

NAG: Neural feature aggregation framework for credit card fraud detection

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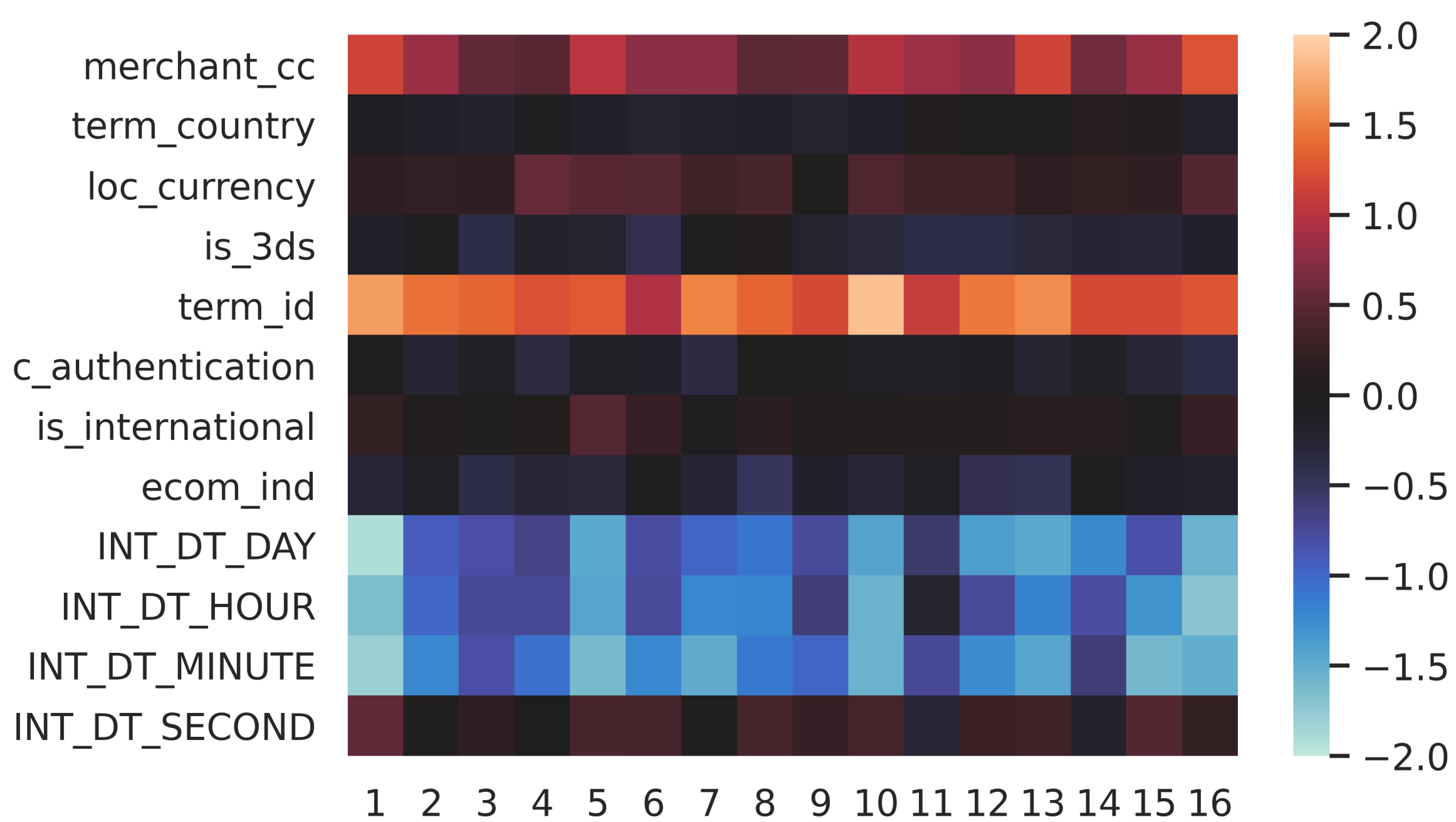
Introduction

- Fraud detection systems use a user’s past transactions through feature engineering as context for predicting whether the current transaction is fraud or not [1].
- The state-of-the-art feature-engineering method uses manually engineered features. aggregates -> expensive and has certain limitations [2][3].
- Automatic feature extraction approaches do not consider the specific structure of the manual aggregates [4][5].

Methodology

- We designed a novel neural network-based feature aggregation framework, the Neural Aggregate Generator (NAG).
- The NAG closely mimics the structure of manual feature aggregates.
- Additionally, it extends manual aggregates through soft feature matching and relative weighting of feature importances.

