MODUL 3

MEDIUM

Naufal is an informatics student who is developing a hospital management system to assist in the administrative processes of doctors and patients. In the system he has created, each doctor and patient has their own complete data. Each doctor has several patients with the following initial data:

The patient data recorded includes Patient ID, Patient Name, Age, Systolic Blood Pressure, and Diastolic Blood Pressure. Meanwhile, the doctor data recorded includes: Doctor ID, Doctor Name, Specialization, and Work Experience (in years).

After the data is entered, Naufal wants to ensure that all information is correct. So, he displays the entire list of doctors and patients registered in the system.

```
======  Menampilkan Seluruh Data Dokter dan Pasien  ======
------------------------------------------------------------
Doctor ID     : 1
Doctor        : Dr. Michael Harris
Specialization: Cardiology
Experience    : 12 years
------------------------------------------------------------
Patient List:

ID      Patient Name    Age     Systolic        Diastolic
1       Daniel Carter    20     110             75
2       Alicia Morgan    45     135             85
3       Ryan Mitchell    33     125             80
4       Natalie Brooks   55     145             95
5       Brandon Cooper   28     118             78
6       Laura Walker     60     160             100
7       Jonathan Reed    39     130             84
8       Emily Parker     26     119             77
9       Christian Hall   52     148             96
10      Victoria Adams   47     140             92
11      Samuel Morris    31     123             81
12      Olivia Turner    29     116             76
13      Andrew Scott     58     155             99
14      Grace Phillips   42     133             87
15      Dylan Hughes     36     127             82
------------------------------------------------------------


------------------------------------------------------------
Doctor ID     : 2
Doctor        : Dr. Emily Parker
Specialization: Neurology
Experience    : 15 years
------------------------------------------------------------
Patient List:

ID      Patient Name    Age     Systolic        Diastolic
1       Ethan Sullivan   37     128             82
2       Chloe Ramirez    50     142             94
3       Marcus Turner    29     117             76
4       Sophie Turner    61     155             98
5       Liam Anderson    46     138             90
6       Isabella Moore   33     125             83
7       Jason Bennett    41     131             86
8       Madison Clark    27     118             77
9       George Ramirez   54     150             97
10      Sophia Grant     44     139             91
11      Patrick Carter   35     126             82
12      Abigail Foster   30     120             79
13      Nicholas Hayes   59     156             101
14      Ella Simmons     43     134             88
15      Lucas Griffin    38     129             84
------------------------------------------------------------

Doctor ID     : 3
Doctor        : Dr. Jonathan Reed
Specialization: Orthopedics
Experience    : 20 years
------------------------------------------------------------
Patient List:

ID      Patient Name    Age     Systolic        Diastolic
1       Oliver Foster    42     132             88
2       Hannah Price     34     120             79
3       William Scott    58     150             92
4       Amelia Collins   41     134             88
5       Henry Walton     63     159             101
6       Mia Thompson     27     115             75
7       Joshua Morgan    39     129             83
8       Charlotte Gray   32     118             78
9       Anthony Rivera   55     147             95
10      Natalie Hughes   46     136             89
11      Christian Bell   30     122             81
12      Amelia Barnes    28     117             76
13      Sebastian Gray   60     158             100
14      Lilian Cooper    40     133             87
15      Jackson Perez    35     126             82
------------------------------------------------------------
```

One day, Dr. Jonathan Reed requested the data of a patient named “Sebastian Gray” for further examination. Naufal searched the doctor's patient list using the Linear Search method, then recorded the search time and calculated the number of comparisons made by the algorithm.

```
================================================================================
 Mencari pasien dari Dr. Jonathan Reed yang bernama Sebastian Gray dengan Linear Search
================================================================================
Patient found for doctor Dr. Jonathan Reed
ID       : 13
Name     : Sebastian Gray
Age      : 60
Systolic : 158
Diastolic: 100
Jumlah perbandingan: 13
Waktu eksekusi: 0,00140090 detik
```

After that, Dr. Michael Harris wanted to find a 45-year-old patient. Naufal used Linear Search to find the patient.

```
================================================================================
 Mencari pasien dari Dr. Michael Harris yang berumur 45 tahun dengan Linear Search
================================================================================
Patient found for doctor Dr. Michael Harris
ID       : 2
Name     : Alicia Morgan
Age      : 45
Systolic : 135
Diastolic: 85
Jumlah perbandingan: 2
Waktu eksekusi: 0,00353070 detik
```

