Improving Employee Retention by Predicting Employee Attrition

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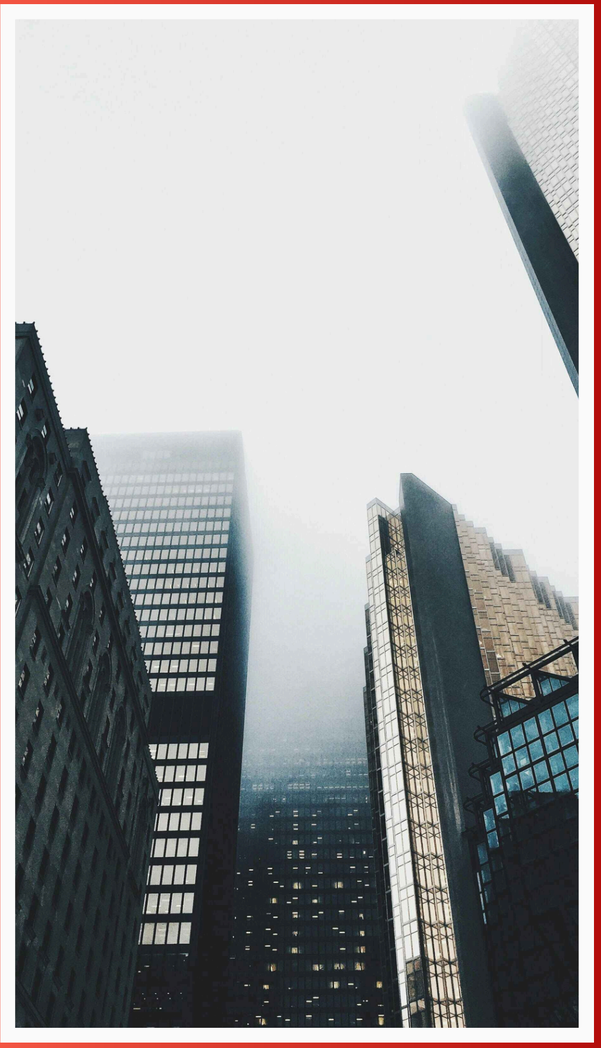
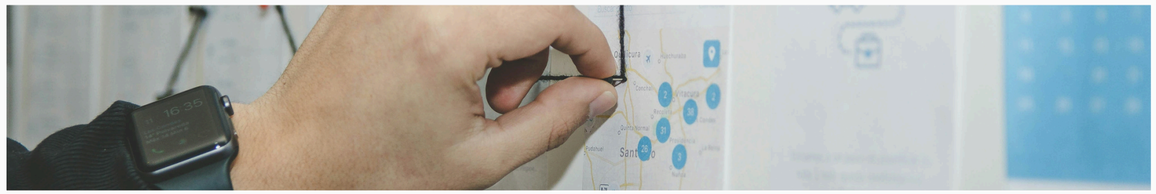


Problem & Objectives



Problem Statement

The organization struggles with **high employee turnover**, leading to **costly recruitment** and **lost productivity**. Attrition also **harms team morale and cohesion**. A lack of data-driven insight into why employees leave makes retention efforts mostly reactive.

Goal

To **reduce the overall employee turnover rate by 15%** within the **next 18 months** by developing and fully implementing a **predictive, data-driven retention framework** that proactively identifies at-risk employees and enables targeted intervention strategies

Objectives

- Analyze **key variables** to identify **top predictors of attrition**
- Build a **machine learning model** to **assign attrition risk scores** to employees
- Translate insights into **actionable HR recommendations** to improve culture, growth, and satisfaction

Success Metrics

-15%

Attrition Rate

Compared to the previous period (resignations)

