NANYANG TECHNOLOGICAL UNIVERSITY
SINGAPORE

SC2006-24S1 Software Engineering
#Lab 1 Deliverables

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Functional Requirements

REQ-1: Upon loading, the system must **show all public carparks with vacancies** within a radius of 100 metres within 2 seconds.

1.1 There is a button for the user to toggle below the search bar to indicate the sorting method for carparks.

1.1.1 If the button is toggled on, the system shows nearest carparks for all searches within 2 seconds.

1.1.2 If the button is toggled off, the system shows carparks with the lowest parking fees for all searches within 2 seconds.

1.2 There is another button for the user to toggle below the search bar, which indicates if the user is driving an electric vehicle.

1.2.1 If the button is toggled on, the system shows carparks with electric vehicle charging points for all searches.

1.2.2 If the button is toggled off, the system shows parking spaces for all searches.

1.3 If the user clicks on a carpark, a description of the carpark is shown to the reader. There will also be a button that allows the user to navigate to the chosen carpark directly.

1.3.1 If the user clicks on the button to move to the carpark, a navigation route will be initialised for the user to follow.

1.4 If there is no internet connection on the system device, it is reported and the user is notified of the report.

REQ-2: Users are able to query the system for **nearest carpark availability.**

2.1 Users are able to query with *either their current location address* or enter a *chosen location address* on a search bar on the top of the screen.

2.1.1 The location address must be text of at least 1 character and less than 512 characters

2.1.2 As the user types the location address, the system shows a drop-down menu of the 5 most relevant addresses to the text in the search bar.

2.1.3 If there are no relevant addresses to the input text, it is reported and the user is notified. The application will then show the nearest carparks in the nearest 100 metre radius.

2.2 All query results must have the same format.

2.2.1 The format of the results must be as follows:

- Carpark Address
- Distance from User
- Estimated Travel Time by Car
- Carpark Hourly Rates

- Carpark remaining capacity

REQ-3: Users are able to query the system for **navigation routes** after selecting a destination.

3.1 The query results must have the same format

3.1.1 If the destination queried is a carpark, the results must show the following:

- Distance: Total Distance from the users location to the selected carpark
- Estimated Travel Time: Approximate time required to reach the selected carpark based on current traffic conditions
- Estimated Carpark Rates:
- Estimated ERP Rates:
- Directions: Step by step turn by turn navigation instructions to guide the user from their current location to the carpark.

3.1.2 If the destination queried is not a carpark, the results must show the following:

- Distance: Total Distance from the users location to the selected carpark
- Estimated Travel Time: Approximate time required to reach the selected carpark based on current traffic conditions
- Estimated ERP Rates:
- Directions: Step by step turn by turn navigation instructions to guide the user from their current location to the carpark.

3.2 Users are able to select a carpark from the list of available options provided by the system.

3.2.1 Users must be able to sort the options based on review rating, rates or distance

3.3 Users should have the option to view navigation route on a map with key points of interests(e.g. Fuel stations, EV charging points)

REQ-4: Users are able to bookmark frequently visited locations.
4.1 If the bookmarked location is a carpark, there will be a dropdown showing the following information: - Carpark pricing - Vacancies - If EV charging spots are available - Carpark address
4.2 Users are able to navigate to bookmarked locations by tapping on them in the bookmarks page
4.3 Users are able to delete bookmarked locations.

REQ-5: Users are able to select their vehicle type.
5.1 The default vehicle type will be set to ‘Car’. 5.1.1 Carpark and ERP pricing will be applied according to the pricings for cars.
- 5.2 After selecting their vehicle type, carpark ERP pricing will be applied immediately according to their vehicle type.

