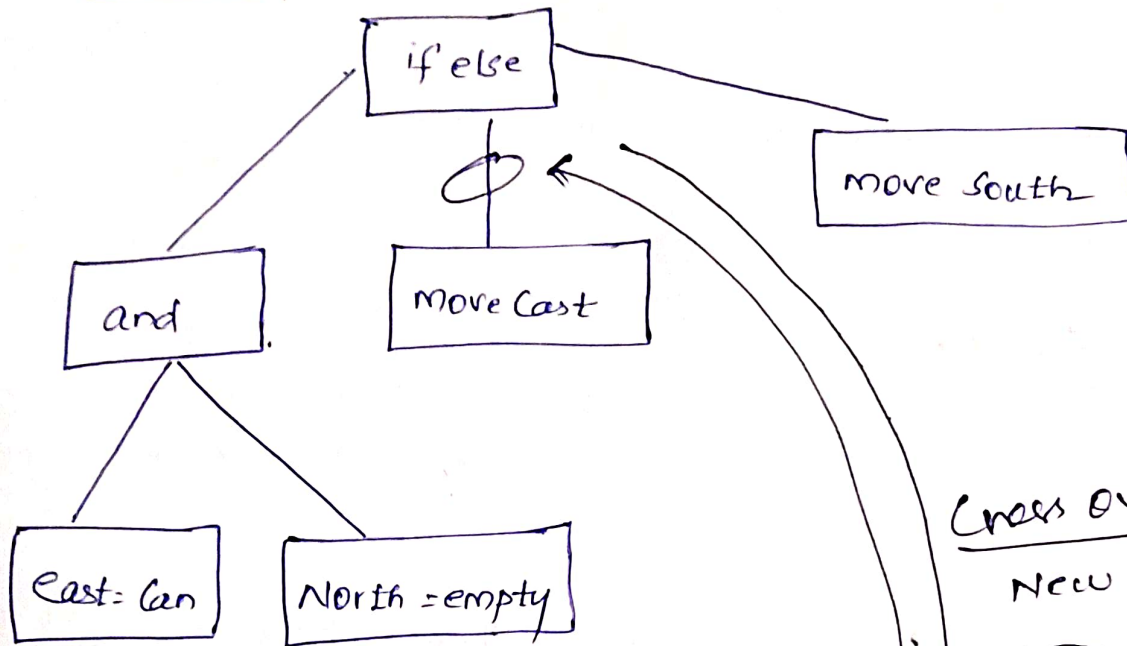
// The Robot should Collect Can without fail in that game.
like sink in water (or) Touched on the wall. In that manner we should have to Navigate //.

* As per the ^{given} program Robot move towards East.

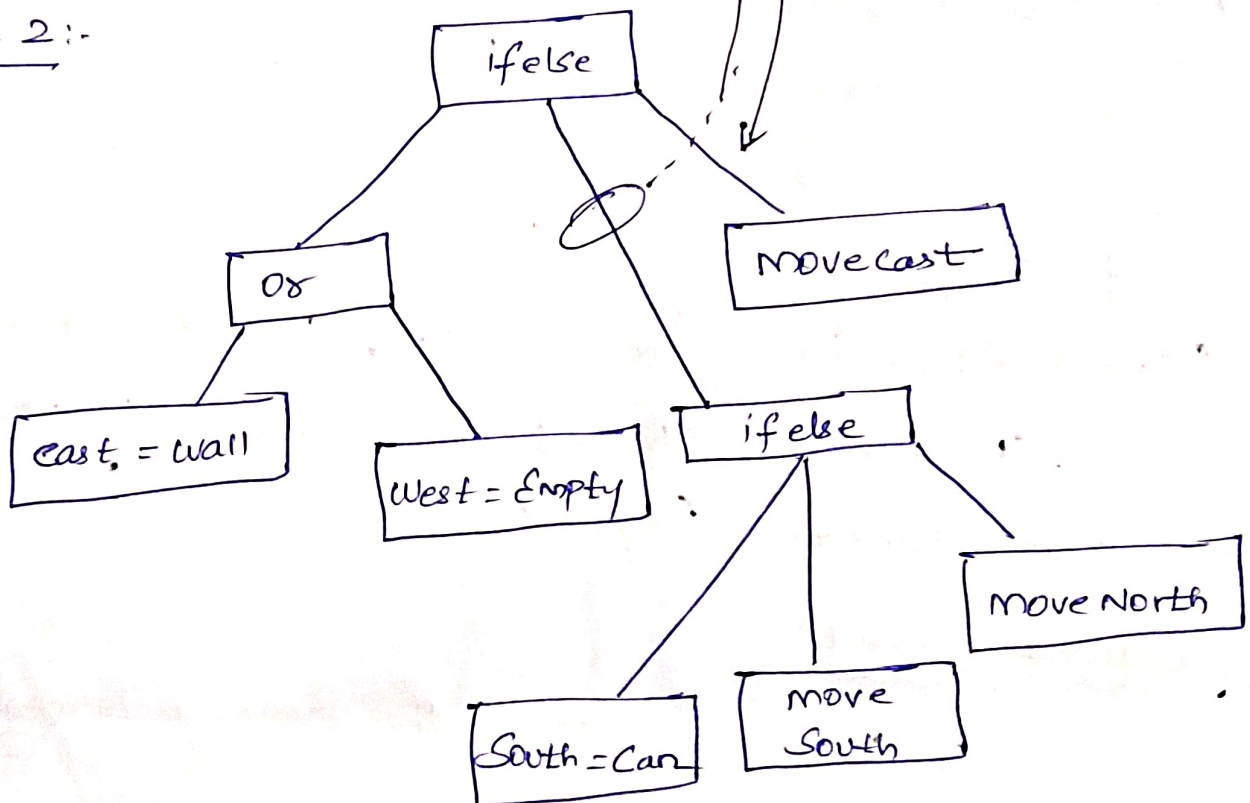
Inform of tree structure have to be Represent.

