



Refill.Me

No Waste, No Haste - Package-Free

Design

By Team Iron
Old Dominion University
CS 410
12/06/2022
Fall 2022

Image source:

<https://www.pexels.com/photo/person-holding-orange-fruits-in-white-net-3737624/>



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Meet the Team



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Packaging Waste: A Big Problem

USA

- ❖ 82.2 million tons of packaging waste / year
(in 2018) ⁽³⁾
- approx. 160 times the weight
of the One World Trade Center
- ❖ 28.1 % of total waste generation ⁽³⁾



Image source:

https://commons.wikimedia.org/wiki/File:One_World_Trade_Center_Building.jpg

Main Issues With Packaging

Plastic - Paper - Aluminum - Glass

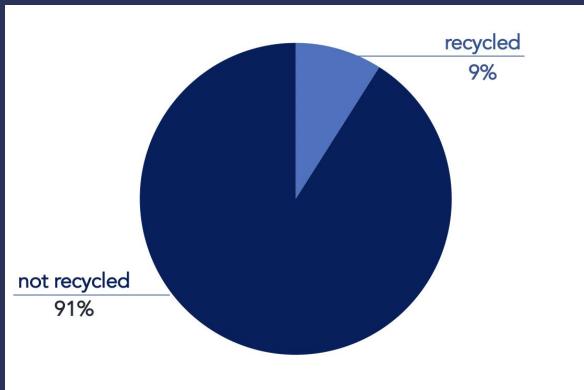
- ❖ greenhouse gas emissions ⁽⁸⁾
- ❖ microplastics pollution ⁽⁸⁾
- ❖ usage of nonrenewable resources ⁽⁸⁾
- ❖ plastic and glass do not biodegrade ⁽¹⁾
- ❖ paper can be recycled max. seven times ⁽⁹⁾
- ❖ leakage of harmful chemicals from plastic packaging into food ⁽⁵⁾
 - ❖ paper packaging: often lined with plastic ⁽¹⁰⁾



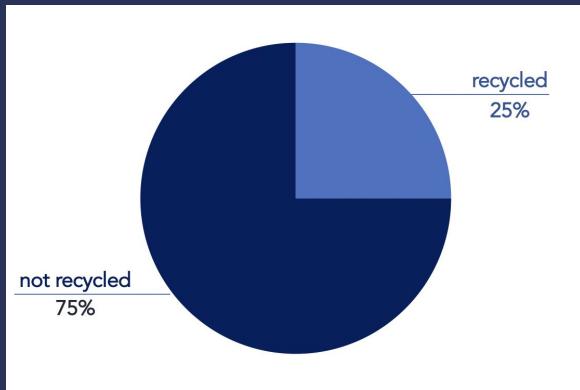
Image source: <https://www.flickr.com/photos/jeepersmedia/15213386005>

Recycling Is Not Good Enough

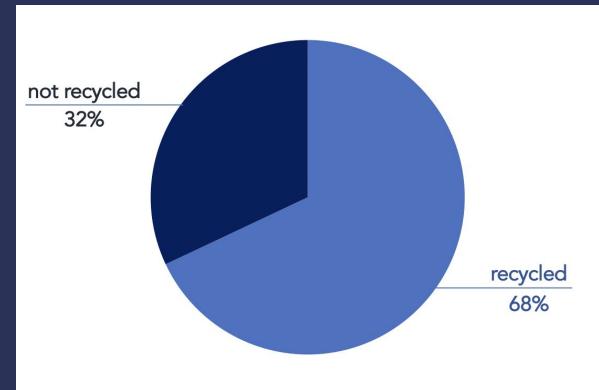
Recycling rates (in 2018) ⁽⁴⁾



Plastic



Glass

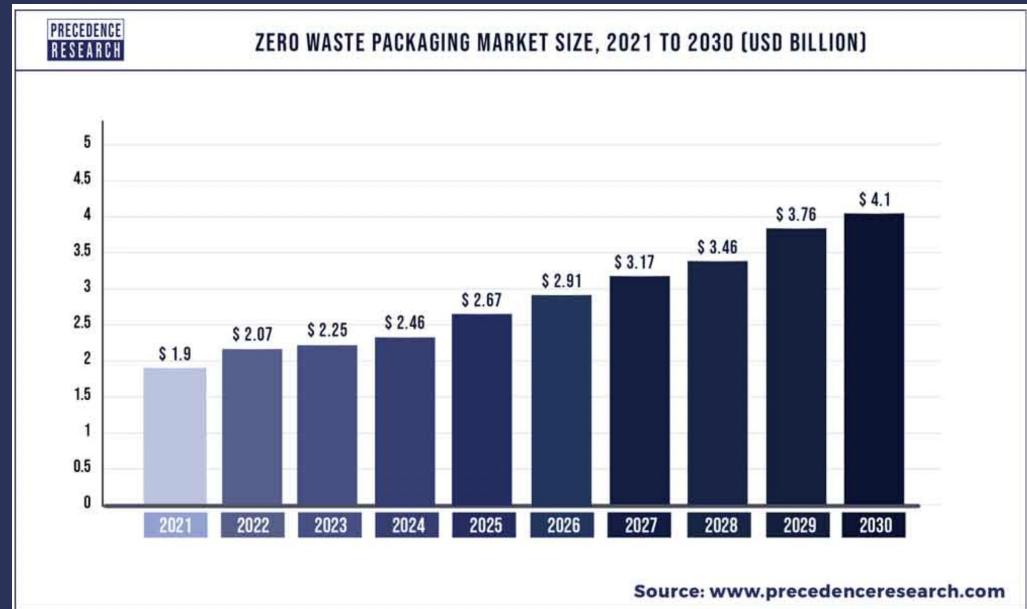


Paper

Market of Reusable, Compostable, Edible Goods

predicted to increase significantly as a result of:

- ❖ the strict regulatory environment
- ❖ single-use plastics are prohibited in a large number of nations
- ❖ the worldwide environmental crisis



What We Mean By Package-Free Shopping

BYOC Bring Your Own Containers

- ❖ tote bags
- ❖ plastic or glass jars, boxes
- ❖ plastic or glass bottles for liquids
- ❖ produce bags



Who Is Struggling?

Shoppers who would like to

- ❖ reduce their packaging waste
- ❖ reduce transportation emissions
- ❖ consume with consciousness

In the USA, concerned about packaging waste: ⁽²⁾

87% of Generation Boomers

79% of Generation X

83% of Generation Millennials

85% of Generation Z



Image source:
<https://www.pexels.com/photo/crop-woman-putting-vegetables-into-wicker-basket-7262859/>

Problem Statement

Mainstream grocery shopping damages our ecosystem through packaging waste from cans, glass, cardboard, and plastic.

Shoppers who are interested in reducing their environmental impact and would like to do package-free shopping lack detailed information such as product and price listings of loose products that are available in their neighborhood.

These shoppers need a tool that provides relevant and accessible information to make sustainable shopping less intimidating.



Problem Characteristics

Lack of Information

zero or little knowledge about where package-free stores are located

lack of knowledge about stores' package-free offerings

lack of transparency regarding prices of loose products

Shoppers' Struggle

frustrated by unnecessary, wasteful packaging

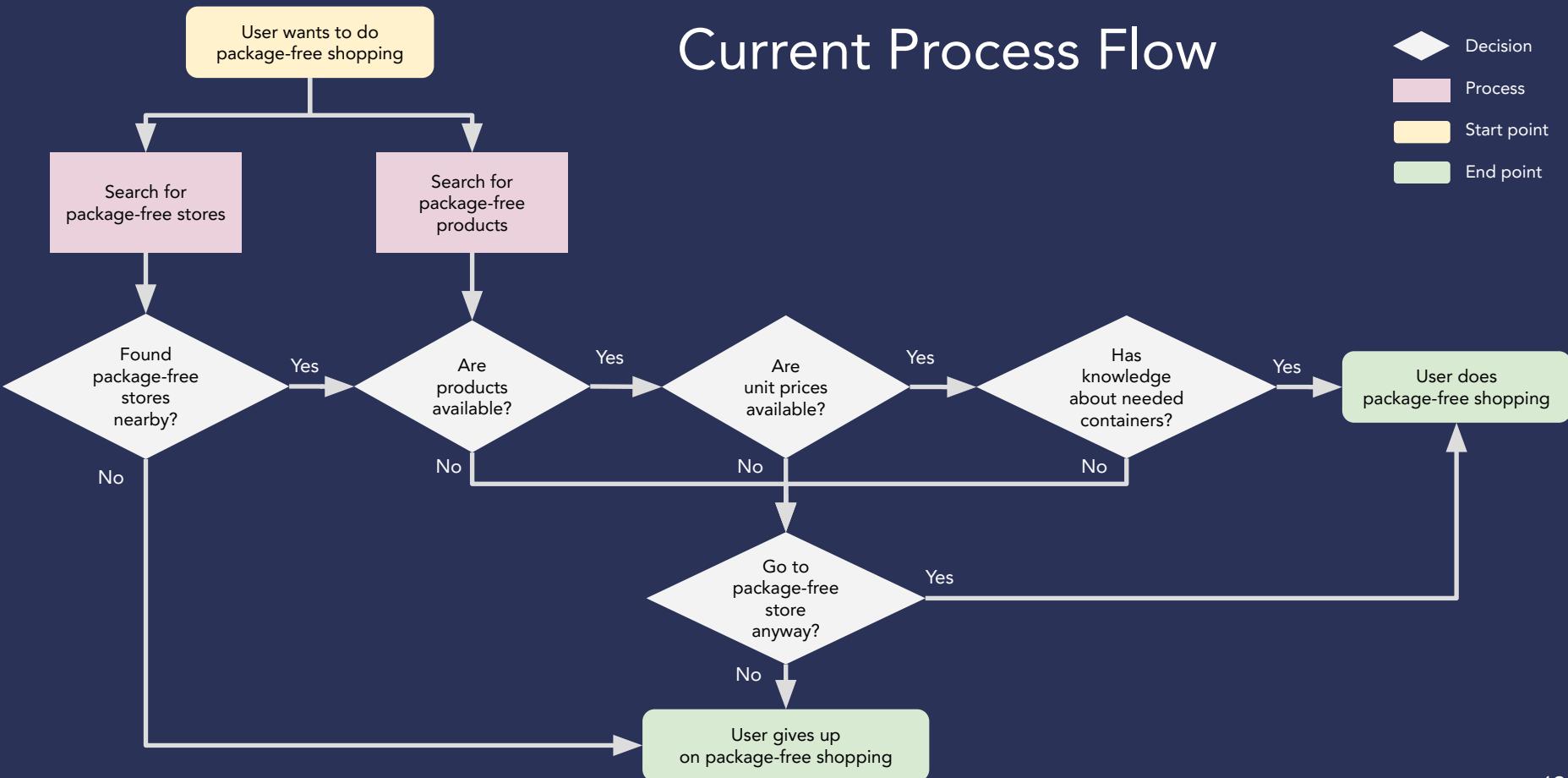
tiresome and difficult to search for package-free stores and products

lack of knowledge about containers to use

Missing Hub

existing apps offer limited features that are only somewhat useful for package-free shoppers, as opposed to many apps supporting mainstream grocery shopping

Current Process Flow



Our Solution: Refill.Me

Refill.Me is an encompassing information-hub in the form of a mobile phone application that provides relevant, practical and up-to-date information regarding package-free shopping.

Refill.Me helps novice package-free shoppers throughout their transition into package-free shopping and supports experienced shoppers to keep up their eco-friendly shopping habits.

By using Refill.Me, package-free shoppers save time and support local businesses, while reducing packaging waste.



Image source
<https://www.flickr.com/photos/nenadstojkovic/49984904868>

Solution Characteristics

Plenty of Information

exhaustive listing of nearby supermarkets with bulk section, package-free stores, and farmers' markets

product listings with unit prices

Shoppers' Delight

easy search by product or by stores
information about containers provided in the Container Guide, and by the smart container recommendation feature

shopping list makes shopping easy to plan

reward system, Reward.Me to collect points and enjoy discounts

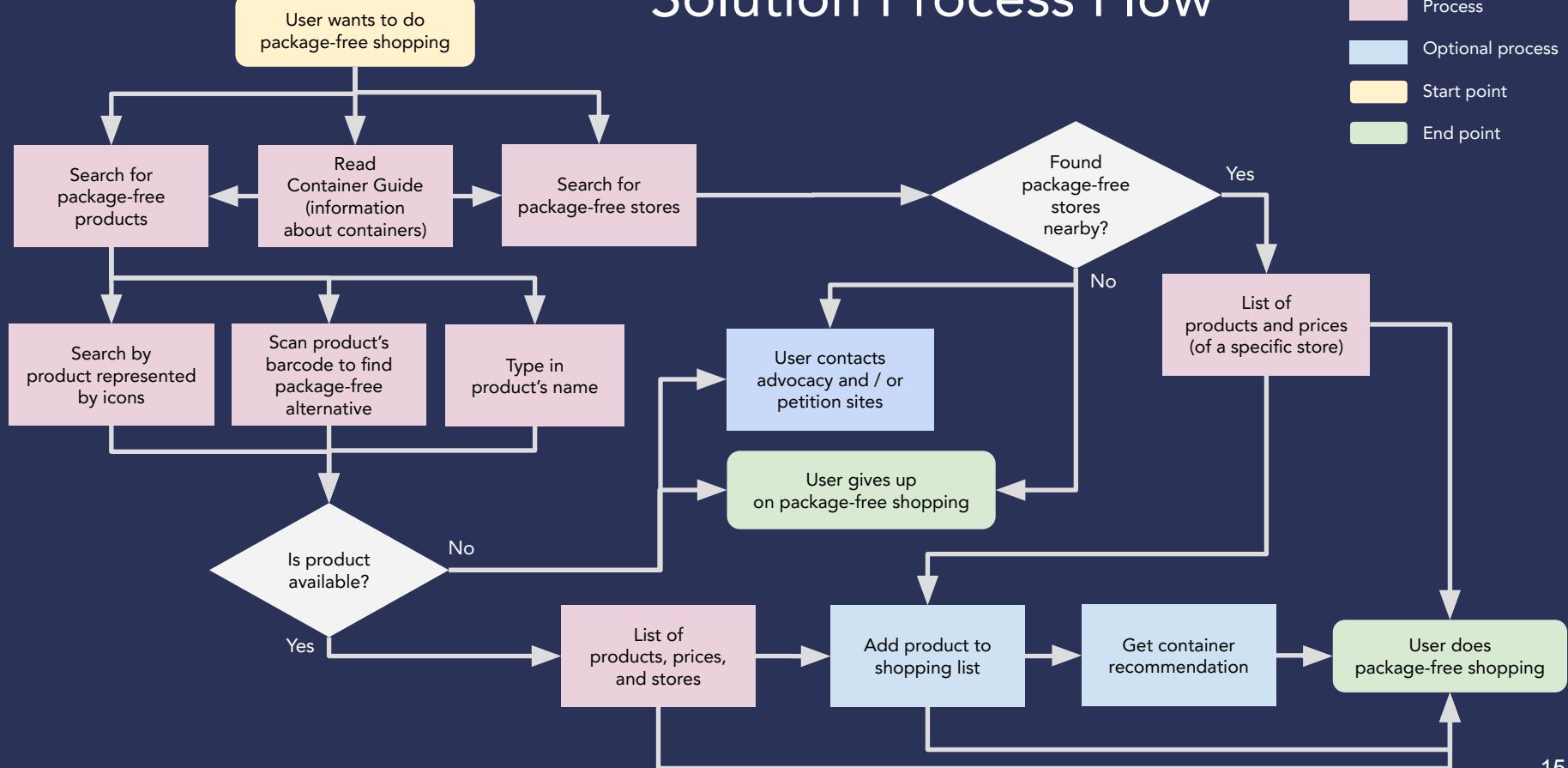
Resource Hub

a convenient app for both new and experienced package-free shoppers

collect shoppers' search information to improve stores' product offerings

use crowdsourcing to increase data accuracy

Solution Process Flow



Benefits

Users

- easy to plan package free shopping based on store and product information
- good understanding of needed containers
- transparency regarding prices