Non-Functional Requirements

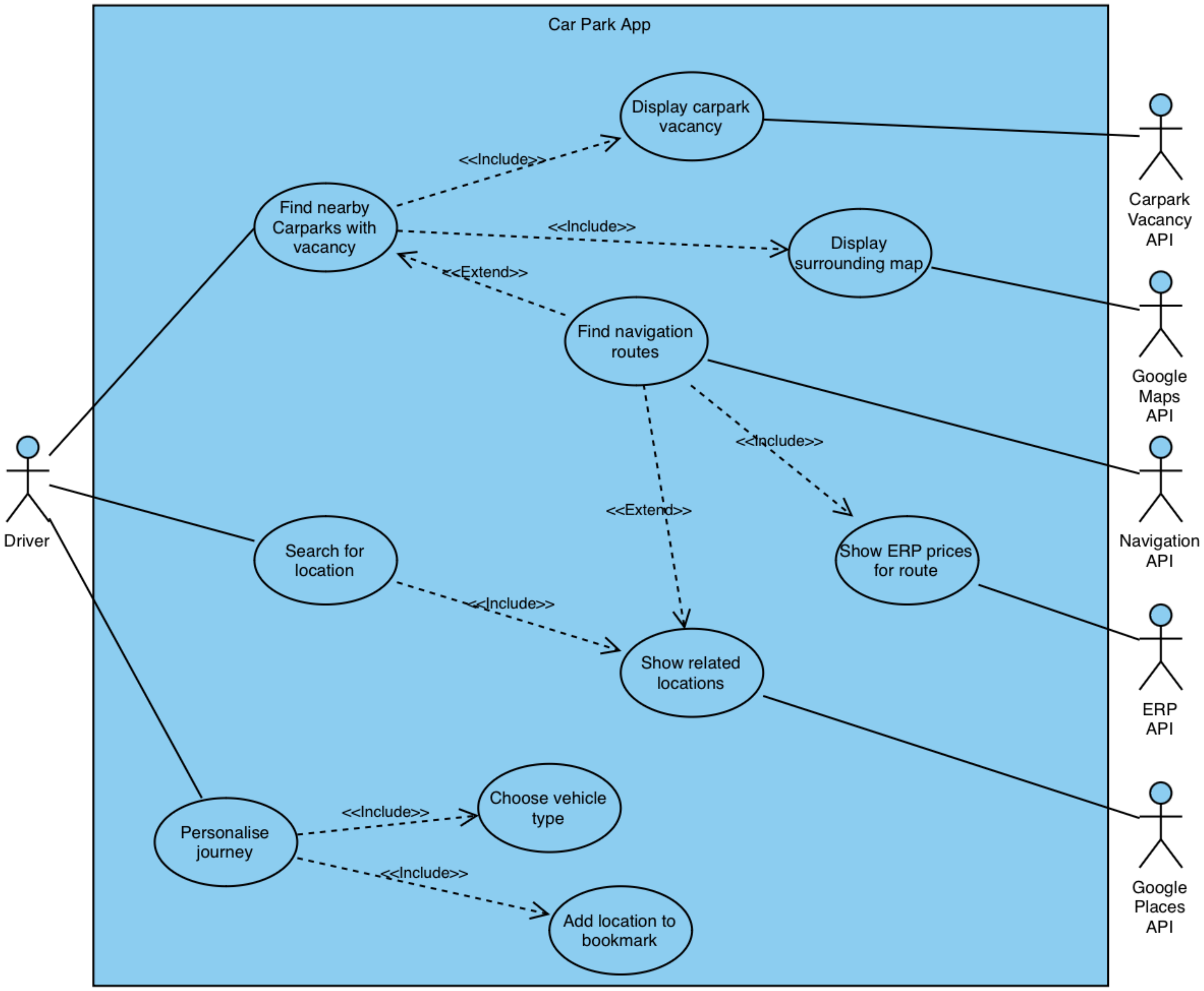
Reliability	1. The generated carpark availability and rates must be at least 95% accurate to ensure that the users have a safe ride. 2. The navigation route must not include roads or bridges that do not exist anymore at least 99% of the time.
Usability	1. The application must be user-friendly and intuitive to minimise the driver's physical interaction with the application. 2. Essential interactions should be done within 10 taps within 60 seconds from the initialisation of the application.
Performance	1. 80% of the navigation updates need to be provided to the user within 120 seconds to ensure smooth journeys. 2. The interface should initialise and become interactive to the user within 30 seconds of launch.
Security	1. User's location and navigation routes should not be stored for privacy purposes. 2. If there is an urgent need to store the user's location and navigation routes, the data must be anonymised.
Maintainability	1. System should be modular in the sense that individual components (such as map display, carpark info, etc) have minimal impact on other components and can be updated independently.

