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Modul 6 : Pengurutan lanjutan

1. Ubahlah kode mergeSort dan quickSort diatas agar bisa mengurutkan list yang berisi object-object mhsTIF yang sudah dibuat di Modul 2.

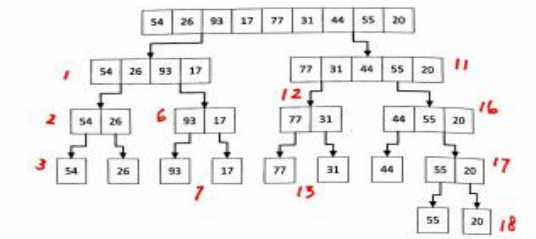
```
# No 1
print('No 1')
class MhsTIF(object):
    def __init__(self, nama, NIM, kotaTinggal, us):
        self.nama = nama
        self.NIM = NIM
        self.kotaTinggal = kotaTinggal
        self.uangSaku = us

a0 = MhsTIF('Bintang', 193, 'Purwodadi', 240000)
a1 = MhsTIF('Ainin', 195, 'Pati', 230000)
a2 = MhsTIF('Danang', 204, 'Sragen', 250000)
a3 = MhsTIF('Cecyl', 210, 'Surakarta', 235000)
a4 = MhsTIF('Alfian', 194, 'Semarang', 240000)
a5 = MhsTIF('Aviza', 187, 'Madiun', 250000)
a6 = MhsTIF('Baity', 211, 'Klaten', 245000)
a7 = MhsTIF('Ulin', 190, 'Madiun', 245000)
a8 = MhsTIF('Viola', 173, 'Boyolali', 245000)
a9 = MhsTIF('Riska', 192, 'Rembang', 270000)
a10 = MhsTIF('Fatwa', 179, 'Boyolali', 230000)
a11 = MhsTIF('Sekar', 188, 'Sulawesi', 300000)

Daftar = [a0.NIM, a1.NIM, a2.NIM, a3.NIM, a4.NIM, a5.NIM
          , a6.NIM, a7.NIM, a8.NIM, a9.NIM, a10.NIM, a11.NIM]

def mergeSort(nlist):
    print("Membelah ", nlist)
    if len(nlist)>1:
        mid = len(nlist)//2
        lefthalf = nlist[:mid]
        righthalf = nlist[mid:]

        mergeSort(lefthalf)
        mergeSort(righthalf)
        i=j=k=0
        while i < len(lefthalf) and j < len(righthalf):
            if lefthalf[i] < righthalf[j]:
                nlist[k]=lefthalf[i]
                i=i+1
```

```
            else:
                nlist[k]=righthalf[j]
                j=j+1
            k=k+1

        while i < len(lefthalf):
            nlist[k]=lefthalf[i]
            i=i+1
            k=k+1

        while j < len(righthalf):
            nlist[k]=righthalf[j]
            j=j+1
            k=k+1
    print("Menggabungkan ",nlist)
nlist = Daftar
print("Hasil MergeSort")
mergeSort(nlist)
print(nlist)

def quickSort(data_list):
   quickSortHlp(data_list,0,len(data_list)-1)

def quickSortHlp(data_list,first,last):
   if first < last:

       splitpoint = partition(data_list,first,last)

       quickSortHlp(data_list,first,splitpoint-1)
       quickSortHlp(data_list,splitpoint+1,last)


def partition(data_list,first,last):
   pivotvalue = data_list[first]

   leftmark = first+1
   rightmark = last

   done = False
   while not done:
       while leftmark <= rightmark and data_list[leftmark] <= pivotvalue:
           leftmark = leftmark + 1

       while data_list[rightmark] >= pivotvalue and rightmark >= leftmark:
           rightmark = rightmark -1

       if rightmark < leftmark:
           done = True
       else:
           temp = data_list[leftmark]
           data_list[leftmark] = data_list[rightmark]
           data_list[rightmark] = temp

   temp = data_list[first]
   data_list[first] = data_list[rightmark]
   data_list[rightmark] = temp


   return rightmark

data_list = Daftar
quickSort(data_list)
print("\n"+"Hasil QuickSort")
print(data_list)
```

