



InfraRAT: Data Analysis Platform for Behavioural Neuroscience Research

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<http://ratbat.cas.mcmaster.ca/> github.com/OCD-Rats-Capstone/OCD-Rat-Infrastructure



Engineering

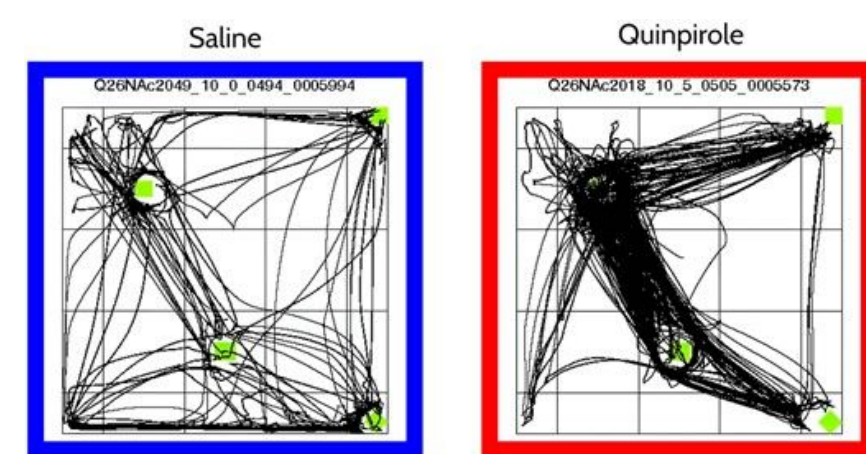
Introduction

Motivation

The management, exploration, and visualization of behavioral neuroscience data is hindered by isolated data silos, rigid schema constraints, and ad-hoc analysis tools. Modern behavioral research generates large-scale datasets spanning thousands of experimental sessions, with complex, multidimensional relationships between subjects, surgical manipulations, pharmaceutical treatments, and granular behavioral observations.

The Problem:

Traditional methods of data management (such as scattered spreadsheets and isolated SPSS files) are cumbersome, error-prone, and severely limit a researcher's ability to cross-reference data or perform longitudinal studies efficiently.



Objective

Deliver a secure platform that enables seamless multi-source data ingestion, natural language querying, and dynamic visualization, accelerating progress in OCD behavioral research.

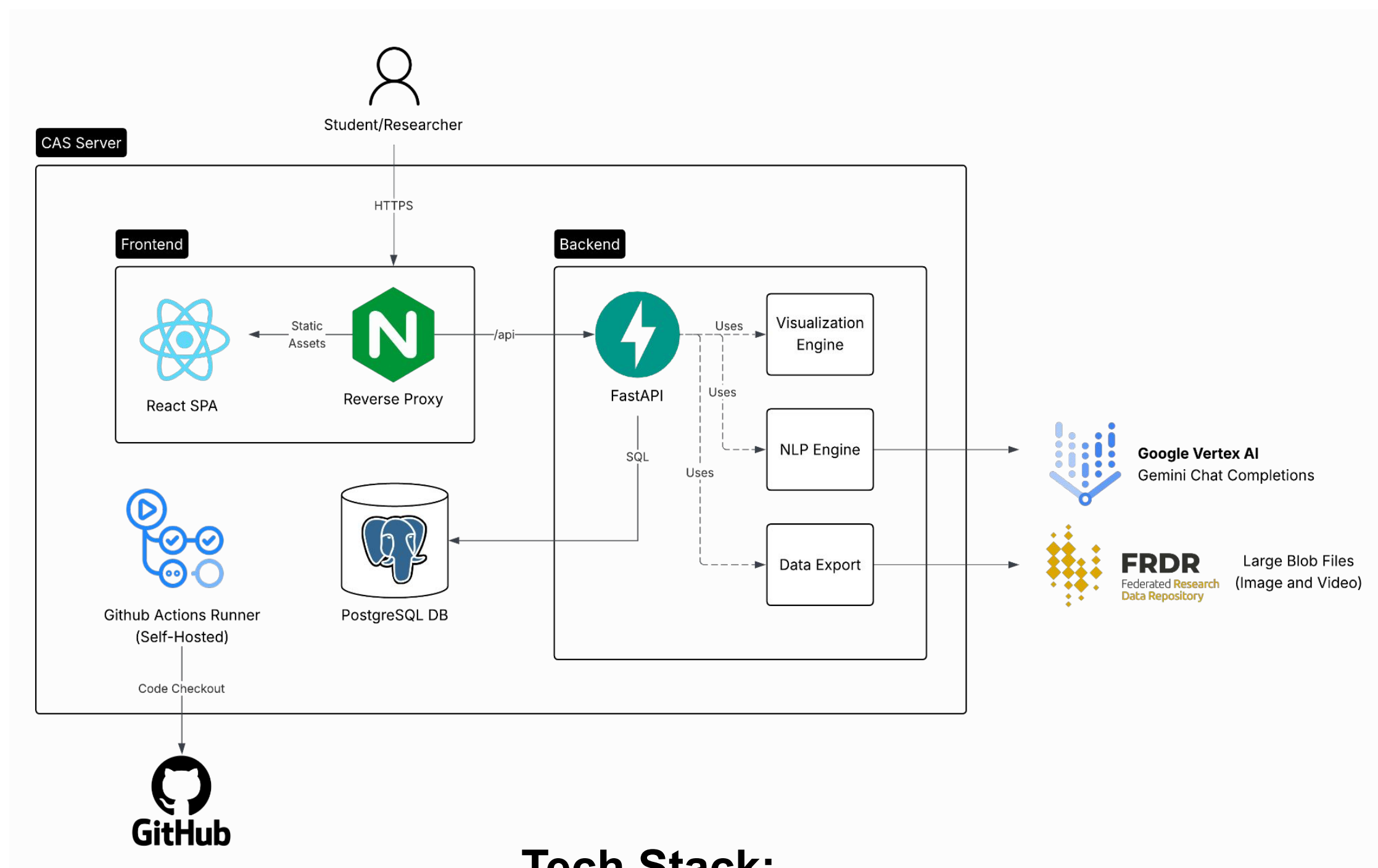
Centralized Data Hub: Provide a robust relational database capable of supporting session-centric neurobehavioral data schemas to serve data for students and researchers alike. Leverage session filter output to provide a unified hub for downloading otherwise fragmented experimental files.

