

**NANYANG
TECHNOLOGICAL
UNIVERSITY**
SINGAPORE

SC2006 - Software Engineering
Lab 1 Deliverables

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1. Documentation of Functional and Non-Functional Requirements

A. Functional Requirements

1. ParkMate shall allow Users to perform parking search & selection tasks.
 - 1.1. ParkMate shall allow Users to enter a destination to search for nearby carparks.
 - 1.1.1. ParkMate shall provide a text input for address/place name.
 - 1.1.2. ParkMate shall display geocoding suggestions matching the query.
 - 1.1.3. Selecting a suggestion shall set that location as the search destination.
 - 1.2. ParkMate shall display nearby carparks around the selected destination in map and list views.
 - 1.2.1. Each carpark shall render as a map marker; tapping a marker shall open a pop-up showing the same fields as 1.7.1.
 - 1.2.2. Clicking/tapping a marker shall open Carpark Details (1.7).
 - 1.3. ParkMate shall refresh live availability data at a fixed interval.
 - 1.3.1. On first load, ParkMate shall fetch availability for all visible/returned carparks.
 - 1.3.2. ParkMate shall auto-refresh availability every 60 seconds, or at the maximum rate allowed by API.
 - 1.4. ParkMate shall allow Users to filter carparks.
 - 1.4.1. ParkMate shall provide filters for height limit, EV chargers availability, sheltered, and operating hours.
 - 1.4.2. Activating/deactivating a filter shall immediately update both map and list results.
 - 1.4.3. ParkMate shall display the number of active filters and allow Users to clear all filters in one action.
 - 1.5. ParkMate shall allow Users to sort carparks.
 - 1.5.1. ParkMate shall support sorting by Availability (descending), Price, and Distance.
 - 1.5.2. The currently selected sort shall be visually indicated; ties shall be resolved by Distance.
 - 1.6. ParkMate shall display parking cost details for the selected carpark (read-only tariff rules).
 - 1.6.1. ParkMate shall retrieve the latest tariff information from the system's carpark database and present the corresponding rates clearly.
 - 1.6.2. If tariff data is incomplete, outdated, or unavailable, ParkMate shall display: "Parking cost information unavailable."
 - 1.7. ParkMate shall display Carpark Details.
 - 1.7.1. Details shall include full address, height limit, carpark type, tariff table, operating hours, availability by lot type (if provided), and data-source attribution.
 - 1.7.2. ParkMate shall display the last-updated time for availability and the source (e.g., HDB/URA).

2. ParkMate shall support basic account & profile management.
 - 2.1. ParkMate shall allow Users to register with email and password.
 - 2.1.1. ParkMate shall require email format validation and a password of at least 12 characters including uppercase, lowercase, numbers, and symbols.
 - 2.1.2. If the email is already registered, ParkMate shall display "Email already in use."
 - 2.1.3. If passwords do not match, ParkMate shall display "Passwords do not match."
 - 2.2. ParkMate shall allow Users to log in.
 - 2.2.1. If credentials are invalid, ParkMate shall display "Email and password do not match."
 - 2.2.2. On successful login, ParkMate shall navigate the User to the Home screen.
 - 2.3. ParkMate shall allow Users to reset their password.
 - 2.3.1. At the login page, the user will click on the "Reset your password" option.
 - 2.3.2. ParkMate shall send a password reset email upon request.
 - 2.3.3. After password change (per 2.1.1), the user shall be able to log in.
 - 2.4. ParkMate shall allow Users to delete their account.
 - 2.4.1. ParkMate shall require explicit confirmation before deletion.
 - 2.4.2. Upon deletion, ParkMate shall remove favourites and profile preferences associated with the account.
 - 2.5. ParkMate shall allow Users to view Terms of Service (TOS) and Privacy Policy.
 - 2.5.1. TOS and Privacy Policy shall be accessible from the Profile Page.
 - 2.5.2. ParkMate shall display the content version/date.
 - 2.6. ParkMate shall allow users to log out.
 - 2.6.1. At the settings page, the user will be able to log out.
 - 2.6.2. After logout, the User shall be directed to the Login page.
3. ParkMate shall handle external data, errors, and edge cases visibly to the User.
 - 3.1. When external APIs are unreachable, ParkMate shall display a banner: "Live data temporarily unavailable – showing last update at HH:MM."
 - 3.1.1. ParkMate shall continue to show the last-known availability values with a timestamp of the latest update.
 - 3.1.2. ParkMate shall refresh in the background and remove the banner once fresh data is received.
 - 3.2. When location permission is denied, ParkMate shall still allow destination-based search.
 - 3.2.1. ParkMate shall compute distance from destination rather than current location and label it "from destination".
 - 3.3. ParkMate shall limit the frequency of external data requests initiated by the User.
 - 3.3.1. ParkMate shall throttle manual refresh actions to at most 1 request per second per User and queue excess requests.
 - 3.3.2. ParkMate shall indicate when results are being refreshed with a loading state.
 - 3.4. ParkMate shall expose an "Open in Maps" link as an optional external handoff (not turn-by-turn in-app navigation).
 - 3.4.1. Selecting the link shall open the carpark location in the device's Google Maps app.

- 3.4.2. If no maps app is available, ParkMate shall display an error message with copyable address text.
4. Parkmate will redirect to external maps
 - 4.1. ParkMate shall expose an “Open in Maps” link as an optional external handoff (not turn-by-turn in-app navigation).
 - 4.1.1. Selecting the link shall open the carpark location in the device’s Google Maps app.
 - 4.1.2. If no maps app is available, ParkMate shall display an error message with copyable address text.
5. ParkMate shall allow Users to view and manage their Carpark Selection History.
 - 5.1. ParkMate shall automatically record a history entry whenever a User selects a carpark (from List view, Map pop-up, or Details view).
 - 5.1.1. Each entry shall store the carpark identifier and the timestamp of selection.
 - 5.1.2. Consecutive duplicate selections of the same carpark shall update the existing entry’s timestamp instead of creating a duplicate.
 - 5.1.3. ParkMate shall retain the most recent 20 entries.
 - 5.1.4. Each history row shall display: carpark name and last selected time.
 - 5.1.5. Tapping a history entry shall open Carpark Details and set it as the current selection.
 - 5.1.6. ParkMate shall persist history per authenticated User.
 - 5.1.7. If history cannot be retrieved (e.g., offline or service error), ParkMate shall show a non-blocking message and display any locally cached entries if available.
6. ParkMate will allow EV mode for EV users.
 - 6.1. ParkMate shall allow Users to toggle EV mode to focus on EV charging sites near the selected destination.
 - 6.1.1. When EV mode is on, ParkMate shall display EV sites with live status (available / in use / offline) and a last-updated timestamp (if provided).
 - 6.1.2. When EV mode is off, EV-specific UI elements shall be hidden.
 - 6.2. ParkMate shall allow Users to filter EV results by connector type and charging speed.
 - 6.2.1. Connector type options shall include common standards (e.g., Type 2, CCS2).
 - 6.2.2. Charging speed filters shall distinguish AC vs DC and/or kW bands as available from the data source.
 - 6.2.3. Applying/removing an EV filter shall immediately update both map and list results.
 - 6.3. ParkMate shall allow Users to sort EV sites.
 - 6.3.1. ParkMate shall support sorting by Available chargers (descending) and Distance (ascending) in EV mode.
 - 6.3.2. The selected sort shall be visually indicated; ties shall be resolved by Distance.
 - 6.4. ParkMate shall retain the active EV filters/sort for the current session and apply them to refreshed results.

B. Non-Functional Requirements

Efficiency	<p>Destination search latency: Results shall be returned within $\leq 3\text{s}$ (95th pct) on normal 4G; $\leq 1.5\text{s}$ (50th pct).</p> <p>Panning/zooming shall maintain ≥ 55 FPS with ≤ 500 markers visible at low zoom, scaling up to $\leq 3,000$ markers at high zoom via deterministic down-sampling.</p> <p>Automatic EV updates (60–120s) shall complete in $\leq 800\text{ms}$ and shall not block UI thread.</p> <p>Time-to-interactive shall be $\leq 2.5\text{s}$ on mid-tier Android (2021) over 4G; bundles are code-split and compressed (gzip/br).</p> <p>All list/map APIs shall support HTTP caching (ETag/Last-Modified) and delta responses where available, reducing payload by $\geq 40\%$ versus full loads.</p> <p>Map tiles and static assets shall be cached with a TTL of $\geq 24\text{h}$ and respect cache revalidation headers.</p>
Robustness	<p>All multi-step writes (e.g., save favourite → write history) shall be executed atomically with rollback on any error.</p> <p>Client and server shall validate all inputs; invalid requests return 400 with field-level errors, no partial writes.</p> <p>External provider calls shall timeout in $\leq 5\text{s}$, retry up to 3 times with exponential backoff (500ms→2s).</p> <p>After 3 consecutive provider failures in 60s, the circuit shall open for 30–60s to protect the system.</p> <p>When providers fail, the app shall surface cached results with a “Live data temporarily unavailable” banner and keep navigation/filters usable.</p> <p>All POST endpoints that may be re-tried shall support idempotency keys to prevent duplicate writes.</p>
Maintainability	<p>Features (auth, carpark, EV, history, filters) shall be isolated modules with separate controllers/services and shared interfaces.</p> <p>All endpoints shall be described in OpenAPI/Swagger and generated client types used in the app.</p> <p>CI shall enforce lint, format, type-check, and unit tests with $\geq 70\%$ line & branch coverage on core services.</p> <p>Environment-specific settings (API keys, TTLs, limits) shall be injected via env variables; no secrets in code.</p> <p>Logs shall include request id, user id (if available), endpoint,</p>

	<p>latency, status, provider, and be retained ≥ 30 days.</p> <p>New behavior (e.g., an additional EV provider) shall be toggleable at runtime with safe fallbacks.</p>
Reliability	The system shall be available $\geq 99.5\%$ monthly, including peak evening hours.
	Live availability shall auto-refresh every 60–120s; UI shows “Last updated HH:MM”.
	On app restart or network loss, the app shall restore last search state and show cached results within 5s.
	Readiness/liveness probes shall expose dependency health; a failing dependency must not crash the process.
	API error rate shall remain $<1\%$ (5-min rolling); alerts trigger when $\geq 2\%$ for 10 minutes.
	Forms shall submit only when all validations pass; otherwise a consolidated error list is shown.
Security	Issue short-lived JWT access tokens and refresh tokens; revoke on logout/rotation.
	Passwords are stored using bcrypt (≥ 10 rounds) with per-user salts; never returned in any response (server strips passwordHash).
	Backend uses role-based access and principle of least privilege for DB/service accounts.
	All traffic over TLS 1.2+; frontend enforces CORS allow-list and Content-Security-Policy.
	Sanitize and validate all inputs; encode outputs to prevent XSS/SQLi; denylist dangerous headers; rate-limit auth endpoints.
	Secrets are stored in env/secret manager; access is audited; security logs capture auth failures, token use, and admin actions.

