EGYPTOPIA Recommendation System

In recommendation systems, the cold start problem refers to the challenge of making accurate suggestions when there is little or no data available. This usually happens when a new user joins the system or a new item is added, and the system doesn't have enough information to understand preferences or patterns. As a result, it becomes difficult to personalize recommendations effectively at the beginning.

System Goal

The system wants to recommend suitable places

User Problem

New User With **No** Historical Data

This represents a key challenge for most recommendation systems, especially in newly launched applications that aim to deliver personalized content to new users.

How Egyptopia Recommender Solve Cold-Start Problem ?

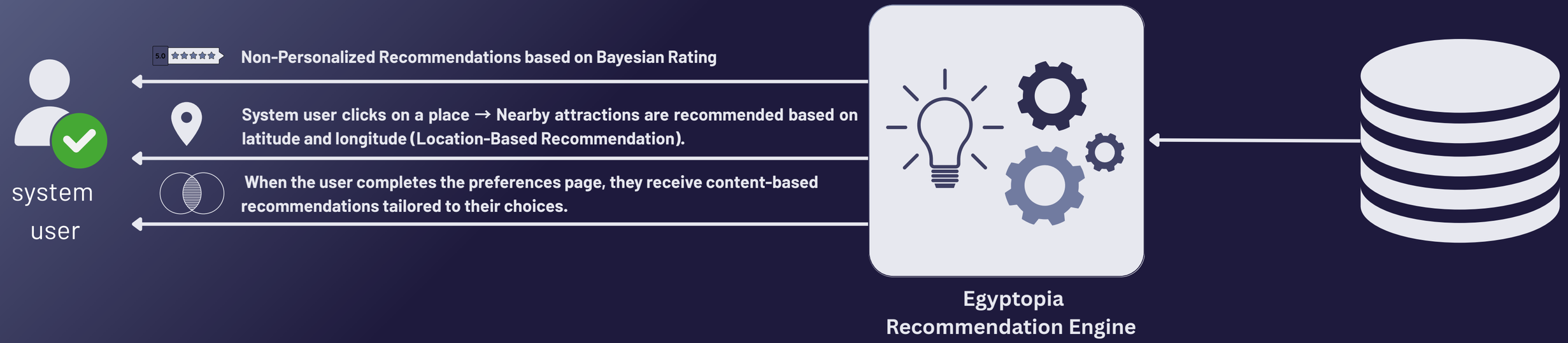
- We Have Used **Item-Based** approach Instead of **User-Based**

	Item-Based Approach	User-Based Approach	
Criteria	✓	✗	**Winner Approach**
Needing for many users with interaction history	**No Need**	**Need**	**Item-Based**
Works well with new users (cold start)	**Yes**	**Need Historical Data**	**Item-Based**
Suitable for small or new platforms	**Too Suitable if there is Metadata about Items**	**Not ideal**	**Item-Based**
Depending on similarity between users	**Focuses on item similarity**	**Need**	**Item-Based**

Egyptopia Recommendation System logic

Egyptopia Recommendation System with (Guest User) :

Egyptopia Recommendation System with (System User) :



1.Egyptopia Non-Personalized Recommendations

In new tourism apps, there's often no data about users at the start. Non-personalized recommendation systems help by showing popular or highly rated places to everyone. This gives new users useful suggestions from the beginning, even before the system learns their preferences.

Advantages of Non Personalized Recommendation : ★★★★☆

- **Works without user data**:
  It gives suggestions even if the user is new or hasn't interacted with the app yet.
- **Easy to apply in early stages**:
  Great for new apps that don't have enough data to build personalized profiles.
- **Fast and scalable**:
  It can give instant results to many users without needing complex calculations.
- **Boosts early engagement**:
  By showing trending or top-rated places, it helps attract and keep users interested from the start.

Egyptopia Non-Personalized Recommendations

Choosing the Optimal Rating Strategy for Our Non-Personalized Recommendations :

Arithmetic Mean	Total Score	Wilson Score Interval	Bayesian Average
• Does not consider confidence in ratings • Promotes attractions with few but high ratings, potentially low-quality or untested. • **Provides a direct view of overall user satisfaction when the number of ratings is large and balanced.**	• Biased toward popular places regardless of rating quality • Ignores user satisfaction per rating quantity. • Hides poor experiences under large data volumes. • **Easy to calculate and sort**.	• **Highly conservative, preventing overestimation of items with few positive ratings.** • **Provides a probabilistic confidence measure.** • Designed for binary data (e.g., like/dislike), not 5-star scales. our collected places in Egyptopia Bases on 5 star scale as the data source is google maps	• **Balances fairness and accuracy by boosting popular places with high ratings.** • **Prevents bias toward lesser-known attractions with smoother, more interpretable scoring.** • **Robust against data sparsity and tracks closer to actual ratings.** • Are there companies that could potentially become competitors?
✗	✗	✗	✓

Extracting Bayesian Average Score Feature :

Inputs → Rate | Total Rates →

$$\text{Bayesian Average} = \frac{(C \times \mu) + (n \times \text{avg}_i)}{C + n}$$