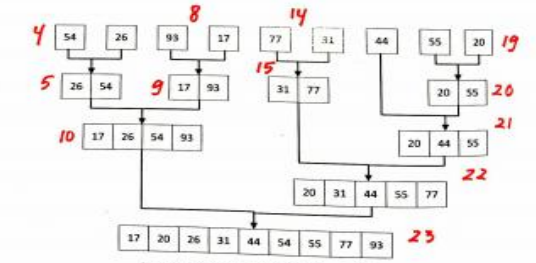
Hasil Run :

```
 RESTART: E:\Materi Kuliah\Semester 4\Praktikum Algoritma dan Struktur Data\Modu
l6.py
No 1
Hasil MergeSort
Membelah  [193, 195, 204, 210, 194, 187, 211, 190, 173, 192, 179, 188]
Membelah  [193, 195, 204, 210, 194, 187]
Membelah  [193, 195, 204]
Membelah  [193]
Menggabungkan  [193]
Membelah  [195, 204]
Membelah  [195]
Menggabungkan  [195]
Membelah  [204]
Menggabungkan  [204]
Menggabungkan  [195, 204]
Menggabungkan  [193, 195, 204]
Membelah  [210, 194, 187]
Membelah  [210]
Menggabungkan  [210]
Membelah  [194, 187]
Membelah  [194]
Menggabungkan  [194]
Membelah  [187]
Menggabungkan  [187]
Menggabungkan  [187, 194]
Menggabungkan  [187, 194, 210]
Menggabungkan  [187, 193, 194, 195, 204, 210]
Membelah  [211, 190, 173, 192, 179, 188]
Membelah  [211, 190, 173]
Membelah  [211]
Menggabungkan  [211]
Membelah  [190, 173]
Membelah  [190]
Menggabungkan  [190]
Membelah  [173]
Menggabungkan  [173]
Menggabungkan  [173, 190]
Menggabungkan  [173, 190, 211]
Membelah  [192, 179, 188]
Membelah  [192]
Menggabungkan  [192]
Membelah  [179, 188]
Membelah  [179]
Menggabungkan  [179]
Membelah  [188]
Menggabungkan  [188]
Menggabungkan  [179, 188]
Menggabungkan  [179, 188, 192]
Menggabungkan  [173, 179, 188, 190, 192, 211]
Menggabungkan  [173, 179, 187, 188, 190, 192, 193, 194, 195, 204, 210, 211]
[173, 179, 187, 188, 190, 192, 193, 194, 195, 204, 210, 211]

Hasil QuickSort
[173, 179, 187, 188, 190, 192, 193, 194, 195, 204, 210, 211]
```

2. Memakai bolpoin merah atau biru, tandai dan beri nomor urut eksekusi proses pada Gambar 6.1 dan 6.2, dengan mengacu pada output halaman 59.



Gambar 6.1: Membelah list sampai tiap sub-list berisi satu elemen atau kosong. Sesudah itu digabung seperti ditunjukkan di Gambar 6.2.



Gambar 6.2: Menggabungkan list satu demi satu.

3. Uji kecepata. Ujilah mergeSort dan quickSort diatas (bersama metode sort yang kamu pelajari sebelumnya) dengan kode berikut

```
# No 3
print('\nNo 3')
from time import time as detak
from random import shuffle as kocok
import time
k = [i for i in range(1,6001)]
kocok(k)

def bubb(arr):
    n = len(arr)
    for i in range(n):
        for j in range(0, n-i-1):
            if arr[j] > arr[j+1] :
                arr[j], arr[j+1] = arr[j+1], arr[j]

def sele(A):
    for i in range(len(A)):
        min_idx = i
        for j in range(i+1, len(A)):
            if A[min_idx] > A[j]:
                min_idx = j
        A[i], A[min_idx] = A[min_idx], A[i]

def inse(arr):
    for i in range(1, len(arr)):
        key = arr[i]
        j = i-1
        while j >=0 and key < arr[j] :
                arr[j+1] = arr[j]
                j -= 1
        arr[j+1] = key
def mergeSort(arr):
    if len(arr) >1:
        mid = len(arr)//2
        L = arr[:mid]
        R = arr[mid:]
        mergeSort(L)
        mergeSort(R)
        i = j = k = 0
        while i < len(L) and j < len(R):
            if L[i] < R[j]:
                arr[k] = L[i]
                i+=1
            else:
                arr[k] = R[j]
                j+=1
            k+=1
        while i < len(L):
            arr[k] = L[i]
            i+=1
            k+=1
        while j < len(R):
            arr[k] = R[j]
            j+=1
            k+=1
def partition(arr,low,high):
    i = ( low-1 )
    pivot = arr[high]
    for j in range(low , high):
        if   arr[j] <= pivot:
            i = i+1
            arr[i],arr[j] = arr[j],arr[i]
    arr[i+1],arr[high] = arr[high],arr[i+1]
    return ( i+1 )

def quickSort(arr,low,high):
    if low < high:
        pi = partition(arr,low,high)
        quickSort(arr, low, pi-1)
        quickSort(arr, pi+1, high)


bub = k[:]
sel = k[:]
ins = k[:]
mer = k[:]
qui = k[:]
```

```
aw=detak();bubb(bub);ak=detak();print('bubble : %g detik' %(ak-aw));
aw=detak();sele(sel);ak=detak();print('selection : %g detik' %(ak-aw));
aw=detak();inse(ins);ak=detak();print('insertion : %g detik' %(ak-aw));
aw=detak();mergeSort(mer);ak=detak();print('merge : %g detik' %(ak-aw));
aw=detak();quickSort(qui,0,len(qui)-1);ak=detak();print('quick : %g detik' %(ak-aw));
```

