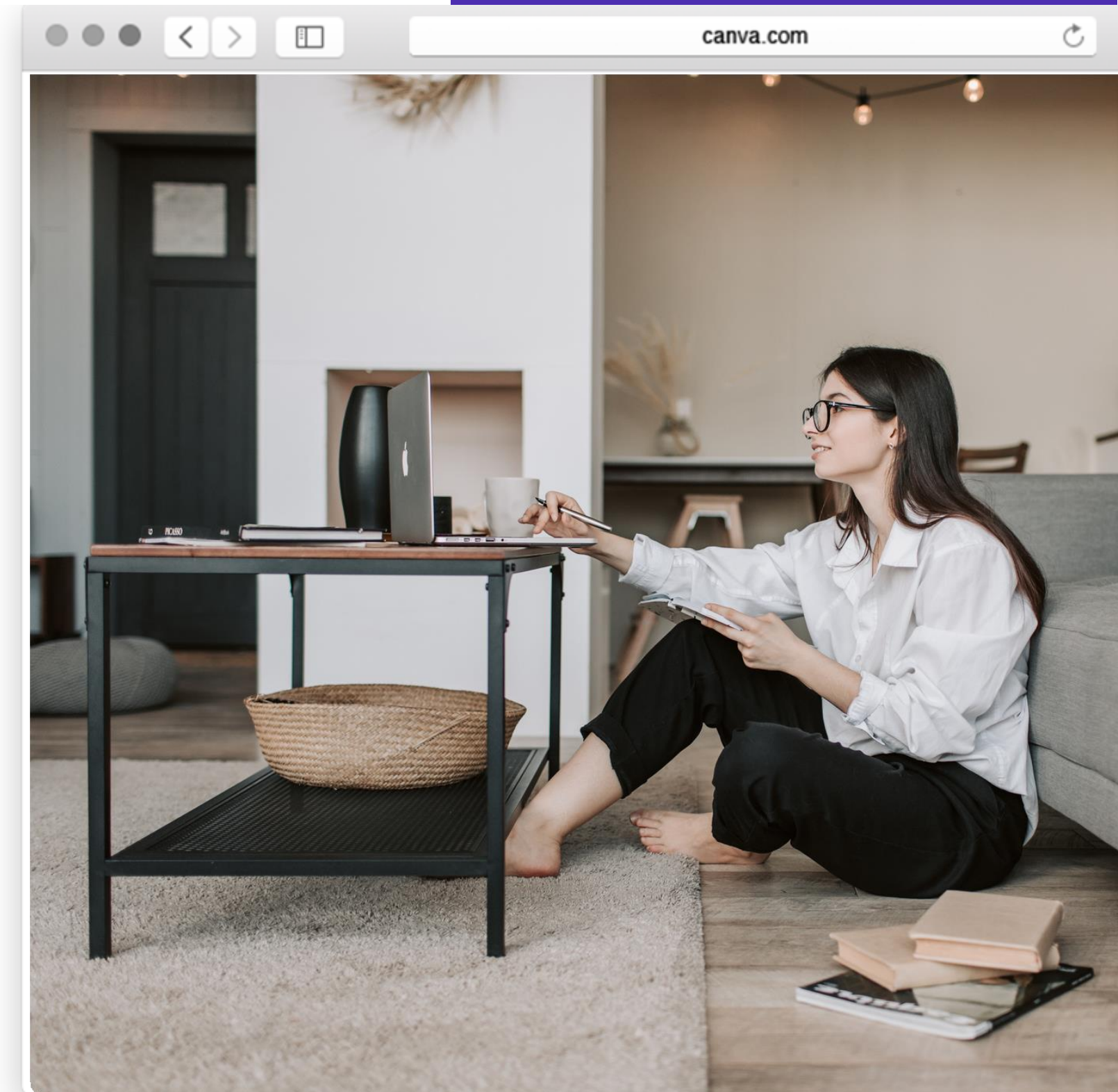


CASE STUDY

Toy Library application



Problem statement

John owns a toy library in New Delhi. A typical toy library has 5000 toys which are rented out to users. A typical user, say Jane, pays a deposit when she becomes a member of the library. She also pays a monthly subscription. In return she can rent a maximum of 3 toys at a time for one week; and a maximum of 10 toys per month. John's business is doing very well and he wants to expand across the nation. He is planning to have 100 toy libraries over 45 prominent cities in India. In order to minimize costs, he plans to augment the business with an online application. With the new application, a user like Jane will be able to search the toys available in the area and book a toy for rent. She can choose to pickup the toy from the library or can ask for a home delivery. The home delivery option is available only if she is a premium user. She can optionally rate or review the toy, add the photo of the toy with the kid or share feedback on social media.