2. Data Dictionary

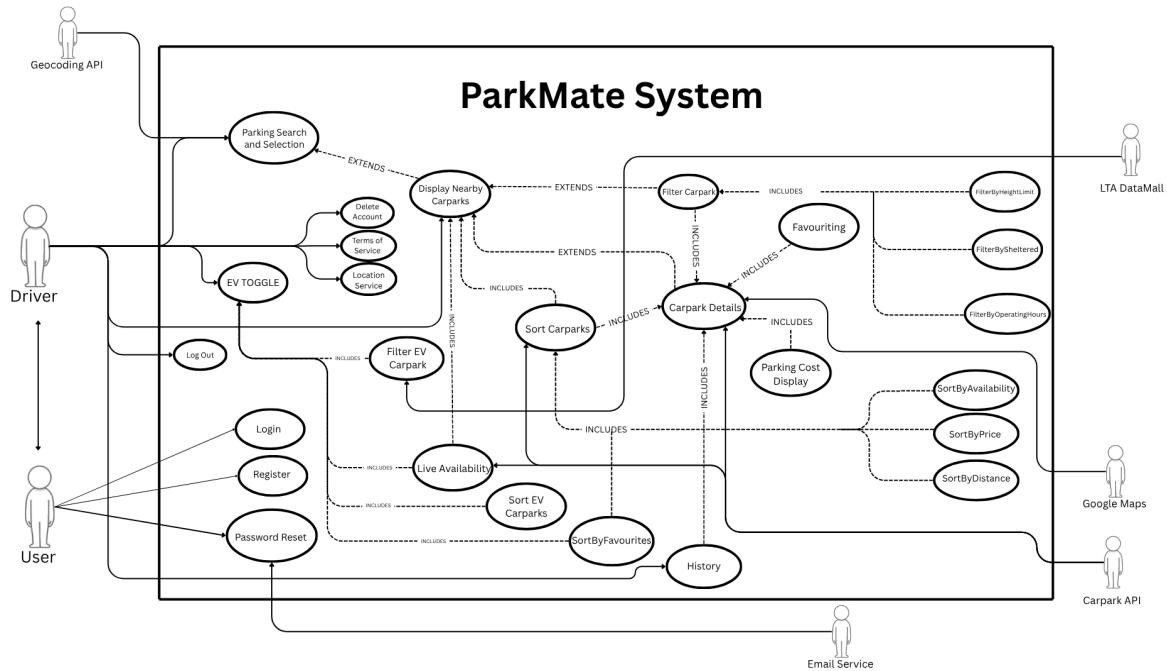
Term	Definition
Account	A registered user profile in the ParkMate system that stores authentication credentials and user preferences.
API (Application Programming Interface)	An external service that ParkMate integrates with to retrieve data such as carpark information, geocoding, and availability.
API Timeout	A failure condition that occurs when an API does not respond within the expected timeframe.
Availability	The current number of parking lots available at a specific carpark at a given time.
Auto-refresh	An automated system process that updates carpark availability data at regular intervals (every 60 seconds).
Cached Data	Previously retrieved information stored locally on the device to display.
Carpark	A parking facility where vehicles can be parked, with associated attributes like location, pricing, and availability.
Carpark API	An external service that provides real-time information about carpark details and availability.
Carpark Details	Comprehensive information about a specific carpark including name, distance, availability, price, type, and height limit.
Carpark Type	The classification of a carpark (e.g., open, sheltered).
Charging Speed	The rate at which an EV charger can charge a vehicle.
Connector Type	The specific type of charging plug used at an EV charging station (e.g., Type 2, CCS2, CHAdeMO).
Credentials	The email and password combination used by a user to authenticate and access their account.
Current Location	The user's present geographic position, obtained through device location services.

Destination	A location selected by the user as the reference point for searching nearby carparks.
Distance	The measured proximity between a carpark and either the user's current location or selected destination.
EV (Electric Vehicle)	A vehicle powered by electricity rather than conventional fuel.
EV Charging Station	A facility within or near a carpark that provides charging infrastructure for electric vehicles.
EV Mode	A specialized interface theme and feature set designed specifically for electric vehicle drivers, with green UI color scheme.
Favourite	A carpark that a user has marked for quick access and reference in future sessions.
Filter	A user-applied criteria that limits displayed carparks to only those matching specific attributes.
Geocoding API	An external service that converts address text into geographic coordinates and provides location suggestions.
Height Limit	The maximum vehicle height (in meters) that can enter a carpark facility.
History	A chronological record of carparks that a user has previously selected or viewed.
Hourly Rate	The parking fee charged per hour at a carpark.
Live Availability	Real-time data showing the current number of available parking slots at a carpark.
Location Permission	Device settings that allow or deny ParkMate access to the user's current geographic position.
Login	The process of authenticating a user's credentials to grant access to the ParkMate system.
Logout	The process of terminating a user's active session and returning to the login screen.
Map View	A display format showing carparks as markers on an interactive map interface.
Operating Hours	The time periods during which a carpark is open and available

	for use.
Password	A secret authentication credential used with email to access a user account.
Password Hash	An encrypted version of a user's password stored securely in the database.
Price	The cost of parking at a carpark, which may vary based on duration and time of day.
Session	An authenticated period during which a user remains logged into the ParkMate system.
Sheltered Parking	Covered parking facilities that protect vehicles from weather elements.
Sort	A function that reorders displayed carparks based on selected criteria (Distance, Price, Availability, Favourites, Nearby).
Tariff	The pricing structure and rules for parking fees at a specific carpark.
Timestamp	A date and time marker indicating when an event occurred or data was last updated.
Toggle	A UI control that switches between two states (e.g., map view/list view, EV mode on/off).
User	A person who interacts with the ParkMate system, typically a driver seeking parking.

3. Initial Use Case Model

A. Use Case Diagram



CANVA LINK:

https://www.canva.com/design/DAGx_sMz68o/EdTjFh16nnCxX3W4SvKUiw/edit

B.Use Case Descriptions

I. For Functional Requirement #1

a. Parking Search & Selection

Use Case ID:	#1-1		
Use Case Name:	Parking Search & Selection		
Created By:	Yibin	Last Updated By:	Harshil
Date Created:	06 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver(user), Parkmate System, Geocoding API
Description:	Searches for nearby carparks by entering the destination. ParkMate provides geocoding suggestions based on the query, and when a suggestion is selected, the system sets the location as the search destination in Google Maps.
Preconditions:	<ul style="list-style-type: none">User account exists (#2-1)User logged in (#2-2)Parkmate has access to a geocoding service and a carpark database.
Postconditions:	<p>Success:</p> <ul style="list-style-type: none">Destination is set as the search location and a List of nearby carparks is retrieved and displayed <p>Failure:</p> <ul style="list-style-type: none">No location set
Priority:	High
Frequency of Use:	High
Flow of Events:	<ol style="list-style-type: none">User navigates to the Search Carpark.Parkmate prompts users to input addresses with the “Current Location” option.User input address.Parkmate retrieves location data from the Geocoding API.Parkmate displays a list of location suggestions based on the query.User selects a location from the list.Parkmate sets selection as search destination in google maps.
Alternative Flows:	<p>No location suggestions</p> <ol style="list-style-type: none">Display message: No matching locations found.Return to Step 2.

Exceptions:	EX-01: Geocoding API unavailable 1. Parkmate is unable to connect to API. 2. Display message: "Unable to retrieve location data. Please try again later." EX-02: Invalid address format 1. User enters gibberish, special characters, or unsupported language. 2. Display message: "Invalid input. Please enter a valid address." EX-03: Carpark database not reachable 1. Parkmate cannot connect to the backend database storing the carpark information.
Includes:	None
Special Requirements:	None
Assumptions:	None
Notes and Issues:	None

b. Display Nearby Carparks

Use Case ID:	#1-2		
Use Case Name:	Display Nearby Carparks		
Created By:	Yibin	Last Updated By:	Harshil
Date Created:	06 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver(user), Parkmate System
Description:	ParkMate displays nearby carparks around the selected destination. The user can toggle between map view and list view.
Preconditions:	<ul style="list-style-type: none"> • Destination selected (#1-1) • Parkmate has access to the carpark data
Postconditions:	<p>Success:</p> <ul style="list-style-type: none"> • Parkmate displays nearby carparks <p>Failure:</p> <ul style="list-style-type: none"> • No carpark display
Priority:	High
Frequency of Use:	High
Flow of Events:	<ol style="list-style-type: none"> 1. Parkmate displays a toggle for user to choose list or map based view while showing map view on default 2. Parkmate displays markers on the map, each representing a carpark 3. User selects a marker. 4. The selected carpark will be saved to history. 5. Each carpark shows (map view) the following details (#1-8): <ul style="list-style-type: none"> - Name - Distance - Live availability of carpark slots - Price - Height limit - Last updated time
Alternative Flows:	<p>List view</p> <ol style="list-style-type: none"> 1. Displays each carpark as a list with the same details as Step 5. 2. Clicking on any list will be saved to history.
Exceptions:	<p>EX-01: Carpark data service unavailable</p> <ol style="list-style-type: none"> 1. Parkmate cannot fetch carpark details due to database outage. 2. Display: "Carpark information unavailable. Please try again"

	<p>later”</p> <p>EX-02: Map Rendering Failure</p> <ol style="list-style-type: none"> 1. Map view cannot load 2. Default list view with available carparks
Includes:	#1-1 (destination selected), #1-7 (display carpark details)
Special Requirements:	None
Assumptions:	AS-01: User has selected a destination
Notes and Issues:	None

c. Live Availability

Use Case ID:	#1-3		
Use Case Name:	Live Availability		
Created By:	Yibin	Last Updated By:	Harshil
Date Created:	06 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver(user), Parkmate System, Carpark API
Description:	ParkMate fetches and refreshes live carpark availability data at fixed intervals so users see up-to-date information; when data is outdated, the system flags it accordingly.
Preconditions:	<ul style="list-style-type: none"> Nearby carparks displayed(#1-2)
Postconditions:	<p>Success:</p> <ul style="list-style-type: none"> Displays updated availability for all visible carparks <p>Failure:</p> <ul style="list-style-type: none"> Shows the timestamp of the last updated information
Priority:	High
Frequency of Use:	High
Flow of Events:	<ol style="list-style-type: none"> Parkmate fetch availability from Carpark API for all visible carparks Parkmate displays the latest updated availability
Alternative Flows:	<p>Unable to fetch availability</p> <ol style="list-style-type: none"> Display last updated availability (cached), marked with its timestamp.
Exceptions:	<p>EX-01: Carpark API unavailable</p> <ol style="list-style-type: none"> Parkmate cannot connect to Carpark API Display: "Live availability temporarily unavailable." and shows last known data with a timestamp. <p>EX-02: API rate limit exceeded</p> <ol style="list-style-type: none"> Too many requests within a short period, API rejects calls. Parkmate pauses auto-refresh and displays: "Service busy. Retrying shortly." <p>EX-03: Timeout on data fetch</p> <ol style="list-style-type: none"> API does not response within timeframe Parkmate shows last availability, display: "Data not refreshed."
Includes:	#1-2 (carparks displayed)
Special	Auto-refresh every 60s (subject to API constraints)

Requirements:	
Assumptions:	AS-1: User logged in (#2-2) AS-2: User selected a destination (#1-1)
Notes and Issues:	None

d. Filter Carparks

Use Case ID:	#1-4		
Use Case Name:	Filter Carparks		
Created By:	Yibin	Last Updated By:	Harshil
Date Created:	06 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver(user), Parkmate System
Description:	Users can toggle filters to show only the relevant carpark markers/results.
Preconditions:	<ul style="list-style-type: none"> Nearby carparks are displayed (#1-2).
Postconditions:	<p>Success:</p> <ul style="list-style-type: none"> Filtered results are displayed instantly on both map view and list view <p>Failure:</p> <ul style="list-style-type: none"> Filters are not applied; the previous (unfiltered or last-known) results remain visible, and ParkMate shows an error/timeout message.
Priority:	Medium
Frequency of Use:	High
Flow of Events:	<ol style="list-style-type: none"> User opens the filter interface. Parkmate displays available filters. User chooses one or more filter options. ParkMate applies the selected filters and updates the current view (map/list) immediately.
Alternative Flows:	<p>User reset filter</p> <ol style="list-style-type: none"> User click on reset button Clear all filter selected Parkmate displays non-filtered results. (#1-2) <p>No matching filters for carpark</p> <ol style="list-style-type: none"> Users filter options unable to display a matching carpark Prompts "No carparks matched" Goes to Step 1
Exceptions:	<p>EX-01: Filter data missing</p> <ol style="list-style-type: none"> Carpark database has missing or inconsistent data for a chosen filter. Parkmate shows partial data, display message: Some carparks may have missing information.

