

Project Synopsis
On
**“Data Mining Techniques for Customer
Relationship Management”**

Is submitted partial fulfillment of the requirement of the

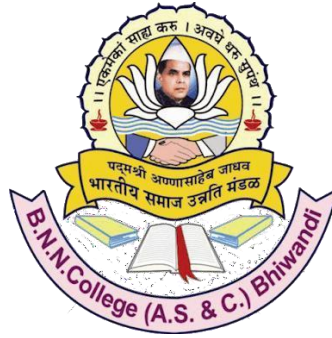
M.Sc. (Computer Science) Sem-IV

SUBMITTED BY

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UNDER GUIDANCE OF

Mrs. Varsha Mam.



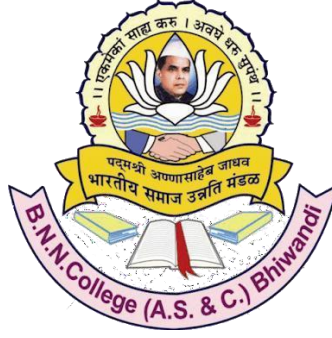
Department of Computer Science

B.N.N. College, Bhiwandi

A.Y. - 2024-2025



Mumbai University



Padmashri Annasaheb Jadhav Bharatiya Samaj Unnati Mandal's
B. N. N. College of Arts, Science & Commerce, Bhiwandi.
(Self Funded Courses)
(Department of Computer Science)

CERTIFICATE

This is to certify that **Miss.Pallavi Narendra Bhangare** has successfully completed the project synopsis titled “**Data Mining Techniques for Customer Relationship Management**” and has duly submitted the project synopsis in fulfillment of the requirements for the **M.Sc. (Computer Science) – Semester IV** degree from the **University of Mumbai** during the academic year **2024-25**.

It is further certified that he has successfully completed all the required phases of the project proposal as per the academic guidelines.

Project Guide
Mrs. Varsha More

External Examiner

Signature of HOD
Mr. Pramod Lala Shewale

Signature Principal
Dr. Ashok D. Wagh

ACKNOWLEDGEMENT

I would like to extend our heartiest thanks with a deep sense of gratitude and respect to all those who provide me immense help and guidance during my project synopsis work.

I would like to thank my Project Guide **Mrs. Varsha More** for providing a vision about the system. I have greatly benefited from her regular positive reviews and inspiration throughout my work. I am grateful for her guidance, encouragement, understanding and insightful support in the development process.

I would also like to sincerely thank my college for giving required resources whenever I needed and for giving the opportunity to develop the project.

I would like to express my sincere thanks to our Principal **Dr. Ashok D. Wagh** and our Head of Department **Mr. Pramod Lala Shewale** for providing me with the essential infrastructure & resources without which this project would not have been completed.

Finally I would like to sincerely thank my colleagues, friends for their cooperation to complete my project.

With sincere regards,
Pallavi Narendra Bhangare

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Research Project Proposal

Title: Data Mining Techniques for Customer Relationship Management

OBJECTIVE

Customer Relationship Management (CRM) has become a crucial component for businesses seeking to enhance customer engagement and retention. Data mining techniques offer powerful tools for extracting valuable insights from large datasets, enabling companies to make data-driven decisions that improve customer satisfaction and business performance. This research aims to explore various data mining techniques used in CRM and assess their effectiveness in predicting customer behavior, segmenting customers, and enhancing personalized marketing strategies.

Customer relationship management (CMR) is a customer centered business strategy. Firms abidingly accumulate, analyze and exploit customer comprehensive information to allocate resources rationally according to customer oriented WORKING mode, and meet customer demand through meaningful communication, understanding and influence customer behavior. Thereby increasing customer satisfaction and loyalty, and to obtain the maximum profit. The general CRM covers customer resource management, marketing management, sales management, customer care and service management, and many other aspects. Its ultimate goal is to provide the basis for business management and decision-making through proactive market research and analysis and processing of customer feedback. Simple from the content of customer relationship management, CMR is customer propaganda, tracking, revisit and

classification. Of course, with the development of modern information technology, the pursuit of personalized service has become the new target in the field of after-sales service

INTRODUCTION

A new business culture is developing today. Within it, the economics of customer relationships are changing in fundamental ways, and companies are facing the need to implement new solutions and strategies that address these changes. The concepts of mass production and mass marketing, first created during the Industrial Revolution, are being supplanted by new ideas in which customer relationships are the central business issue. Firms today are concerned with increasing customer value through analysis of the customer lifecycle. The tools and technologies of data warehousing, data mining, and other customer relationship management (CRM) techniques afford new opportunities for businesses to act on the concepts of relationship marketing. The old model of “design-build-sell” (a product-oriented view) is being replaced by “sell-build-redesign” (a customer-oriented view). The traditional process of mass-marketing is being challenged by the new approach of one-to-one marketing. In the traditional process, the marketing goal is to reach more customers and expand the customer base. But given the high cost of acquiring new customers, it makes better sense to conduct business with current customers. In so doing, the marketing focus shifts away from the breadth of customer base to the depth of each customer’s needs. The performance metric changes from market share to so-called “wallet share”. Businesses do not just deal with customers in order to make transactions; they turn the opportunity to sell products into a service experience and endeavor to establish a long-term relationship with each customer.

The advent of the Internet has undoubtedly contributed to the shift of marketing focus. As on-line information becomes more accessible and abundant, consumers become more informed and sophisticated. They are aware of all that is being offered, and they demand the best. To cope with this condition, businesses have to distinguish their

products or services in a way that avoids the undesired result of becoming mere commodities. One effective way to distinguish themselves is with systems that can interact precisely and consistently with customers. Collecting customer demographics and behavior data makes precision targeting possible. This kind of targeting also helps when devising an effective promotion plan to meet tough competition or identifying prospective customers when new products appear. Interacting with customers consistently means businesses must store transaction records and responses in an on-line system that is available to knowledgeable staff members who know how to interact with it. The importance of establishing close customer relationships is recognized, and CRM is called for.

It may seem that CRM is applicable only for managing relationships between businesses and consumers. A closer examination reveals that it is even more crucial for business customers.