After conducting the search, Naufal moved on to sorting the patient data to make administration easier. First, he sorted Dr. Jonathan Reed’s patients by name using the Selection Sort method. Naufal also displayed the number of comparisons and swaps made by the algorithm.

```
================================================================================
 Mengurutkan pasien dari Dr. Jonathan Reed berdasarkan Nama dengan Selection Sort
================================================================================
Doctor Dr. Jonathan Reed's patients have been successfully sorted by name (ascending) - Selection Sort
Jumlah perbandingan: 105
Jumlah pertukaran: 13
ID      Patient Name    Age     Systolic        Diastolic
1       Amelia Barnes    28     117             76
2       Amelia Collins   41     134             88
3       Anthony Rivera   55     147             95
4       Charlotte Gray   32     118             78
5       Christian Bell   30     122             81
6       Hannah Price     34     120             79
7       Henry Walton     63     159             101
8       Jackson Perez    35     126             82
9       Joshua Morgan    39     129             83
10      Lilian Cooper    40     133             87
11      Mia Thompson     27     115             75
12      Natalie Hughes   46     136             89
13      Oliver Foster    42     132             88
14      Sebastian Gray   60     158             100
15      William Scott    58     150             92
------------------------------------------------------------
Waktu eksekusi: 0,01077060 detik
```

To speed up the sorting process, Naufal tried again to sort Dr. Jonathan Reed’s patient list. He sorted the doctor’s patient data using the Insertion Sort method.

```
================================================================================
 Mengurutkan pasien dari Dr. Jonathan Reed berdasarkan nama dengan Insertion Sort
================================================================================
Data pasien dari Dr. Jonathan Reed telah dikembalikan ke kondisi awal
Doctor Dr. Jonathan Reed's patients have been successfully sorted by name (ascending) - Insertion Sort
Jumlah perbandingan: 52
Jumlah pemindahan: 15
ID      Patient Name    Age     Systolic        Diastolic
1       Amelia Barnes    28     117             76
2       Amelia Collins   41     134             88
3       Anthony Rivera   55     147             95
4       Charlotte Gray   32     118             78
5       Christian Bell   30     122             81
6       Hannah Price     34     120             79
7       Henry Walton     63     159             101
8       Jackson Perez    35     126             82
9       Joshua Morgan    39     129             83
10      Lilian Cooper    40     133             87
11      Mia Thompson     27     115             75
12      Natalie Hughes   46     136             89
13      Oliver Foster    42     132             88
14      Sebastian Gray   60     158             100
15      William Scott    58     150             92
------------------------------------------------------------
Waktu eksekusi: 0,00156790 detik
```

To make it easier for doctors to monitor patient conditions, Naufal also sorted patients based on blood pressure. He began by sorting Dr. Emiliy Parker's patients based on systolic pressure using Selection Sort.

```
================================================================================================
 Mengurutkan pasien dari Dr. Emily Parker berdasarkan tekanan systolic dengan Selection Sort
================================================================================================
Doctor Dr. Emily Parker's patients have been successfully sorted by systolic (ascending) - Selection Sort
Jumlah perbandingan: 105
Jumlah pertukaran: 13
ID      Patient Name    Age     Systolic        Diastolic
1       Marcus Turner    29     117             76
2       Madison Clark    27     118             77
3       Abigail Foster   30     120             79
4       Isabella Moore   33     125             83
5       Patrick Carter   35     126             82
6       Ethan Sullivan   37     128             82
7       Lucas Griffin    38     129             84
8       Jason Bennett    41     131             86
9       Ella Simmons     43     134             88
10      Liam Anderson    46     138             90
11      Sophia Grant     44     139             91
12      Chloe Ramirez    50     142             94
13      George Ramirez   54     150             97
14      Sophie Turner    61     155             98
15      Nicholas Hayes   59     156             101
------------------------------------------------------------
Waktu eksekusi: 0,00222870 detik
```

