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Predictive maintenance

Content

Introduction

- Powerdot faces challenges in **ensuring smooth operation** and **minimizing downtime**.
- Charging logs (e.g., OCPP) **record charger-customer interactions**.
- Predictive maintenance system needed to **foresee malfunctions**.
- Uses charger logs and network performance to **predict issues** (e.g., performance decline, error events).

Data Provided

- **Sessions :**

charge_date	charger_id	connector_id	sessions	failed_sessions
2023-01-16	34406128	5	4	0
2023-01-23	37A80B4D	3	3	3
2023-01-18	AA92D18E	2	2	0
2023-01-28	FF15DC0B	3	2	0
2023-01-19	06B95C56	2	1	0

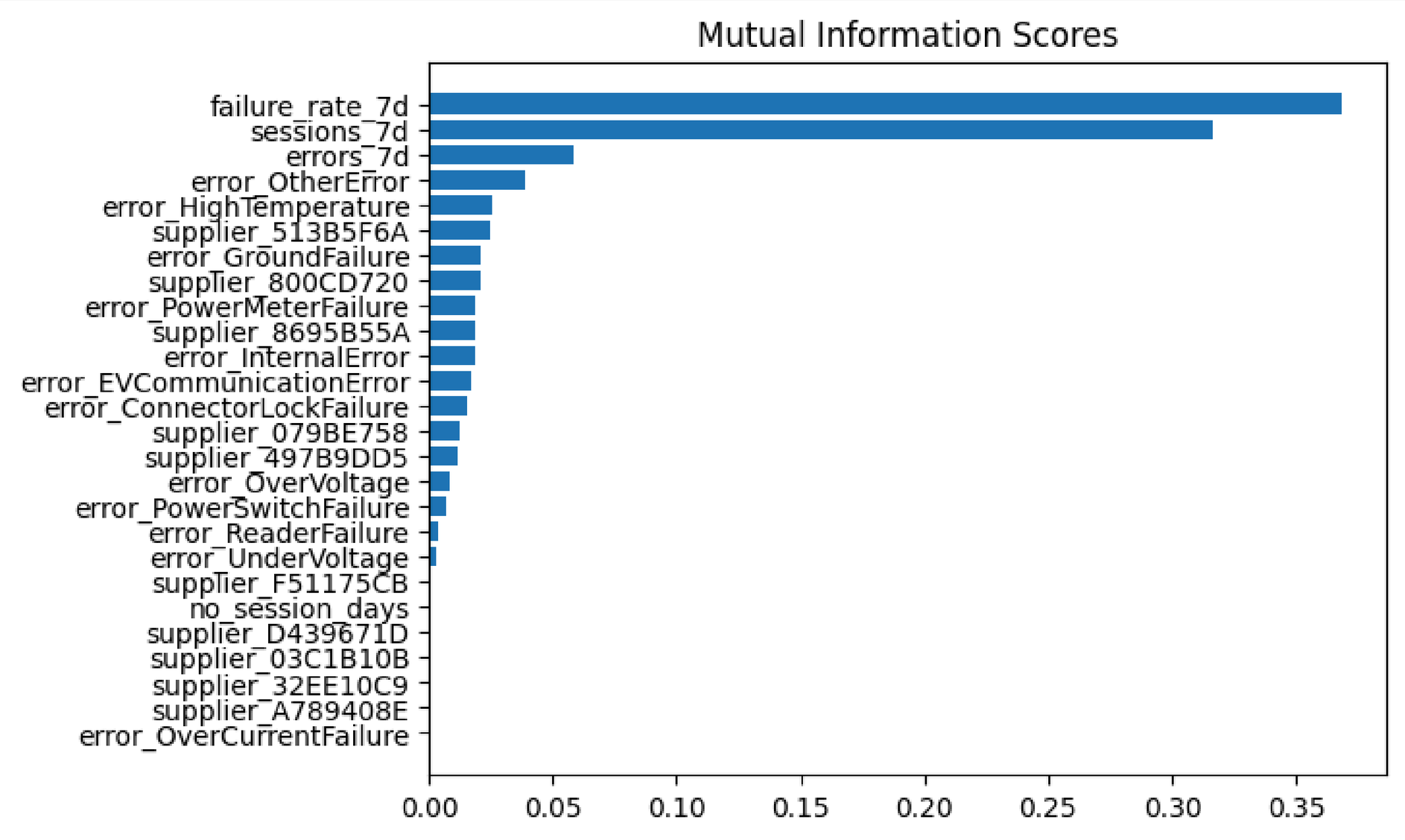
- **OCPP Logs :**

supplier	charger_id	connector_id	error_code	vendor_error_code	error_at
513B5F6A	AFE79784	1	HighTemperature	TRANSFORMER_OVERHEAT	2023-08-21
513B5F6A	0DAF7992	3	OtherError	RemoteStart	2023-09-05