Hasil Run :

```
No 3
bubble : 7.79517 detik
selection : 2.95743 detik
insertion : 3.93923 detik
merge : 0.0733578 detik
quick : 0.023638 detik
```

4. Diberikan list L = [80, 7, 24, 16, 43, 91, 35, 2, 19, 72], gambarlah trace pengurutan untuk algoritma.

a) Merge sort

L = [80, 7, 24, 16, 43, 91, 35, 2, 19, 72]

80	7	24	16	43	91	35	2	19	72

Proses 1

7	80		26	24		43	91		2	35		19	72

Proses 2

7	16	24	80		2	35	43	91		19	72

Proses 3

2	7	16	24	35	43	80	91		19	72

Proses 4

2	7	16	19	24	35	43	72	80	91

b) Quick sort

L = [80, 7, 24, 16, 43, 91, 35, 2, 19, 72]

80	7	24	16	43	91	35	2	19	72

Pivot

80	7	24	16	43	91	35	2	19	72

Low High

Pivot

72	7	24	16	43	91	35	2	19	80

Low High

Pivot

72	7	24	16	43	91	35	2	19	80

Low High

Pivot

72	7	24	16	43	80	35	2	19	91

Low High

								Pivot	
72	7	24	16	43	19	35	2	80	91
					Low			High	

Pivot									
72	7	24	16	43	19	35	2	80	91
Low							High		

							Pivot		
2	7	24	16	43	19	35	72	80	91
Low							High		

Pivot									
2	7	24	16	43	19	35	72	80	91
Low						High			

	Pivot								
2	7	24	16	43	19	35	72	80	91
	Low					High			

		Pivot							
2	7	24	16	43	19	35	72	80	91
		Low				High			

		Pivot							
2	7	24	16	43	19	35	72	80	91
		Low			High				

					Pivot				
2	7	19	16	43	24	35	72	80	91
		Low			High				

					Pivot				
2	7	19	16	43	24	35	72	80	91
				Low	High				

				Pivot					
2	7	19	16	24	43	35	72	80	91
				Low	High				

		Pivot							
2	7	19	16	24	43	35	72	80	91
		Low	High						

			Pivot						
2	7	16	19	24	43	35	72	80	91
		Low	High						

					Pivot				
2	7	16	19	24	43	35	72	80	91
					Low	High			

						Pivot			
2	7	16	19	24	35	43	72	80	91
					Low	High			

2	7	16	19	24	35	43	72	80	91

5. Tingkatkan efisiensi program mergeSort dengan tidak memakai operator slice (seperti A[:mid] dan A[mid:]), dan lalu mem-puss index awal dan index akhir bersama listnyabsaat kita memanggil mergeSort secara rekursif. Kamu akan perlu memisah fungsi mergeSort itu menjadi beberapa fungsi, mirip halnya dengan apa yang dilakukan algoritma quick sort

```
# No 5
print ('\nNo 5')
import random
def _merge_sort(indices, the_list):
    start = indices[0]
    end = indices[1]
    half_way = (end - start)//2 + start
    if start < half_way:
        _merge_sort((start, half_way), the_list)
    if half_way + 1 <= end and end - start != 1:
       _merge_sort((half_way + 1, end), the_list)

    sort_sub_list(the_list, indices[0], indices[1])
    return the_list


def sort_sub_list(the_list, start, end):
    orig_start = start
    initial_start_second_list = (end - start)//2 + start + 1
    list2_first_index = initial_start_second_list
    new_list = []
    while start < initial_start_second_list and list2_first_index <= end:
        first1 = the_list[start]
        first2 = the_list[list2_first_index]
        if first1 > first2:
            new_list.append(first2)
            list2_first_index += 1
        else:
            new_list.append(first1)
            start += 1
    while start < initial_start_second_list:
        new_list.append(the_list[start])
        start += 1

    while list2_first_index <= end:
        new_list.append(the_list[list2_first_index])
        list2_first_index += 1
    for i in new_list:
        the_list[orig_start] = i
        orig_start += 1
        orig_start += 1
    return the_list


def merge_sort(the_list):
    return _merge_sort((0, len(the_list) - 1), the_list)

print(merge_sort([13,45,12,3,10,2]))
```

