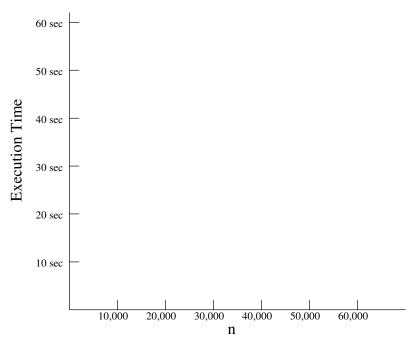
1. Draw the graph for sumList (O(n)) and someLoops  $(O(n^2))$  from the previous lecture.



2. Consider the following sumSomeListItems function.

```
import time
def main():
    n = eval(input("Enter size of list: "))
    aList = list(range(1, n+1))
    start = time.clock()
    sum = sumSomeListItems(aList)
    end = time.clock()
    print("Time to sum the list was %.9f seconds" % (end-start))
def sumSomeListItems(myList):
    """Returns the sum of some items in myList"""
    total = 0
    index = len(myList) - 1
    while index > 0:
        total = total + myList[index]
        index = index // 2
    return total
main()
```

- a) What is the problem size of sumSomeListItems?
- b) If we input n of 10,000 and sumSomeListItems takes 10 seconds, how long would you expect sumSomeListItems to take for n of 20,000?

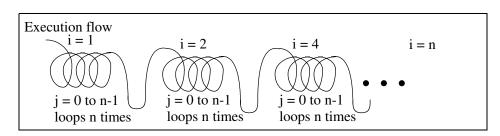
(Hint: For n of 20,000, how many more times would the loop execute than for n of 10,000?)

- c) What is the big-oh notation for sumSomeListItems?
- d) Add the execution-time graph for sumSomeListItems to the graph.

Lecture 3

Name:\_\_\_\_\_

```
3.
i = 1
while i <= n:
    for j in range(n):
        # something of O(1)
    # end for
    i = i * 2
# end while</pre>
```

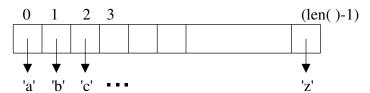


- a) Analyze the above algorithm to determine its big-oh notation, O().
- b) If n of 10,000, takes 10 seconds, how long would you expect the above code to take for n of 20,000?

- c) Add the execution-time graph for the above code to the graph.
- 4. Most programming languages have a built-in array data structure to store a collection of same-type items. Arrays are implemented in RAM memory as a contiguous block of memory locations. Consider an array X that contains the odd integers:

address	Memory	
4000	1	X[0]
4004	3	X[1]
4008	5	X[2]
4012	7	X[3]
4016	9	X[4]
4020	11	X[5]
4024	13	X[6]
•		

- a) Any array element can be accessed randomly by calculating its address. For example, address of X[5] = 4000 + 5 \* 4 = 4020. What is the general formula for calculating the address of the ith element in an array?
- b) What is the big-oh notation for accessing the ith element?
- c) A Python list uses an array of references (pointers) to list items in their implementation of a list. For example, a list of strings containing the alphabet:



Since a Python list can contain heterogeneous data, how does storing references in the list aid implementation?

Data Structures (C	CS 1520)	)
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5. Arrays in most HLLs are static in size (i.e., cannot grow at run-time), so arrays are constructed to hold the "maximum" number of items. For example, an array with 1,000 slots might only contain 3 items:

			0	1	2	3		999
size:	3	scores:	20	10	30			

- a) The *physical size* of the array is the number of slots in the array. What is the physical size of scores?
- b) The *logical size* of the array is the number of items actually in the array. What is the logical size of scores?
- c) The *load factor* is faction of the array being used. What is the load factor of scores?
- d) What is the O() for "appending" a new score to the "right end" of the array?
- e) What is the O() for adding a new score to the "left end" of the array?
- f) What is the *average* O() for adding a new score to the array?
- g) During run-time if an array fills up and we want to add another item, the program can usually:
  - Create a bigger array than the one that filled up
  - Copy all the items from the old array to the bigger array
  - Add the new item
  - Delete the smaller array to free up its memory

When creating the bigger array, how much bigger than the old array should it be?

- h) What is the O() of moving to a larger array?
- 6. Consider the following list methods in Python:

Method	Usage	Average $O()$ for myList containing n items
indox []	<pre>itemValue = myList[i]</pre>	
index []	<pre>myList[i] = newValue</pre>	
append	myList.append(item)	
extend	<pre>myList.extend(otherList)</pre>	
insert	<pre>myList.insert(i, item)</pre>	
pop	<pre>myList.pop( )</pre>	
pop(i)	myList.pop(i)	
del	del myList[i]	
remove	myList.remove(item)	
index	myList.index(item)	
iteration	for item in myList:	
reverse	<pre>myList.reverse( )</pre>	

**Dictionary Operations:** 

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Method	Usage	Explanation	Average $O()$ for n keys
get item	<pre>myDictionary.get(myKey) value = myDictionary[myKey]</pre>	Returns the value associated with myKey; otherwise <i>None</i>	O(1)
set item	myDictionary[myKey]=value	Change or add myKey:value pair	<i>O</i> (1)
in	myKey in myDictionary	Returns True if myKey is in myDictionary; otherwise False	O(1)
del	del myDictionary[myKey]	Deletes the mykey:value pair	O(1)