



University  
of Windsor

**MASTER OF APPLIED COMPUTING-ADVANCE  
COMPUTING CONCEPT**

**Smartphone Recommendation System  
(Group 9)**

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## Smartphone Recommendation System

| Student  | Tasks                                                                                                                                                                                                                                                  |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Krutarth | <ul style="list-style-type: none"><li>• <b>Search</b></li><li>• <b>Filter</b></li><li>• Filter.java</li><li>• DataLoader.java</li><li>• displaySuggestions,loadSmartphoneData, searchSmartphones methods in SmartphoneRecommendationGUI.java</li></ul> |
| Shiv     | <ul style="list-style-type: none"><li>• <b>Data validation</b></li><li>• <b>Spell checking</b></li><li>• CuckooHashTable.java</li><li>• EditDistance.java</li><li>• SpellCheckerGUI.java</li></ul>                                                     |
| Mitansh  | <ul style="list-style-type: none"><li>• <b>Word completion</b></li><li>• <b>Statistics</b></li><li>• TrieWordCompletion.java</li><li>• displayTrendingSearches method in SmartphoneRecommendationGUI.java</li></ul>                                    |
| Kaushal  | <ul style="list-style-type: none"><li>• <b>Frequency count</b></li><li>• <b>Search frequency</b></li><li>• Smartphone.java</li><li>• searchFrequency method in SmartphoneRecommendationGUI.java</li></ul>                                              |
| Smit     | <ul style="list-style-type: none"><li>• <b>Page ranking</b></li><li>• Vocabularyloader.java</li><li>• sortedEntries method in SmartphoneRecommendationGUI.java</li></ul>                                                                               |

## 1. Web crawler and Html parser

The task of the web crawler is to crawl for different data of mobile phones like name , price, key features, and many more data related to smartphones and this is developed by all group members from assignment 1.

Html parser is used to parse the html data into text so which is helpful to crawl all the pages and get the content.

In our GUI as user click the Open web crawler button the crawler opens in new tab in which user can input the website name to crawl also if user give wrong input then it also shows the url is wrong which is related to error handling.