Hasil Run :

```
No 5
[2, 3, 10, 12, 13, 45]
```

6. Apakah kita bisa meningkatkan efisiensi program quickSort dengan memakai metode median-dari-tiga untuk memilih pivotnya? Ubahlah kodenya dan ujilah

```
# No 6
print ('\nNo 6')
def quickSort(L, ascending = True):
    quicksorthelp(L, 0, len(L), ascending)

def quicksorthelp(L, low, high, ascending = True):
    result = 0
    if low < high:
        pivot_location, result = Partition(L, low, high, ascending)
        result += quicksorthelp(L, low, pivot_location, ascending)
        result += quicksorthelp(L, pivot_location + 1, high, ascending)
    return result


def Partition(L, low, high, ascending = True):
    result = 0
    pivot, pidx = median_of_three(L, low, high)
    L[low], L[pidx] = L[pidx], L[low]
    i = low + 1
    for j in range(low+1, high, 1):
        result += 1
        if (ascending and L[j] < pivot) or (not ascending and L[j] > pivot):
            L[i], L[j] = L[j], L[i]
            i += 1
    L[low], L[i-1] = L[i-1], L[low]
    return i - 1, result

def median_of_three(L, low, high):
    mid = (low+high-1)//2
    a = L[low]
    b = L[mid]
    c = L[high-1]
    if a <= b <= c:
        return b, mid
    if c <= b <= a:
        return b, mid
    if a <= c <= b:
        return c, high-1
    if b <= c <= a:
        return c, high-1
    return a, low

listel = list([14,4,2,104,23,50])

quickSort(listel, False)  # descending order
print('sorted:')
print(listel)
```