Extensible Analytics Platform: Offer dynamic data exploratory capabilities through a robust, configurable Visualization Engine of compulsive checking criteria. Allow for session-based visualizations for evaluating the size of datasets based on parameters such as drug injection. Provide analytical tools to evaluate single sessions including a path plot trajectory and various summary measures.

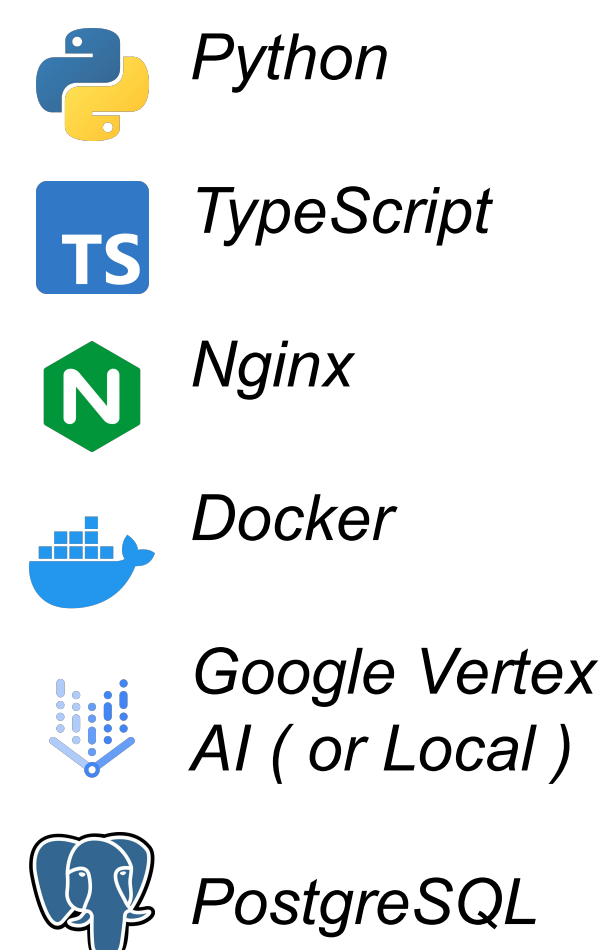
Artificial Intelligence Enabled Insights: Provide access for non-technical students and researchers to perform granular, fine-tuned queries on the available data powered by an LLM pipeline which transforms natural language into robust SQL queries, expanding the possibilities of experimental design with the available dataset.

