

```

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

n=[5,10,20,50,100,500,1000,5000,10000]

swapInsertion=[]
compareInsertion=[]
swapSelection=[]
compareSelection=[]
swapBubble=[]
compareBubble=[]

arr=[]
arr1=[]
arr2=[]
arr3=[]
a=0
a1=0

for a in range(5):
    element=rn.randint(0,10000000000)
    arr.append(element)

for a1 in range (5):
    arr1.append(arr[a1])
    arr2.append(arr[a1])
    arr3.append(arr[a1])

print("The unsorted array is ",arr)

#insertionsort

numComparisons=0
numSwaps=0
temp=0

for i in range(1,len(arr1)):
    k=arr1[i]
    b=i-1
    numComparisons=numComparisons+1
    numSwaps=numSwaps+1
    while b >=0 and k < arr1[b] :
        arr1[b+1] = arr1[b]
        b-= 1
        arr1[b+1] = k
        numComparisons

swapInsertion.append(numSwaps)
compareInsertion.append(numComparisons)

```

```
print("Number of swaps done in insertion sort ",numSwaps)
print("Number of comparisons done in insertion sort ",numComparisons)
```

#selectionsort

```
numComparisons=0
numSwaps=0
temp=0
```

```
for i in range(len(arr2)):
    min=i
    for k in range(i,len(arr2)):
        numComparisons=numComparisons+1
        if arr2[min] > arr2[k]:
            min=k
    temp=arr2[min]
    arr2[min]=arr2[i]
    arr2[i]=temp
    numSwaps=numSwaps+1
```

```
swapSelection.append(numSwaps)
compareSelection.append(numComparisons)
```

```
print("Number of swaps done in selection sort ",numSwaps)
print("Number of comparisons done in selection sort ",numComparisons)
```

#bubblesort

```
numComparisons=0
numSwaps=0
temp=0
```

```
for i in range(len(arr3)):
    for j in range(len(arr3)-i-1):
        numComparisons=numComparisons+1
        if arr3[j]>arr3[j+1]:
            temp=arr3[j]
            arr3[j]=arr3[j+1]
            arr3[j+1]=temp
            numSwaps=numSwaps+1
```

```
swapBubble.append(numSwaps)
compareBubble.append(numComparisons)
```

```
print("Number of swaps done in bubble sort ",numSwaps)
print("Number of comparisons done in bubble sort ",numComparisons)
```

The unsorted array is [3557380, 985092831, 121120427, 383766593, 918559518]

Number of swaps done in insertion sort 4

Number of comparisons done in insertion sort 4

Number of swaps done in selection sort 5

Number of comparisons done in selection sort 15

Number of swaps done in bubble sort 3

Number of comparisons done in bubble sort 10

```
arr=[]
```

```
arr1=[]
```

```
arr2=[]
```

```
arr3=[]
```

```
a=0
```

```
a1=0
```

```
for a in range(10):  
    element=rn.randint(0,10000000000)  
    arr.append(element)
```

```
for a1 in range (10):  
    arr1.append(arr[a1])  
    arr2.append(arr[a1])  
    arr3.append(arr[a1])
```

```
print("The unsorted array is ",arr)
```

```
#insertionsort
```

```
numComparisons=0
```

```
numSwaps=0
```

```
temp=0
```

```
for i in range(1,len(arr1)):  
    k=arr1[i]  
    b=i-1  
    numComparisons=numComparisons+1  
    numSwaps=numSwaps+1  
    while b >=0 and k < arr1[b] :  
        arr1[b+1] = arr1[b]  
        b-= 1  
        arr1[b+1] = k  
    numComparisons
```

```
swapInsertion.append(numSwaps)
```

```
compareInsertion.append(numComparisons)
```

```
print("Number of swaps done in insertion sort ",numSwaps)
print("Number of comparisons done in insertion sort ",numComparisons)
```

#selectionsort

```
numComparisons=0
numSwaps=0
temp=0
```

```
for i in range(len(arr2)):
    min=i
    for k in range(i,len(arr2)):
        numComparisons=numComparisons+1
        if arr2[min] > arr2[k]:
            min=k
    temp=arr2[min]
    arr2[min]=arr2[i]
    arr2[i]=temp
    numSwaps=numSwaps+1
```

```
swapSelection.append(numSwaps)
compareSelection.append(numComparisons)
```

```
print("Number of swaps done in selection sort ",numSwaps)
print("Number of comparisons done in selection sort ",numComparisons)
```

