



EVEOS: Exploratory Visual System for Predictive Machine Learning of Event-Organisation Data

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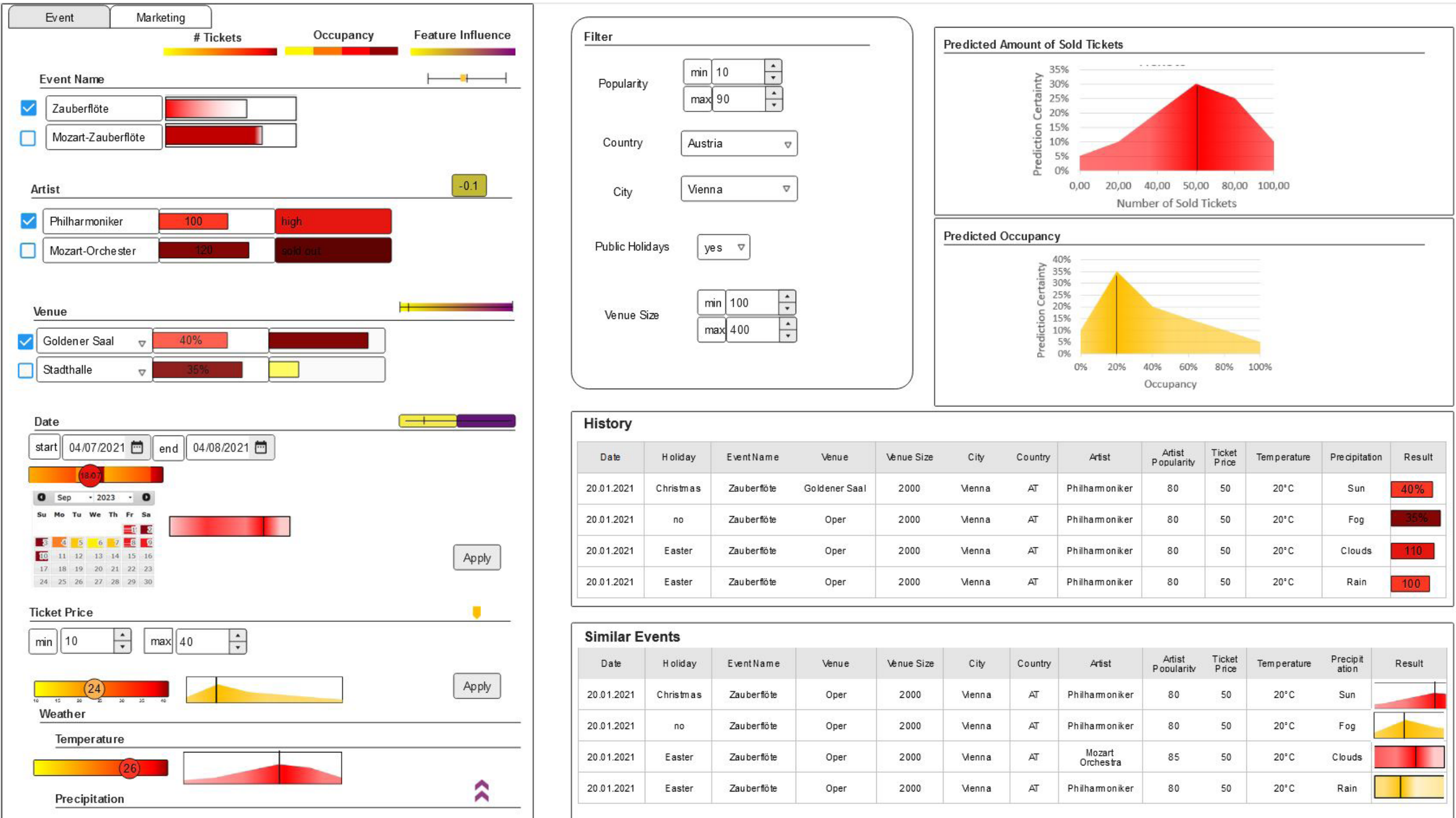
Problem & Motivation

In this thesis, we are focusing on predictive machine learning (ML) using event-organisation data with the goal of finding parameters that optimse profit. Event-organisers do not have sufficient knowledge about machine learning to just work with a model. They need an interface to work with the model that allows them to answer the following questions:

- For a given set of input parameters, how many tickets will be sold for the event?
What is the probability of selling a given amount of tickets?
The model predicts that 500 tickets will be sold, but what is the probability of 600 tickets being sold?
- How does changing a single parameter influence the ticket sale?
How does the ticket price affect sales?
- Which parameters should be changed to increase the number of sold tickets?
Are there parameters that have a greater impact than others?

