# Intelligent Agents in AI-based Fitness Data Analysis Systems

**Module**: Intelligent Agents

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# Project Objective

**Develop an AI-based fitness data analysis system**

Leverages a multi-agent architecture

Supports anomaly detection and personalized monitoring

Identifies unusual patterns in fitness data

# System Architecture

| | |
|---|---|
| Data Retrieval | Collects fitness information |
| Validation | Ensures data quality |
| AI Analysis | Processes and interprets data |
| Reporting | Presents insights to users |
| Security | Protects user data and system integrity |

Emphasis on modular, secure communication between agents

# Technologies and Methods

| | |
|---|---|
| **Python Ecosystem** | • sklearn<br>• seaborn<br>• pandas |
| **Data Sources** | Fitbit API for real-time data |
| **AI Techniques** | • Isolation Forest for anomaly detection<br>• Feature engineering for AI insight |
| **System Design** | Hybrid edge-cloud system |

# Data Preparation & Feature Engineering

## Data Cleaning

Removed 11,728 duplicates
Cleaned and formatted date fields

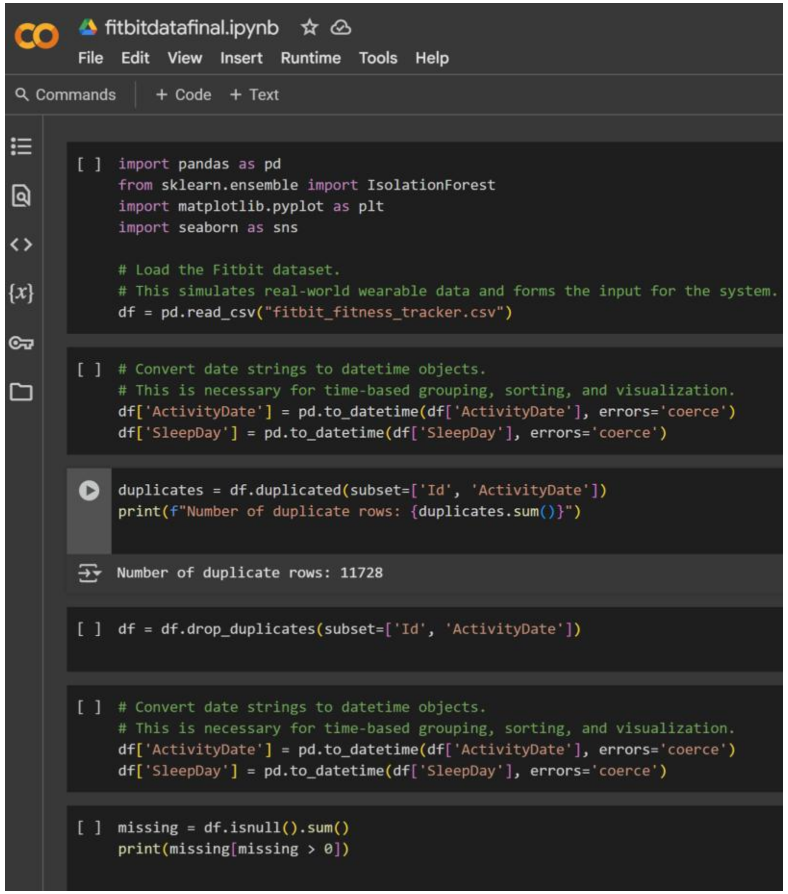
Dropped missing values

## Feature Creation

Sleep Efficiency

Activity Ratio

Calories per Step




**Visual examples**

# Anomaly Detection

## Algorithm Selection

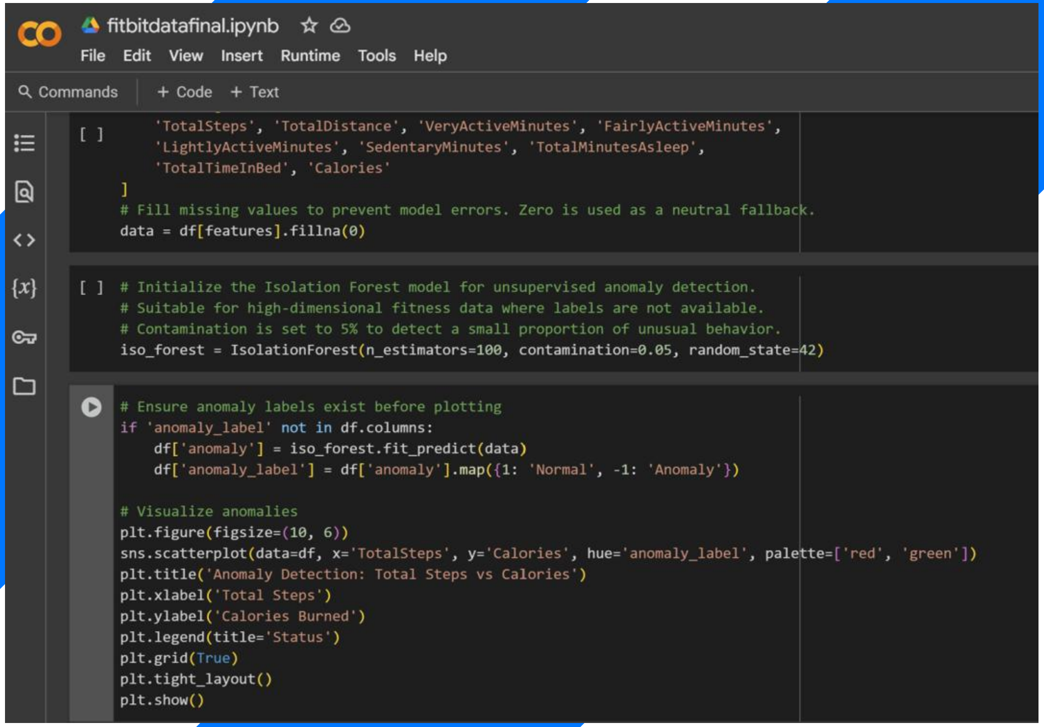
Used Isolation Forest (unsupervised)

## Data Labeling

Labeled data as "Normal" or "Anomaly"

## Model Training

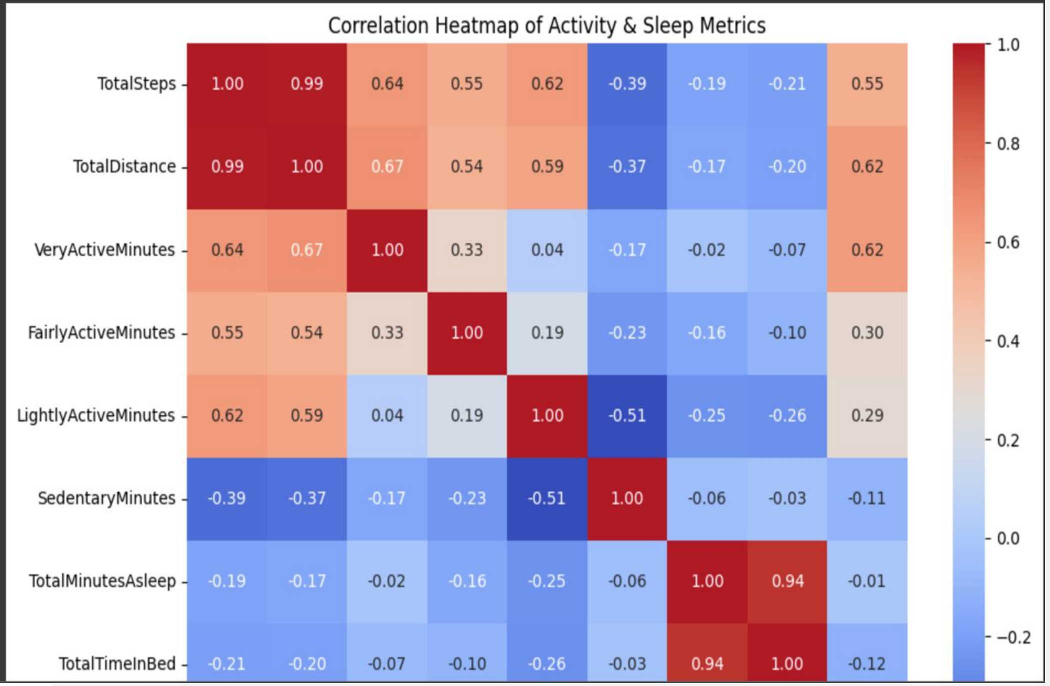
Trained on 9 features including engineered ones