#bubblesort

```
numComparisons=0
numSwaps=0
temp=0
```

```
for i in range(len(arr3)):
    for j in range(len(arr3)-i-1):
        numComparisons=numComparisons+1
        if arr3[j]>arr3[j+1]:
            temp=arr3[j]
            arr3[j]=arr3[j+1]
            arr3[j+1]=temp
            numSwaps=numSwaps+1
```

```
swapBubble.append(numSwaps)
compareBubble.append(numComparisons)
```

```
print("Number of swaps done in bubble sort ",numSwaps)
print("Number of comparisons done in bubble sort ",numComparisons)
```

The unsorted array is [227860203, 117761606, 486226927, 256070613, 703850913, 803887723, 58999996, 552721800, 991813376, 497886013]

Number of swaps done in insertion sort 9

Number of comparisons done in insertion sort 9

Number of swaps done in selection sort 10

Number of comparisons done in selection sort 55

Number of swaps done in bubble sort 14

Number of comparisons done in bubble sort 45

```
arr=[]
```

```
arr1=[]
```

```
arr2=[]
```

```
arr3=[]
```

```
a=0
```

```
a1=0
```

```
for a in range(20):  
    element=rn.randint(0,1000000000)  
    arr.append(element)
```

```
for a1 in range (20):  
    arr1.append(arr[a1])  
    arr2.append(arr[a1])  
    arr3.append(arr[a1])
```

```
print("The unsorted array is ",arr)
```

```
#insertionsort
```

```
numComparisons=0
```

```
numSwaps=0
```

```
temp=0
```

```
for i in range(1,len(arr1)):  
    k=arr1[i]  
    b=i-1  
    numComparisons=numComparisons+1  
    numSwaps=numSwaps+1  
    while b >=0 and k < arr1[b] :  
        arr1[b+1] = arr1[b]  
        b-= 1  
        arr1[b+1] = k  
    numComparisons
```

```
swapInsertion.append(numSwaps)
```

```
compareInsertion.append(numComparisons)
```

```
print("Number of swaps done in insertion sort ",numSwaps)
```

```
print("Number of comparisons done in insertion sort ",numComparisons)
```

```
#selectionsort
```

```
numComparisons=0
```

```
numSwaps=0
```

```
temp=0
```

```
for i in range(len(arr2)):
    min=i
    for k in range(i,len(arr2)):
        numComparisons=numComparisons+1
        if arr2[min] > arr2[k]:
            min=k
    temp=arr2[min]
    arr2[min]=arr2[i]
    arr2[i]=temp
    numSwaps=numSwaps+1
```

```
swapSelection.append(numSwaps)
compareSelection.append(numComparisons)
```

```
print("Number of swaps done in selection sort ",numSwaps)
print("Number of comparisons done in selection sort ",numComparisons)
```

```
#bubblesort
```

```
numComparisons=0
```

```
numSwaps=0
```

```
temp=0
```

```
for i in range(len(arr3)):
    for j in range(len(arr3)-i-1):
        numComparisons=numComparisons+1
        if arr3[j]>arr3[j+1]:
            temp=arr3[j]
            arr3[j]=arr3[j+1]
            arr3[j+1]=temp
            numSwaps=numSwaps+1
```

```
swapBubble.append(numSwaps)
compareBubble.append(numComparisons)
```

```
print("Number of swaps done in bubble sort ",numSwaps)
print("Number of comparisons done in bubble sort ",numComparisons)
```

The unsorted array is [936934104, 809065505, 746842628, 509044818, 574118230, 53737787, 88824731, 50944800, 262234790, 113414920,

329166881, 284692512, 855662957, 710405890, 197327202, 348288345,
37300401, 818625229, 29880089, 304466257]