+15%

Employee Engagement Score

Target increase from previous period

Dataset Overview

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Dataset Summary

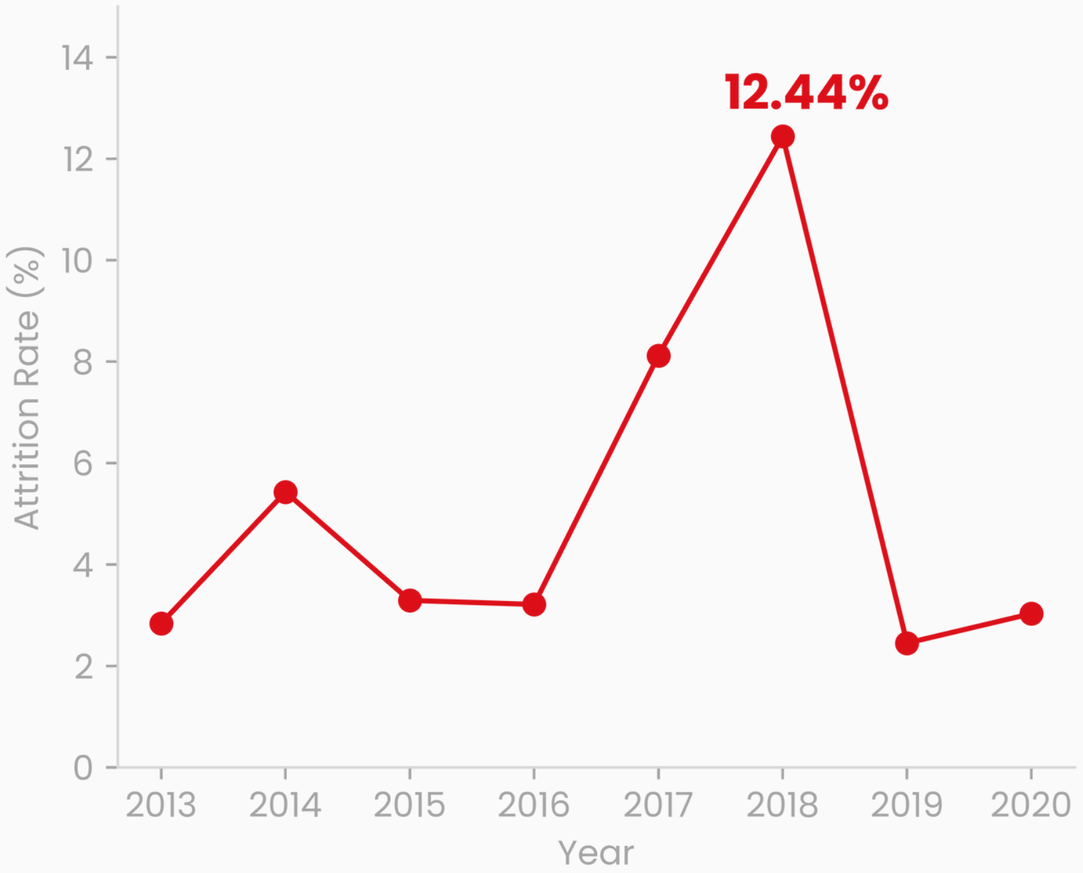
- Total Employees: 287
- Resigned Employees: 89
- Hiring Period: Jan 2006 – Jul 2018
- Resignation Period: May 2013 – Sep 2020

Features

- Demographics: Gender, Marital Status, Region
- Employment Info: Job Role, Career Track, Hiring Platform
- Scores: Engagement Score, Satisfaction Score, Project Count
- Behavioral Data: Absences, Late Arrivals, Resignation Reason