Data Dictionary

Term	Definition
Carpark	A designated area for parking vehicles, which may include public parking spaces and/or private parking spaces
Vacancy	An available parking space within a carpark
Electric Vehicle (EV)	A vehicle that uses one or more electric motors for propulsion, requiring specific charging infrastructure.
User Location	The current geographical position of the app user, which can be automatically detected or manually entered.
User Destination	The intended geographical position the user is heading towards, which may or may not be a carpark
Search Radius	The circular area around a specified location within which the app searches for available carparks. Default is set to 100 metres.
Estimated Travel Time	The predicted duration of travel based on current traffic conditions.
Carpark Capacity	The total number of parking spaces available in a carpark
Carpark Remaining Capacity	The number of vacancies left in a carpark
Navigation Route	A series of directions guiding the user from User Location to a User Destination
Points of Interest	Notable locations along a route indicated by User, such as fuel stations or EV charging points.
Bookmark Page	A page where a list of Bookmarked Locations are shown.
Bookmarked Locations	A place that a user has saved for quick access in future searches

Use Case Diagram example

Use Case Diagram



Use Cases:

Use Case 1: Locating Nearby Carparks

Actor	User (Initiating), Carpark vacancy API, Navigation API, ERP API
Description	Users can **find nearby carparks with vacancy**
Preconditions	1. User has GPS and internet access turned on 2. User is located in Singapore
Postconditions	
Priority	High
Frequency of use	Medium User can choose to perform this action soon after opening the app
Flow of events	1. User opens app and triggers the search for nearby carparks by allowing access to their gps location(need confirmation for this step 1) 2. System will display surrounding carparks around the user's location 3. System will fetch vacancy, routing, and pricing data from the Carpark vacancy API, navigation API, and ERP API for the carparks displayed. 4. The app user selects a carpark and chooses to navigate there 5. System provides navigation details to the selected carpark
Alternative flows	1. A carpark nearby gets its last vacancy filled 2. The system will show the user that the carpark has no more vacancies but still show vacancies for other nearby carparks 3. System returns to normal flow from step #3
Exceptions	1. User does not turn on GPS or navigation services unavailable 2. User does not have Network connectivity 3. Either carpark API or ERP api is down
Includes	-
Special requirements	-
Assumptions	-
Notes and Issues	-

Use Case 2: Searching Locations

Actor	User (Initiating), Google Maps API
Description	Drivers can **search** for a **location of interest**
Preconditions	1. The app user has launched the app and is logged in 2. The app user has access to the internet
Postconditions	1. Successful exit condition: The app user receives information about location of interest and presses the ‘leave’ tab 2. Unsuccessful exit condition: The system informs the user that no relevant locations were found with the search query or there was an invalid location input
Priority	High
Frequency of use	Medium User can choose to perform this action soon after opening the app
Flow of events	1. User selects SearchLocation on the UI. 2. System displays consolidated details of most relevant location results in a dropdown - LocationName, Address, DistanceAway, EstimatedArrivalTime, using the *included use case ‘Show list of related locations’.* 3. User selects the chosen location. 4. System shows details of selected location on the map and shows valid navigation routes using the extended use case ‘Find Navigation Routes’.
Alternative flows	1. User enters location that is not relevant to singapore 2. The system fails to find any relevant locations based on the search query 3. The system displays a message that informs the app user that no results were found and suggests refining the search 4. The app user refines the query and the system resumes from the normal flow at step #1
Exceptions	1. User does not have Network connectivity 2. User does not turn on GPS or navigation services unavailable
Includes	-
Special requirements	-
Assumptions	-
Notes and Issues	-