Number of swaps done in insertion sort 19

Number of comparisons done in insertion sort 19

Number of swaps done in selection sort 20

Number of comparisons done in selection sort 210

Number of swaps done in bubble sort 116

Number of comparisons done in bubble sort 190

```
arr=[]
```

```
arr1=[]
```

```
arr2=[]
```

```
arr3=[]
```

```
a=0
```

```
a1=0
```

```
for a in range(50):  
    element=mn.randint(0,1000000000)  
    arr.append(element)
```

```
for a1 in range (50):  
    arr1.append(arr[a1])  
    arr2.append(arr[a1])  
    arr3.append(arr[a1])
```

```
print("The unsorted array is ",arr)
```

```
#insertionsort
```

```
numComparisons=0
```

```
numSwaps=0
```

```
temp=0
```

```
for i in range(1,len(arr1)):  
    k=arr1[i]  
    b=i-1  
    numComparisons=numComparisons+1  
    numSwaps=numSwaps+1  
    while b >=0 and k < arr1[b] :  
        arr1[b+1] = arr1[b]  
        b-= 1  
        arr1[b+1] = k  
    numComparisons
```

```
swapInsertion.append(numSwaps)
```

```
compareInsertion.append(numComparisons)
```

```
print("Number of swaps done in insertion sort ",numSwaps)
```

```
print("Number of comparisons done in insertion sort ",numComparisons)
```

```
#selectionsort
```

```
numComparisons=0  
numSwaps=0  
temp=0
```

```
for i in range(len(arr2)):  
    min=i  
    for k in range(i,len(arr2)):  
        numComparisons=numComparisons+1  
        if arr2[min] > arr2[k]:  
            min=k  
    temp=arr2[min]  
    arr2[min]=arr2[i]  
    arr2[i]=temp  
    numSwaps=numSwaps+1
```

```
swapSelection.append(numSwaps)  
compareSelection.append(numComparisons)
```

```
print("Number of swaps done in selection sort ",numSwaps)  
print("Number of comparisons done in selection sort ",numComparisons)
```

```
#bubblesort
```

```
numComparisons=0  
numSwaps=0  
temp=0
```

```
for i in range(len(arr3)):  
    for j in range(len(arr3)-i-1):  
        numComparisons=numComparisons+1  
        if arr3[j]>arr3[j+1]:  
            temp=arr3[j]  
            arr3[j]=arr3[j+1]  
            arr3[j+1]=temp  
            numSwaps=numSwaps+1
```

```
swapBubble.append(numSwaps)  
compareBubble.append(numComparisons)
```

```
print("Number of swaps done in bubble sort ",numSwaps)  
print("Number of comparisons done in bubble sort ",numComparisons)
```

The unsorted array is [802887728, 926366195, 169000465, 754154349, 920702069, 123967166, 257154187, 440139753, 673381028, 374973967,


```
162160446, 414831239, 99390609, 447181766, 722364915, 94550366,
695348853, 961197508, 55524562, 52414312, 91085538, 804676775,
505629366, 793014653, 444880889, 605438330, 689777030, 22020924,
323618396, 19106821, 660479848, 740847495, 440712391, 186647439,
919920498, 195080610, 459803160, 606376615, 815615033, 528199256,
812943719, 482422380, 745297528, 212604654, 439190754, 117038917,
941399432, 765013094, 197601118, 889660120]
```

```
Number of swaps done in insertion sort 49
```

```
Number of comparisons done in insertion sort 49
```

```
Number of swaps done in selection sort 50
```

```
Number of comparisons done in selection sort 1275
```

```
Number of swaps done in bubble sort 579
```

```
Number of comparisons done in bubble sort 1225
```

```
arr=[]
```

```
arr1=[]
```

```
arr2=[]
```

```
arr3=[]
```

```
a=0
```

```
a1=0
```

```
for a in range(100):
    element=rn.randint(0,1000000000)
    arr.append(element)
```

```
for a1 in range (100):
    arr1.append(arr[a1])
    arr2.append(arr[a1])
    arr3.append(arr[a1])
```

```
print("The unsorted array is ",arr)
```

```
#insertionsort
```

```
numComparisons=0
```

```
numSwaps=0
```

```
temp=0
```

```
for i in range(1,len(arr1)):
    k=arr1[i]
    b=i-1
    numComparisons=numComparisons+1
    numSwaps=numSwaps+1
    while b >=0 and k < arr1[b] :
        arr1[b+1] = arr1[b]
        b-= 1
        arr1[b+1] = k
        numComparisons
```

```
swapInsertion.append(numSwaps)
```

```
compareInsertion.append(numComparisons)

print("Number of swaps done in insertion sort ",numSwaps)
print("Number of comparisons done in insertion sort ",numComparisons)
```

#selectionsort

```
numComparisons=0
numSwaps=0
temp=0

for i in range(len(arr2)):
    min=i
    for k in range(i,len(arr2)):
        numComparisons=numComparisons+1
        if arr2[min] > arr2[k]:
            min=k
    temp=arr2[min]
    arr2[min]=arr2[i]
    arr2[i]=temp
    numSwaps=numSwaps+1
```

```
swapSelection.append(numSwaps)
compareSelection.append(numComparisons)
```

```
print("Number of swaps done in selection sort ",numSwaps)
print("Number of comparisons done in selection sort ",numComparisons)
```

