MCT-242L COMPUTER PROGRAMMING-I

SEMESTER PROJECT

N_KNIGHT_PROBLEM

Submitted By: **Muhammad Anss** **2022-MC-01**

Submitted to: **Mam Qurrat-ul-Ain**

DEPARTMENT OF MECHATRONICS & CONTROL ENGINEERING

University of Engineering and Technology, Lahore.

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INTRODUCTION:-

Algorithms are powerful tools for solving complex problems. In our learning process, we were tasked with solving the 'n knight problem,' determining how many knights can be placed on a chessboard and their positions without any of them attacking each other. To tackle this challenge, we utilized a Genetic Algorithm approach to fill the board with knights while avoiding attacks between them.

Genetic Algorithm:

It is a type of search algorithm that helps us to find the best solution to a problem.Here the generic Genetic Algorithm to solve any problem.

function Genetic-Algorithm(population, Fitness-fn) returns an individual
inputs: population -> set of individuals with different genes
Fitness-fn -> a function that measures the fitness of an
individual required survival
repeat
parents <-- Select parents from Population
(Survival of fittest)
population <-- Offsprings created by parents
(cross-over, mutation)
repeat until desired fit individual is obtained
return the best individual in the population

Possibe Applications:

Here our possible applications of this problem

- it can be used in the army where a particular troop or a weapon can attack to somewhere similar to a night can attack so it will tell Esther minimum number of tropes and their orientation that can cover the area to be attacked
- it can also be used in placing the set lights which emits infrared waves or any waves oh for frequency such that wave generated by neighbouring satellite can superimpose meaning they can perform interference with each other so this code

will tell us the minimum number of satellites and their orientation which will cover the targeted area by the waves

Pseudo Code:

Here's the Pseudo code of my code

Pseudo Code of n_KNIGHT_problem using Genetic Algorithm

Declaration of arrays like boards(3D array), chromosome(2D array),fitness(1D array) and sol

Initialization of some macros __BOARD_SIZE__ to 8 (or any number whose answer is required), __EMPTY__ to ' ' , __KNIGHT__ to 'O', __ATTACK__ to 'X', __POP__ to 200, __MAX_KNIGHT__ to a number which would calculate from the formula 2*(((__BOARD_SIZE__ * __BOARD_SIZE__)/9)+4)

Declaration and Initialization of variable like nParents to __POP__/2 and trying knights to ((__BOARD_SIZE__ * __BOARD_SIZE__)/9)+4,isOver to 0, iter to 0 and maxIter to 5000

Initialize all the elements of chromosome(2D array) to a random number excluding the number which will result in placing the knight in first or last column or first row or last row
And make sure no 2 elements in 1D array are same

Reset all the elements of boards(3D array) to __EMPTY__

Convert random numbers in chromosome array to row and column by dividing and taking reminder operator on that number and place there knight

Place attacks of each knight by giving relative coordinates of knights (2,1),(2,-1), (-2,1),(-2,-1), (1,2),(1,-2), (-1,2)and(-1,-2)

Calculate No. of spaces in each board and put that in fitness array

Sort in ascending order the fitness and also sort the chromosome array on the basis of fitness

Check if first element of fitness is 0

If Yes

Print Board

Else

Select the first half of the population as parents

Give even childrens the even values of even parents

Give even childrens the odd values of odd parents

Give odd childrens the odds values of even parents

Give odd childrens the even values of odd parents

Give random value at random position to every chromosome element by making sure that the random may not result in placing knight first row or last row or first column or last columns and no two values in that array are the same.

Add one plus value to iter variable

Repeat the process just after randome initialization of chromosome array until iter become equal to maxIter

Print “Solution not found”

FlowChart:

Here the flow chart of my code:

Result:

Here's the most optimum solution I got from my code

```
 -----------------
 |1|2|3|4|5|6|7|8|
 -----------------
1|x|x|x|x|x|x|x|x|
 -----------------
2|x|x|o|x|x|x|x|x|
 -----------------
3|x|x|o|o|x|o|o|x|
 -----------------
4|x|x|x|x|x|o|x|x|
 -----------------
5|x|x|o|x|x|x|x|x|
 -----------------
6|x|o|o|x|o|o|x|x|
 -----------------
7|x|x|x|x|x|o|x|x|
 -----------------
8|x|x|x|x|x|x|x|x|
 -----------------
Knights were placed at the following
 positions:
(2,3),(3,3),(3,4),(3,6),(3,7),(4,6),
(5,3),(6,2),(6,3),(6,5),(6,6)and (7,
6),
No. of knights in this solution = 12
```

Efficiency:

I ran my code 100 times and calculated time and no. iterations done in finding a solution and stored in a text file using techniques of file handling. Here it is what I got:

Solution found after 4488 iterations!
Time taken in finding solution no. 0 = 2.336000 seconds
Solution found after 134 iterations!
Time taken in finding solution no. 1 = 0.102000 seconds
Solution found after 304 iterations!
Time taken in finding solution no. 2 = 0.188000 seconds
Solution found after 2482 iterations!
Time taken in finding solution no. 3 = 1.343000 seconds
Solution found after 663 iterations!
Time taken in finding solution no. 4 = 0.328000 seconds
Solution found after 345 iterations!
Time taken in finding solution no. 5 = 0.201000 seconds
Solution found after 785 iterations!
Time taken in finding solution no. 6 = 0.390000 seconds
Solution found after 2129 iterations!

