ID07905536 ; Syed Shahriar Hosaini. (EA) Fina

Ans. to the q. no-1 (a)

Basic Properties of (EA):-

1. Responsiveness
2. Parent Selection
3. Crossover Operation
4. Mutation "
5. Survival selection
6. Termination selection

EA is preferred for engineering tasks;

Because:-

1. EA is one of the best or produces best algorithms for solving engineering problems.
2. EA is easy to implement.
3. We can use EA with trial and error method to solve engineering problems with many constrains.

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Ans. to the q. no - 1 (b)

Characterstics of Intelligence:

Adaptation, Randomness, Communication, Feedback, Exploration, Exploitation.

Randomness in EA:

Random population members are taken to start test, Mutation and crossovers are also done randomly.

Exploration in EA:

Exploration for Local Maxima and later Global Maxima is a part of EA.

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Ans. 1 (c)

Intelligent characterstics of Bees:

① From a bee hive scout bees search foor necter randomly.

② Bees returning to the hive, evalue the different patches alementing of quality (sogar content etc)

③ They diposit their necter and perform wagle dance to ~~con~~ communicate, quality, direction and distance of necter.

④ Followers bee then evaluate those patches, and dance to communicate too.

⑤ The best patch will be explored and communicated the most of the time, (greedy method).

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Ans. to the q. no 2 (a)

Local Search: This is a heuristic method for solving hard optimization problems. Local search can be used on problems that can be formulated as finding a solution maximizing a criterion among many solutions.

Global Search: It is a solution search method within the environment, that provides dynamic, object specific or cross object results.

Local and Global both are important for EA. Local search is generally incorporated into EA for better results and efficiency.

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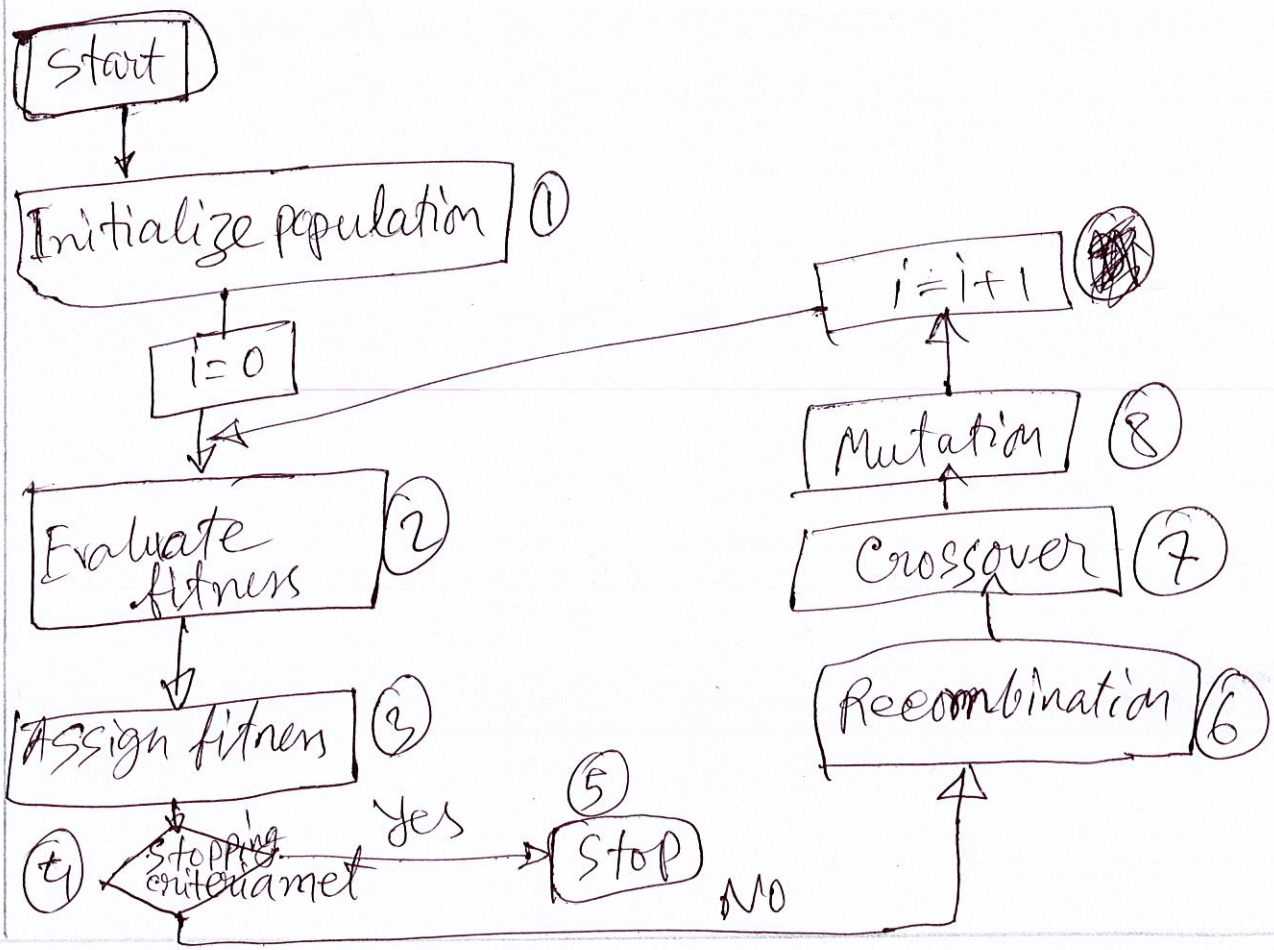
Global search provides new possibilities of finding better solutions. without GS we may only get stuck in LS, local minima or local maxima only.