→ Bayesian Average Score

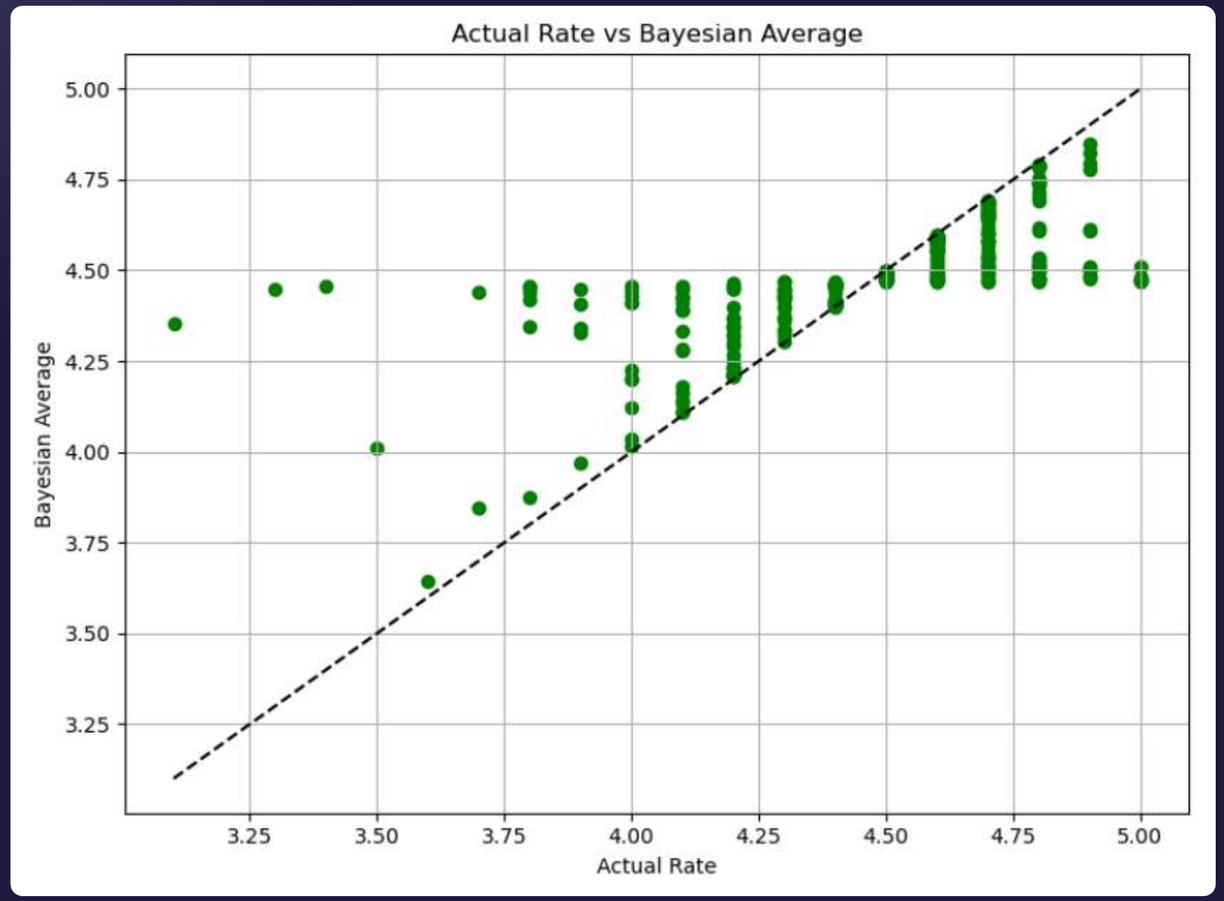
Applying Calculations by Python

	place_id	Name	Category	Google Maps Link	City	Rate	Total Rates	Description	Tourism Type	city_id	Bayesian Average
0	2044	Wadi El Natrun Monastery	Monastery	https://maps.app.goo.gl/4na9bVZqHNQfrwN87	Beheira	4.9	5685	The Wadi El Natrun Monasteries, located in Beh...	Religious and Spiritual Attractions	19	4.850384
1	2020	Monastery of Saint Paul	Monastery	https://maps.app.goo.gl/Mcjsncn5ZzTDTcVB9	Red Sea	4.9	3373	Monastery of Saint Paul, Red Sea, Egypt The Mo...	Religious and Spiritual Attractions	13	4.822484
2	2034	Syrian Monastery	Monastery	https://maps.app.goo.gl/y1V2K9Mth8UNZDRE6	Beheira	4.9	2324	The Syrian Monastery (Deir Al-Surian) in Behei...	Religious and Spiritual Attractions	19	4.795932
3	4004	Luxor Temple	Temple	https://maps.app.goo.gl/QTDLBrKuWetZUHfEA	Luxor	4.8	30746	Luxor Temple is one of the most breathtaking a...	Cultural and Historical Attractions	18	4.792223
4	4003	Karnak Temple	Temple	https://maps.app.goo.gl/UuM5Nobqa81Kvs2b7	Luxor	4.8	26643	The Karnak Temple is one of the most magnifice...	Cultural and Historical Attractions	18	4.791058

Egyptopia Non-Personalized Recommendations

Evaluating the Effectiveness of Bayesian Averaging in Non-Personalized Recommendations :

- It can be observed that most of the points lie above the diagonal line, indicating that the Bayesian average is generally lower than the actual rating, especially for places with fewer reviews.
- This behavior demonstrates how the Bayesian approach reduces rating inflation caused by small sample sizes. By incorporating a global average into the score calculation, the system produces more stable and trustworthy recommendations. This is particularly useful for our non-personalized recommendation systems in early-stage



Eyptopia Non-Personalized Recommendations

Top 10 Cultural and Historical Tourist Attractions In Egypt Ranked by Bayesian Average Ratings :

Rank	Name	Category	City	Rate	Total Rates	Bayesian Average
1	Luxor Temple	Temple	Luxor	4.8	30746	4.792222874549
2	Karnak Temple	Temple	Luxor	4.8	26643	4.791057505752
3	Valley of the Kings	Historical Site	Luxor	4.8	18702	4.7874047012036
4	Abu Simbel Temples	Temple	Aswan	4.8	17856	4.786831648807
5	Temple of Horus at Edfu	Temple	Aswan	4.8	4767	4.755524674189
6	Saqqara Pyramid	Historical Site	Giza	4.8	3921	4.747449531870
7	Temple of Hathor	Temple	Qena	4.8	3090	4.736043122306
8	National Museum of Egyptian Civilization	Museum	Cairo	4.7	25381	4.693452826193
9	Great Sphinx of Giza	Historical Site	Giza	4.7	23223	4.692863180257
10	Temple of Hatshepsut	Temple	Luxor	4.7	20677	4.692014713350

Total Places Belong to Cultural and Historical Tourist Attractions : **117**

Rate Disturbuation : 5(**3**), 4.9(**3**), 4.8(**14**), 4.7(**13**), 4.6(**23**), 4.5(**25**), 4.4(**14**), 4.3(**10**), 4.2(**7**) , 4.1(**3**), 4(**1**), 3.3(**1**)

Average rate Counts of Average rate

2.Egyptopia Location Based Recommendations

One of the key goals of our tourism recommendation system is to offer users a rich and varied travel experience. To support this, Egyptopia introduces a feature that displays nearby attractions whenever a user views a specific place. This ensures the system not only responds to user interest but also promotes exploration and discovery — a valuable strategy for new applications with limited data.

Advantages of Location Based Recommendations :

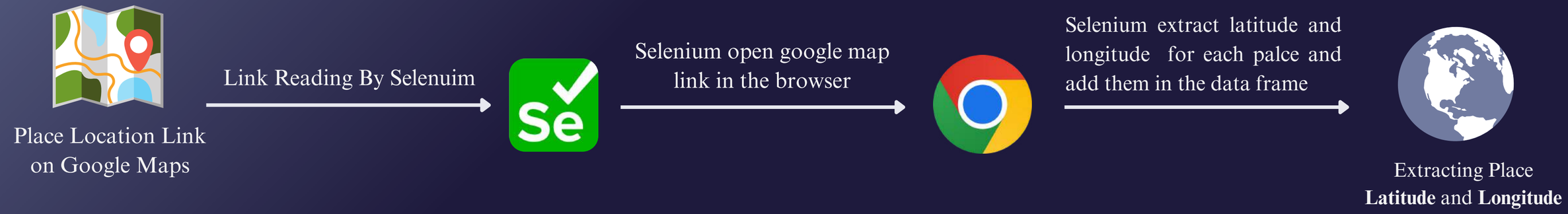
- **Improves Diversity:** Recommends a wider range of places, not just the top-rated ones
- **Solves Cold Start for New Places:** Even new or lesser-known spots get visibility
- **Encourages Exploration:** Helps tourists discover more hidden gems around them

Egyptopia Location Based Recommendations

The Egyptopia Places Dataset includes **direct Google Maps links** for each tourist attraction. This feature significantly helped us extract accurate latitude and longitude coordinates, enabling the implementation of location-based recommendations. By applying the Haversine formula, we were able to calculate the real-world distances between places and sort nearby attractions from nearest to farthest."