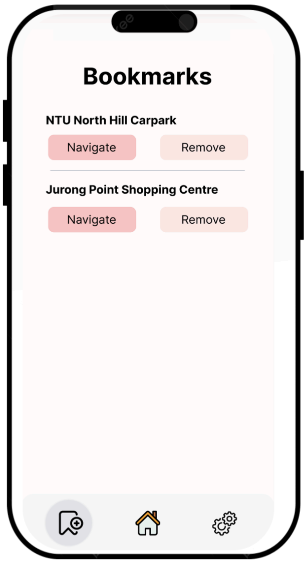
Use case 3: Settings

Actors	User (Initial Actor), System
Description	Drivers can **personalise** the app to be more suited for their journeys
Entry Conditions	1. App user must have internet access on their phone 2. App user clicks on “Settings” tab
Exit Conditions	1. App user clicks on “Leave” tab
Priority	
Frequency of Use	
Flow of Events	1. User selects “Settings” on the UI 2. System displays the settings previously customised by the User. a. If first time entry, or for options not set by the user, System will display the default setting options. This includes Language: English, Vehicle: Car 3. Users change their vehicle type or language according to their preference 4. System updates the app functionalities according to user preference. a. This includes changing the display language, changing the routes and carpark rates and carpark availability and ERP prices for motorcycles and car.
Alternative Flows	1. System encounters an error or network disconnects while updating preferences 2. System informs app user that changes could not be saved due to a system error and prompts the user to try again later 3. System returns to normal flow from step #3 after network and system are restored
Exceptions	1. User does not have Network connectivity
Includes	-
Special Requirements	-
Assumptions	-
Notes and Issues	-

Use case 4: Bookmarking Locations

Actor	User (initial actor)
Description	Users can **bookmark locations** on the app for search convenience
Entry conditions	1. App user must have internet access on their phone 2. App user click on “Bookmark Tab”
Exit conditions	1. User clicks on ‘leave’ tab
Priority	Low
Frequency of use	Low
Flow of events	1. User selects “Bookmark” tab on the UI. 2. System retrieves the bookmarks saved by the user from server-side database and display it on the UI. 3. User selects a chosen location. 4. User selects “Add Bookmark” button on the UI. 5. System saves the bookmarks added by the user to server-side database and displays the new bookmark on the UI. 6. User selects “Remove Bookmark” button on the UI. 7. System removes the bookmarks removed by the user from the UI and updates the information on the server-side database 8. User selects “Navigate To” button on the UI. 9. System performs the SearchLocation function from step 2) to 4) (see above)
Alternative flows	1. User has no bookmarks 2. System displays message indicating that no bookmarks are available and prompts the user to add new bookmarks 3. System returns to normal flow from step #2
Exceptions	1. User does not have Network connectivity 2. Database error when retrieving bookmark information
Includes	-
Special requirements	-
Assumptions	-
Notes and Issues	-

UI Mockups



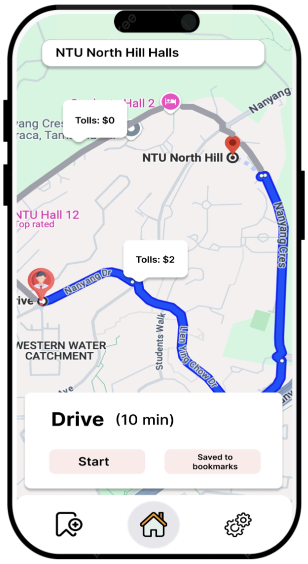
Bookmarks

NTU North Hill Carpark

Navigate Remove

Jurong Point Shopping Centre

Navigate Remove



NTU North Hill Halls

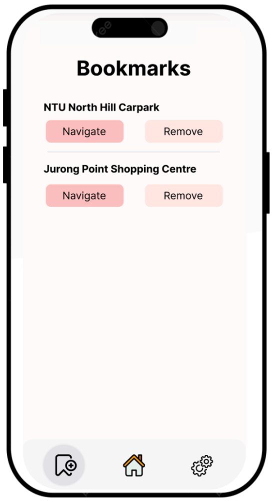
Tolls: $0

Tolls: $2

Drive (10 min)