Source Data

The 2018 Crisis



Product Manager

Severe attrition in a strategic role signals leadership instability

Long Working Hours

Most cited reason for leaving indicates unsustainable workload

Website

Highest attrition source shows gap between employer branding and reality

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April Attrition Spike

8.2%

High-performing employees resigned during this period

14.3%

Employees with low engagement were more likely to resign

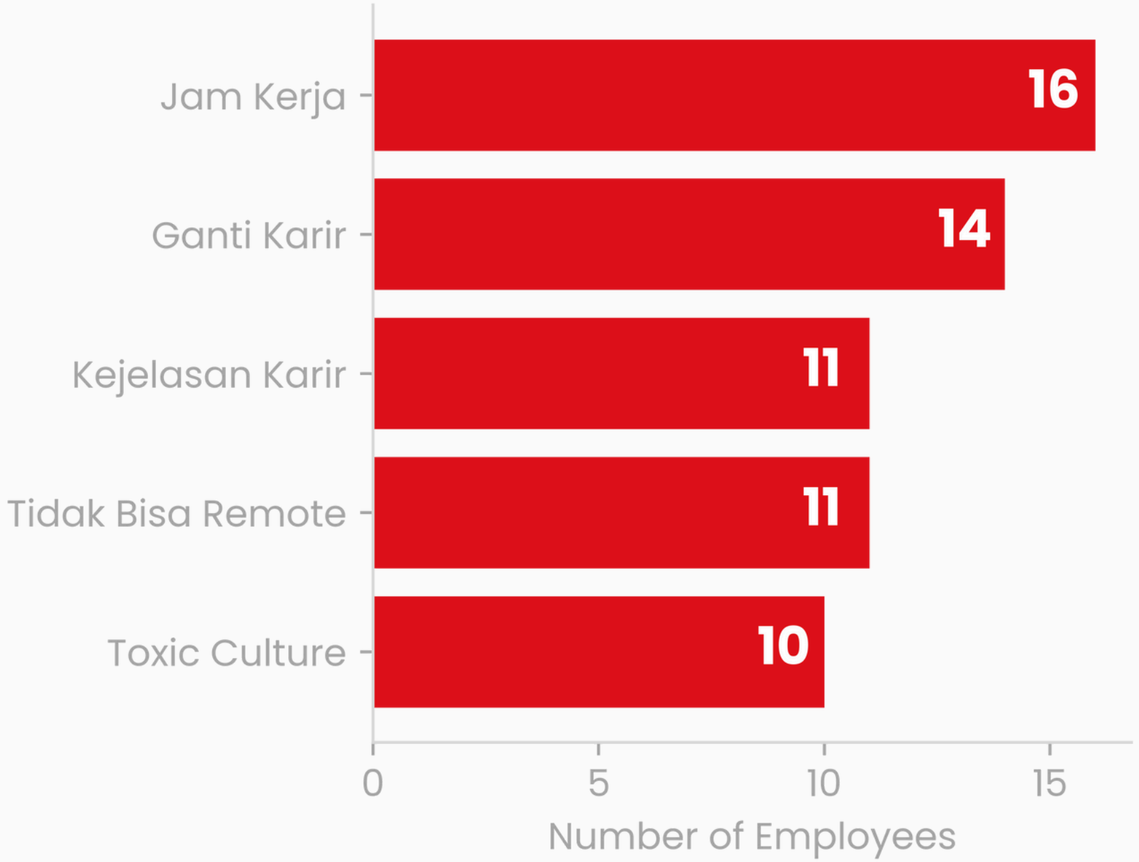
12.5%

The Product Design team experienced a significant attrition rate

13.6%

Employees hired through CareerBuilder showed a higher attrition rate

Top 5 Resignation Reasons



Front-End Engineers

8 out of 11 resigned due to lack of **remote work** options

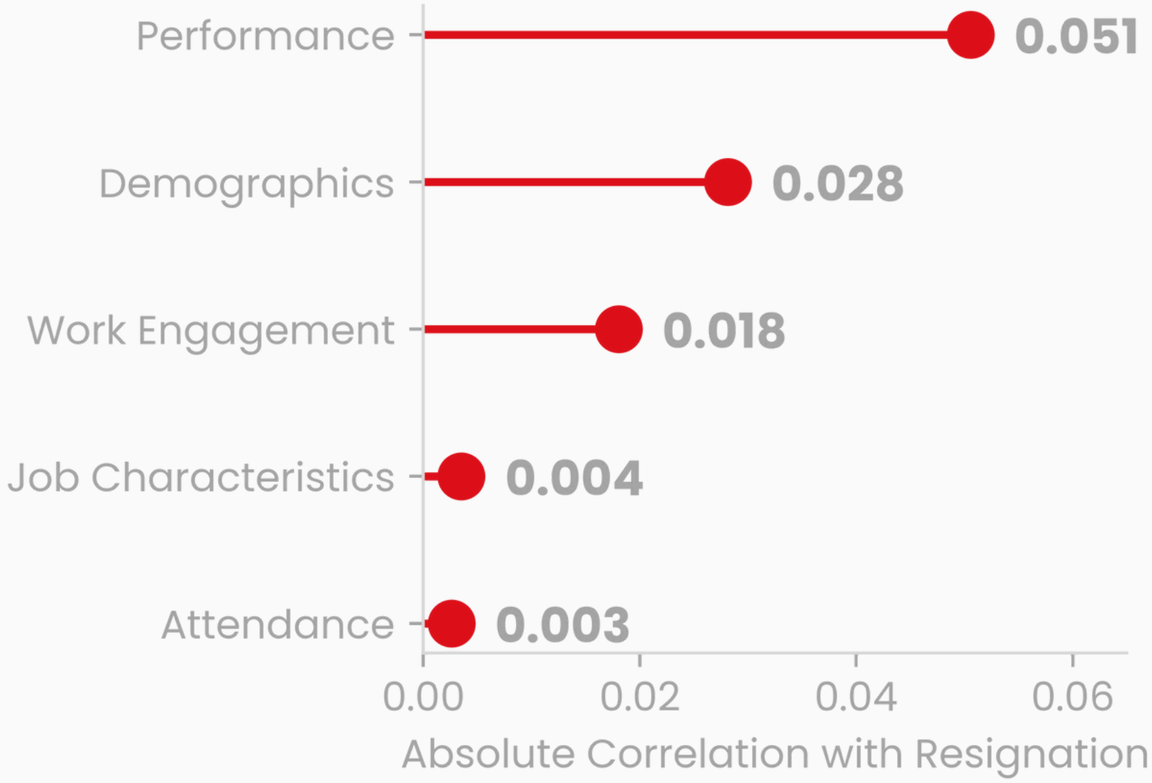
Data Analysts

6 employees cited **toxic culture** as their main reason for leaving

Top Performers

7 high-performing employees left because **remote work wasn't allowed**

No Significant Predictors Found



Key Finding

A comprehensive analysis of **287 employees** across **five feature categories** revealed **extremely weak correlations**, all below 0.06. The highest was just 0.051, indicating no factor group shows predictive power.

Implications

- Turnover is **complex** and **personal**
- **HR metrics alone can't** predict resignations
- **Culture** and **personal** factors matter more

Preprocessing

Data Splitting

- Features (X) and target (y) separated
- Stratified train-test split (80/20)

Missing Value & Outlier

- Numerical columns filled with median
- Categorical column filled with mode
- Outliers imputed with median

