Traveling Salesman

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CSE 633

Problem Definition

- The traveling salesman problem - a mathematical problem in which one tries to find the shortest route that passes through each of a set of points once and only once.

Applications

Some variations/adaptations include:

- Visiting all Major League Baseball fields (30) in one month.
- A UPS truck delivering packages to a set of houses.
- Laying power cable networks for large systems.
- Pay phone change collection.

Problem Definition 2

- To find the most optimal path often distances from two points, or cost to travel a road is used.
- For this problem we will assume a connected graph with the weight of a given edge to be the euclidean distance between the two vertices it connects.

Proposed Solution

Using $N^2 + 1$ processors. 1 master, N^2 workers.

- Processor 0 is given bounds on the data and then distributes to the individual processors based on a grid.
- Each processor then computes the solution locally of the subset of its values it has received.
- Each processor sends its sub solution to the master who combines the N^2 values together to obtain a final result.
    - Note that the N^2 values the master receives represent a much larger set of values. Where each of the N values could represent n cities (but normally would be $O(n/N^2)$.

Local Computation

Locally each of the worker processes compute the solution as follows:

- Receive in all data corresponding to the assigned grids section
  - insert into sorted list based on x value
- initialize left most point as start
- randomly select 3 values from the list and choose best
- repeat until list is empty
- cycle through list to swap adjacent nodes when a more optimal path can be found
- send result to master

Asymptotic Run Time

- The run time is linear, $\Theta(n + k)$ based on the fact that the master processor does have to distribute all of the values, and stitch the k results back together.
- For the k worker processes the run time is on average $\Theta(n/k)$

Results - Optimal tour for 395 points

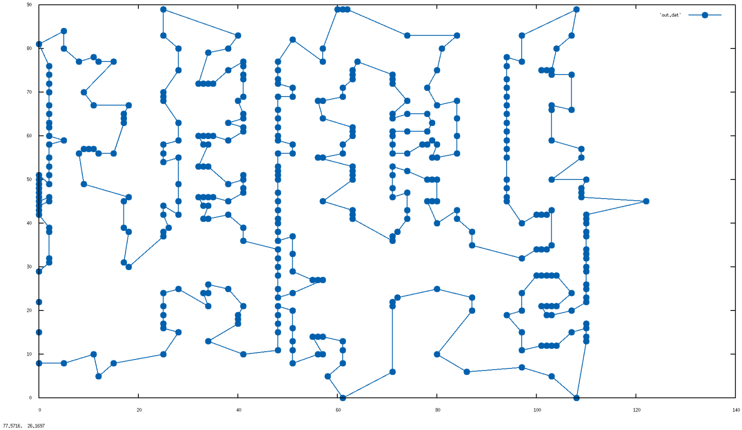

Figure: Optimal tour

Results - Non optimal tour for 395 points

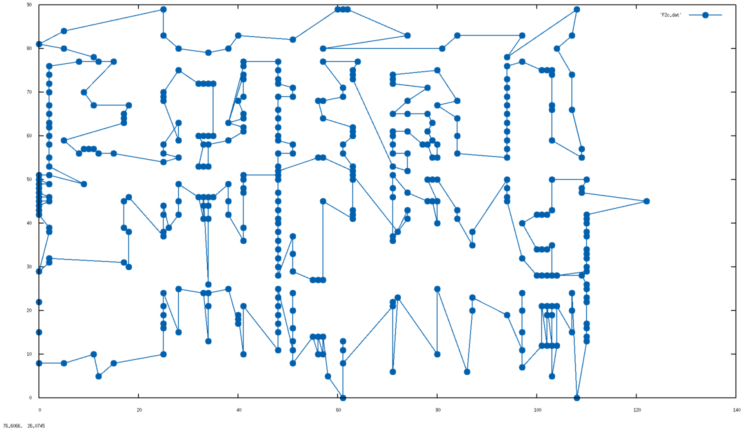

Figure: Non optimal tour

Results Explained

- For the following graphs the total processors used can be calculated by squaring the x value and adding 1.
- If the data values are shortened the x values did not adjust properly at times, thus add the shift values accordingly.

