Software Engineering & Project (COMP SCI 7015)

# Snapshot Week 10 of Group RAIL PG-2

Rail Break Prediction ML

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# 1. Product Backlog and Task Board

## 1.1. The product backlog

| ID | Priority | User Story/Task/Spike | Description |
|---|---|---|---|
| PB1 | 1 | Feature Engineering | Create new features based on domain knowledge and data patterns to improve model performance. |
| PB2 | 1 | Feature Selection | Identify and retain the most relevant features to reduce noise and improve efficiency. |
| PB3 | 1 | Model Research & Selection | Investigate suitable machine learning techniques for imbalance temporal datasets |
| PB4 | 2 | Data Ingestion into InsightFactory.ai | Import the provided real-world production dataset into the InsightFactory platform. |
| PB5 | 2 | Data Cleaning & Preprocessing | Handle missing values, outliers, and inconsistencies in the dataset. |
| PB6 | 2 | Exploratory Data Analysis (EDA) | Analyze data distributions, trends, and anomalies to understand key characteristics. |
| PB7 | 3 | Model Training | Train predictive models using the processed and engineered dataset. |
| PB8 | 3 | Model Evaluation | Assess models using Accuracy, F1 Score, and AUCPR metrics. |
| PB9 | 3 | Benchmark Comparison | Compare the model's performance against the InsightFactory bench mark model for potential bonus marks. |
| PB10 | 4 | Model Optimization & Finalization | Fine-tune model parameters, optimize features, and prepare the final deliverable. |
| PB11 | 1 | Implement Feature Engineering Methods | exploring and testing different feature transformation and construction approaches to enhance the predictive power of the dataset. |
| PB12 | 1 | Implement Feature Selection Methods | applying statistical and algorithmic techniques to identify the most relevant features and reduce dimensionality for improved model efficiency. |
| PB13 | 2 | Implement Machine Learning Techniques for Datasets | investigating specialized algorithms and resampling strategies to handle class imbalance effectively. |
| PB14 | 2 | Training Table Preparation Implementation | Implement Training table preparation scripts, these scripts provide the fundamental data integration for the overall project pipeline. |
| PB15 | 1 | Implement additional feature engineering techniques | Try out at least 2 more feature engineering techniques. |

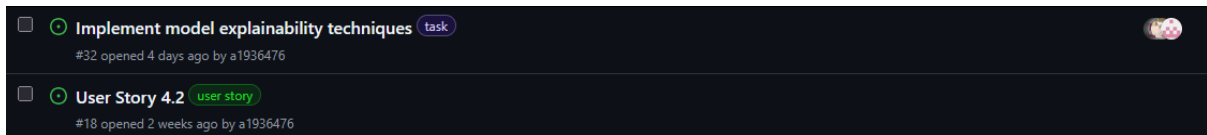| PB16 | 1 | Implement additional feature selection techniques | Try out at least 2 more feature selection techniques. |
|---|---|---|---|
| PB17 | 1 | Implement ML techniques for addressing imbalanced datasets | Try out at least 2 more techniques for handling imbalanced datasets. |
| PB18 | 2 | Implement different ML models with hyperparameters tuning | Tuning hyperparameter of<br>● at least 3 different ML models<br>● feature selection, feature engineering, and imbalanced dataset handling techniques, if they have hyperparameters to tune |
| PB19 | 1 | Research model explainability techniques | Identify and explore at least 5 model XAi techniques relevant to the project. |
| PB20 | 2 | Implement model explainability techniques | 1. Implement and try out at least 3 model explainability techniques.<br>2. Continue:<br>   ● hyperparameter tuning<br>   ● experiments on different feature engineering methods, feature selection methods and techniques to approach an imbalanced dataset<br>3. Report what combination of techniques, model and explainability method worked so far<br>4. Achieve a minimum InsightFactory leaderboard score of 60% |

## 1.2. The task board

## 2. Sprint Backlog and User Stories
### 2.1. The Sprint backlog



### 2.2. User stories

User Story 4.2:

As a software engineer, I want to tryout model XAi techniques, so that the model can explain the reason(s) behind its predictions while achieving an F1 score exceeding 60%.

**Related tasks:**

1. Implement model explainability techniques.

## 3. Definition of Done

A backlog item is considered "Done" when:

Task:

- Create different branches for different tasks
- Code (including database scripts) is implemented according to acceptance criteria.
- Code has been peer-reviewed and approved if a new table is created in the final schema.
- All relevant tests (unit, integration) have been passed.
- Documentation (code comments, user guides) is updated.
- No major open defects remain.

## 4. Summary of Changes

In sprint 4.2, each team member chose a combination of model and XAI technique and implemented them.

A new branch "SP4/XAI_IMPLEMENTATION" is created, and all team members have committed their code to it. By the end of sprint 4, the branch has been merged into the main branch.

The best combination for AUC_PR is:

- Model: SVM
- XAI: SHAP
- Rebalanced technique: Class weighting
- Tuning Hyperparameters: Manual C selection

| d9ea01b5 | RAIL-PG-2 | Completed | 22 days ago | 68d5f68e5900.csv | Competition 3 - The Defribillator | ★ Accuracy: 43.37%, AUC_PR: 61.49%, F1_Score: 51.88% |

The best combination for F1 is:

- Model: Group Lasso Transformer
- Rebalance technique: Stratified batch resampling (75% positive samples per batch) combined with weighted loss function (pos_weight = neg_count/pos_count)
- XAI: SHAP

  The best score of using SHAP explanation is to select top 10 features:

  Accuracy: 64.98%, ACC_PR: 46.00%, F1_score: 52.42%

| f389b93c | RAIL-PG-2 | Completed | a minute ago | 68f3292e3463.csv | Competition 3 - The Defribillator | Accuracy: 64.98%, AUC_PR: 46.00%, F1_Score: 52.42% | ⓘ 🔲 |

- The best score for F1 is using gating technique to select top 8 features:

  Accuracy: 64.32%, ACC_PR: 46.57%, F1_score: 57.68%

| be55df2e | RAIL-PG-2 | Completed | 20 days ago | 68d781805425.csv | Competition 2 - Senna | ★ Accuracy: 64.32%, AUC_PR: 46.57%, F1_Score: 57.68% | ⓘ 🔲 |