Shops

- attract package-free shoppers
- increase revenue
- increase digital presence
- gain first-hand information about products that shoppers are searching for
- being rated by shoppers

Environment

- less trash
- less food waste
- less harmful chemicals

Our Partners

Stakeholders

- non-governmental environmental organizations
- individual investors

contributions

- ❖ initial funding
- ❖ ideas
- ❖ networking

Customers

- supermarkets with bulk section
- package-free stores
- farmers' markets

app usage

- ❖ free account
- ❖ manage list of products
- ❖ update prices

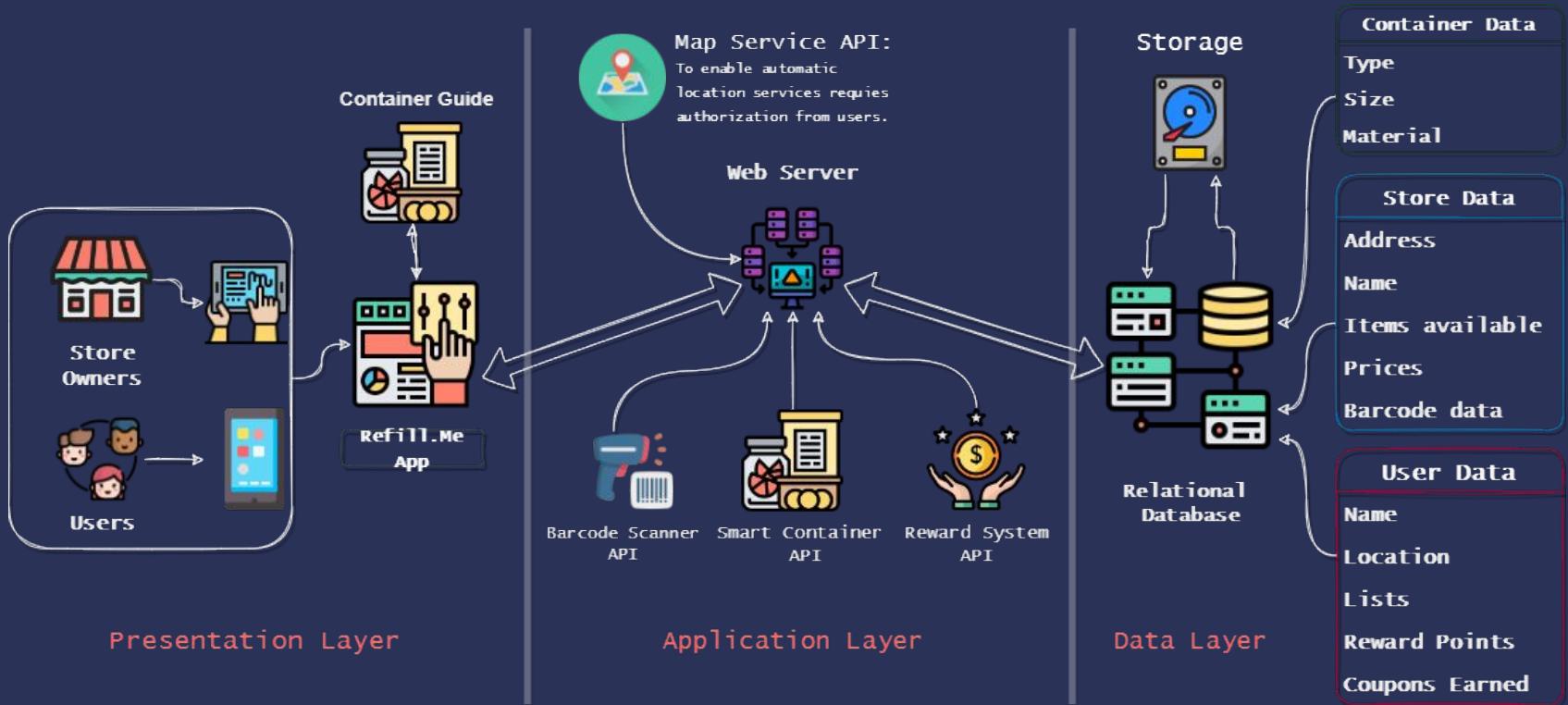
Users

- novice package-free shoppers
- experienced package-free shoppers

app usage

- ❖ free trial period
- ❖ subscription-based pricing model

Major Functional Component Diagram



Sizing Up The Competition

	Refill.Me	Go Zero Waste	Zero Waste App	ZeroWasteHome	Litterless	Google Maps
Nearby Stores	✓	✓	✓	✓	✓	✓
Product Availability	✓	✓	✓	✓	✓	
Search by Product	✓	✓		✓		
Unit Prices	✓					
Shopping List	✓					
Container Recommendation	✓					
Store Rating	✓	✓				✓
Reward.Me	✓					

implementation: ✓ full ✅ partial

What Refill.Me Will Not Do

- ❖ Not a webshop
 - ◊ system for delivering products in reusable containers is not in place - yet
 - ◊ buying loose products from trucks is not widespread - yet

- ❖ Not an educational app
 - ◊ plenty of websites and blogs related to package-free shopping



Image source:
<https://www.rawpixel.com/image/3307216/free-photo-image-warehouse-food-distribution>

User Roles

The size of the cards represents the extent of the control that the user role has over different areas and features of the app.

Administrator

- admins
- developers
- testers

have full access to:

- ❑ every functionality of the app
- ❑ user accounts
 - both shoppers and stores

Package-free shopper

- shoppers with a 'Refill.Me' account
- novice package-free shoppers
- experienced package-free shoppers
- shoppers who would like to get information about package-free options nearby

Store owner / employee

- owners of supermarkets with a bulk section
- owners of package-free stores
- vendors at farmers' markets

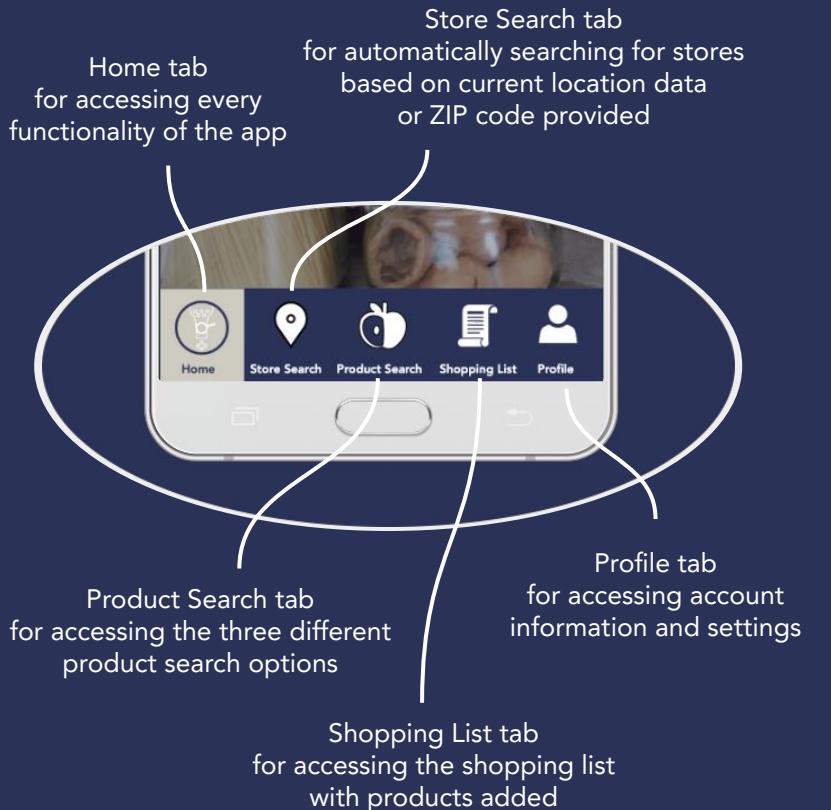
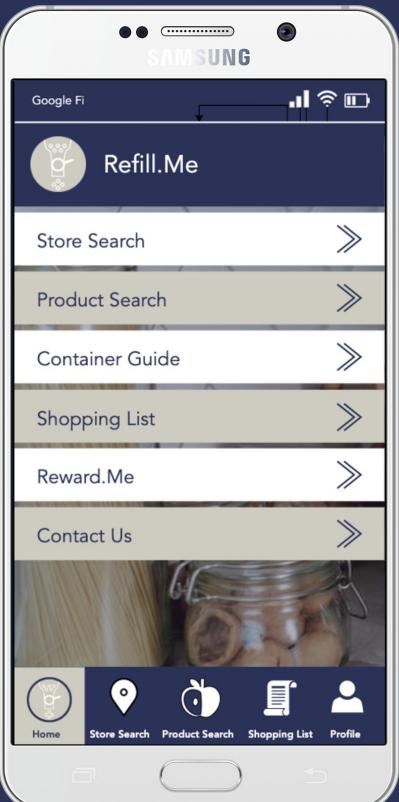
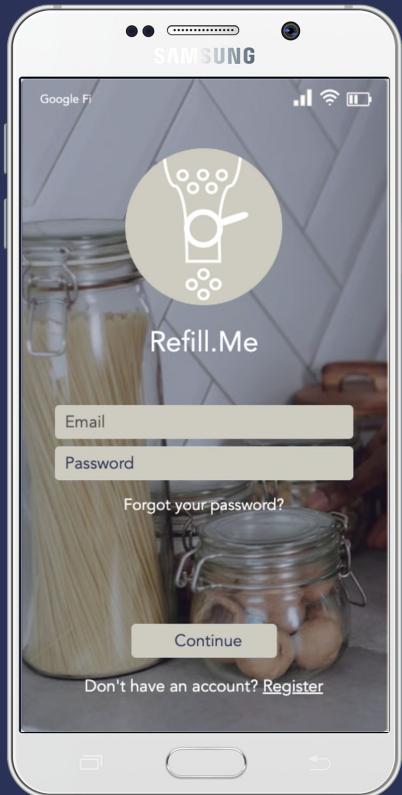
Guest

- shoppers without a 'Refill.Me' account

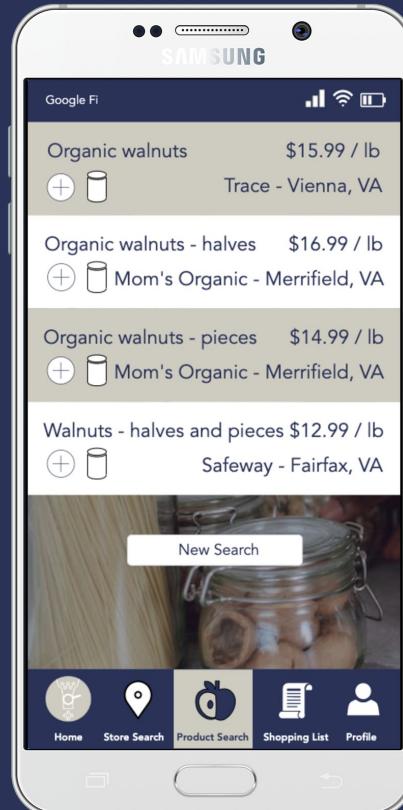
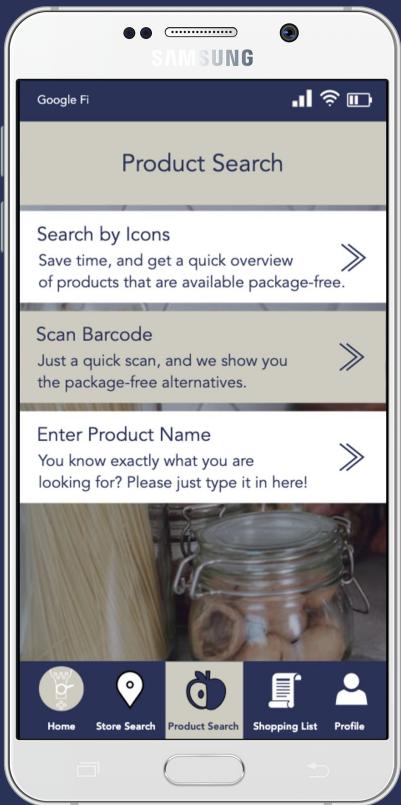
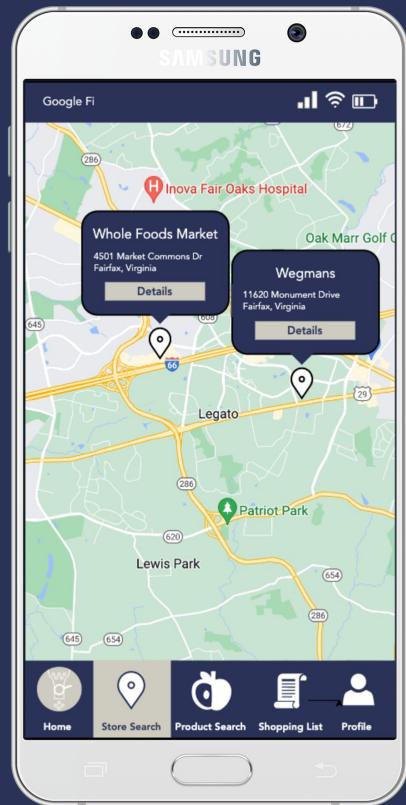
Features Table

