# Case study round submission guidelines

- Follow this template while working on your submission
- Keep your submission under 10 slides maximum (excluding slides 1 & 2)
- Download these slides as a PDF for submission. Only PDF format will be accepted
- Save your file in this name format: Name_University_YearofGrad
- (e.g. BabarAzam_IBA_2025)
- Be creative and have fun!

# Evaluation Criteria

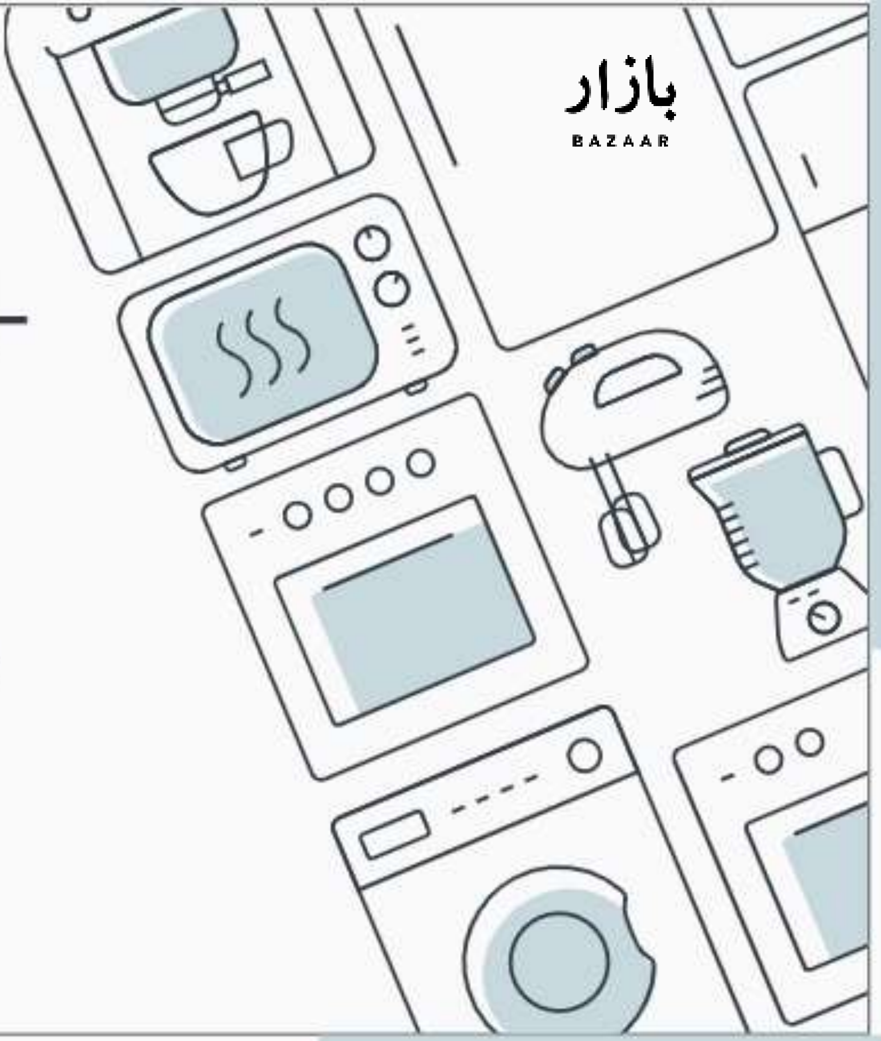
- **Clarity & Structure:** Presenting ideas in a logical and easy-to-follow manner.
- **Understanding the Numbers**: Being able to pull valuable insights from the key metrics and KPIs we're tracking.
- **Practical Steps for Improvement:** Coming up with actionable strategies that we can realistically implement to move forward.
- **Conciseness:** Keeping things clear, simple, and to the point without unnecessary fluff.
- **Impact - Driven:** At Bazaar, Every move we make is about creating meaningful change and making a real difference.

# Muhammad Hammad Raza - IT Student | Full-Stack Developer Aspirant

Join Muhammad Hammad Raza as he explores innovative backend development strategies for Kiryana Stores, showcasing insights from his academic journey at Bahria University Karachi Campus.

**Hammad Raza**

Presentation Designer



# Meet Muhammad Hammad Raza

Insights into Muhammad Hammad Raza's journey

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### Background

Hammad is a 21-year-old pursuing a BS in Information Technology at BUKC.

### Passion for Development

He is particularly passionate about backend development and automation.

### Technical Skills

Skilled in Python, Flask, Django, C/C++, Java, SQL, and Web Development.