Feature Engineering Process

- Extracting Latitiude and Longitude From Each google map link



Egyptopia Location Based Recommendations

Egyptopia Dataset Update

- Extracting Latitiude and Longitude From Each google map link

Name	Category	Google Maps Link	City	Tourism Type	Latitude	Longitude
Dream Park	Theme Park	https://maps.app.goo.gl/HKuc4iMGP3xxkuzT7	Giza	Entertainment and Modern Attractions	29.966006	31.058090
Magic Land	Theme Park	https://maps.app.goo.gl/pagQ93SuUb5smLFT7	Giza	Entertainment and Modern Attractions	29.963340	31.024918
Sindbad Amusement Park	Theme Park	https://maps.app.goo.gl/Y2oiuubB3HZFshM69	Cairo	Entertainment and Modern Attractions	30.119268	31.368494
Zed Park	Theme Park	https://maps.app.goo.gl/2Ya6VcWJUCakgbgy6	Giza	Entertainment and Modern Attractions	30.043229	30.994429
Family Park	Theme Park	https://maps.app.goo.gl/zkstQZsVx3x32cES8	Cairo	Entertainment and Modern Attractions	30.087279	31.518893

Egyptopia Location Based Recommendations

Haversine Distance

- $d = 2r\ arcsine(\sqrt{sin^2\left(\frac{\varphi_2-\varphi_1}{2}\right) + cos\varphi_1.cos\varphi_2.sin^2(\frac{\omega_2-\omega_1}{2})})$
- Where
  - φ_1, φ_2 are the latitude of point 1 and point 2 in radian form.
  - ω_1, ω_2 are the longitude of point 1 and point 2 in radian form.

Since the **latitude** and **longitude** for each place successfully extracted

implementing a location-based recommendation system became straightforward. appliying the **Haversine formula** to calculate the geographical distance between places, allowing us to recommend the nearest attractions with high accuracy."

Egyptopia LBRS

User click on a specific place

System use Haversine formula to calculate the distance between the selected place and all other places in the same city

System sort places in order from the nearest to farest in the city of the place

System return nearby attractions within the same city

ALEXANDRIA ZOO

Egyptopia Location Based Recommendations

LBRS Outputs

Name	Category	City	Rate	Total Rates	Tourism Type	Latitude	Longitude	Distance_km
Antoniades Garden	Garden	Alexandria	4.2	5202	Entertainment and Modern Attractions	31.205676	29.946999	0.398760
Alexandria National Museum	Museum	Alexandria	4.4	2859	Cultural and Historical Attractions	31.200741	29.913198	2.937050
Alexandria National Museum (Islamic Section)	Museum	Alexandria	4.4	2859	Religious and Spiritual Attractions	31.200741	29.913198	2.937050
Bibliotheca Alexandrina	Library	Alexandria	4.6	8507	Cultural and Historical Attractions	31.208903	29.909159	3.367846
Bibliotheca Alexandrina Antiquities Museum	Museum	Alexandria	4.6	30	Cultural and Historical Attractions	31.208809	29.908459	3.431286
Graeco-Roman Museum	Museum	Alexandria	4.5	1982	Cultural and Historical Attractions	31.199185	29.906600	3.579815
Kom El-Dikka Theater	Theater	Alexandria	4.3	152	Cultural and Historical Attractions	31.194478	29.904631	3.863317
Roman Theatre of Alexandria	Theater	Alexandria	4.4	6043	Cultural and Historical Attractions	31.194646	29.904025	3.914545
Eliahou Hanabi Synagogue	Synagogue	Alexandria	3.8	166	Religious and Spiritual Attractions	31.199205	29.900370	4.168138
City Centre Alexandria	Shopping	Alexandria	4.5	32035	Entertainment and Modern Attractions	31.166618	29.933399	4.192003

Nearest Places to Alexandria Zoo :






BIBLIOTHECA ALEXANDRINA

Egyptopia Location Based Recommendations

LBRS Outputs

Name	Category	City	Rate	Total Rates	Tourism Type	Latitude	Longitude	Distance_km
Bibliotheca Alexandrina Antiquities Museum	Museum	Alexandria	4.6	30	Cultural and Historical Attractions	31.208809	29.908459	0.067326
Alexandria National Museum	Museum	Alexandria	4.4	2859	Cultural and Historical Attractions	31.200741	29.913198	0.985490
Alexandria National Museum (Islamic Section)	Museum	Alexandria	4.4	2859	Religious and Spiritual Attractions	31.200741	29.913198	0.985490
Graeco-Roman Museum	Museum	Alexandria	4.5	1982	Cultural and Historical Attractions	31.199185	29.906600	1.107645
Eliahou Hanabi Synagogue	Synagogue	Alexandria	3.8	166	Religious and Spiritual Attractions	31.199205	29.900370	1.364378
Roman Theatre of Alexandria	Theater	Alexandria	4.4	6043	Cultural and Historical Attractions	31.194646	29.904025	1.658856
Kom El-Dikka Theater	Theater	Alexandria	4.3	152	Cultural and Historical Attractions	31.194478	29.904631	1.660826
Alexandria Lighthouse (Historical)	Tower	Alexandria	4.4	51	Entertainment and Modern Attractions	31.214247	29.891432	1.787445
Menasha Synagogue	Synagogue	Alexandria	3.8	20	Religious and Spiritual Attractions	31.198633	29.893467	1.879208
Alexandria Aquarium	Aquarium	Alexandria	4.2	1445	Natural Attractions	31.212639	29.884042	2.424455

Nearest Places to Bibliotheca Alexandrina :



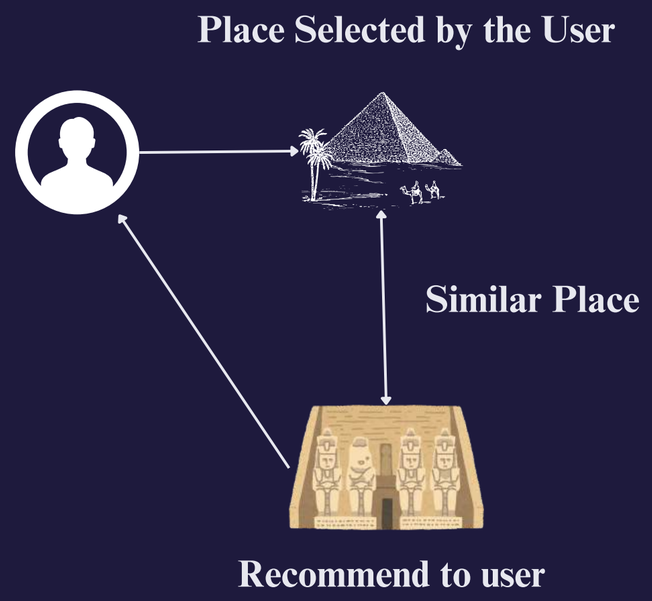



Egyptopia Personalized Recommendations For Egypt Vistors

3. Egyptopia Content Based Recommendation System

Why CBRS ?

- Personalized Recommendations: Suggest tourist spots that match the user's interests
- Ensuring Diversity in Recommendations that include different types (museums, temples, beaches) and various cities (Cairo, Luxor, Siwa).
- Improving Tourism in Egypt: By recommending low popularity places along with popular ones, the system helps reduce crowds, lets tourists discover hidden gems



Why CBRS is Better for New Users ?

- No Need for User Data (Solves Cold Start)
- Accurate Recommendations from the Start
- Flexible with New Preferences
- We Have Encriched Dataset for our Items

new user

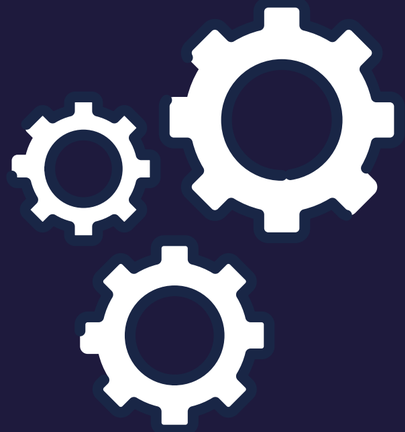
Cold Start Problem

Egyptopia Content Based Recommendation System

How our CBRS track new users preferences ?