RELATED WORKS / LITERATURE SURVEY

Several data mining techniques are widely used in Customer Relationship Management (CRM) to analyze customer data, enhance customer experience, and improve business decision-making. Here are some key models and techniques related to data mining in CRM:

1. Classification Models

- **Decision Trees:** Used to classify customers based on attributes like demographics, purchase history, and behavior.
- **Naïve Bayes:** Helps in predicting customer preferences and churn rates.
- **Support Vector Machines (SVM):** Useful for customer segmentation and fraud detection.

2. Clustering Techniques

- **K-Means Clustering:** Groups customers into different segments based on purchasing behavior.
- **Hierarchical Clustering:** Helps in understanding relationships among customers.
- **DBSCAN:** Detects anomalies and outlier customers who do not fit into usual patterns.

3. Association Rule Mining

- **Apriori Algorithm:** Identifies relationships between products frequently bought together (market basket analysis).

- **FP-Growth Algorithm:** A more efficient way to find frequent item sets in large databases.

4. Predictive Analytics Models

- **Regression Analysis:** Predicts future customer behavior, such as lifetime value (CLV) and purchase likelihood.
- **Neural Networks:** Used for complex pattern recognition in customer behavior.

5. Anomaly Detection

- **Isolation Forest:** Identifies unusual customer activity (e.g., fraud detection).
- **Local Outlier Factor (LOF):** Finds customers with unusual buying patterns.

6. Sentiment Analysis & Text Mining

- **Natural Language Processing (NLP):** Analyzes customer reviews and feedback.
- **Latent Dirichlet Allocation (LDA):** Extracts topics from customer complaints and support tickets.

7. Recommendation Systems

- **Collaborative Filtering:** Suggests products based on similar customers' preferences.
- **Content-Based Filtering:** Recommends products based on a customer's past behavior.

Literature Survey on Data Mining Techniques for Customer Relationship Management (CRM)

1. Introduction Customer Relationship Management (CRM) is a strategic approach focused on managing customer interactions to enhance customer satisfaction and

business performance. Data mining plays a crucial role in CRM by extracting valuable insights from large datasets to improve decision-making and customer engagement.

2. Data Mining Techniques in CRM Various data mining techniques are applied in CRM to analyze customer data and predict behaviors. The key techniques include:

- **Classification:** Algorithms such as Decision Trees, Naïve Bayes, and Support Vector Machines (SVM) classify customers based on their purchasing patterns and behaviors (Han et al., 2011).
- **Clustering:** Techniques like K-Means, DBSCAN, and Hierarchical Clustering help segment customers based on similarities in preferences and demographics (Ngai et al., 2009).
- **Association Rule Mining:** Apriori and FP-Growth algorithms are used to identify relationships between customer purchases and product affinities (Agrawal et al., 1993).
- **Regression Analysis:** Linear and logistic regression models predict customer lifetime value and churn probability (Kotler & Keller, 2016).
- **Neural Networks and Deep Learning:** Artificial Neural Networks (ANNs) and deep learning models analyze complex customer interactions and behavior patterns (LeCun et al., 2015).
- **Sentiment Analysis:** Natural Language Processing (NLP) techniques extract insights from customer reviews and feedback (Pang & Lee, 2008).

.Challenges in Data Mining for CRM Despite its benefits, data mining in CRM faces several challenges:

- **Data Quality and Integration:** Inconsistent and incomplete customer data can hinder analysis (Witten et al., 2016).
- **Privacy and Security Concerns:** Ethical concerns regarding the use of customer data require robust security measures (Culnan & Williams, 2009).
- **Scalability Issues:** Processing large datasets efficiently demands high-performance computing (Chen et al., 2012).

PROPOSED METHODOLOGY

Proposed Methodology for Data Mining in Customer Relationship Management (CRM)

Data mining techniques in CRM help businesses extract meaningful insights from customer data to enhance customer acquisition, retention, and satisfaction. The proposed methodology consists of the following key phases:

1. Data Collection & Preprocessing

- **Data Sources:** Customer databases, transaction history, social media, website interactions, and customer service logs.
- **Data Cleaning:** Remove duplicates, handle missing values, and standardize data formats.
- **Data Integration:** Merge data from multiple sources for a unified view.
- **Data Transformation:** Convert raw data into a suitable format for mining (e.g., normalization, feature selection).

2. Customer Segmentation

- **Techniques Used:**
 - **Clustering (K-Means, DBSCAN, Hierarchical Clustering):** Group customers based on purchasing behavior, demographics, and preferences.
 - **Association Rule Mining (Apriori, FP-Growth):** Identify patterns in customer purchases (e.g., market basket analysis).

3. Customer Behavior Prediction

- **Techniques Used:**

- **Classification (Decision Trees, Random Forest, SVM, Neural Networks):** Predict customer churn, potential high-value customers, and buying likelihood.
- **Regression Analysis (Linear/Logistic Regression):** Forecast sales and customer spending trends.

4. Sentiment Analysis & Customer Feedback Analysis

- **Text Mining Techniques:**
 - **Natural Language Processing (NLP):** Analyze customer reviews, complaints, and feedback.
 - **Opinion Mining (Sentiment Analysis using LSTM, Naïve Bayes, or BERT models):** Categorize sentiments as positive, neutral, or negative.

5. Personalization & Recommendation Systems

- **Techniques Used:**
 - **Collaborative Filtering (User-Based, Item-Based):** Suggest products based on similar customer behavior.
 - **Content-Based Filtering:** Recommend products based on customer preferences and past purchases.

6. Customer Retention Strategies

- **Predictive Analytics:** Identify at-risk customers and recommend personalized engagement strategies.
- **Loyalty Program Optimization:** Use data mining insights to refine reward programs and incentives.

7. Implementation & Evaluation

- **Deploying Data Models:** Integrate the predictive and analytical models into CRM software.

- **Performance Metrics:** Evaluate accuracy, precision, recall, and F1-score of the models.
- **A/B Testing:** Validate effectiveness of personalized recommendations and marketing strategies.

Significance / Scope of the Work: Data Mining Techniques for Customer Relationship Management (CRM)

Customer Relationship Management (CRM) is crucial for businesses to understand, predict, and enhance customer interactions. Data mining techniques play a significant role in CRM by extracting valuable insights from large datasets to improve customer engagement, retention, and overall business performance.