As John has a lot of business connections in New Delhi, he has decided to keep the central warehouse in New Delhi. The new toys will be provided to the libraries in the other cities through this central warehouse.

Question 1 - You have a meeting with John where you want to propose a system design to address his business problems. What will you showcase?

Note:

1. Explain the technical architectural options, recommendations, and your rationale behind the choice. Be as detailed as you can be
2. Feel free to recommend additional features which will make the solution better
3. Ignore the schedule and effort impact while answering this question

Question 2 - You have launched the product successfully. Mobile as well as the web version are very successful. John wants to have a more objective evaluation of the business. He wants to know the following things

- a. What is the state of business on daily, weekly, monthly, and quarterly basis? Clearly define KPIs and metrics
- b. Are there any trends in data which will help improve profitability?

Provide a solution to John to address these questions. Include rough sketch of proposed report

Question 3 - You have delivered the insights discussed in question 2. John is using these insights to make business decisions. In your last meeting, he mentioned "I have heard a lot about machine learning and artificial intelligence. Can we use them and improve our system?"

Provide a point of view on this.

Q1 System Design

Software Architecture

The application will be a microservices architecture. It will use APIs and Services to execute the orders

Rationale

- 1) Microservices is highly scalable
- 2) While updating and deploying, we can update and deploy different parts of application independently. You do not need to release entire application again

Functional Requirements

- 1) Search Toys
- 2) Book a toy for rent
- 3) Pick up or home delivery
- 4) Rate or review a toy
- 5) Freemium service
- 6) Share feedback on social media

Non Functional requirements

- 1) Reliability
- 2) Scalability
- 3) Maintainability
- 4) responsiveness
- 5) Low Latency
- 6) High Consistency

Assumptions

- 1) User Profile has been created
- 2) Product onboarding is provided
- 3) Payment gateway is provided

Capacity Estimation

Total Products: 5000
1product needs 10 MB storage

Total Product Storage
= 5000 X 10MB
= 50 GB

Database Design

User DB - SQL

User ID - primary key
User Name - String
Password - String encrypted
First Name - String
Last Name - String
Email - String
Instagram ID - String
Last Login - DDTM
Created - DDTM
isPremium - Y/N
Deposit paid - Y/N

Order DB - SQL

Oder ID - primary key
Address ID - Foreign Key
Items Delivered - Number

Address DB - SQL

Address ID - primary key
User ID - Foreign Key
Address Type - Billing/Shipping/Home
Address Line 1- String
Address Line 2 - String
City - String
Zipcode - Number

Review DB - NoSQL - Key Value DB (product ID as key)

```
{
  "Key": "77654321"
  "Rating": 4
  "Description" : "Product review description"
  "images/videos" : [
    {"Attachment ID" : "123"
    "User ID" : "987654"},
    {"Attachment ID" : "456"
    "User ID" : "87654389"}
  ]
}
```

Product DB - NoSQL - MongoDB or DynamoDB

```
{
  "Id": "124abc"
  "Category": "educational toys"
  "item" : "lego"
  "images" : [
    {"Image ID" : "123"},
    {"Image ID" : "456"}
  ]
}
```

Inventory DB - SQL

Product ID - primary key
Items Quantity - Number

APIs

- 1) Search(search String, User ID) - GET method and returns a list of products
- 2) AddToCart(User ID, Product ID, Amount) - Returns a boolean status(Y/N)
- 3) PlaceOrder(User ID, Product ID, Address ID) - Returns boolean (Y/N)
- 4) CheckOrderStatus(Order ID) - GET Returns Order Status
- 5) PaymentService(User ID, card info) - GET account Status
- 6) Getrecommendation(User ID) - Returns a list of product recommendations
- 7) ProductReview(User ID, Product ID) - Returns/Writes product reviews
- 8) ShareFeedback(User ID) - Directs the user to instagram account

Additional recommendations:

