Artificial Life

Assignment Sheet # 5

Date: 1/06/2020

Submitted By :

Karim Baidar (s6kabaid@uni-bonn.de)

Cüneyt Erem : s6cuerem@uni-bonn.de

Stephen Abikoye, s6stabik@uni-bonn.de

28] $N(S) = \cancel{a} \cdot \frac{1}{S^{\alpha}}$

$\log N(S) = \log\left(a \cdot \frac{1}{S^{\alpha}}\right)$

2 $= \log a + \log \frac{1}{S^{\alpha}}$

$= \log a - \alpha \cdot \log S$

then $\log N(S)$ and $\log S$ are linearly dependent

33] We have $f(X) = \sum_{j=1}^{d} (-x_j) \cdot \sin\sqrt{|x_j|}$ · when $x_j \in [-500, 500]$

$X = x_1$ to x_d is local minimum depends on x_j of Schwefel's values are also local minimum

If all $\cancel{X} = x_1$ to x_d are local minimum, for adding small number ε, then

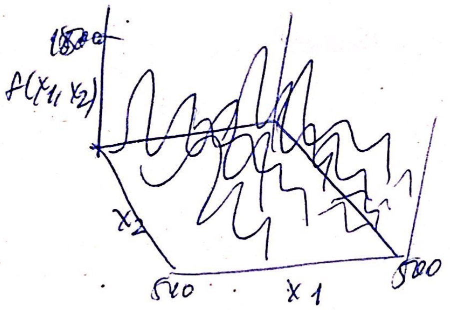
$f(X+\varepsilon)$ when $x_1+\varepsilon_1, \to x_d+\varepsilon_d > f(X) = \sum -x_j \sin\sqrt{|x_j|} = x_1$ to x_d,

1 then $f(X)$ is local minimum. If it is not local minimum, then,

$f(X+\varepsilon)$ when $x_1+\varepsilon_1 \to x_d+\varepsilon_d < f(X) = x_1$ to $x_d = \sum -x_j \sin\sqrt{|x_j|}$,

and $f(X)$ is not local minimum.

Therefore number of local minima of d depends on Schwefel's function growth.



your final result?

34] It is important for dynamical environment because ant can adapt and apply changed behavior by explorative moves and updated values.

It can detect new paths, follow new resources and find better path according to environmental changes.

2

29.) A function $f(z)$ is called scale invariant, if scaling the argument z with a constant factor k yields a proportional scaling of the function value

$f(kz) \sim f(z)$.

Show, ~~that~~ that the function $N(s) = a\frac{1}{s^\alpha}$ is scale invariant.

Give another function, or family of functions, that is scale invariant.

$$N(s) = a\frac{1}{s^\alpha}$$

$$N(ks) = a\frac{1}{(ks)^\alpha}$$

$$N(ks) = k^{-\alpha}\left[a\frac{1}{s^\alpha}\right]$$

1

$$N(ks) = k^{-\alpha} N(s)$$

$$\underline{\underline{N(ks) \sim N(s)}}.$$

30) Derive a formula to implement an exponential decay (pheromones for an ~~ant~~ ant algorithm) that calculates the pheromone concentration to decay to 10% after 42 steps of iteration.

1

$C(i) = C(0)\,a^i$ $\qquad 0 < a < 1$ ------(i)

$C(i) = 10\%$ of $C(0)$

$C(i) = 0.1\,C(0)$ $\qquad$ 42 steps. ------(ii)

$0.1\,\cancel{C(0)} = \cancel{C(0)}\,a^{42}$

$0.1 = a^{42}$

~~$a = \sqrt[42]{}$~~

$a = \sqrt[42]{0.1} \approx 0.947$

$C(i) = 0.947^i\,C(0)$.

31) Gradient descent is a widely used method of optimization, still it has some drawbacks. Name, and describe at least three properties of a gradient descent task, that could be called negative.

1

- It is only applied on differential function.
- It looks ~~only~~ for only local minima rather than global.
- The conversion speed is dependent on the curvature.
- It is hard to choose the step size.

32') Compare the methods Random Search and Random Optimization. What is different, what is common?

Similarities:

Random Search and Random Optimization, both are a family of numerical optimization methods that do not require the gradient of the problem to be optimized, and hence can be used on functions that are not continuous or differentiable.

~~Differences:~~ Differences:

Random Search works by iteratively moving to better positions in the search-space, which are sampled ~~by~~ from a hypersphere surrounding the current position.

While,

Random Optimization works by iteratively moving to ~~be~~ better positions in the search-space which are sampled using a normal distribution surrounding the current position.

2