Significance of the Work:

1. **Enhanced Customer Insights** – Data mining allows businesses to analyze customer behaviors, preferences, and trends, leading to better decision-making.
2. **Personalized Marketing** – By identifying customer segments, businesses can tailor marketing strategies to individual preferences, increasing customer satisfaction and sales.
3. **Customer Retention and Loyalty** – Predictive analytics help detect patterns of customer churn, allowing businesses to implement proactive retention strategies.
4. **Fraud Detection** – Data mining techniques can identify suspicious patterns and prevent fraudulent activities in customer transactions.
5. **Operational Efficiency** – Automating customer data analysis reduces manual effort, enhances service quality, and optimizes business processes.

Scope of the Work:

1. **Application of Data Mining Techniques** – Implementing classification, clustering, association rule mining, and predictive modeling in CRM data.
2. **Customer Segmentation** – Grouping customers based on demographics, purchasing behavior, and interaction history.

3. **Churn Prediction Models** – Developing models to predict customer attrition and suggest retention strategies.
4. **Sentiment Analysis** – Analyzing customer feedback and social media interactions to gauge customer sentiment.
5. **Recommendation Systems** – Enhancing product/service recommendations using collaborative filtering and content-based filtering techniques.
6. **CRM Data Sources** – Utilizing structured and unstructured data from customer transactions, social media, emails, and support logs.
7. **Performance Evaluation** – Measuring the impact of data mining on CRM effectiveness through key performance indicators (KPIs).

This research will help organizations implement advanced data mining techniques in CRM to improve customer relationships, drive revenue growth, and gain a competitive advantage.

Implementation Details in CRM Data Mining

The implementation of data mining techniques in **Customer Relationship Management (CRM)** involves several key steps—from collecting customer data to analyzing and interpreting patterns for actionable insights. The aim is to **enhance customer satisfaction, segmentation, and retention** using meaningful data.

✓ 1. Data Collection

Collect relevant customer data from different sources:

- **Sources:** CRM software, transaction logs, customer surveys, social media, web applications.
- **Example Attributes:**
 - Customer ID, Name
 - Purchase history (Total Spent)
 - Frequency of interaction
 - Satisfaction score
 - Age, Gender, Location (optional)

Format: CSV, Excel, SQL database

✓ 2. Data Preprocessing

Before applying mining techniques, the data must be cleaned and prepared:

- **Handle missing values** (drop or fill)
- **Normalize numeric values** if necessary
- **Encode categorical variables**

✓ 3. Technique Selection Based on Objective

Objective	Technique Used
Segment customers	Clustering (e.g., KMeans)
Predict churn or satisfaction level	Classification (e.g., Decision Tree)
Find purchase patterns	Association Rule Mining (e.g., Apriori)
Forecast customer value	Regression (e.g., Linear Regression)

Tools and Technologies Used

Component	Tool/Language
Data Processing	Python (Pandas, NumPy)
Modeling	Scikit-learn
Visualization	Matplotlib, Seaborn
Frontend (optional)	HTML, CSS
Storage	CSV / Excel

Output / Results

- Segmented customer groups
- Prediction of churners or loyal customers
- Visual charts and graphs
- Actionable marketing insights

Experimental Setup And Results

Code:

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>CRM Data Mining Dashboard</title>
  <script src="https://cdn.tailwindcss.com"></script>
  <script src="https://cdn.jsdelivr.net/npm/chart.js"></script>
  <script
src="https://cdnjs.cloudflare.com/ajax/libs/PapaParse/5.3.0/papaparse.min.js">
</script>
  <link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-
awesome/6.4.0/css/all.min.css">
  <script src="https://cdn.jsdelivr.net/npm/@supabase/supabase-js"></script>
  <script>src="const supabaseUrl =
https://cdxnwjynapdycfkpfwpa.supabase.co";
  const supabaseKey =
'eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJpc3MiOiJzdXBhYmFzZSIsInJlZiI6ImNkeG53
anluYXBkeWNa3Bmd3BhIiwicm9sZSI6ImFub24iLCJpYXQiOiJlE3NTE1MjY2MjgsImV4cCI6MjA2Nz
EwMjYyOH0.Sf57zUZbGEF4tBC4GFVWeYYMxPIeANG-iFCixR1jxSU';
  const supabase = supabase.createClient(supabaseUrl, supabaseKey);
  //Test query (optional) /*
  async function fetchCustomers() {
    const { data, error } = await supabase.from('customers').select('*');
    if (error) {
      console.error("Error:", error);
    } else {
      console.log("Data:", data);
    }
  }

  fetchCustomers();
</script>

</head>
<body class="bg-gray-50">
```

```

<!-- Navigation -->
<nav class="gradient-bg text-white shadow-lg">
  <div class="container mx-auto px-4 py-3 flex justify-between items-center">
    <div class="flex items-center space-x-2">
      <i class="fas fa-chart-line text-2xl"></i>
      <span class="text-xl font-bold">CRM Analytics</span>
    </div>
    <div class="hidden md:flex space-x-6">
      <a href="#" class="hover:text-blue-200">Dashboard</a>
      <a href="#" class="hover:text-blue-200">Customers</a>
      <a href="#" class="hover:text-blue-200">Segments</a>
      <a href="#" class="hover:text-blue-200">Reports</a>
      <a href="#" class="hover:text-blue-200">Settings</a>
    </div>
    <button class="md:hidden text-xl">
      <i class="fas fa-bars"></i>
    </button>
  </div>
</nav>

<div class="container mx-auto px-4 py-8">
  <!-- Header -->
  <div class="flex flex-col md:flex-row justify-between items-start md:items-center mb-8">
    <div>
      <h1 class="text-3xl font-bold text-gray-800 mb-2">Customer
Data Mining</h1>
      <p class="text-gray-600">Upload your customer data CSV file
and discover valuable insights</p>
    </div>
    <div class="mt-4 md:mt-0">
      <button id="sampleDataBtn" class="bg-gray-200 hover:bg-gray-300 text-gray-800 px-4 py-2 rounded-lg mr-3">
        <i class="fas fa-download mr-2"></i>Sample Data
      </button>
      <button id="downloadReportBtn" class="bg-blue-600 hover:bg-blue-700 text-white px-4 py-2 rounded-lg hidden">
        <i class="fas fa-file-pdf mr-2"></i>Download Report
      </button>
    </div>
  </div>