Includes:	#1-1 (destination selected), #1-2 (carparks displayed)
Special Requirements:	None
Assumptions:	AS-1: User logged in (#2-2) AS-2: User selected a destination (#1-1)
Notes and Issues:	None

1. Filter Height

Use Case ID:	#1-4-1-1		
Use Case Name:	Filter Height		
Created By:	Yibin	Last Updated By:	Harshil
Date Created:	08 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver(user), Parkmate System
Description:	Users can enable or disable height filters
Preconditions:	<ul style="list-style-type: none"> Nearby carparks are displayed (#1-2).
Postconditions:	<p>Success:</p> <ul style="list-style-type: none"> Filtered results are displayed instantly on both map view and list view <p>Failure:</p> <ul style="list-style-type: none"> Filters are not applied; the previous results remain visible, and ParkMate shows “Filtering failed/timed out, showing previous results.”
Priority:	Medium
Frequency of Use:	High
Flow of Events:	<ol style="list-style-type: none"> User clicks on “height” filter button Parkmate updates the result on the map view
Alternative Flows:	<p>AF-S1: Reset</p> <ol style="list-style-type: none"> User taps Reset/Clear → all height filters cleared ParkMate shows unfiltered results (#1-2). <p>AF-S2: No matches</p> <ol style="list-style-type: none"> Zero results ParkMate shows “No carparks match this height” with “Relax filter” action.
Exceptions:	<p>EX-01: Height data missing</p> <ol style="list-style-type: none"> Some carparks do not have height limit informations Parkmate display with message: Height data unavailable <p>EX-02: Timeout on filter execution</p> <ol style="list-style-type: none"> Filtering takes too long >5 minutes Displays: Filtering timed out, displaying previous results.
Includes:	#1-1 (destination selected), #1-2 (carparks displayed)
Special Requirements:	Units are meters (m).

Assumptions:	AS-1: User logged in (#2-2) AS-2: User selected a destination (#1-1) AS-3: User on filter interface(#1-4 Step 2)
Notes and Issues:	None

2. Filter Sheltered Parking

Use Case ID:	#1-4-1-2		
Use Case Name:	Filter Sheltered Parking		
Created By:	Yibin	Last Updated By:	Harshil
Date Created:	08 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver(user), Parkmate System
Description:	Users can enable or disable “Sheltered Parking” filters
Preconditions:	<ul style="list-style-type: none"> Nearby carparks are displayed (#1-2).
Postconditions:	<p>Success:</p> <ul style="list-style-type: none"> Filtered results are displayed instantly on map view. <p>Failure:</p> <ul style="list-style-type: none"> Filters are not applied; the previous results remain visible, and ParkMate shows: “Filtering failed/timed out, showing previous results.”
Priority:	Medium
Frequency of Use:	High
Flow of Events:	<ol style="list-style-type: none"> User clicks on “Sheltered Parking” filter button Parkmate updates the result on the map view.
Alternative Flows:	<p>Reset Filters</p> <ol style="list-style-type: none"> User clears filters ParkMate removes the sheltered constraint and shows unfiltered results (#1-2) <p>No matching filters for carpark</p> <ol style="list-style-type: none"> Users filter options unable to display a matching carpark Prompts (“No carparks matched”) Goes to #1-4 Step 2 (choosing filter)
Exceptions:	<p>EX-01: Shelter information missing</p> <ol style="list-style-type: none"> Some carparks do not have shelter information Parkamates display: shelter information unavailable. <p>EX-02: Timeout on filter execution</p> <ol style="list-style-type: none"> Filtering takes too long >5 minutes Displays: Fltlering timed out, displaying previous results.
Includes:	#1-1 (destination selected), #1-2 (carparks displayed)
Special Requirements:	None

Assumptions:	AS-1: User logged in (#2-2) AS-2: User selected a destination (#1-1) AS-3: User on filter interface(#1-4 Step 2)
Notes and Issues:	None

3. Filter Operating Hours

Use Case ID:	#1-4-1-3		
Use Case Name:	Filter Operating Hours		
Created By:	Yibin	Last Updated By:	Harshil
Date Created:	08 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver(user), Parkmate System
Description:	Users can modify Operating Hours filters
Preconditions:	<ul style="list-style-type: none"> Nearby carparks are displayed (#1-2).
Postconditions:	<p>Success:</p> <ul style="list-style-type: none"> Filtered results are displayed instantly on the map view. <p>Failure:</p> <ul style="list-style-type: none"> Filters are not applied; the previous results remain visible, and ParkMate shows: “Filtering failed/timed out, showing previous results.”
Priority:	Medium
Frequency of Use:	High
Flow of Events:	<ol style="list-style-type: none"> User clicks on “Overnight / all / Non Overnight” filter button Parkmate updates the result on the current view map
Alternative Flows:	<p>No matching filters for carpark</p> <ol style="list-style-type: none"> Users filter options unable to display a matching carpark Prompts (“No carparks matched”) Goes to #1-4 Step 2 (choosing filter)
Exceptions:	<p>EX-01: Operating Hours information missing</p> <ol style="list-style-type: none"> Some carparks do not have operating hours information Parkmate display: Operating Hours information unavailable. <p>EX-02: Timeout on filter execution</p> <ol style="list-style-type: none"> Filtering takes too long >5 minutes Displays: Filtering timed out, displaying previous results
Includes:	#1-1 (destination selected), #1-2 (carparks displayed)
Special Requirements:	None
Assumptions:	<p>AS-1: User logged in (#2-2)</p> <p>AS-2: User selected a destination (#1-1)</p> <p>AS-3: User on filter interface(#1-4 Step 2)</p>

Notes and Issues:

None

e. Sort Carparks

Use Case ID:	#1-5		
Use Case Name:	Sort Carparks		
Created By:	Yibin	Last Updated By:	Harshil
Date Created:	06 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver(user), Parkmate System, Carpark API
Description:	User sorts the currently displayed carparks by a chosen criterion (Distance, Price, Availability) and order.
Preconditions:	<ul style="list-style-type: none"> Nearby carparks displayed (#1-2)
Postconditions:	<p>Success:</p> <ul style="list-style-type: none"> Carparks sorted based on criteria <p>Failure:</p> <ul style="list-style-type: none"> Sorting is not applied; the previous order remains, and ParkMate shows: “Sorting failed/timed out—showing previous order.”
Priority:	Medium
Frequency of Use:	High
Flow of Events:	<ol style="list-style-type: none"> Parkmate displays sorting options (Availability, Price, Distance) User selects a sorting criteria Parkmate reorders the result on current view (map)
Alternative Flows:	<p>Resets to default</p> <ol style="list-style-type: none"> User taps Reset ParkMate restores default order and removes the sort
Exceptions:	<p>EX-01: Missing data for sorting criteria</p> <ol style="list-style-type: none"> Some carparks do not have values for chosen criteria (e.g. missing prices, no availability data) Parkmate places them at bottom, displays: Data unavailable <p>EX-02: Sorting Logic Failure</p> <ol style="list-style-type: none"> Internal error when reordering results (e.g. null values or calculation errors) Parkmate displays previous unsorted results with message: Sorting failed, showing default values.
Includes:	#1-2 (carparks displayed)
Special	None

Requirements:	
Assumptions:	AS-1: User logged in (#2-2) AS-2: User selected a destination (#1-1)
Notes and Issues:	None

f. Parking Cost Details

Use Case ID:	#1-6		
Use Case Name:	Display Parking Cost		
Created By:	Yibin	Last Updated By:	Harshil
Date Created:	06 Sept 2025	Date Last Updated:	15 Nov 2025

Actor:	Driver(user), Parkmate System, Carpark API
Description:	<p>This use case allows the user to view the official parking cost information for a selected carpark.</p> <p>When the user opens a carpark's details page, ParkMate retrieves the relevant tariff rules (base rate, hourly rate, peak/off-peak fees, and EV charging fees if applicable) and displays them clearly in the UI.</p> <p>This feature provides transparency and helps users make informed decisions before selecting a parking location.</p>
Preconditions:	<ul style="list-style-type: none"> • User has selected a destination (#1-1) • Nearby carparks displayed (#1-2) • Tariff data must exist in the ParkMate carpark database (unless unavailable).
Postconditions:	<p>Success:</p> <ul style="list-style-type: none"> • Parking cost information is displayed to the user. <p>Failure:</p> <ul style="list-style-type: none"> • Parkmate displays “Parking details unavailable.”
Priority:	Medium
Frequency of Use:	Medium
Flow of Events:	<ol style="list-style-type: none"> 1. The user selects a carpark from the list or map. 2. The system loads the carpark details page. 3. The system retrieves tariff rules from the database. 4. The system displays the parking cost information, including relevant rates and fees.
Alternative Flows:	None
Exceptions:	<p>EX-01: Database retrieval error</p> <ol style="list-style-type: none"> 1. Unable to retrieve information from database or database network failure <p>EX-02: Carpark Tariff data missing</p> <ol style="list-style-type: none"> 1. Carpark API does not return tariff rules, or rules are incomplete (e.g. weekend rates missing) 2. Display: “Pricing details unavailable.”

	<p>EX-03: API timeout</p> <ol style="list-style-type: none"> 1. Parkmate cannot fetch information due to slow response or API downtime. 2. Display: “Unable to retrieve information. Please try again later.”
Includes:	#1-2 (carparks displayed)
Special Requirements:	None
Assumptions:	AS-1: User logged in (#2-2) AS-2: User selected a destination (#1-1)
Notes and Issues:	None

g. Carpark Details

Use Case ID:	#1-7		
Use Case Name:	Carpark Details		
Created By:	Yibin	Last Updated By:	Harshil
Date Created:	06 Sept 2025	Date Last Updated:	15 Nov 2025

Actor:	Driver(user), Parkmate System, Carpark API
Description:	Displays detailed information for a selected carpark, including pricing, lot availability, price, height limits, and operating hours.
Preconditions:	<ul style="list-style-type: none"> User has selected a carpark
Postconditions:	<p>Success:</p> <ul style="list-style-type: none"> Parkmate displays complete carpark information <p>Failure:</p> <ul style="list-style-type: none"> Data retrieval fails, shows warning message
Priority:	High
Frequency of Use:	High
Flow of Events:	<ol style="list-style-type: none"> Parkmate retrieves carpark details from Carpark API Parkmate displays carpark details: <ul style="list-style-type: none"> - Name - Distance - Live availability of carpark slots - Price - Carpark type - Height limit
Alternative Flows:	<p>Retrieval Failure:</p> <ol style="list-style-type: none"> Shows warning message "Failed to retrieve data." <p>Partial Failure:</p> <ol style="list-style-type: none"> Some sections are missing from the source Renders available sections; for each missing section, shows "Not provided by operator"
Exceptions:	<p>EX-01: API timeout</p> <ol style="list-style-type: none"> Parkmate cannot fetch information due to slow response or API downtime. Display: "Unable to retrieve information. Please try again later." <p>EX-02: Network Timeout / Connectivity Loss</p> <ol style="list-style-type: none"> Request to Carpark API takes too long or fails due to poor internet.