Engineering Overview

Architecture Diagram:



Tech Stack:



Results

Natural Language Querying Interface: Researchers can query the database conversationally without SQL knowledge, using Ask mode for autonomous execution or Select mode to review the generated SQL, with matched session files available for instant download.

Dynamic Data Visualization Engine: The platform offers Bar Charts, Line Charts, Heatmaps, and a Behavior Graph Dashboard that consolidates five key queries into a unified multi-panel view for rapid behavioral exploration.

Filterable Data Inventory: A Data Inventory view displays raw file counts across the dataset, filterable by drug treatment, file type, drug regimen, brain manipulation, and apparatus, with a toggle to isolate unoperated subjects.

Analysis ToolBox: Researchers can load any rat session by ID to inspect its full tracked data points and Path Trajectory map for session-level behavioural analysis.

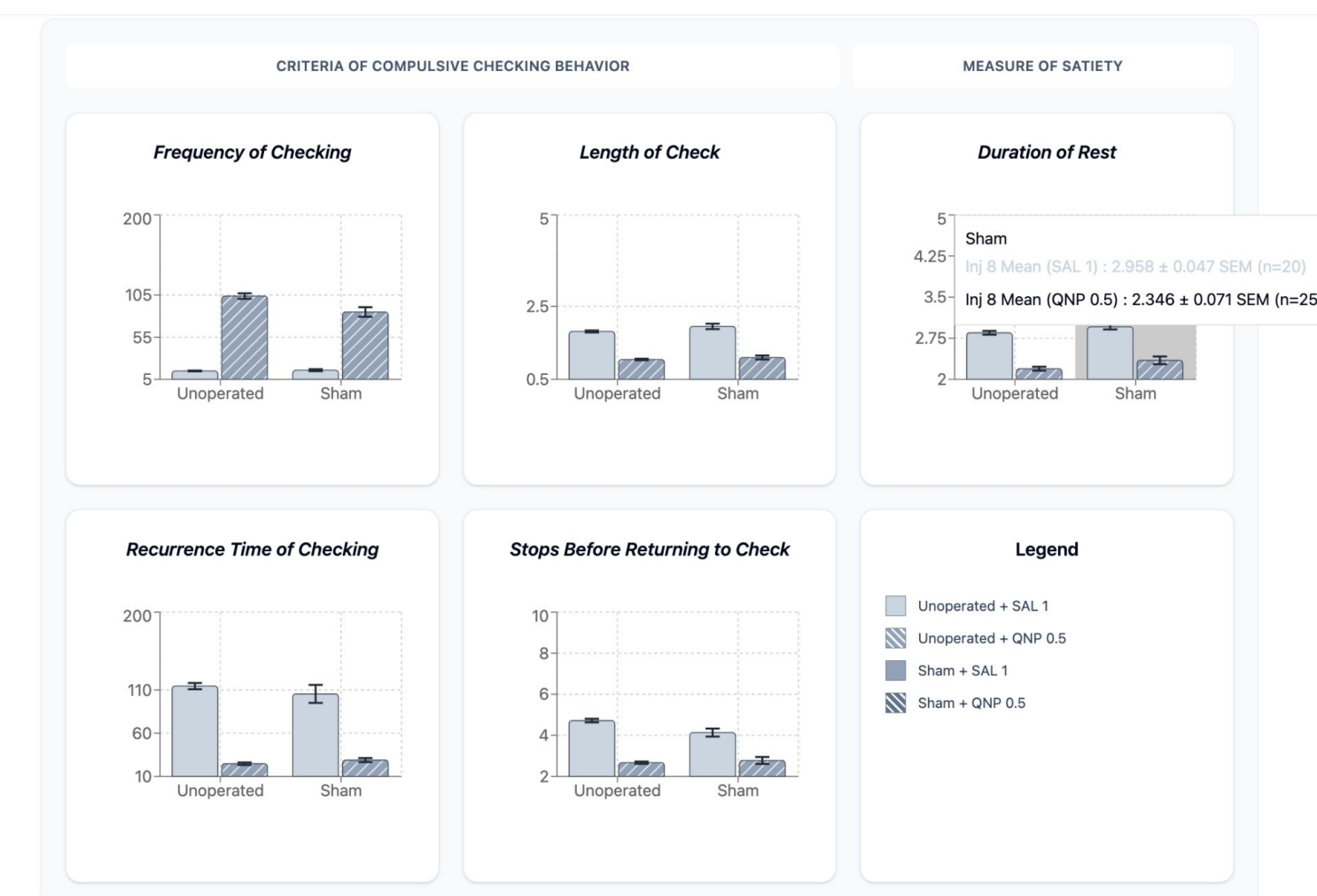


Figure 1: Performance on Criteria of Compulsive Checking using the Tucci et al. (2014) Method