Start

Saved to bookmarks



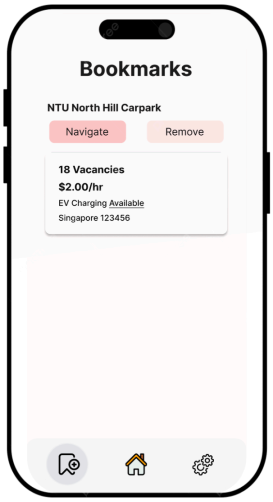
Bookmarks

NTU North Hill Carpark

Navigate Remove

Jurong Point Shopping Centre

Navigate Remove



Bookmarks

NTU North Hill Carpark

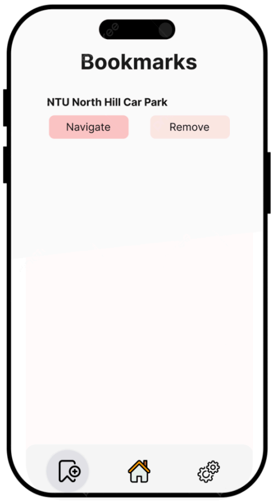
Navigate Remove

18 Vacancies

$2.00/hr

EV Charging Available

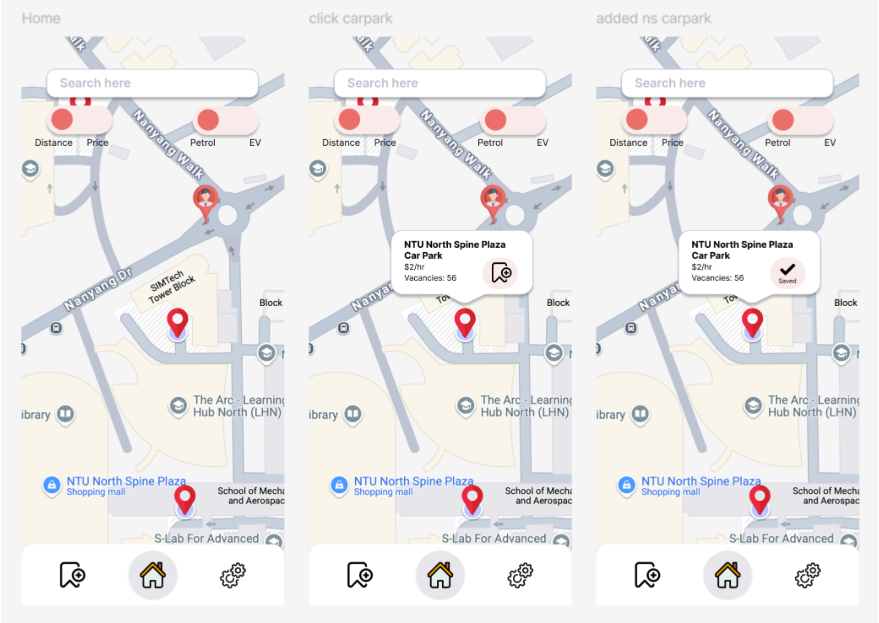
Singapore 123456



Bookmarks

NTU North Hill Car Park

Navigate Remove



Home

Search here

Distance Price Petrol EV

click carpark

Search here

Distance Price Petrol EV

NTU North Spine Plaza Car Park

$2/hr

Vacancies: 56

added ns carpark

Search here

Distance Price Petrol EV

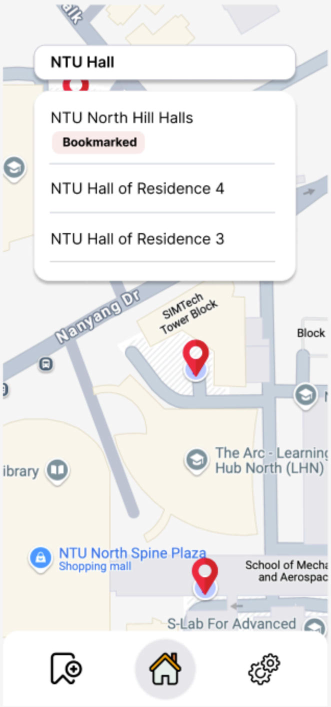
NTU North Spine Plaza Car Park