	<p>2. Show cached details (if available)</p> <p>3. Message: "Offline, showing cached data (if available)."</p>
Includes:	#1-2 (carparks displayed)
Special Requirements:	None
Assumptions:	AS-1: User logged in (#2-2) AS-2: User selected a destination (#1-1)
Notes and Issues:	None

h. Add Favourites

Use Case ID:	#1-8		
Use Case Name:	Add Favourites		
Created By:	Yibin	Last Updated By:	Harshil
Date Created:	07 Sept 2025	Date Last Updated:	15 Nov 2025

Actor:	Driver(user), Parkmate System
Description:	Allows users to add a carpark to their favourites list by clicking on the heart button in the carpark information window (#1-8)
Preconditions:	<ul style="list-style-type: none"> Carparks are already displayed(#1-2)
Postconditions:	<p>Success:</p> <ul style="list-style-type: none"> Selected carpark is added to favourites <p>Failure:</p> <ul style="list-style-type: none"> No change to favourites; icon reverts (if optimistically filled); error banner shown.
Priority:	High
Frequency of Use:	High
Flow of Events:	<ol style="list-style-type: none"> User selects a carpark from the list or mapview. User taps the “Favourite” icon. ParkMate marks the carpark as favourited. Carpark is stored in the user’s Favourites list. ParkMate updates the UI with a filled favourite icon.
Alternative Flows:	<p>Already Favoured:</p> <ol style="list-style-type: none"> Server returns 409 Conflict (or client detects duplicate).. System keeps state unchanged; shows non-blocking toast: “Already in Favourites.”
Exceptions:	<p>EX-01: Database/Storage Failure</p> <ol style="list-style-type: none"> ParkMate cannot write to the database or local storage (e.g., storage full, server error) Display message: “Unable to add to favourites. Please try again later.” <p>EX-02: Invalid Carpark ID</p> <ol style="list-style-type: none"> Selected carpark references are missing, expired, or corrupted in the database. Prevent add action; show: “Carpark not found. Cannot add to favourites.” <p>EX-03: Network/Connectivity Loss</p> <ol style="list-style-type: none"> Action requires server confirmation but network is down Message: “No internet connection. Please try again later.”

Includes:	#1-2 (carpark displayed)
Special Requirements:	None
Assumptions:	AS-1: User already logged in. (#2-2) AS-2: User already entered a destination. (#1-1)
Notes and Issues:	None

II. For Functional Requirement #2

a. Create Account

Use Case ID:	#2-1		
Use Case Name:	Create Account		
Created By:	Abdillah	Last Updated By:	Preetham
Date Created:	08 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver (User), ParkMate System
Description:	User creates a ParkMate account using email and password, with validation and duplicate account checks.
Preconditions:	<ul style="list-style-type: none"> • User does not already have an account with that email. • Internet connection is available.
Postconditions:	<ul style="list-style-type: none"> • Success: New account created, user directed to login page. • Failure: No account created, error message shown.
Priority:	High
Frequency of Use:	Low
Flow of Events:	<ol style="list-style-type: none"> 1. User selects “Sign Up” 2. User enters email & password. <ol style="list-style-type: none"> a. System validates email format b. System checks for password requirement (ideally more than 12 characters, and use a combination of uppercase letters, lowercase letters, numbers, and symbols) 3. If valid -> Account created 4. If invalid -> System shows error message 5. If email already registered -> System shows “Email already in use” 6. If passwords do not match -> System shows “Password do not match”
Alternative Flows:	Weak password -> “Password must meet the requirements”
Exceptions:	Network/server error -> “Service unavailable”
Includes:	Validation Service
Special Requirements:	Secure password storage (hashed)
Assumptions:	User owns email provided

Notes and Issues:

Login via social may be added later.

b. Login

Use Case ID:	#2-2		
Use Case Name:	Login		
Created By:	Abdillah	Last Updated By:	Yibin
Date Created:	08 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver (User), ParkMate System
Description:	User logs into the system with registered credentials.
Preconditions:	<ul style="list-style-type: none"> User has a registered account.
Postconditions:	<ul style="list-style-type: none"> On login: User navigates to Home screen.
Priority:	High
Frequency of Use:	High
Flow of Events:	<ol style="list-style-type: none"> User enters email and password System verifies credentials. If valid -> Navigate to Home screen If invalid -> “Email and password do not match” Logout -> User session cleared, redirected to login screen
Alternative Flows:	Account not found → “Email not registered.”
Exceptions:	Server down → “Unable to connect.”
Includes:	nil
Special Requirements:	<ul style="list-style-type: none"> Secure session management.
Assumptions:	User inputs correct credentials.
Notes and Issues:	nil

c. Password Reset

Use Case ID:	#2-3		
Use Case Name:	Password Reset		
Created By:	Abdillah	Last Updated By:	Abdillah
Date Created:	08 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver (User), ParkMate System, Email Service
Description:	User resets forgotten password or changes password after login
Preconditions:	<ul style="list-style-type: none"> • Registered email. • Internet connection.
Postconditions:	User has new valid password.
Priority:	Medium
Frequency of Use:	Medium
Flow of Events:	<ol style="list-style-type: none"> 1. User selects “Forgot Password” 2. User has to fill in their registered Email Address. 3. System sends reset link to user’s email. 4. User clicks reset link in the email and redirected back to ParkMate to set a new password. 5. Authenticated Users can also change password after verifying current password
Alternative Flows:	Unregistered Email → System shows “Unregistered Email. Please enter again.”
Exceptions:	Invalid reset link expired.
Includes:	nil
Special Requirements:	<ul style="list-style-type: none"> • Token expiration for reset link.
Assumptions:	User can access registered email.
Notes and Issues:	nil

d. Delete Account

Use Case ID:	#2-4		
Use Case Name:	Delete Account		
Created By:	Abdillah	Last Updated By:	Preetham
Date Created:	08 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver (User), ParkMate System
Description:	User deletes account permanently.
Preconditions:	User is logged in.
Postconditions:	Account and preferences removed.
Priority:	Medium
Frequency of Use:	Low
Flow of Events:	<ol style="list-style-type: none"> 1. User goes into Settings 2. User selects “Delete Account.” 3. System prompts confirmation and user has to fill in their password to confirm 4. If confirmed -> Account deleted, favourites/preferences erased.
Alternative Flows:	User fills in the wrong password -> Account is not deleted
Exceptions:	nil
Includes:	nil
Special Requirements:	<ul style="list-style-type: none"> • Irreversible deletion.
Assumptions:	User intends permanent removal.
Notes and Issues:	nil

e. View Terms of Service & Privacy Policy

Use Case ID:	#2-5		
Use Case Name:	View Terms of Service and Policy		
Created By:	Abdillah	Last Updated By:	Abdillah
Date Created:	08 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver (User), ParkMate System
Description:	User views TOS and from Profile page.
Preconditions:	User is logged in.
Postconditions:	Content displayed with date.
Priority:	Low
Frequency of Use:	Medium
Flow of Events:	<ol style="list-style-type: none"> 1. User navigates to Settings. 2. User selects TOS/Privacy Policy. 3. System displays content with version/date
Alternative Flows:	None
Exceptions:	nil
Includes:	nil
Special Requirements:	<ul style="list-style-type: none"> • Must show latest date updated.
Assumptions:	TOS content is updated in system backend.
Notes and Issues:	Consider multilingual support.

f. Log Out

Use Case ID:	#2-6		
Use Case Name:	Log Out		
Created By:	Yibin	Last Updated By:	Yibin
Date Created:	09 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver(user), Parkmate System
Description:	Logged-in user logs out of the ParkMate application via the Settings page.
Preconditions:	<ul style="list-style-type: none"> User logged in
Postconditions:	<p>Success:</p> <ul style="list-style-type: none"> Upon successful logout, the user is redirected to the Login page.
Priority:	High
Frequency of Use:	Medium
Flow of Events:	<ol style="list-style-type: none"> User taps the “Logout” button. ParkMate invalidates the current user session. ParkMate clears cached data related to the logged-in user. ParkMate redirects the user to the Login page.
Alternative Flows:	None
Exceptions:	None
Includes:	nil
Special Requirements:	None
Assumptions:	None
Notes and Issues:	None

III. For Functional Requirement #3

a. Handle External API Failure

Use Case ID:	#3-1		
Use Case Name:	Handle External API Failure		
Created By:	Abdillah	Last Updated By:	Harshil
Date Created:	07 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver (User), ParkMate System, External API
Description:	When live availability data cannot be retrieved due to API issues, ParkMate displays a visible banner and continues showing last-known data.
Preconditions:	<ul style="list-style-type: none"> User has searched for carparks (#1-1, #1-2). (If showing cached data) A previous successful live fetch exists and is stored.
Postconditions:	Success: Banner displayed with timestamp, last-known data shown with “Stale” tag
Priority:	High
Frequency of Use:	High
Flow of Events:	<ol style="list-style-type: none"> ParkMate requests live carpark data from API API call fails (unreachable or error) ParkMate displays banner: “Live data temporarily unavailable - showing last update at HH:MM” ParkMate shows cached availability with “Stale” tag System retries in background If the system successfully calls API, ParkMate refreshes data and removes banner.
Alternative Flows:	<ol style="list-style-type: none"> If the API recovers, ParkMate updates results If the API is unavailable for more than 15 minutes, ParkMate displays, “Live data unavailable for extended period, please try again later or check offline options.”. Suggests user to retry after some time or contact support if persistent. If local cached data is missing or corrupted, ParkMate displays, “Carpark availability information cannot be retrieved. We are working to restore service.”
Exceptions:	If there is a Database/network error when accessing cached data, ParkMate displays, “Carpark availability information cannot be retrieved. We are working to restore service.”

Includes:	#1-3 (Live Availability)
Special Requirements:	None
Assumptions:	Internet connection available
Notes and Issues:	none

b. Location Permission disabled

Use Case ID:	#3-2		
Use Case Name:	Location Permission disabled		
Created By:	Abdillah	Last Updated By:	Harshil
Date Created:	07 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver (User), ParkMate System, Geocoding api
Description:	If location access is not enabled, ParkMate still allows destination-based search and adjusts distance labels accordingly.
Preconditions:	User had denied location access
Postconditions:	<p>Success:</p> <ul style="list-style-type: none"> • Carparks are displayed relative to chosen destination <p>Failure:</p> <ul style="list-style-type: none"> • None (search still works)
Priority:	Medium
Frequency of Use:	Medium
Flow of Events:	<ol style="list-style-type: none"> 1. User launches ParkMate and denies location permission when prompted. 2. User initiates a search by entering a destination address or postal code. 3. ParkMate queries the external API using the provided destination. 4. ParkMate calculates distances from the chosen destination to nearby carparks. 5. ParkMate displays the carpark list, with distances clearly labeled as “from destination” instead of “from current location.”
Alternative Flows:	If Geocoding API is unreachable or times out, ParkMate displays, “Location service temporarily unavailable, search results may be incomplete or inaccurate.”
Exceptions:	<p>If Geocoding API returns an error or invalid data, System displays, “Could not process the destination address. Please check the input and try again.”</p> <p>If no network/offline, “You’re offline. Enter a destination when you’re back online.”</p>
Includes:	#1-1 (Search Destination), #1-2 (Display Carparks).