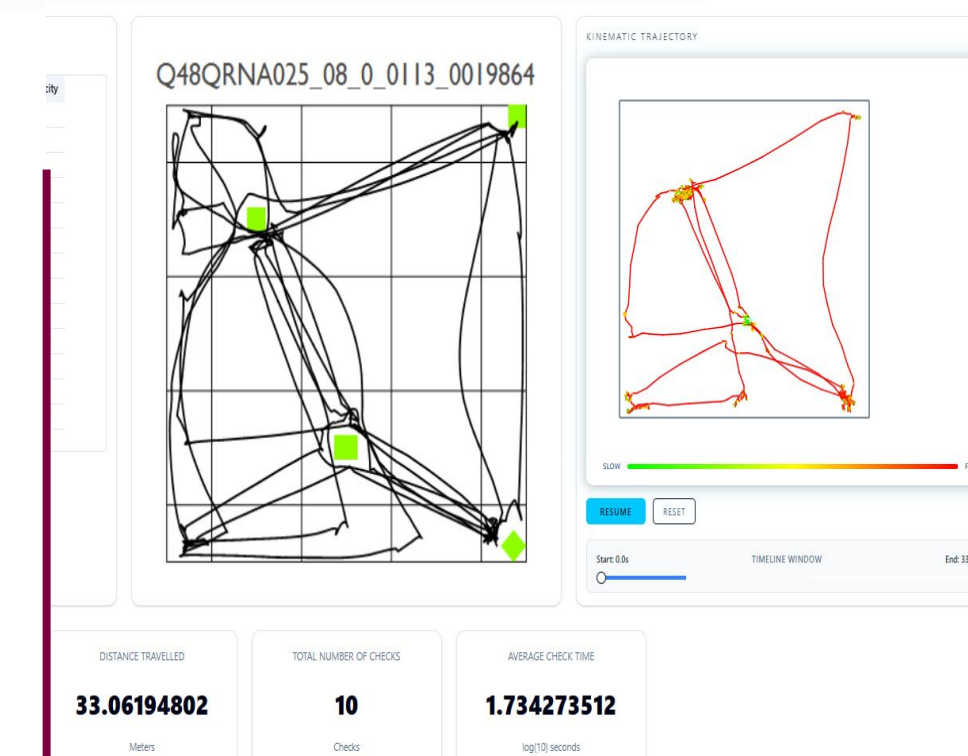


Figure 2: Analysis of OCD Rat Session. Path Trajectory and Behavioural Summary Statistics

This tool is designed to help you navigate and analyze the "Szechtman Lab's behavioral database", which focuses on the "quinpirole-induced compulsive checking model of OCD" in rats. measures (e.g., checking frequency, duration, or ritualization) across different drug treatments and doses.. "Understand the Model:" Learn about the quinpirole sensitization protocol and why it serves as a validated animal model for Obsessive-Compulsive Disorder. "large open field" setup and how "checking" is operationally defined, how the database is structured (e.g., tables for subjects, sessions, and movement data) to help you perform your own analysis. in rats. How can I help you get started?

Ask, Search or Chat...

Dummy Token Usage: 1%

Figure 3: Natural Language Engine to convert non-technical language into SQL queries.

