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Homework 1

1. Insertion sort runs in steps, while merge sort runs in steps. For what values of n does insertion sort run faster than merge sort?

Insertion sort will run faster than merge sort so long as n is less than or equal to 43

1. The following are the relationships (while dismissing most of the constants):
   1. f(n) = (g(n))
   2. f(n) = (g(n))
   3. f(n) = O(g(n)), logs are all the treated the same
   4. f(n) = (g(n))
   5. f(n) = (g(n))
   6. f(n) = (g(n))
   7. f(n) = (g(n))
   8. f(n) = O(g(n))
   9. f(n) = O(g(n))
   10. f(n) = (g(n))
2. Prove or disprove each of the following conjectures:
   1. If (n) = O(g(n)) and (n) = O(g(n)) then (n) = ((n))

f1 = O(g(n)) and f2 = O(g(n)) both indicate a upper bound while (g(n)) indicates a tighter bound between two constants. An example is f1 = n^2 + n and f2 = n^. They will have the same O(n^2) upper bound but their constants and lower order terms are different. Therefore (n) ((n))

* 1. (n) and (n) thus,

As stated in the asymptotic notation, Big Oh O notation asymptotic is “less than”

1. Submitted via TEACH
2. Modify the insertsort.py and mergesort.py so that it can record the runtime of the algorithm and also generate random integer arrays (with values between 0 and 10,000) of n size. Below are the results:
   1. Below are excerpts of the modifications performed to the system

Modfications to Insertion Sort program (the algorithm stayed the same):

def main():

randomIntArray = []

# what will be the size of the array, this will contain the values 1000, 2000, 5000, and 10,000

n = 10000

while len(randomIntArray) < n:

randomIntArray.append(randint(0, 10000))

# will start the timer now that we are about to enter the insertion sort algorithm/function

start\_time = time.time()

#insertion sort algorithm

newArray = insert\_sort(randomIntArray)

# to identify how many seconds have passed we substract from the

# current time the start time

print("--- Algorithm took %s seconds --- " % (time.time() - start\_time))

# print newArray

main()

#----------------------------------------------------------------------------------------------

Modifications to the Mergesort program (the algorithm stayed the same):

def main():

randomIntArray = []

# what will be the size of the array, this will contain the values 1000, 2000, 5000, and 10,000

n = 10000

while len(randomIntArray) < n:

randomIntArray.append(randint(0, 10000))

# will start the timer now that we are about to enter the insertion sort algorithm/function

start\_time = time.time()

#insertion sort algorithm

newArray = merge\_sort(randomIntArray)

# to identify how many seconds have passed we substract from the

# current time the start time

print("--- Algorithm took %s seconds --- " % (time.time() - start\_time))

print newArray

main()

* 1. Included code to time within the system clock to determine the runtime in seconds. See code above. Used the time.time() function in python.

Below is a table which shows the results of our run times:



* 1. Below are graphs in which the points are plotted on a x-axis and y-axis.

In reviewing the graphs, I can see that insertion sort algorithm is a polynomial algorithm vs. the merge sort which appears more linear. Clearly the merge sort algorithm out performed the insertion sort algorithm. Also, as expected, merge sort performed better than insertion sort when the value of n grew larger.