Interpretability



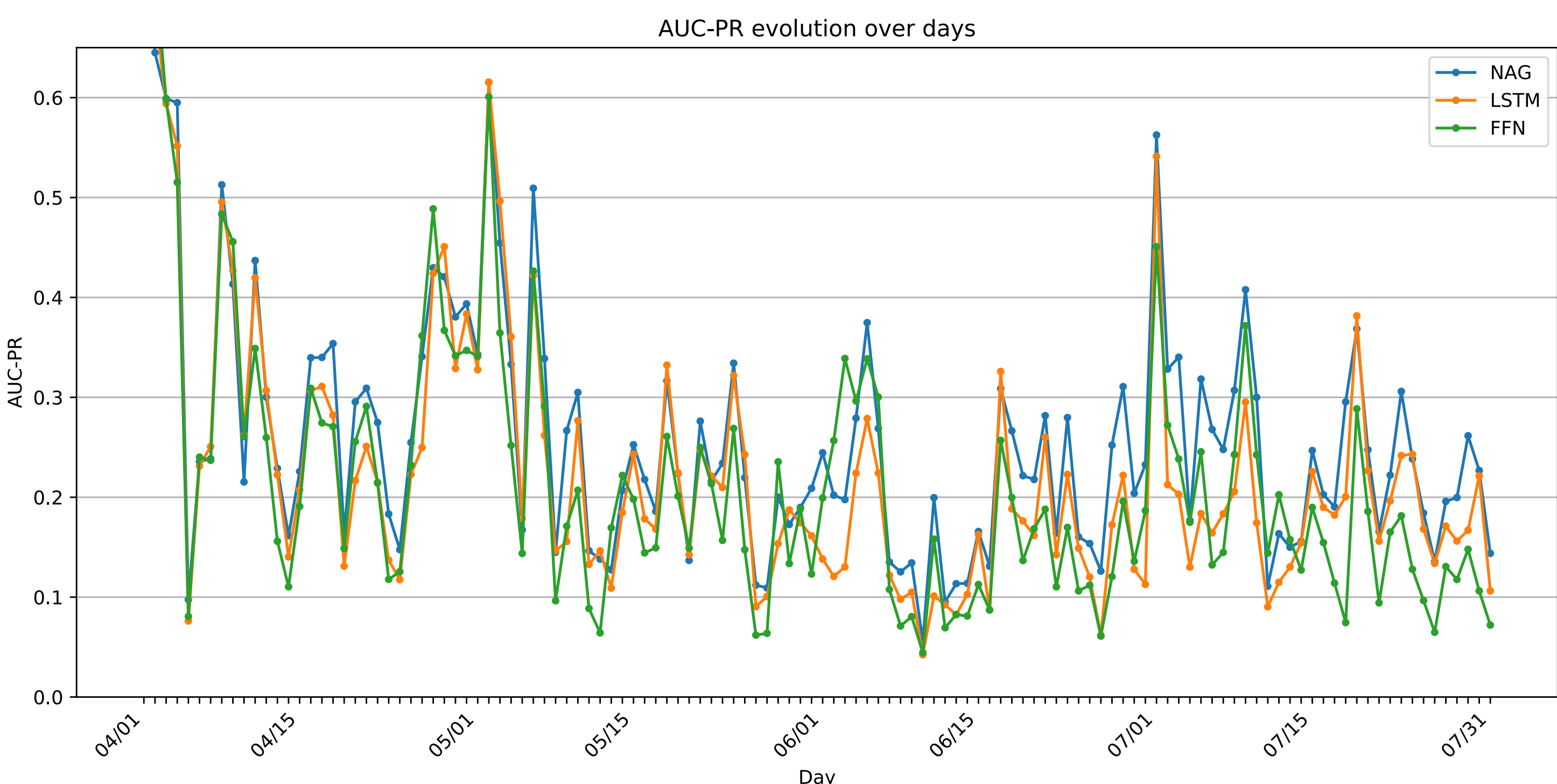
Heatmap showing the the contribution of individual categorical features in the computation of aggregates (Higher absolute value indicates more influence). The columns correspond to 16 fitted weight vectors of the NAG.

Fraud Detection

	April	May	June	July
FFN (Base)	0.230 ± 0.001	0.168 ± 0.003	0.126 ± 0.001	0.126 ± 0.003
FFN (Base + Aggs)	0.300 ± 0.030	0.205 ± 0.024	0.157 ± 0.006	0.179 ± 0.009
RF (Base)	0.251 ± 0.001	0.157 ± 0.002	0.121± 0.001	0.128 ± 0.005
RF (Base + Aggs)	0.308 ± 0.002	0.221 ± 0.004	0.138 ± 0.001	0.178 ± 0.005
LSTM (Base)	0.330 ± 0.009	0.222 ± 0.005	0.143 ± 0.008	0.173 ± 0.009
CNN (Base)	0.290 ± 0.011	0.199 ± 0.007	0.149 ± 0.007	0.172 ± 0.020
NAG (Base)	0.346 ± 0.004	0.236 ± 0.030	0.187± 0.004	0.206 ± 0.005

Predictive performance (AUCPR) on the fraud classification task.

- The use of manual aggregates improve fraud detection accuracy.
- The LSTM and CNN show similar performance to using manual feature aggregates.
- The NAG outperforms both manual and automatic approaches across all months of testing.



Predictive performance (AUCPR) on individual test days

References

- [1] Jurgovsky et al., Ph.D. dissertation, Universitat Passau, 2019.
- [2]. Bahnsen et al., Expert Systems with Applications, 2016.
- [3]. Whitrow et al., Data mining and knowledge discovery, 2008.
- [4]. Cheng et al., AAAI, 2020.
- [5]. Jurgovsky et al., Expert Systems with Applications, 2018.

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