- 1) Product recommendations based on search history
- 2) Share product information with friends/contacts

Probable Tech Stack:

Infrastructure:

- 1) Application of AWS cloud, user details can be on private/on-premise for security reasons
- 2) Containerized application: Docker, CI/CD: using Kuberntes
- 3) Scaling using: Terraform or Auto Scaling can be used

Database:

SQL and No-SQL databases, if we go for AWS DynamoDB can be used

Back-end:

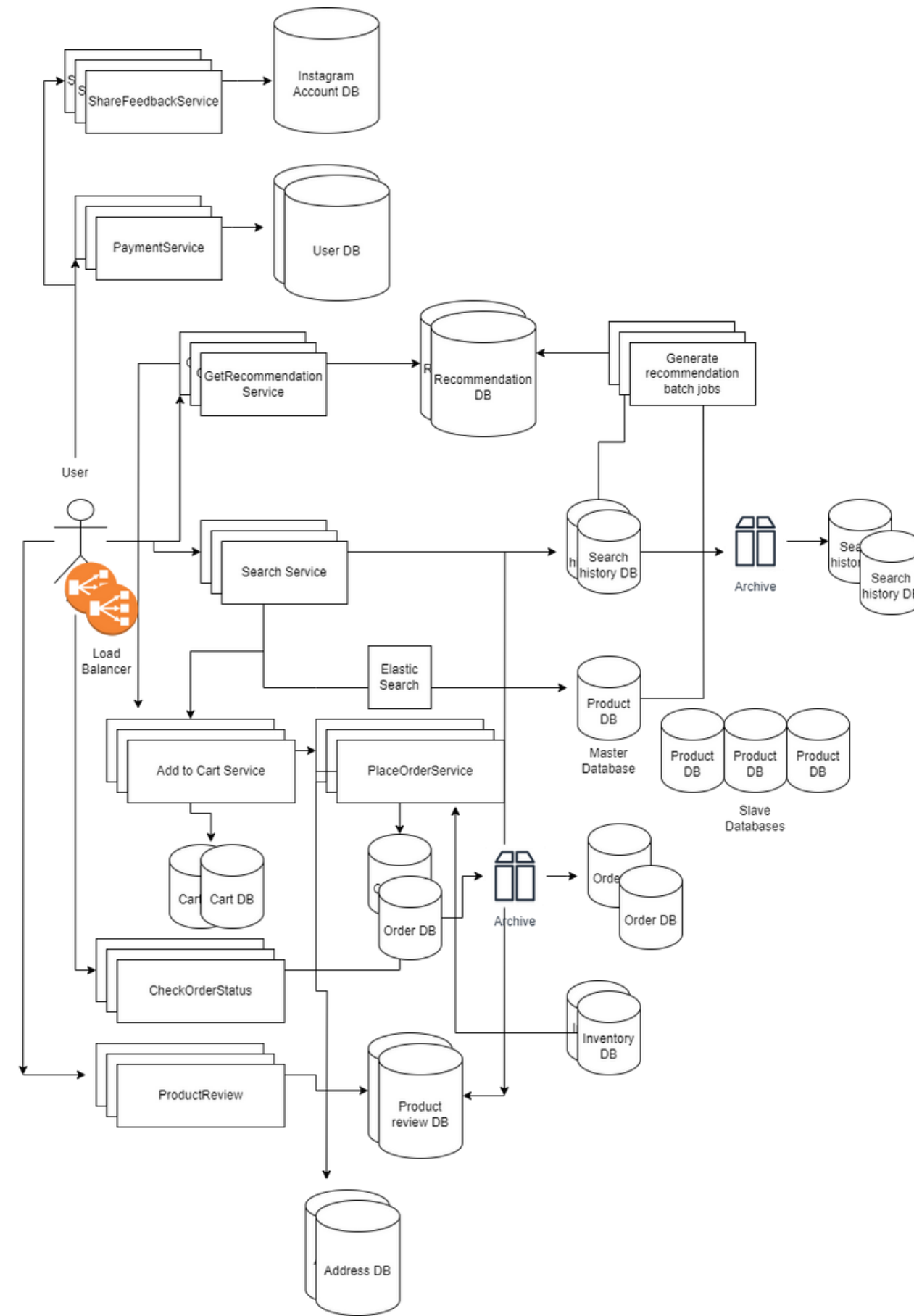
JavaScript frameworks like Node.js or Express.js can be used