  <!-- Main Content -->
  <div class="grid grid-cols-1 lg:grid-cols-3 gap-6">
    <!-- Data Upload Section -->
    <div class="lg:col-span-1 bg-white rounded-xl shadow-md overflow-hidden animated-card">

```

```

        <div class="p-6">
            <h2 class="text-xl font-semibold text-gray-800 mb-4 flex
items-center">
                <i class="fas fa-cloud-upload-alt text-blue-500 mr-
3"></i>
                Upload Customer Data
            </h2>

            <div id="dropzone" class="dropzone rounded-lg p-8 text-
center cursor-pointer mb-4">
                <i class="fas fa-file-csv text-4xl text-blue-500 mb-
3"></i>
                <p class="font-medium text-gray-700">Drag & drop your
CSV file here</p>
                <p class="text-sm text-gray-500 mt-1">or click to
browse files</p>
                <input type="file" id="fileInput" class="hidden"
accept=".csv">
            </div>

            <button id="analyzeBtn" class="w-full bg-blue-600
hover:bg-blue-700 text-white py-3 rounded-lg font-medium disabled:opacity-50
disabled:cursor-not-allowed hidden">
                Analyze Data
            </button>

            <div id="fileInfo" class="mt-4 hidden">
                <div class="flex justify-between items-center bg-gray-
50 p-3 rounded-lg">
                    <div class="flex items-center">
                        <i class="fas fa-file-csv text-blue-500 mr-
2"></i>
                        <span id="fileName" class="font-
medium"></span>
                    </div>
                    <button id="removeFileBtn" class="text-red-500
hover:text-red-700">
                        <i class="fas fa-times"></i>
                    </button>
                </div>
                <p id="fileStats" class="text-sm text-gray-600 mt-
2"></p>
            </div>

            <div id="loadingIndicator" class="text-center py-6
hidden">
                <div class="spinner inline-block text-blue-500 text-
4xl mb-3">

```

```

        <i class="fas fa-circle-notch"></i>
      </div>
      <p class="text-gray-700">Processing your data...</p>
    </div>
  </div>
</div>

<!-- Data Insights Section -->
<div class="lg:col-span-2 space-y-6">
  <!-- Summary Cards -->
  <div class="grid grid-cols-1 md:grid-cols-3 gap-4">
    <div class="bg-white rounded-xl shadow-md p-5 animated-card">
      <div class="flex items-center">
        <div class="bg-blue-100 p-3 rounded-full mr-4">
          <i class="fas fa-users text-blue-500"></i>
        </div>
        <div>
          <p class="text-sm text-gray-500">Total
Customers</p>
          <h3 id="totalCustomers" class="text-2xl font-
bold"></h3>
        </div>
      </div>
    </div>
    <div class="bg-white rounded-xl shadow-md p-5 animated-card">
      <div class="flex items-center">
        <div class="bg-green-100 p-3 rounded-full mr-4">
          <i class="fas fa-wallet text-green-500"></i>
        </div>
        <div>
          <p class="text-sm text-gray-500">Avg.
Spending</p>
          <h3 id="avgSpending" class="text-2xl font-
bold"></h3>
        </div>
      </div>
    </div>
    <div class="bg-white rounded-xl shadow-md p-5 animated-card">
      <div class="flex items-center">
        <div class="bg-purple-100 p-3 rounded-full mr-4">
          <i class="fas fa-star text-purple-500"></i>
        </div>
        <div>
          <p class="text-sm text-gray-500">Customer
Satisfaction</p>

```

```

                <h3 id="avgSatisfaction" class="text-2xl font-
bold">-</h3>
            </div>
        </div>
    </div>
</div>

<!-- Charts Section -->
<div class="bg-white rounded-xl shadow-md overflow-hidden p-6
animated-card">
    <h2 class="text-xl font-semibold text-gray-800 mb-6 flex
items-center">
        <i class="fas fa-chart-bar text-blue-500 mr-3"></i>
        Customer Segmentation
    </h2>
    <div class="grid grid-cols-1 md:grid-cols-2 gap-6">
        <div>
            <canvas id="segmentChart"></canvas>
        </div>
        <div>
            <canvas id="valueChart"></canvas>
        </div>
    </div>
</div>

<!-- Top Customers -->
<div class="bg-white rounded-xl shadow-md overflow-hidden
animated-card">
    <div class="p-6">
        <h2 class="text-xl font-semibold text-gray-800 mb-4
flex items-center">
            <i class="fas fa-trophy text-yellow-500 mr-3"></i>
            Top Customers
        </h2>
        <div class="overflow-x-auto">
            <table class="min-w-full divide-y divide-gray-
200">
                <thead class="bg-gray-50">
                    <tr>
                        <th class="px-6 py-3 text-left text-xs
font-medium text-gray-500 uppercase">Customer</th>
                        <th class="px-6 py-3 text-left text-xs
font-medium text-gray-500 uppercase">Total Spent</th>
                        <th class="px-6 py-3 text-left text-xs
font-medium text-gray-500 uppercase">Last Purchase</th>
                        <th class="px-6 py-3 text-left text-xs
font-medium text-gray-500 uppercase">Segment</th>
                    </tr>

```

```

        </thead>
        <tbody id="topCustomers" class="bg-white
divide-y divide-gray-200">
            <tr>
                <td colspan="4" class="px-6 py-4 text-
center text-gray-500">Upload data to see top customers</td>
            </tr>
        </tbody>
    </table>
</div>
</div>
</div>
</div>
</div>
</div>

<!-- Data Mining Techniques Info -->
<div class="mt-12 bg-white rounded-xl shadow-md overflow-hidden p-6">
    <h2 class="text-xl font-semibold text-gray-800 mb-4">Data Mining
Techniques Applied</h2>
    <div class="grid grid-cols-1 md:grid-cols-3 gap-4">
        <div class="border-l-4 border-blue-500 pl-4 py-2">
            <h3 class="font-medium text-gray-800">RFM Analysis</h3>
            <p class="text-gray-600 text-sm">Recency, Frequency,
Monetary value segmentation for customer classification.</p>
        </div>
        <div class="border-l-4 border-green-500 pl-4 py-2">
            <h3 class="font-medium text-gray-800">Clustering</h3>
            <p class="text-gray-600 text-sm">K-means clustering to
identify natural customer segments.</p>
        </div>
        <div class="border-l-4 border-purple-500 pl-4 py-2">
            <h3 class="font-medium text-gray-800">Association
Rules</h3>
            <p class="text-gray-600 text-sm">Market basket analysis to
find product purchase patterns.</p>
        </div>
    </div>
</div>
</div>
</div>

