

# Project Idea

An application to provide a car rental service, which can be rented for a day or for several months  
THIS APP FOR  
For customers who want to rent a car  
For employees of a car rental company.





# Used Data Structure :

01

## 1 Array List

Class Employees

## 2 Linked List

Class Cars, Class  
CustomerQueueList

02

03

## 1 Queue

Class CustomerQueueList



# Array List

# 01

## Employees

Used algorithms:

- 1- Insertion sort Algorithm to sort employees first names  $O(n^2)$
- 2- merge sort algorithm to sort employees first names  $O(n \log n)$



# LinkedList

## 🚗 Class Cars

Used algorithms:

- 1- Insertion sort Algorithm to sort Cars Car make  $O(n^2)$
- 2- merge sort algorithm to sort Cars Car make  $O(n \log n)$
- 3- linear search algorithm to search for car using registration number  $O(n)$
- 4- linear recursion sum To calculate the expected daily, monthly and yearly profit of the company



## Customer

Used To store customer rentals

# 02



# Queue

# 03

## CustomerQueueList algorithms:

- 1- Insertion sort Algorithm to sort customer by name  $O(n^2)$
- 2- Recursion Algorithm to calculate the total rental price Cars
- 3- linear search algorithm to search for customer  $O(n)$



# OUTPUT OF LOG IN AS EMPLOYEE



-----RENTAL CAR APP-----

1-LOG IN AS AN EMPLOYEE    2-REGISTER AS A CUSTOMER    3-EXIT

1

ENTER YOUR USERNAME:

user1

ENTER YOUR PASSWORD:

1234

-----WELCOME FARAH-----

1-VIEW CARS    2-UPDATE CAR STATUS    3- VIEW AND SORT EMPLOYEES    4- VIEW AND SORT CARS    5-VIEW POTENTIAL PROF

1

CAR INFORMATION

CAR MAKE : Toyota  
CAR MODEL : Camry  
CAR COLOUR : Red  
CAR TYPE : Sedan  
CAR YEAR : 2021  
CAR REGISTRATION NUMBER : TCB123415856  
CAR PRICE PER DAY : 250.0  
CAR STATUS : Available

CAR INFORMATION

CAR MAKE : Hyundai  
CAR MODEL : Kona  
CAR COLOUR : Black  
CAR TYPE : Small SUV  
CAR YEAR : 2022  
CAR REGISTRATION NUMBER : HK877567891324

-----WELCOME FARAH-----

1-VIEW CARS    2-UPDATE CAR STATUS    3- VIEW AND SORT EMPLOYEES    4- VIEW AND SORT CARS    5-VIEW POTENTIAL PROF

2

ENTER THE CAR REGISTRATION NUMBER :

OPP612345544

ENTER THE CAR STATUS :

Available

-----WELCOME FARAH-----

1-VIEW CARS    2-UPDATE CAR STATUS    3- VIEW AND SORT EMPLOYEES    4- VIEW AND SORT CARS    5-VIEW POTENTIAL PROF

3

PLEASE CHOOSE THE PREFERRED ALGROTHIM TO SORT THE NAMES

1- MERGE SORT ALGROTHIM    2- INSERT SORT ALGROTHIM    3-EXIT

1

Abigail

Abraham

Adam

Aida

Aiden

Alberta

Alen

Alexander

Alford

Alina

Alina

Alissa

Amber

Anna

Antony

Arianna

Sophia  
Sophia  
Steven  
Tess  
Thomas  
Thomas  
Tiana  
Valeria  
Vanessa  
Walter