User Preference page

User Reactions

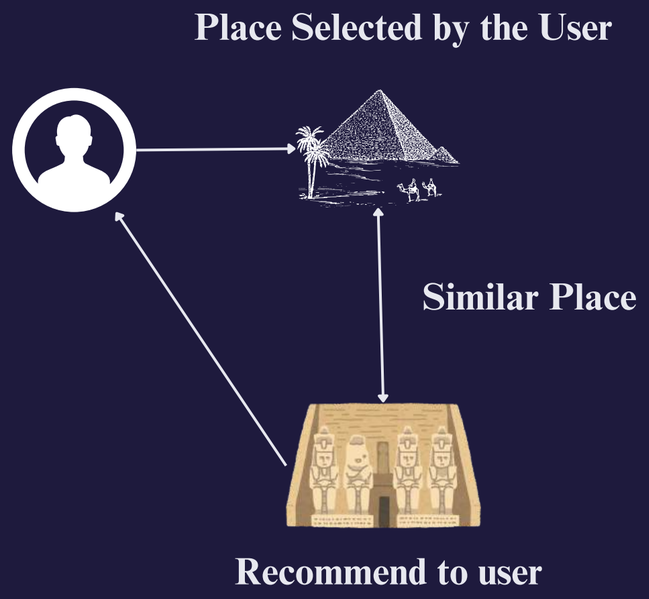


Preferences Customization

3. Egyptopia Content Based Recommendation System

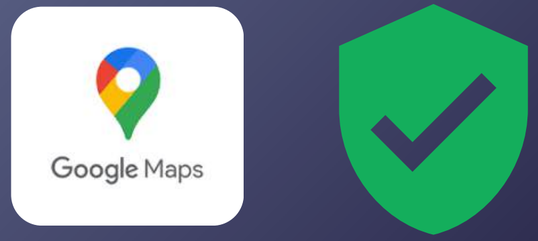
Egyptopia CBRS Goals

- **Personalized Recommendations:** Suggest tourist spots that match the user's interests
- **Improving Tourism in Egypt:** By recommending low popularity places along with popular ones, the system helps reduce crowds, lets tourists discover hidden gems
- **Variety of Places:** Ensuring Diversity in Recommendations that include different types (museums, temples, beaches) and various cities (Cairo, Luxor, Siwa).
- **Seamless Experience**: Simplifying traveling with accurate recommendations that consider geographic location and places` rates



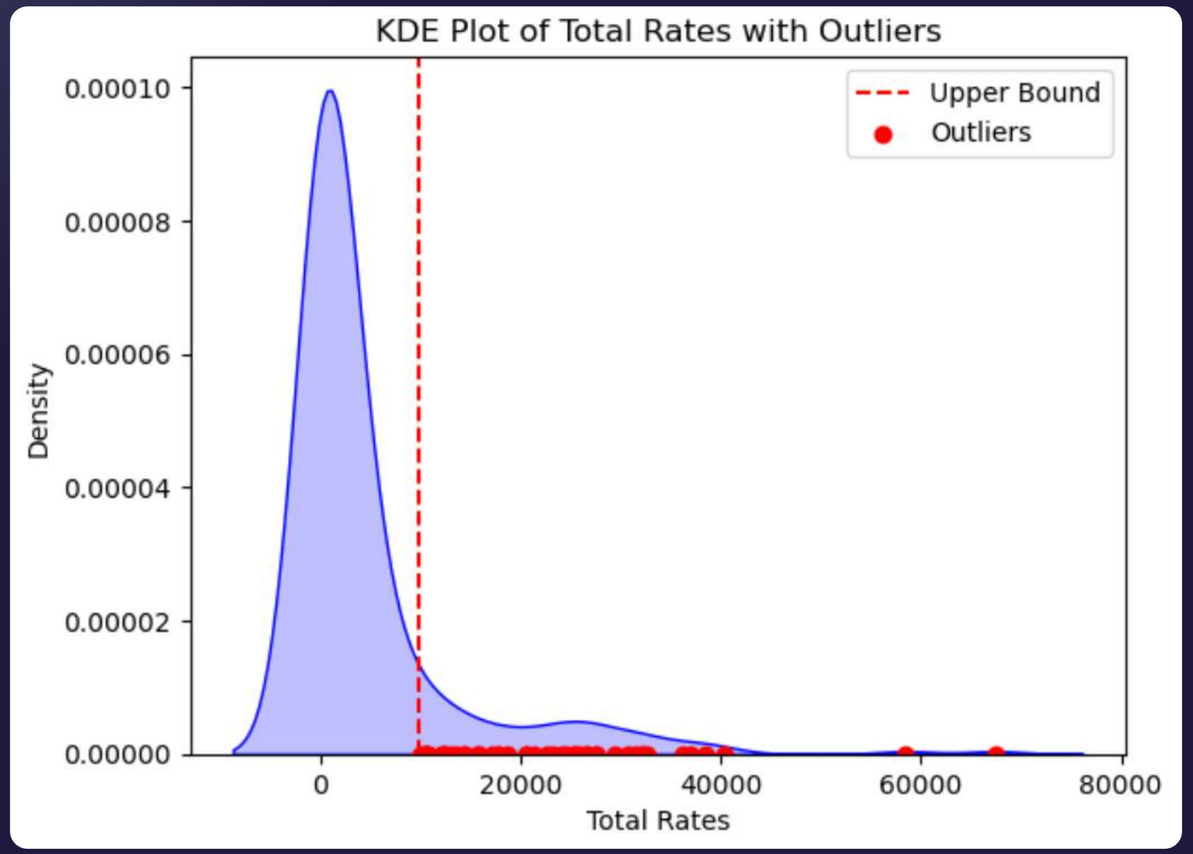
Popularity Classification for Egyptopia Places

Classification based on **Total Rates** of place on Google Map



Classification Rules :

Below the median → **Low**
Between the median and upper bound → **Moderate**
Above the upper bound → **High** Popularity



Egyptopia Content Based Recommendation System - Feature Engineering Process

Features Extraction and Selection

	Name	Category	City	Rate	Total Rates	Tourism Type	Latitude	Longitude	Popularity
0	Wadi El Natrun Monastery	Monastery	Beheira	4.9	5685	Religious and Spiritual Attractions	30.410208	30.154400	Moderate Popularity
1	Monastery of Saint Paul	Monastery	Red Sea	4.9	3373	Religious and Spiritual Attractions	28.847306	32.550623	Moderate Popularity
2	Syrian Monastery	Monastery	Beheira	4.9	2324	Religious and Spiritual Attractions	30.317832	30.202350	Moderate Popularity
3	Luxor Temple	Temple	Luxor	4.8	30746	Cultural and Historical Attractions	25.699908	32.636784	High Popularity
4	Karnak Temple	Temple	Luxor	4.8	26643	Cultural and Historical Attractions	25.718835	32.657270	High Popularity
5	Valley of the Kings	Historical Site	Luxor	4.8	18702	Cultural and Historical Attractions	25.740347	32.598946	High Popularity
6	Abu Simbel Temples	Temple	Aswan	4.8	17856	Cultural and Historical Attractions	22.337232	31.625799	High Popularity
7	Al-Azhar Mosque	Mosque	Cairo	4.8	17143	Religious and Spiritual Attractions	30.045814	31.262564	High Popularity
8	Pickalbatros Aqua Park	Water Park	Sharm El Sheikh	4.8	12342	Entertainment and Modern Attractions	27.857420	34.307575	High Popularity
9	Monastery of Saint Macarius	Monastery	Beheira	4.9	1921	Religious and Spiritual Attractions	30.291386	30.476418	Moderate Popularity

Egyptopia CBRS System Workflow

[User Inputs]

(Category, Tourism Type, City)

(1) Preferences Analysis

- Validate Inputs
- Find Similar Alternatives

get_similar_categories()

(2) Data Transformation

- MultiLabelBinarizer
  - Category -> [1,0,0,...]
  - Tourism -> [1,0,0,...]