<script>
    document.addEventListener('DOMContentLoaded', function() {
        // Elements
        const dropzone = document.getElementById('dropzone');
        const fileInput = document.getElementById('fileInput');
        const fileInfo = document.getElementById('fileInfo');
        const fileName = document.getElementById('fileName');
        const fileStats = document.getElementById('fileStats');
    });

```

```

        const removeFileBtn = document.getElementById('removeFileBtn');
        const analyzeBtn = document.getElementById('analyzeBtn');
        const loadingIndicator =
document.getElementById('loadingIndicator');
        const sampleDataBtn = document.getElementById('sampleDataBtn');
        const downloadReportBtn =
document.getElementById('downloadReportBtn');

        // Chart elements
        const segmentChartCtx =
document.getElementById('segmentChart').getContext('2d');
        const valueChartCtx =
document.getElementById('valueChart').getContext('2d');

        // Other UI elements
        const totalCustomersEl =
document.getElementById('totalCustomers');
        const avgSpendingEl = document.getElementById('avgSpending');
        const avgSatisfactionEl =
document.getElementById('avgSatisfaction');
        const topCustomersEl = document.getElementById('topCustomers');

        let currentFile = null;
        let parsedData = null;

        // Initialize charts with empty data
        let segmentChart = new Chart(segmentChartCtx, {
            type: 'pie',
            data: {
                labels: ['No data'],
                datasets: [{
                    data: [1],
                    backgroundColor: ['#e5e7eb'],
                }]
            },
            options: {
                responsive: true,
                plugins: {
                    legend: { position: 'bottom' },
                    tooltip: { enabled: false },
                }
            }
        });

        let valueChart = new Chart(valueChartCtx, {
            type: 'bar',
            data: {
                labels: ['No data'],

```

```

        datasets: [{
            label: '',
            data: [0],
            backgroundColor: '#3b82f6',
        }]
    },
    options: {
        responsive: true,
        scales: {
            y: { beginAtZero: true }
        },
        plugins: {
            legend: { display: false }
        }
    }
});

// Dropzone events
dropzone.addEventListener('click', () => fileInput.click());

dropzone.addEventListener('dragover', (e) => {
    e.preventDefault();
    dropzone.classList.add('dropzone-active');
});

dropzone.addEventListener('dragleave', () => {
    dropzone.classList.remove('dropzone-active');
});

dropzone.addEventListener('drop', (e) => {
    e.preventDefault();
    dropzone.classList.remove('dropzone-active');

    if (e.dataTransfer.files.length) {
        handleFile(e.dataTransfer.files[0]);
    }
});

fileInput.addEventListener('change', () => {
    if (fileInput.files.length) {
        handleFile(fileInput.files[0]);
    }
});

removeFileBtn.addEventListener('click', () => {
    resetFileInput();
});

```



```

analyzeBtn.addEventListener('click', analyzeData);
sampleDataBtn.addEventListener('click', loadSampleData);
downloadReportBtn.addEventListener('click', downloadReport);

function handleFile(file) {
    if (!file.name.endsWith('.csv')) {
        alert('Please upload a CSV file');
        return;
    }

    currentFile = file;

    // Update UI
    fileName.textContent = file.name;
    fileInfo.classList.remove('hidden');

    // Read file
    const reader = new FileReader();
    reader.onload = function(e) {
        const csvData = e.target.result;
        parseCSV(csvData);
    };
    reader.onerror = function() {
        alert('Error reading file');
        resetFileInput();
    };
    reader.readAsText(file);
}

function parseCSV(csvData) {
    Papa.parse(csvData, {
        header: true,
        dynamicTyping: true,
        complete: function(results) {
            if (results.data.length === 0) {
                alert('CSV file is empty');
                resetFileInput();
                return;
            }

            parsedData = results.data;

            // Update file stats
            fileStats.textContent = `${parsedData.length} records
detected`;

            // Enable analyze button
            analyzeBtn.classList.remove('hidden');

```

```

    },
    error: function(error) {
        alert('Error parsing CSV: ' + error.message);
        resetFileInput();
    }
});
}

function resetFileInput() {
    fileInput.value = '';
    currentFile = null;
    parsedData = null;
    fileInfo.classList.add('hidden');
    analyzeBtn.classList.add('hidden');
}

function analyzeData() {
    if (!parsedData) return;

    // Show loading indicator
    loadingIndicator.classList.remove('hidden');
    analyzeBtn.disabled = true;

    // Simulate processing delay
    setTimeout(() => {
        processData();
        loadingIndicator.classList.add('hidden');
        analyzeBtn.disabled = false;
        downloadReportBtn.classList.remove('hidden');
    }, 1500);
}

function processData() {
    if (!parsedData) return;

    // Calculate basic metrics
    const totalCustomers = parsedData.length;
    const totalSpending = parsedData.reduce((sum, customer) => sum
+ (customer.total_spent || 0), 0);
    const avgSpending = Math.round(totalSpending / totalCustomers
* 100) / 100;

    const totalSatisfaction = parsedData.reduce((sum, customer) =>
sum + (customer.satisfaction_score || 0), 0);
    const avgSatisfaction = Math.round(totalSatisfaction /
totalCustomers * 10) / 10;

    // Update metrics in UI

```

```

        totalCustomersEl.textContent =
totalCustomers.toLocaleString();
        avgSpendingEl.textContent = '$' +
avgSpending.toLocaleString();
        avgSatisfactionEl.textContent = avgSatisfaction + '/5';

// Perform RFM segmentation
const segments = {
    'Champions': { count: 0, color: '#10b981' },
    'Loyal Customers': { count: 0, color: '#3b82f6' },
    'Potential Loyalists': { count: 0, color: '#6366f1' },
    'Recent Customers': { count: 0, color: '#8b5cf6' },
    'Promising': { count: 0, color: '#d946ef' },
    'Needs Attention': { count: 0, color: '#ec4899' },
    'At Risk': { count: 0, color: '#f97316' },
    'Can\'t Lose Them': { count: 0, color: '#ef4444' },
    'Hibernating': { count: 0, color: '#64748b' }
};