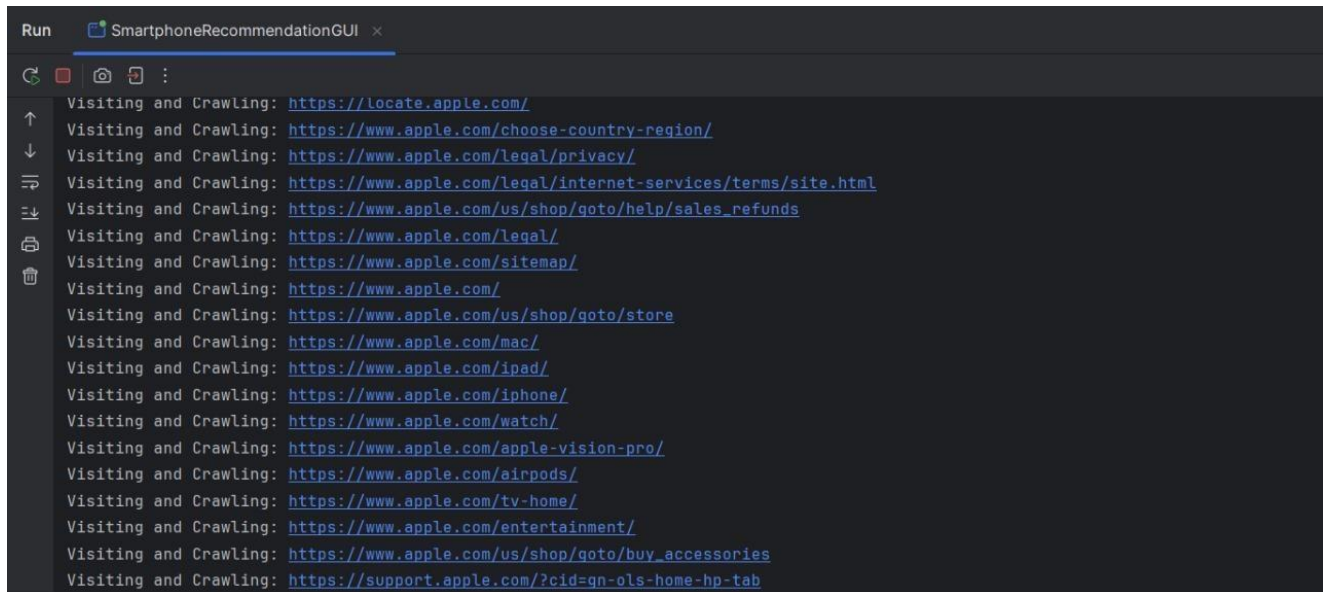


Figure 1.1 Web crawler with error handling

When the user enters the proper link for the smartphone website then the webcrawler starts crawling the website and displays the result along with parsing the data to data.csv file.

# Smartphone Recommendation System

Web Crawler

Enter URL:

Crawl

Crawling completed. Visited URLs:

<https://www.apple.com/>  
<https://www.apple.com/us/shop/goto/store>  
<https://www.apple.com/mac/>  
<https://www.apple.com/ipad/>  
<https://www.apple.com/iphone/>  
<https://www.apple.com/watch/>  
<https://www.apple.com/apple-vision-pro/>  
<https://www.apple.com/airpods/>  
<https://www.apple.com/tv-home/>  
<https://www.apple.com/entertainment/>  
[https://www.apple.com/us/shop/goto/buy\\_accessories](https://www.apple.com/us/shop/goto/buy_accessories)  
<https://support.apple.com/?cid=gn-ols-home-hp-tab>  
<https://www.apple.com/us/search>  
<https://www.apple.com/us/shop/goto/bag>  
<https://www.apple.com/#footnote-1>  
<https://www.apple.com/product-red/>  
[https://www.apple.com/us/shop/gifts/shopping\\_event](https://www.apple.com/us/shop/gifts/shopping_event)  
<https://www.apple.com/iphone-16-pro/>  
[https://www.apple.com/us/shop/goto/buy\\_iphone/iphone\\_16\\_pro](https://www.apple.com/us/shop/goto/buy_iphone/iphone_16_pro)  
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<https://www.apple.com/ipad-air/>  
[https://www.apple.com/us/shop/goto/buy\\_ipad/ipad\\_air](https://www.apple.com/us/shop/goto/buy_ipad/ipad_air)  
<https://www.apple.com/airpods-pro/hearing-health/>  
[https://www.apple.com/us/shop/goto/buy\\_airpods/airpods\\_pro\\_2](https://www.apple.com/us/shop/goto/buy_airpods/airpods_pro_2)  
<https://www.apple.com/apple-watch-series-10/>  
[https://www.apple.com/us/shop/goto/buy\\_watch/apple\\_watch\\_series\\_10](https://www.apple.com/us/shop/goto/buy_watch/apple_watch_series_10)  
[https://www.apple.com/us/shop/goto/trade\\_in](https://www.apple.com/us/shop/goto/trade_in)  
<https://www.apple.com/apple-card/>  
<https://card.apple.com/apply/application?referrer=cid%3Dapy-200-10000036&start=false>  
<https://wallet.apple.com/apple-card/setup/feature/ccs?referrer=cid%3Dapy-200-10000036>  
[https://fitness.apple.com/us/studio-collection/travel-friendly-workouts/1691360777?itscg=10000&itsct=afp-apl\\_hp-watch\\_now--240326](https://fitness.apple.com/us/studio-collection/travel-friendly-workouts/1691360777?itscg=10000&itsct=afp-apl_hp-watch_now--240326)  
[https://apps.apple.com/us/app/nba-2k25-arcade-edition/id6504000920?itscg=10000&itsct=aa-apl\\_hp-play\\_now--240326](https://apps.apple.com/us/app/nba-2k25-arcade-edition/id6504000920?itscg=10000&itsct=aa-apl_hp-play_now--240326)  
[https://music.apple.com/us/album/spotify-collaborations-436x1044610f47d6b166k370ar4672itscg=10000&itsct=aa-apl\\_hp-listen\\_now--240326](https://music.apple.com/us/album/spotify-collaborations-436x1044610f47d6b166k370ar4672itscg=10000&itsct=aa-apl_hp-listen_now--240326)

# Smartphone Recommendation System

## 2. Search & Filter Functionality

The filter functionality processes a list of smartphones and narrows it down based on user-defined criteria such as brand, price range, features, and storage options.

