CSE 3500
Homework 2
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Merge k Sorted Lists

```python
import heapq

#takes arguement of k_lists, which is a list which contains k amount of lists
def merge_k_lists(k_lists):
    minheap = []
    heapq.heapify(minheap)

    #runs in O(nlogk) time, where n is the total amount of elements
    for k in k_lists:
        #adds every item in each sublist to a heap
        for n in k:
            #runs in O(logk) time
            heapq.heappush(minheap,n)

    newlist = []

    #pops every item from the minheap: runs in O(n) time
    while minheap:
        newlist.append(heapq.heappop(minheap))

    return newlist
```

Above is an algorithm written in python that merges k lists using a heap. The code runs in O(nlogk) time, where n is the total number of items in k_lists, and where k is the number of lists. We can see that pushing to the heap takes O(nlogk) operations, as it takes O(logk) operations to push to the heap, over n iterations. Popping from the heap and appending to a new list only takes O(n) operations.

Run-time analysis

Device Specs/Language

Language:

Computer:

Inspiron 7590 2n1

CPU:

CPU Intel(R) Core(TM) i7-8565U CPU @ 1.80GHz

Memory:

Memory 16.0 GB

Algorithm Comparison

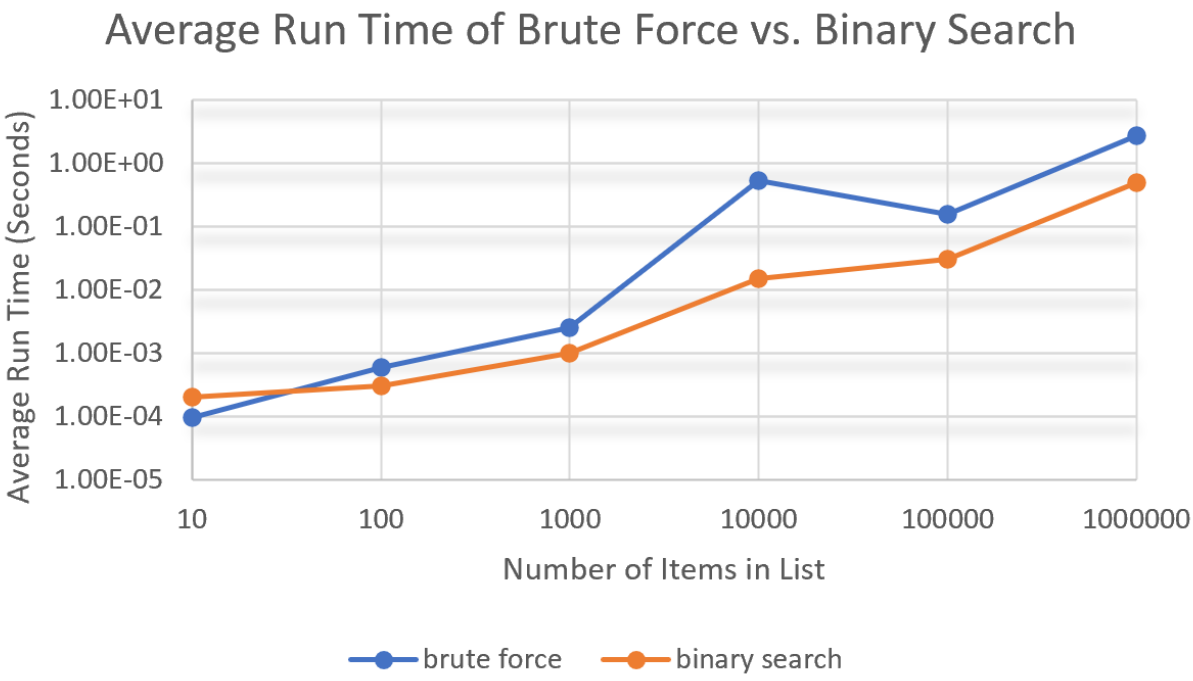
Table:

Average run time of both algorithms

Size of list	brute force	binary search
10	9.68E-05	0.00019968
100	0.0005943	0.00029833

1000	**0.0024897**	**0.0009975**
10000	**0.5319317**	**0.01485856**
100000	**0.1558083**	**0.03059528**
1000000	**2.7116085**	**0.492155**

Note: All the values in the brute force and binary search columns are in seconds.



Note: Both axes are logarithmic

Conclusion

From the results above, it is clear that for large data sets, the binary search method is faster, by over 5 times in some trial runs! This is because the brute force method runs in O(n^2) time, while the binary search method runs in only O(nlogn) time. Choice of algorithm matters because by choosing a faster algorithm, we can save tremendous amounts of computing power and time, as was shown in this assignment.

Code

Attached in the homework submission is the python file that contains my code.