CS 382
Fall 2023

Computer Architecture
and Organization

Lab 9 Report

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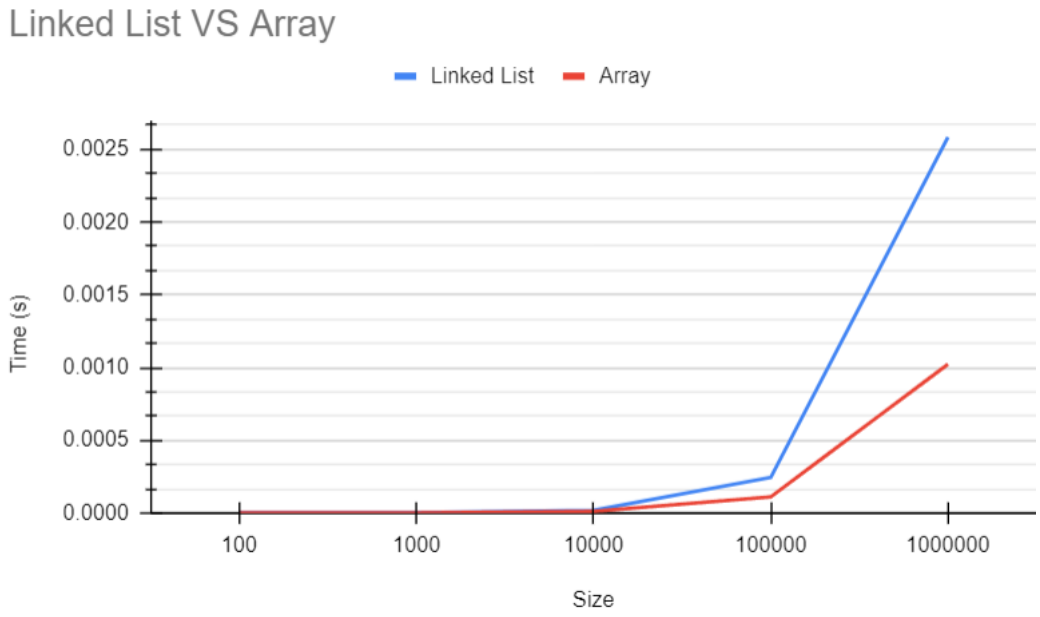
Collaborator	
Pledge	I pledge my honor that I have abided by the stevens honors system.

1 Task 1: Profiling a Linked List and an Array

Please present your experiment record below: either a graph or a chart.

Size	Linked List	Array
100	0.000002	0.000002
1000	0.000003	0.000002
10000	0.000019	0.000012
100000	0.000244	0.000111
1000000	0.002583	0.001023



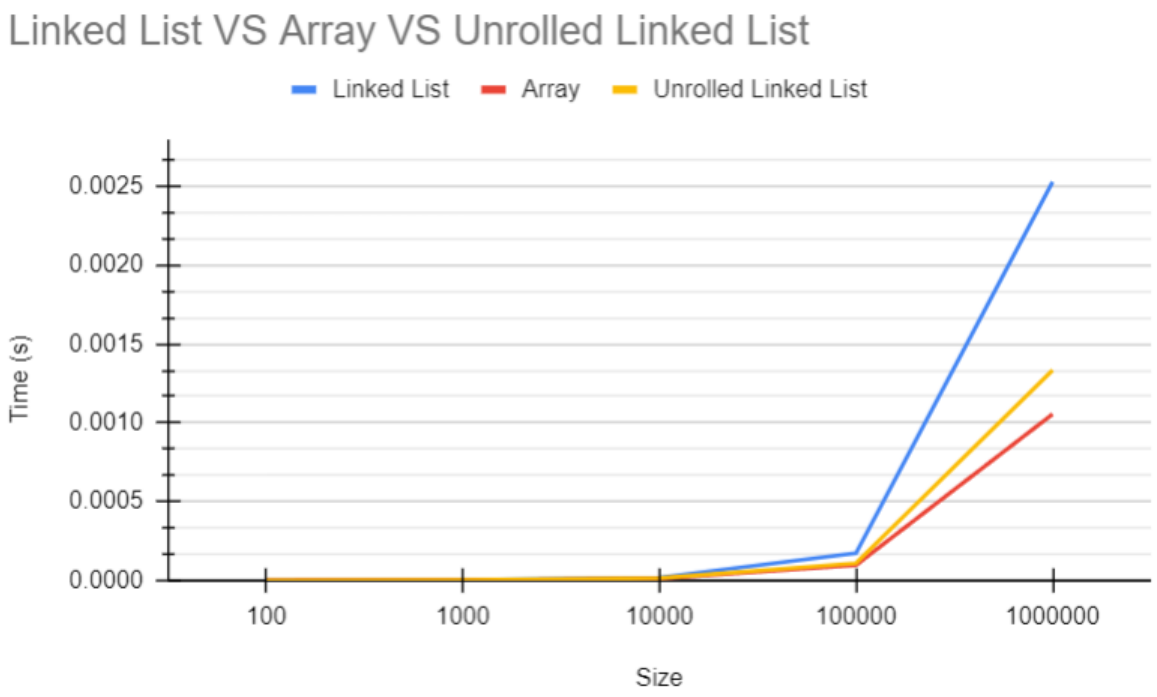
Please explain: why does the two algorithms with both $\mathcal{O}(n)$ complexity, have very different performance when n increases? You need to explain in detail from the perspective of **locality**.

The elements in a linked list are stored in a different memory location, and are only connected by pointers. This means that while we traverse through the linked list, cache misses will occur, and it will only get worse as the length of the list increases. As a result, this means that the locality of a linked list is very poor. The elements in an array on the other hand are stored in memory locations that are right next to each other. Compared to a linked list, less cache misses will occur in an array even as the length of the lists increases. The locality of an array is also much better when compared to a linked list. This means that when we traverse through both lists, we will traverse through an array faster due to its better locality and less cache misses.

2 Task 2: Locality Improved Linked List

Please present your experiment record below: either a graph or a chart.

Size	Linked List	Array	Unrolled Linked List
100	0.000001	0.000001	0.000001
1000	0.000003	0.000002	0.000002
10000	0.000018	0.000012	0.000014
100000	0.000173	0.000097	0.000109
1000000	0.002529	0.001055	0.001333



Please explain: what is the time complexity of unrolled linked list? How does a unrolled linked list improve the efficiency of traversal in terms of locality?

The time complexity of an unrolled linked list is O(n). The traversal efficiency is improved in an unrolled linked list compared to a regular linked list due to its use of arrays. An unrolled linked list uses less pointers and has less memory scattered, as most of its memory would be stored adjacent to each other due to the use of arrays in each node. This also means that there will be less cache misses and better locality when compared to a regular linked list, so if we traverse through an unrolled linked list, we would have done it faster than a regular linked list.

The End 🖐