Visual examples

# Correlation Between Key Metrics

```
[ ] #  Correlation Heatmap of Key Features
    plt.figure(figsize=(10, 8))
    corr = df[features].corr()
    sns.heatmap(corr, annot=True, cmap='coolwarm', fmt='.2f')
    plt.title('Correlation Heatmap of Activity & Sleep Metrics')
    plt.tight_layout()
    plt.show()
```




**Visual examples**

**Correlations confirm expected links between activity metrics.**

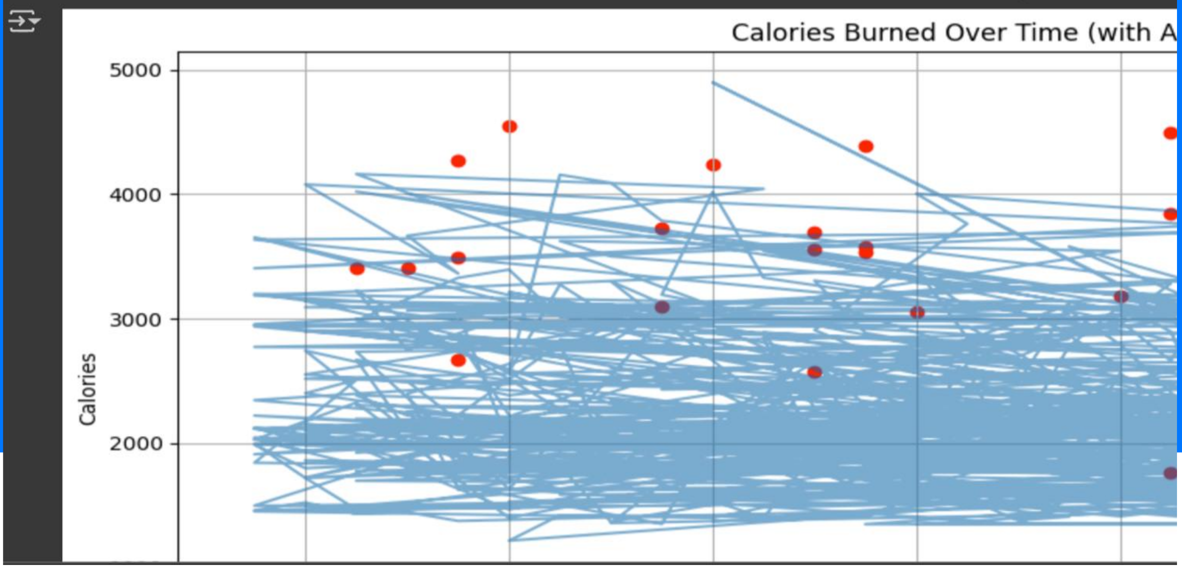
**Weak ties with sleep and sedentary behavior highlight distinct patterns.**

**These insights informed balanced feature selection for better anomaly detection.**

# Calories Burned Over Time

```
[ ]  #  Calories Burned Over Time with Anomaly Highlights
     plt.figure(figsize=(12, 6))
     normal = df[df['anomaly_label'] == 'Normal']
     anomalies = df[df['anomaly_label'] == 'Anomaly']

     plt.plot(normal['ActivityDate'], normal['Calories'], label='Normal', alpha=0.6)
     plt.scatter(anomalies['ActivityDate'], anomalies['Calories'], color='red', label='Anomaly')
     plt.title('Calories Burned Over Time (with Anomalies)')
     plt.xlabel('Date')
     plt.ylabel('Calories')
     plt.legend()
     plt.grid(True)
     plt.tight_layout()
     plt.show()
```




Visual examples

Most days show consistent calorie burn, while anomalies (red dots) reveal outliers due to skipped workouts or extreme effort.

