```
def merge(a,b,arr):
    i=0
    j=0
    k=0

    while (i<len(a) and j<len(b)):
        if (a[i]<=b[j]):
            arr[k]=a[i]
            i+=1
        else:
            arr[k]=b[j]
            j+=1
        k+=1

    while (i<len(a)):
        arr[k]=a[i]
        i+=1
        k+=1

    while (j<len(b)):
        arr[k]=b[j]
        j+=1
        k+=1

def mergeSort(arr):
    if len(arr)<=1:
        return

    mid=len(arr)//2
    low=arr[:mid]
    high=arr[mid:]

    mergeSort(low)
    mergeSort(high)
    merge(low,high,arr)

import timeit
import matplotlib.pyplot as plt
import random as rn

runtime=[]
n=[5,10,20,50,100,500,1000,2000,3000,4000,5000,7000,10000]

arr=[]

for x in range (5):
    arr.append(rn.randint(0,100000))

print("Unsorted array is ", arr)
start=timeit.default_timer()
```

```
mergeSort(arr)
stop=timeit.default_timer()
print("Sorted array is ",arr)
print("Time taken to sort ",(stop) - (start))
runtime.append((stop) - (start))
```

```
Unsorted array is  [86852, 35464, 7463, 43497, 12644]
Sorted array is  [7463, 12644, 35464, 43497, 86852]
Time taken to sort  0.00010880000081670005
```

```
for x in range (10):
    arr.append(rn.randint(0,100000))

print("Unsorted array is ", arr)
start=timeit.default_timer()
mergeSort(arr)
stop=timeit.default_timer()
print("Sorted array is ",arr)
print("Time taken to sort ",(stop) - (start))
runtime.append((stop) - (start))
```

```
Unsorted array is  [7463, 12644, 35464, 43497, 86852, 6751, 25982,
16869, 73897, 72399, 97652, 90573, 50135, 13009, 89221]
Sorted array is  [6751, 7463, 12644, 13009, 16869, 25982, 35464,
43497, 50135, 72399, 73897, 86852, 89221, 90573, 97652]
Time taken to sort  9.239999963028822e-05
```

```
for x in range (20):
    arr.append(rn.randint(0,100000))

print("Unsorted array is ", arr)
start=timeit.default_timer()
mergeSort(arr)
stop=timeit.default_timer()
print("Sorted array is ",arr)
print("Time taken to sort ",(stop) - (start))
runtime.append((stop) - (start))
```

```
Unsorted array is  [6751, 7463, 12644, 13009, 16869, 25982, 35464,
43497, 50135, 72399, 73897, 86852, 89221, 90573, 97652, 41169, 70283,
56814, 83556, 38957, 23591, 86360, 71737, 26426, 4258, 90612, 12967,
39618, 96435, 32941, 41449, 16749, 51589, 66757, 20600]
Sorted array is  [4258, 6751, 7463, 12644, 12967, 13009, 16749, 16869,
20600, 23591, 25982, 26426, 32941, 35464, 38957, 39618, 41169, 41449,
43497, 50135, 51589, 56814, 66757, 70283, 71737, 72399, 73897, 83556,
86360, 86852, 89221, 90573, 90612, 96435, 97652]
Time taken to sort  0.0002770000010059448
```

```
for x in range (50):
    arr.append(rn.randint(0,100000))

print("Unsorted array is ", arr)
start=timeit.default_timer()
mergeSort(arr)
stop=timeit.default_timer()
print("Sorted array is ",arr)
print("Time taken to sort ",(stop) - (start))
runtime.append((stop) - (start))
```

```
Unsorted array is  [4258, 6751, 7463, 12644, 12967, 13009, 16749,
16869, 20600, 23591, 25982, 26426, 32941, 35464, 38957, 39618, 41169,
41449, 43497, 50135, 51589, 56814, 66757, 70283, 71737, 72399, 73897,
83556, 86360, 86852, 89221, 90573, 90612, 96435, 97652, 96689, 24937,
29831, 65869, 6571, 79835, 49156, 39045, 31435, 95595, 45700, 28638,
40547, 68267, 43402, 68985, 16265, 61372, 96735, 70818, 459, 81276,
34454, 96139, 50512, 99112, 62489, 77241, 61243, 94056, 72154, 55136,
64738, 59901, 62211, 16531, 53952, 56211, 35956, 71292, 95876, 31252,
58484, 12376, 79933, 86450, 31097, 99495, 47345, 92969]
Sorted array is  [459, 4258, 6571, 6751, 7463, 12376, 12644, 12967,
13009, 16265, 16531, 16749, 16869, 20600, 23591, 24937, 25982, 26426,
28638, 29831, 31097, 31252, 31435, 32941, 34454, 35464, 35956, 38957,