Time taken in finding solution no. 7 = 1.156000 seconds
Solution found after 504 iterations!
Time taken in finding solution no. 8 = 0.300000 seconds
Solution found after 619 iterations!
Time taken in finding solution no. 9 = 0.310000 seconds
Solution found after 823 iterations!
Time taken in finding solution no. 10 = 0.393000 seconds
Solution found after 1504 iterations!
Time taken in finding solution no. 11 = 0.790000 seconds
Solution found after 9537 iterations!
Time taken in finding solution no. 12 = 5.080000 seconds
Solution found after 108 iterations!
Time taken in finding solution no. 13 = 0.091000 seconds
Solution found after 63 iterations!
Time taken in finding solution no. 14 = 0.058000 seconds
Solution found after 3164 iterations!
Time taken in finding solution no. 15 = 1.716000 seconds
Solution found after 321 iterations!
Time taken in finding solution no. 16 = 0.180000 seconds
Solution found after 348 iterations!
Time taken in finding solution no. 17 = 0.192000 seconds
Solution found after 273 iterations!
Time taken in finding solution no. 18 = 0.163000 seconds
Solution found after 429 iterations!
Time taken in finding solution no. 19 = 0.231000 seconds
Solution found after 414 iterations!
Time taken in finding solution no. 20 = 0.226000 seconds
Solution found after 348 iterations!
Time taken in finding solution no. 21 = 0.186000 seconds
Solution found after 2140 iterations!
Time taken in finding solution no. 22 = 1.193000 seconds
Solution found after 302 iterations!
Time taken in finding solution no. 23 = 0.212000 seconds
Solution found after 199 iterations!
Time taken in finding solution no. 24 = 0.124000 seconds
Solution found after 8170 iterations!
Time taken in finding solution no. 25 = 4.350000 seconds
Solution found after 530 iterations!
Time taken in finding solution no. 26 = 0.278000 seconds
Solution found after 71 iterations!

Time taken in finding solution no. 27 = 0.062000 seconds
Solution found after 465 iterations!
Time taken in finding solution no. 28 = 0.252000 seconds
Solution found after 591 iterations!
Time taken in finding solution no. 29 = 0.306000 seconds
Solution found after 158 iterations!
Time taken in finding solution no. 30 = 0.098000 seconds
Solution found after 5836 iterations!
Time taken in finding solution no. 31 = 3.055000 seconds
Solution found after 78 iterations!
Time taken in finding solution no. 32 = 0.078000 seconds
Solution found after 140 iterations!
Time taken in finding solution no. 33 = 0.105000 seconds
Solution found after 399 iterations!
Time taken in finding solution no. 34 = 0.218000 seconds
Solution found after 979 iterations!
Time taken in finding solution no. 35 = 0.478000 seconds
Solution found after 162 iterations!
Time taken in finding solution no. 36 = 0.146000 seconds
Solution found after 371 iterations!
Time taken in finding solution no. 37 = 0.218000 seconds
Solution found after 328 iterations!
Time taken in finding solution no. 38 = 0.182000 seconds
Solution found after 413 iterations!
Time taken in finding solution no. 39 = 0.226000 seconds
Solution found after 4079 iterations!
Time taken in finding solution no. 40 = 2.162000 seconds
Solution found after 109 iterations!
Time taken in finding solution no. 41 = 0.086000 seconds
Solution found after 99 iterations!
Time taken in finding solution no. 42 = 0.083000 seconds
Solution found after 421 iterations!
Time taken in finding solution no. 43 = 0.228000 seconds
Solution found after 530 iterations!
Time taken in finding solution no. 44 = 0.265000 seconds
Solution found after 5648 iterations!
Time taken in finding solution no. 45 = 2.994000 seconds
Solution found after 1542 iterations!
Time taken in finding solution no. 46 = 0.811000 seconds
Solution found after 372 iterations!