After that, Naufal tried another sorting algorithm because he wanted to find the most suitable algorithm for his work. The sorting process was done using Insertion Sort.

```
================================================================================================
 Mengurutkan pasien dari Dr. Emily Parker berdasarkan tekanan sistolic dengan Insertion Sort
================================================================================================
Data pasien dari Dr. Emily Parker telah dikembalikan ke kondisi awal
Doctor Dr. Emily Parker's patients have been successfully sorted by systolic (ascending) - Insertion Sort
Jumlah perbandingan: 56
Jumlah pemindahan: 15
ID      Patient Name    Age     Systolic        Diastolic
1       Marcus Turner    29     117             76
2       Madison Clark    27     118             77
3       Abigail Foster   30     120             79
4       Isabella Moore   33     125             83
5       Patrick Carter   35     126             82
6       Ethan Sullivan   37     128             82
7       Lucas Griffin    38     129             84
8       Jason Bennett    41     131             86
9       Ella Simmons     43     134             88
10      Liam Anderson    46     138             90
11      Sophia Grant     44     139             91
12      Chloe Ramirez    50     142             94
13      George Ramirez   54     150             97
14      Sophie Turner    61     155             98
15      Nicholas Hayes   59     156             101
------------------------------------------------------------
Waktu eksekusi: 0,00140630 detik
```

Not long after, Naufal also wanted to find a patient named “Sebastian Gray” in Dr. Jonathan Reed's list using a different algorithm. This time, Naufal used Binary Search to perform the search.

```
==========================================================================================
 Mencari pasien dari Dr. Jonathan Reed yang bernama Sebastian Gray dengan Binary Search
==========================================================================================
Patient found for doctor Dr. Jonathan Reed
ID       : 14
Name     : Sebastian Gray
Age      : 60
Systolic : 158
Diastolic: 100
Jumlah perbandingan: 3
Waktu eksekusi: 0,00401630 detik
```

A while later, the administration department requested the patient list of Dr. Michael Harris, sorted by age. For this sorting task, Naufal used the Insertion Sort method.

```
==========================================================================================
 Mengurutkan pasien dari Dr. Michael Harris berdasarkan umur dengan Insertion Sort
==========================================================================================
Doctor Dr. Michael Harris's patients have been successfully sorted by age (ascending) - Insertion Sort
Jumlah perbandingan: 58
Jumlah pemindahan: 15
ID      Patient Name    Age     Systolic        Diastolic
1       Daniel Carter    20     110             75
2       Emily Parker     26     119             77
3       Brandon Cooper   28     118             78
4       Olivia Turner    29     116             76
5       Samuel Morris    31     123             81
6       Ryan Mitchell    33     125             80
7       Dylan Hughes     36     127             82
8       Jonathan Reed    39     130             84
9       Grace Phillips   42     133             87
10      Alicia Morgan    45     135             85
11      Victoria Adams   47     140             92
12      Christian Hall   52     148             96
13      Natalie Brooks   55     145             95
14      Andrew Scott     58     155             99
15      Laura Walker     60     160             100
----------------------------------------------------------
Waktu eksekusi: 0,00110900 detik
```

After that, Naufal wanted to try searching again for the 45-year-old patient of Dr. Michael Harris using binary search because he wanted to compare it with the linear search algorithm he had used previously.

```
==========================================================================
 Mencari pasien dari Dr. Michael Harris yang berumur 45 tahun dengan Binary Search
==========================================================================
Patient found for doctor Dr. Michael Harris
ID       : 10
Name     : Alicia Morgan
Age      : 45
Systolic : 135
Diastolic: 85
Jumlah perbandingan: 3
Waktu eksekusi: 0,00266520 detik
```

Comparative analysis:

- Analyze the results of the sorting and searching that has been done, comparing the results of each sorting and searching algorithm.
- The analysis is carried out on the number of algorithms used for comparison and the execution time required.
- Determine which algorithm is the most effective and efficient for each sorting and searching task based on the available data.
- Provide reasons for why each algorithm performs faster or slower than the others.
- Perform the analysis only on Dr. Michael Harris' patient list with 100, 200, and 300 data points compared.

Notes:

- To calculate the search and sort time, you can use the following code or another algorithm:

```
long startTime = System.nanoTime();
//Method algoritma sorting atau searching yang digunakan
long endTime = System.nanoTime();
double waktu = (double) (endTime - startTime) / 1000000000.0;
System.out.printf(format:"Waktu eksekusi: %.8f detik\n", waktu);
```

- The movement in Insertion Sort is different from the swapping process in Selection Sort.
- In Insertion Sort, a movement is counted when a value has been placed into the sorted portion.
- Sorting is performed on random data, not using the results of previous sorts when sorting again.

Rules:

- Use a nested linked list for the list of doctors and their patients.
- Use the selection sort and insertion sort methods.
- Use the linear search and binary search methods.
- Example of comparison results for execution time:

Number of data	Linear Searching	Binary Searching	Selection Sorting	Insertion Sorting
100	time	time	time	time
200	time	time	time	time
300	time	time	time	time