$2/hr

Vacancies: 56

Saved

search



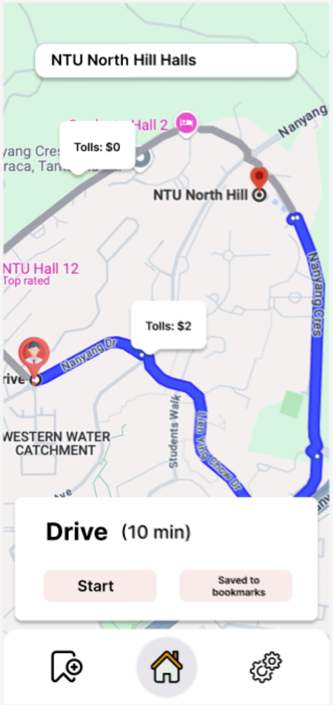
NTU Hall

NTU North Hill Halls
Bookmarked

NTU Hall of Residence 4

NTU Hall of Residence 3

ntu nh



NTU North Hill Halls

Tolls: $0

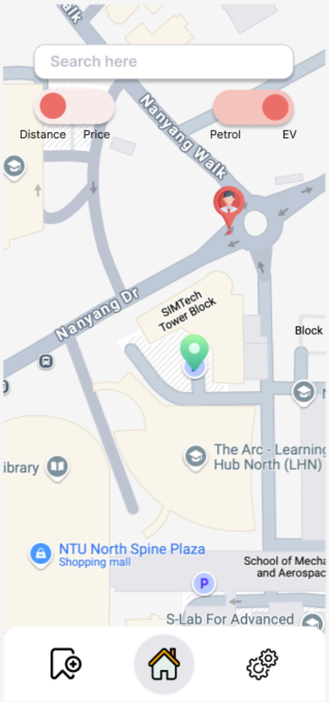
Tolls: $2

Drive (10 min)

Start

Saved to bookmarks

ev button

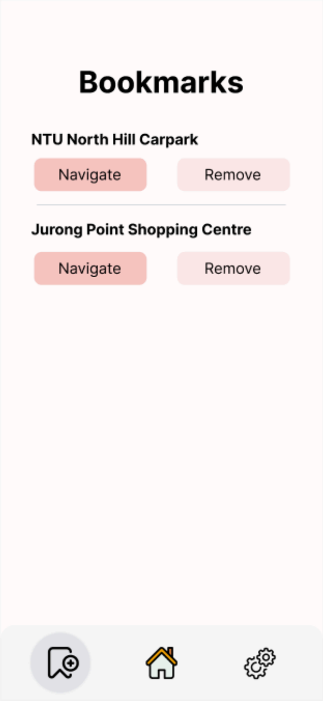


Search here

Distance Price

Petrol EV

Bookmarks



Bookmarks

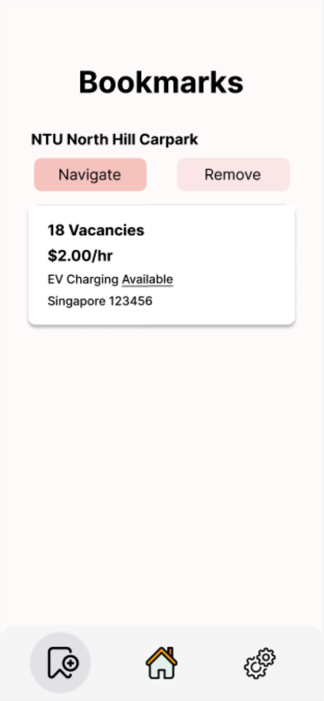
NTU North Hill Carpark

Navigate Remove

Jurong Point Shopping Centre

Navigate Remove

Bookmarks details



Bookmarks

NTU North Hill Carpark

Navigate Remove

18 Vacancies
$2.00/hr
EV Charging Available
Singapore 123456