

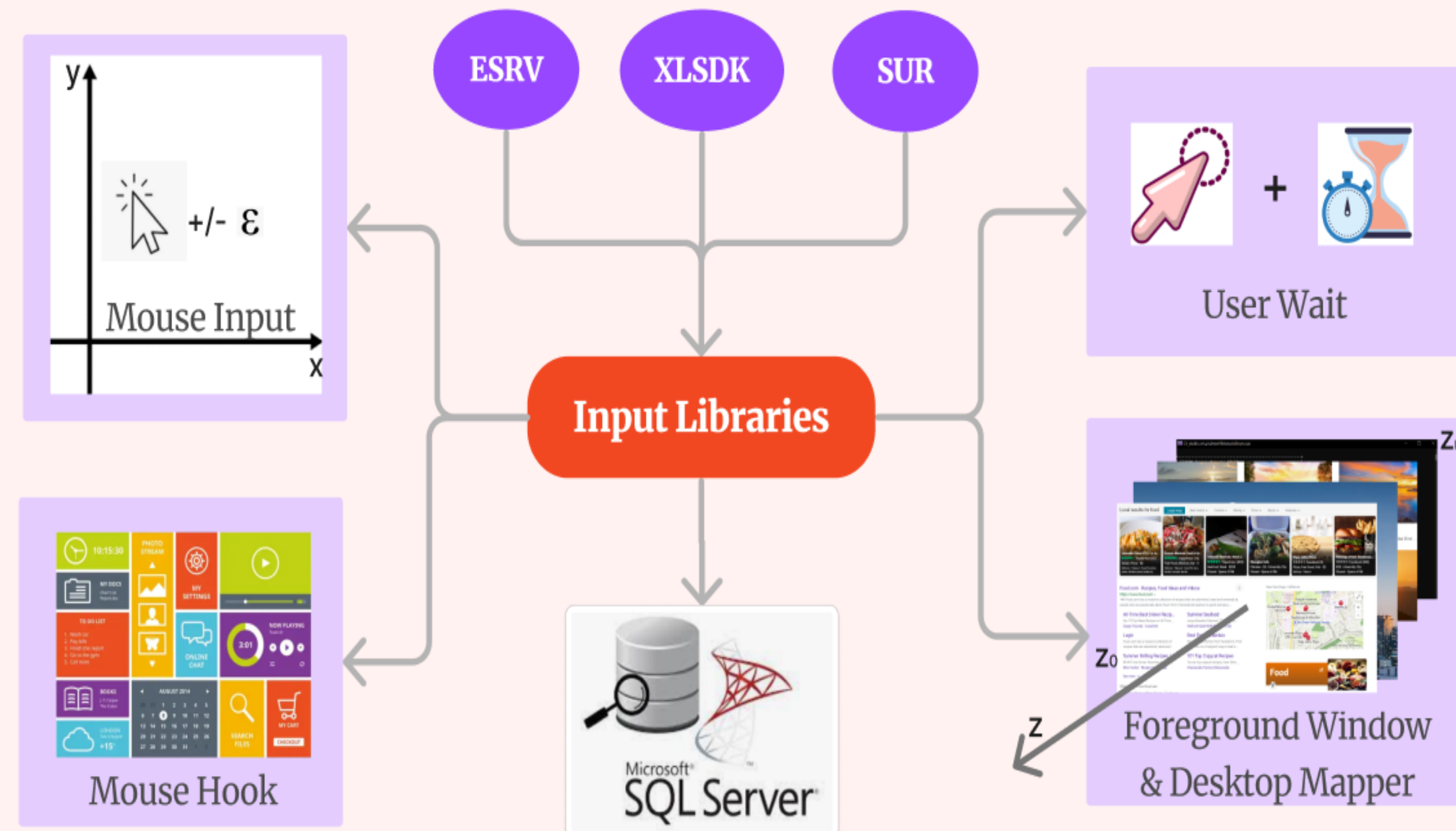
Abstract

- “Data loading” icons signal unpleasant user-wait experiences and can tear people away from using an app.
- We mitigate the initial latency by collecting system usage data using Intel’s Telemetry and analyzing past behaviors by EDA, HMM, and LSTM/RNN.