**Brand Filtering:** Compares the smartphone's brand to the selected brand. If "All" is selected, skips the brand filter to include all brands.

**Price Range Filtering:** Ensures the smartphone's price is between the specified minimum and maximum price values.

**Features Filtering:** Checks if the smartphone has all the features specified in required Features. Uses the contains All method for matching.

**Storage Filtering:** Matches the smartphone's storage capacity to the selected options. Uses the contains method to check if the smartphone's storage is in the list of selected storage options.

The implementation uses the List data structure to hold smartphones and their attributes. The Filter logic applies multiple filtering conditions efficiently, using containment checking (contains All and contains) for features and storage validation, and comparison for price and brand.

The screenshot displays the 'Smartphone Recommendation System' web application. At the top, there is a search bar with the placeholder text 'Search by phone name, brand, storage, or features' and a 'Search' button. Below the search bar are three buttons: 'Open Spell Checker', 'Open Web Crawler', and 'Show Company and Price Stats'. The main interface is divided into three sections: 'Filters', 'Products', and 'Analytics'. The 'Filters' section on the left includes a 'Brand' dropdown menu currently set to 'All', a 'Price Range' section with 'Min \$' and 'Max \$' input fields, and 'Features' and 'Storage' sections with checkboxes for various attributes. The 'Products' section in the center lists five iPhone models with their prices and specifications. The 'Analytics' section on the right contains a 'See Trending Searches' button.

| Product Name  | Brand | Price   | Storage | Features                                                   |
|---------------|-------|---------|---------|------------------------------------------------------------|
| iPhone 15     | Apple | \$ 1000 | 128 GB  | 5G Support, OLED Display, A16 Bionic Chip, Dual Camera,    |
| iPhone 15 Pro | Apple | \$ 1250 | 256 GB  | High-Resolution Camera, OLED Display, A16 Bionic Chip, T   |
| iPhone 16     | Apple | \$ 1300 | 512 GB  | 5G Support, Wireless Charging, OLED Display, A17 Bionic t  |
| iPhone 14 Pro | Apple | \$ 999  | 512 GB  | OLED Display, A16 Bionic Chip, Triple Camera, 6.1-inch dis |
| iPhone 14     | Apple | \$ 899  | 512 GB  |                                                            |

## 3. Spell Checker and Data Validation

We have used Cuckoo hashing for Spell Checker

**Storing Valid Words:** Created a cuckoo hash table to store valid words such as smartphone brands, features, and storage options. This table helps quickly check if the user input matches any of the valid options.