These insights help identify irregular behavior and enhance user feedback through intelligent agent alerts.

# Testing and Challenges

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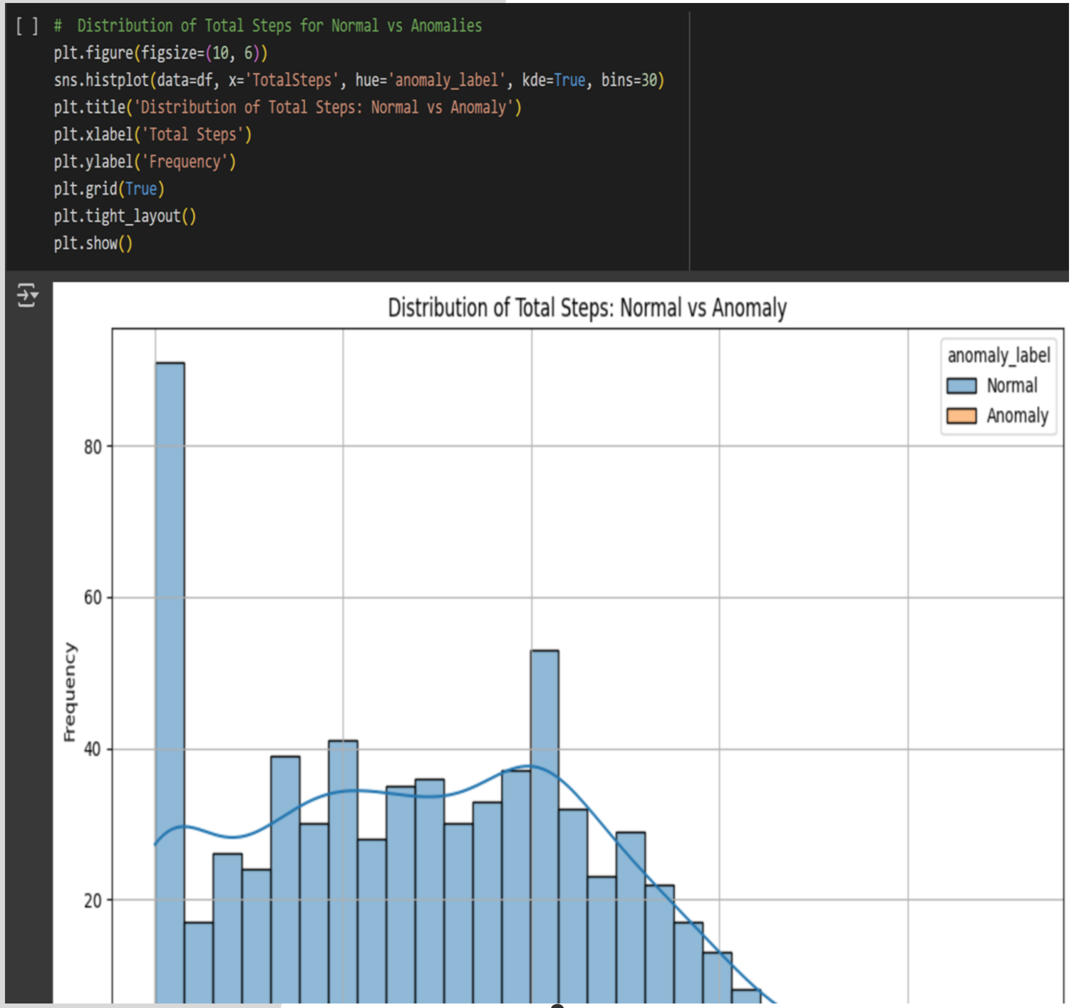


Visual examples

# Conclusion & Reflection

## Key Achievements

AI + agents = smart fitness monitoring

Modular and secure design

Effective data cleaning and modeling

## Future Plan

Add UI

Multi-device integration

Advanced personal insights

# Thanks

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# References:


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- **Henry, E. (2022).** *FitBit Fitness Tracker Dataset*. Available at: https://www.kaggle.com/datasets/ezechukwunonsohenry/fitbit-fitness-tracker-dataset (Accessed: 6 April 2025).