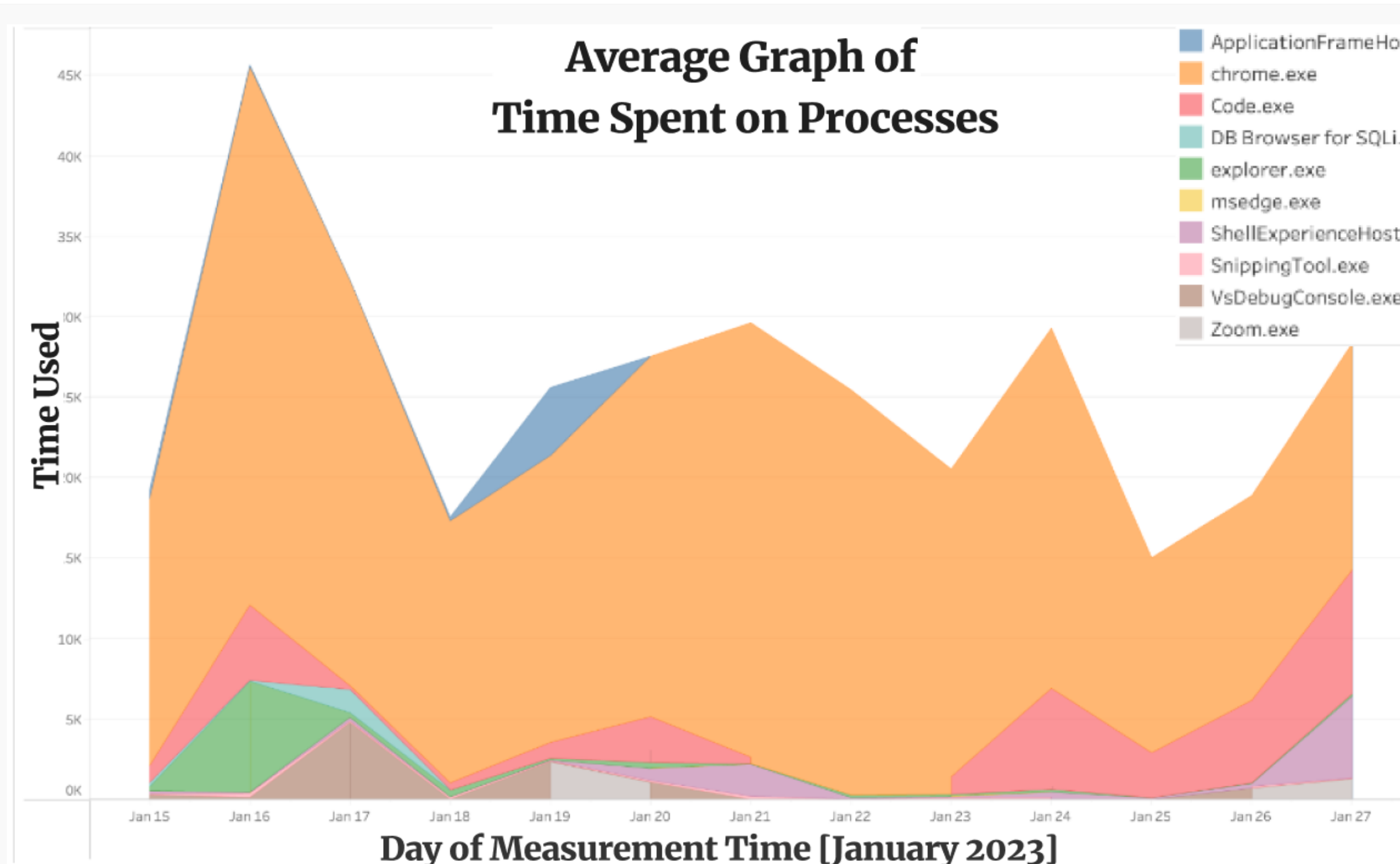
Methodology of Data Collection

- Tools:** Software Development Kit, Environment Server, Intel® System Usage Report framework
- Purposes** Anonymously gather and analyze data usage from multiple devices.