(3) Similarity Calculation

Cosine Similarity:
→ category_similarity
→ tourism_similarity
Haversine Distance:
→ Geo Similarity

(4) Similarity Aggregation

- Weighted Similarity
- Diversity Bonus
- Normalized Rating
- Final Weighted Sim

(5) Diversification

- Balance Cities (max 5-7)
- Balance Categories
- Ensure Low Popularity (min 2)
  - Filter by Popularity
  - Select Top Low Pop Places

[Output]

(14 Recommended Places)

user_preferences = {

"tourism_type": ["Entertainment and Modern Attractions","Cultural and Historical Attractions"],
"category": ['Church', 'Garden','Temple'], **"City"**: ['Alexandria', 'Giza','Cairo'] **}**

Precision: 1.0
Preference_Coverage: 1.0

Category_Diversity: 0.8571
Tourism_Type_Diversity: 0.6071

Egyptopia CBRS Outputs :

+2 +2

	Name	Category	City	Tourism Type	Popularity	Rate	Total Rates	weighted_similarity
✓	Al Azhar Park	Garden	Cairo	Entertainment and Modern Attractions	High Popularity	4.5	37053	1.863
✓	International Garden	Garden	Cairo	Entertainment and Modern Attractions	High Popularity	4.1	27554	1.490
💡	Karnak Temple	Temple	Luxor	Cultural and Historical Attractions	High Popularity	4.8	26643	1.384
💡	Temple of Hatshepsut	Temple	Luxor	Cultural and Historical Attractions	High Popularity	4.7	20677	1.198
✓	Orman Garden	Garden	Giza	Entertainment and Modern Attractions	High Popularity	4.2	13069	1.046
✓	The Hanging Church	Church	Cairo	Religious and Spiritual Attractions	Moderate Popularity	4.7	6949	0.995
💡	Dream Park	Theme Park	Giza	Entertainment and Modern Attractions	High Popularity	4.2	25565	0.707
💡	San Stefano Grand Plaza	Shopping	Alexandria	Entertainment and Modern Attractions	High Popularity	4.5	32635	0.705
✓	Saint Mark's Coptic Orthodox Cathedral	Church	Alexandria	Religious and Spiritual Attractions	Moderate Popularity	4.8	3056	0.671
✓	Antoniades Garden	Garden	Alexandria	Entertainment and Modern Attractions	Moderate Popularity	4.2	5202	0.660
✓	Church of the Holy Virgin (Maadi Church)	Church	Cairo	Religious and Spiritual Attractions	Moderate Popularity	4.8	2191	0.569
💡	Temple of Hathor	Temple	Qena	Cultural and Historical Attractions	Moderate Popularity	4.8	3090	0.471
✓	Church of (Mar Girgis)	Church	Cairo	Religious and Spiritual Attractions	Low Popularity	4.7	538	0.277
	Taposiris Magna Temple	Temple	Alexandria	Cultural and Historical Attractions	Low Popularity	4.5	104	0.082

Simulation-Driven Evaluation of Content-Based Recommendations Across Diverse User Scenarios

Evaluation Methodology

Synthetic data were utilized to generate random user preferences for simulation, enabling a comprehensive evaluation of the performance of the Content-Based Recommendation System across diverse scenarios.

(1) Generating Random Preferences

- Calling generate_random_preferences()
- For num_scenarios (506)
- Random Categories (1-9)
- Random Cities (0-7)
- Random Tourism Types (0-3)
- **Output**: List of Preferences

(2) Simulation Running

- Calling run_simulation()
- For each scenario:

1. Generate Recommendations
   Calling recommend_places_content_based( )
2. Evaluating Recommendations
   Calling evaluate_recommendations ()
   Compute Metrics:
   1. Precision
   2. Preference_Coverage
   3. Category_Diversity
   4. Tourism_Type_Diversity
3. Store Results
   - Scenario Details
   - Metrics Values

(3) Results Saving

- Creating Results DataFrame
- Saving to CSV

.CSV

Removing Duplicates

505 unique scenarios

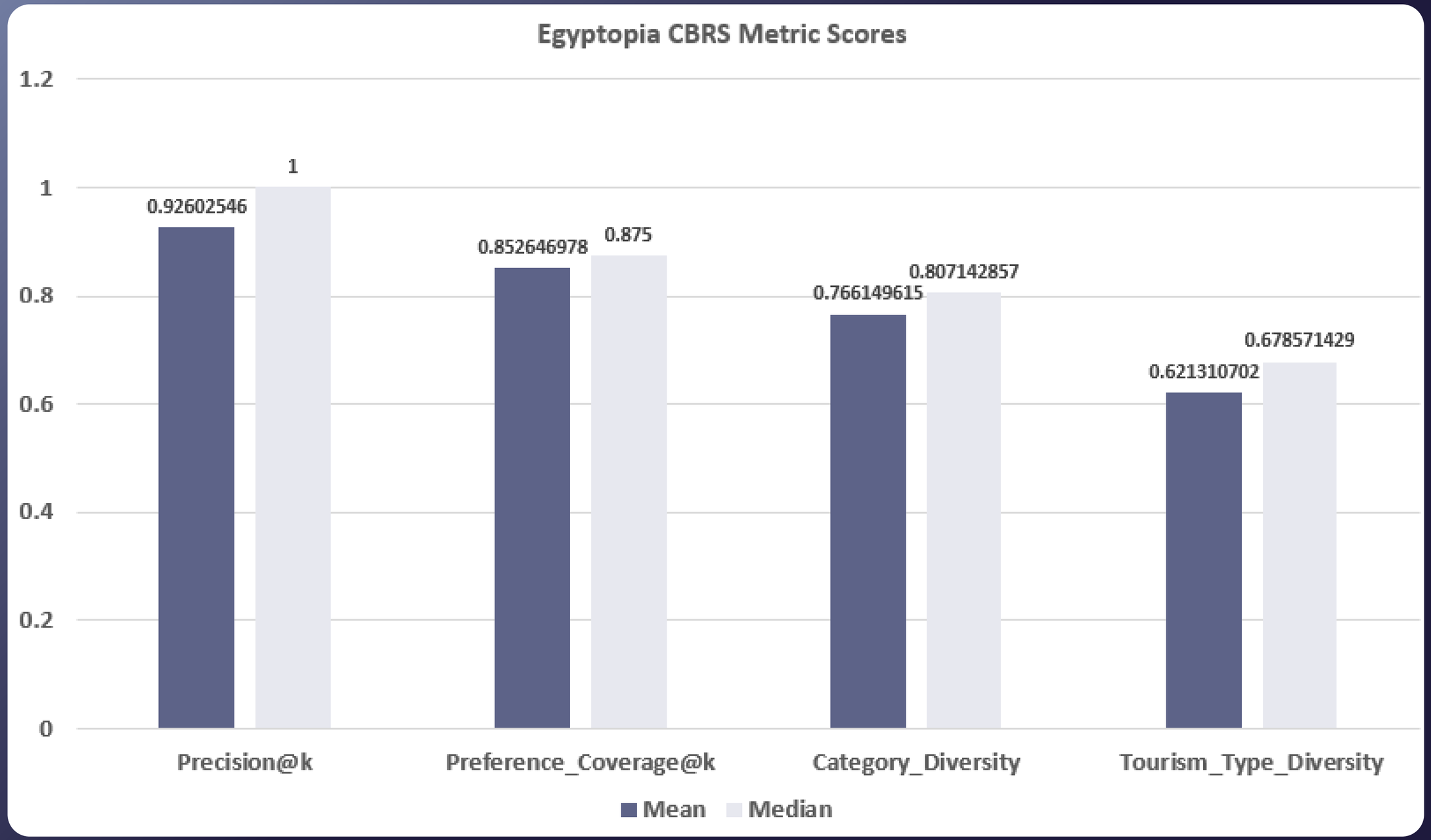
Generated Synthetic Data to Evaluate the Egyptopia Content-Based Recommendation System

```
final_simulation
```