#bubblesort

```
numComparisons=0
numSwaps=0
temp=0

for i in range(len(arr3)):
    for j in range(len(arr3)-i-1):
        numComparisons=numComparisons+1
        if arr3[j]>arr3[j+1]:
            temp=arr3[j]
            arr3[j]=arr3[j+1]
            arr3[j+1]=temp
            numSwaps=numSwaps+1
```

```
swapBubble.append(numSwaps)
compareBubble.append(numComparisons)
```

```
print("Number of swaps done in bubble sort ",numSwaps)
print("Number of comparisons done in bubble sort ",numComparisons)
```

The unsorted array is [5517822, 829962701, 967684414, 674396170, 584727907, 439763662, 296196161, 947634617, 996877899, 158571572, 473343220, 803598221, 862192775, 390972348, 435970534, 621647967, 115995124, 542172337, 707234333, 454221573, 7173024, 310416450, 341001035, 23073481, 130639293, 326263846, 403749923, 472900844, 477090225, 748928733, 99210702, 171746915, 373504061, 797587460, 216171333, 589714958, 631438336, 617140534, 140533066, 693714037, 354156599, 8883152, 587277275, 871927713, 108388939, 524475132, 569943487, 604692330, 988562443, 429687884, 533437142, 779361620, 406651458, 469681233, 81162965, 197664255, 3002550, 332689324, 180733446, 591670308, 165537428, 828557174, 616155752, 373748405, 191796864, 130245498, 11082108, 993184727, 281842721, 643935438, 117110238, 819668989, 651007041, 943354271, 155103740, 299579130, 805434797, 285990726, 873482238, 978866231, 801688484, 509958420, 866900812, 456086985, 990311123, 353953772, 903671993, 723792828, 328686560, 434935960, 681137972, 103039693, 325802239, 588055317, 805148175, 940338838, 56956954, 294978122, 741606696, 884000913]

Number of swaps done in insertion sort 99

Number of comparisons done in insertion sort 99

Number of swaps done in selection sort 100

Number of comparisons done in selection sort 5050

Number of swaps done in bubble sort 2330

Number of comparisons done in bubble sort 4950

```
arr=[]
```

```
arr1=[]
```

```
arr2=[]
```

```
arr3=[]
```

```
a=0
```

```
a1=0
```

```
for a in range(500):
```

```
    element=rn.randint(0,1000000000)
```

```
    arr.append(element)
```

```
for a1 in range (500):
```

```
    arr1.append(arr[a1])
```

```
    arr2.append(arr[a1])
```

```
    arr3.append(arr[a1])
```

```
print("The unsorted array is ",arr)
```

```
#insertionsort
```

```
numComparisons=0
```

```
numSwaps=0
```

```
temp=0
```

```

for i in range(1,len(arr1)):
    k=arr1[i]
    b=i-1
    numComparisons=numComparisons+1
    numSwaps=numSwaps+1
    while b >=0 and k < arr1[b] :
        arr1[b+1] = arr1[b]
        b-= 1
        arr1[b+1] = k
        numComparisons

swapInsertion.append(numSwaps)
compareInsertion.append(numComparisons)

print("Number of swaps done in insertion sort ",numSwaps)
print("Number of comparisons done in insertion sort ",numComparisons)

```

#selectionsort

```

numComparisons=0
numSwaps=0
temp=0

for i in range(len(arr2)):
    min=i
    for k in range(i,len(arr2)):
        numComparisons=numComparisons+1
        if arr2[min] > arr2[k]:
            min=k
    temp=arr2[min]
    arr2[min]=arr2[i]
    arr2[i]=temp
    numSwaps=numSwaps+1

swapSelection.append(numSwaps)
compareSelection.append(numComparisons)

print("Number of swaps done in selection sort ",numSwaps)
print("Number of comparisons done in selection sort ",numComparisons)

```

#bubblesort

```

numComparisons=0
numSwaps=0
temp=0

for i in range(len(arr3)):

```

```

    for j in range(len(arr3)-i-1):
        numComparisons=numComparisons+1
        if arr3[j]>arr3[j+1]:
            temp=arr3[j]
            arr3[j]=arr3[j+1]
            arr3[j+1]=temp
            numSwaps=numSwaps+1

swapBubble.append(numSwaps)
compareBubble.append(numComparisons)

print("Number of swaps done in bubble sort ",numSwaps)
print("Number of comparisons done in bubble sort ",numComparisons)