Exploratory Data Analysis

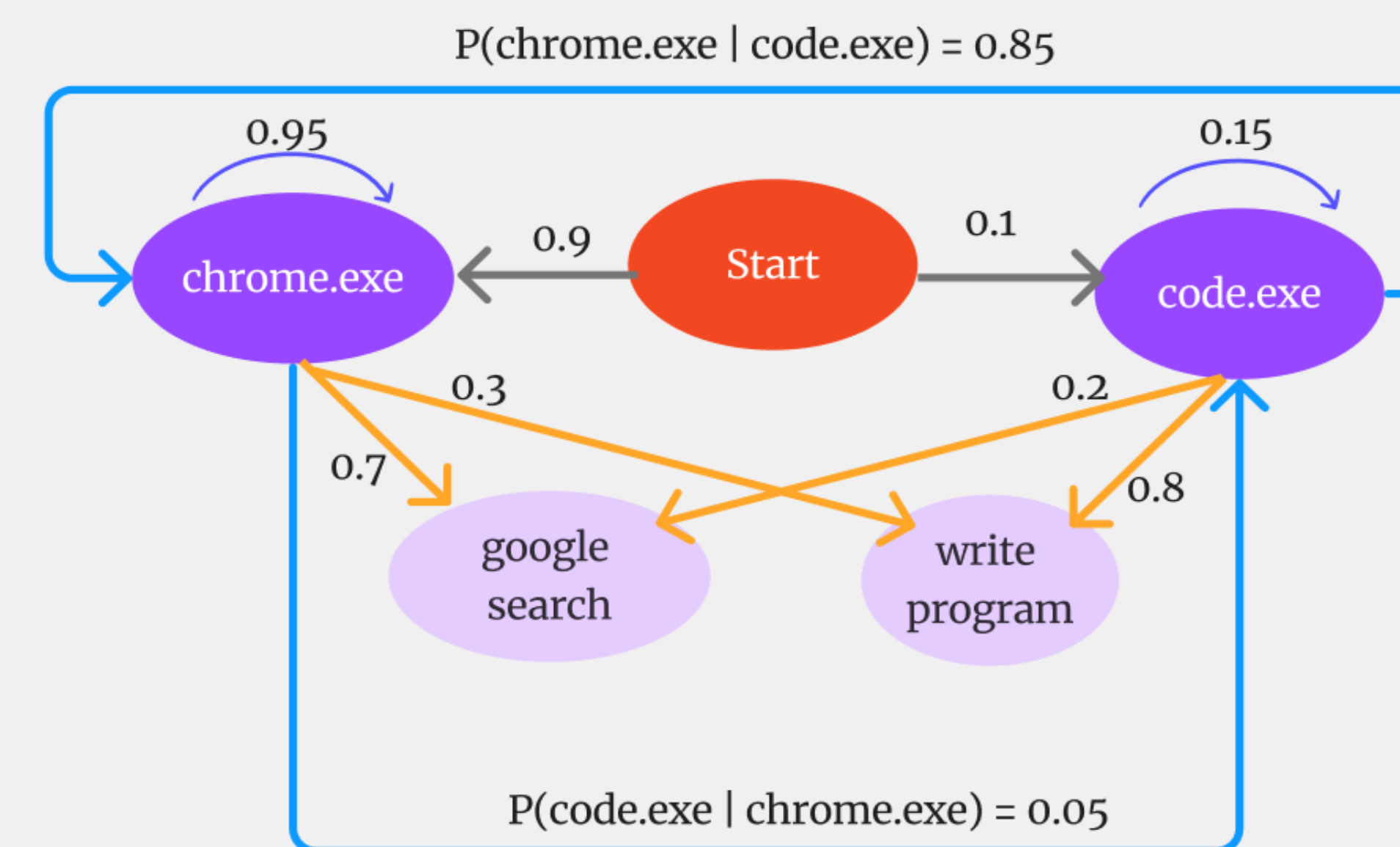
Chrome is the top frequently used app of this user according to the time measurement in 01/2023



Methodology of Predictive Tasks

Hidden Markov Model (HMM)