Category	Features	Guest	Registered Shopper	Registered Store Owner	Administrator
Account Management	Login / Authentication		✓	✓	✓
	Location usage	✓	✓	✓	✓
	Account Creation / Deletion		✓	✓	✓
Mobile App Features	Search by Store	✓	✓	✓	✓
	Search by Product		✓	✓	✓
	Container Guide	✓	✓		✓
	Container Recommendation		✓	✓	✓
	Shopping List		✓		✓
	Reward.Me		✓		✓
	Product and Price Dashboard			✓	✓
	Reward Point Conversion Dashboard			✓	✓
	Coupon Dashboard			✓	✓
	Store Rating Dashboard			✓	✓
Data Management	Search Information Dashboard			✓	✓
	Data Analytics				✓
	Trend Reports				✓
	Search Information Analysis				✓
	Tags				✓

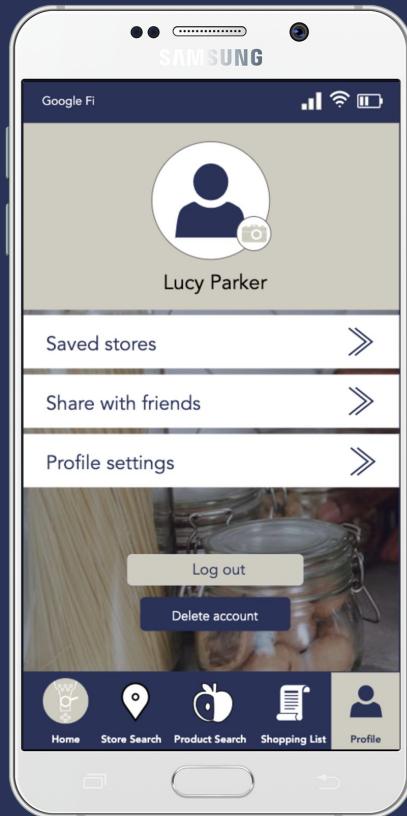
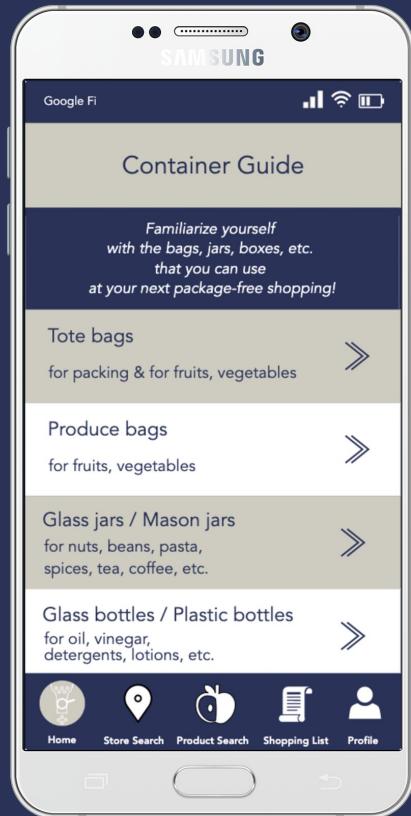
Mockup for Smartphone



Mockup for Smartphone



Mockup for Smartphone



Mockup for Tablet

The image displays two side-by-side tablet mockups of the Refill.Me mobile application.

Left Screen (Login Screen):

- Time: 11:29 PM
- Date: Mon Nov 21
- Battery: 24%
- Icon: Circular logo with a stylized tree or leaf design.
- Text: "Refill.Me"
- Form fields:
 - Email
 - Password
- Links:
 - Forgot your password?
 - Don't have an account? [Register](#)
- Buttons:
 - Continue

Right Screen (Home Screen):

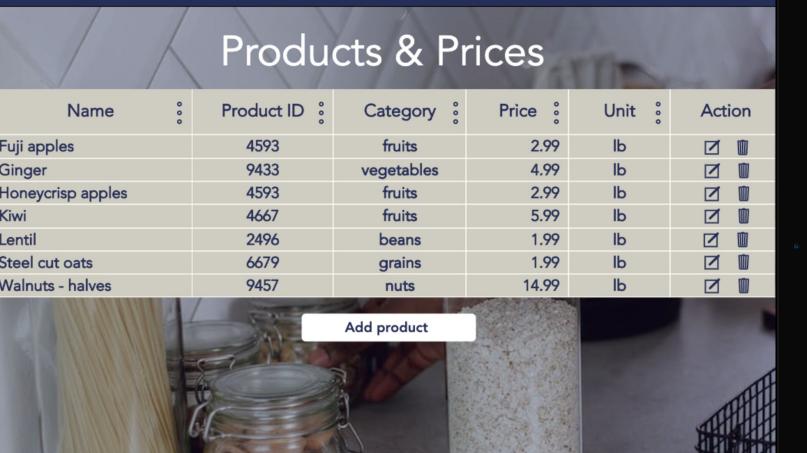
- Time: 11:29 PM
- Date: Mon Nov 21
- Icon: Circular logo with a stylized tree or leaf design.
- Title: Home
- Card 1: Products & Prices
- Card 2: Reward Point Conversion
- Card 3: Coupons
- Card 4: Store Rating
- Card 5: Store Analysis
- Card 6: Store Search
- Card 7: Product Search
- Card 8: Profile
- Bottom Navigation Bar:
 - Home
 - Products & Prices
 - Reward Point Conversion
 - Store Analytics
 - Profile

Mockup for Tablet

11:29 PM Mon Nov 21 24% 

Products & Prices

Name	Product ID	Category	Price	Unit	Action
Fuji apples	4593	fruits	2.99	lb	<input checked="" type="checkbox"/> 
Ginger	9433	vegetables	4.99	lb	<input checked="" type="checkbox"/> 
Honeycrisp apples	4593	fruits	2.99	lb	<input checked="" type="checkbox"/> 
Kiwi	4667	fruits	5.99	lb	<input checked="" type="checkbox"/> 
Lentil	2496	beans	1.99	lb	<input checked="" type="checkbox"/> 
Steel cut oats	6679	grains	1.99	lb	<input checked="" type="checkbox"/> 
Walnuts - halves	9457	nuts	14.99	lb	<input checked="" type="checkbox"/> 





11:29 PM Mon Nov 21 24% 

Reward Point Conversion

Name	Reward Points	Expiry Date	Action
Fuji apple (2 pc)	50	12/31/2022	<input checked="" type="checkbox"/> 
10% discount on any pasta product	100	12/31/2022	<input checked="" type="checkbox"/> 
5% discount on any liquid detergent	50	1/31/2023	<input checked="" type="checkbox"/> 
5% discount on any spices	80	1/31/2023	<input checked="" type="checkbox"/> 





Mockup for Tablet

The image displays two side-by-side tablet mockups of a mobile application interface.

Left Tablet Mockup: Store Analytics

- Header:** 11:29 PM Mon Nov 21, 24% battery.
- Title:** Store Analytics
- Section:** Recent Searches in Your Area
- Table:** Shows a list of recent searches with columns: Product Searched, Product Found, Date, Product Available in My Store, and Action (Save). The table includes rows for Turmeric, Spaghetti, All-purpose flour, Orange, Lentil, and Steel cut oats, with varying search results and save status.
- Buttons:** See Full Listing, See Saved Searches.
- Section:** Redeemed Reward Points & Coupons
- Bottom Navigation:** Home, Products & Prices, Reward Point Conversion, Store Analytics (selected), Profile.

Right Tablet Mockup: Profile Screen

- Header:** 11:29 PM Mon Nov 21, 24% battery.
- User Profile:** Placeholder image of a person with a camera icon.
- Title:** Mom's Organic Merrifield
- Card:** Store Information (Address: 8298 Glass Alley, Fairfax, VA 22031, Hours: Monday-Saturday: 9am-9pm, Sunday: 9am-8pm, Website: www.momsorganicmarket.com, Phone: (703) 663-8810).
- Card:** Profile settings.
- Card:** Notification settings.
- Card:** Roles & Permissions.
- Buttons:** Log out, Delete account.
- Bottom Navigation:** Home, Products & Prices, Reward Point Conversion, Store Analytics, Profile.

Software / Hardware Tools

UI/UX (Front End)

- React Native + Expo
- Languages:
 - HTML
 - CSS
 - Javascript

Middleware (Back-End)

- API server (server for REST APIs)
- Application services
- Services for data management
- AWS Application Integration services

Databases (Back-End)