### Leadership Achievement

Led his team to victory in the Federal Board Cricket Tournament.

### Problem-Solving Mindset

Hammad enjoys solving real-world problems with intelligent systems.

# Efficient Inventory Tracking Solutions

Understanding the Inventory Management Problem

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1

### Inventory Tracking Challenges

Kiryana stores face significant issues in tracking inventory as they scale.

2

### Backend Solution Requirements

Bazaar Technologies needs a backend that starts simple yet scales effectively across thousands of stores.

3

### System Functionality

The system should handle product stock-ins, sales, removals, and generate filtered reports.

4

### Authentication and Scalability

Focus on authentication and scalability to ensure secure and efficient operations.

## Progressive Scaling in System Design

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- **Stage 1: Initial CLI/API**

  Developed a single store CLI/API utilizing local storage for simplicity.

- **Stage 2: Database Integration**

  Implemented PostgreSQL DB for multi-store functionality with RESTful API and authentication.

- **Stage 3: Advanced Features**

  Introduced async updates, API caching, audit logs, and rate limiting for enhanced performance.

- **Focus on Modular Design**

  Emphasized a modular architecture to facilitate future scalability and maintainability.

- **Performance Optimization**

  Prioritized performance improvements to ensure efficient data processing and retrieval.

- **Data Consistency Assurance**

  Maintained strong data consistency across stages to support reliable operations.

# Core Technologies for Backend Development

Overview of Technologies for Backend Solutions

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- **Programming Language: Python**

  Utilizes Python for its simplicity and versatility in backend development.

- **Framework: Flask**

  Employs Flask as a lightweight framework for building web applications efficiently.

- **Database: PostgreSQL**

  Integrates PostgreSQL for robust, reliable data storage and management.

- **ORM: SQLAlchemy**

  Uses SQLAlchemy for seamless database interaction through an Object-Relational Mapping approach.

- **Security: Flask-HTTPAuth**

  Implements Flask-HTTPAuth to secure API endpoints with authentication mechanisms.

- **Caching: Flask-Caching**

  Incorporates Flask-Caching to enhance performance by caching data and responses.

- **Rate Limiting: Flask-Limiter**

  Employs Flask-Limiter to control API request rates and prevent abuse.

- **Testing: Postman**

  Utilizes Postman for comprehensive testing and documentation of APIs.

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# API Endpoints for Store Management

Explore essential API endpoints for management tasks

- **POST /store**

  This endpoint allows users to add a new store to the system.

- **POST /product**

  Users can add a new product using this API endpoint.

- **POST /stock**

  This endpoint facilitates stock-in, sales, or stock removal operations.

- **GET /inventory**

  View the inventory of a specific store, with data cached for performance.

- **GET /movements**

  Generate a stock movement report filtered by date for a specified store.

# Progress on Backend Features Implementation

Overview of features across development stages

| Stage | Features |
|---|---|
| Stage 1 | Single store CLI with SQLite |
| Stage 2 | Multi-store with PostgreSQL, REST API, authentication |
| Stage 3 | Asynchronous updates, caching, rate limiting, audit logs |

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## Strategic Design Decisions for Backend

- **Threading for Async Updates**
  Implemented threading to efficiently simulate asynchronous stock updates, improving responsiveness.
- **Flask-Caching for API**
  Utilized Flask-Caching to cache GET inventory API responses, enhancing performance and reducing server load.
- **SQL Timestamp Logging**
  Employed SQL timestamps to accurately log each stock movement, ensuring reliable transaction history.
- **Basic Authentication Added**
  Introduced Basic Authentication to secure API endpoints, protecting sensitive data from unauthorized access.
- **Rate Limiting Implemented**
  Implemented rate limiting to mitigate spam and abuse, safeguarding system resources and enhancing stability.

