MCE 079 05536 Assignment2 on Optimization

Assignment- ;Evolutionary Optimization Algorithms;CHAPTER-2.

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Ans 2.1 Considering min $f(x)$, where

$$f(x) = 40 + \sum_{i=1}^{4} x_i^2 - 10\cos(2\pi x_i)$$ and

$f(x)$ is the Rastrigin function

2.1 (a) Independent variables are x_1, x_2, x_3 and x_4

~~D~~ Decision variable are x_1, x_2, x_3 & x_4

Solution features are also x_1, x_2, x_3 & x_4

2.1 (b) This is a 4 dimentional problem.

2.1 (c) The solution is $x_1 = x_2 = x_3 = x_4 = 0$

2.1 (d) min $f(x) \Longleftrightarrow$ max $g(x)$, so,

$$g(x) = -(f(x)) = -4 - \sum_{i=1}^{4} x_i^2 + 10\cos(2\pi x_i)$$

2.2 Ans: Considering the function $f(x) = \sin(x)$

2.2(a) $f(x)$ has an (∞) infinite number of local minima: $x^* = \frac{3\pi}{2} + \cancel{2k\pi}\ 2k\pi$ for any integer k, and $f(x^*) = -1$ $[\because f'(x) = \frac{d}{dx}[\sin x] = \cos x; \frac{d}{dx}[\cos x] = -\sin x;$
$\therefore f''(x) = -\sin x$ (second derivative)$]$

2.2(b) $f(x)$ has an infinite number of global minima: $x^* = \frac{3\pi}{2} + 2l\pi$ for any integer l and $f(x^*) = -1$.

Ans: 2.3

Ans. 2.3 Considering $f(x) = x^3 + 4x^2 - 4x + 1$

$\therefore f'(x) = 3x^2 + 8x - 4$ [By applying power rule]

$\therefore x = \dfrac{-8 \pm \sqrt{8^2 - 4 \times 3 \times (-4)}}{2 \times 3}$ [roots of quadratic eqn.]

$\therefore x = 0.43$ or $x = -3.097$.

$x \approx -3.10$

& $f''(x) = \dfrac{d}{dx}(3x^2 + 8x - 4) = 6x + 8$

2.3(a) When $x = 0.43$; $f(x) = (0.43)^3 + 4(.43)^2 - 4(.43) + 1$

$= 0.10$

~~& when $x = -3.097$~~ So, $f(x)$ has one local minima; $x \approx 0.43$ and $f(x) \approx 0.10$

minima : $x \approx 0.43$ and $f(x) \approx 0.10$

2.3(b) When $x = -3.10$ then $f(x) =$

$(-3.10)^3 + 4(-3.10)^2 - 4(-3.10) + 1$

$= 22.05$

So, $f(x)$ has one local maxima, $x \approx -3.10$ and $f(x) = 22.05$

2.3(c) $f(x)$ does not have any global minima as it decreases without bound, $x \to -\infty$.

2.3(d) $f(x)$ does not have any global maxima because in decreass without bound as $x \to \infty$.

Ans 2.4 Considering problem 2.3 and $f(x) = x^3 + 4x^2 + 1 - 4x$ but, with constrains $x \in [-5, 3]$

2.4(a) $f(x)$ has two local minima: $x_1^* \approx 0.43$ with $f(x_1^*) \approx 0.10$ (from solution 2.3)

and $x_2^* = -5$ with $f(x_2^*) = (-5)^3 + 4(-5)^2 - 4(-5) + 1$

$= -4$

2.4(b) $f(x)$ has two local maxima: $x_1^* \approx 3.10$ with $f(x_1^*) \approx 22.05$ [from solution 2.3] and

$x_2^* = 3$ with $f(x_2^*) = (3)^3 + 4 \times 9 - 4(3) + 1$

$= 52$

2.4(c) $f(x)$ has one global minima:

$x^*_2 = -5$ with $f(x_2^*) = -4$

2.4(d) $f(x)$ has one global maximum:

$x^*_2 = 3$ with $f(x_2^*) = 52$.

2.6 Ans

There are $N!$ possible permutation of N cities. If the starting city does not matter, then the number of possible routes reduced to $N!/N = (N-1)!$.

If the direction of travel does not matter, then the number of possible routes further reduces to $(N-1)!/2$.

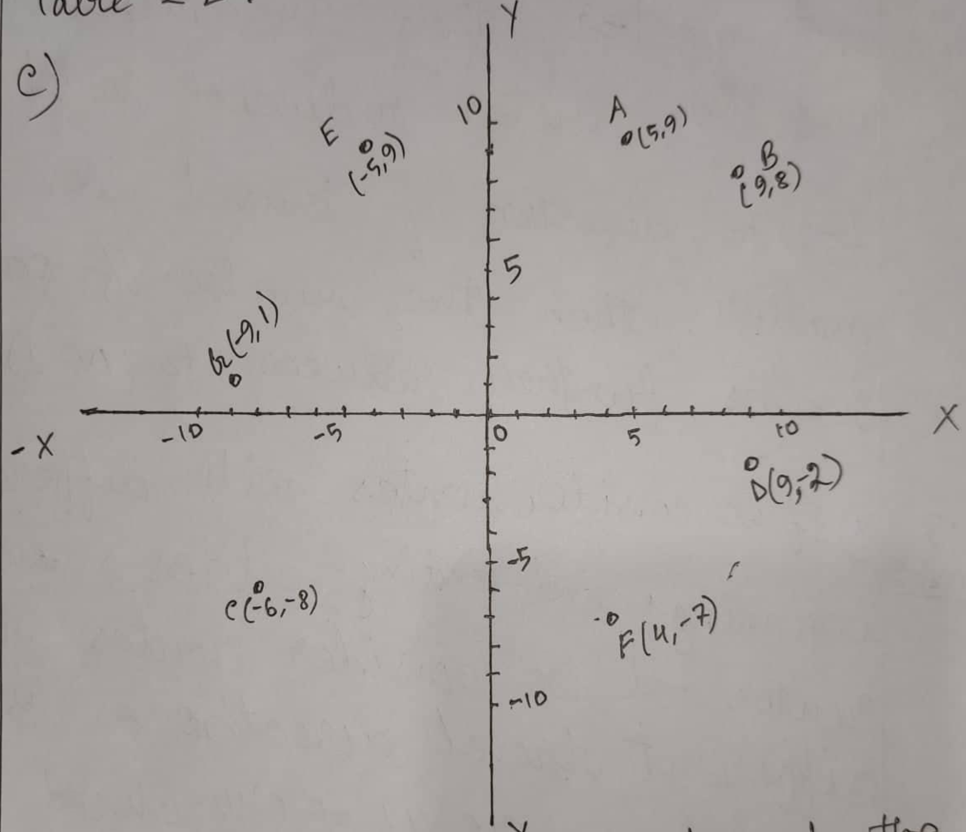
2.7 a) If we consider routes with different

2.7 **Ans:**

a) If we consider routes with different beginnings and ending citites as unique routes and we consider routes with different trovel directions as unique, then there are $7! = 5,040$ closed routes. If the starting city does not matter then possible routes number is $\frac{7!}{7} = (7-1)! = 6! = 720$. If we do not consider routes with different startings and different directions of travel as different routes, then unique closed loops are $\frac{6!}{2} = 360$ numbers.

2.7 b) No, it is not easy to see the solution by looking at the coordinates table in Table 2.2.

2.7 c)



Plots for the coordinats is shown in the above figure. Optimal solution from the plot is : A → B → ~~B~~ D → F → C → G → E → A