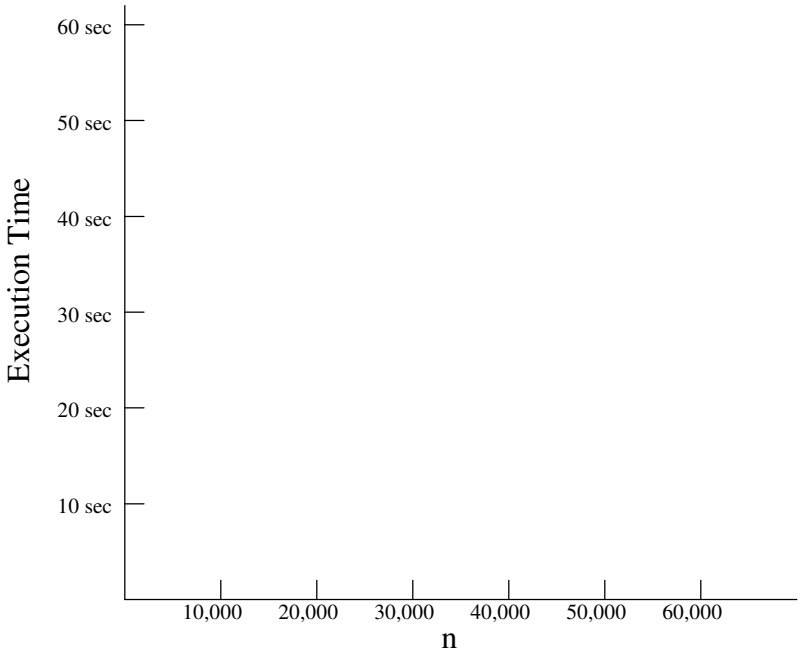
1. Draw the graph for `sumList` ($O(n)$) and `someLoops` ($O(n^2)$) from the previous lecture.



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?

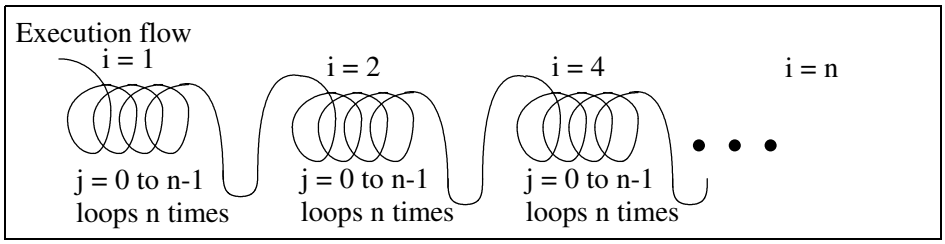
(Hint: For n of 20,000, how many more times would the loop execute than for n of 10,000?)

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.

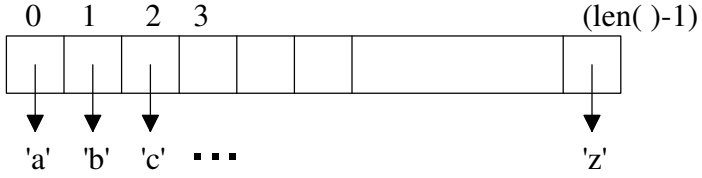
4. Most programming languages have a built-in array data structure to store a collection of same-type items. Arrays are implemented in RAM memory as a contiguous block of memory locations. Consider an array X that contains the odd integers:

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 ith element in an array?

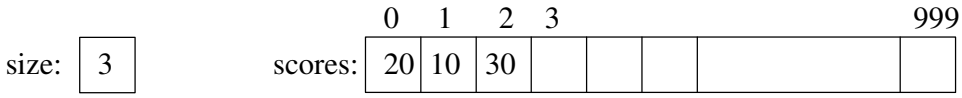
b) What is the big-oh notation for accessing the ith element?

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?

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 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
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 *None*	*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)