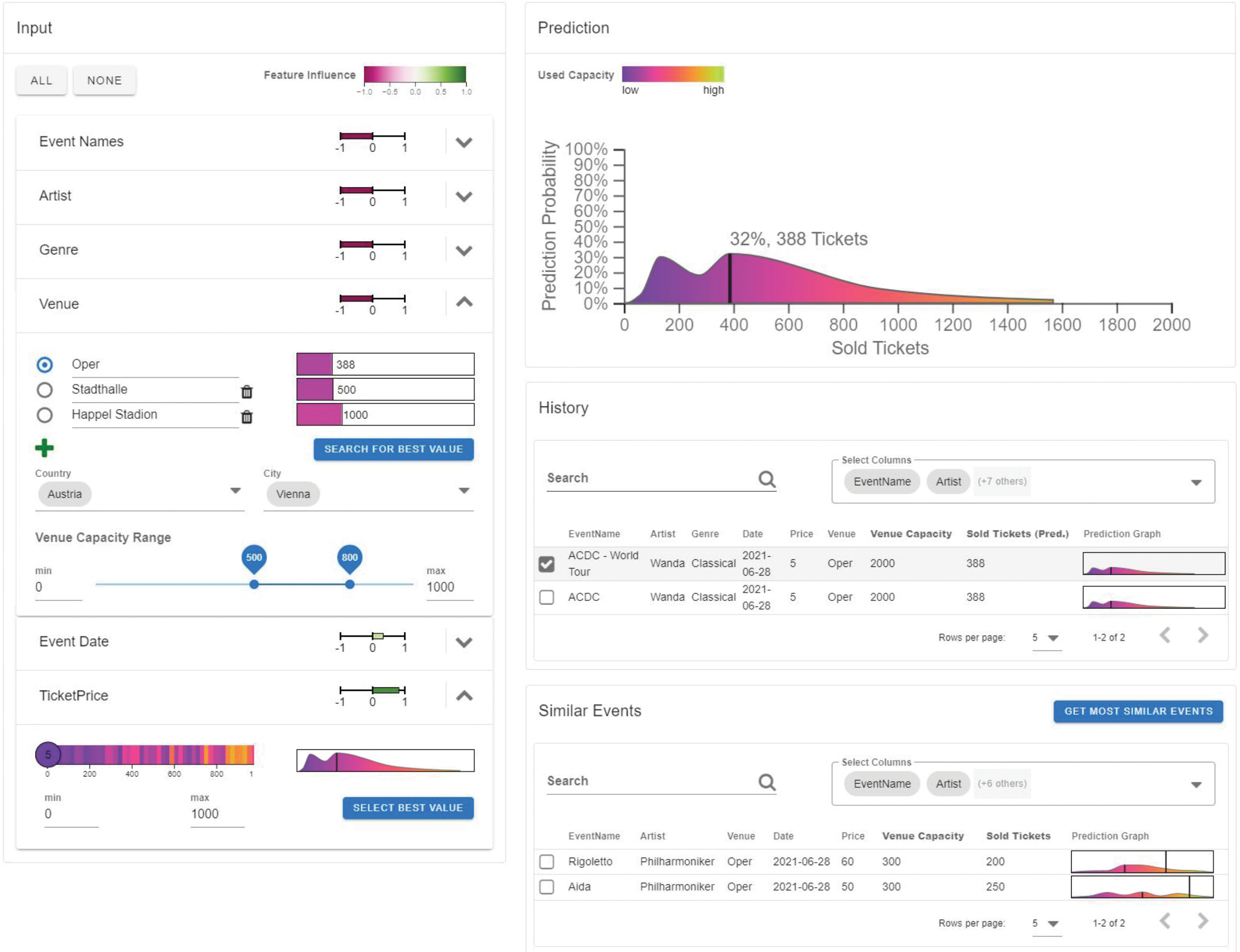
1) Digital Paper Prototype

- Show prediction result using area graph
- Feature sample filtering in isolated component
- DNN returns 9 values with probabilities
- Interaction history to compare parameter combinations
- Evaluate local partial dependence (LPD) encodings to make predictions comparable
- Show events similar to input to allow case-based reasoning
- Evaluate feature quality (FQ) encodings



2) Interactive Prototype

- Implemented with Vue.js and D3.js
- Not connected to ML and database
- Result view: probabilities on y-axis, number of sold tickets on x-axis and occupancy rate as colour
- FQ: bar chart centred around 0
- Numerical LPD: LPD bar by Krause et al.[1]
- LPD 1: small version of result view
- LPD 2: bar chart showing value with highest probability
- Perceptually sequential rainbow colour map
- Interaction History: revert to previous input
- Filter at corresponding feature input