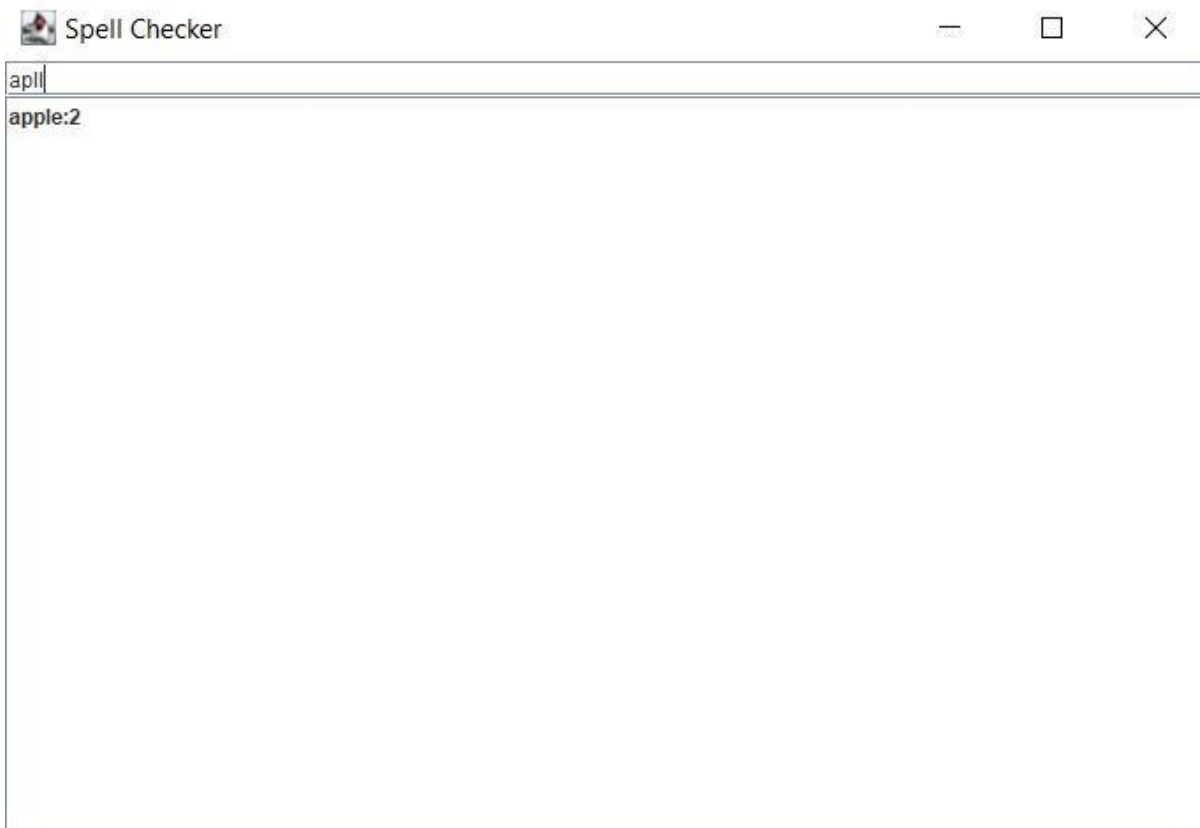
**Two Hash Functions:** Implemented two hash functions (hash1 and hash2). Each word is hashed into one of two possible positions in the table. If the first position is already taken, the word that is there gets moved to the second position and so on.

**User Input Checking:** When a user types a search query, the input is checked against the hash table. I hash each word using both hash functions to check if the word exists in either of the two positions in the table.

If a word is not found in the hash table, it's flagged as a potential misspelling. I then prompt the user to provide suggestions based on Edit Distance.

Used the Edit distance algorithm to calculate and give the suggestions. This helps identify words that are close to valid entries.

**Suggestions for Misspellings:** When a user types a misspelled word, the algorithm suggests corrections based on words in the hash table with a small edit distance.



# Smartphone Recommendation System

## Data Validation

Validating User Input: Used the cuckoo hash table to validate user inputs, like checking if a selected brand or feature exists in the predefined list. If it doesn't match any entry, it's flagged as invalid.

| Products                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>iPhone 14 Pro Max</b><br><i>Apple</i><br><b>\$ 1299</b><br>128 GB<br>High-Resolution Camera, OLED Display, A16 Bionic Chip, Triple Camera, 6.7-inch display, 128GB storage             |
| <b>iPhone 16 Pro Max</b><br><i>Apple</i><br><b>\$ 1399</b><br>128 GB<br>5G Support, High-Resolution Camera, OLED Display, A17 Bionic Chip, Triple Camera, 6.7-inch display, 128GB storage |
| <b>Blaze 3 5G</b><br><i>Lava</i><br><b>\$ 399</b><br>128 GB<br>High-Resolution Camera, LCD Display, MediaTek Dimensity 700, Dual Camera, 6.5-inch display, 128GB storage                  |
| <b>Blaze Curve</b><br><i>Lava</i><br><b>\$ 349</b><br>128 GB<br>High-Resolution Camera, LCD Display, MediaTek Helio G90, Dual Camera, 6.5-inch display, 128GB storage                     |

## 4. Word Completion

We have used **Trie-based** Word Completion.

**Storing Words in a Trie:** A Trie is used to store valid words such as smartphone brands, features, and storage options. Each character in a word is stored as a node, forming a tree structure.