- MySQL
- AWS Data Management services
- Express

Testing

- Jest
- Mocha, Jenkins
- Gitlab CI/CD

Third Party Software

- Amazon Maps
- Barcode Scanner
- OCR
- Amazon Kinesis
- Tesseract 4
- Scrapy

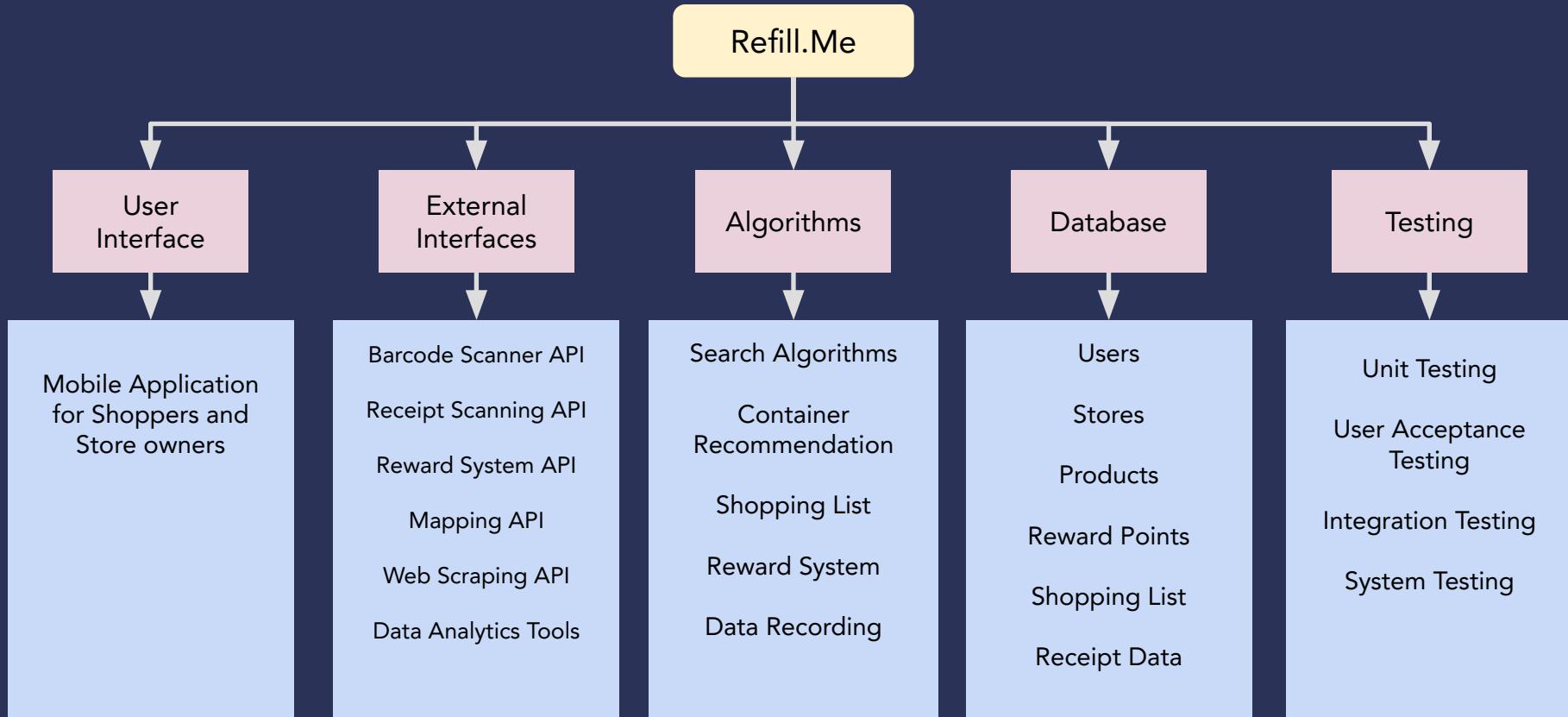
Hardware

- Smartphone
- Tablet

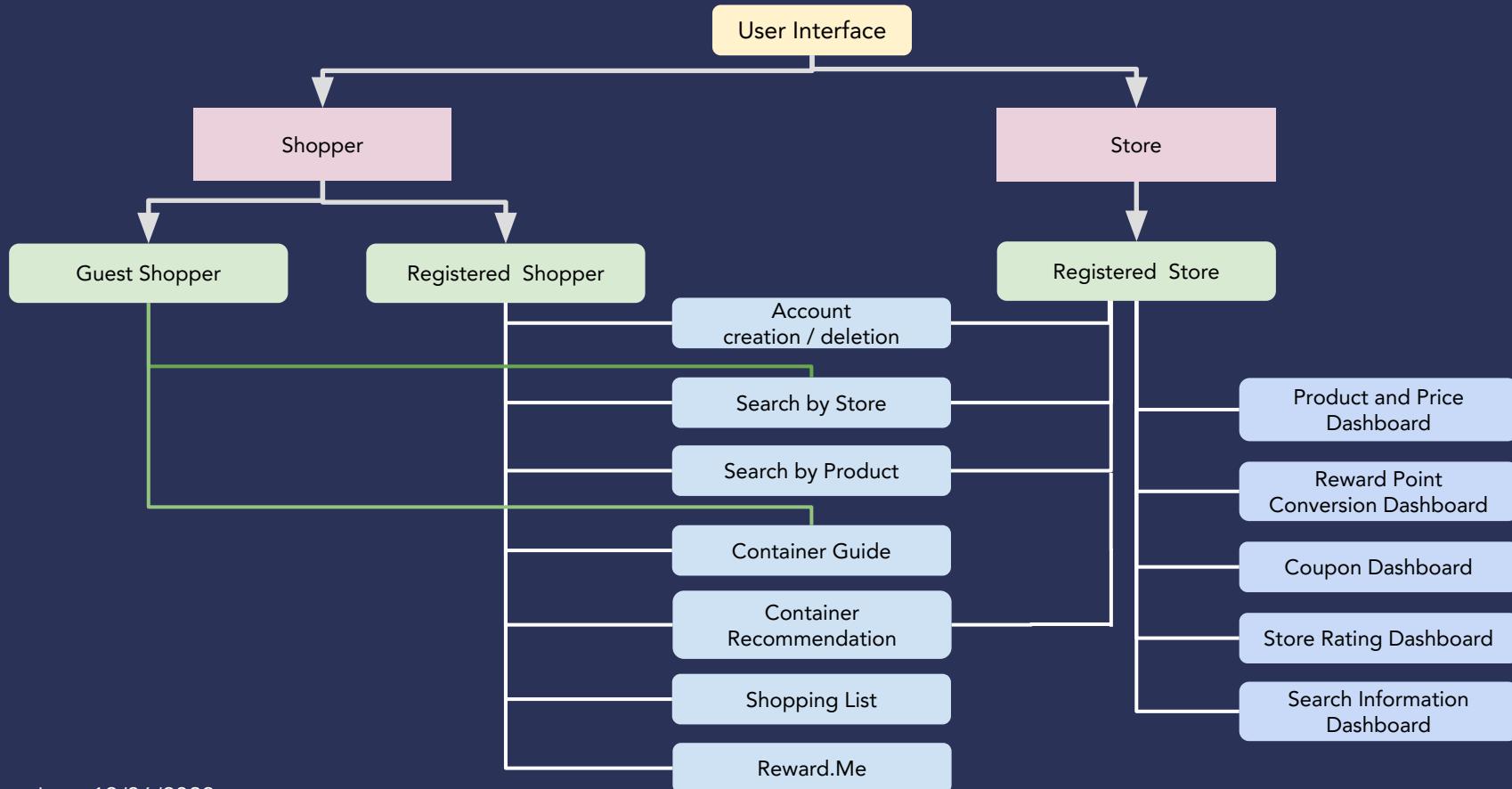
Development Tools

	Android	iOS	Web App
Language	JavaScript		
Framework	React Native + Expo		
IDE	Visual Studio Code		
UI/UX	HTML, CSS		
Database	Amazon RDS for MySQL		
Build Manager	Webpack, Node Package Manager		
Issue Tracker	Gitlab		
Testing Framework	Jest		

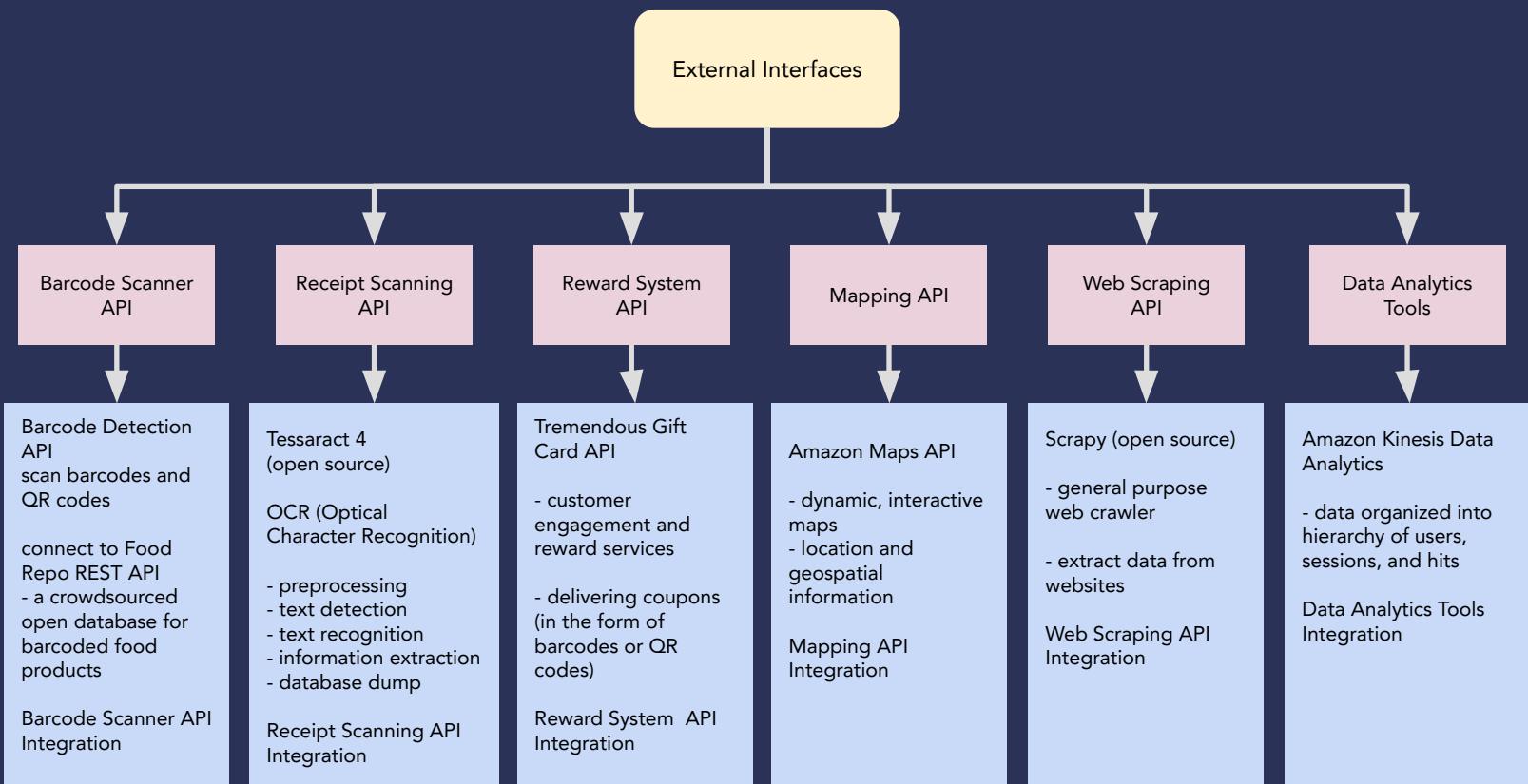
Work Breakdown Structure Overview



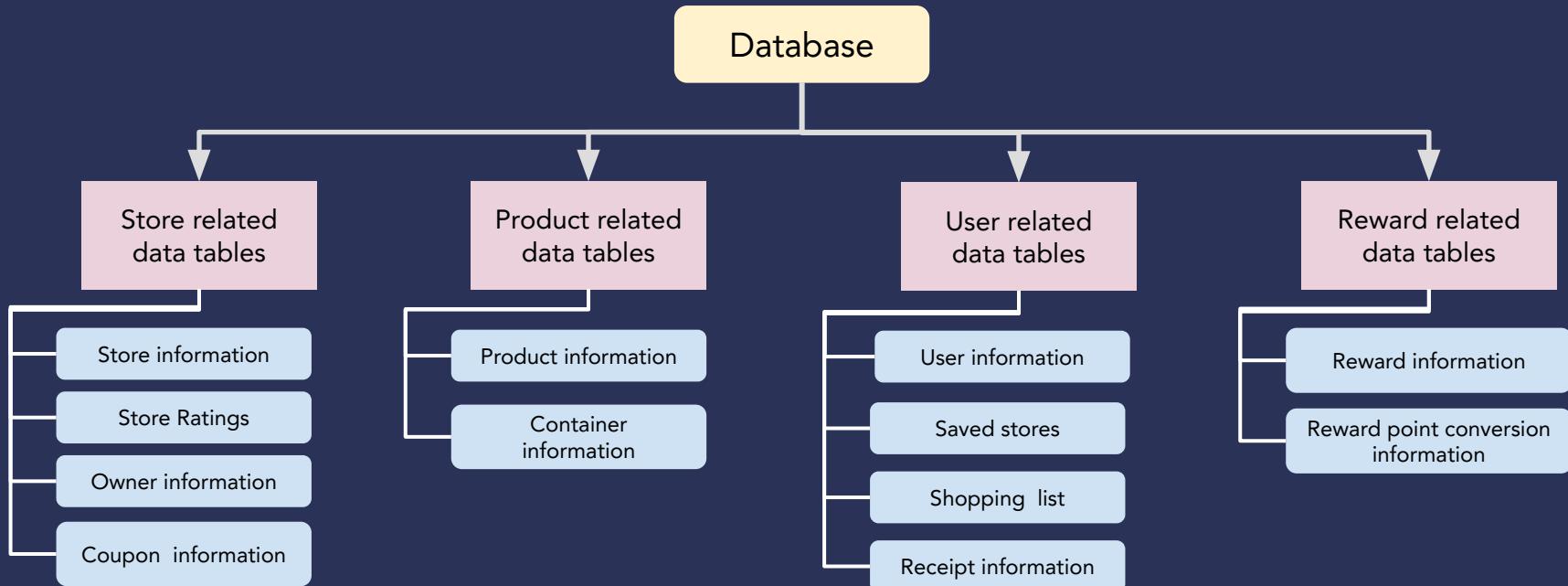
WBS - User Interface



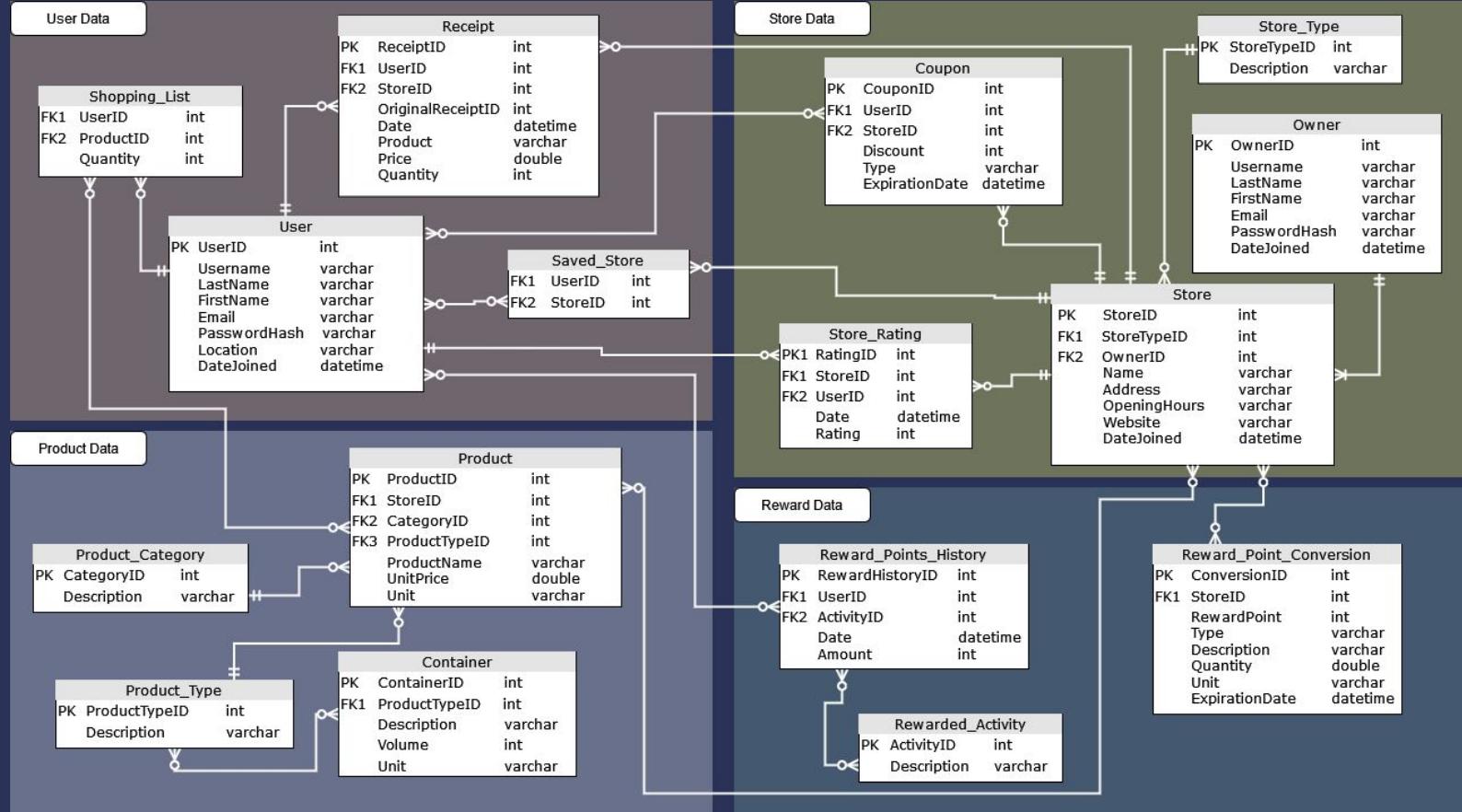
WBS - External Interfaces



WBS - Database



WBS - Database Schema



Data Management

Data Input

JSON inputs:

- Store information
- Third-Party APIs

Non-JSON inputs:

- User feedback

Data Storage

MySQL supported by AWS Relational Database Service (RDS)

- modern scalable cloud storage service
- built-in security features

Threat Protection

AWS GuardDuty:

- intelligent threat detection
- continuously monitors for threats
- creates reports for threats

