Programming Assignment 1

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1. The idea of your program

**Serial version:**

num\_city: number of cities to connect

2opt\_swap(start, end);

for (i = 1; i < num\_city - 1; ++i)

for (j = i + 1; j < num\_city; ++j)

2opt\_swap(i, j);

**Can be changed to:**

start from (1) to (num\_city - 1)

2opt\_swap with \*depth\* (2) to (num\_city - i)

for (i = 1; i < num\_city - 1; ++i)

for (depth = 1; depth < num\_city - i; ++depth)

2opt\_swap(i, i + depth);

*depth* is the length between the 2opt\_swap indices

**Idea: Split *depth* across threads**

maximum\_depth = num\_city - 1

depth\_for\_each\_thread = maximum\_depth / num\_thread

for (depth = thread\_depth\_start[n]; depth < thread\_depth\_end[n]; ++depth)

for (i = 1; i < num\_city - depth; ++i)

2opt\_swap(i, i + depth);

2opt\_swap(start, end):

\_read\_lock

create new\_route

\_unlock

assert(distance(new\_route) < distance(current\_route))

\_write\_lock

current\_route = new\_route

\_unlcok

end

**Note:**

* A race condition may occur when a thread pass through assertion, but not yet change the current\_route; a better current\_route may be overwritten, so the assertion have to be done again after applying \_write\_lock
* The aforementioned race condition also prevents partial update of the current\_route, so a new array(new\_route) is created every operation.
* distance(current\_route) can be cached.
* There are also two ways to split the depth

Example 9 depth, 3 threads

Chunk:

Thread 1: 1/2/3 depth

Thread 2: 4/5/6 depth

Thread 3: 7/8/9 depth

Balanced:

Thread 1: 1/4/7 depth

Thread 2: 2/5/8 depth

Thread 3: 3/6/9 depth

1. Performance (run-time) analysis with 1, 2, 4, 8, 16 core(s)

|  |  |  |
| --- | --- | --- |
| Time | 2opt\_call - **Chunk** | 2opt\_call - **Balanced** |
| 1 | 29511 | 22687 |
| 2 | 55504 | 40865 |
| 4 | 77554 | 78964 |
| 8 | 137454 | 156811 |
| 16 | 187609 | 263862 |

**Chunk**’s performance is affected by other program on the server, so the two splitting method is not comparable, and the scaling is also affected.

1. Record your distance every 30 seconds with **test11**

|  |  |  |
| --- | --- | --- |
| Time | Distance - **Chunk** | Distance - **Balanced** |
| 0m 30s | 5236100228259.406250 | 5236717679532.094727 |
| 1m 00s | 5231971534271.667969 | 5233515634808.969727 |
| 1m 30s | 5227836991118.258789 | 5230367659596.432617 |
| 2m 00s | 5223718046276.681641 | 5227120073294.151367 |
| 2m 30s | 5219646075512.209961 | 5223826016575.713867 |
| 3m 00s | 5215371936230.681641 | 5220503616187.361328 |
| 3m 30s | 5211304150395.791016 | 5217188075359.485352 |
| 4m 00s | 5207007363954.340820 | 5213956574863.473633 |
| 4m 30s | 5202663341521.856445 | 5210696144937.516602 |
| 5m 00s | 5198240863981.068359 | 5207478719493.100586 |
| 5m 30s | 5193779622377.418945 | 5204159468348.786133 |
| 6m 00s | 5189308262554.725586 | 5200850919899.376953 |
| 6m 30s | 5184965645238.834961 | 5197510202195.328125 |
| 7m 00s | 5180461832133.696289 | 5194199228798.541992 |
| 7m 30s | 5175974494965.203125 | 5190893764368.701172 |
| 8m 00s | 5171505812054.311523 | 5187529485820.927734 |
| 8m 30s | 5167053654242.847656 | 5184208784862.052734 |
| 9m 00s | 5162558193041.388672 | 5180851947875.826172 |
| 9m 30s | 5158053381453.726562 | 5177470862782.342773 |
| 10m 00s | 5153657131562.408203 | 5174167590672.028320 |

1. Discussion
2. Feedback