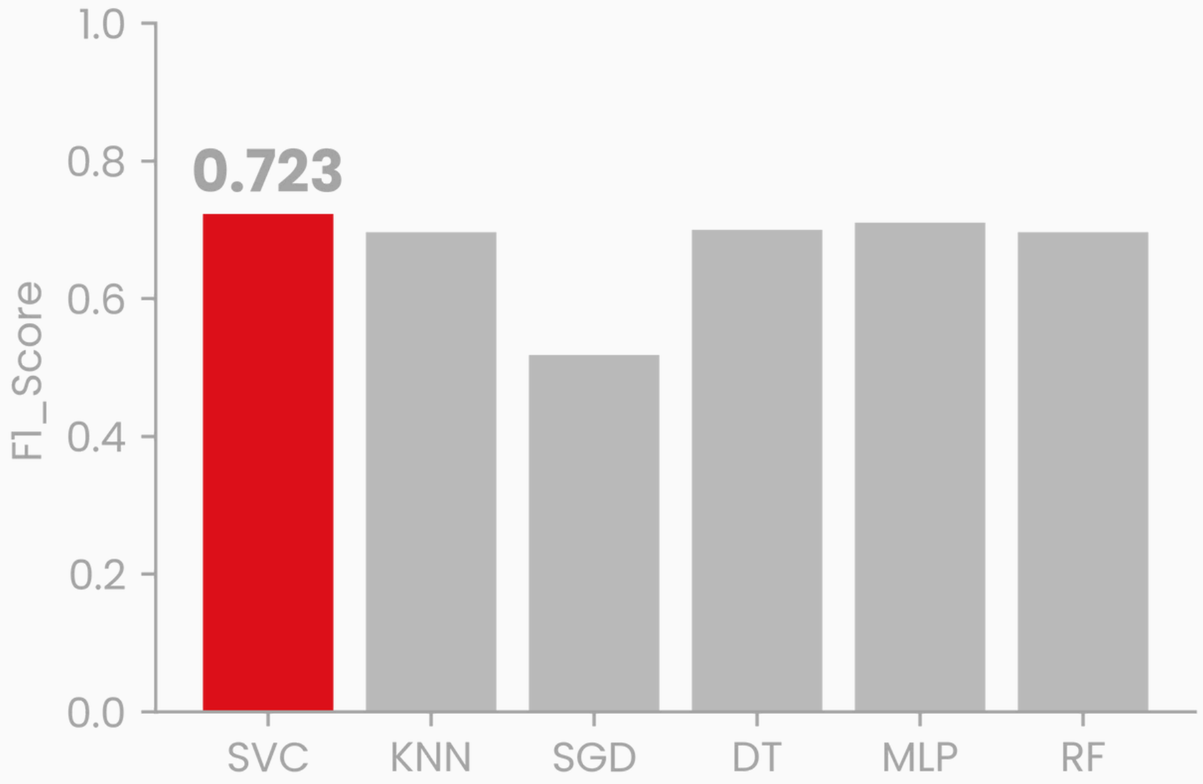
Feature Scaling & Encoding

- Numerical features scaled using RobustScaler
- Ordinal encoding for ordinal variables
- Frequency encoding for high-cardinality columns

Feature Engineering Highlights

- Time-Based Features
- Performance & Engagement
- Attendance Patterns
- Career Signals
- Demographics
- Advanced Features
- Clustering & Risk Scores

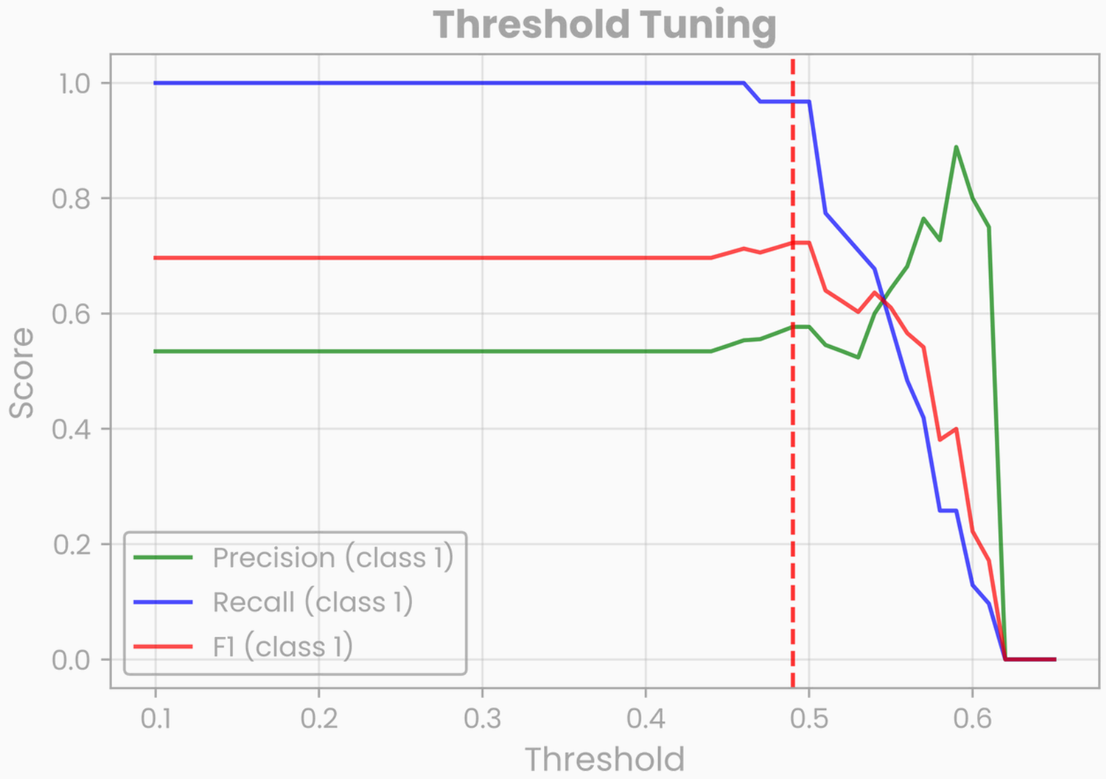
Model Selection



The **SVC model outperformed** other candidates, showing consistent metrics. Its **highest F1 score** indicates strong class separation ability.

