CSCI-2100 Data Structures Lab
Profiling Dijkstra's Algorithm

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I. INTRODUCTION

A. Algorithm Complexity

$|V| :=$ the number of vertices in the graph,

$|E| :=$ the number of edges in G

For the linear implmentation of `minVertex`, the run time (for the worst case) is described by:

$$\Theta(|V|^2 + |E|)$$

where the $|E|$ term arises from the fact that we visit each edge once.

B. Comparison

From this we can see that if $|E| \in |V|$, then the upper bound for the run time is $O(|V|^2)$.

The use of a binary-heap in `minVertex` yields a lower time complexity on average relative to the linear implementation

This can be broken down into two components. The $|V| \log |E|$ term comes from the fact that for every vertex, we must call the `minVertex` function. The $|E| \log |E|$ term is the cost of adding an element to the heap for every edge (worst case).

The total runtime is

$$\Theta((|V| + |E|) \cdot \log |E|)$$

To understand the asymptotic performance of this algorithm, we need to consider a few cases. If $|E|$ is bounded above by $|V|$, (ie. $|E| \in O(|V|)$), then the linear implementation is $\Theta(|V|^2)$, and the heap implementation is $O(|V| \log |V|)$.

II. RESULTS

An analysis of each implmentation was tested for three cases, namely:

$$\begin{cases} |E| = |V|/2 \\ |E| = |V| \\ |E| = |V|^2 \end{cases}$$

TABLE I: Runtimes

	DENSITY	LINEAR	HEAP
Adjacency List	$\lvert E\rvert \in \lvert V\rvert/2$	0.0	0.0
	$\lvert E\rvert \in \lvert V\rvert$	0.0	0.0
	$\lvert E\rvert \in \lvert V\rvert^2$	0.0	0.0
Adjacency Matrix	$\lvert E\rvert \in \lvert V\rvert/2$	0.0	0.0
	$\lvert E\rvert \in \lvert V\rvert$	0.0	0.0
	$\lvert E\rvert \in \lvert V\rvert^2$	0.0	0.0

III. CONCLUSION

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REFERENCES

[1] C. A. Shaffer, *A Practical Introduction to Data Structures and Algorithm Analysis*. Citeseer, 1997.