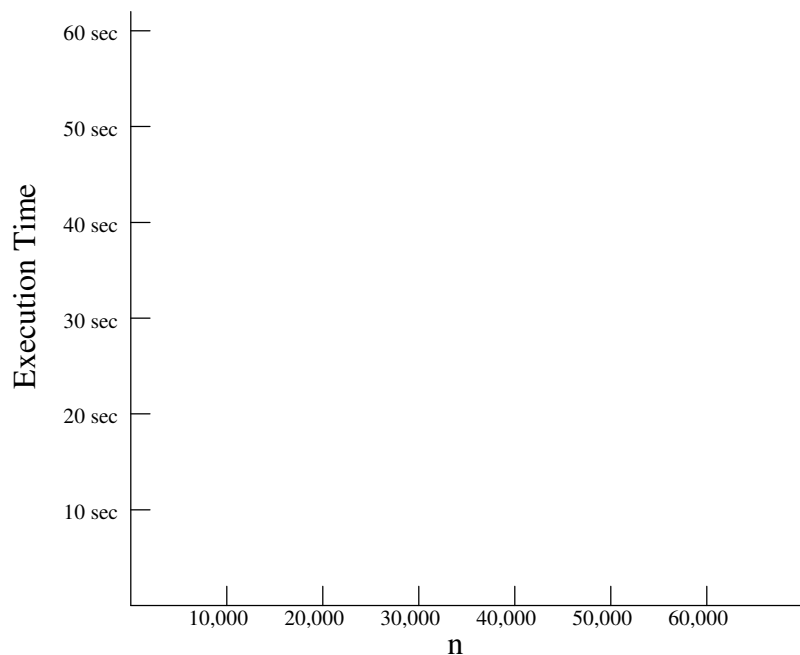


1. Draw the graph for `sumList` ( $O(n)$ ) and `someLoops` ( $O(n^2)$ ) from the previous lecture.



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?

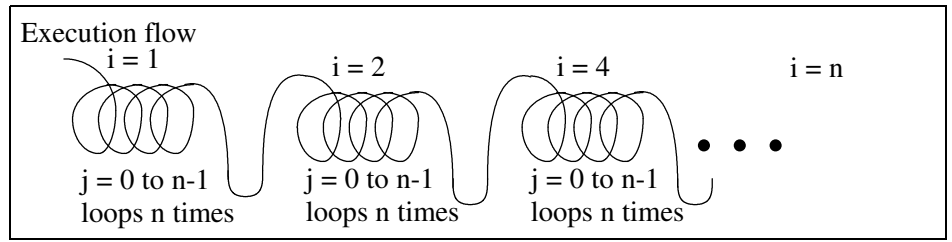
(Hint: For `n` of 20,000, how many more times would the loop execute than for `n` of 10,000?)

c) What is the big-oh notation for `sumSomeListItems`?

d) Add the execution-time graph for `sumSomeListItems` to the graph.

```

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



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.

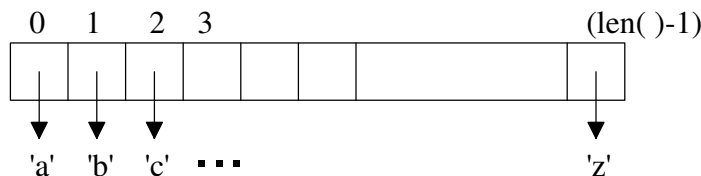
4. Most programming languages have a built-in array data structure to store a collection of same-type items. Arrays are implemented in RAM memory as a contiguous block of memory locations. Consider an array  $X$  that contains the odd integers:

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  $i$ th element in an array?

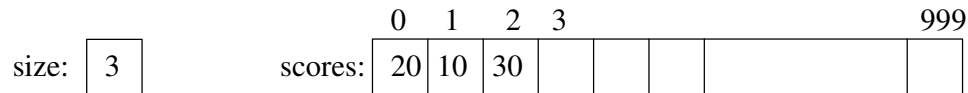
b) What is the big-oh notation for accessing the  $i$ th element?

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?

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:



- 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 fraction 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
index []	itemValue = myList[i]	
	myList[i] = newValue	
append	myList.append(item)	
extend	myList.extend(otherList)	
insert	myList.insert(i, item)	
pop	myList.pop( )	
pop(i)	myList.pop(i)	
del	del myList[i]	
remove	myList.remove(item)	
index	myList.index(item)	
iteration	for item in myList:	
reverse	myList.reverse( )	

Dictionary Operations:

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