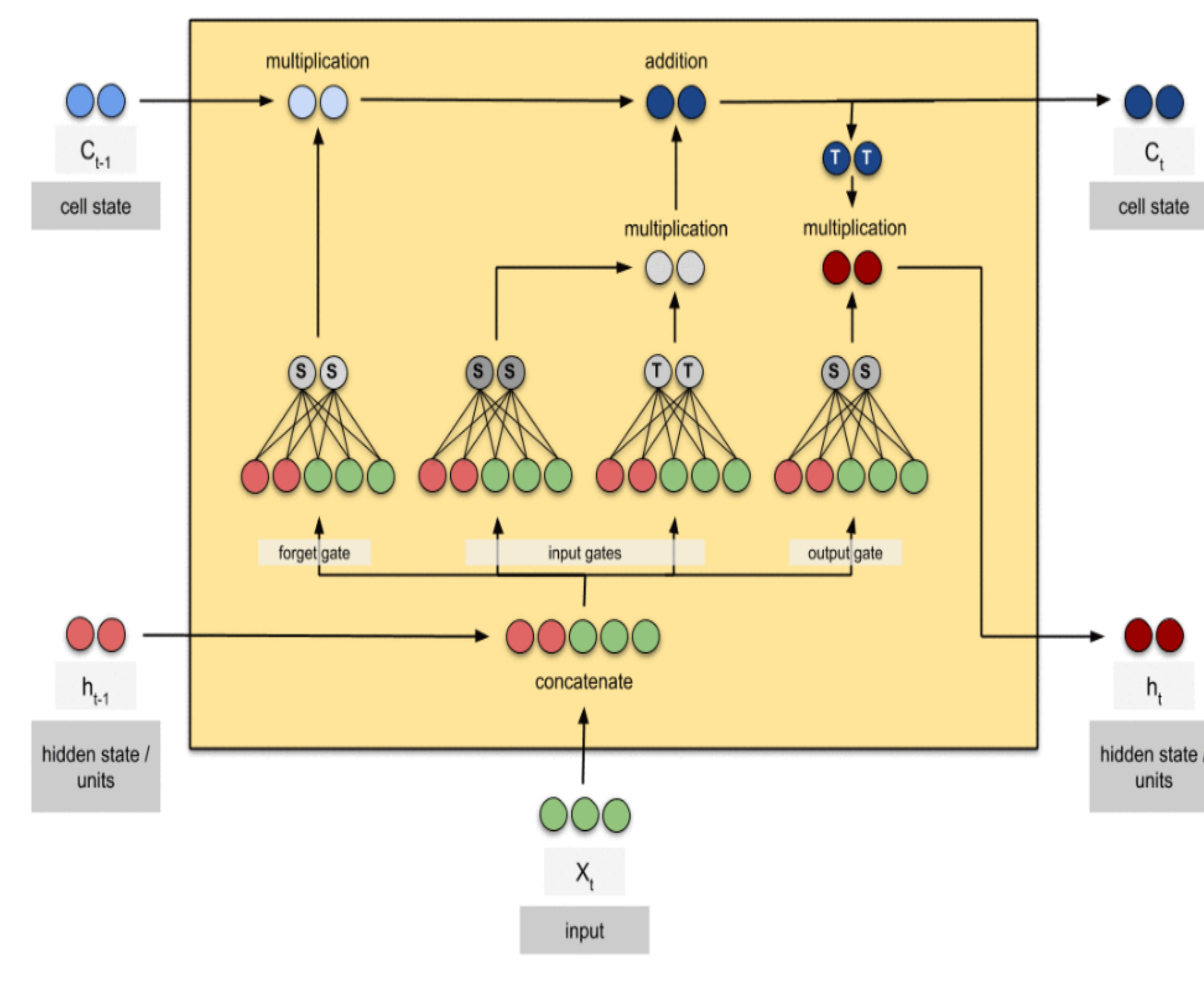
- Problem Statement:** Predict the likelihood of using an app given the former sequence of application usage
- Idea:** Use conditional probability $P(A|B) = \frac{P(A \cap B)}{P(B)}$
- A1. Markov Chain:** Only the current state q_{i-1} plays the most crucial role in predicting the future in the sequence
 $P(q_i = a | q_1 q_2 \dots q_{i-1}) = P(q_i = a | q_{i-1})$
- A2. Output Independence:** The probability of observing an event o_i only relies on the state q_i that directly produced o_i
 $P(o_i | q_1, \dots, q_i, \dots, q_T, o_1, \dots, o_i, \dots, o_T) = P(o_i | q_i)$