AWS CloudTrail

AWS CloudWatch

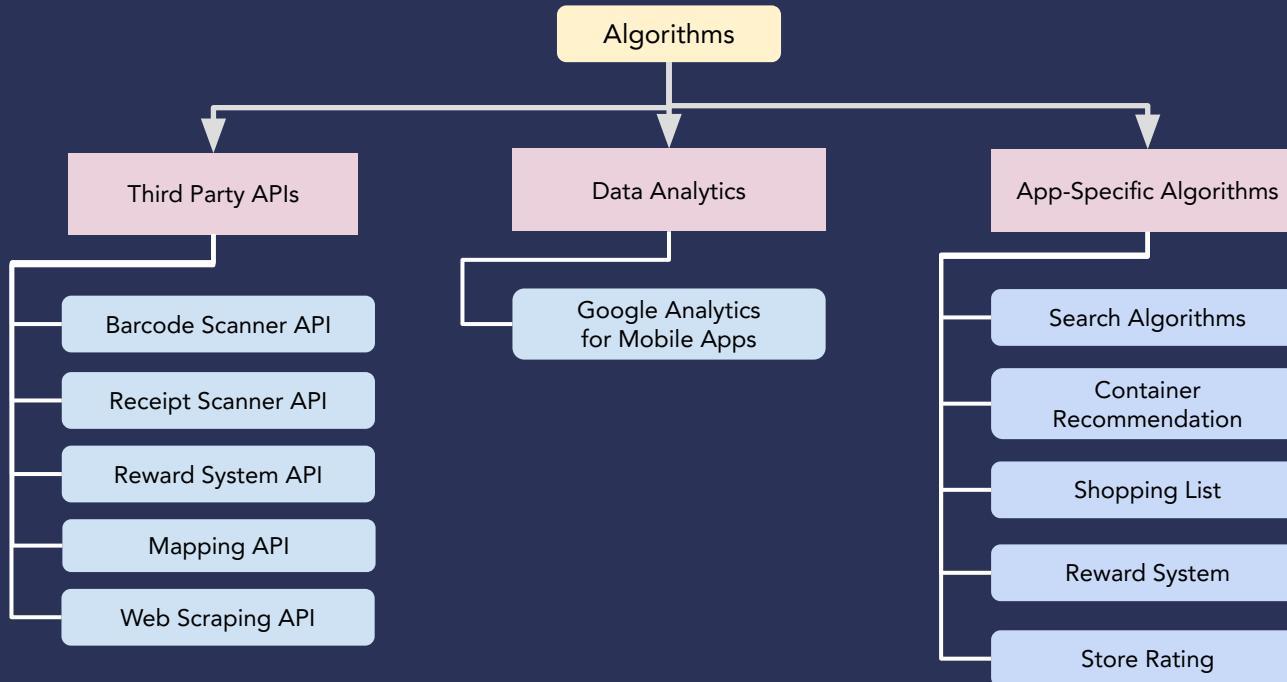
Data Backup

stored data backup with AWS as frequently as specified by the database (e.g. daily)