```

The unsorted array is [237303840, 980690460, 101577909, 322543184, 118113496, 956522570, 240236796, 67726386, 20368572, 495847819, 240992802, 464159746, 557816105, 789049420, 259655743, 274025813, 630730114, 667598052, 857523662, 559827221, 376289358, 990151482, 609118713, 570346178, 922602173, 147308350, 569352266, 737467313, 825268653, 766700458, 229740866, 634841077, 55105418, 456844921, 961632098, 592219606, 616043214, 418084515, 935796703, 634603590, 979218274, 632055002, 398901081, 779413007, 101621620, 743062100, 752821740, 312750975, 207886474, 261513748, 347618778, 378099429, 844384564, 402867441, 713439150, 9240532, 970744283, 7772168, 558715681, 608493991, 673936519, 83971423, 159903858, 403011741, 712074922, 914298483, 225261840, 372946513, 983238450, 749919111, 255619983, 89099134, 594853979, 199507447, 340353131, 816270915, 5114057, 44876559, 807486046, 54235221, 439257485, 669434733, 957049794, 161645077, 874289148, 817197029, 239344369, 282176675, 43858912, 427069435, 517766340, 257850730, 140830614, 732769144, 480538072, 104996343, 26845463, 913017329, 320419357, 918705425, 866363450, 898754701, 935943345, 813382398, 713698569, 101112629, 772329206, 319854138, 545469347, 683821846, 962802534, 208483371, 306623950, 842651261, 46379837, 610944716, 660949392, 24396055, 563377805, 274276003, 964808660, 670412020, 983402165, 216588328, 427716988, 46255103, 863387900, 94904038, 10044042, 762128588, 323571875, 111128146, 324674686, 682481623, 6553784, 757360615, 243965305, 859000554, 931159035, 799356614, 509649198, 523854469, 332469587, 44335513, 519754035, 468545946, 469512095, 6169666, 236312338, 727672034, 173447684, 326360332, 883114176, 203787402, 337509937, 840395971, 347861658, 483928512, 400037538, 704455169, 26199842, 694490796, 274759872, 229897081, 979061210, 421193866, 655883241, 87489079, 16673432, 387592295, 96414389, 532398964, 393160423, 579195528, 790271427, 22535399, 875892997, 399560986, 888806152, 559001417, 970618215, 595843125, 705645267, 69467175, 269821838, 215229351, 641432909, 796317622, 477763379, 673414949, 140250036, 272958705, 51671109, 799940047, 506343825, 394788874, 834824618, 138023972, 812061970, 180992297, 916137699, 860541044,

421072698, 852908128, 22662105, 833661081, 851848597, 875333343,
440433723, 519608070, 938144406, 332971760, 101499750, 97292713,
98769614, 960147654, 336088156, 230590096, 244694950, 16872525,
457759708, 182404034, 876305670, 214233876, 905041684, 328801733,
489246928, 220712688, 287103697, 857212665, 320632570, 61953965,
968691524, 605089967, 149186902, 689068110, 183648666, 384941300,
942990880, 348228658, 556271520, 34573924, 596934367, 843174135,
630306682, 411637124, 553181944, 996925156, 73849298, 449429304,
142903613, 719267637, 33402574, 850136771, 583929895, 499838633,
214854406, 38919452, 541925118, 214214168, 505828533, 218115810,
13266940, 769973204, 586556004, 477929509, 382953591, 483218124,
565829586, 991931297, 400550689, 927083565, 936494840, 313149157,
912171408, 882301756, 398826293, 174640806, 338220107, 130066874,
359586887, 139966721, 627078264, 596007205, 95409796, 67491128,
484130553, 119137954, 566084329, 852549523, 280829583, 847816089,
868973349, 971550393, 610893259, 80119381, 916104566, 479024988,
144975924, 313340622, 442364820, 956301042, 167326511, 824793210,
12422287, 11066596, 909686503, 63029726, 952922471, 398132758,
962638348, 412712448, 449924881, 949847633, 337399199, 475625886,
59611008, 761315751, 48438496, 380227365, 964079109, 487914034,
946547164, 324153419, 624541272, 304836717, 321167994, 215502127,
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```
Number of swaps done in insertion sort  499
Number of comparisons done in insertion sort  499
Number of swaps done in selection sort  500
Number of comparisons done in selection sort  125250
Number of swaps done in bubble sort  63498
Number of comparisons done in bubble sort  124750
```

```
arr=[]
arr1=[]
arr2=[]
arr3=[]
a=0
a1=0
```

```
for a in range(1000):
    element=rn.randint(0,1000000000)
    arr.append(element)
```

