Ryan Pascal 1
2932732
April 3rd, 2019

A

Table 1-1 Running time in millisecond for case 1 (points are within a circle)			
n*	Running time		
	Graham Scan	Jarvis March	Quickhull
10	.008	.001	.005
1000	0.248	0.113	.091
10,000	1.313	1.748	0.923
100,000	15.027	28.151	9.46
1,000,000	161.12	369.087	102.014

Table 1-2 Running time in millisecond for case 2 (points are on a circle)			
n*	Running time		
	Graham Scan	Jarvis March	Quickhull
10	.004	.002	.005
1000	.099	0.78	0.193
10,000	10418	9.315	1.555
100,000	11.779	89.911	14.948
1,000,000	127.781	937.349	164.004

Table 1-3 Running time in millisecond for case 3 (points are within a rectangle)			
n*	Running time		
	Graham Scan	Jarvis March	Quickhull
10	.004	.002	.004
1000	0.102	.082	.094
10,000	1.309	1.222	.898
100,000	14.655	12.202	8.868
1,000,000	162.022	116.798	105.205

Table 1-4 Running time in millisecond for case 3 (points are within a triangle)			
n*	Running time		
	Graham Scan	Jarvis March	Quickhull
10	.003	.001	.005
1000	0.102	.071	.073
10,000	1.276	.488	.687
100,000	14.672	3.759	7.204
1,000,000	158.77	28.329	91.441

Ryan Pascal 3
2932732
April 3rd, 2019

B

	Running time complexity		
	Graham Scan	Jarvis March	Quickhull
Best case	$O(nlogn)$	$O(nlogn)$	$O(nlogn)$
Average case	$O(nlogn)$	$O(nlogn)$	$O(nlogn)$
Worst case	$O(nlogn)$	$O(n^2)$	$O(n^2)$

C

Does your empirical analysis match with your theoretical analysis? Justify your answer.

For 1-1 where the points are within a circle it makes sense that Quickhull would perform the best. With the points being within a circle as Quickhull is running there is a much higher chance to eliminate points. Jarvis March however would perform poorly on this dataset because of the need to check many points to find the desired point with smallest angle.

For 1-2 where the points are on a circle Jarvis March should perform the best and as shown in the tests it does. Jarvis March is commonly referred to a gift wrapping method and with the points being on a circle it will be much quicker to find the next point when computing the algorithm. Quickhull however would perform poorly in this case due to not being able to eliminate points as quickly as in the first case of points within a circle.

For 1-3 with points being within a rectangle as seen in the testing Jarvis March and Quickhull both performed very similarly. This would make sense because in both cases there is not a high probability of being able to quickly evaluate points. The shape is not ideal for eliminating points for Quickhull and it is also not ideal for going around the shape as in Jarvis March.

For 1-4 with the points within a triangle Jarvis March performed very good. The layout is good for determining the next point in the sequence when determining the convex hull. Quickhull does not really have any advantages or disadvantages in this case which shows in the average time.

In all these cases it can be seen that Graham Scan performs basically the same across all data sets. This makes perfect sense due to Graham Scan having a runtime of $O(nlogn)$ regards of the dataset.