513B5F6A	DD37CC5F	3	InternalError	sessmgr.emvPaymentController	2023-10-11
513B5F6A	4365B1B8	8	InternalError	sessmgr.emvPaymentController	2023-09-07
513B5F6A	4365B1B8	4	EVCommunicationError	COMMUNICATION_ERROR	2023-12-09

Preprocessing

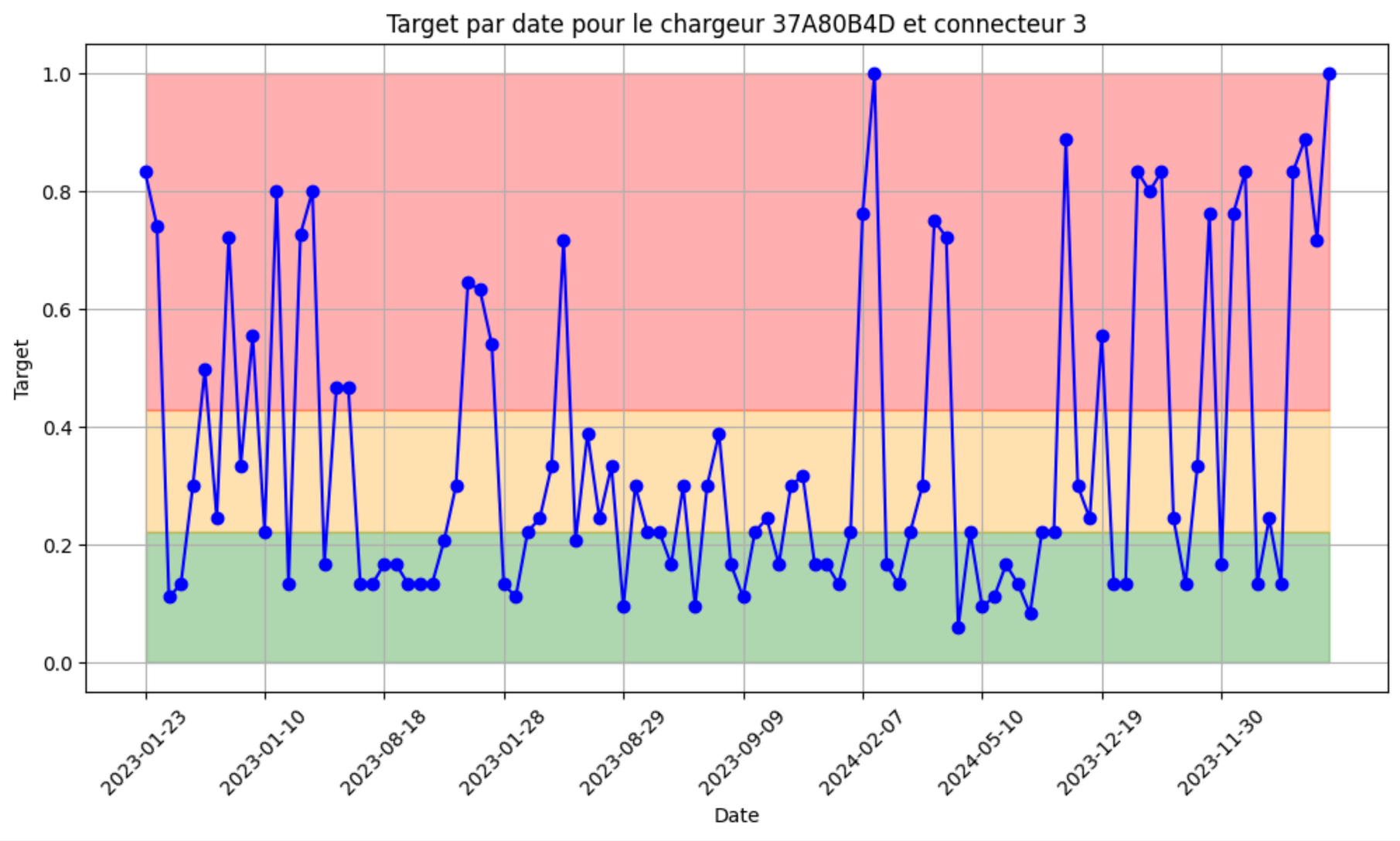
- **Data Preprocessing**
  - Date Conversion
  - Handling NaN (to avoid bias)
  - Removing Duplicates
- **Error Counting**
  - Counted unique errors per charger per day.
  - Identified errors occurring during charging sessions and created new features based on errors over the last 7 days .
- **Feature Creation**
  - Sessions in Last 7 Days
  - Counted days with no sessions, indicating underused chargers.
  - Proportion of failed sessions over the past 7 days.
- **Target Creation**
  - Created the target variable by calculating the ratio of failed sessions to total sessions, adjusting for chargers with few sessions.

