CSCI-2100 Data Structures Lab
Profiling Dijkstra's Algorithm

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I. Introduction

$|V|$ will be used to denote the number of vertices in the graph, and $|E|$ will be used to denote the number of edges.

II. Implementations

For the linear (naive) implmentation of `minVertex`, the average runtime is

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

which can be though of as $\Theta(|V|)$ for |V| vertices. The runtime for the worst case is $\Theta(|V|^2 + |E|)$, where the $|E|$ term arises from the fact that we visit each edge once.

With the binary heap data structure is used in the `minVertex` function, the distances are stored in a min-heap. The runtime is

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

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).

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 $O(|V| \log |V|)$.

III. Results

In this context, the density graph is defined as ___.

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TABLE I: Runtimes

	DENSITY	LINEAR	HEAP
Adjacency List	$\|E\| = \|V\|/2$	0.0	0.0
	$\|E\| = \|V\|$	0.0	0.0
	$\|E\| = \|V\|^2$	0.0	0.0
Adjacency Matrix	$\|E\| = \|V\|/2$	0.0	0.0
	$\|E\| = \|V\|$	0.0	0.0
	$\|E\| = \|V\|^2$	0.0	0.0

IV. Conclusion

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References

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