

# **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?

### **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:

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? Arethere parameters that have a greater impact than others?

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?

# 1) Digital Paper Protoype

DNN returns 9 values with probabilities • Evaluate local partial dependence (LPD) encodings to make predictions comparable • Evaluate feature quality (FQ) encodings

• Show prediction result using area graph • Feature sample filtering in isolated component • Interaction history to compare parameter combinations

> • Show events similar to input to allow case-based reasoning

• Numerical LPD: LPD bar by Krause et al.[1]

• LPD 2: bar chart showing value with highest

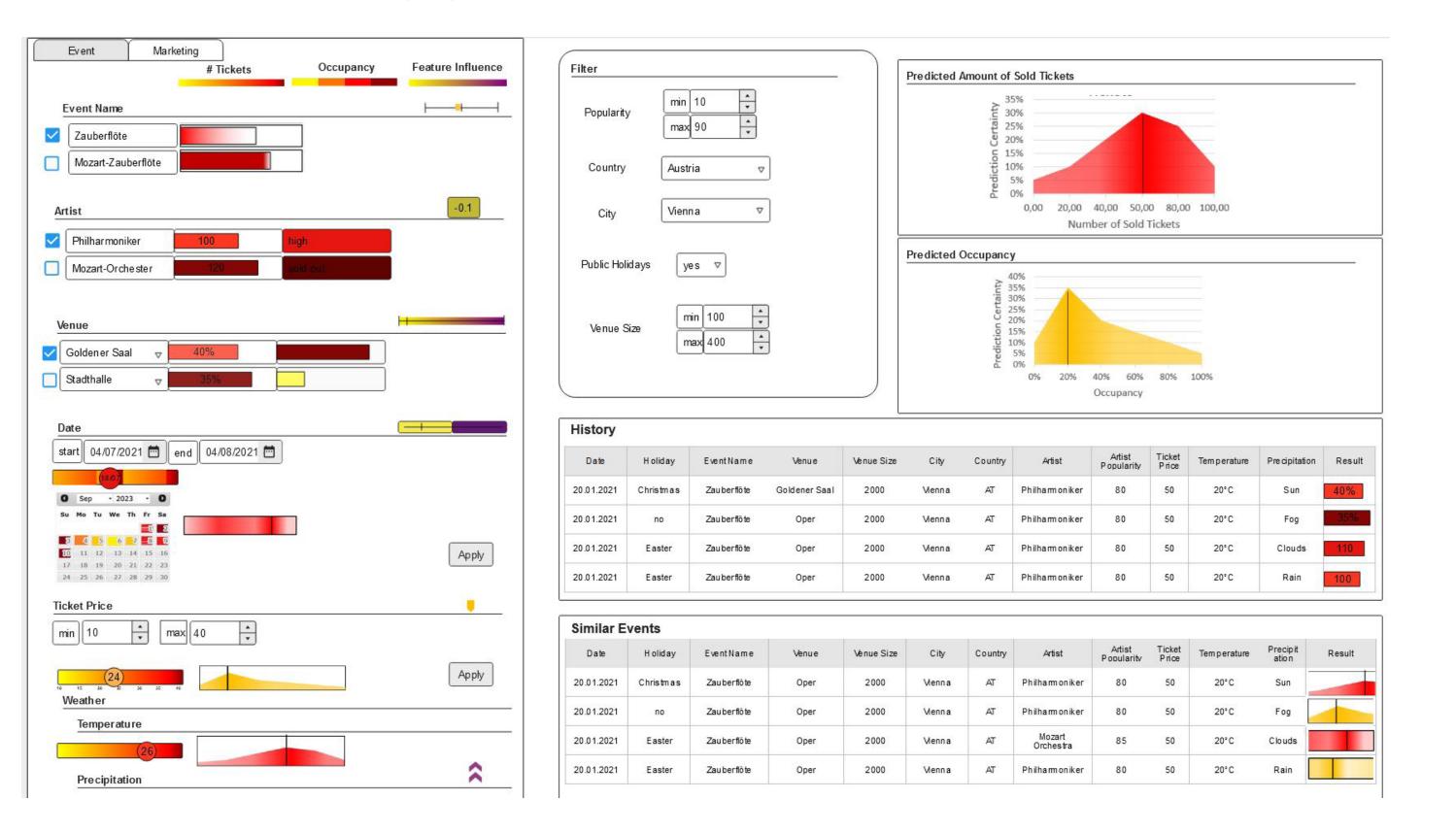
Perceptually sequential rainbow colour map