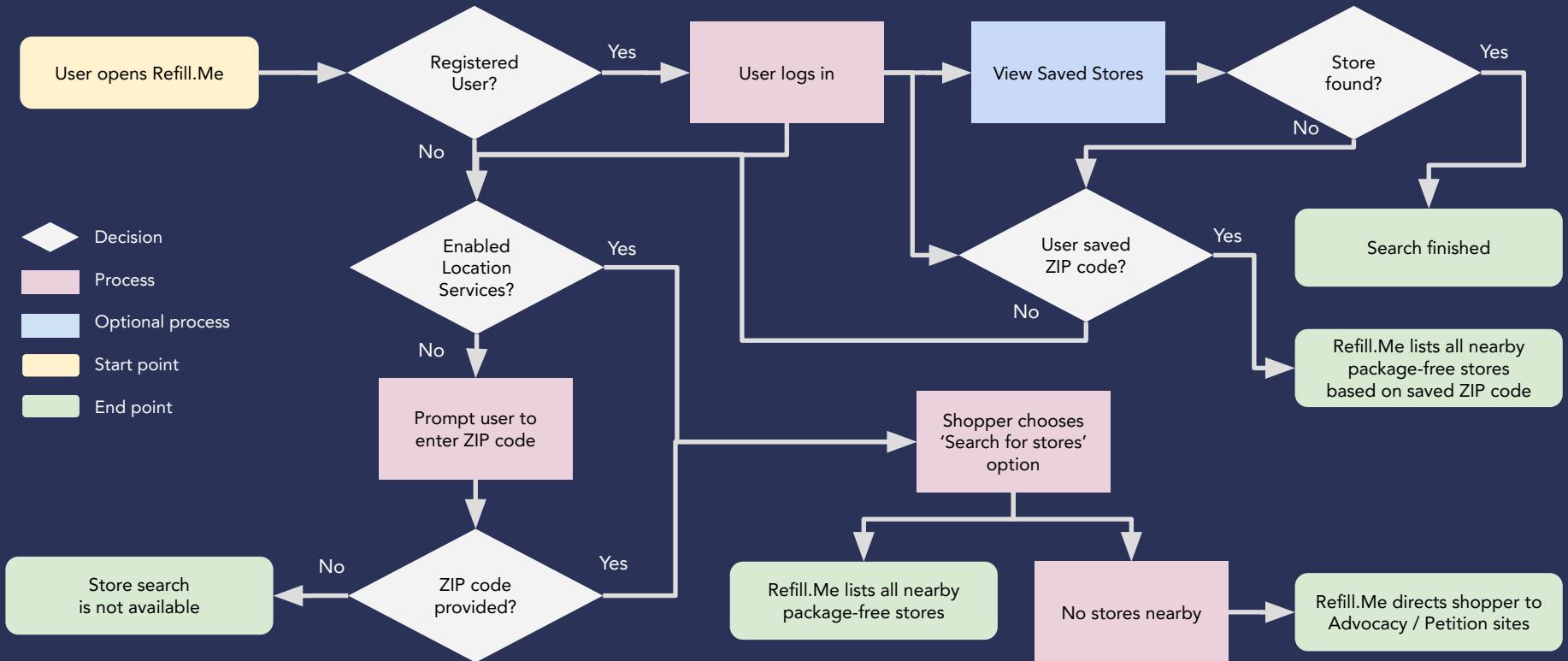
Data Recovery

recovery solutions offered by AWS to retrieve lost data

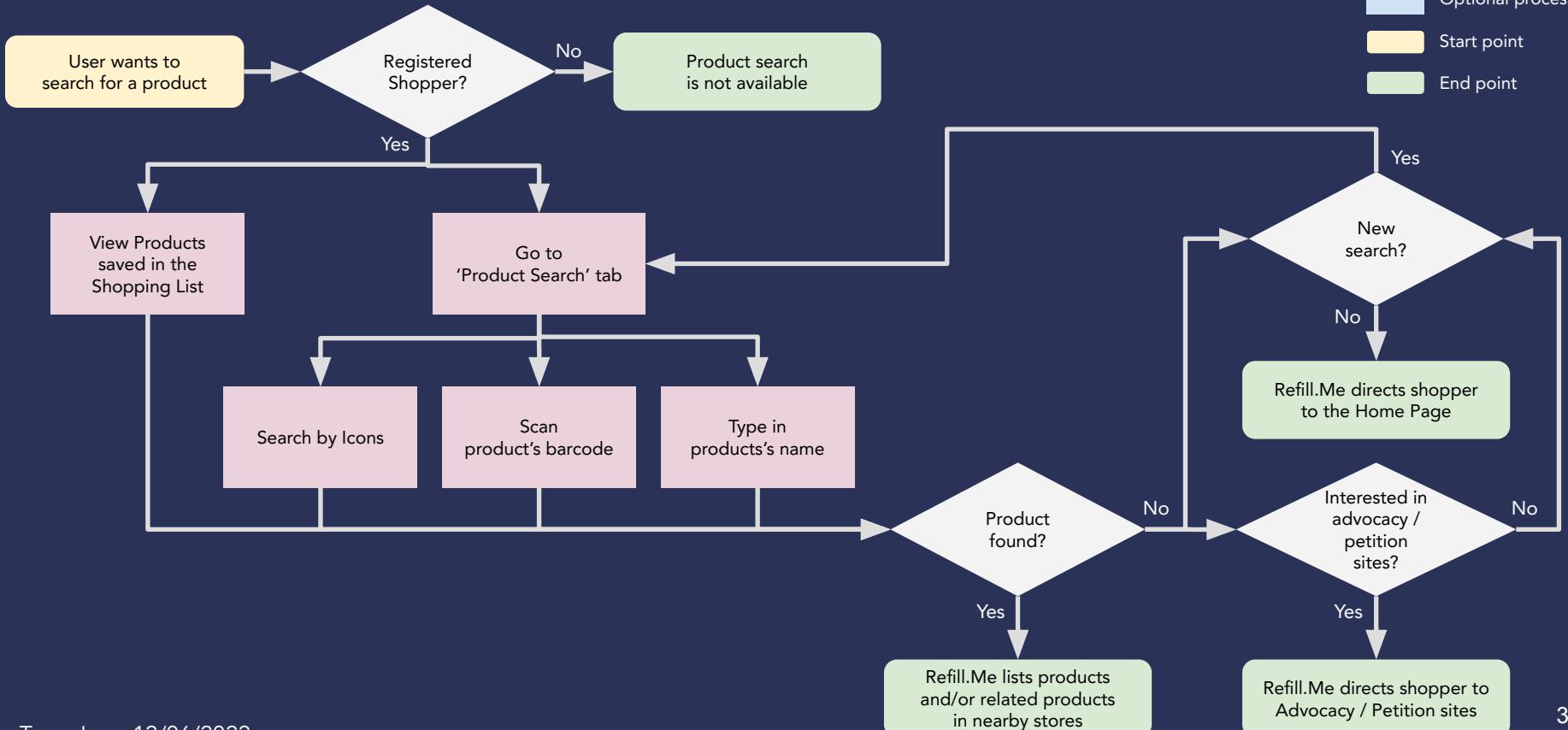
WBS - Algorithms



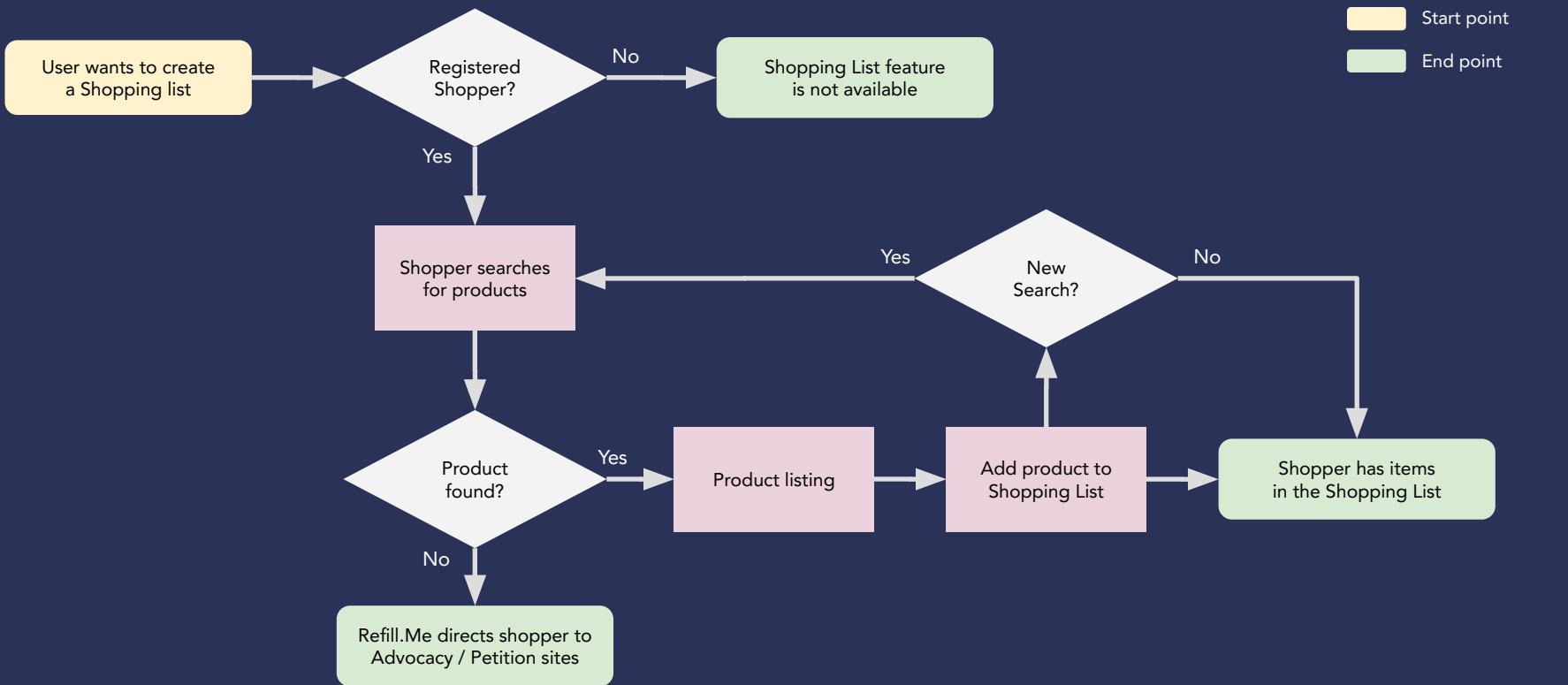
Algorithms - Store Search



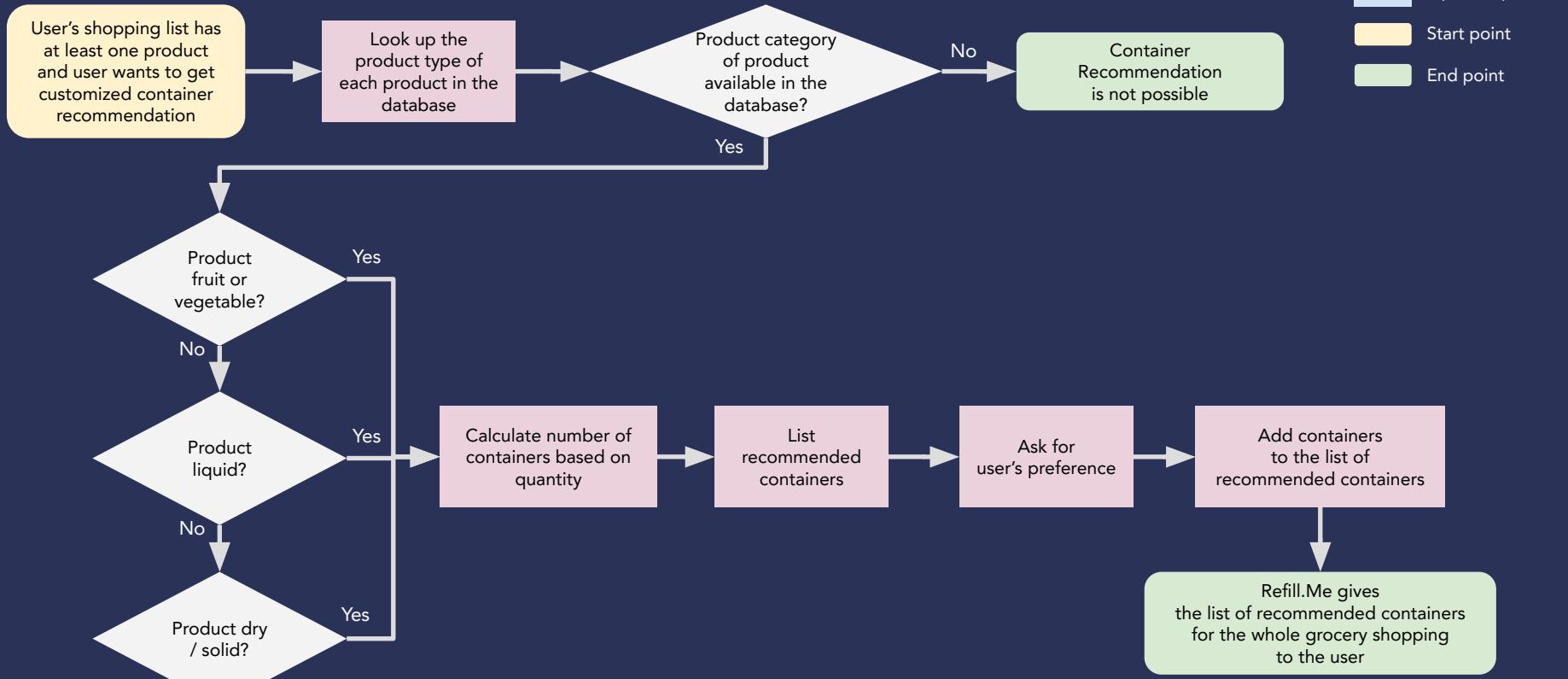
Algorithms - Product Search



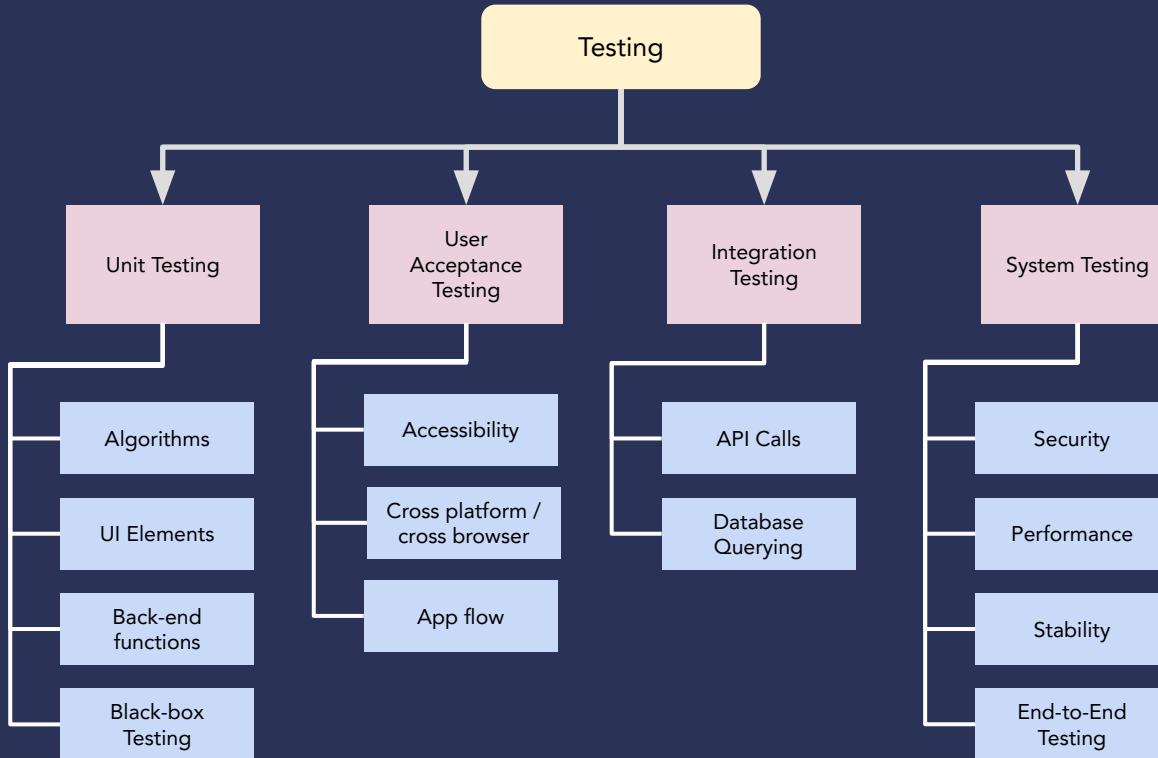
Algorithms - Shopping List



Algorithms - Container Recommendation



WBS - Testing



Sprint Breakdown

*Each sprint represent 2 weeks

Sprint 0: Setup & Configure

- Setup the development environment
- Configure Trello board
- Integrate GitLab
- Configure Amazon RDS
 - User profiles/logins
 - Define user roles

Sprint 2: User Interfaces

- UI basic functionality
- Integrate frontend and backend
- Search Functionality
- Container Guide
- Unit tests

Sprint 1: Framework

- Implement framework for Frontend/backend.
- Unit tests

Sprint 3: Major Features

- Improve UI functionality
- Product and Price dashboard
- Shopping List Functionality
- Unit/System tests

Sprint Breakdown

*Each sprint represent 2 weeks

Sprint 4: Feature Expansion

- Update UI
- Reward System
- Implement:
 - Amazon Maps API
 - Barcode Scanner API
 - Receipt Scanning API
- Unit/Systems tests
 -

Sprint 6: Wrap up Features

- Improve/polish UI
- Performance testing
- Unit/Systems tests

Sprint 5: Mobile Integration

- Integrate data analytics
- Unit/System tests

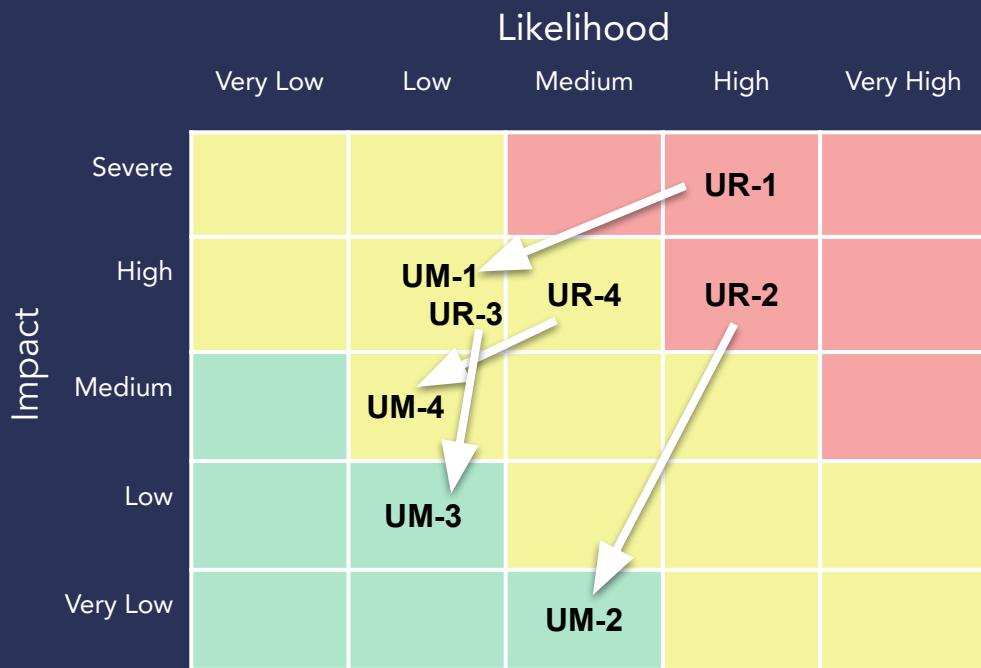
Sprint 7: Polish and Release

- Backup and recovery
- Unit / System tests
- Publish build (alpha/beta version)

Legend:



User Risk Matrix



Risks

- UR-1: Shopper has no package-free stores in their area
- UR-2: Shoppers are not familiar with needed containers
- UR-3: Shopper loses interest in the app
- UR-4: Shopper types in product name and app returns no product available

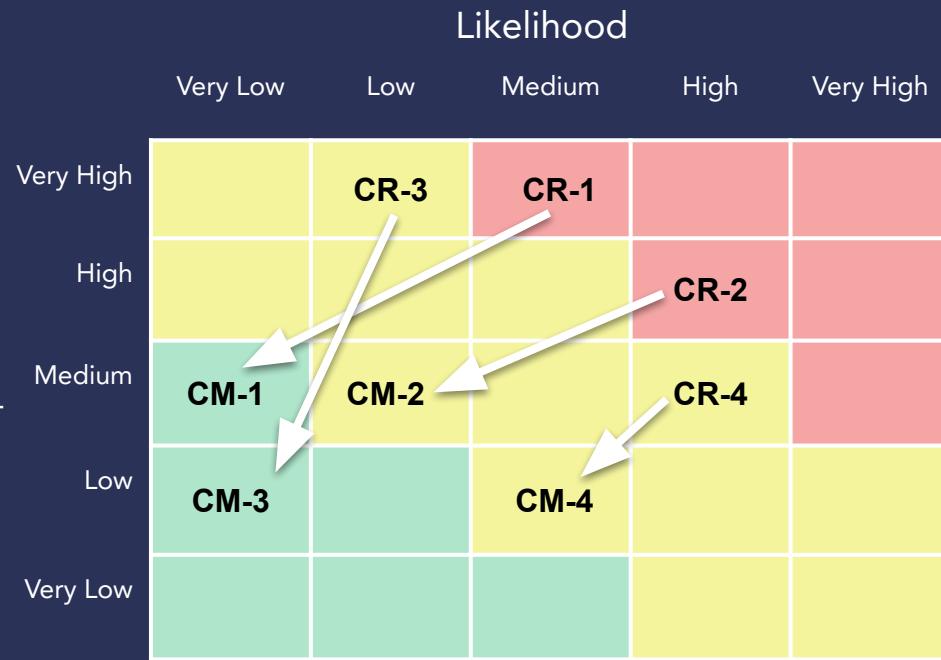
Mitigation

- UM-1: App connects shoppers to advocacy and petition sites
- UM-2: App provides 'Container Guide'
- UM-3: Product and price listing is constantly updated, reward system keeps shoppers engaged
- UM-4: App lists related products

Legend:

- low risk
- medium risk
- high risk

Customer Risk Matrix



Risks

CR-1: Stores cannot keep product/price information up-to-date
CR-2: Stores submit partial information
CR-3: Stores are unable to scan the barcode provided for the reward points for the user
CR-4: Holiday hours are not updated

Mitigation

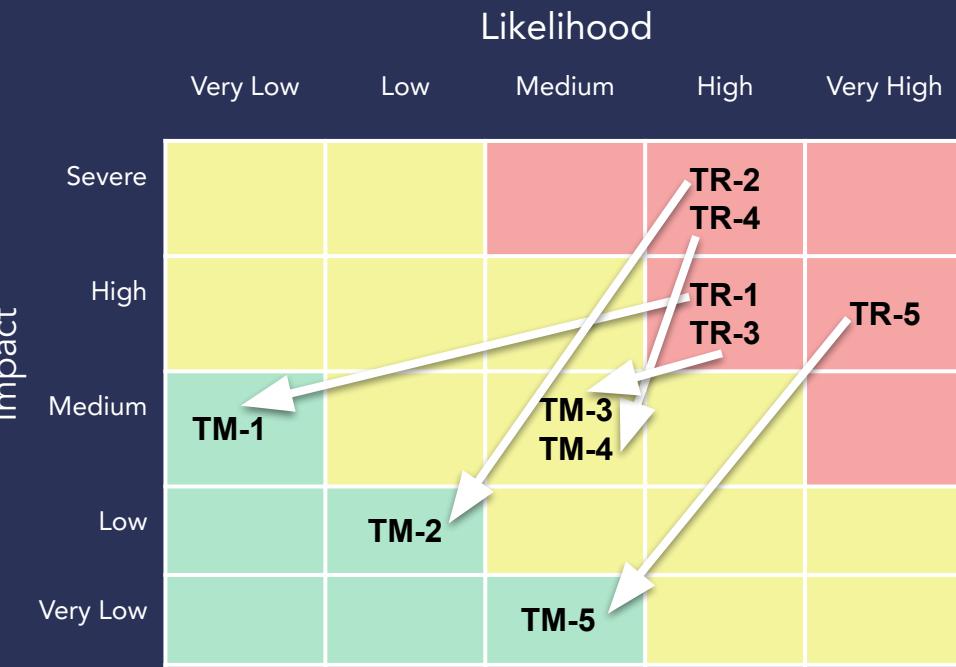
CM-1: Remind stores weekly to update product/price information
CM-2: Provide a template/form for store owners to follow
CM-3: Generate new barcode for the shopper
CM-4: Automated reminder for stores to update their holiday hours

Legend:

- low risk
- medium risk
- high risk

Technical Risk Matrix

Risks



- TR-1: Receipt upload fails because the OCR cannot process the data
- TR-2: App lists wrong product or wrong price
- TR-3: Credentials/data compromised
- TR-4: API integration comes with technical complexities
- TR-5: Mapping feature fails

Mitigation

- TM-1: Allow user to manually enter the data
- TM-2: App updates data every 4-8 hrs with automated scheduled script; error log for developers to track
- TM-3: Use good cybersecurity practices
- TM-4: Studying API documentation, using an API Integration Platform
- TM-5: An offline map of the closest 5 stores to the user will be saved

Key Points

Refill.Me provides
*the service of connecting people
with the nearest package-free stores.*

A comprehensive tool for

- ❖ novice shoppers who want to transition into package-free shopping
- ❖ experienced package-free shoppers who want to keep up their shopping habits
- ❖ package-free stores to attract shoppers



Image source:

https://commons.wikimedia.org/wiki/File:USDA_is_working_hard_to_expand_access_to_farmers%26%20%29_markets_for_those_participating_in_the_Supplemental_Nutrition_Assistance_Program_%28SNAP%29.jpg

Appendix A: User Stories - Shoppers

As a package-free shopper, I want to...