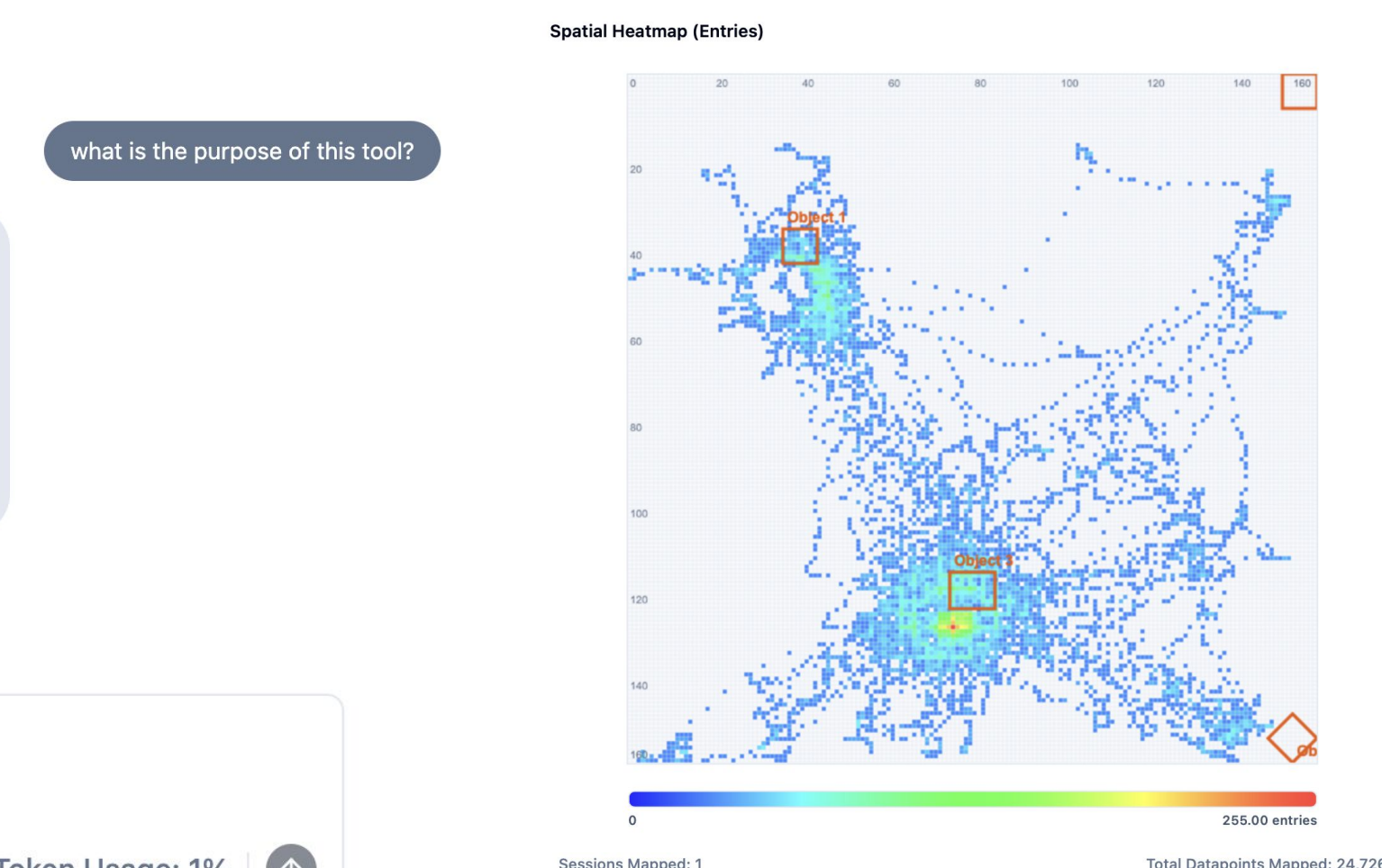
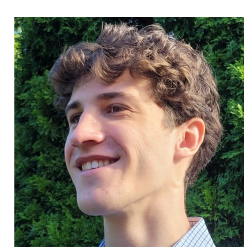
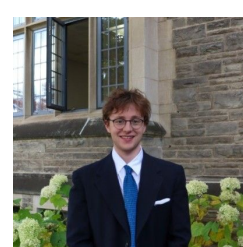


Figure 4: Spatial heat map of rat path trajectory, with overlaid object markers.



Gouda Engineers Capstone Team



Szechtman Lab Collection Team

References

- Tucci, Mark C., et al. "Performance of compulsive behavior in rats is not a unitary phenomenon – validation of separate functional components in compulsive checking behavior." *European Journal of Neuroscience*, vol. 40, no. 6, 16 June 2014, pp. 2971–2979, <https://doi.org/10.1111/ejn.12652>.
- Nucleus Accumbens Core and Pathogenesis of Compulsive... : Behavioural Pharmacology*, journals.lww.com/behaviouralpharm/fulltext/2015/02000/nucleus_accumbens_core_and_pathogenesis_of.23.aspx. Accessed 27 Mar. 2026.