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Documentation: Assignment 4

Using Red Deer Algorithm to solve the travelling salesman problem.

The travelling salesman problem was solved using RDA in a serial and parallel manner. The main steps involved were:

- Using the RT method to encode the input.
- Select Elite population as male.
- Let the male roar and check randomly if moving within the search space increases the fitness or not. Use corresponding equation mathematically.
- Select commanders randomly from males.
- Let the commander and stags fight and let the best solution after each fight be male.
- Form harems for each commander. Number of females(or hinds) in harems will be proportional to the fitness value of the commander.
- Let commander mate with alpha percent females from his harem and with beta percent females from some other random harem.
- Let stag mate with the nearest hind.
- Pass male to next population.
- To fill the rest of the new population, the roulette method is used for all offsprings and hinds.
- Then pass this new population to the next iteration

However, in a parallel algorithm following steps were done differently:

- Starting population in each iteration is divided among threads.
- Each thread will include roaring, selection, fighting, harems formation, mating, and roulette selection.
- Then sub-population from all threads will combine again to a global population.
- The global population is then shuffled.
- Then the next iteration will start with this global population as starting population.

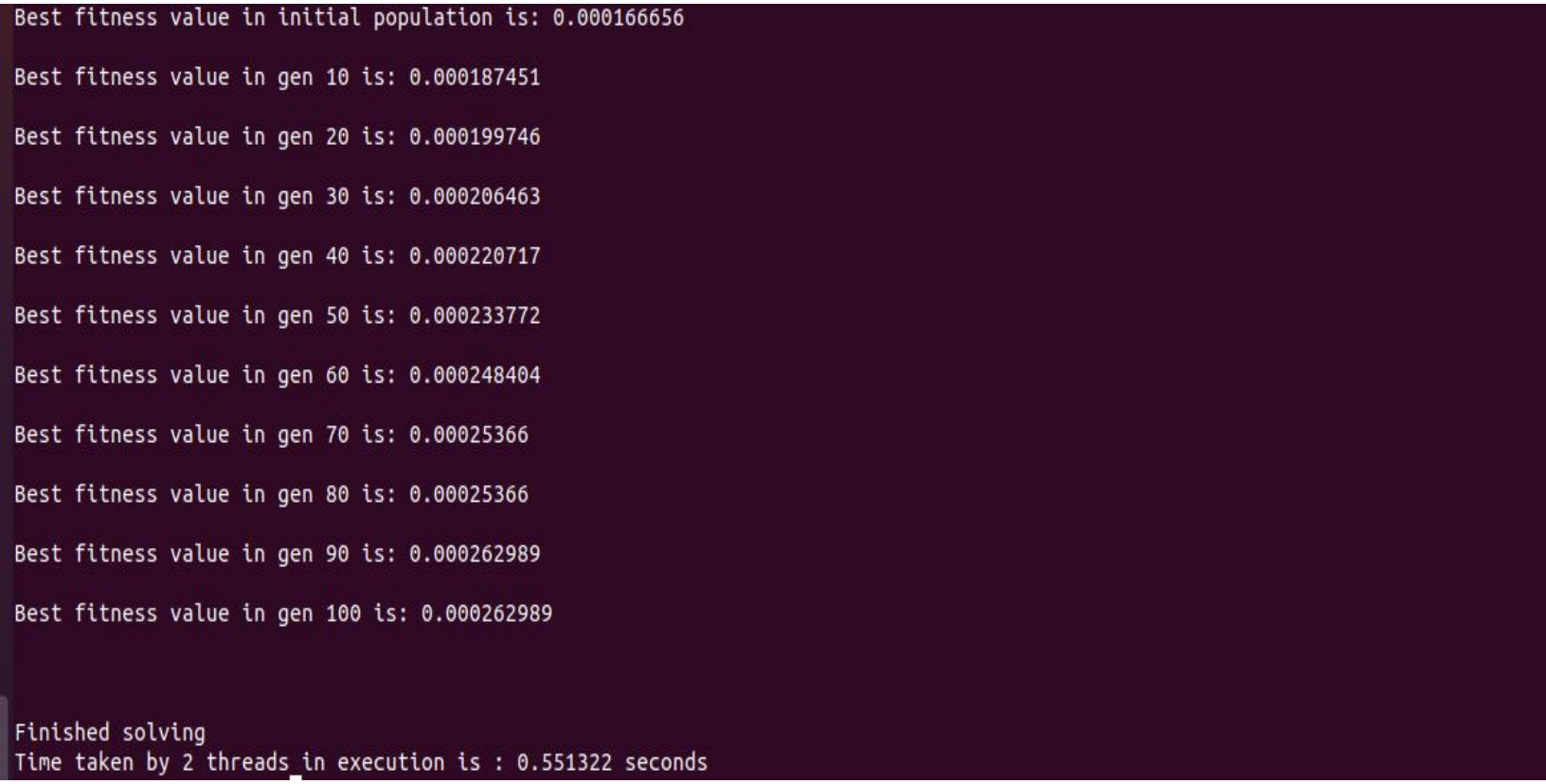
Results:

A test containing 25 cities was used to evaluate the algorithm. The input was the distance matrix of these 25 cities. Population size was set to 200. Some Important points deduced from output were:

- **Sequential**
  Vertices=25
  Iterations=100
  Time=1.36952 seconds

```
Best fitness value in initial population is: 0.00019414

Best fitness value in gen 10 is: 0.00019414

Best fitness value in gen 20 is: 0.000203192

Best fitness value in gen 30 is: 0.000214853

Best fitness value in gen 40 is: 0.000240695

Best fitness value in gen 50 is: 0.000247983

Best fitness value in gen 60 is: 0.000247983

Best fitness value in gen 70 is: 0.000247983

Best fitness value in gen 80 is: 0.000247983

Best fitness value in gen 90 is: 0.000278335

Best fitness value in gen 100 is: 0.000278335


Elapsed time: 1.36952 seconds
```

- **Parallel(2 threads)**
  Vertices=25
  Iterations=100
  Time=0.551322 seconds



- **Parallel(4 threads)**
  Vertices=25
  Iterations=100
  Time=0.291491 seconds