Front-end:

JavaScript frameworks like React.js or Angular.js

High Level Design

<https://drive.google.com/file/d/1Z-J9mtPGaEzSTgf7TZG3uCKA6s-PaVAY/view?usp=sharing>



Q2 Metrics

In-product Metrics:

- 1) # of searches/day/week/month
- 2) # of successful cart additions/user
- 3) # of successful order placed /user
- 4) # of successful cart additions/day/week/month
- 5) # of successful orders placed/day/week/month
- 6) # of reviews submitted/user
- 7) Average product ratings
- 8) # of feedback shared on social media/user

Business Metrics:

- 1) # of successful signups
- 2) # of users taking premium subscription
- 3) # of toys rented/user
- 4) # of Daily/Weekly/Monthly Active Users

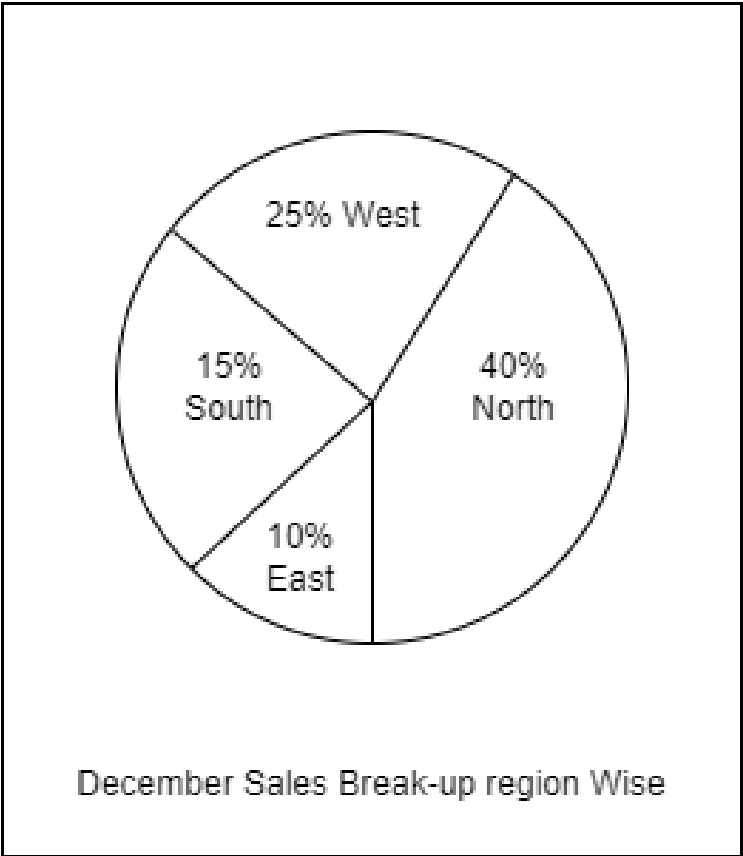
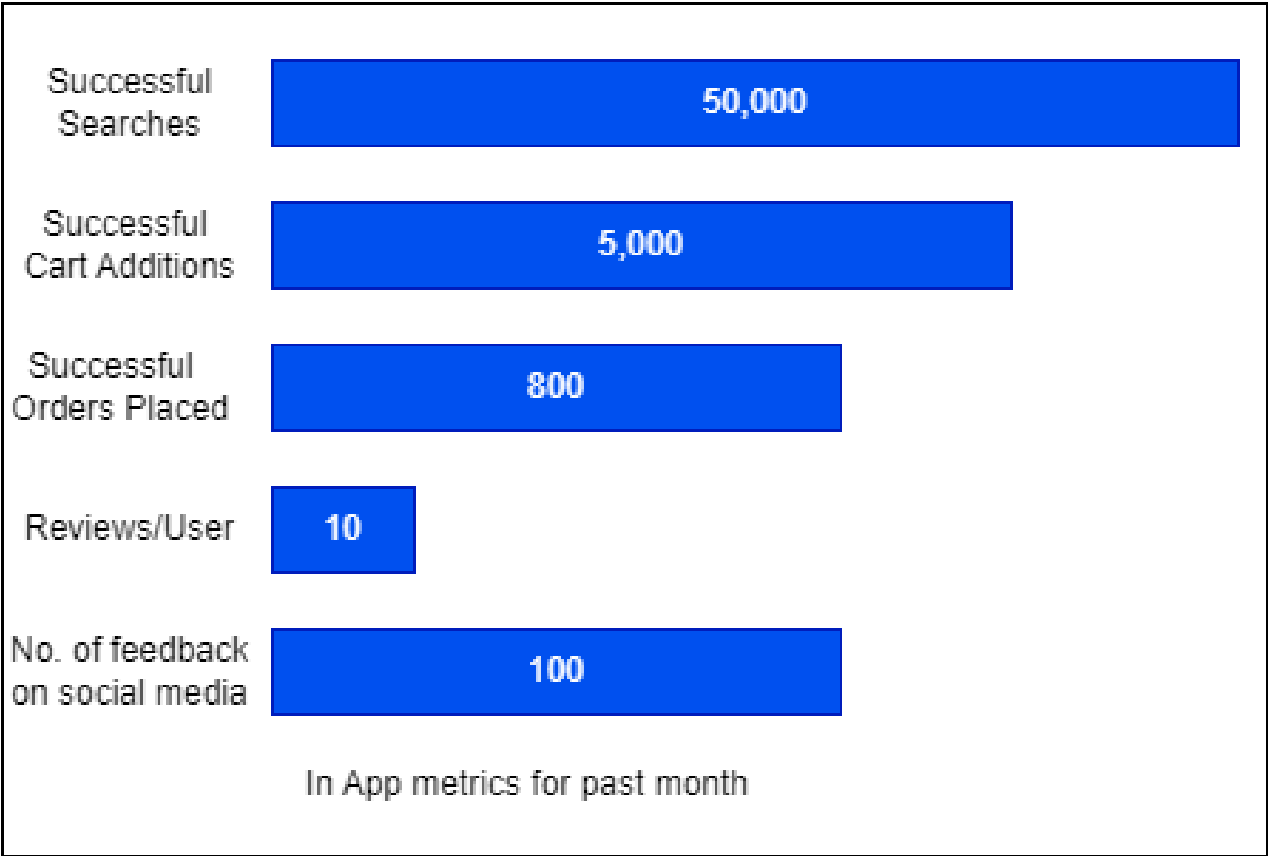
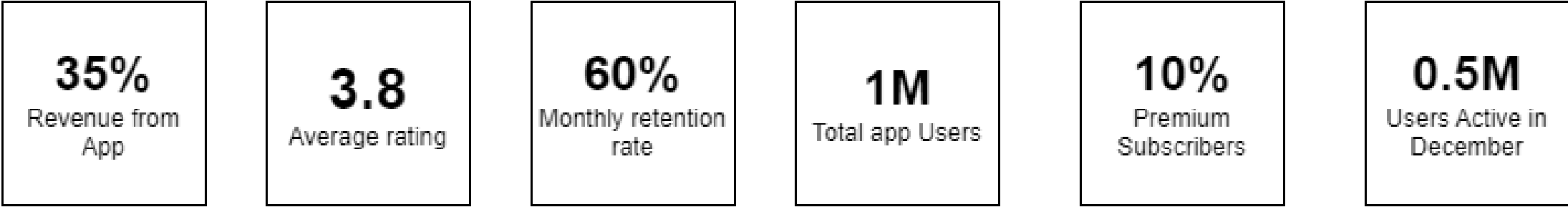
Top Level Metric

- 1) %of toys rented using app

North Star:

Total Revenue from App

Q2 Sample Report



Trends in the data:

1) Repeat rentals for certain toys hence option should be provided for the users to buy that particular toy from app or from library. Additional revenue can be generated from selling the toys

Q3 AI/ML for Application

1) Image based search: Complaints from customers that they are not able to find a particular toy using text based search. Hence image based search can be introduced

2) AI/ML based tools can be used to improve product images that will lead to more number of successful orders placed and successful cart additions

3) Certain toys are extremely in demand for a particular time. Dynamic Pricing algorithm using ML models can be used to arrive a price point. Users can pay additional few rupees to rent this product

4) Image processing while assessing the return of product at the end of rental period. Using before and after image results product damage and the extent of damage can be identified. Based on the damage amount can be charged from user account