**Finding Words by Prefix:** When a user enters a prefix, the Trie is searched to locate the node corresponding to the last character of the prefix. All valid words starting from that node are collected.

**Recursive Search:** From the prefix node, the algorithm explores all possible paths to gather complete words. This ensures all words starting with the prefix are found.



**User Input Handling:** Users type a prefix, and the program searches the Trie to find matching words. If no words are found, it informs the user.

**Efficient Searches:** The Trie structure allows fast lookups, even for large word sets, making it ideal for word completion.

**Real-Time Suggestions:** The program displays all words starting with the given prefix along with their count, helping users find what they're looking for quickly.



# Smartphone Recommendation System

Filters

Brand

All

Price Range

Min \$200 - Max \$900

Features:

☐ 5G Support

☐ Wireless Charging

☐ Headphone Jack

☒ High-Resolution Camera

☐ OLED Display

☐ A16 Bionic Chip

☐ A17 Bionic Chip

☐ MediaTek Dimensity

☐ Snapdragon 8 Gen 1

Storage:

☒ 128GB

☐ 256GB

☐ 512GB

Apply Filters

Reset Filters

Products

Blaze 3 5G

Lava

\$ 399

128 GB

High-Resolution Camera, LCD Display, MediaTek Dimensity 700, Dual Camera, 6.5-inch display, 128G

Blaze Curve

Lava

\$ 349

128 GB

High-Resolution Camera, LCD Display, MediaTek Helio G90, Dual Camera, 6.5-inch display, 128GB sto

## 5. Statistics

When the statistics button is clicked, a new window titled "Company and Price Statistics" is displayed.

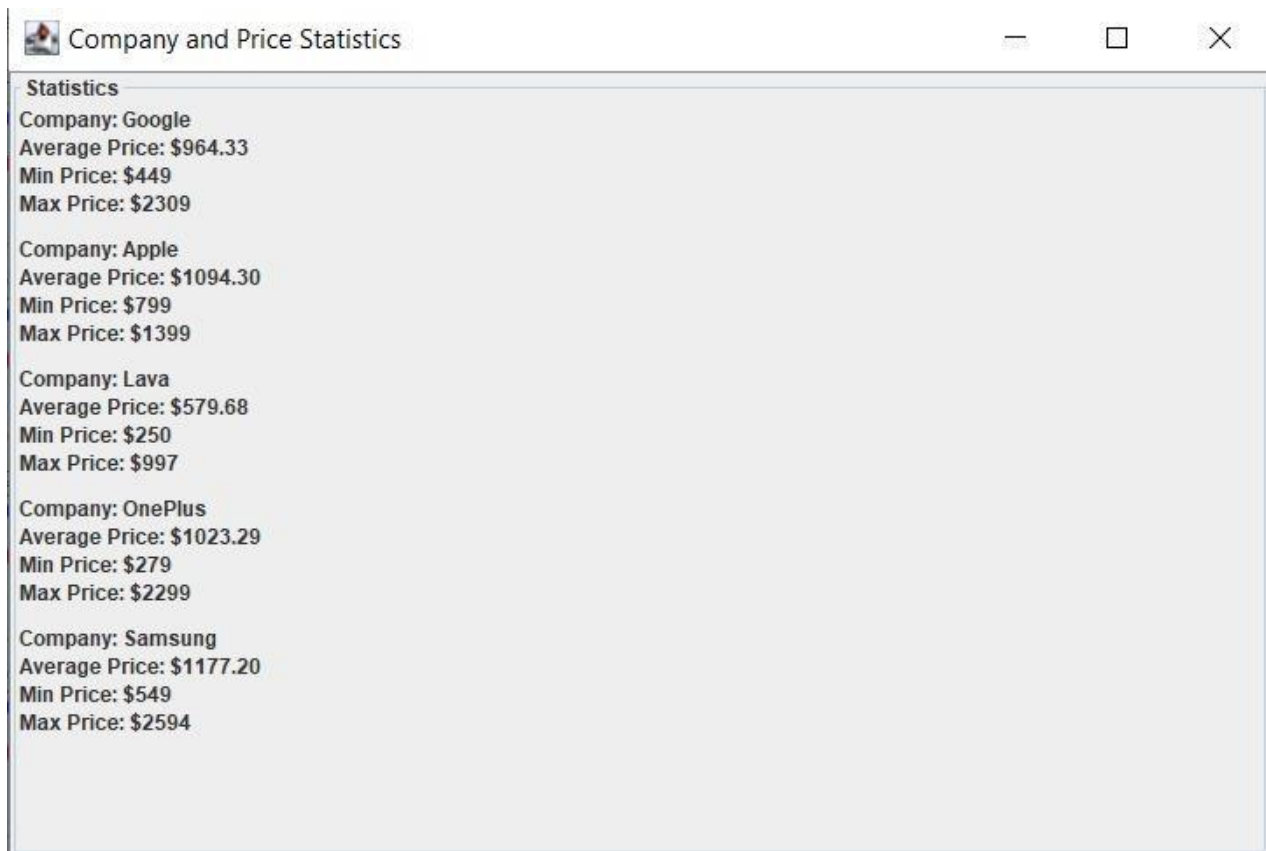
A HashMap groups smartphone prices by brand. Each brand is a key, and its value is a list of prices for that brand.