Tree 1:-



Tree 1:-

Cross over
New Tree will
Produce.

Tree 2:-

// Next By using Tree 1 and Tree 2 we are
going to do Cross over //. In order to make more
Efficient //.

Models of Evolution and Learning:-

2 Evolution models:-

1) Lamarckian Evolution

2) Baldwin Effect.

* Lamarckian Evolution:-

Believed that individual Genetic makeup is changed by life time Experience.

[i.e] According to Environment, we should have to change our Characteristics (in-built).]

(i.e) if an organism changes during its life to adapt to the environment, then those changes are passed to its offsprings.

Ex. [Grand father have some Qualities, same Qualities father also got, Because of changes in Environment updated some New Characters compared to his father.]

* Baldwin Effect:-

Baldwin explained about the learning behaviour d)

With two things:-

1. Genotype - Genetic Code (DNA)
- Global Search.

2. Phenotype - Your Character (Behaviour)
- Local Search. (Only your behaviour).

→ measures Cost of learning not in terms of 47
But in terms of time and Energy.

Ex:- fish ① learning (4 days) fish ② learning (6 days)

Among this fish 1 will select due to less days.

// The same relate with machine //

— x — x —


Parallel Genetic Algorithm:-

It uses multiple Algorithms to solve a single task.

2 Categories:-

1) Fine - Grained:-

Detailed Description which deals with much smaller components.

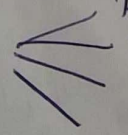
Whole  Divided into much much smaller component.

2) Coarse - Grained:-

Divides into fewer components.

(Size of component is more than that of fine grained)

→ All the Algorithms, solve the same task and
Once they obtained soln. best one is selected.

10 Alg  Result 1
Result 2
⋮
R 10

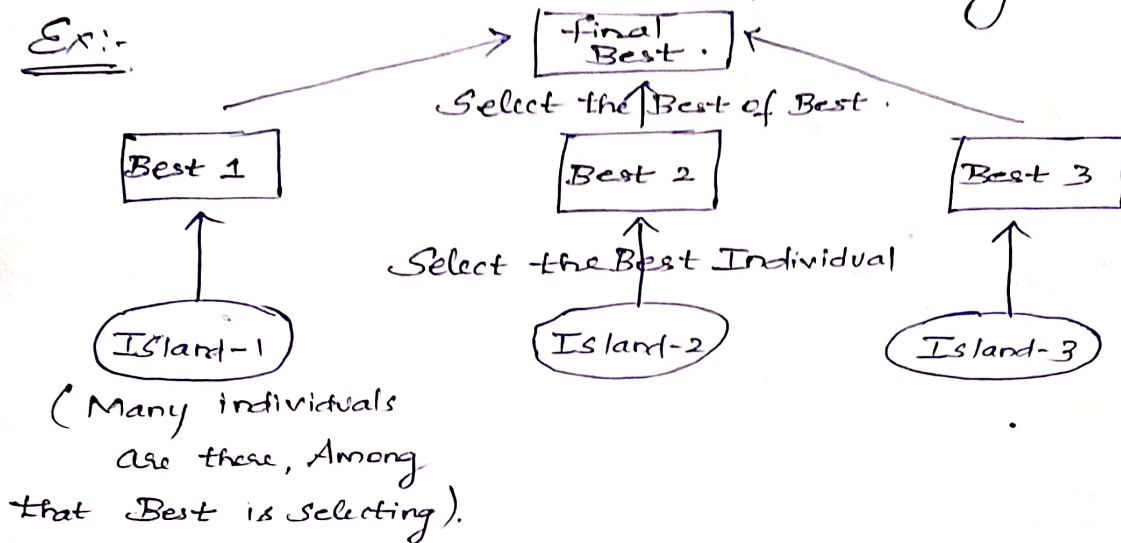
→ Among this Best one is selected.

* Parallel Alg is also called island model.

→ They do not depend on epu. ∴ They can Run Parallely.

Adv:- Avoids Problem of Crowding.

Ex:-



Learning Set of Rules:-

⇒ 2 ways

① Way - first learn ^{1st step} Decision Tree and Translate that tree _{2nd step} into Rules, One Rule for each leaf Node. _{3rd.}

② way - using Genetic Algorithm that Encodes Each rule as a bit string.

- We have 2 types of Alg that learn Directly from Set of Rules.

1. First Order Rules
2. Sequential Covering Algorithm.