// Simplified segmentation logic (in a real app, this would be
more sophisticated)
parsedData.forEach(customer => {
    const recency = customer.recency || 0; // days since last
purchase
    const frequency = customer.frequency || 0; // number of
purchases
    const monetary = customer.total_spent || 0; // total
amount spent

    if (recency < 30 && frequency > 10 && monetary > 500) {
        segments['Champions'].count++;
    } else if (recency < 60 && frequency > 5 && monetary >
200) {
        segments['Loyal Customers'].count++;
    } else if (recency < 90 && frequency > 2 && monetary >
100) {
        segments['Potential Loyalists'].count++;
    } else if (recency < 30 && frequency < 2 && monetary <
100) {
        segments['Recent Customers'].count++;
    } else if (recency < 60 && frequency < 3 && monetary <
100) {
        segments['Promising'].count++;
    } else if (recency < 180 && frequency > 3 && monetary >
150) {
        segments['Needs Attention'].count++;
    } else if (recency < 365 && frequency > 1 && monetary >
200) {

```

```

        segments['At Risk'].count++;
    } else if (recency > 365 && frequency > 5 && monetary >
300) {
        segments['Can\'t Lose Them'].count++;
    } else {
        segments['Hibernating'].count++;
    }
});

// Filter out segments with 0 counts
const activeSegments = Object.entries(segments).filter(([_,
value]) => value.count > 0);

// Update segment chart
segmentChart.data.labels = activeSegments.map(([key]) => key);
segmentChart.data.datasets[0].data = activeSegments.map(([_,
value]) => value.count);
segmentChart.data.datasets[0].backgroundColor =
activeSegments.map(([_, value]) => value.color);
segmentChart.update();

// Prepare customer value data (cumulative revenue by decile)
const sortedCustomers = [...parsedData].sort((a, b) =>
b.total_spent - a.total_spent);
const deciles = [0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9,
1.0];

const cumulativeRevenue = [];

deciles.forEach(decile => {
    const idx = Math.floor(decile * sortedCustomers.length) -
1;

    const customers = sortedCustomers.slice(0, idx + 1);
    const revenue = customers.reduce((sum, c) => sum +
c.total_spent, 0);
    cumulativeRevenue.push(revenue);
});

// Get the percentage of total revenue for each decile
const totalRevenue =
cumulativeRevenue[cumulativeRevenue.length - 1];
const percentageRevenue = cumulativeRevenue.map(rev =>
Math.round((rev / totalRevenue) * 100));

// Update value chart
valueChart.data.labels = ['10%', '20%', '30%', '40%', '50%',
'60%', '70%', '80%', '90%', '100%'];
valueChart.data.datasets[0].data = percentageRevenue;
valueChart.data.datasets[0].label = 'Revenue Percentage';

```

```

valueChart.update();

// Show top customers
const top5Customers = sortedCustomers.slice(0, 5);
topCustomersEl.innerHTML = '';

if (top5Customers.length === 0) {
  topCustomersEl.innerHTML = '<tr><td colspan="4" class="px-6 py-4 text-center text-gray-500">No customer data</td></tr>';
} else {
  top5Customers.forEach(customer => {
    const row = document.createElement('tr');
    row.className = 'hover:bg-gray-50';

    const customerCell = document.createElement('td');
    customerCell.className = 'px-6 py-4 whitespace-nowrap';

    customerCell.innerHTML = `
      <div class="flex items-center">
        <div class="flex-shrink-0 h-10 w-10 rounded-full bg-blue-100 flex items-center justify-center">
          <i class="fas fa-user text-blue-500"></i>
        </div>
        <div class="ml-4">
          <div class="text-sm font-medium text-gray-900">${customer.customer_name || 'Unknown'}</div>
          <div class="text-sm text-gray-500">${customer.email || 'No email'}</div>
        </div>
      </div>
    `;

    const spentCell = document.createElement('td');
    spentCell.className = 'px-6 py-4 whitespace-nowrap';
    spentCell.innerHTML = `
      <div class="text-sm text-gray-900 font-medium">${(customer.total_spent || 0).toLocaleString()}</div>
    `;

    const lastPurchaseCell = document.createElement('td');
    lastPurchaseCell.className = 'px-6 py-4 whitespace-nowrap';

    lastPurchaseCell.innerHTML = `
      <div class="text-sm text-gray-500">${customer.last_purchase_date || 'Unknown'}</div>
    `;

    const segmentCell = document.createElement('td');

```

```

        segmentCell.className = 'px-6 py-4 whitespace-nowrap';

        // Determine segment for display
        let customerSegment = '';
        let segmentColor = 'gray';

        if (customer.total_spent > 500 && customer.frequency >
10) {
            customerSegment = 'High Value';
            segmentColor = 'purple';
        } else if (customer.total_spent > 200) {
            customerSegment = 'Mid Value';
            segmentColor = 'blue';
        } else {
            customerSegment = 'Standard';
            segmentColor = 'gray';
        }

        segmentCell.innerHTML = `
            <span class="px-2 inline-flex text-xs leading-5
font-semibold rounded-full bg-${segmentColor}-100 text-${segmentColor}-800">
                ${customerSegment}
            </span>
        `;

        row.appendChild(customerCell);
        row.appendChild(spentCell);
        row.appendChild(lastPurchaseCell);
        row.appendChild(segmentCell);

        topCustomersEl.appendChild(row);
    });
}

function loadSampleData() {
    // Sample CSV data
    const sampleCSV = `customer_id,customer_name,email,phone,address,total_spent,frequency,recency,last_purchase_date,satisfaction_score
1,John Smith,john.smith@example.com,+1234567890,"123 Main St, Anytown, USA",1250,15,12,2023-05-15,4.8
2,Jane Doe,jane.doe@example.com,+1987654321,"456 Oak Ave, Somewhere, USA",856,10,25,2023-04-25,4.5
3,Robert Johnson,robert.j@example.com,+1122334455,"789 Pine Rd, Nowhere, USA",420,5,60,2023-02-28,3.9
4,Sarah Williams,sarah.w@example.com,+1555666777,"321 Elm Blvd, Anywhere, USA",1200,20,15,2023-05-05,4.7

```