Hasil Run :

```
No 6
sorted:
[104, 50, 23, 14, 4, 2]
```

7. Uji kecepatan keduanya dan perbandingkan juga dengan kode awalnya

```
# NO 7
print ('\nNo 7')
from time import time as detak
from random import shuffle as kocok
import time
k = [i for i in range(1,6001)]
kocok(k)

def mergeSort(arr):
    if len(arr) >1:
        mid = len(arr)//2
        L = arr[:mid]
        R = arr[mid:]
        mergeSort(L)
        mergeSort(R)
        i = j = k = 0
        while i < len(L) and j < len(R):
            if L[i] < R[j]:
                arr[k] = L[i]
                i+=1
            else:
                arr[k] = R[j]
                j+=1
            k+=1
        while i < len(L):
            arr[k] = L[i]
            i+=1
            k+=1
        while j < len(R):
            arr[k] = R[j]
            j+=1
            k+=1
def partition(arr,low,high):
    i = ( low-1 )
    pivot = arr[high]
    for j in range(low , high):
        if   arr[j] <= pivot:
            i = i+1
            arr[i],arr[j] = arr[j],arr[i]
    arr[i+1],arr[high] = arr[high],arr[i+1]
    return ( i+1 )

def quickSort(arr,low,high):
    if low < high:
        pi = partition(arr,low,high)
        quickSort(arr, low, pi-1)
        quickSort(arr, pi+1, high)

import random
def _merge_sort(indices, the_list):
    start = indices[0]
    end = indices[1]
    half_way = (end - start)//2 + start
    if start < half_way:
        _merge_sort((start, half_way), the_list)
    if half_way + 1 <= end and end - start != 1:
       _merge_sort((half_way + 1, end), the_list)

    sort_sub_list(the_list, indices[0], indices[1])



def sort_sub_list(the_list, start, end):
    orig_start = start
    initial_start_second_list = (end - start)//2 + start + 1
    list2_first_index = initial_start_second_list
    new_list = []
    while start < initial_start_second_list and list2_first_index <= end:
        first1 = the_list[start]
        first2 = the_list[list2_first_index]
        if first1 > first2:
            new_list.append(first2)
            list2_first_index += 1
        else:
            new_list.append(first1)
            start += 1
    while start < initial_start_second_list:
        new_list.append(the_list[start])
        start += 1
```

```
    while list2_first_index <= end:
        new_list.append(the_list[list2_first_index])
        list2_first_index += 1
    for i in new_list:
        the_list[orig_start] = i
        orig_start += 1


def merge_sort(the_list):
    return _merge_sort((0, len(the_list) - 1), the_list)

def quickSortMOD(L, ascending = True):
    quicksorthelp(L, 0, len(L), ascending)

def quicksorthelp(L, low, high, ascending = True):
    result = 0
    if low < high:
        pivot_location, result = Partition(L, low, high, ascending)
        result += quicksorthelp(L, low, pivot_location, ascending)
        result += quicksorthelp(L, pivot_location + 1, high, ascending)
    return result


def Partition(L, low, high, ascending = True):
    result = 0
    pivot, pidx = median_of_three(L, low, high)
    L[low], L[pidx] = L[pidx], L[low]
    i = low + 1
    for j in range(low+1, high, 1):
        result += 1
        if (ascending and L[j] < pivot) or (not ascending and L[j] > pivot):
            L[i], L[j] = L[j], L[i]
            i += 1
    L[low], L[i-1] = L[i-1], L[low]
    return i - 1, result

def median_of_three(L, low, high):
    mid = (low+high-1)//2
    a = L[low]
    b = L[mid]
    c = L[high-1]
    if a <= b <= c:
        return b, mid
    if c <= b <= a:
        return b, mid
    if a <= c <= b:
        return c, high-1
    if b <= c <= a:
        return c, high-1
    return a, low
mer = k[:]
qui = k[:]
mer2 = k[:]
qui2 = k[:]


aw=detak();mergeSort(mer);ak=detak();print('merge : %g detik' %(ak-aw));
aw=detak();quickSort(qui,0,len(qui)-1);ak=detak();print('quick : %g detik' %(ak-aw));
aw=detak();merge_sort(mer2);print('merge mod : %g detik' %(ak-aw));
aw=detak();quickSortMOD(qui2, False);print('quick mod : %g detik' %(ak-aw));
```

Hasil Run :

```
No 7
merge : 0.0802112 detik
quick : 0.0238872 detik
merge mod : -0.0224972 detik
quick mod : -0.14111 detik
```

8. Buatlah versi linked-list untuk program mergeSort diatas

```
# No 8
print ('\nNo 8')
class Node:
  def __init__(self, data):
    self.data = data
    self.next = None

class LinkedList:
  def __init__(self):
    self.head = None

  def appendList(self, data):
    node = Node(data)
    if self.head == None:
      self.head = node
    else:
      curr = self.head
      while curr.next != None:
        curr = curr.next
    curr.next = node

  def appendSorted(self, data):
    node = Node(data)
    curr = self.head
    prev = None

    while curr is not None and curr.data < data:
      prev = curr
      curr = curr.next

    if prev == None:
      self.head = node
    else:
      prev.next = node

    node.next = curr

  def printList(self):
    curr = self.head
    while curr != None:
      print ("%d"%curr.data),
      curr = curr.next
  def mergeSorted(self, list1, list2):
    if list1 is None:
      return list2
    if list2 is None:
      return list1

    if list1.data < list2.data:
      temp = list1
      temp.next = self.mergeSorted(list1.next, list2)
    else:
      temp = list2
      temp.next = self.mergeSorted(list1, list2.next)
    return temp


list1 = LinkedList()
list1.appendSorted(13)
list1.appendSorted(12)
list1.appendSorted(3)
list1.appendSorted(16)
list1.appendSorted(7)

print("List 1 :"),
list1.printList()
list2 = LinkedList()
list2.appendSorted(9)
list2.appendSorted(10)
list2.appendSorted(1)

print("\nList 2 :"),
list2.printList()
list3 = LinkedList()
list3.head = list3.mergeSorted(list1.head, list2.head)

print("\nMerged List :"),
list3.printList()
```

Hasil Run :

```
No 8
List 1 :
3
7
12
13
16

List 2 :
1
9
10

Merged List :
1
3
7
9
10
12
13
16
>>>
```