Model	F1-Score	Precision	Recall
SVC	**0.72**	**0.58**	**0.97**
MLP	0.71	0.6	0.87
SGD	0.7	0.57	0.9
KNN	0.7	0.53	1
RF	0.7	0.53	1

Best Model Optimization



Hyperparameter Tuning

- Method: **Optuna** (30 trials, 5-fold CV, scoring = ROC AUC)
- Best Parameters:
  - C=**3.069**
  - kernel=**linear**
  - gamma=**auto**

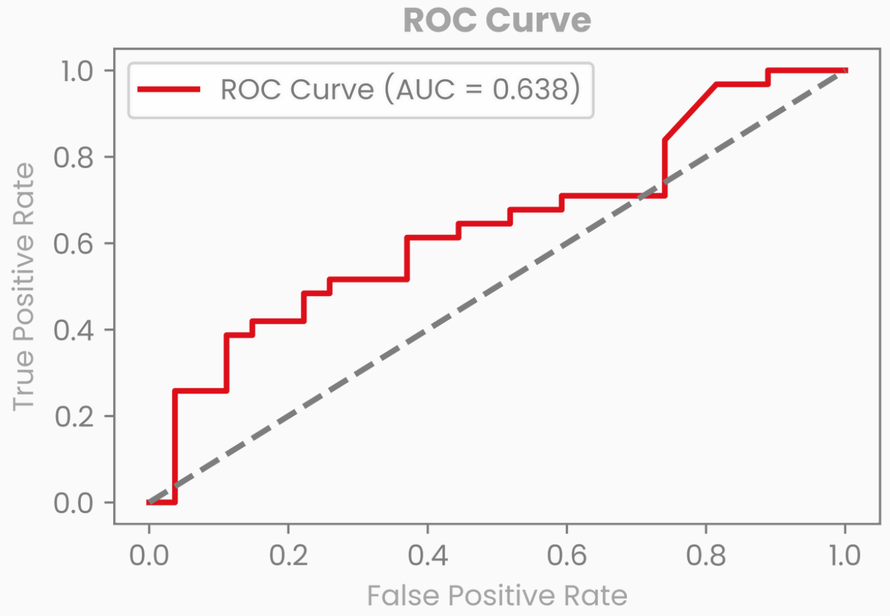
Threshold Tuning

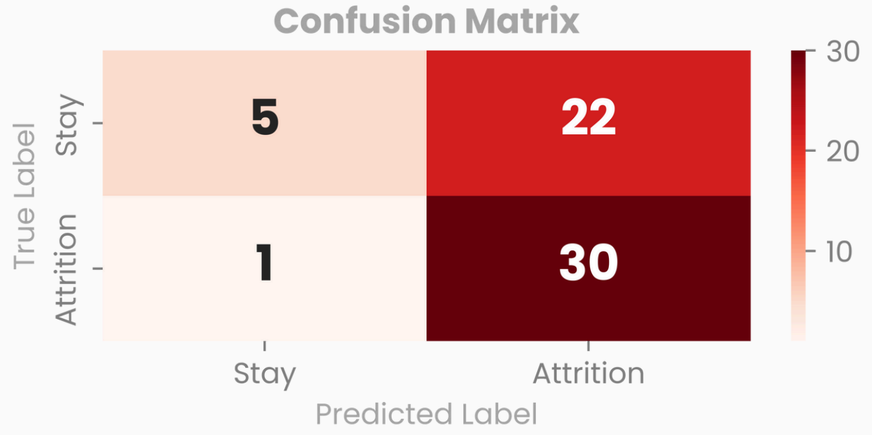
- Method: Threshold search (0.1–0.9) with **Precision–Recall–F1 trade-off** evaluation
- Best Threshold = **0.49**

Best Model Evaluation

Recall: 0.97
Precision: 0.58
F1-Score: 0.72

The model demonstrates strong predictive capability with an AUC of **0.638** and F1-score of **0.72**, achieving exceptional sensitivity (**97% recall**) in identifying at-risk cases while maintaining acceptable overall performance metrics.