```
for a1 in range (1000):
    arr1.append(arr[a1])
    arr2.append(arr[a1])
    arr3.append(arr[a1])
```

```
print("The unsorted array is ",arr)
```

```
#insertionsort
```

```
numComparisons=0
numSwaps=0
temp=0
```

```
for i in range(1,len(arr1)):
    k=arr1[i]
    b=i-1
    numComparisons=numComparisons+1
    numSwaps=numSwaps+1
    while b >=0 and k < arr1[b] :
        arr1[b+1] = arr1[b]
        b-= 1
        arr1[b+1] = k
    numComparisons
```

```
swapInsertion.append(numSwaps)
compareInsertion.append(numComparisons)
```

```
print("Number of swaps done in insertion sort ",numSwaps)
print("Number of comparisons done in insertion sort ",numComparisons)
```

```
#selectionsort
```

```

numComparisons=0
numSwaps=0
temp=0

for i in range(len(arr2)):
    min=i
    for k in range(i,len(arr2)):
        numComparisons=numComparisons+1
        if arr2[min] > arr2[k]:
            min=k
    temp=arr2[min]
    arr2[min]=arr2[i]
    arr2[i]=temp
    numSwaps=numSwaps+1

swapSelection.append(numSwaps)
compareSelection.append(numComparisons)

print("Number of swaps done in selection sort ",numSwaps)
print("Number of comparisons done in selection sort ",numComparisons)

```

#bubblesort

```

numComparisons=0
numSwaps=0
temp=0

for i in range(len(arr3)):
    for j in range(len(arr3)-i-1):
        numComparisons=numComparisons+1
        if arr3[j]>arr3[j+1]:
            temp=arr3[j]
            arr3[j]=arr3[j+1]
            arr3[j+1]=temp
            numSwaps=numSwaps+1

swapBubble.append(numSwaps)
compareBubble.append(numComparisons)

print("Number of swaps done in bubble sort ",numSwaps)
print("Number of comparisons done in bubble sort ",numComparisons)

```

The unsorted array is [892465590, 7846119, 48900208, 21486770, 241963724, 920507005, 722496045, 529332939, 952432275, 799208980, 226999423, 54965252, 566332176, 749223990, 528409675, 629316918, 878408273, 651242189, 496114210, 912826846, 511597442, 519220123,

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Number of swaps done in insertion sort 999

Number of comparisons done in insertion sort 999

Number of swaps done in selection sort 1000

Number of comparisons done in selection sort 500500

Number of swaps done in bubble sort 257216

Number of comparisons done in bubble sort 499500

```
arr=[]
```

```
arr1=[]
```

```
arr2=[]
```

```
arr3=[]
```

```
a=0
```

```
a1=0
```

```
for a in range(5000):  
    element=rn.randint(0,1000000000)  
    arr.append(element)
```

```
for a1 in range (5000):  
    arr1.append(arr[a1])  
    arr2.append(arr[a1])  
    arr3.append(arr[a1])
```

```
print("The unsorted array is ",arr)
```

```
#insertionsort
```

```
numComparisons=0
```

```
numSwaps=0
```

```
temp=0
```

```
for i in range(1,len(arr1)):  
    k=arr1[i]  
    b=i-1  
    numComparisons=numComparisons+1  
    numSwaps=numSwaps+1
```

```
while b >=0 and k < arr1[b] :  
    arr1[b+1] = arr1[b]  
    b-= 1  
    arr1[b+1] = k  
    numComparisons
```

```
swapInsertion.append(numSwaps)  
compareInsertion.append(numComparisons)
```

```
print("Number of swaps done in insertion sort ",numSwaps)  
print("Number of comparisons done in insertion sort ",numComparisons)
```

#selectionsort

```
numComparisons=0  
numSwaps=0  
temp=0
```

```
for i in range(len(arr2)):  
    min=i  
    for k in range(i,len(arr2)):  
        numComparisons=numComparisons+1  
        if arr2[min] > arr2[k]:  
            min=k  
    temp=arr2[min]  
    arr2[min]=arr2[i]  
    arr2[i]=temp  
    numSwaps=numSwaps+1
```

```
swapSelection.append(numSwaps)  
compareSelection.append(numComparisons)
```

```
print("Number of swaps done in selection sort ",numSwaps)  
print("Number of comparisons done in selection sort ",numComparisons)
```

#bubblesort

