Research Centre for Information Systems Engineering
(LIRIS), KU Leuven, Leuven, Belgium

Predictive Process Monitoring for Airport Operational Support

Björn Rafn Gunnarsson, Jochen De Weerdt, Seppe vanden Broucke

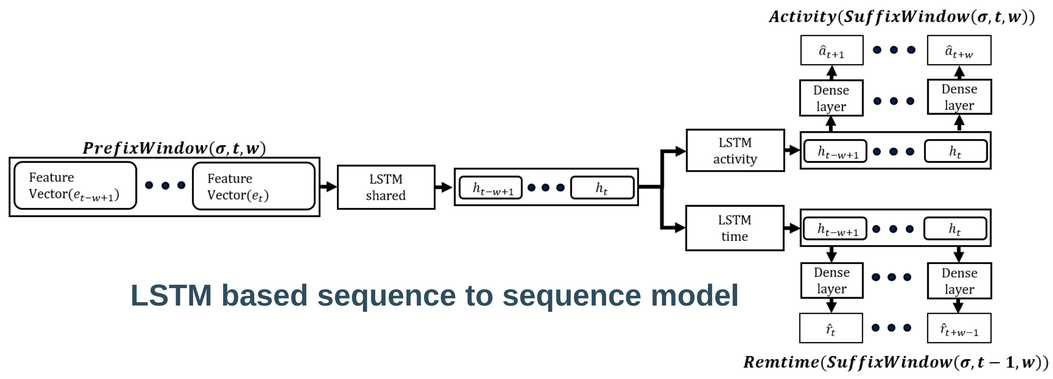
Introduction

- Airports have become competitive consumer brands competing for travellers
- Customer experience has become a strategy focus in the management of airports, e.g. through data-driven personalized passenger information services
- We investigate the applicability of predictive process monitoring for supporting luggage handling operations at an airport
- Several iterations of a development cycle for predictive process monitoring were executed to develop an application of a predictive process monitoring technique which performs acceptably when utilized for this purpose
- More specifically, a number of novel LSTM based sequence to sequence models were constructed using different features

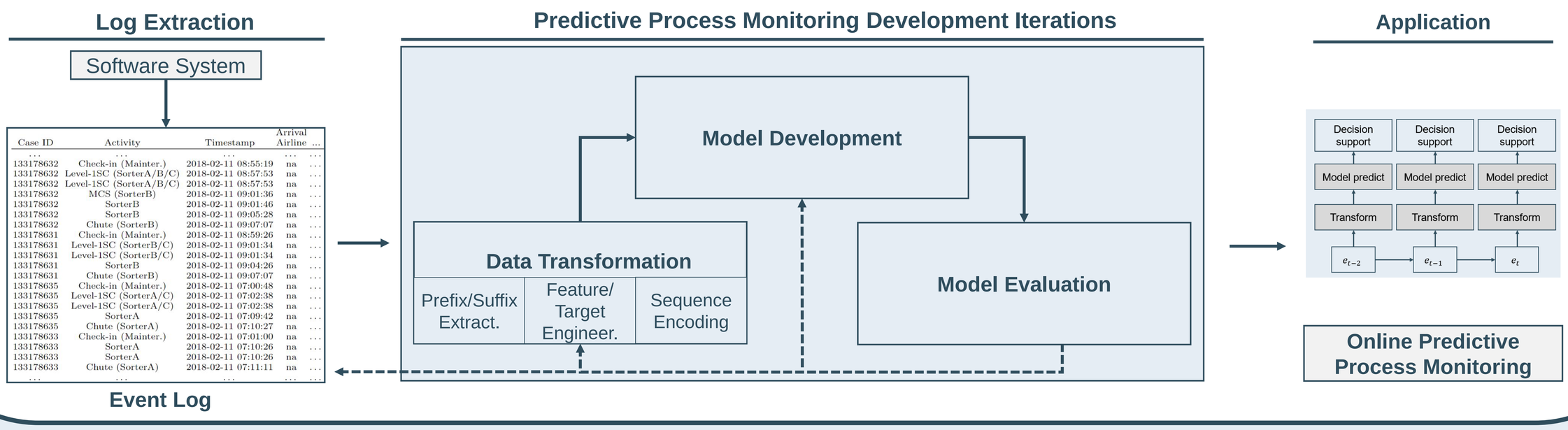
Development Cycle for Predictive Process Monitoring Applications

Model Development

- Devise a novel LSTM based sequence to sequence model
- Allows for training models that can directly predict the complete remaining trace as well as its runtime
- Robust in terms of utilizing all available attributes relating to previously observed event for prediction
- Natively data aware



LSTM based sequence to sequence model



Data Transformation

Prefix/Suffix Extraction

- Prefixes and suffixes are extracted for each process step from recorded traces contained in the extracted event log

Feature Engineering

- Control flow information, information engineered from time features and flight information considered as features
- Novel inter-case dynamics featurization approach was additionally considered to encode the relevant mutli-location load state of the luggage handling system

Sequence Encoding

- All features and targets encoded using a sliding window of a fixed size

Model Evaluation

- Execute several iterations of the development cycle to identify a model that performs acceptably for remaining trace and runtime prediction
- Performance of developed model further evaluated for different groups of luggage
- Model comfortably outperforms considered baseline models for both prediction tasks

	Remaining trace	Remaining time
Act. + Time	0.7166	526
Act. + Time + Inter	0.7276 (+1.1%)	520 (+1.1%)
Act. + Time + Flight	0.9070 (+19.0%)	233 (+55.7%)
Act. + Time + Flight + Inter	0.8980 (+18.1%)	306 (+41.8%)

CRTP-LSTM

	Remaining trace	Remaining time
Departing luggage	0.9222 (+19%)	108 (+59%)
Transferring luggage	0.9213 (+34%)	155 (+79%)
Early luggage	0.8176 (+32%)	1158 (+61%)
Late luggage	0.5722 (+18%)	2284 (+25%)

Baseline models

	Remaining trace	Remaining time
Departing luggage	0.7278	264
Transferring luggage	0.5856	750
Early luggage	0.5021	2940
Late luggage	0.3922	3063

Conclusion

- Developed LSTM based sequence to sequence model comfortably outperforms baseline models for both prediction tasks
- Model can be used to identify deviations based on predicted remaining traces and remaining runtimes

Future work

- Incorporate external factors into predictive setup (e.g. weather)
- Develop object-centric predictive process monitoring techniques which take into account the interdependence between different processes at an airport