Ans. to the q. no-2 (b)



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1. Randomly initialize population/Data
2. Evaluate the fitness/cost of problem.
3. Assign fitness and Select the solution.
4. Check the solution fitness and
5. ~~Stop~~ Stop /But if stopping criteria not met ;
6. Recombination
7. Cross of parrents, to get better ~~ge~~ genes,
8. Mutation to prevent prepature convergence. then go back to step 2

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Ans. to the q. no-2(c)

Fitness function: Fitness function quantifies the optimality of a solution so that, particular solution may be ranked against all the other solutions.

Fitness function is ~~not~~ related to the problem. It ~~simply~~ simply defined in a function which takes a candidate solution to the problem as input and produces as output, how fit or good the solution is wrt respect to the problem. We can only mint the cost/fitness criteria from problem statement, not form algorithm (Algorithm may differ).

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Ans. to the q. no 3(a)

Constrain Satisfaction is a technique, where a problem is solved when its values satisfy certain constrains or rules of the problem. Such type of technique leads to a deeper understanding of the problem structure as well as its complexity.

Ant colony optimization (to solve TSP) is the most used / popular, well studied CSP.

Properties of ACO:

1. Tries to mimic ~~and~~ ants by observing them.
2. Randomly ~~[illegible]~~ starts searching and random pheromone is introduced.

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(3) After locating food; they ~~and~~ go back to city, leaving trail of pheromone.

(4) Other ants follow the trail of pheromone and going back and forth from food to city.

(5) The trail with shortest path will have most number of ants and have highest pheromone.

(6) The paths with longest distance, will have less ants and less pheromone and may be lost.

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Ans. to the q. no = 3 (b)

Parents are

(a) 1 2 4 5 6 3

(b) 1 5 4 6 3 2

Edge table:-

1	-2	3	5
2	-1	3	4
3	1	2	-6
4	2	-5	6
5	1	-4	6
6	-3	4	5

Enhanced Edge recombination operation:

Take 4 randomly at first

4			

1	-2	3	5
2	-1	3	
3	1	2	-6
4	2	-5	6
5	1	6	
6	-3	5	

(Taking 5)

4	5		

(P.T.O)

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1	-2	3	
2	-1	3	
3	1	2	-6
4	2	6	
5	1	6	
6	-3	~~4~~	

4	5	6		

1	-2	3	
2	-1	3	
3	1	2	
4	2		
5	1		
6	-3	~~4~~	

4	5	6	3	

1	-2		
2	-1		
3	1	2	
4	2		
5	1		
6	~~4~~		

4	5	6	3	2	

1	
2	-1
3	1
4	
5	1
6	~~4~~

4	5	6	3	2	1

Using Enhensed Edge recogonbination method we get offspring 4-5-6-3-2-1 string.

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Ans. to the q. no-3(c)

Basic ways or criteria to stop EA are ~~3hr~~ three:

1. Deemed best solution
2. Time limit
3. Iteration limit.

~~Pros of Deem~~ Cons of Deemed best solution

1. Deemed / Probable best solution can only predict/give the predicted or estimated best cost solution, but not the actual best solution. This may be a local maxima only. This process may not account for time or resource waste.

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Pros of Deemed best solution:

We may stop the iterations as soon as we think the results are close to the best results; No limit of time of iteration beforehead.

(2) Time limited:

Pros: This method stops the experiment within a ~~a~~ limited time. We can look at the results, analize and if needed can continue again, ~~as~~ as we wish to get better solutions.

Cons: May not get the best ~~result~~ result within that limited time.

(3) Iteration limitation:

Pros: Keep the experiment within limited number of iterations/generations. So, we can know about

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characteristicks of specific generations.

<u>Cons:</u> This method may not provide the best solution, ~~to~~ due to control of parent to offspring gene transfer.

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Ans to q.no-5(a)

Exploration: Exploration is the search for new ideas and or strategies to get solution.

Exploitation: Is the use of existing ideas and strategies that have proven successful in the past.

Exploration is high risk; waste of time or may lead to ~~ded~~ dead ends, but pay off with high return in many cases. Intelligence includes proper balance use of Exploration & Exploitation to get to optimization.

In PSO, is control search behaviour and Inertia weight have high value then that encourages exploration

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and their low value promotes exploitation. But once the inertia weigh is decreased, the swarm ~~sot~~ loses its ability to search new ~~at~~ area (can not go back to exploration mode)

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Ans. to the q. no 5(b)

Ant move from one city to another city i to j with some transition probability.

Transition probability equation

$$P_{ij}^{k}(t) = \frac{[T_{ij}(t)]^{a}[n_{ij}]^{B}}{\sum_{k \in J_i^k} [T_{ik}(t)]^{a} \cdot [n_{ik}]^{B}} \quad \text{if } j \in N_i^k$$

$n = \frac{1}{d}$ = visibility ; d = distance

N = set of all cities, was not visited

Pheromone Trail = $T_{ij}(t)$

Closes cities are selected based upon pheromone and distance intensity is α, visibility β, evaporation rate ρ

$$T(t+1) = (1-\rho) T_{ij}(t + \sum_{k=1}^{m} \Delta T_{ij}^{k}(t)$$

Ans. to the q. no-5 (e)

Convergence is a phenomenon in evolutionary computation that causes evolution that halt because preciously every individual in the population is identical.

Full convergence might be seen in genetic algorithms using only crossover.

Premature convergences → when the solution is of low quality single solution, prevented by - Mutation & crossover. But convergence to best solution is good.

In ACO convergence is guranteed, but time to convergence is unclear.

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That means that, eventually all the ant go to trail path with the highest pheromone with least distance. But how long will it take is uncertain.

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Ans. 4 (b)

To retain the good solution, is ment that, solution will ~~give~~ be the best solution, will most good or less bad properties.