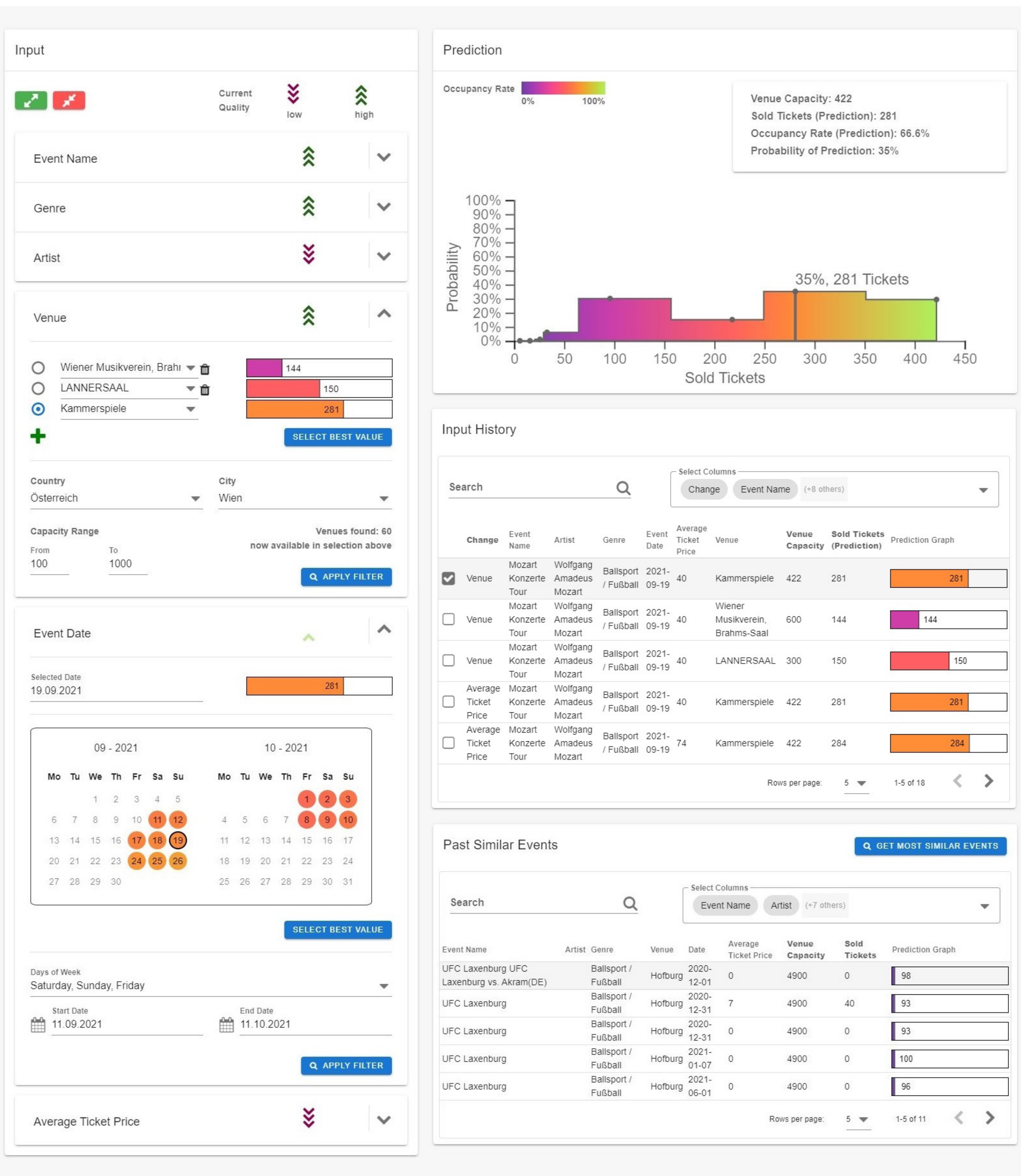
Contribution & Research Questions

The main contribution of this thesis is the conception, development and evaluation of an exploratory visual event-organisation system (EVEOS) on top of a predictive ML model for event organisers who, until now, have not been able to perform such analyses with their domain-specific data. Within the iterative design process, we aim to learn more about the needs of laypeople in the field of machine learning in regards to model interpretability. We strive to grasp which concepts in the field of user interface design work well in the proposed use case and which do not. Additionally, our work can hopefully serve as a best practice example on how to deal with different data types during predictive machine learning and post-hoc model analyses. Designing the proposed EVEOS we aim to answer the following questions:

- How can we visualise the results of predictive machine learning models so that they are useful and comprehensible to non-expert users?
- How can we make multiple predictions comparable against each other?
- How can we support users in gaining trust in the predictions using model interpretation methods?

3) Final Prototype

- Added connection to ML and database
- Result view: circle markers that show values returned by ML model, step curve to make graph mathematically correct
- Result view legend: detailed information about value with highest probability
- FQ: arrow glyphs with adopted legend
- LPD: bar chart showing value with highest probability
- LPD for dates: scented date-picker
- Interaction History with added changelog
- Filter: improved interaction handling
- Similar events: users want to use domain knowledge to search for events they know are similar



Conclusion

The results of three rounds of implementing and evaluating the proposed exploratory visual event-organisation system (EVEOS) provided us with several interesting discoveries regarding the system itself and also regarding the employed user-centred design process. While the general feedback we got from the participating domain experts was positive, we also had to realise that some parts of our work were not developed thoroughly enough.

Future Work

- Basic and expert view to show both abstracted and detailed encodings
- Bar chart for result view showing intervals with their probabilities
- Add information about influence of directly linked features on prediction
- Allow users to search for similar events on their own
- Improve underlying ML model
- Extend usage to other domains

[1] J. Krause, A. Perer, and K. Ng. Interacting with predictions: Visual inspection of black-box machine learning models. Conference on Human Factors in Computing Systems - Proceedings, pages 5686–5697, 2016.