	Categories	Cities	Tourism_Types	Precision@k	Preference_Coverage@k	Category_Diversity	Tourism_Type_Diversity
0	Mountain	Beni Suef, Hurghada, Qena	Religious and Spiritual Attractions, Medical A...	0.714286	0.666667	0.607143	0.607143
1	Water Park	Red Sea, Cairo, Sharm El Sheikh	Medical Attractions, Natural Attractions	1.000000	1.000000	0.714286	0.607143
2	Fortress, Mosque	Qena, Sharqia, Beheira, Alexandria	Religious and Spiritual Attractions, Entertain...	1.000000	0.777778	0.857143	0.619048
3	Theme Park	Fayoum, Assiut, Aswan	Religious and Spiritual Attractions, Entertain...	1.000000	0.285714	0.750000	0.333333
4	Beach	Sohag, Sharm El Sheikh, Cairo	Entertainment and Modern Attractions, Cultural...	1.000000	0.833333	0.750000	0.750000
...	...	...	...	...	...	...	...
500	No Input	No Input	Entertainment and Modern Attractions	0.857143	1.000000	0.000000	0.928571
501	No Input	No Input	Natural Attractions	0.785714	1.000000	0.000000	0.892857
502	No Input	No Input	Religious and Spiritual Attractions	0.642857	1.000000	0.000000	0.821429
503	No Input	No Input	Medical Attractions	0.642857	1.000000	0.000000	0.821429
504	No Input	No Input	Cultural and Historical Attractions	0.857143	1.000000	0.000000	0.928571

505 rows × 7 columns

Performance of Egyptopia Content-Based Recommendation System with User Preference Inputs

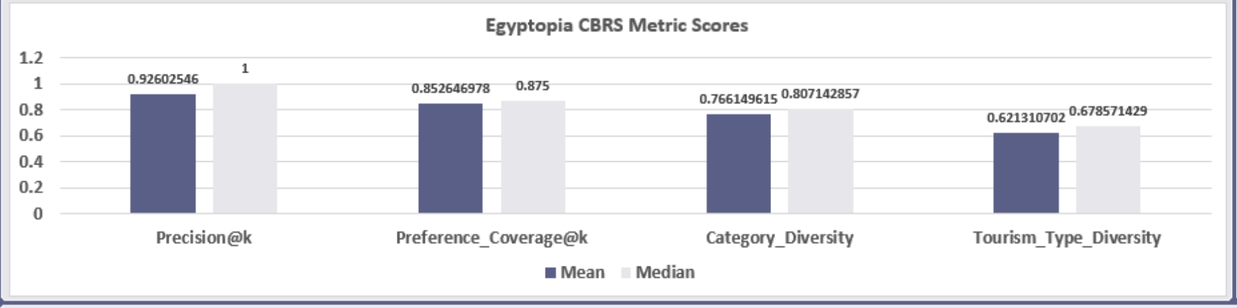


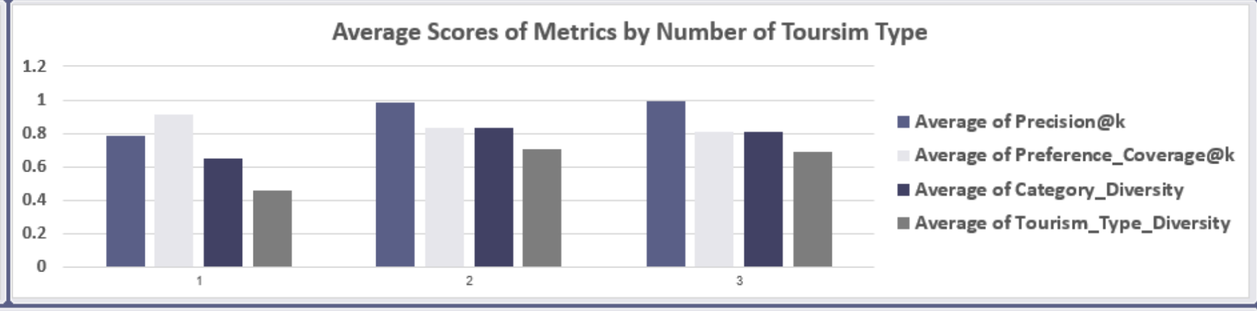
Detailed Analysis of the Performance of the Egyptopia Content-Based Recommendation System with User Preference Inputs

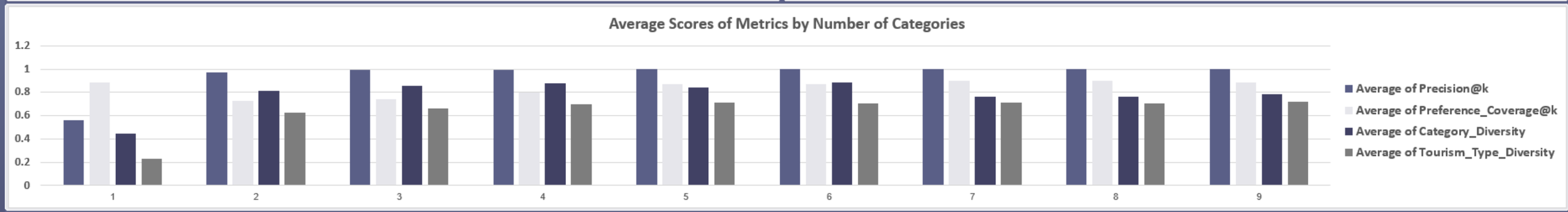
Performance of Egyptopia Content-Based Recommendation System with User Preference Inputs