Special Requirements:	None
Assumptions:	User manually inputs destination
Notes and Issues:	None

c. Display Refresh Loading State

Use Case ID:	#3-3		
Use Case Name:	Display Refresh Loading State		
Created By:	Abdillah	Last Updated By:	Harshil
Date Created:	07 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver (User), ParkMate System
Description:	When data is being refreshed (manual pull-to-refresh or scheduled auto-refresh), ParkMate shows a non-blocking loading state and then replaces results atomically. If refresh fails, the app keeps previous results and shows an error.
Preconditions:	Carparks displayed (#1-2), A refresh is triggered
Postconditions:	<p>Success:</p> <ul style="list-style-type: none"> User sees updated results after refresh OR error message if refresh fails <p>Failure:</p> <ul style="list-style-type: none"> Previous results remain visible; a banner/toast shows “Couldn’t refresh” with a Retry action
Priority:	Medium
Frequency of Use:	High (whenever user refreshes or data auto-updates)
Flow of Events:	<ol style="list-style-type: none"> User initiates refresh (manual or auto) ParkMate displays loading state Once data is retrieved, the loading indicator disappears. Updated results shown to user
Alternative Flows:	<ol style="list-style-type: none"> If the user switches away during refresh, the loading state is paused and resumes once the app returns to foreground.
Exceptions:	<p>API failure</p> <ol style="list-style-type: none"> Keep previous data, show banner “Can’t refresh right now” with Retry <p>Partial Failure</p> <ol style="list-style-type: none"> Update what succeeded; label affected sections “Live data unavailable”; keep prior availability for a short grace window with “Stale” tag
Includes:	#1-2 Display Carparks, #1-3 Live Availability
Special Requirements:	None

Assumptions:	None
Notes and Issues:	None

IV. For Functional Requirement #4

a. Open in Maps

Use Case ID:	#4-1		
Use Case Name:	Open in Maps		
Created By:	Abdillah	Last Updated By:	Preetham
Date Created:	07 Sept 2025	Date Last Updated:	15 Nov 2025

Actor:	Driver (User), ParkMate System, Google Maps Application, Browser
Description:	ParkMate allows users to open a carpark location in their device's Google Maps application.
Preconditions:	User has selected a carpark from the map.
Postconditions:	User is given the choice to use Google Maps through the Google Maps Application, or the Browser
Priority:	High
Frequency of Use:	High
Flow of Events:	<ol style="list-style-type: none"> 1. User opens the carpark to show the details window(#1-8). 2. User selects "Open in Google Maps" 3. ParkMate presents the user with a choice to open Google Maps through the Google Maps Application or through the Browser. 4. User selects the Google Maps Application 5. Routing is calculated through the Google Maps Application
Alternative Flows:	<ol style="list-style-type: none"> 1. User opens the carpark to show the details window(#1-8). 2. User selects "Open in Google Maps" 3. ParkMate presents the user with a choice to open Google Maps through the Google Maps Application or through the Browser. 4. User selects the Browser 5. Routing is calculated through the Google Maps Web App.
Exceptions:	none
Includes:	none
Special Requirements:	None
Assumptions:	Device has internet connectivity

Notes and Issues:

none

V. For Functional Requirement #5

a. View & Manage Carpark Selection History

Use Case ID:	#5-1		
Use Case Name:	View & Manage Carpark Selection History		
Created By:	Yibin	Last Updated By:	Abdillah
Date Created:	09 Sept 2025	Date Last Updated:	14 Nov 2025

Actor:	Driver(user), Parkmate System
Description:	View and manage their Carpark Selection History in ParkMate. The system automatically records selected carparks and allows users to revisit them.
Preconditions:	<ul style="list-style-type: none"> User must be logged in. User has previously selected at least one carpark to generate history entries.
Postconditions:	<p>Success:</p> <ul style="list-style-type: none"> User's history of selected carpark is displayed. <p>Failure:</p> <ul style="list-style-type: none"> ParkMate displays a non-blocking message and loads locally cached entries if available.
Priority:	Medium
Frequency of Use:	Medium
Flow of Events:	<ol style="list-style-type: none"> User navigates to the History Tab from the Profile Page or main navigation. ParkMate retrieves and displays the list of previously selected carparks. Each history row displays the carpark name and timestamp. User taps a history entry to reopen the Carpark Details and set it as the current selection. ParkMate updates the history list immediately and syncs the changes.
Alternative Flows:	<p>Empty History:</p> <ol style="list-style-type: none"> If there is no carpark selection history exists for the user (first-time use or cleared data).e, ParkMate displays a message: "No history found. Start selecting carparks to build your history." <p>Logged out:</p> <ol style="list-style-type: none"> If User is not logged in, ParkMate displays only local (on-device) selection history and a prompt: "Log in to sync your full carpark history across devices."

Exceptions:	<ol style="list-style-type: none"> 1. If History sync to the server fails due to network or API outage, ParkMate displays a message: “Unable to sync carpark history. Changes will be synced when you are online.” 2. If Corrupted or unreadable history data (local or server-side), ParkMate displays an error: “History data could not be loaded.
Includes:	#1-7
Special Requirements:	None
Assumptions:	User may be offline; local storage is available
Notes and Issues:	None

VI. For Functional Requirement #6

a. Toggle EV mode

Use Case ID:	#6-1		
Use Case Name:	Toggle EV mode		
Created By:	Abdi	Last Updated By:	Yibin
Date Created:	11 Nov 2025	Date Last Updated:	11 Nov 2025

Actor:	User (EV Driver), ParkMate System
Description:	This use case lets ParkMate change its whole UI to suit EV functionality. The UI colour scheme will be changed to a green colour and the filter functions and sorting navigation tabs will be changed.
Preconditions:	1. User has logged in.
Postconditions:	1. The UI is successfully switched to EV Mode. 2. EV-related filters and navigation options become active
Priority:	Medium-High (Enhances user personalization and usability for EV drivers)
Frequency of Use:	Medium-High
Flow of Events:	1. The user opens the profile menu. 2. The user selects the EV Mode toggle. 3. The system updates the UI and switches to EV Mode.
Alternative Flows:	None
Exceptions:	EX-01: Failure to load EV mode 1. If the system fails to load EV mode resources, the toggle is not applied and an error is displayed.
Includes:	None
Special Requirements:	None
Assumptions:	AS-01: User owns an EV 1. User has an EV and requires to use EV mode
Notes and Issues:	None

b. Filter by Connector Type & Charging Speed

Use Case ID:	#6-2		
Use Case Name:	Filter by Connector Type & Charging Speed		
Created By:	Harshil	Last Updated By:	Preetham
Date Created:	19 Oct 2025	Date Last Updated:	15 Nov 2025

Actor:	User (EV Driver), ParkMate System
Description:	This use case lets EV users filter and sort carparks or charging stations based on their vehicle's plug type and preferred charging speed (Type 2, CCS 2 (Fast), CHAdeMO, CCS2, CC2). It helps users quickly find chargers that are compatible with their car and reduce waiting time by showing only stations that match their needs.
Preconditions:	<ol style="list-style-type: none"> 1. User has opened the Search Results or Map View after entering a destination. 2. Connector type and power information are included in the dataset
Postconditions:	Map updates to show only stations that match the selected connector type and speed.
Priority:	Medium (Enhances user personalization and usability for EV drivers)
Frequency of Use:	Medium (Users are likely to apply filters during every search session)
Flow of Events:	<ol style="list-style-type: none"> 1. The user opens the Filter menu on the search or map screen. 2. ParkMate shows a section labeled "EV Charger Filters." 3. The user selects a preferred charging speed 4. The user taps Apply Filters. 5. ParkMate updates the map and list instantly, showing only chargers that meet the criteria. 6. If no stations match, the system displays a message suggesting to clear or adjust filters.
Alternative Flows:	<ol style="list-style-type: none"> 1. To clear filters, The user taps "Reset All." and ParkMate resets the results to show all carparks and EV stations again. 2. When live data refreshes, ParkMate keeps the active filters and updates only the visible chargers that match them.
Exceptions:	If a refresh fails while filters are active, cached data remains visible until the next update.
Includes:	NIL
Special Requirements:	<ul style="list-style-type: none"> • Results update immediately when filters are applied, no need to reload the whole page.

	<ul style="list-style-type: none"> • ParkMate remembers the user's last chosen connector and speed preferences for the next session. • Users can select multiple connector types and charging speeds simultaneously. • Each filter option includes both icons and text for accessibility. • Filters rely on standardized connector names from LTA or operator datasets.
Assumptions:	<ul style="list-style-type: none"> • The app has access to structured metadata for each EV station (connector type, speed). • At least one filterable EV attribute (type or speed) is available for every listed station.
Notes and Issues:	NIL

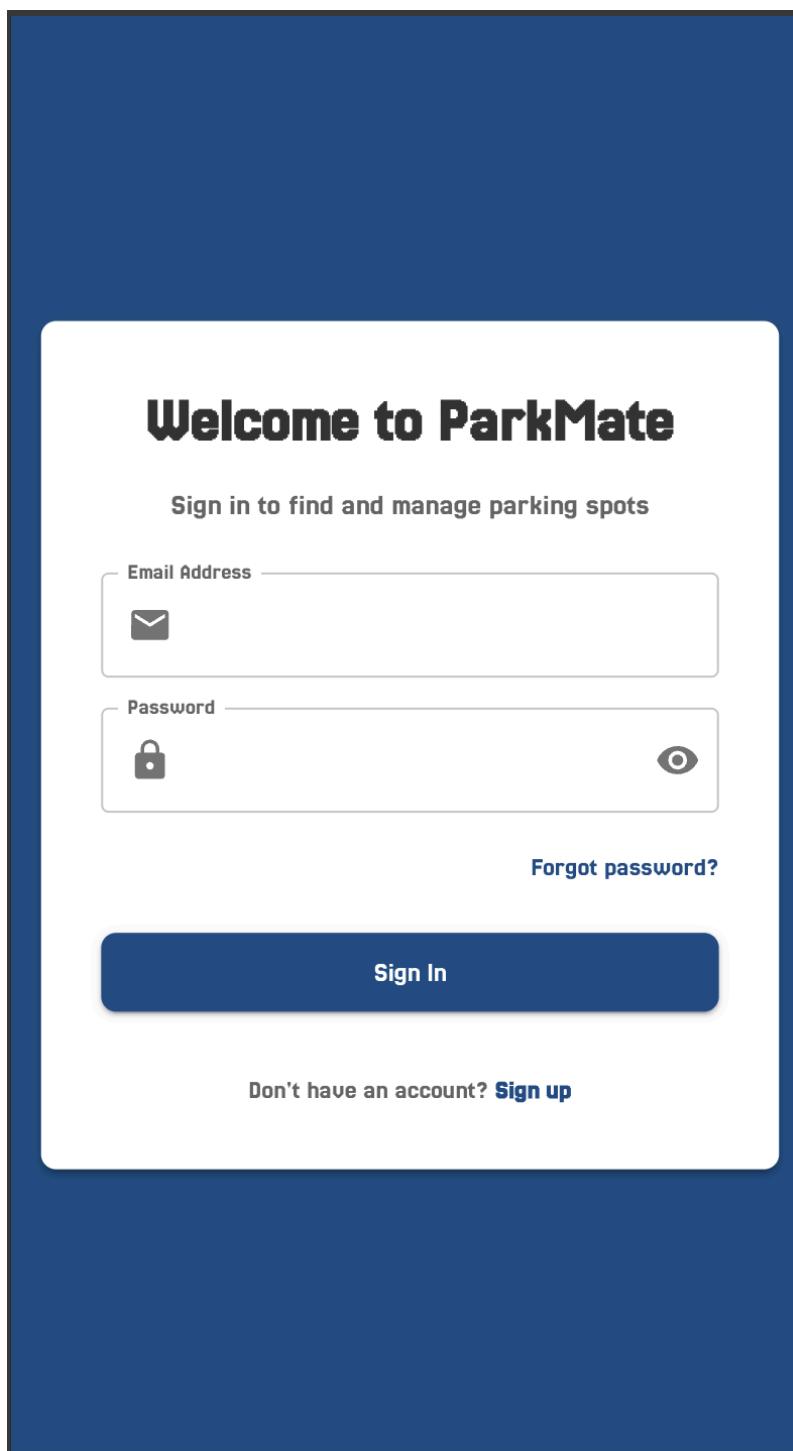
c. EV carpark sorting

Use Case ID:	#6-3		
Use Case Name:	Sort EV Carparks (Favourites & Nearby)		
Created By:	Abdi	Last Updated By:	Yibin
Date Created:	11 Nov 2025	Date Last Updated:	11 Nov 2025

