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.
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.
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 \( O(n/N^2) \)).
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
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
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.
Figure: Full results
Results - Run Time

Figure: First 2 removed
Results - Run Time

Figure: First 4 removed
Figure: Best for 6880 - 37537
Figure: Best - 1581
Results - Length

Figure: Best 9764
Results - Length

Figure: Best - 18538
Results - Length

Figure: Latency - old / new
Questions?