- ❖ avoid purchasing products with wasteful product packaging so that I can help the environment.
- ❖ find nearby package-free stores so that I can do package-free shopping.
- ❖ learn about containers that I could use for package-free shopping so that I will know what containers I can use for package-free shopping.
- ❖ know what type of containers I will need to bring with me so that I can be prepared when I go package-free shopping.
- ❖ know how many containers I will need to bring with me so that I can do package-free shopping.
- ❖ search for specific package-free products near me in a quick and efficient way so that I will know what products are available package-free in my area.
- ❖ scan the barcode of a product so that I can find package-free alternatives for it.
- ❖ type in a product's name and search for it so that I will know what products are available package-free in my area.
- ❖ know the unit prices of products so that I will have information about the prices of products in advance.
- ❖ create a shopping list so that I will not forget anything that I would like to buy.
- ❖ have an overview of my reward points, and coupons I received, and their expiration date so that I can use them in time.
- ❖ redeem my reward points at the stores so that I can get some benefits.
- ❖ upload my receipts so that I can receive reward points for them.
- ❖ report new / closed stores, new products, or products that are not available anymore, or prices that changed so that I can help others with up-to-date information.
- ❖ rate stores so that I can provide some feedback about their services.
- ❖ provide feedback about the functionalities and the usage of the app so that the app will be optimized according to my needs.

Appendix A: User Stories - Stores

As a store owner/employee, I want to...

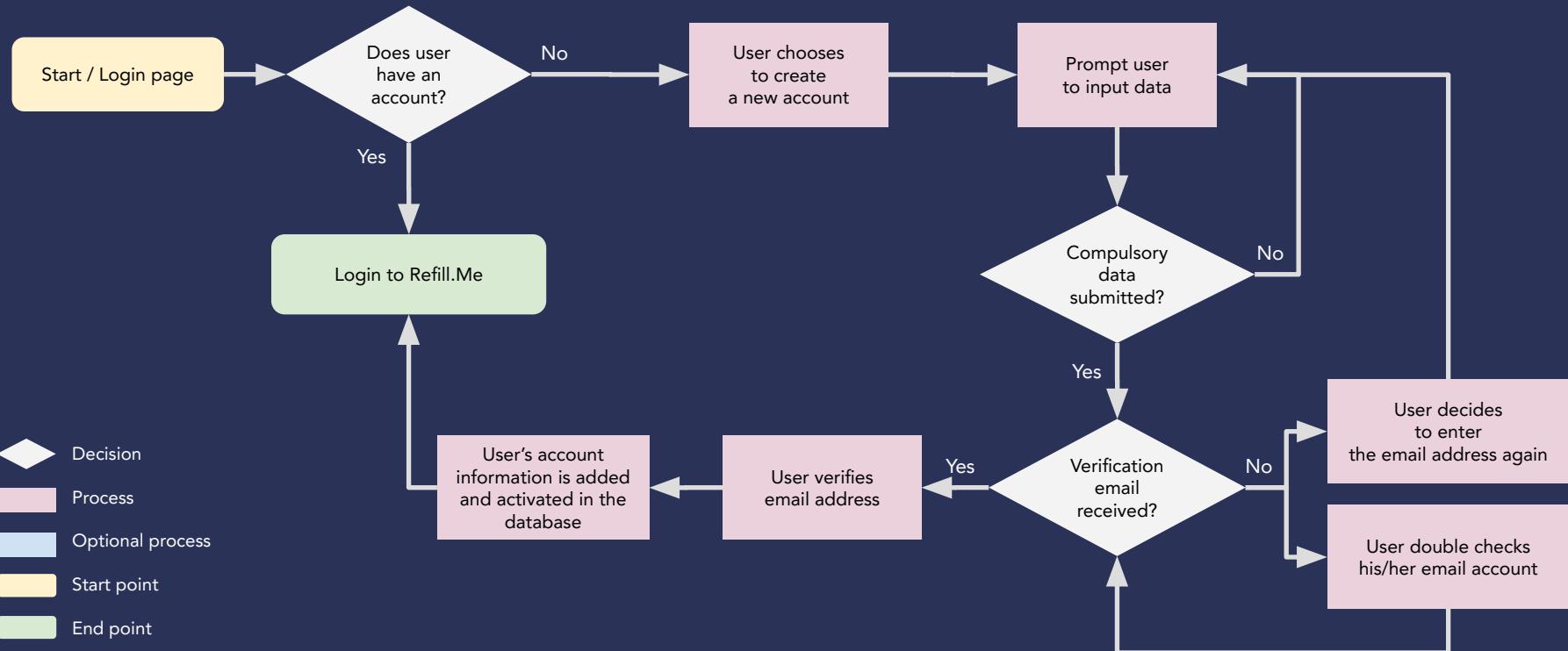
- ❖ efficiently edit / add / delete my store information, product listing, and prices so that the shoppers will see only up-to-date information regarding my store and products.
- ❖ see a preview of the data that I entered so that I can see what the shoppers will see in the app.
- ❖ see the store's site in the app from the user's view so that I can see what the shopper will see in the app.
- ❖ decide what products or services the users will get for a certain amount of reward points so that the shoppers can use their reward points.
- ❖ issue coupons to the shoppers for their reward points so that they will come to the store, and eventually buy other items, not just the one that the coupon is valid for.
- ❖ be able to accept the reward points and coupons earned by the shoppers so that they will come to my store and eventually buy other products too.
- ❖ receive reminders to update my information in the app so that I can provide up-to-date information to the shoppers.
- ❖ be notified in case any information is missing so that shoppers will find everything they need.
- ❖ be contacted when information about my store, my products, or my prices are reported by a user of the app so that I can verify it.
- ❖ be able to respond to store ratings so that I can provide my feedback regarding any comments or questions.
- ❖ receive information from the app regarding what products the users in my vicinity are searching for so that I can adjust my product offerings.

Appendix A: User Stories - Administrators

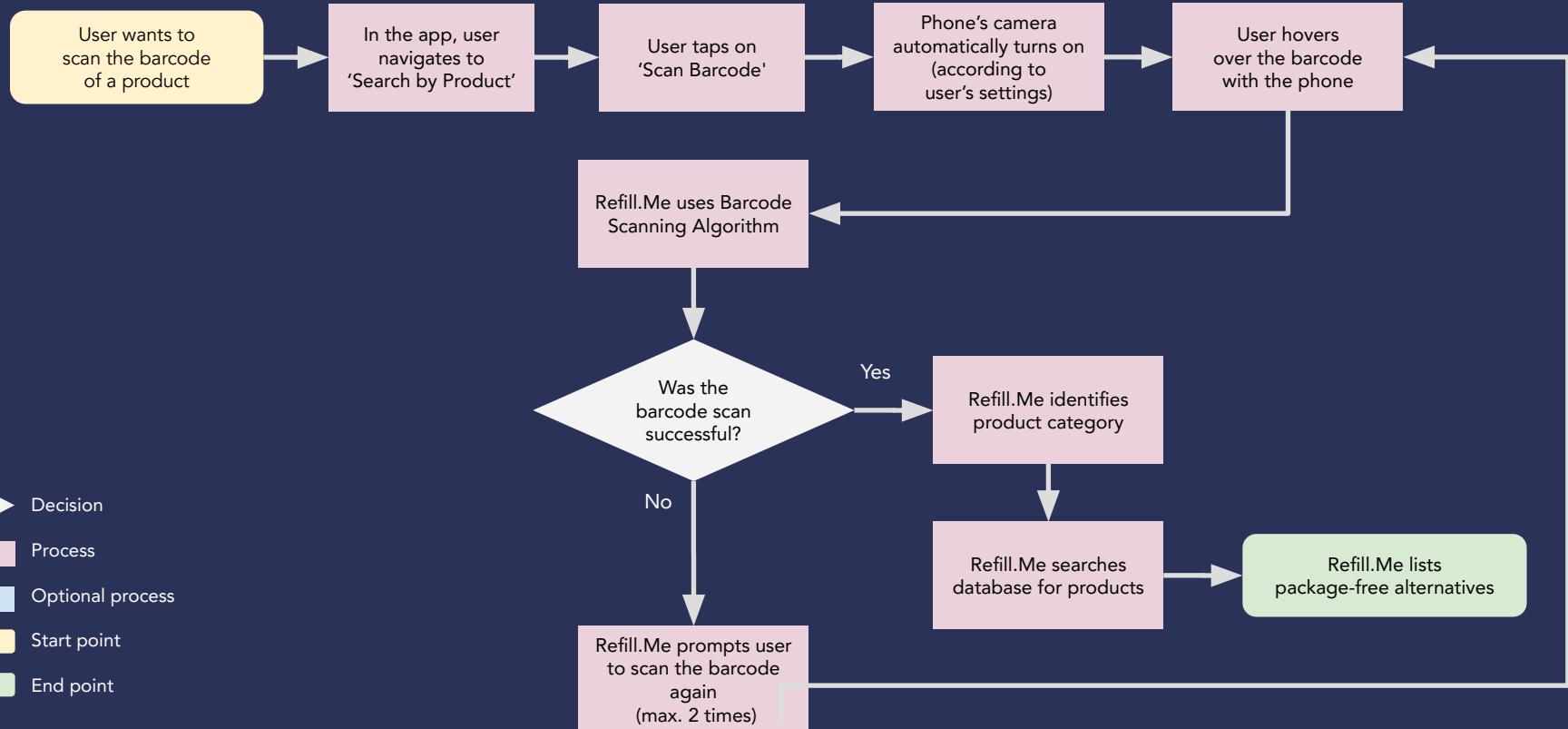
As an administrator, I want to...

- ❖ have access to all dashboards and user profiles so that I can make changes if needed.
- ❖ be able to add / update / delete accounts so that I can make changes if needed.
- ❖ have access to logs related to the app so that I can perform troubleshooting if needed.
- ❖ have data analytics tools so that I can see how the users of my app (both shoppers, and store owners) behave, what functionalities they use, etc.
- ❖ set up automatic notifications for the stores regarding updating their information and verifying crowdsourced data so that the app will always provide up-to-date information
- ❖ review information from the 'Contact Us' forms so that I can provide feedback regarding comments.
- ❖ respond to any questions posed in 'Contact Us' forms so that I can provide answers.
- ❖ perform necessary fixes and updates to the system so that the app will function as intended.
- ❖ use the best possible third party APIs, and if needed switch to a different API so that I can improve the app's performance.
- ❖ regularly do database data clean up so that I can improve efficiency and performance.
- ❖ be able to identify vulnerabilities in the app (for example, using DAST) so that I can improve the security of the app.

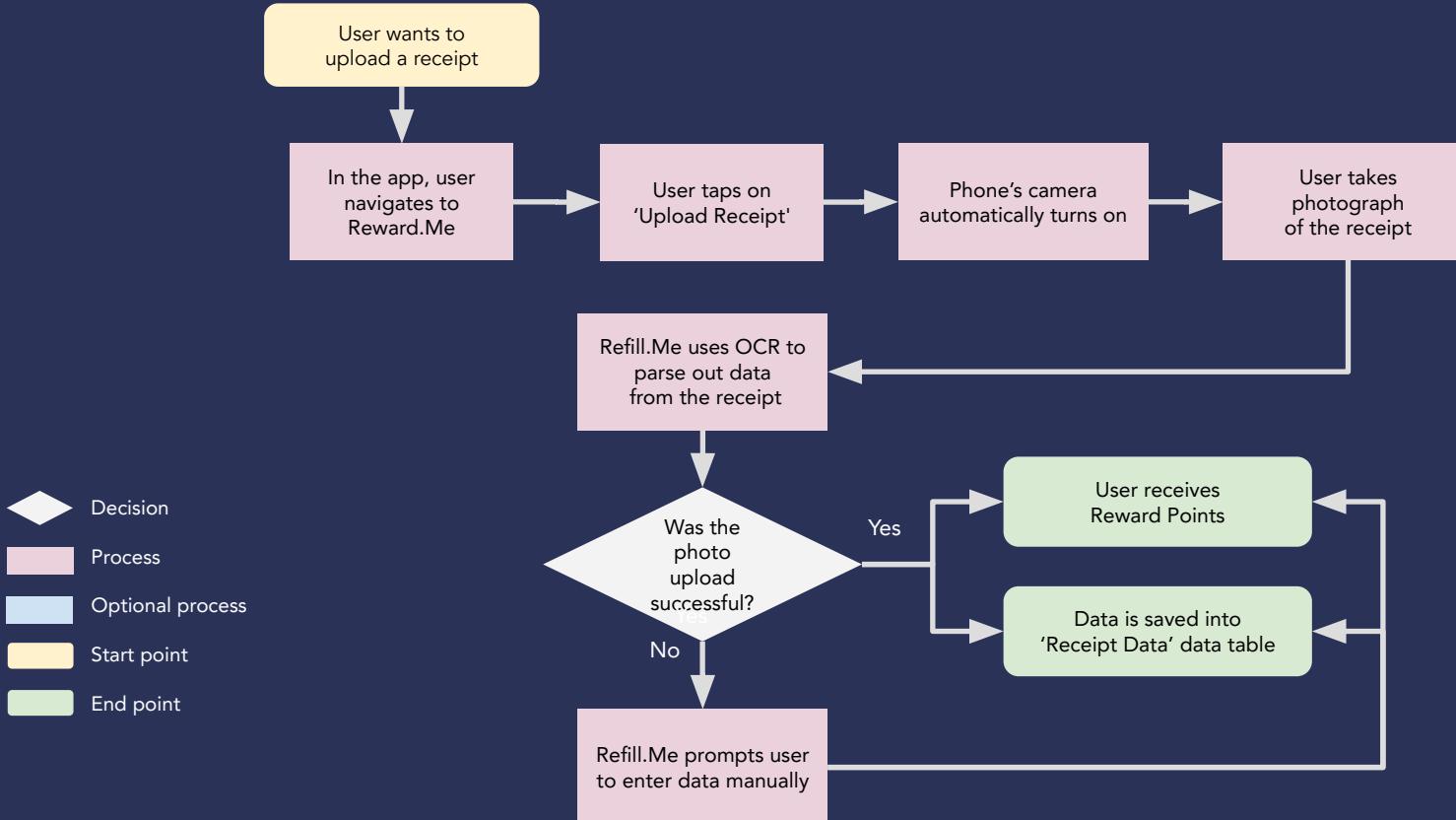
Appendix B: Algorithms - Create an Account