Actor:	User (EV Driver), ParkMate System
Description:	This use case enables the EV driver to sort EV-enabled carparks based on Favourites or Nearby options. When sorting is applied, ParkMate reorganizes the carpark list according to the selected criterion:
Preconditions:	<ol style="list-style-type: none"> 1. User is logged in 2. Location Services are enabled. (required for nearby sorting)
Postconditions:	<ol style="list-style-type: none"> 1. Carpark list is sorted based on the chosen criterion. 2. UI reflects updated sorted order.
Priority:	Medium-High (Enhances user personalization and usability for EV drivers)
Frequency of Use:	Medium-High
Flow of Events:	<ol style="list-style-type: none"> 1. The user navigates to the EV Carpark List screen. 2. The user opens the sorting menu. 3. The user selects either Favourites or Nearby. 4. The system retrieves relevant data (favourites list or location). 5. The system sorts the EV carparks accordingly 6. The UI updates to show the new sorted order.
Alternative Flows:	<p>AF-01: Location Permission Denied</p> <ol style="list-style-type: none"> 1. If user selects Nearby but location access is disabled, the system prompts the user to enable location permission.
Exceptions:	<p>EX-01: System fails to retrieve favourite list</p> <ol style="list-style-type: none"> 1. System displays unsorted list and notify user.
Includes:	None
Special Requirements:	<p>SR-01: Sorting under specific time requirement</p> <ol style="list-style-type: none"> 1. Sorting must complete within 1 second under normal network conditions.
Assumptions:	AS-01: User has at least one favourite carpark
Notes and Issues:	None

4. UI Mockups

4.1 Login



4.2 Register

Create Account

Join ParkMate to start finding parking spots

Full Name



Email Address



Password

Min 8 characters with uppercase, lowercase, and number

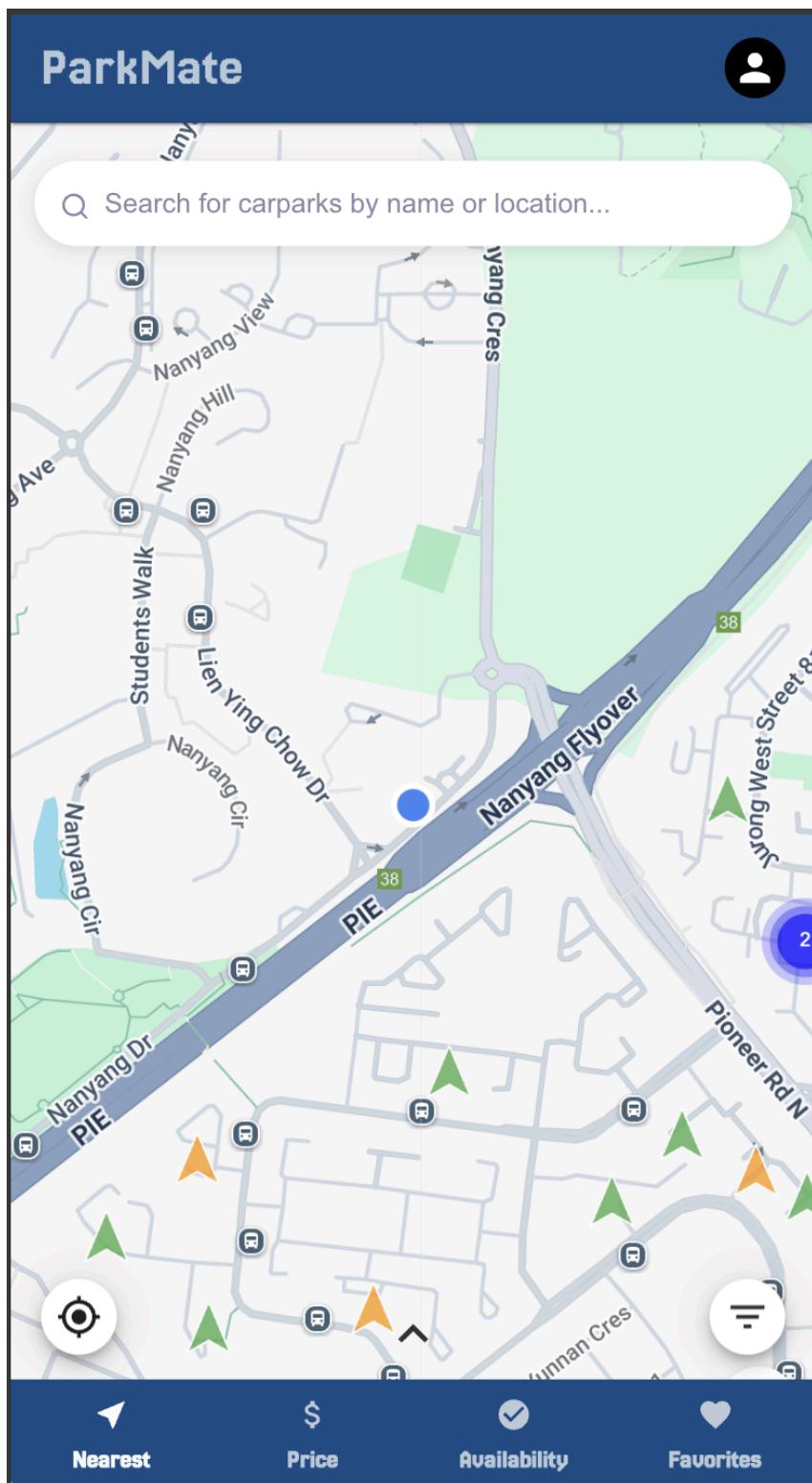
Confirm Password

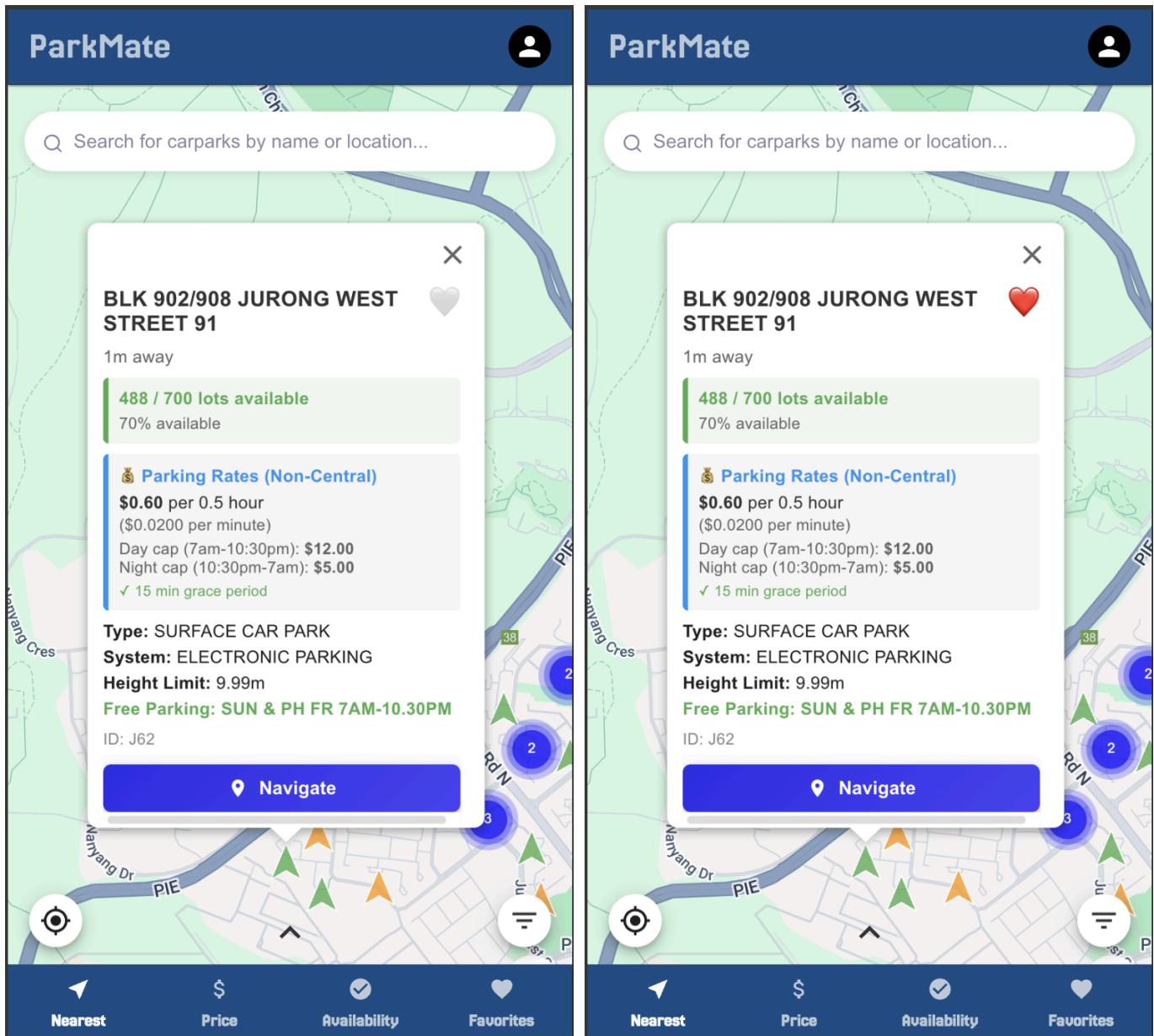
Create Account

Already have an account? [Sign in](#)

4.3 Homepage/Map



4.4 Carpark information (navigation button goes to googlemaps)/After favoured



4.5 Sort by distance

The screenshot shows the ParkMate app interface. At the top, there is a search bar with the placeholder text "Search for carparks by name or location...". Below the search bar is a map showing a street labeled "Janyang Ave". At the bottom of the screen, there is a navigation bar with four buttons: "Nearest" (selected), "Price", "Availability", and "Favorites".

The main content area displays a list of car parks sorted by distance:

- BLK 844A JURONG WEST STREET 81**
1m | MULTI-STOREY CAR PARK | Free
- BLK 865A JURONG WEST STREET 81**
10m | MULTI-STOREY CAR PARK | Free
- BLK 812/826 JURONG WEST STREET 81**
15m | SURFACE CAR PARK | Free
- BLK 821A JURONG WEST STREET 81**
24m | MULTI-STOREY CAR PARK | Free
- BLK 859A JURONG WEST STREET 81**
29m | MULTI-STOREY CAR PARK | Free

A circular button with a minus sign is located at the bottom right of the list.