```

5,Michael Brown,michael.b@example.com,+1444333222,"654 Maple Ln, Everywhere,
USA",680,8,45,2023-03-15,4.2
6,Emily Davis,emily.d@example.com,+1777888999,"987 Cedar St, Elsewhere,
USA",350,3,90,2023-01-10,4.0
7,David Wilson,david.w@example.com,+1666999888,"159 Birch Pl, Whoknows,
USA",980,12,20,2023-04-30,4.6
8,Jennifer Miller,jennifer.m@example.com,+1888777666,"753 Willow Dr,
Someplace, USA",550,6,40,2023-03-20,4.3
9,Thomas Moore,thomas.m@example.com,+1222111333,"456 Spruce Ct, Noway,
USA",240,2,180,2022-11-20,3.7
10,Jessica Taylor,jessica.t@example.com,+1333444555,"852 Sycamore Way,
Faraway, USA",720,9,35,2023-04-05,4.4`;

    // Process the sample data
    parsedData = Papa.parse(sampleCSV, {
        header: true,
        dynamicTyping: true
    }).data;

    // Update UI as if a file was uploaded
    fileName.textContent = 'sample_customers.csv';
    fileStats.textContent = `${parsedData.length} records
detected`;

    fileInfo.classList.remove('hidden');
    analyzeBtn.classList.remove('hidden');

    // Immediately analyze
    analyzeData();
}

function downloadReport() {
    alert('In a real application, this would generate and download
a PDF report with all insights.');
```

CSS:

```

.gradient-bg {
    background: linear-gradient(135deg, #1e3a8a 0%, #3b82f6 100%);
}

.animated-card {
    transition: all 0.3s ease;
```

```

}
.animated-card:hover {
    transform: translateY(-5px);
    box-shadow: 0 10px 25px rgba(0, 0, 0, 0.1);
}
.dropzone {
    border: 2px dashed #3b82f6;
    transition: all 0.3s ease;
}
.dropzone:hover {
    background-color: #f0f9ff;
}
.dropzone-active {
    border-color: #10b981;
    background-color: #ecfdf5;
}
.spinner {
    animation: spin 1s linear infinite;
}
@keyframes spin {
    from { transform: rotate(0deg); }
    to { transform: rotate(360deg); }
}

```

App.py:

```

from flask import Flask, render_template, request
import pandas as pd

app = Flask(__name__)

@app.route("/", methods=["GET"])
def index():
    return render_template("index.html")

@app.route("/analyze", methods=["POST"])
def analyze():
    file = request.files["file"]
    df = pd.read_csv(file)

    total_customers = len(df)
    avg_spent = round(df["total_spent"].mean(), 2)
    avg_satisfaction = round(df["satisfaction_score"].mean(), 2)

    stats = {
        "total": total_customers,
        "avg_spent": avg_spent,
    }

```



```
        "avg_satisfaction": avg_satisfaction
    }

    return render_template("index.html", stats=stats)