```
numComparisons=0  
numSwaps=0  
temp=0
```

```
for i in range(len(arr3)):  
    for j in range(len(arr3)-i-1):  
        numComparisons=numComparisons+1  
        if arr3[j]>arr3[j+1]:  
            temp=arr3[j]  
            arr3[j]=arr3[j+1]  
            arr3[j+1]=temp
```

```
numSwaps=numSwaps+1
```

```
swapBubble.append(numSwaps)  
compareBubble.append(numComparisons)
```

```
print("Number of swaps done in bubble sort ",numSwaps)  
print("Number of comparisons done in bubble sort ",numComparisons)
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Number of swaps done in insertion sort 4999
Number of comparisons done in insertion sort 4999
Number of swaps done in selection sort 5000
Number of comparisons done in selection sort 12502500

Number of swaps done in bubble sort 6296937
Number of comparisons done in bubble sort 12497500

```
arr=[]
arr1=[]
arr2=[]
arr3=[]
a=0
a1=0

for a in range(10000):
    element=rn.randint(0,1000000000)
    arr.append(element)

for a1 in range (10000):
    arr1.append(arr[a1])
    arr2.append(arr[a1])
    arr3.append(arr[a1])

print("The unsorted array is ",arr)

#insertionsort

numComparisons=0
numSwaps=0
temp=0

for i in range(1,len(arr1)):
    k=arr1[i]
    b=i-1
    numComparisons=numComparisons+1
    numSwaps=numSwaps+1
    while b >=0 and k < arr1[b] :
        arr1[b+1] = arr1[b]
        b-= 1
        arr1[b+1] = k
        numComparisons

swapInsertion.append(numSwaps)
compareInsertion.append(numComparisons)

print("Number of swaps done in insertion sort ",numSwaps)
print("Number of comparisons done in insertion sort ",numComparisons)

#selectionsort

numComparisons=0
numSwaps=0
temp=0
```

```

for i in range(len(arr2)):
    min=i
    for k in range(i,len(arr2)):
        numComparisons=numComparisons+1
        if arr2[min] > arr2[k]:
            min=k
    temp=arr2[min]
    arr2[min]=arr2[i]
    arr2[i]=temp
    numSwaps=numSwaps+1

swapSelection.append(numSwaps)
compareSelection.append(numComparisons)

print("Number of swaps done in selection sort ",numSwaps)
print("Number of comparisons done in selection sort ",numComparisons)

```

#bubblesort

```

numComparisons=0
numSwaps=0
temp=0

for i in range(len(arr3)):
    for j in range(len(arr3)-i-1):
        numComparisons=numComparisons+1
        if arr3[j]>arr3[j+1]:
            temp=arr3[j]
            arr3[j]=arr3[j+1]
            arr3[j+1]=temp
            numSwaps=numSwaps+1

swapBubble.append(numSwaps)
compareBubble.append(numComparisons)

print("Number of swaps done in bubble sort ",numSwaps)
print("Number of comparisons done in bubble sort ",numComparisons)

```

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```
Number of swaps done in insertion sort 9999
Number of comparisons done in insertion sort 9999
Number of swaps done in selection sort 10000
Number of comparisons done in selection sort 50005000
Number of swaps done in bubble sort 25129909
Number of comparisons done in bubble sort 49995000
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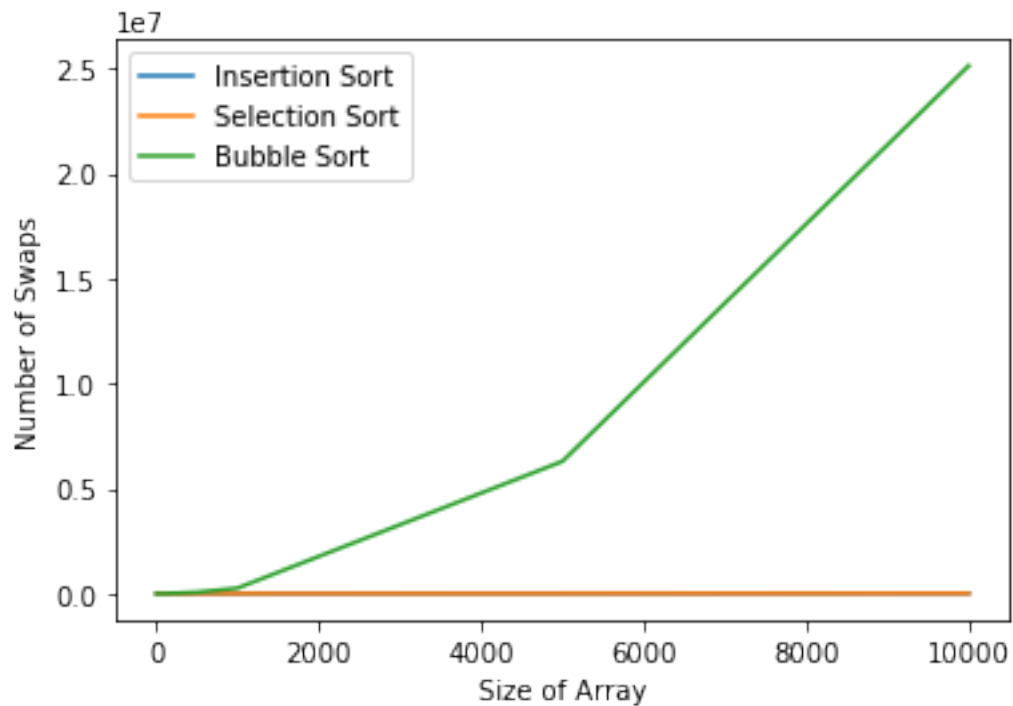
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print(swapInsertion)
print(compareInsertion)
print(swapSelection)
print(compareSelection)
print(swapBubble)
print(compareBubble)
```

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```