**Average Price:** The mean price of all smartphones for the brand.

**Minimum Price:** The lowest price among the brand's smartphones.

**Maximum Price:** The highest price for the brand.

A vertical layout displays the statistics. Each brand's name, average price, minimum price, and maximum price.



## 6. Frequency Count and Search Frequency

**Frequency Count:** Tracks how many times each word or phrase appears in user searches. This helps identify popular keywords or frequently searched terms.



**Search Frequency Storage:** A data structure (e.g., HashMap) stores words as keys and their search frequencies as values. Each time a user searches for a word, its count is increased.

**Real-Time Updates:** The frequency count is updated dynamically as users enter new search queries. This ensures accurate tracking of search trends over time.

**Search Suggestion Integration:** Frequently searched terms can be highlighted in autocomplete suggestions, prioritizing the most popular searches.

**Benefits:** Helps refine search optimization by focusing on popular terms. Provides insights into user behavior, enabling better personalization and decision-making.

# Smartphone Recommendation System

## 7. Ranking

**Purpose of Ranking:** Ranking determines the order in which results are displayed based on their relevance or importance to the user's query.

**Ranking Factors:** Results can be ranked based on various criteria, such as:

- **Search Frequency:** Popular words or items (those searched more often) appear higher.
- **Relevance:** Matches closer to the user's query or preferences are prioritized.

**Dynamic Ranking:** Ranking is updated dynamically as new data (e.g., search frequency or user interactions) is collected.

**Integration with Suggestions:** Frequently searched and highly ranked items can appear at the top of autocomplete or suggestion lists.

**Benefits of Ranking:** Ensures the most relevant and valuable results are presented. Increases the efficiency and effectiveness of the search process for users.

The screenshot displays the Smartphone Recommendation System interface, which includes several components:

- Web Crawler:** A window showing the crawling progress and a list of visited URLs, including various Apple and Samsung product pages.
- Company and Price Statistics:** A window displaying statistics for different companies and their products, such as Google, Apple, Lava, OnePlus, and Samsung, including average price, minimum price, and maximum price.
- Spell Checker:** A window showing the spell checker interface, currently displaying the word "samsung2".
- Smartphone Recommendation System:** The main application window, which includes a search bar, filters, products list, and analytics.

The main application window features the following sections:

- Search:** A search bar with the placeholder text "Search by phone name, brand, storage, or features".
- Filters:** A section with filters for Brand (All), Price Range (Min \$, Max \$), Features (5G Support, Wireless Charging, Headphone Jack, High-Resolution Camera, OLED Display, A16 Bionic Chip, A17 Bionic Chip), and Storage (128GB, 256GB, 512GB).
- Products:** A list of recommended products, including iPhone 15, iPhone 15 Pro, iPhone 16, and iPhone 14 Pro, with their respective prices and specifications.
- Analytics:** A section showing trending searches and search frequency for various phone models and features.