• Interaction History: revert to previous input

• LPD 1: small version of result view

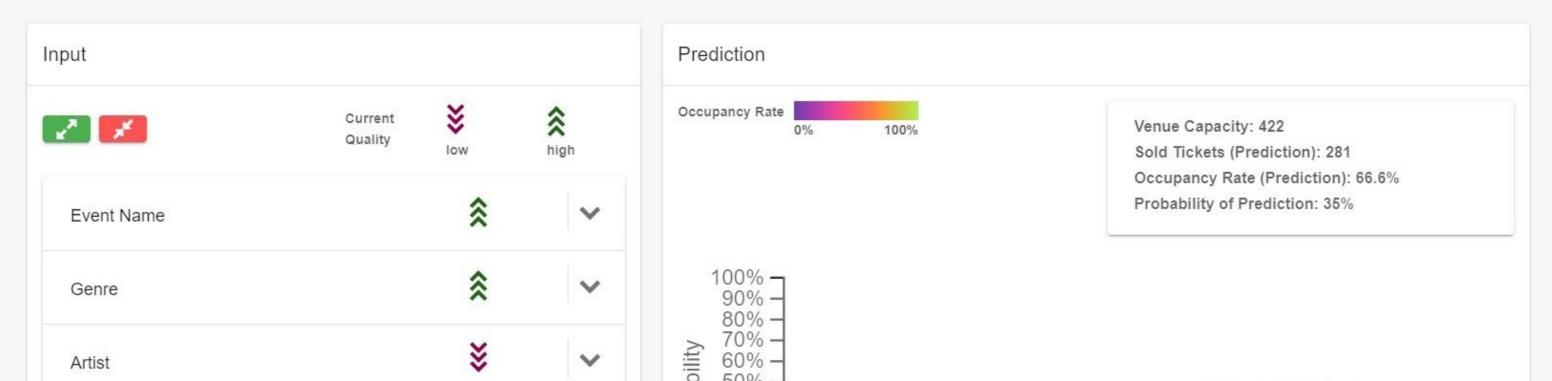
• Filter at corresponding feature input

probability



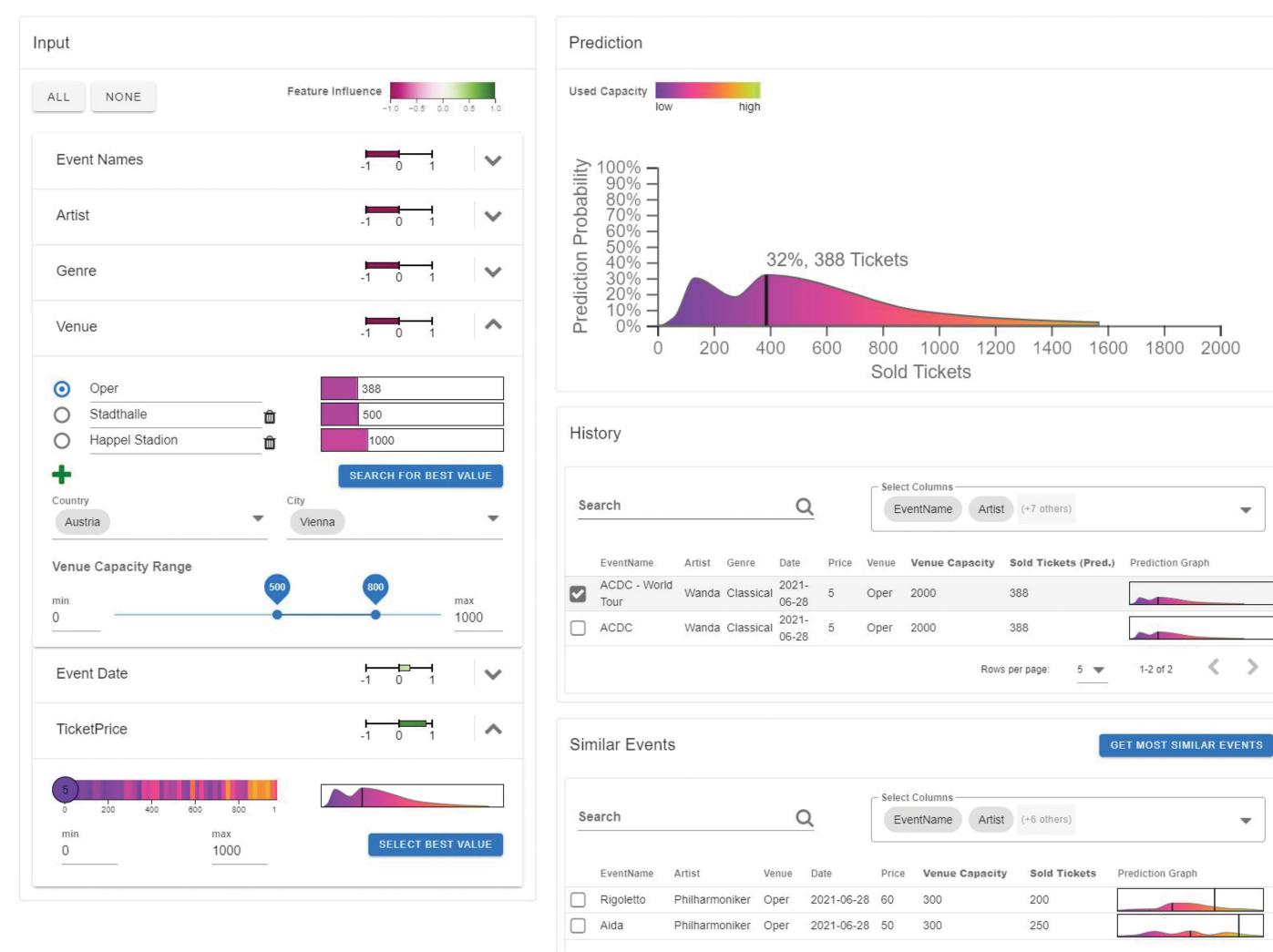
## 3) Final Protoype

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



# 2) Interactive Protoype

- 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



\* Venue 0 Wiener Musikverein. Brahı 🔻 🏦 0 LANNERSAAL ▼ 🛍  $\odot$ Kammerspiele v SELECT BEST VAI City Country Österreich Wien **Capacity Range** Venues found now available in selection ab 1000 100 **Q** APPLY FILT Event Date Selected Date 281 19.09.2021 09 - 2021 10 - 2021 We Th Fr Sa Su Mo Tu We Th Fr Sa 1 2 3 6 7 8 9 10 11 1 4 5 6 7 8 9 10 13 14 15 16 17 18 19 11 12 13 14 15 16 17 20 21 22 23 24 25 18 19 20 21 22 23 24 27 28 29 30 25 26 27 28 29 30 31 SELECT BEST VAI Days of Week Saturday, Sunday, Friday Start Date End Date 11.10.2021 11.09.2021

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## Conclusion

The results of three rounds of implementing evaluating the proposed exploratory and 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.