Time taken in finding solution no. 47 = 0.201000 seconds
Solution found after 163 iterations!
Time taken in finding solution no. 48 = 0.108000 seconds
Solution found after 7532 iterations!
Time taken in finding solution no. 49 = 4.009000 seconds
Solution found after 421 iterations!
Time taken in finding solution no. 50 = 0.214000 seconds
Solution found after 422 iterations!
Time taken in finding solution no. 51 = 0.231000 seconds
Solution found after 141 iterations!
Time taken in finding solution no. 52 = 0.105000 seconds
Solution found after 163 iterations!
Time taken in finding solution no. 53 = 0.123000 seconds
Solution found after 204 iterations!
Time taken in finding solution no. 54 = 0.140000 seconds
Solution found after 1625 iterations!
Time taken in finding solution no. 55 = 0.844000 seconds
Solution found after 1824 iterations!
Time taken in finding solution no. 56 = 0.922000 seconds
Solution found after 2409 iterations!
Time taken in finding solution no. 57 = 1.237000 seconds
Solution found after 450 iterations!
Time taken in finding solution no. 58 = 0.277000 seconds
Solution found after 115 iterations!
Time taken in finding solution no. 59 = 0.087000 seconds
Solution found after 4080 iterations!
Time taken in finding solution no. 60 = 2.133000 seconds
Solution found after 698 iterations!
Time taken in finding solution no. 61 = 0.344000 seconds
Solution found after 8556 iterations!
Time taken in finding solution no. 62 = 4.452000 seconds
Solution found after 71 iterations!
Time taken in finding solution no. 63 = 0.077000 seconds
Solution found after 214 iterations!
Time taken in finding solution no. 64 = 0.127000 seconds
Solution found after 343 iterations!
Time taken in finding solution no. 65 = 0.195000 seconds
Solution found after 816 iterations!
Time taken in finding solution no. 66 = 0.398000 seconds
Solution found after 453 iterations!

Time taken in finding solution no. 67 = 0.244000 seconds
Solution found after 242 iterations!
Time taken in finding solution no. 68 = 0.132000 seconds
Solution found after 1460 iterations!
Time taken in finding solution no. 69 = 0.770000 seconds
Solution found after 116 iterations!
Time taken in finding solution no. 70 = 0.096000 seconds
Solution found after 137 iterations!
Time taken in finding solution no. 71 = 0.105000 seconds
Solution found after 543 iterations!
Time taken in finding solution no. 72 = 0.273000 seconds
Solution found after 304 iterations!
Time taken in finding solution no. 73 = 0.169000 seconds
Solution found after 685 iterations!
Time taken in finding solution no. 74 = 0.337000 seconds
Solution found after 159 iterations!
Time taken in finding solution no. 75 = 0.116000 seconds
Solution found after 1583 iterations!
Time taken in finding solution no. 76 = 0.809000 seconds
Solution found after 619 iterations!
Time taken in finding solution no. 77 = 0.329000 seconds
Solution found after 296 iterations!
Time taken in finding solution no. 78 = 0.171000 seconds
Solution found after 212 iterations!
Time taken in finding solution no. 79 = 0.181000 seconds
Solution found after 2175 iterations!
Time taken in finding solution no. 80 = 1.169000 seconds
Solution found after 53 iterations!
Time taken in finding solution no. 81 = 0.073000 seconds
Solution found after 2214 iterations!
Time taken in finding solution no. 82 = 1.188000 seconds
Solution found after 225 iterations!
Time taken in finding solution no. 83 = 0.148000 seconds
Solution found after 577 iterations!
Time taken in finding solution no. 84 = 0.284000 seconds
Solution found after 173 iterations!
Time taken in finding solution no. 85 = 0.133000 seconds
Solution found after 71 iterations!
Time taken in finding solution no. 86 = 0.075000 seconds
Solution found after 297 iterations!

Time taken in finding solution no. 87 = 0.181000 seconds
Solution found after 129 iterations!
Time taken in finding solution no. 88 = 0.093000 seconds
Solution found after 73 iterations!
Time taken in finding solution no. 89 = 0.065000 seconds
Solution found after 738 iterations!
Time taken in finding solution no. 90 = 0.373000 seconds
Solution found after 85 iterations!
Time taken in finding solution no. 91 = 0.071000 seconds
Solution found after 97 iterations!
Time taken in finding solution no. 92 = 0.082000 seconds
Solution found after 99 iterations!
Time taken in finding solution no. 93 = 0.081000 seconds
Solution found after 86 iterations!
Time taken in finding solution no. 94 = 0.069000 seconds
Solution found after 1493 iterations!
Time taken in finding solution no. 95 = 0.758000 seconds
Solution found after 311 iterations!
Time taken in finding solution no. 96 = 0.170000 seconds
Solution found after 135 iterations!
Time taken in finding solution no. 97 = 0.109000 seconds
Solution found after 55 iterations!
Time taken in finding solution no. 98 = 0.059000 seconds
Solution found after 248 iterations!
Time taken in finding solution no. 99 = 0.155000 seconds
Solution found after 371 iterations!
Time taken in finding solution no. 100 = 0.197000 seconds
Total time taken in finding all solutions = 80.765000 seconds

Things I Learn:

Solving this problem opened a door to new learning beyond the coursework. Key Takeaways:

- **Problem definition:** I understood how to identify problems ideally suited for computers, not humans.
- **Computer communication:** I learned how to instruct computers to perform tedious or impossible tasks for humans, overcoming the communication barrier.

- **Advanced C skills**: I explored new C features like: Colorful outputs: Creating text with different colors. 3D data visualization: Understanding and manipulating 3D arrays.
- **Header files**: Mastering their creation and usage for modular programming. Dynamic animation: Simulating movement through screen clearing and repeated printing.

Conclusion:

So overall I learned so much things from for this complex engineering problem it helped me improving my problem solving skills and programming skills and open gate for me to see the world in a different way and making computer my best friend to do my tasks