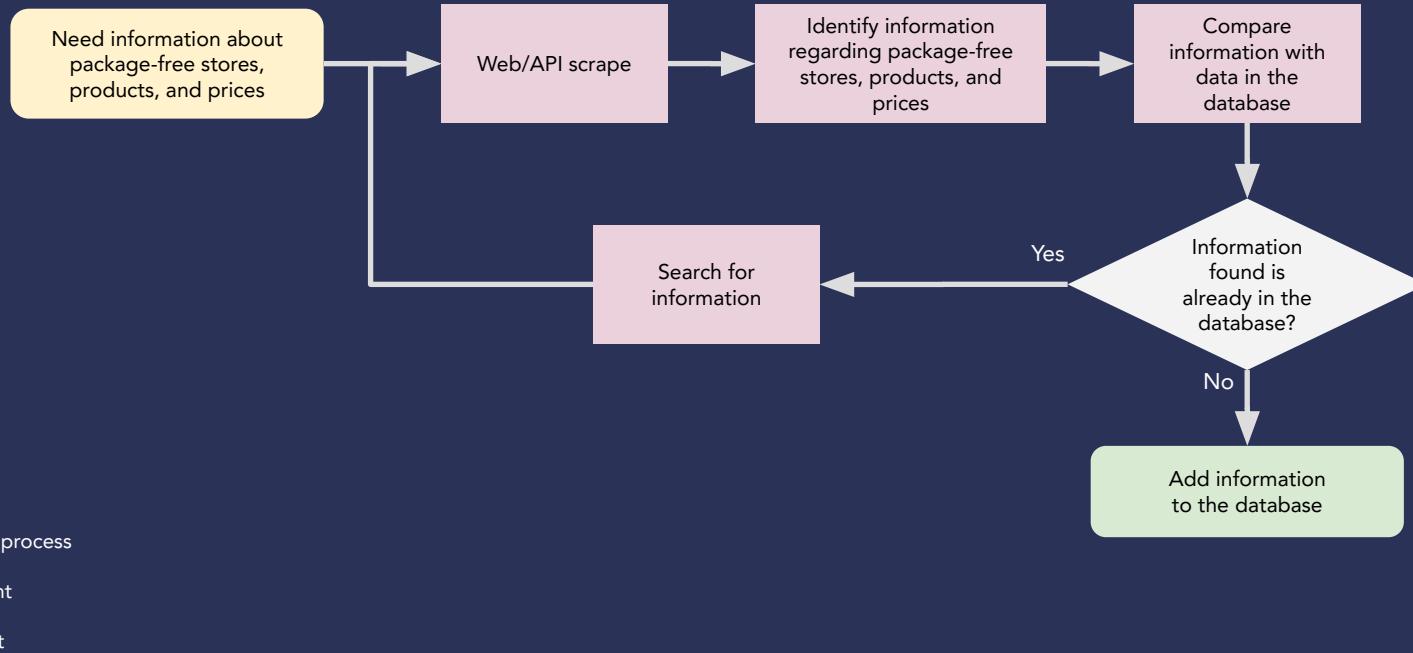
Appendix B: Algorithms - Barcode Scanning API



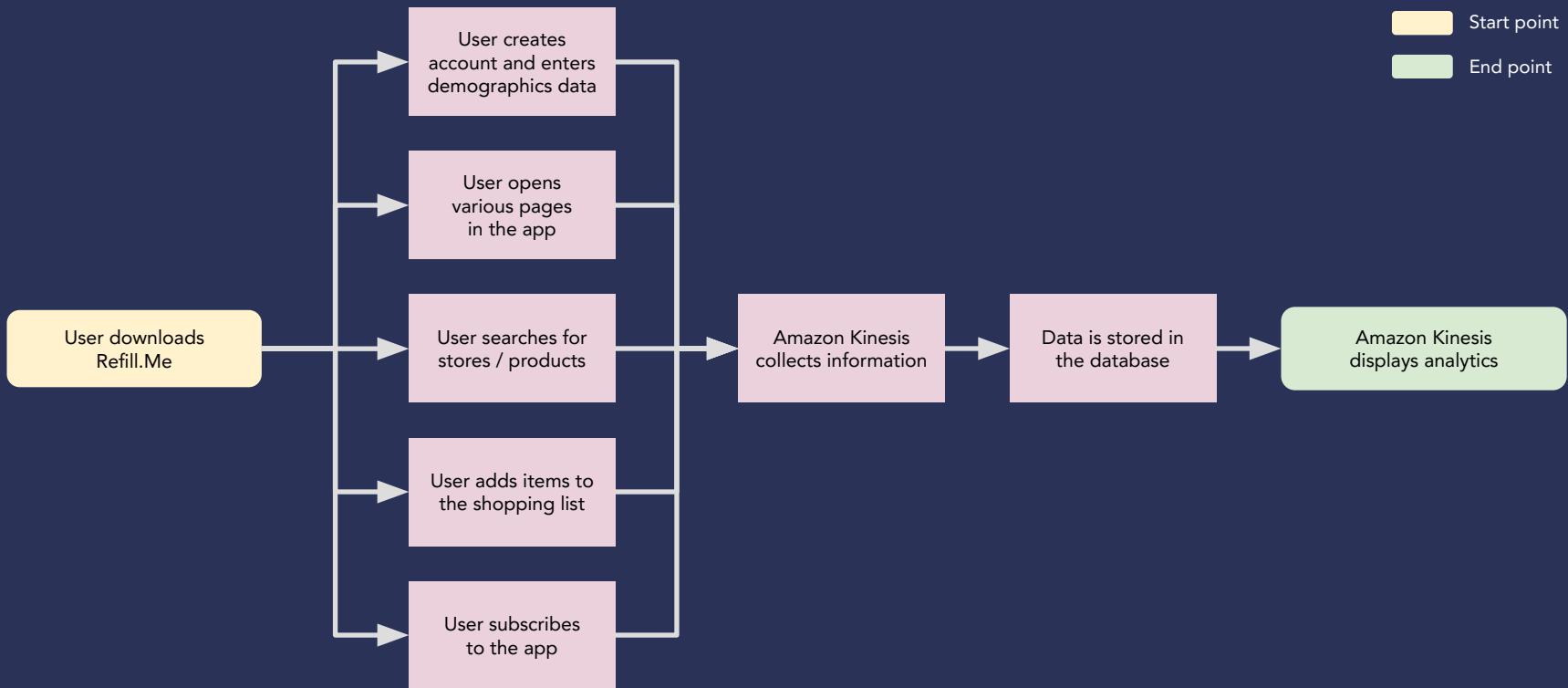
Appendix B: Algorithms - Receipt Uploading API



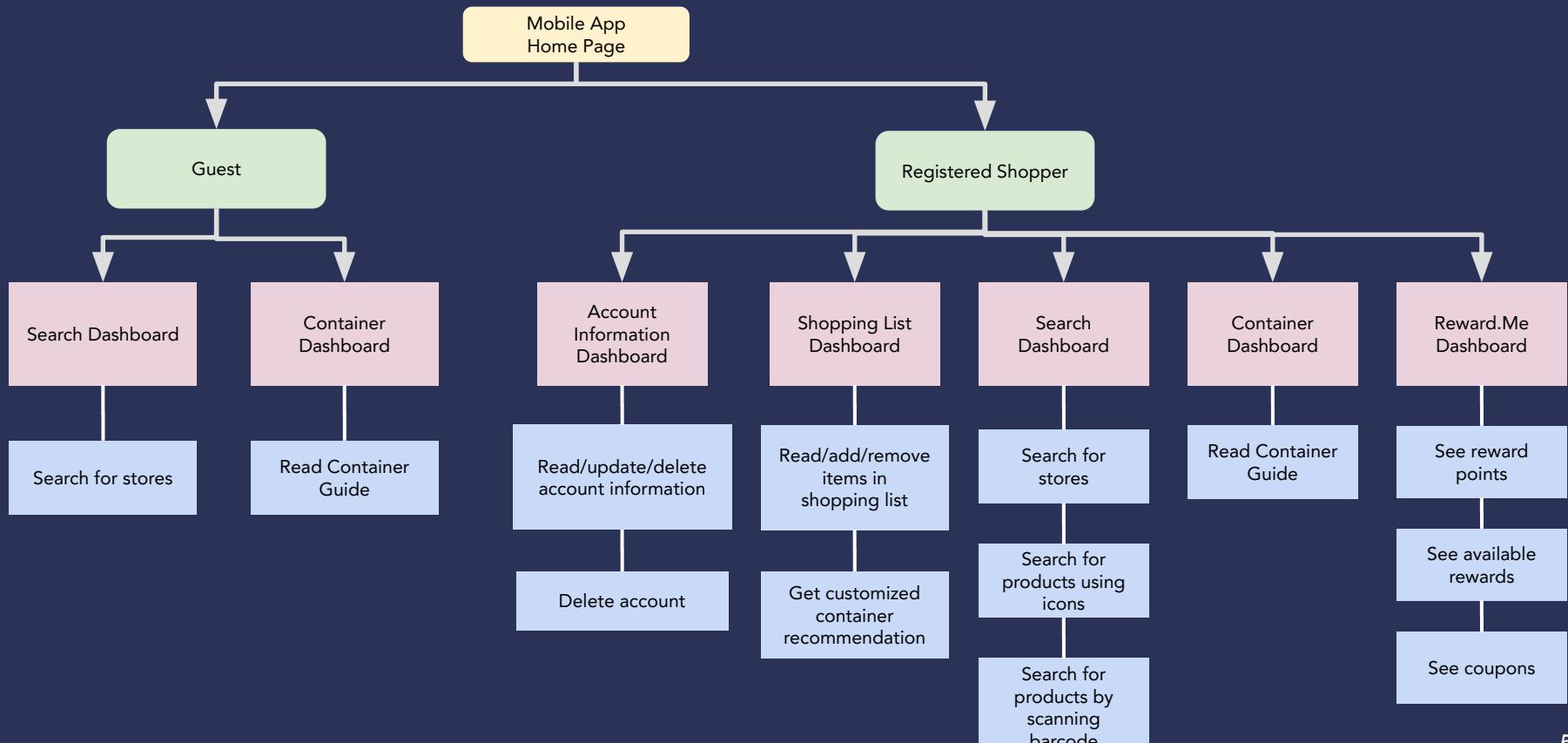
Appendix B: Algorithms - Web Scraping



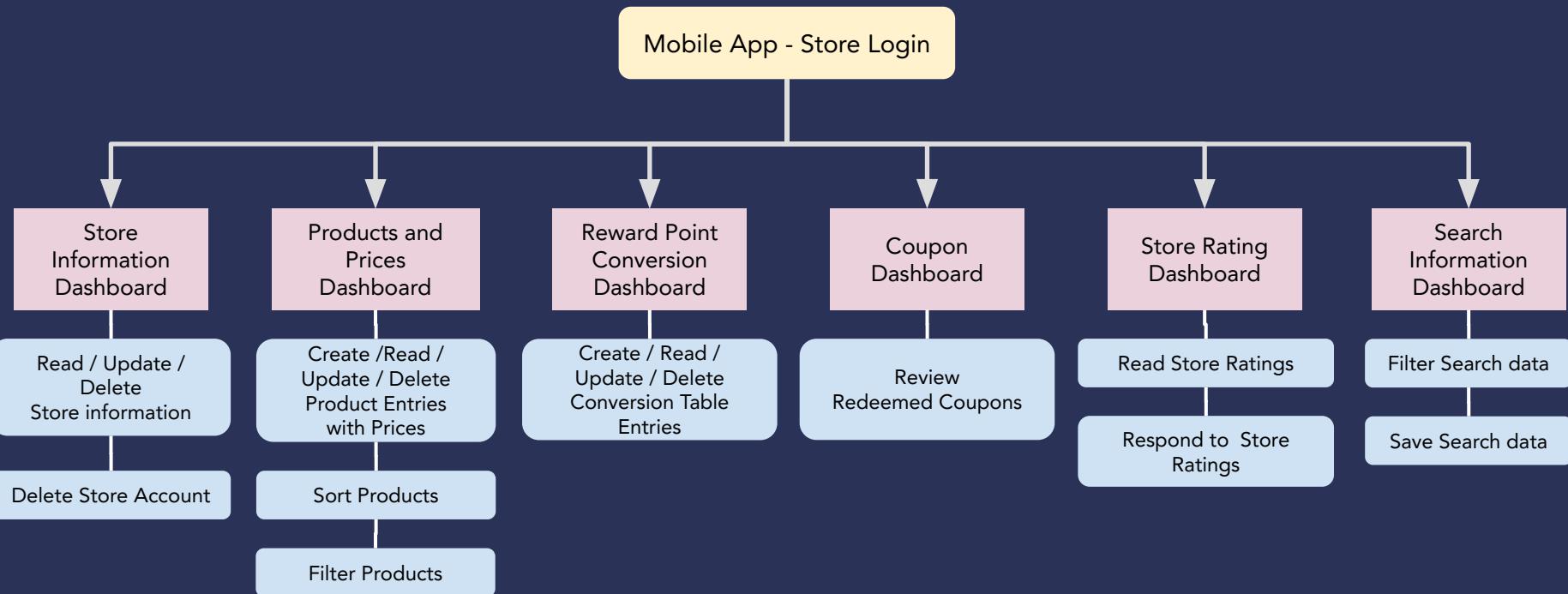
Appendix B: Algorithms - Analytics



Appendix C: Site Map - Shopper



Appendix C: Site Map - Store



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Thank you

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Q & A
Any questions?

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