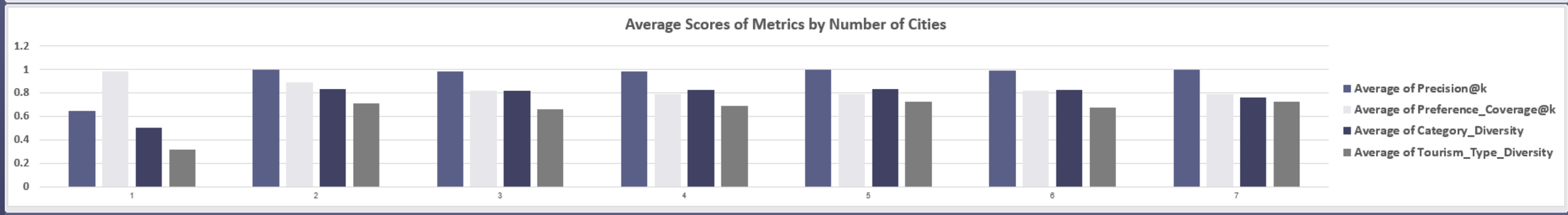
Total Multiple Scenarios : **451**

Total Single Scenarios : **55**









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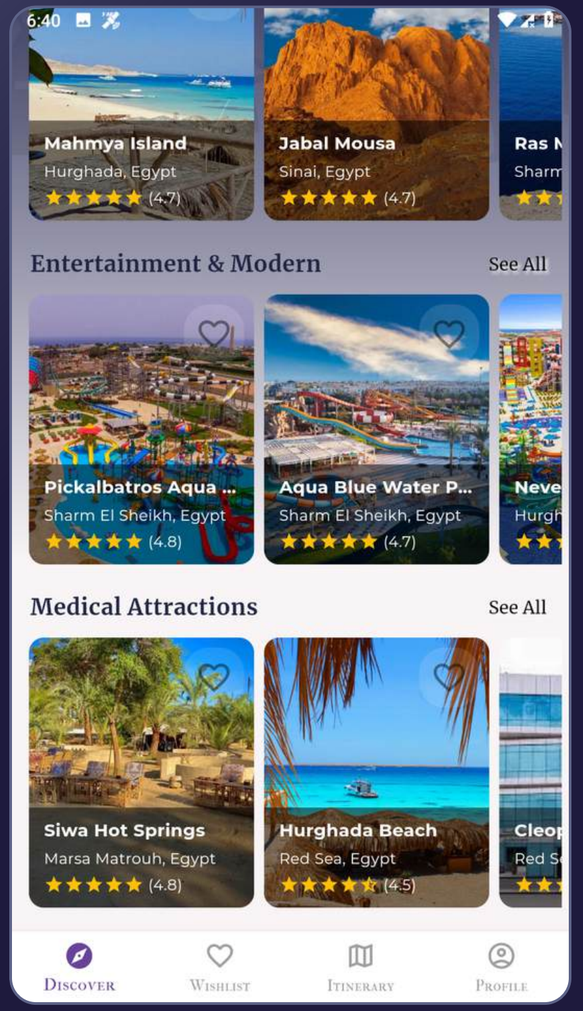
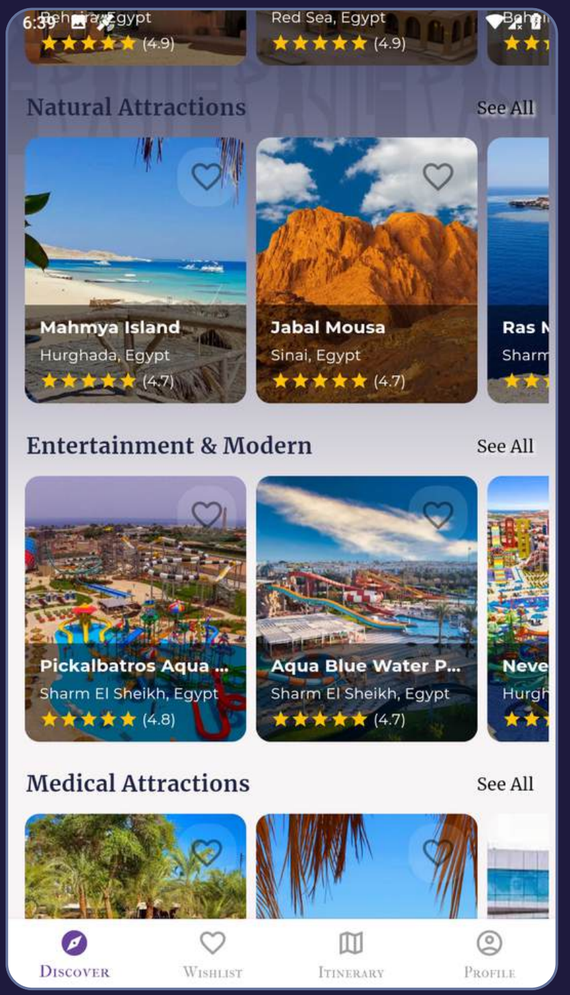
Model Implementation in the Production Version of the Egyptopia Mobile Application

1.Egyptopia Non-Personalized Recommendations

In the non-personalized recommendation system, all places within each tourism type category were ranked based on their **Bayesian Average score**. This ranking serves as the default recommendations presented to new users, addressing the cold start problem. The system organizes recommendations across five distinct tourism types, with each type displayed through a separate slider, enabling users to explore recommended places by category.

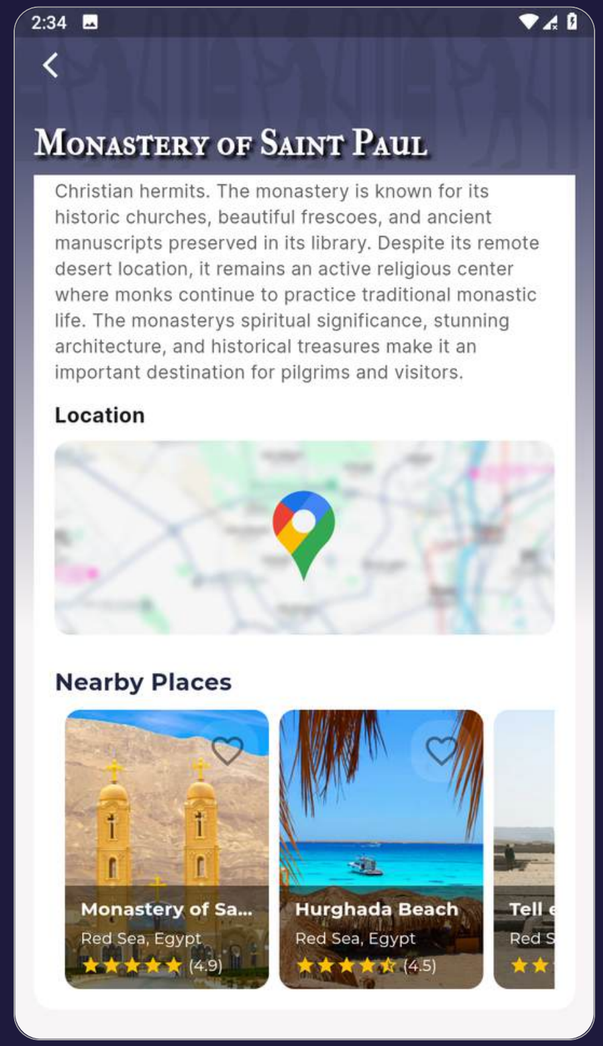




Model Implementation in the Production Version of the Egyptopia Mobile Application