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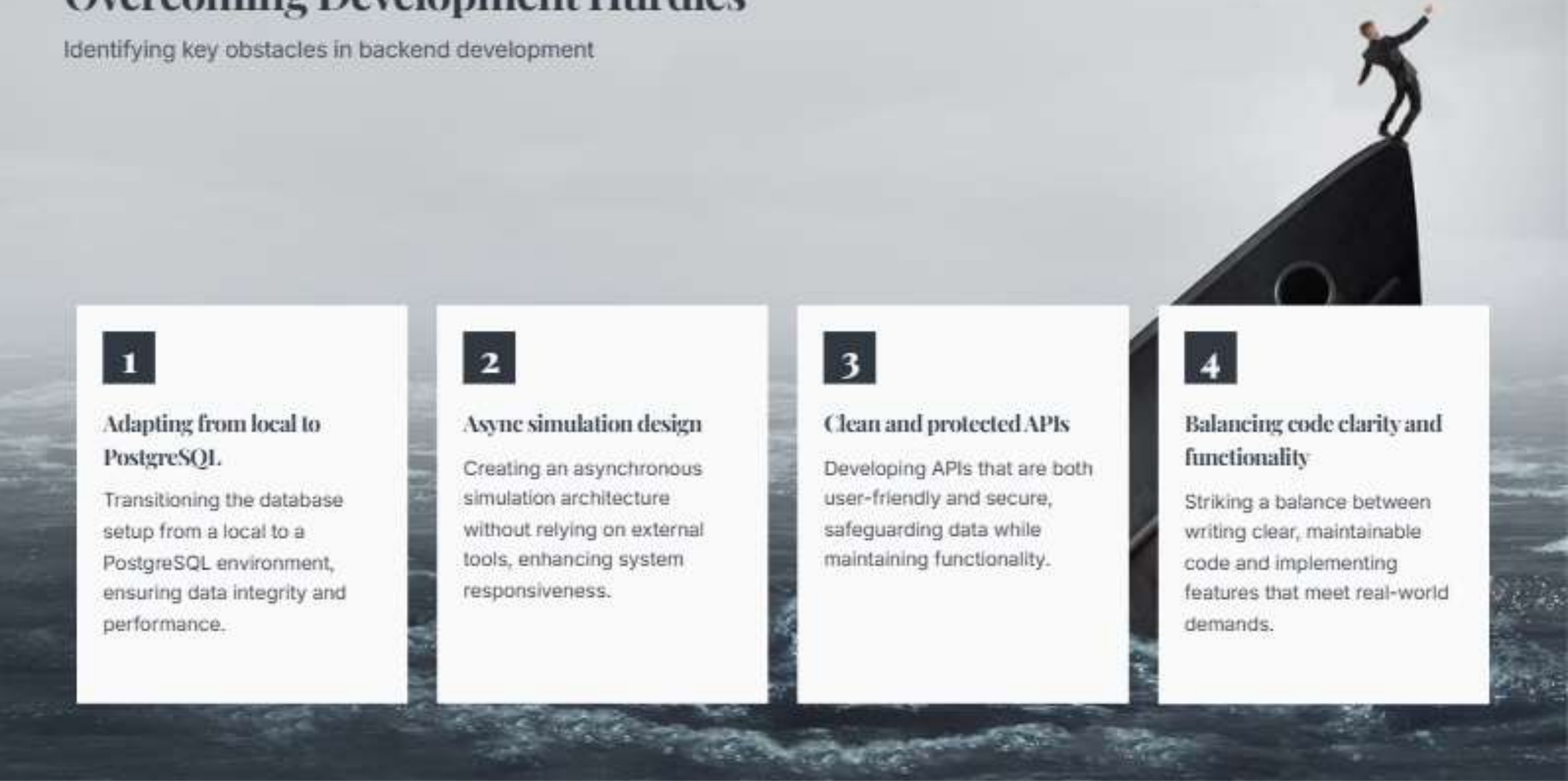
## Overcoming Development Hurdles

Identifying key obstacles in backend development



**1**

### Adapting from local to PostgreSQL

Transitioning the database setup from a local to a PostgreSQL environment, ensuring data integrity and performance.

**2**

### Async simulation design

Creating an asynchronous simulation architecture without relying on external tools, enhancing system responsiveness.

**3**

### Clean and protected APIs

Developing APIs that are both user-friendly and secure, safeguarding data while maintaining functionality.

**4**

### Balancing code clarity and functionality

Striking a balance between writing clear, maintainable code and implementing features that meet real-world demands.

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## Future Enhancements for Kiryana Stores

Strategic enhancements for improved functionality

- **Frontend Dashboard Development**
  Create an intuitive dashboard for store owners to manage operations effectively.
- **Implement Message Queues**
  Use RabbitMQ or Celery instead of threading for better task management and performance.
- **Role-Based Access Control**
  Establish different user roles like store admin and viewer for enhanced security.
- **Containerization with Docker**
  Utilize Docker and Gunicorn to streamline deployment and improve scalability.
- **Quality Assurance Implementation**
  Add unit tests and monitoring tools to ensure system reliability and performance.

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## Final Words of Gratitude and Ambition

Thank you for considering my submission *This project enhanced my coding and system design skills. I look forward to growing with Bazaar Technologies.*