Results - Run Time

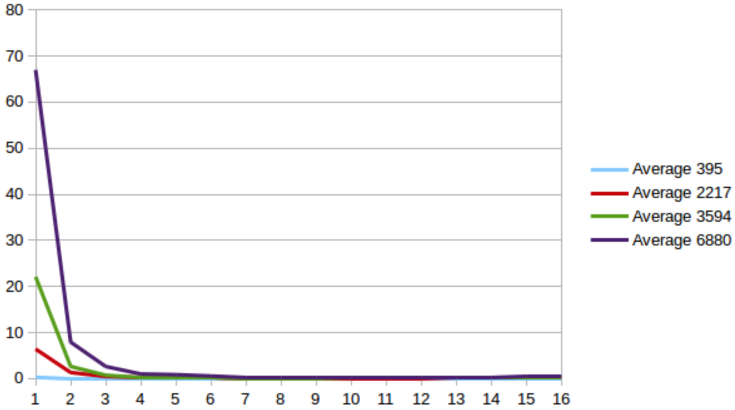

Figure: Full results

Results - Run Time

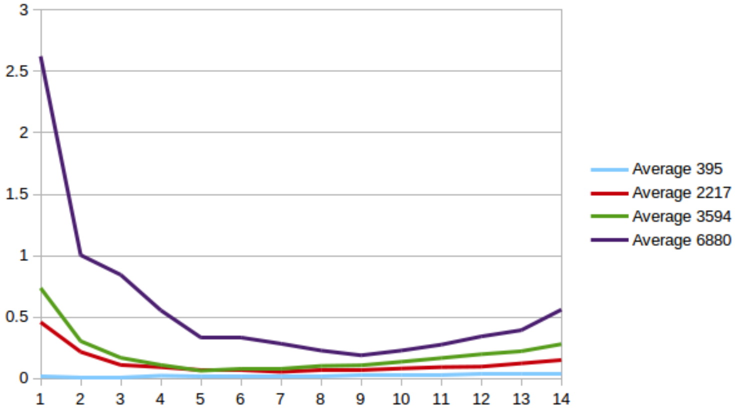

Figure: First 2 removed

Results - Run Time

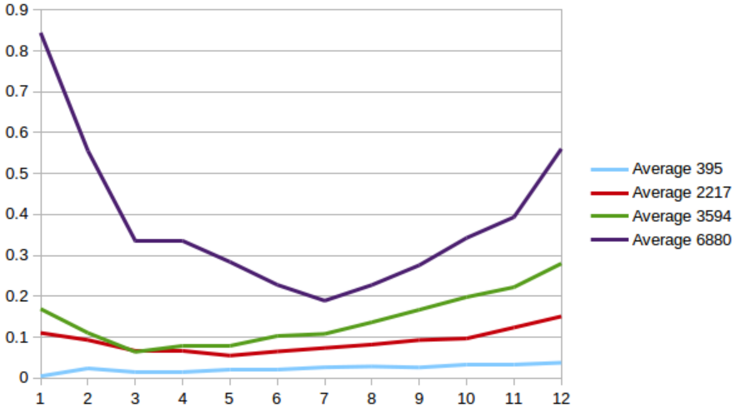

Figure: First 4 removed

Results - Length

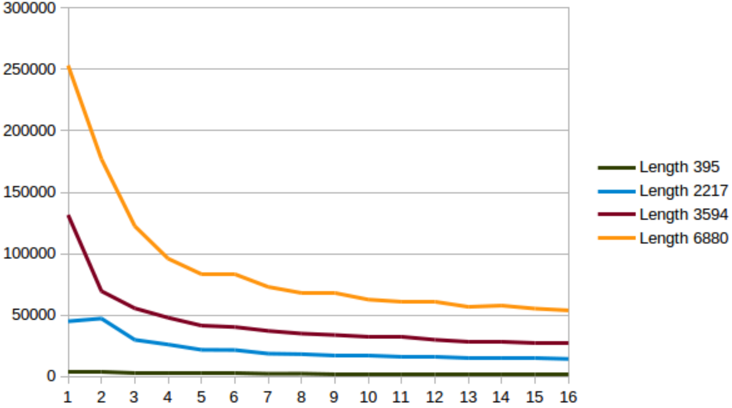

Figure: Best for 6880 - 37537