the execution time= 8155750

PLEASE CHOOSE THE PREFERRED ALGORITHM TO SORT THE NAMES

1- MERGE SORT ALGORITHM 2- INSERT SORT ALGORITHM 3-EXIT

3

-----WELCOME FARAH-----

1-VIEW CARS 2-UPDATE CAR STATUS 3- VIEW AND SORT EMPLOYEES 4- VIEW AND SORT CARS 5-VIEW POTENTIAL PROF

4

PLEASE CHOOSE THE PREFERRED ALGORITHM TO SORT THE CAR MAKE

1- MERGE SORT ALGORITHM 2- INSERT SORT ALGORITHM 3-EXIT

2

Acura

Acura

Acura

Acura

Acura

Acura

Aston Martin

Aston Martin

Aston Martin

Aston Martin

Saab

Saab

Saab

Saab

Saab

Saab

Suzuki

Suzuki

Suzuki

Suzuki

Suzuki

Suzuki

Toyota

Toyota

Toyota

the execution time= 11782666

PLEASE CHOOSE THE PREFERRED ALGORITHM TO SORT THE CAR MAKE

1- MERGE SORT ALGORITHM 2- INSERT SORT ALGORITHM 3-EXIT

3

-----WELCOME FARAH-----

1-VIEW CARS 2-UPDATE CAR STATUS 3- VIEW AND SORT EMPLOYEES 4- VIEW AND SORT CARS 5-VIEW POTENTIAL PROF

5

WHAT DO YOU WANNA VIEW... 1-DAILY PROFIT 2-MONTHLY PROFIT 3-ANNUAL PROFIT

1

Expected DAILY profit : 23750.0SR

the execution time fot the linearSum Recursion Algorithm= 1827833

-----WELCOME FARAH-----

1-VIEW CARS 2-UPDATE CAR STATUS 3- VIEW AND SORT EMPLOYEES 4- VIEW AND SORT CARS 5-VIEW POTENTIAL PROF

|



# OUTPUT OF REGISTER AS A CUSTOMER



$$\begin{array}{ccccccc}
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\end{array}$$

```
-----RENTAL CAR APP-----
1-LOG IN AS AN EMPLOYEE      2-REGISTER AS A CUSTOMER      3-EXIT
```

```

-----RENTAL CAR APP-----
1-LOG IN AS AN EMPLOYEE      2-REGISTER AS A CUSTOMER      3-EXIT
2
1-VIEW CARS  2-VIEW CUSTOMERS  3-SORT CUSTOMERS BY NAME  4-RENT A CAR  5-VIEW MY RENTED CARS  6-EXIT
1

```

CAR INFORMATION

```
CAR MAKE : Toyota
CAR MODEL : Camry
CAR COLOUR : Red
CAR TYPE : Sedan
CAR YEAR : 2021
CAR REGISTRATION NUMBER : TCB123415856
CAR PRICE PER DAY : 250.0
CAR STATUS : Available
```

### CAR INFORMATION

CAR MAKE : Hyundai  
CAR MODEL : Kona  
CAR COLOUR : Black  
CAR TYPE : Small SUV  
CAR YEAR : 2022  
CAR REGISTRATION NUMBER : HKB77567891324  
CAR PRICE PER DAY : 300.0  
CAR STATUS : Available