4.6 Sort by price

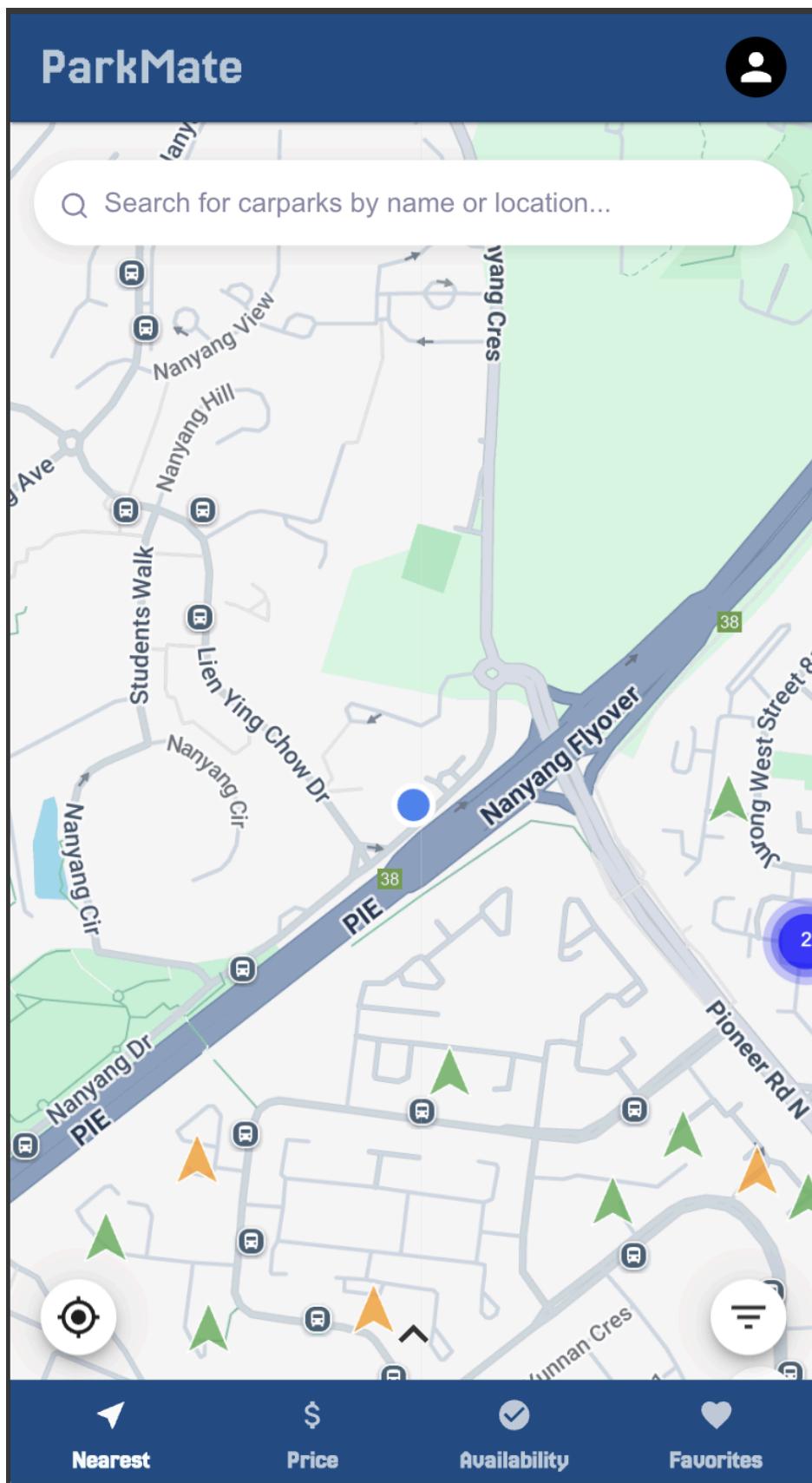
The screenshot shows the ParkMate mobile application interface. At the top, there is a search bar with the placeholder text "Search for carparks by name or location...". Below the search bar is a map showing a green area with some roads and labels like "Jang Ct" and "Janyang Ave". Underneath the map is a navigation bar with four items: "Nearest" (with a location pin icon), "Price" (with a dollar sign icon), "Availability" (with a checkmark icon), and "Favorites" (with a heart icon). The "Price" item is highlighted with a white background and a blue border.

The main content area displays a list of car parks, each with a green dollar sign icon indicating the price level. The listed car parks are:

- BLK 844A JURONG WEST STREET 81**
\$0.00/30min | Day Cap: \$12.00 | SUN & PH FR 7AM-10.30PM | 1m
- BLK 865A JURONG WEST STREET 81**
\$0.00/30min | Day Cap: \$12.00 | SUN & PH FR 7AM-10.30PM | 1m
- BLK 812/826 JURONG WEST STREET 81**
\$0.00/30min | Day Cap: \$12.00 | SUN & PH FR 7AM-10.30PM | 1m
- BLK 821A JURONG WEST STREET 81**
\$0.00/30min | Day Cap: \$12.00 | SUN & PH FR 7AM-10.30PM | 1m
- BLK 859A JURONG WEST STREET 81**
\$0.00/30min | Day Cap: \$12.00 | SUN & PH FR 7AM-10.30PM | 1m

At the bottom of the list, there is a partially visible entry: **BLK 8410 JURONG WEST STREET 81**.

4.7 Sort by availability



4.8 Filters/Reset Filter

The image displays two side-by-side screenshots of the ParkMate mobile application interface, illustrating the process of applying filters and resetting them.

Screenshot 1 (Left): Filter Carparks Dialog

- Carpark Type:**
 - Sheltered (Multi-storey, Basement)
 - Open (Surface)
- Height Limit:**
 - All Heights
 - Low Clearance (< 1.8m)
 - High Clearance ($\geq 1.8m$)
- Operating Hours:**
 - All Operating Hours
 - Non-OVERNIGHT Only
 - Overnight Parking

Showing 0 of 22 **Reset All**

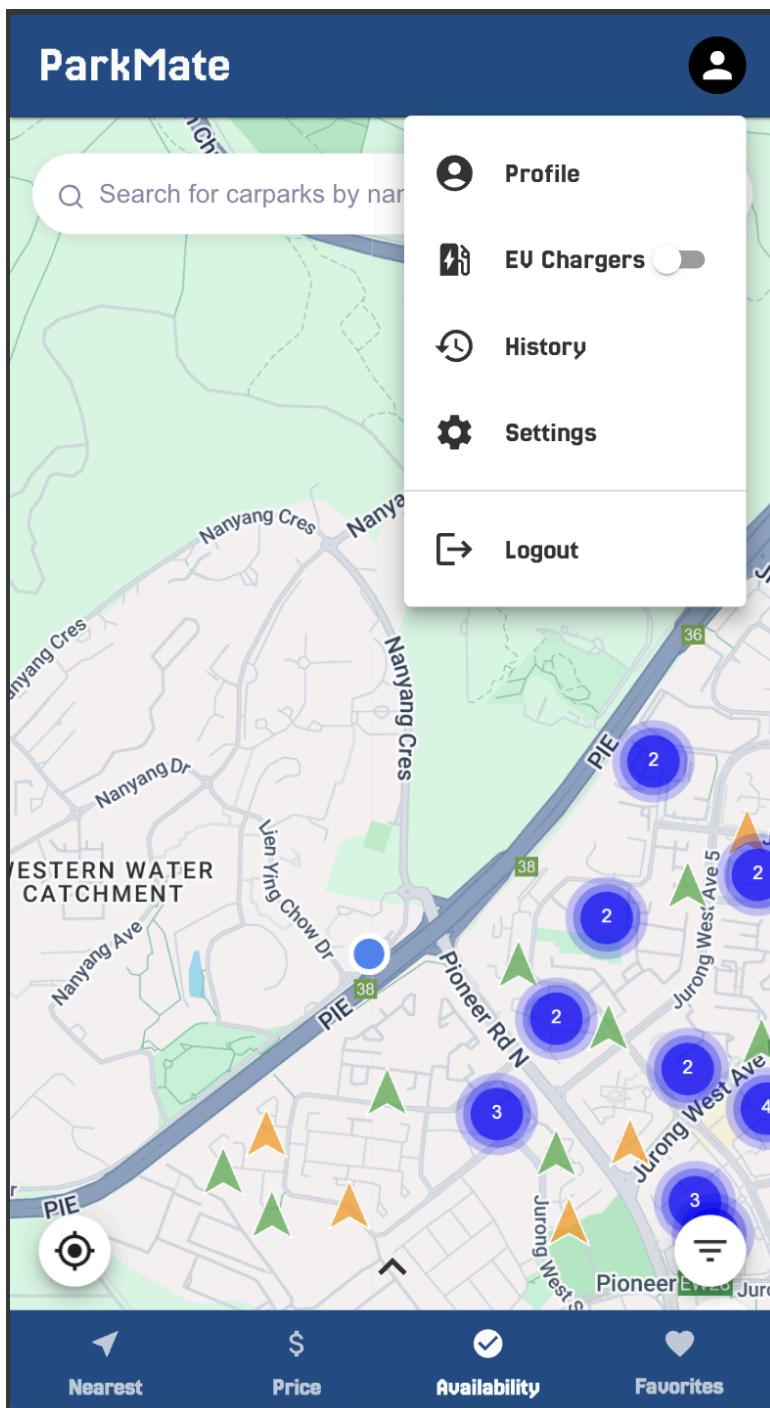
Screenshot 2 (Right): Filter Carparks Dialog

- Carpark Type:**
 - Sheltered (Multi-storey, Basement)
 - Open (Surface)
- Height Limit:**
 - All Heights
 - Low Clearance (< 1.8m)
 - High Clearance ($\geq 1.8m$)
- Operating Hours:**
 - All Operating Hours
 - Non-OVERNIGHT Only
 - Overnight Parking

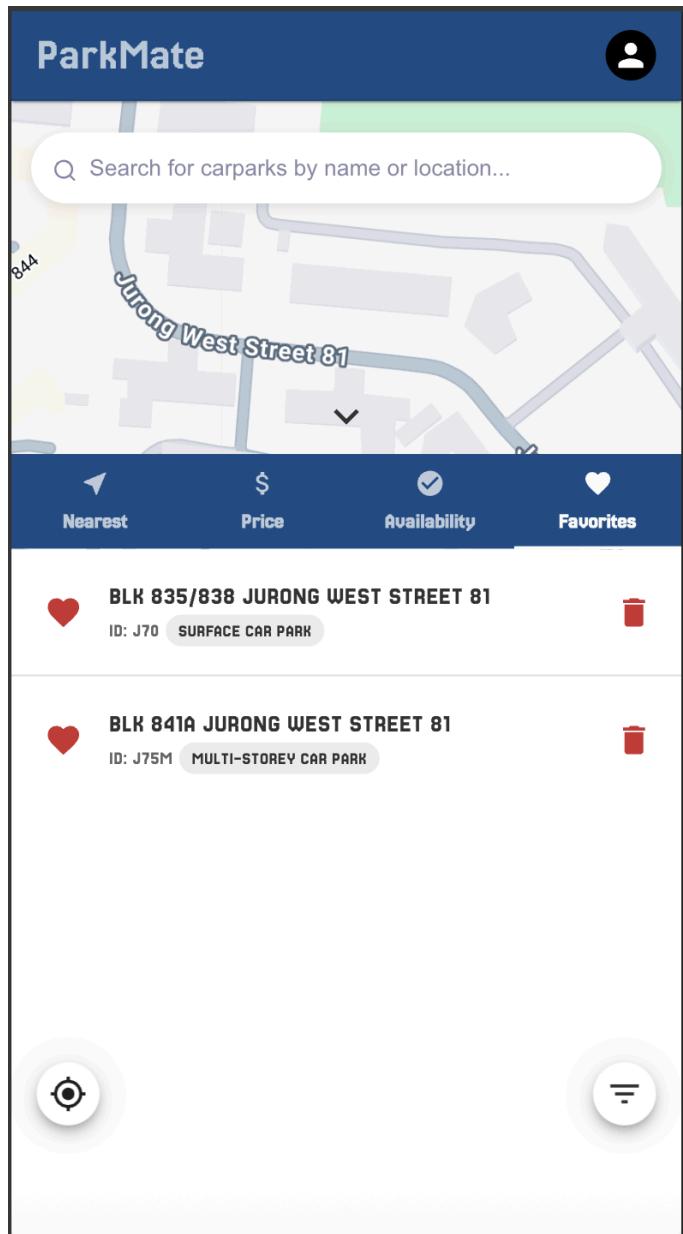
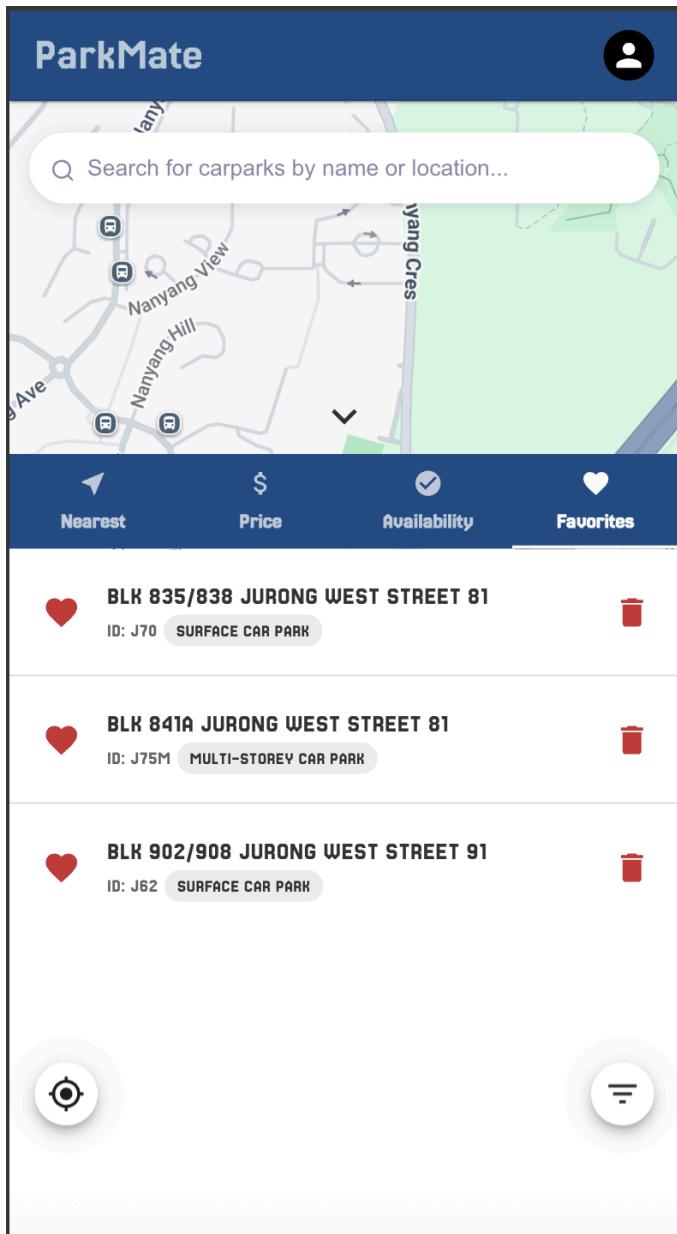
Showing 63 of 63 **Reset All**