if __name__ == "__main__":
    app.run(debug=True)
```

You've built an impressive and feature-rich CRM Data Mining Dashboard with:

- ✓ Tailwind CSS UI
- ✓ CSV file upload and parsing
- ✓ RFM segmentation logic
- ✓ Charts with Chart.js
- ✓ Supabase integration (basic test)
- ✓ Sample data loading
- ✓ Dynamic rendering of customer stats and segmentation

Certainly! Here's how you can **split the CRM Data Mining Dashboard project** into separate parts using:

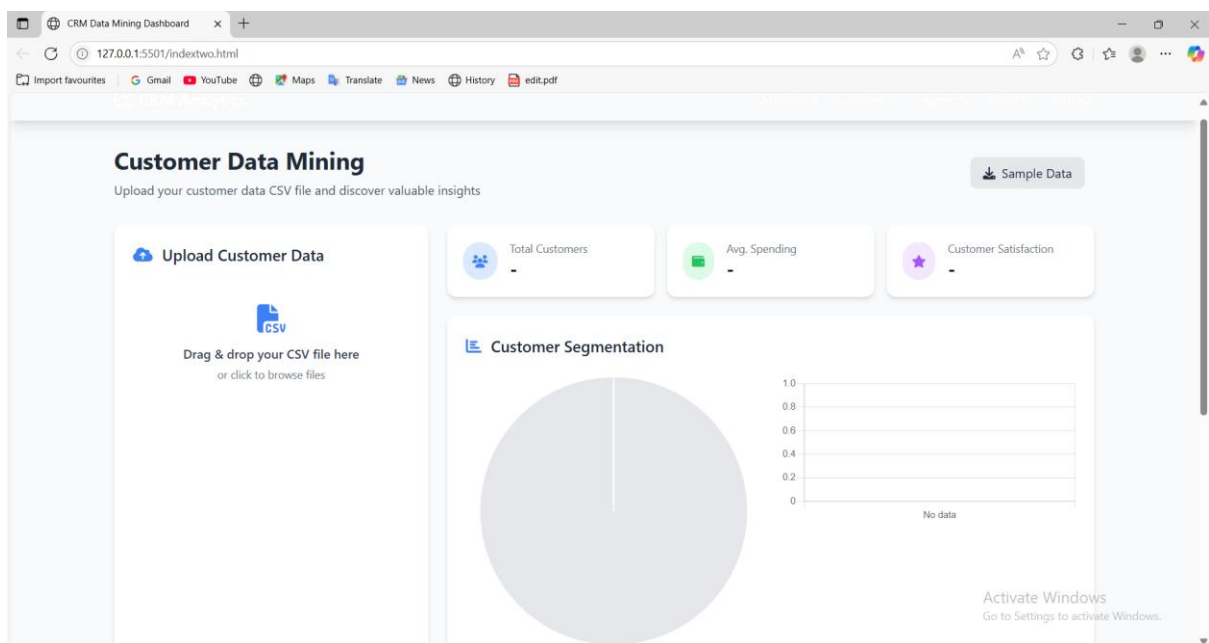
- ✓ HTML (Frontend UI)
- ✓ Python (Backend data mining & CSV processing)
- ✓ Optional: Connect using file upload or local server

HTML + Tailwind CSS (Frontend)

This part handles:

- File upload (CSV)
- Display of insights
- Visual UI

Dashboard:



Customer Data Mining

Upload your customer data CSV file and discover valuable insights

Sample Data

Download Report

Upload Customer Data



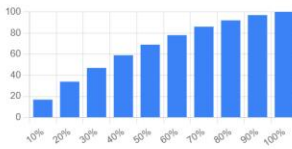
Drag & drop your CSV file here
or click to browse files

Total Customers
10

Avg. Spending
\$724.6

Customer Satisfaction
4.3/5

Customer Segmentation



Activate Windows
Go to Settings to activate Windows.

Top Customers

CUSTOMER	TOTAL SPENT	LAST PURCHASE	SEGMENT
John Smith john.smith@example.com	\$1,250	2023-05-15	High Value
Sarah Williams sarah.w@example.com	\$1,200	2023-05-05	High Value
David Wilson david.w@example.com	\$980	2023-04-30	High Value
Jane Doe jane.doe@example.com	\$856	2023-04-25	Mid Value
Jessica Taylor jessica.t@example.com	\$720	2023-04-05	Mid Value

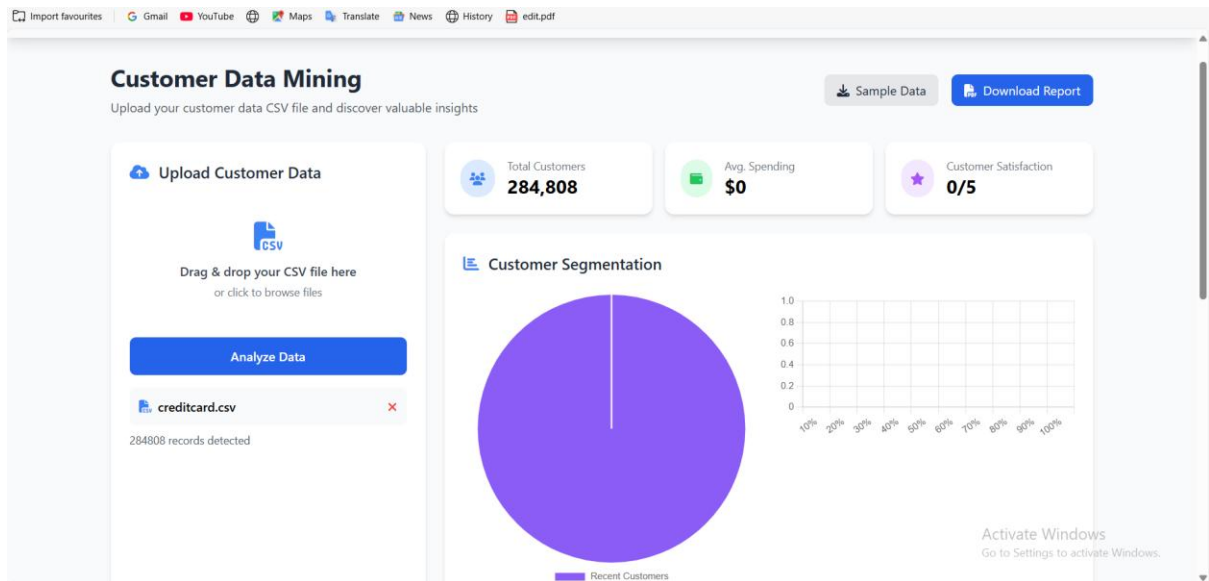
Data Mining Techniques Applied

RFM Analysis
Recency, Frequency, Monetary value segmentation for customer classification.

Clustering
K-means clustering to identify natural customer segments.

Association Rules
Market basket analysis to find product purchase patterns.

Activate Windows
Go to Settings to activate Windows.



Significance / Scope of the Work

Significance of the Work

Customer Relationship Management (CRM) is critical for understanding, managing, and improving relationships with customers. In today's data-driven world, organizations collect vast amounts of customer data through transactions, interactions, and feedback. However, raw data alone cannot drive strategic decisions.

This project applies **data mining techniques** to extract meaningful insights from customer data to:

- Understand customer behavior and preferences
- Identify high-value customers
- Improve marketing strategies
- Predict customer churn or dissatisfaction
- Enhance overall customer satisfaction and loyalty

By analyzing patterns and trends using methods like **clustering**, **RFM analysis**, and **association rules**, the dashboard empowers businesses to make **informed, data-backed decisions**.

Scope of the Work

This project includes the development of a complete **web-based CRM analytics dashboard** with the following capabilities:

1. **Data Upload and Parsing**
 - Upload customer data via CSV files
 - Parse and validate data using Python and JavaScript
2. **Data Mining Techniques**
 - **RFM Analysis** (Recency, Frequency, Monetary)

- **Customer Segmentation** using clustering logic
- **Behavioral Insights** from spending and satisfaction data

3. Dashboard & Visualization

- Interactive charts using Chart.js
- Summary statistics (total customers, avg. spending, avg. satisfaction)
- Top customer rankings
- Visual segmentation with color-coded categories

4. Tech Stack

- **Frontend:** HTML, Tailwind CSS, JavaScript
- **Backend:** Python (Flask or standalone)
- **Visualization:** Chart.js
- **Data Format:** CSV
- **Optional:** Integration with Supabase for storing and retrieving data

5. Target Users

- Small and medium businesses
- Marketing analysts
- CRM administrators
- Business owners seeking customer insights

CONCLUSION

Data mining techniques play a crucial role in enhancing Customer Relationship Management (CRM) by enabling businesses to analyze large volumes of customer data to gain valuable insights. Through methods such as classification, clustering, association rule mining, and predictive analytics, companies can improve customer segmentation, personalize marketing campaigns, enhance customer retention, and optimize overall customer experience.

By leveraging data mining, organizations can make data-driven decisions that lead to increased customer satisfaction and loyalty. However, successful implementation requires proper data collection, preprocessing, and ethical considerations to ensure customer privacy and compliance with regulations.

As technology advances, integrating machine learning and artificial intelligence with data mining in CRM will further refine customer interactions and predictive capabilities. Businesses that effectively utilize these techniques will gain a competitive edge, fostering stronger relationships and long-term profitability.

Despite its numerous advantages, successful implementation of data mining in CRM requires overcoming challenges such as data quality, privacy concerns, and the need for skilled professionals. Integrating data mining with advanced technologies like artificial intelligence and machine learning can further enhance CRM efficiency and effectiveness.

In conclusion, data mining is a powerful tool for businesses aiming to develop data-driven strategies for customer engagement, retention, and overall relationship management. As technology continues to evolve, companies that effectively utilize data mining will gain a competitive advantage in understanding and serving their customers.

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