Raport Tema 1-Matei Andrei Madalin

**1)Descrierea problemei**

Problema acestei teme reprezinta gasirea valorii minime a functiilor De Jong 1, Schwefel 7, Rastrigin,Six-hump camel back folosing algoritmii Hill Climbing Best Improvement, Hill Climbing First Improvement si Simulated Annealing.

**2)Algoritmul utilizat**

a)Pseudocod

Hill Climbing

begin

t := 0

initialize best

repeat

local := FALSE

select a candidate solution (bitstring) vc at random

evaluate vc

repeat

vn := Improve(Neghborhood(vc))

if eval(vn) is better than eval(vc)

then vc := vn

else local := TRUE

until local

t := t + 1

if vc is better than best

then best := vc

until t = MAX

end

Simulated Annealing

begin

t := 0

initialize the temperature T

select a current candidate solution (bitstring) vc at random

evaluate vc

repeat

repeat

select at random vn - a neighbor of vc

if eval(vn) is better than eval(vc)

then vc := vn

else if random[0,1) < exp(-|eval(vn)-eval(vc)|/T)

then vc := vn

until (termination-condition)

T := g(T; t)

t := t + 1

until (halting-criterion)

end

b) Reprezentarea se face pe o matrice de biti;

c) Un vecin al unei solutii repezinta o solutie similara cu cea initiala, doar ca se va schimba un bit.

d) Initializarea unei solutii se face aleator cu o lungime n aleasa de la tastatura ce va cuprinde valori din domeniul de definitie al functiei respective.

e) In cazul functiilor Hill Climbing, algoritmul se opreste cand se ajunge la maximul iteratiilor, iar in cazul functiei Simulated Annealing, algoritmul se opreste cand temperature devine mai mica decat 0,1.

f) Parametrii functiilor sunt cele 1000 de iteratii, cele 30 de rulari, id-ul cu valori cuprinse intre 1 si 4 ce semnifica una dintre cele 4 functii,iar in plus Simulated Annealing are parametrul temperature.

**3)Rezultate experimentale**

|  |  |  |  |
| --- | --- | --- | --- |
|  | HillClimbing  Best DeJong  5 dimensiuni | HillClimbing  Best DeJong  10 dimensiuni | HillClimbing  Best DeJong  30 dimensiuni |
| Minim | 0.165 | 1.855 | 12.904 |
| Media | 0.893 | 3.141 | 19.330 |
| WorstMinim | 2.763 | 7.849 | 32.585 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | HillClimbing  First DeJong  5 dimensiuni | HillClimbing  First DeJong  10 dimensiuni | HillClimbing  First DeJong  30 dimensiuni |
| Minim | 0.487 | 8.977 | 57.204 |
| Media | 2.104 | 14.405 | 76.116 |
| WorstMinim | 6.329 | 21.331 | 107.361 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | Simulated Annealing  DeJong  5 dimensiuni | Simulated Annealing DeJong  10 dimensiuni | Simulated Annealing  DeJong  30 dimensiuni |
| Minim | 0.13 | 1.103 | 10.250 |
| Media | 3.08 | 5.714 | 21.721 |
| WorstMinim | 37.21 | 52.03 | 132.903 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | HillClimbing  Best Schwefel  5 dimensiuni | HillClimbing  Best Schwefel  10 dimensiuni | HillClimbing  Best Schwefel  30 dimensiuni |
| Minim | -1802.31 | -3610.59 | -11862.1 |
| Media | -1723.20 | -3328.18 | -10591.26 |
| WorstMinim | -1619.57 | -3040.85 | -9958.37 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | HillClimbing  First Schwefel  5 dimensiuni | HillClimbing  First Schwefel  10 dimensiuni | HillClimbing  First Schwefel  30 dimensiuni |
| Minim | -1773.91 | -3481.42 | -11355.81 |
| Media | -1682.35 | -3296.51 | -10227.39 |
| WorstMinim | -792.4 | -1613.12 | -7811.24 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | Simulated Annealing  Schwefel  5 dimensiuni | Simulated Annealing  Schwefel  10 dimensiuni | Simulated Annealing  Schwefel  30 dimensiuni |
| Minim | -1857.19 | -3702.13 | -12258.48 |
| Media | -1762.13 | -3589.2 | -11073.26 |
| WorstMinim | -1592.21 | -32286.17 | -8369.91 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | HillClimbing  Best Rastrigin  5 dimensiuni | HillClimbing  Best Rastrigin  10 dimensiuni | HillClimbing  Best Rastrigin  30 dimensiuni |
| Minim | 10.591 | 21.391 | 93.173 |
| Media | 22.345 | 40.230 | 139.471 |
| WorstMinim | 31.744 | 82.912 | 215.399 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | HillClimbing  First Rastrigin  5 dimensiuni | HillClimbing  First Rastrigin  10 dimensiuni | HillClimbing  First Rastrigin  30 dimensiuni |
| Minim | 12.34 | 26.784 | 101.326 |
| Media | 15.893 | 44.239 | 163.438 |
| WorstMinim | 36.238 | 91.235 | 250.673 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | Simulated Annealing  Rastrigin  5 dimensiuni | Simulated Annealing  Rastrigin  10 dimensiuni | Simulated Annealing  Rastrigin  30 dimensiuni |
| Minim | 8.784 | 19.893 | 90.089 |
| Media | 39.123 | 63.217 | 237.675 |
| WorstMinim | 76.238 | 120.453 | 391.592 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | HillClimbing  Best Six-hump | HillClimbing  First Six-hump | Simulated Annealing  Six-hump |
| Minim | -1.025 | -1.016 | -1.029 |
| Media | -0.936 | -0.861 | 7.21 |
| WorstMinim | -0.793 | -0.702 | 0.261 |

Grafic Hill Climbing Best DeJong

Grafic Simulated Annealing

c) Algoritmii depend foarte mult de parametrii pe care ii are.Cu cat avem un numar de iteratii mai mare, cu atat rezultatul returnat va fi mult mai bun pentru functia aleasa.Cu cat dimensiunea este mai mare cu atat timpul de executie va fi mai mare si functia va returna o valoare din ce in ce mai mare fata de cel mai bun minim al functiei.

**4) Comparatia intre metode**

Daca e sa comparam Hill Climbing cu Simulated Annealing, putem spune ca cel de al doilea ofera o valoare mult mai apropiata de minim.Diferenta este ca aceasta ofera uneori o a doua sansa anumitor valori, in timp ce pentru Hill Climbing trebuie sa gasim o valoare mai mica decat cea actuala pentru a schimba valoarea.In schimb Hill Climbing ajunge mai rapid la vecini fata de Simulated Annealing.