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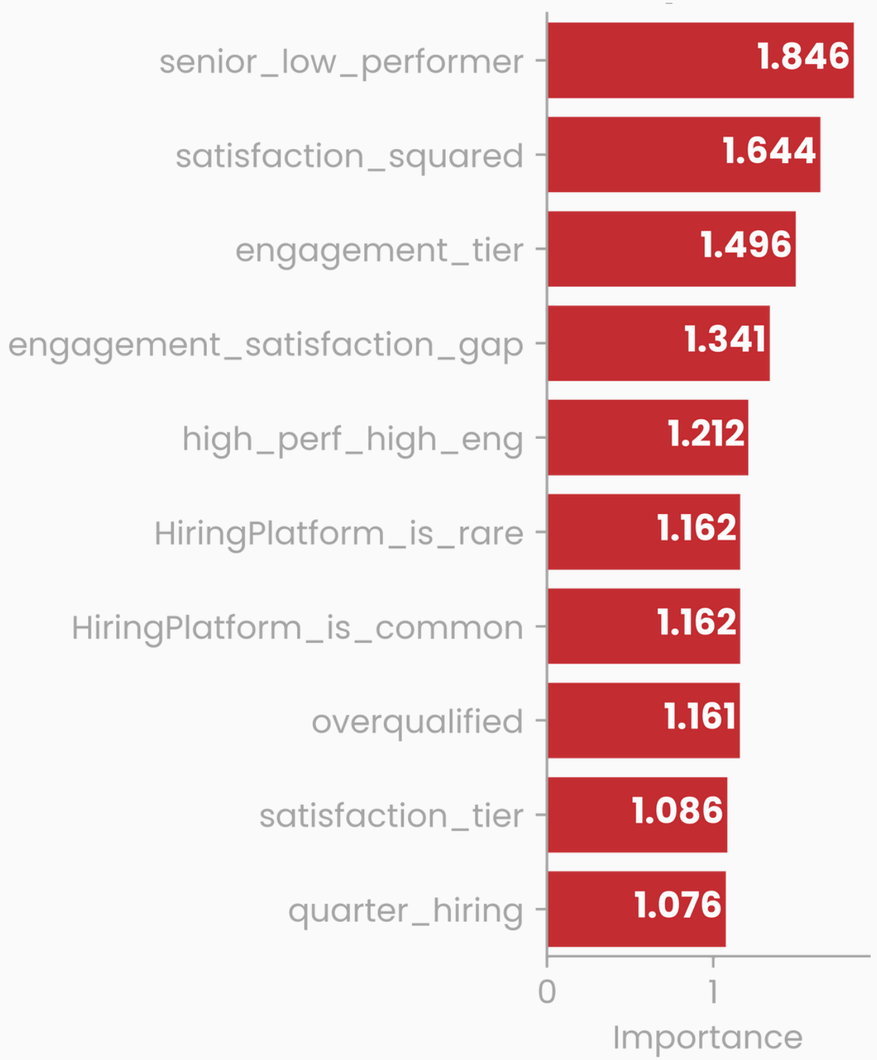

Feature Importance

Performance & Engagement

The model shows senior employees with low performance have the highest attrition risk, followed by satisfaction and engagement factors

Talent Mismatch

Qualification misalignment (overqualified) and engagement-satisfaction gaps are strong turnover predictors

Hiring & Onboarding

Recruitment platforms and hiring timing (quarter) significantly impact employee retention

Strategic Recommendations

Revamp Flexibility & Working Hours

- Implement hybrid/remote work for technical roles
- Conduct workload audit, especially for roles with frequent overtime

Strengthen Work Culture & Team Environment

- Launch cultural intervention for Data team: anonymous surveys, FGDs
- Create safe, anonymous feedback channels

Create Career Clarity & Growth Opportunities

- Develop & communicate clear career paths for each role
- Launch mentorship & skill development programs

Use Predictive Model for Proactive Intervention

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Thank You

Source Code

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