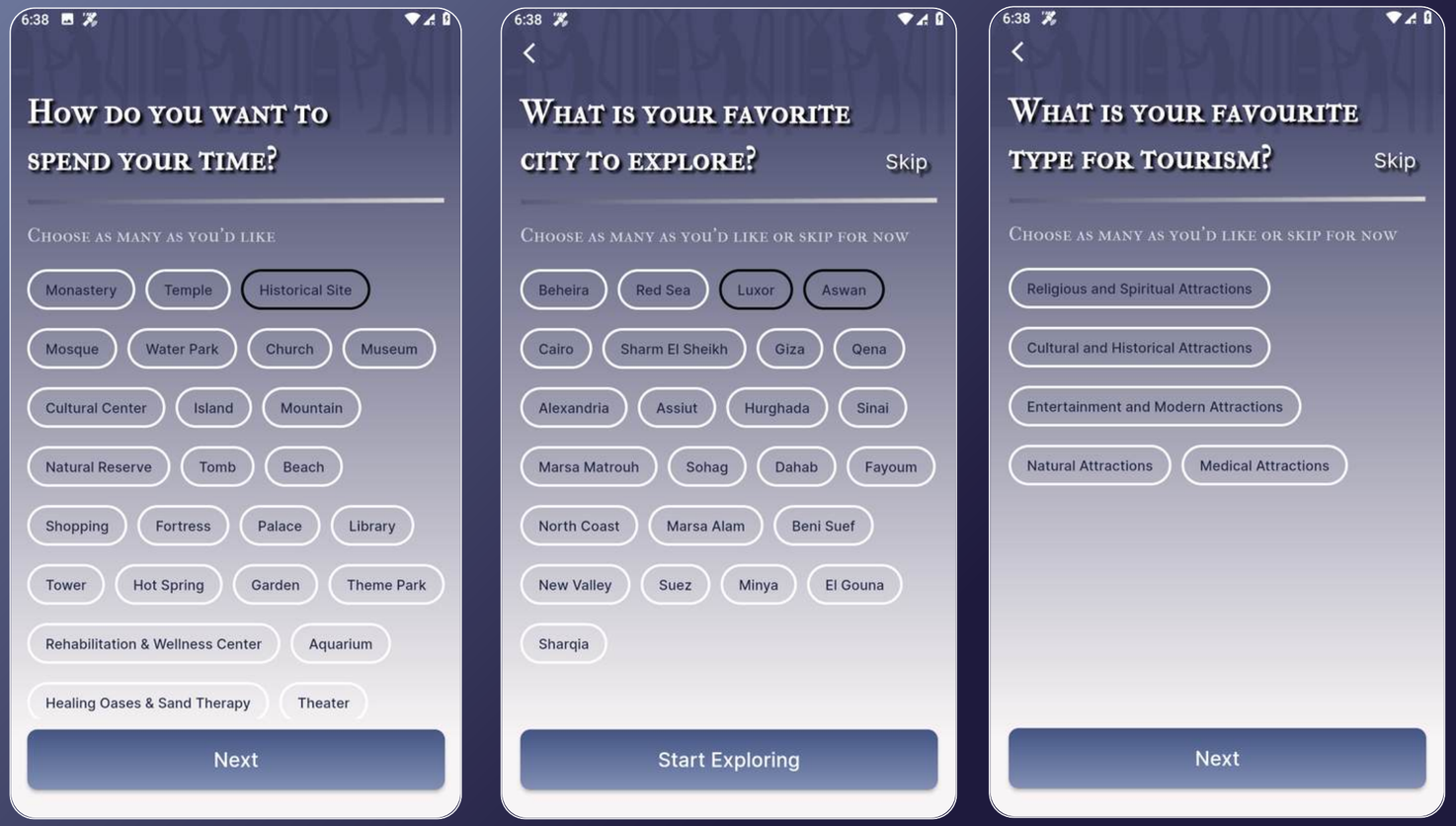
2.Egyptopia Location Based Recommendations

In the location-based recommendation system, when a user selected a tourist place and viewed its information, the system displayed a slider showing the nearest places within the same city. These places were ordered from the closest to the farthest based on calculations using the Haversine formula, which measures geographic distance between coordinates. This approach enabled the user to discover nearby attractions efficiently and intuitively.

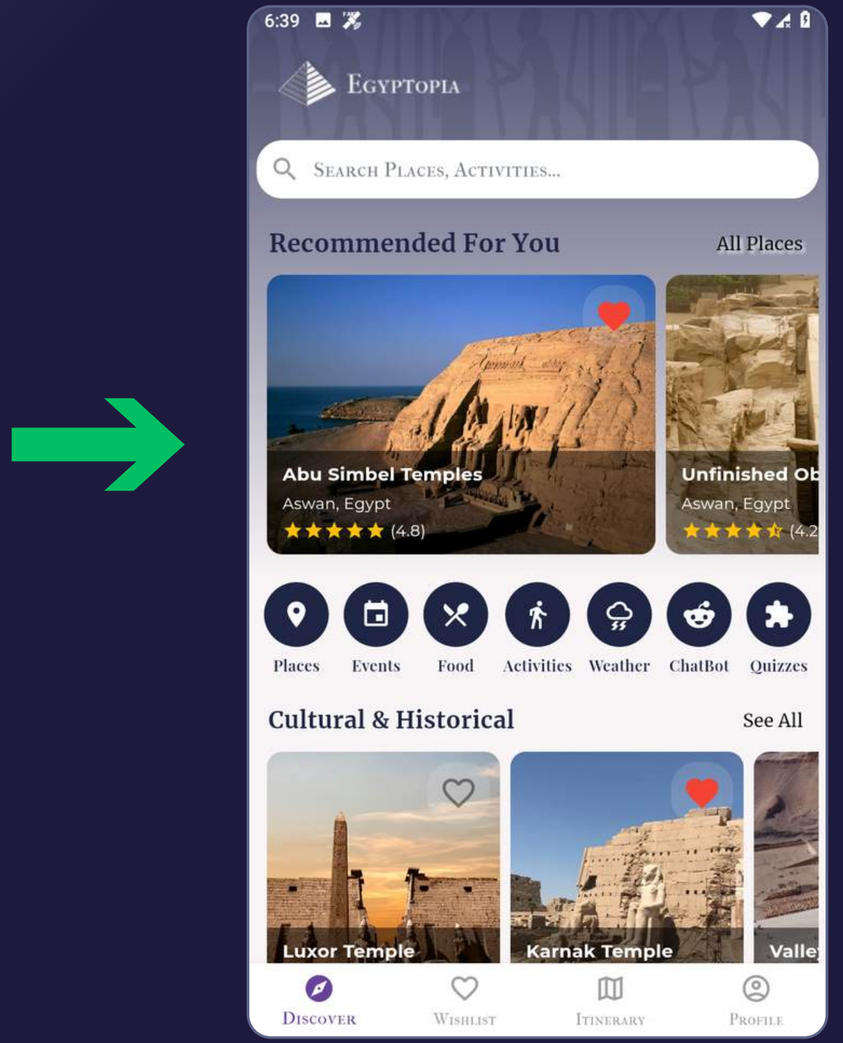


Model Implementation in the Production Version of the Egyptopia Mobile Application

3. Egyptopia Content Based Recommendation System



Egyptopia Preference Pages



User preferences are selected by the user through dedicated preference pages. Based on these inputs, the content-based recommendation system suggests places that are similar to the user's chosen preferences.

Future Enhancements

Non-Personalized Recommendation Enhancements

Beyond top-rated recommendations based on Bayesian Average, recommendations can be adapted dynamically based on user implicit and explicit interactions to refine what is shown by default to new users.

Demographic-Based Recommendation

Uses demographic attributes (e.g., age, gender, nationality) to personalize recommendations for different user segments.

Context-Aware Recommendation

Incorporates contextual information such as time, season, weather, or travel group type to tailor recommendations dynamically.

Knowledge - Based Recommendation

Relies on predefined rules and structured knowledge about user needs and place features (e.g., recommending family-friendly attractions for users traveling with children).

Special Promotions and Events Slider

A slider can be added to highlight places currently offering promotions, discounts, or hosting popular events ("hot" attractions).