39045, 39618, 40547, 41169, 41449, 43402, 43497, 45700, 47345, 49156,
50135, 50512, 51589, 53952, 55136, 56211, 56814, 58484, 59901, 61243,
61372, 62211, 62489, 64738, 65869, 66757, 68267, 68985, 70283, 70818,
71292, 71737, 72154, 72399, 73897, 77241, 79835, 79933, 81276, 83556,
86360, 86450, 86852, 89221, 90573, 90612, 92969, 94056, 95595, 95876,
96139, 96435, 96689, 96735, 97652, 99112, 99495]
Time taken to sort  0.0005522999999811873
```

```
for x in range (100):
    arr.append(rn.randint(0,100000))

#print("Unsorted array is ", arr)
start=timeit.default_timer()
mergeSort(arr)
stop=timeit.default_timer()
#print("Sorted array is ",arr)
print("Time taken to sort ",(stop) - (start))
runtime.append((stop) - (start))
```

```
Time taken to sort  0.0012156000011600554
```

```
for x in range (500):
    arr.append(rn.randint(0,100000))

#print("Unsorted array is ", arr)
start=timeit.default_timer()
mergeSort(arr)
stop=timeit.default_timer()
```

```
#print("Sorted array is ",arr)
print("Time taken to sort ",(stop) - (start))
runtime.append((stop) - (start))
```

```
Time taken to sort  0.005301600000166218
```

```
for x in range (1000):
    arr.append(rn.randint(0,100000))

#print("Unsorted array is ", arr)
start=timeit.default_timer()
mergeSort(arr)
stop=timeit.default_timer()
#print("Sorted array is ",arr)
print("Time taken to sort ",(stop) - (start))
runtime.append((stop) - (start))
```

```
Time taken to sort  0.012655099999392405
```

```
for x in range (2000):
    arr.append(rn.randint(0,100000))

#print("Unsorted array is ", arr)
start=timeit.default_timer()
mergeSort(arr)
stop=timeit.default_timer()
#print("Sorted array is ",arr)
print("Time taken to sort ",(stop) - (start))
runtime.append((stop) - (start))
```

```
Time taken to sort  0.019549900000129128
```

```
for x in range (3000):
    arr.append(rn.randint(0,100000))

#print("Unsorted array is ", arr)
start=timeit.default_timer()
mergeSort(arr)
stop=timeit.default_timer()
#print("Sorted array is ",arr)
print("Time taken to sort ",(stop) - (start))
runtime.append((stop) - (start))
```

```
Time taken to sort  0.041886900000463356
```

```
for x in range (4000):
    arr.append(rn.randint(0,100000))

#print("Unsorted array is ", arr)
start=timeit.default_timer()
mergeSort(arr)
stop=timeit.default_timer()
```

```
#print("Sorted array is ",arr)
print("Time taken to sort ",(stop) - (start))
runtime.append((stop) - (start))
```

```
Time taken to sort  0.07178519999979471
```

```
for x in range (5000):
    arr.append(rn.randint(0,100000))

#print("Unsorted array is ", arr)
start=timeit.default_timer()
mergeSort(arr)
stop=timeit.default_timer()
#print("Sorted array is ",arr)
print("Time taken to sort ",(stop) - (start))
runtime.append((stop) - (start))
```

```
Time taken to sort  0.09421500000098604
```

```
for x in range (7000):
    arr.append(rn.randint(0,100000))

#print("Unsorted array is ", arr)
start=timeit.default_timer()
mergeSort(arr)
stop=timeit.default_timer()
#print("Sorted array is ",arr)
print("Time taken to sort ",(stop) - (start))
runtime.append((stop) - (start))
```

```
Time taken to sort  0.14673949999996694
```

```
for x in range (10000):
    arr.append(rn.randint(0,100000))

#print("Unsorted array is ", arr)
start=timeit.default_timer()
mergeSort(arr)
stop=timeit.default_timer()
#print("Sorted array is ",arr)
print("Time taken to sort ",(stop) - (start))
runtime.append((stop) - (start))
```

```
Time taken to sort  0.21694829999978538
```

Graphical representation of run time

```
plt.scatter(n,runtime)

plt.show
```

```
<function matplotlib.pyplot.show(close=None, block=None)>
```