- Metrics:** Preds==True if within top n probabilities of the app

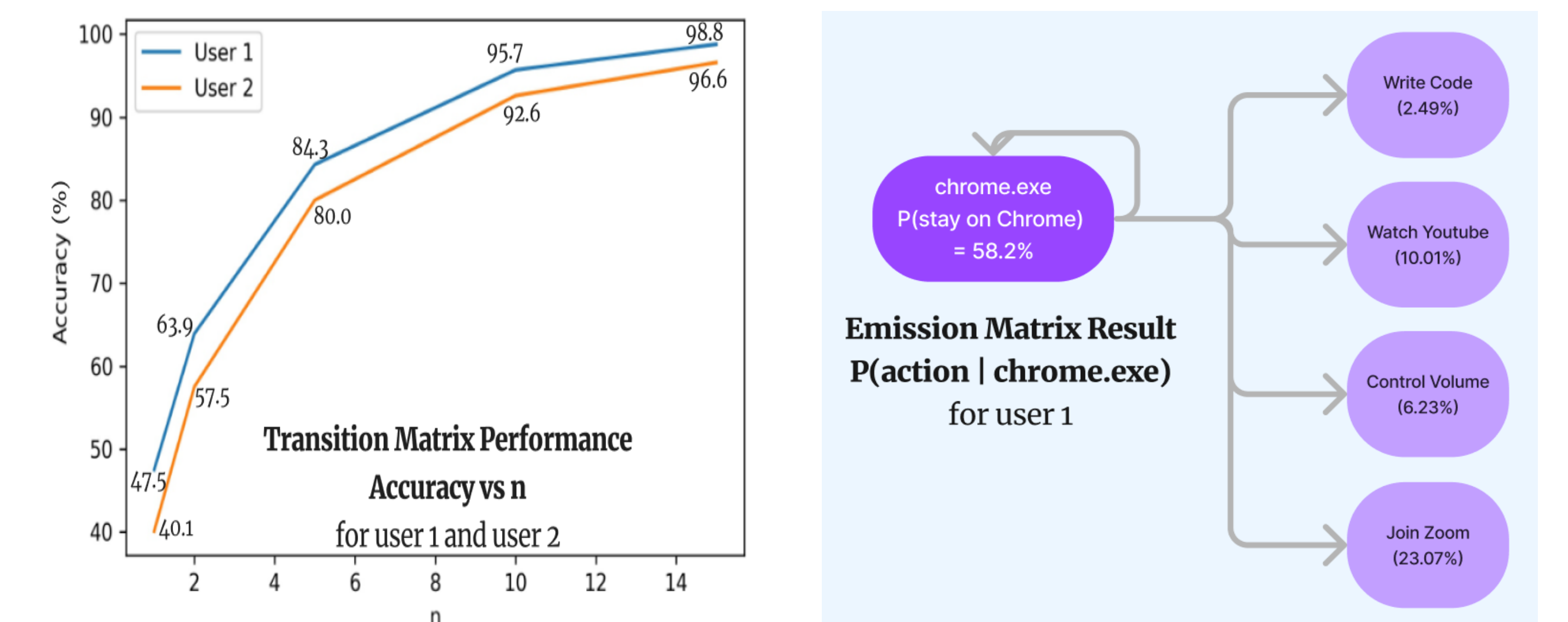
Recurrent Neural Network (LSTM/RNN)

- Problem Statement:** Predict the (total) time usage of an app/tab/recorded process using the past *time-series* data

