2. Write a program to implement binary search algorithm. Repeat the experiment for different values of n, the number of elements in the list to be searched and plot a graph of the time taken versus n.

```
import time
import matplotlib.pyplot as plt


def binary_search(arr,low,high,key):
    while low<=high:
        mid=low+(high-low)//2
        if arr[mid]==key:
            return mid+1
        if arr[mid]<key:
            low=mid+1
        else:
            high=mid-1
    return -1


def main():
    n_values=[]
    times=[]
    r=int(input("Enter the number of runs: "))
    for _ in range(r):
        n=int(input("Enter the number of elements: "))
        arr=sorted(list(map(int,input("\n Enter the elements of an array:").split())))
        key=int(input("\nEnter the key element to be searched:"))
        repeat=10000
        result=-1
        start=time.time()
        for _ in range(repeat):
            result=binary_search(arr,0,n-1,key)
        end=time.time()
        if result!=-1:
```

```
            print(f"key {key} found at position {result}")
        else:
            print(f"key {key} not found")

        time_taken=(end-start)*1000
        print(f"Time taken to search a key element= {time_taken} milli seconds")
        n_values.append(n)
        times.append(time_taken)
    plt.figure()
    plt.plot(n_values,times,'o-')
    plt.xlabel('Number of elements (n)')
    plt.ylabel('Time taken (milli seconds)')
    plt.title('Binary Search Time Complexity')
    plt.grid(True)
    plt.show()

if __name__=="__main__":
    main()
```

Output

```
Enter the number of runs: 3
Enter the number of elements: 15

 Enter the elements of an array:10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

Enter the key element to be searched:150
key 150 found at position 15
Time taken to search a key element= 22.936582565307617 milli seconds
Enter the number of elements: 10

 Enter the elements of an array:10 20 30 40 50 60 70 80 90 100

Enter the key element to be searched:100
key 100 found at position 10
Time taken to search a key element= 19.945383071899414 milli seconds
Enter the number of elements: 5

 Enter the elements of an array:10 20 30 40 50
```

Enter the key element to be searched:50
key 50 found at position 5
Time taken to search a key element= 16.988515853881836 milli seconds