The bottom navigation bar for both screens includes:
Nearest Price Availability Favorites

4.9 Menu Dropdown view



4.10 Favourites/Removed from favourites



4.11 History

Search History

11 searches

Clear All

TODAY

- BLK 66A CIRCUIT ROAD**
3 hours ago **X**
ID: MM3
- BEDOK CENTRAL**
3 hours ago **X**
ID: B7B
- BLK 933-953 JURONG WEST STREET 91**
3 hours ago **X**
ID: J65
- BLK 844A JURONG WEST STREET 81**
4 hours ago **X**
ID: J82M
- BLK 909/911 JURONG WEST STREET 91**
4 hours ago **X**
ID: J63
- BLK 959-961 JURONG WEST STREET 92**

4.12 Settings

The screenshot shows the 'Settings' screen of the ParkMate app. At the top, there is a blue header bar with the 'ParkMate' logo on the left and a user icon on the right. Below the header, there is a section for 'Location Services' with a toggle switch that is turned on (blue). A red-bordered box contains a warning titled 'Danger Zone' with the text: 'Once you delete your account, there is no going back. All your data including favorites and history will be permanently deleted.' It features a red 'Delete Account' button with a trash icon. At the bottom of the screen, there is an 'About' section with the text 'ParkMate v1.0.0' and '© 2025 ParkMate. All rights reserved.' Below this, there are links for 'Terms of Service' (document icon) and 'Privacy Policy' (shield icon), both with the text 'View our terms and conditions' and 'How we handle your data'. At the very bottom, there is a dark blue footer bar with four tabs: 'Nearest' (location pin icon), 'Price' (dollar sign icon), 'Availability' (checkmark icon), and 'Favorites' (heart icon).

ParkMate

Location Services

Allow app to access your location

Danger Zone

Once you delete your account, there is no going back. All your data including favorites and history will be permanently deleted.

Delete Account

About

ParkMate v1.0.0

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Terms of Service

View our terms and conditions

Privacy Policy

How we handle your data

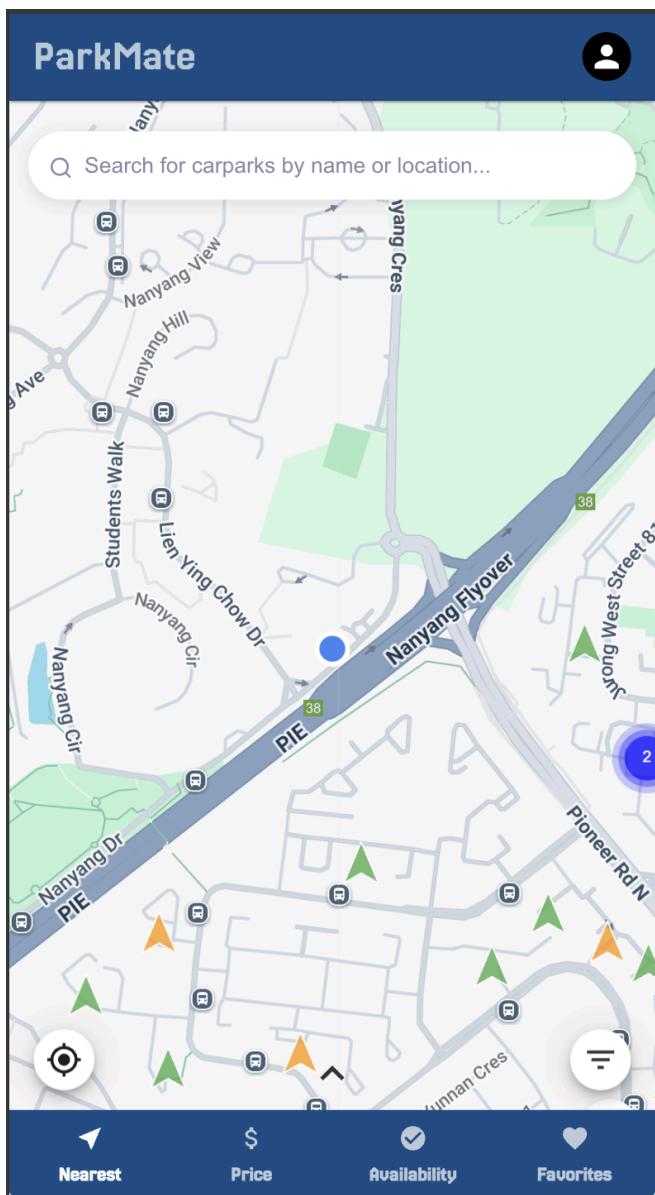
Nearest

Price

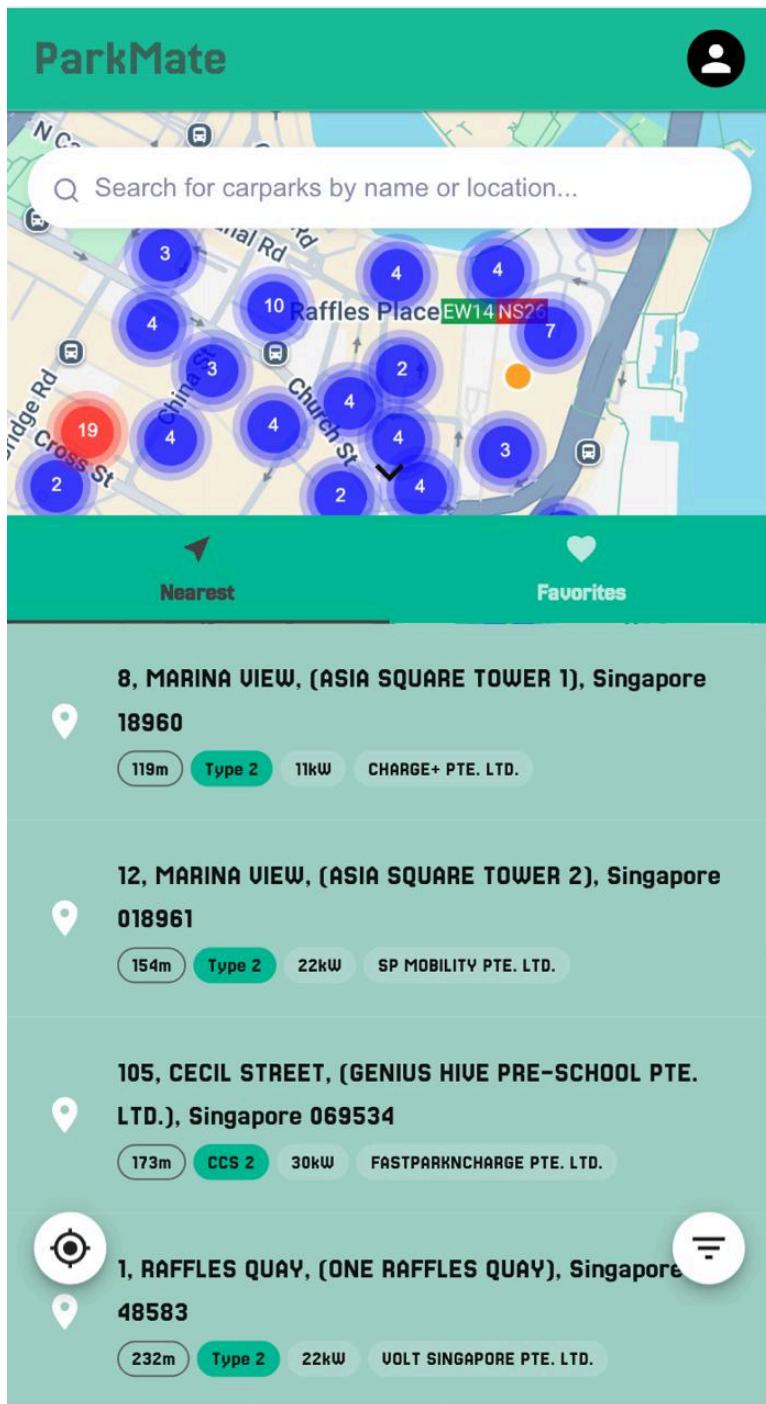
Availability

Favorites

4.13 Recenter map



4.14 EV nearby Chargers (EV toggled ON)



4.15 Terms of Service

← **Terms of Service**

Last updated: November 14, 2025

1. Acceptance of Terms

By accessing and using ParkMate ("the App"), you accept and agree to be bound by the terms and provision of this agreement. If you do not agree to these Terms of Service, please do not use the App.

2. Description of Service

ParkMate provides a mobile application that helps users find available parking spaces in Singapore. The App displays carpark information including location, availability, pricing, and other relevant details sourced from public APIs and databases.

3. User Accounts

To access certain features of the App, you may be required to create an account. You agree to:

- Provide accurate, current, and complete information during registration
- Maintain the security of your password and account
- Accept responsibility for all activities that occur under your account

4.16 Privacy Policy

← **Privacy Policy**

Last updated: November 14, 2025

1. Introduction

ParkMate ("we", "our", or "us") is committed to protecting your privacy. This Privacy Policy explains how we collect, use, disclose, and safeguard your information when you use our mobile application (the "App"). Please read this privacy policy carefully. If you do not agree with the terms of this privacy policy, please do not access the App.

2. Information We Collect

We may collect information about you in a variety of ways. The information we may collect via the App includes:

2.1 Personal Data

When you register for an account, we may collect personally identifiable information, such as:

- Email address
- Name
- Password (encrypted)

2.2 Location Data

With your permission, we may access and track

4.17 Delete Account

