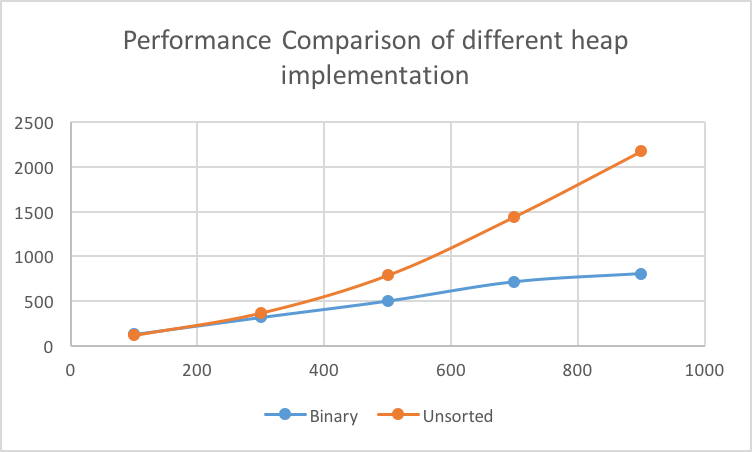
VE281 Programming Assignment Two: Priority Queue

Project Report

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# Project Design

In order to compare the runtime of each sorting algorithm with different array size, we first have to choose 5 different n representing the size of the array. We originally chose 10\*10, 100\*100, 1000\*1000, 10000\*10000, 100000\*100000 for the size but we soon found out that comparing to such large array size the difference of the runtime for each implementation is so significant that the graph was not able to give effective information. Thus we use 10\*10=100, 17\*17=300, 22\*22=500, 26\*26=700, 30\*30=900 as the grid size. Then we use rand() to generate a random start point and random end point and the n use mrand48() command to generate a random grid with n\*n elements. Finally, we apply the two priority queue implementation to it and use clock() command to record the runtime.

## Result

The comparison is a great success, the data we get from the program were close to our expectation, with the data size grows larger, Unsorted-array implementation requires much more time than Binary-heap implementation. Because we need more enqueue and dequeue operation. For Binary-heap, the time complexity of the two methods are both O(log(n)), but for Unsorted-array, although enqueue has O(1) time complexity, dequeue has O(n) time complexity, which is less efficient than O(log(n)). However, when the grid size is 100, we can find that the time used by Unsorted-array is shorter. It is because when the data size is small log(n) is close to n, but the Binary-heap implementation needs more multiply and divide operation which take more time that simple comparison. In addition, we learnt a useful command dealing method getopt\_long() which makes it easier to handle optional command. After all, the project is very successful.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Grid size | 100 | 300 | 500 | 700 | 900 |
| Binary | 129 | 316 | 498 | 711 | 802 |
| Unsorted | 117 | 367 | 788 | 1442 | 2173 |

Table. Average comparison data

APPENDIX. Comparison data

Last login: Sun Nov 8 18:40:23 on ttys000

ZHOUS-MBA:~ bbem$ cd desktop/281project/p2副本

ZHOUS-MBA:p2副本 bbem$ g++ -o test p2.cpp

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 10 10

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (4, 7) to (6, 8) is -208496419.

Path:

Running time: 108

Running program with UNSORTED heap...

The result is:

The shortest path from (4, 7) to (6, 8) is -208496419.

Path:

Running time: 120

ZHOUS-MBA:p2副本 bbem$ g++ -o test p2.cpp

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 10 10

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (2, 8) to (2, 7) is -4529.

Path:

Running time: 119

Running program with UNSORTED heap...

The result is:

The shortest path from (2, 8) to (2, 7) is -4529.

Path:

Running time: 109

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 10 10

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (9, 3) to (5, 9) is -24546.

Path:

Running time: 147

Running program with UNSORTED heap...

The result is:

The shortest path from (9, 3) to (5, 9) is -24546.

Path:

Running time: 102

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 10 10

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (0, 7) to (9, 2) is -38875.

Path:

Running time: 133

Running program with UNSORTED heap...

The result is:

The shortest path from (0, 7) to (9, 2) is -38875.

Path:

Running time: 129

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 10 10

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (6, 9) to (3, 0) is -35127.

Path:

Running time: 140

Running program with UNSORTED heap...

The result is:

The shortest path from (6, 9) to (3, 0) is -35127.

Path:

Running time: 126

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 10 10

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (1, 4) to (9, 7) is -41907.

Path:

Running time: 230

Running program with UNSORTED heap...

The result is:

The shortest path from (1, 4) to (9, 7) is -41907.

Path:

Running time: 172

ZHOUS-MBA:p2副本 bbem$ ./test 10 10

Please enter the size of the grid: 10 10

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (8, 6) to (6, 7) is -16098.

Path:

Running time: 113

Running program with UNSORTED heap...

The result is:

The shortest path from (8, 6) to (6, 7) is -16098.

Path:

Running time: 109

ZHOUS-MBA:p2副本 bbem$ ./test 10 10

Please enter the size of the grid: 100 100

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (3, 2) to (69, 29) is -6894545.

Path:

Running time: 6882

Running program with UNSORTED heap...

The result is:

The shortest path from (3, 2) to (69, 29) is -6894545.

Path:

Running time: 78839

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 30 30

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (13, 4) to (28, 25) is -606720.