Features


Mutual Information Scores
failure_rate_7d
sessions_7d
errors_7d
error_OtherError
error_HighTemperature
supplier_513B5F6A
error_GroundFailure
supplier_800CD720
error_PowerMeterFailure
supplier_8695B55A
error_InternalError
error_EVCommunicationError
error_ConnectorLockFailure
supplier_079BE758
supplier_497B9DD5
error_OverVoltage
error_PowerSwitchFailure
error_ReaderFailure
error_UnderVoltage
supplier_F51175CB
no_session_days
supplier_D439671D
supplier_03C1B10B
supplier_32EE10C9
supplier_A789408E
error_OverCurrentFailure
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35

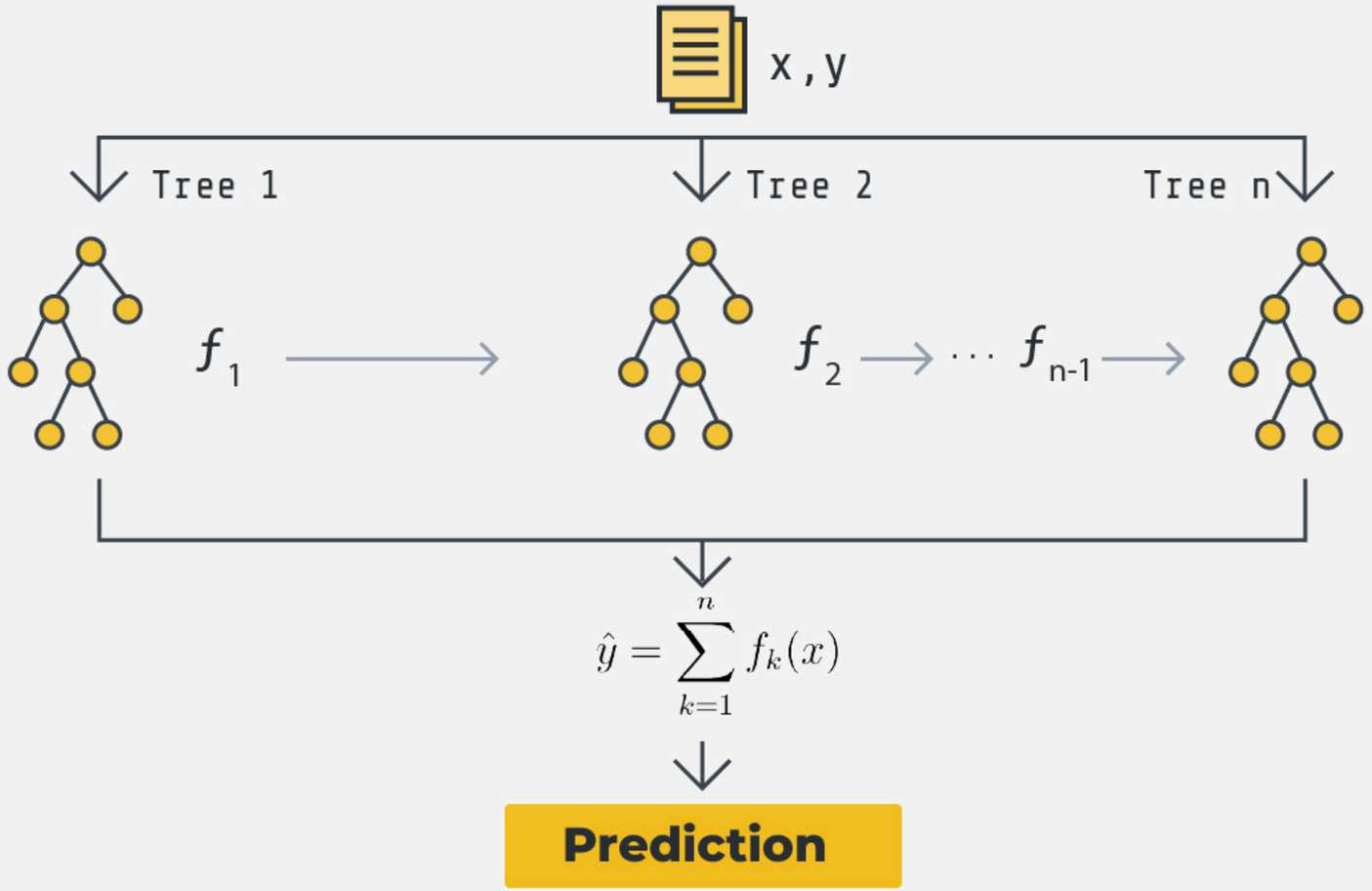
Target Creation

$$\frac{\text{failed\_sessions}}{\text{sessions}} + \frac{1}{1 + \text{sessions}}$$



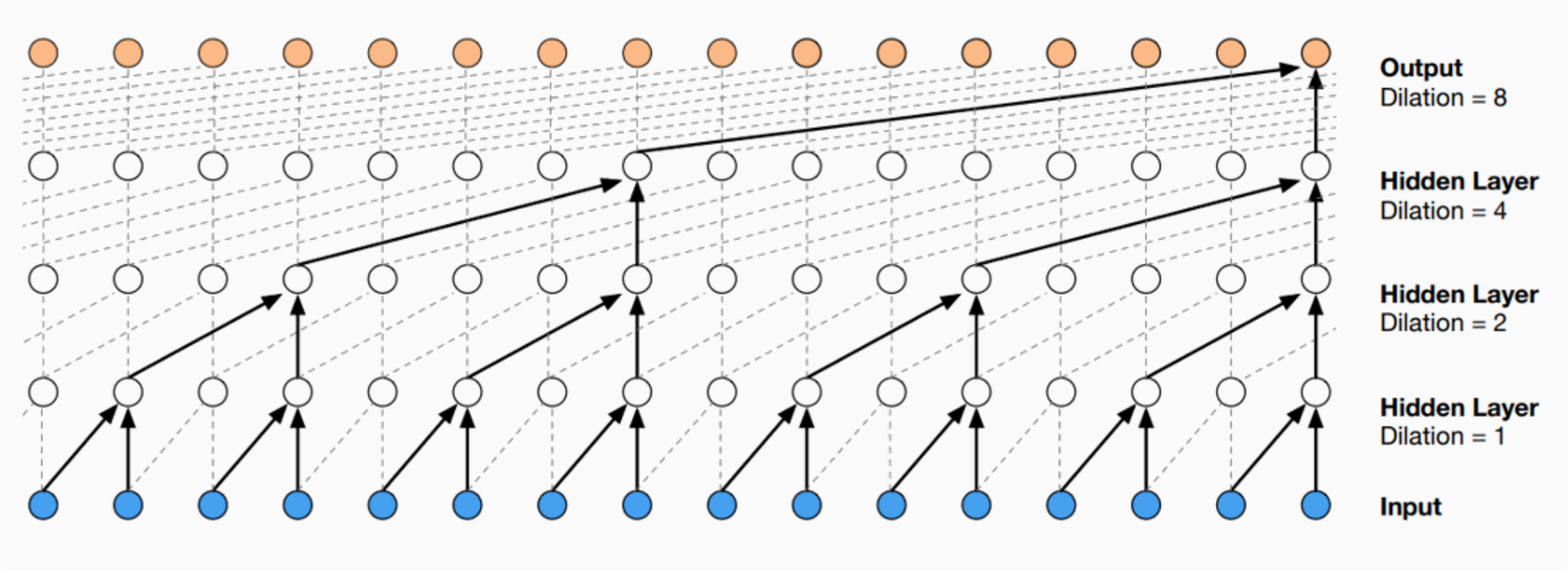
Model

- **XGBoost :**



Model

- **Temporal convolutional network :**



Conclusion

- We achieved a 84% of accuracy with XGBoost
- In just a few iterations, our model is already starting to converge.
- Next steps:
  - Explore advanced techniques like LSTM, attention mechanisms, or even autoencoders to detect anomalies.
  - Deploy the model in real-time on-site to proactively anticipate and prevent failures.