CAR INFORMATION

STATUS : Available	
1-VIEW CARS 2-VIEW CUSTOMERS 3-SORT CUSTOMERS BY NAME 4-RENT A CAR 5-VIEW MY RENTED CARS 6-EXIT	
2	
*****	
All Customers	
Name: Ali Mohammed, License Number: 123456, Address: City Street, Riyadh, Saudi Arabia, Phone Number: 05555555	Total Rental Price: 0.0
Name: Fatima Ahmed, License Number: 234567, Address: Tahlia Street, Jeddah, Saudi Arabia, Phone Number: 055555	Total Rental Price: 0.0
Name: Mohammed Abdullah, License Number: 345678, Address: Sheikh Zayed Road, Dubai, United Arab Emirates, Phon	Total Rental Price: 0.0
Name: Samira Ali, License Number: 456789, Address: Champs-Élysées, Paris, France, Phone Number: 0123456789	Total Rental Price: 0.0
Name: Khalid Mustafa, License Number: 567890, Address: Emerald Street, Cairo, Egypt, Phone Number: 0111111111	Total Rental Price: 0.0
Name: Nour ELDin Mahmoud, License Number: 678901, Address: Hamra Street, Tripoli, Libya, Phone Number: 0922222	Total Rental Price: 0.0
Name: Reem Abdullah, License Number: 789012, Address: University Street, Riyadh, Saudi Arabia, Phone Number: 0	Total Rental Price: 0.0
Name: Ahmed Hussein, License Number: 890123, Address: King Faisal Street, Dammam, Saudi Arabia, Phone Number:	Total Rental Price: 0.0
Name: Zainab Ali, License Number: 901234, Address: Sheikh Rashid Street, Abu Dhabi, United Arab Emirates, Phon	Total Rental Price: 0.0
Name: Mariam Ammar, License Number: 1234567, Address: Gulf Street, Doha, Qatar, Phone Number: 0978965432	Total Rental Price: 0.0
Name: Saud Mohammed, License Number: 2345678, Address: Sea Street, Jeddah, Saudi Arabia, Phone Number: 0505555	Total Rental Price: 0.0
Name: Lama Abdullah, License Number: 3456789, Address: Prince Sultan Street, Riyadh, Saudi Arabia, Phone Numbe	Total Rental Price: 0.0
Name: Omar Hussein. License Number: 4567890. Address: Nile Street. Khartoum. Sudan. Phone Number: 0912345678	
	Total Rental Price: 0.0
	Name: Abdullah Mohammed, License Number: 2345678, Address: King Abdulaziz Road, Jeddah, Saudi Arabia, Phone Nu
	Total Rental Price: 0.0
	Name: Mariam Ali, License Number: 3456789, Address: Specialized Street, Riyadh, Saudi Arabia, Phone Number: 05
	Total Rental Price: 0.0
	1-VIEW CARS 2-VIEW CUSTOMERS 3-SORT CUSTOMERS BY NAME 4-RENT A CAR 5-VIEW MY RENTED CARS 6-EXIT
3	
	Name: Abdullah Mohammed, License Number: 2345678, Address: King Abdulaziz Road, Jeddah, Saudi Arabia, Phone Nu
	Name: Ahmed Hussein, License Number: 890123, Address: King Faisal Street, Dammam, Saudi Arabia, Phone Number:
	Name: Aisha Abdullah, License Number: 9012345, Address: Salam Street, Sana'a, Yemen, Phone Number: 014444444
	Name: Ali Mohammed, License Number: 123456, Address: City Street, Riyadh, Saudi Arabia, Phone Number: 05555555
	Name: Fatima Ahmed, License Number: 234567, Address: Tahlia Street, Jeddah, Saudi Arabia, Phone Number: 055555
	Name: Fatima Mahmoud, License Number: 5678901, Address: Al-Mashtal Street, Amman, Jordan, Phone Number: 079123
	Name: Hassan Ali, License Number: 6789012, Address: Al-Hashemi Street, Baghdad, Iraq, Phone Number: 0799999999
	Name: Khalid Mustafa, License Number: 567890, Address: Emerald Street, Cairo, Egypt, Phone Number: 0111111111
	Name: Laila Ahmed, License Number: 7890123, Address: Khalid Bin Waleed Avenue, Manama, Bahrain, Phone Number:
	Name: Lama Abdullah, License Number: 3456789, Address: Prince Sultan Street, Riyadh, Saudi Arabia, Phone Numbe
	Name: Mariam Ali, License Number: 3456789, Address: Specialized Street, Riyadh, Saudi Arabia, Phone Number: 05
	Name: Mariam Ammar, License Number: 1234567, Address: Gulf Street, Doha, Qatar, Phone Number: 0978965432
	Name: Mohammed Abdullah, License Number: 345678, Address: Sheikh Zayed Road, Dubai, United Arab Emirates, Phon
	Name: Nour ELDin Mahmoud, License Number: 678901, Address: Hamra Street, Tripoli, Libya, Phone Number: 0922222
	Name: Omar Hussein, License Number: 4567890, Address: Nile Street, Khartoum, Sudan, Phone Number: 0912345678
	Name: Reem Abdullah, License Number: 789012, Address: University Street, Riyadh, Saudi Arabia, Phone Number: 0
	Name: Samira Ali, License Number: 456789, Address: Champs-Élysées, Paris, France, Phone Number: 0123456789
	Name: Sara Mohammed, License Number: 1234567, Address: Square Street, Riyadh, Saudi Arabia, Phone Number: 0555
	Name: Saud Mohammed, License Number: 2345678, Address: Sea Street, Jeddah, Saudi Arabia, Phone Number: 0505555
	Name: Youssef Ibrahim, License Number: 8901234, Address: Andalus Street, Muscat, Oman, Phone Number: 95888888
	Name: Zainab Ali, License Number: 901234, Address: Sheikh Rashid Street, Abu Dhabi, United Arab Emirates, Phon
	1-VIEW CARS 2-VIEW CUSTOMERS 3-SORT CUSTOMERS BY NAME 4-RENT A CAR 5-VIEW MY RENTED CARS 6-EXIT

Name: Lama Abdullah, License Number: 3456789, Address: Prince Sultan Street, Riyadh, Saudi Arabia, Phone Number: 05  
Name: Mariam Ali, License Number: 3456789, Address: Specialized Street, Riyadh, Saudi Arabia, Phone Number: 05  
Name: Mariam Ammar, License Number: 1234567, Address: Gulf Street, Doha, Qatar, Phone Number: 0978965432  
Name: Mohammed Abdullah, License Number: 345678, Address: Sheikh Zayed Road, Dubai, United Arab Emirates, Phone Number: 0922222  
Name: Nour ElDin Mahmoud, License Number: 678901, Address: Hamra Street, Tripoli, Libya, Phone Number: 0922222  
Name: Omar Hussein, License Number: 4567890, Address: Nile Street, Khartoum, Sudan, Phone Number: 0912345678  
Name: Reem Abdullah, License Number: 789012, Address: University Street, Riyadh, Saudi Arabia, Phone Number: 0  
Name: Samira Ali, License Number: 456789, Address: Champs-Élysées, Paris, France, Phone Number: 0123456789  
Name: Sara Mohammed, License Number: 1234567, Address: Square Street, Riyadh, Saudi Arabia, Phone Number: 0555  
Name: Saud Mohammed, License Number: 2345678, Address: Sea Street, Jeddah, Saudi Arabia, Phone Number: 0505555  
Name: Youssef Ibrahim, License Number: 8901234, Address: Andalus Street, Muscat, Oman, Phone Number: 95888888  
Name: Zainab Ali, License Number: 901234, Address: Sheikh Rashid Street, Abu Dhabi, United Arab Emirates, Phone Number: 0  
1-VIEW CARS 2-VIEW CUSTOMERS 3-SORT CUSTOMERS BY NAME 4-RENT A CAR 5-VIEW MY RENTED CARS 6-EXIT