```
plt.plot(n,swapInsertion,label="Insertion Sort")
plt.plot(n,swapSelection,label="Selection Sort")
plt.plot(n,swapBubble,label="Bubble Sort")
```

```
plt.xlabel('Size of Array')
plt.ylabel('Number of Swaps')
plt.legend()
```

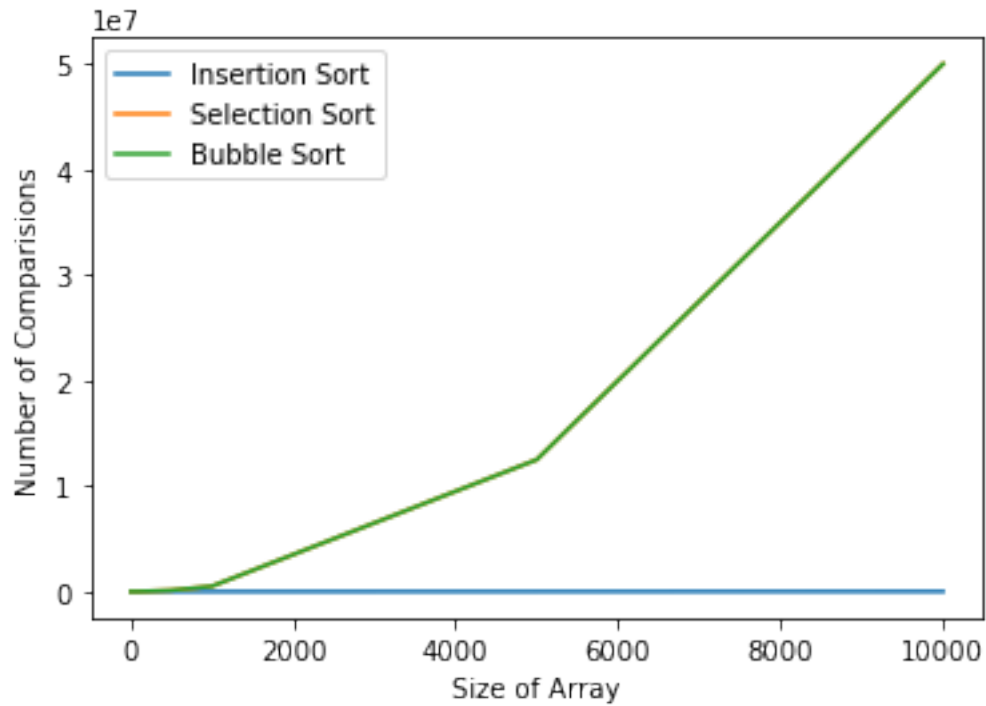
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```
plt.plot(n,compareInsertion,label="Insertion Sort")
plt.plot(n,compareSelection,label="Selection Sort")
plt.plot(n,compareBubble,label="Bubble Sort")

plt.xlabel('Size of Array')
plt.ylabel('Number of Comparisions')
plt.legend()

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Based on the results obtained above the number of swaps and comparisons in bubble sort are significantly higher. Hence it will take more time to execute and thus will take more time. Insertion and selection sorts have almost equal number of swaps and comparisons but insertion sort has a little less, and hence is more efficient