Results - Length

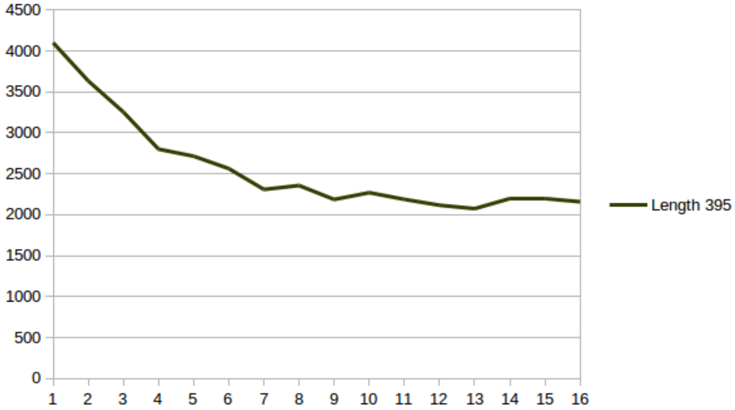

Figure: Best - 1581

Results - Length

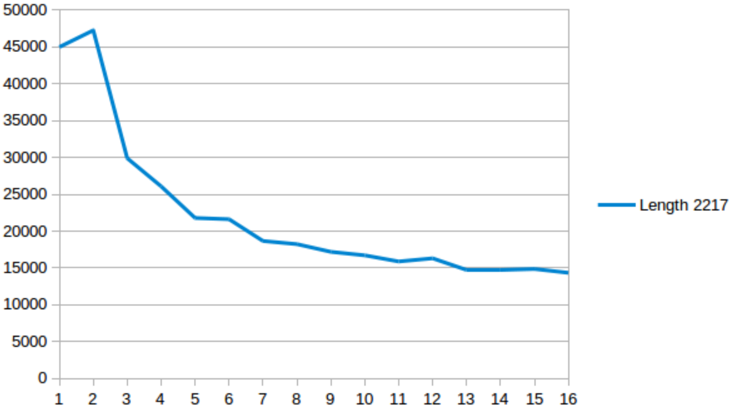

Figure: Best 9764

Results - Length

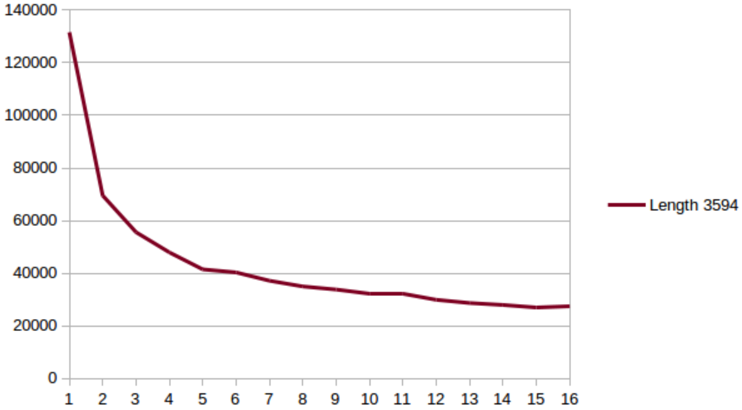

Figure: Best - 18538

Results - Length

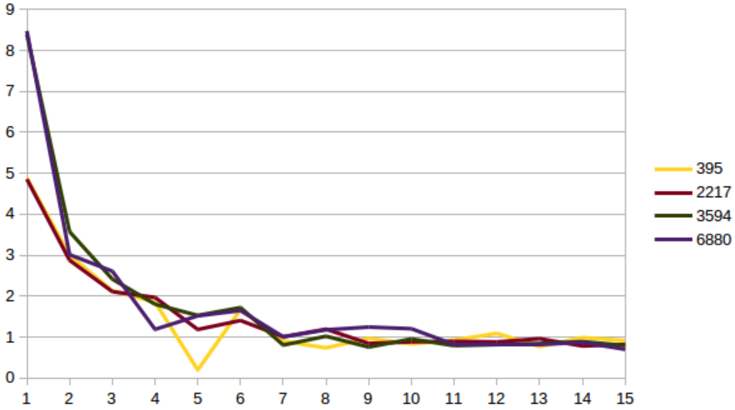

Figure: Latency - old / new

Discussion

Questions?