4

Enter the customer license number that you want to Rent  
2345678  
ENTER THE REGISTRATION NUMBER OF THE CAR YOU WANT TO RENT  
DVH145678956  
ENTER THE RENTAL DATE IN THIS FORMMAT MM/DD/YYYY  
2/22/2023  
ENTER THE RETURN DATE IN THIS FORMMAT MM/DD/YYYY  
3/22/2023  
7000.0  
CARD NUMBER:  
22209374563  
CARDHOLDER NAME:  
asayelamal  
Rental added to Saud Mohammed's rental history.  
1-VIEW CARS 2-VIEW CUSTOMERS 3-SORT CUSTOMERS BY NAME 4-RENT A CAR 5-VIEW MY RENTED CARS 6-EXIT

5

2345678  
ENTER THE REGISTRATION NUMBER OF THE CAR YOU WANT TO RENT  
DVH145678956  
ENTER THE RENTAL DATE IN THIS FORMMAT MM/DD/YYYY  
2/22/2023  
ENTER THE RETURN DATE IN THIS FORMMAT MM/DD/YYYY  
3/22/2023  
7000.0  
CARD NUMBER:  
22209374563  
CARDHOLDER NAME:  
asayelamal  
Rental added to Saud Mohammed's rental history.  
1-VIEW CARS 2-VIEW CUSTOMERS 3-SORT CUSTOMERS BY NAME 4-RENT A CAR 5-VIEW MY RENTED CARS 6-EXIT

5

CAR INFORMATION

CAR INFORMATION

CAR MAKE : GMC  
CAR MODEL : GMC  
CAR COLOUR : Red  
CAR TYPE : Sedan  
CAR YEAR : 2023  
CAR REGISTRATION NUMBER : DVH145678956  
CAR PRICE PER DAY : 250.0  
CAR STATUS : Available  
CAR RENTAL DATE OUT : 2/22/2023  
CAR RENTAL DATE RETURN : 3/22/2023

# BIG O

## For some method





```
public double  
calculateTotalRentalPrice(Customer  
customer) {  
    double total = 0.0;  
    for (Rental rental :  
customer.getRentals()) {  
        total += rental.getTotalPrice();  
    }  
    return total;  
}
```



The big O notation for this code is  $O(n)$ , where  $n$  is the number of rentals in the customer's rental list. The time complexity increases linearly with the number of rentals, so it has a linear time complexity.



```
public void insertionSort( ArrayList <
Employees> a ){
    int i, j, k;
    Employees temp;
    for (i = 1; i < a.size(); i++){
        temp = a.get(i);
        for (j = 0; j < i; j++) {
            if (a.get(i).compareTo(temp) >
a.get(i).compareTo(a.get(j))) {
                break; }
        }
        for (k = i; k > j; k--) {
            a.set(k, a.get(k-1));
        }
        a.set(j,temp); }
}
```



The worst-case time complexity for this insertion sort algorithm is  $O(n^2)$ , where  $n$  is the size of the input array. The total number of comparisons and swaps is roughly  $(1/2)n^2$ , which gives us a quadratic time complexity.



# comparison

We use this method :

```
long startTime = System.currentTimeMillis();
```

```
long endTime =System.currentTimeMillis();
```

```
long elapsed = end Time - startTime;
```

To compare between insert sort algothim and  
merge sort algothem on linked list and array list





# comparison

	ArrayList		LinkedList	
	Merge	Insert	Merge	Insert
Big O	$O(n \log_2 n)$	$O(n^2)$	$O(n \log_2 n)$	$O(n^2)$
Run time	$21386300/5 = 4277260$	$28508200/5 = 5701640$	$12370300/5 = 2474060$	$10112600/5 = 5056300$

Based on the schedule:

- 1-merge sort algorithm is better than insert sort algorithm.
- 2- linked list is better than array list in sorting.