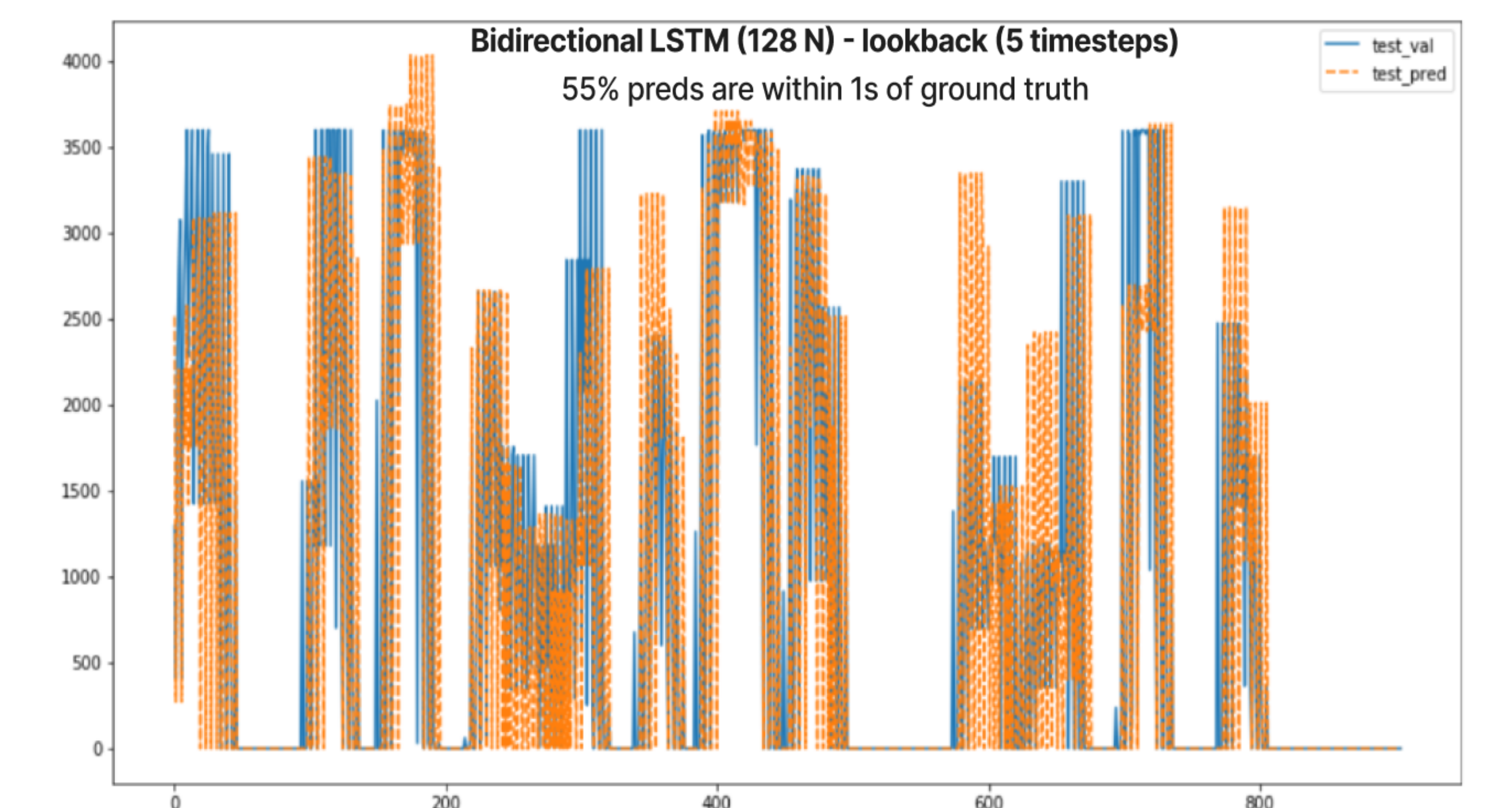
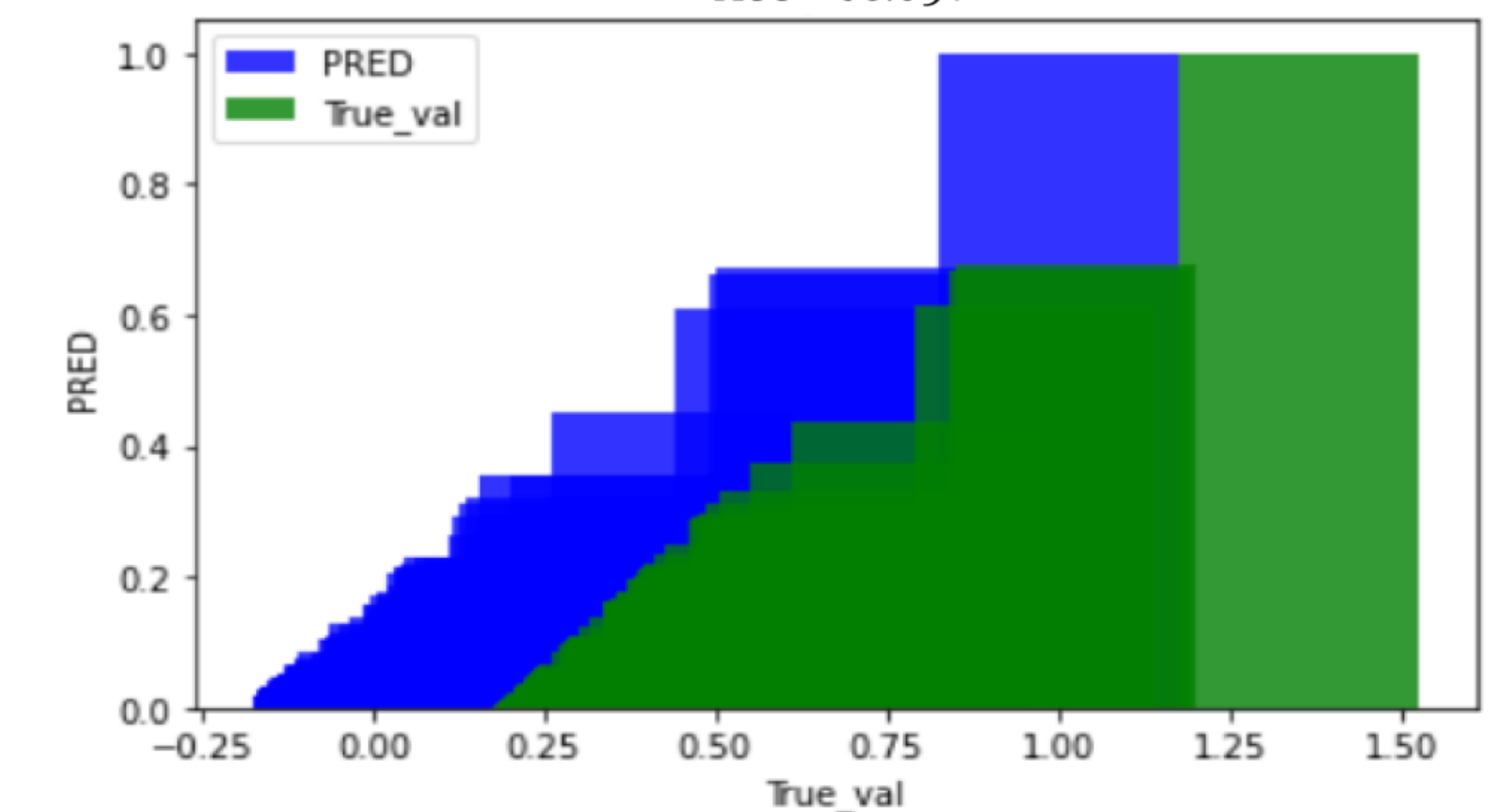


- Feature Engineering:**
 - Hourly split daily usage into 24 cols (labeled 0 - 23)
 - Lookback 3-5 time steps from the current timestamp
 - One-hot-encoding; Min-Max scaler
- Experiments:** Train/Test: 80/20, no shuffle
- Metrics:** RMSE, TP/TN/FP/FN, Preds==True if w/in 1 sec

Predictive Results



Stacked LSTM (16N, 32N, 64N, 1N)
split 24hrs, one-hot (process name)
ACC = 68.65%



Conclusions

- Data should be collected continuously and consistently to achieve high accuracies in detecting patterns of user behaviors
- Using these results helps infer the daily sequence of apps and usage time, so we can further develop a script to process the background tasks and utilize the *Task Manager* to open the next app 2-3 mins beforehand