Path:

Running time: 653

Running program with UNSORTED heap...

The result is:

The shortest path from (13, 4) to (28, 25) is -606720.

Path:

Running time: 1415

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 30 30

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (23, 23) to (24, 16) is -748973.

Path:

Running time: 743

Running program with UNSORTED heap...

The result is:

The shortest path from (23, 23) to (24, 16) is -748973.

Path:

Running time: 1763

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 30 30

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (23, 24) to (26, 5) is -871308.

Path:

Running time: 821

Running program with UNSORTED heap...

The result is:

The shortest path from (23, 24) to (26, 5) is -871308.

Path:

Running time: 2162

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 30 30

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (9, 26) to (0, 13) is -963822.

Path:

Running time: 953

Running program with UNSORTED heap...

The result is:

The shortest path from (9, 26) to (0, 13) is -963822.

Path:

Running time: 3386

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 30 30

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (29, 18) to (12, 27) is -769053.

Path:

Running time: 830

Running program with UNSORTED heap...

The result is:

The shortest path from (29, 18) to (12, 27) is -769053.

Path:

Running time: 2139

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 17 17

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (1, 8) to (13, 1) is -125297.

Path:

Running time: 269

Running program with UNSORTED heap...

The result is:

The shortest path from (1, 8) to (13, 1) is -125297.

Path:

Running time: 268

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 17 17

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (13, 9) to (4, 0) is -177820.

Path:

Running time: 312

Running program with UNSORTED heap...

The result is:

The shortest path from (13, 9) to (4, 0) is -177820.

Path:

Running time: 377

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 17 17

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (16, 6) to (12, 12) is -35544.

Path:

Running time: 240

Running program with UNSORTED heap...

The result is:

The shortest path from (16, 6) to (12, 12) is -35544.

Path:

Running time: 203

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 17 17

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (1, 16) to (11, 4) is -231786.

Path:

Running time: 363

Running program with UNSORTED heap...

The result is:

The shortest path from (1, 16) to (11, 4) is -231786.

Path:

Running time: 520

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 17 17

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (0, 12) to (11, 9) is -197834.

Path:

Running time: 399

Running program with UNSORTED heap...

The result is:

The shortest path from (0, 12) to (11, 9) is -197834.

Path:

Running time: 470

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 22 22

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (12, 6) to (0, 6) is -136920.

Path:

Running time: 358

Running program with UNSORTED heap...

The result is:

The shortest path from (12, 6) to (0, 6) is -136920.

Path:

Running time: 366

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 22 22

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (18, 21) to (17, 12) is -318296.

Path:

Running time: 642

Running program with UNSORTED heap...

The result is:

The shortest path from (18, 21) to (17, 12) is -318296.

Path:

Running time: 1405

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 22 22

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (16, 21) to (7, 18) is -378281.

Path:

Running time: 532

Running program with UNSORTED heap...

The result is:

The shortest path from (16, 21) to (7, 18) is -378281.

Path:

Running time: 869

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 22 22

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (5, 8) to (13, 19) is -105835.

Path:

Running time: 397

Running program with UNSORTED heap...

The result is:

The shortest path from (5, 8) to (13, 19) is -105835.

Path:

Running time: 394

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 22 22

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (15, 18) to (14, 10) is -352255.

Path:

Running time: 656

Running program with UNSORTED heap...

The result is:

The shortest path from (15, 18) to (14, 10) is -352255.

Path:

Running time: 1555

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 22 22

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (3, 7) to (9, 12) is -139129.

Path:

Running time: 408

Running program with UNSORTED heap...

The result is:

The shortest path from (3, 7) to (9, 12) is -139129.

Path:

Running time: 417

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 22 22

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (21, 8) to (15, 7) is -404031.

Path:

Running time: 500

Running program with UNSORTED heap...

The result is:

The shortest path from (21, 8) to (15, 7) is -404031.

Path:

Running time: 706

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 26 26

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (14, 23) to (1, 10) is -237259.

Path:

Running time: 593

Running program with UNSORTED heap...

The result is:

The shortest path from (14, 23) to (1, 10) is -237259.

Path:

Running time: 971

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 26 26

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (4, 5) to (17, 15) is -587232.

Path:

Running time: 758

Running program with UNSORTED heap...

The result is:

The shortest path from (4, 5) to (17, 15) is -587232.

Path:

Running time: 2146

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 26 26

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (6, 7) to (25, 24) is -546369.

Path:

Running time: 845

Running program with UNSORTED heap...

The result is:

The shortest path from (6, 7) to (25, 24) is -546369.

Path:

Running time: 1415

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 26 26

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (7, 16) to (14, 2) is -392760.

Path:

Running time: 587

Running program with UNSORTED heap...

The result is:

The shortest path from (7, 16) to (14, 2) is -392760.

Path:

Running time: 873

ZHOUS-MBA:p2副本 bbem$ ./test

Please enter the size of the grid: 26 26

Generating start point and end point....

Generating the grid...

Running program with BINARY heap...

The result is:

The shortest path from (15, 7) to (9, 3) is -536128.

Path:

Running time: 774

Running program with UNSORTED heap...

The result is:

The shortest path from (15, 7) to (9, 3) is -536128.

Path:

Running time: 1807

ZHOUS-MBA:p2副本 bbem$