Second Option :
Detecting Autism Patterns in Brain Signals

Beyond Static Averages: Quantifying Temporal Dynamics in Calcium Imaging

Background & Topic

The Biological Problem

- **Context:** Shank3 mutation cause Autism.

- **Discovery:** Recent reveals this mutation affects OPC cells.

- **The Phenomenon:** Mutant cells exhibit a "Fading Phenotype"

The Task

Supervised Binary Classification: Predict WT vs. Mutant .

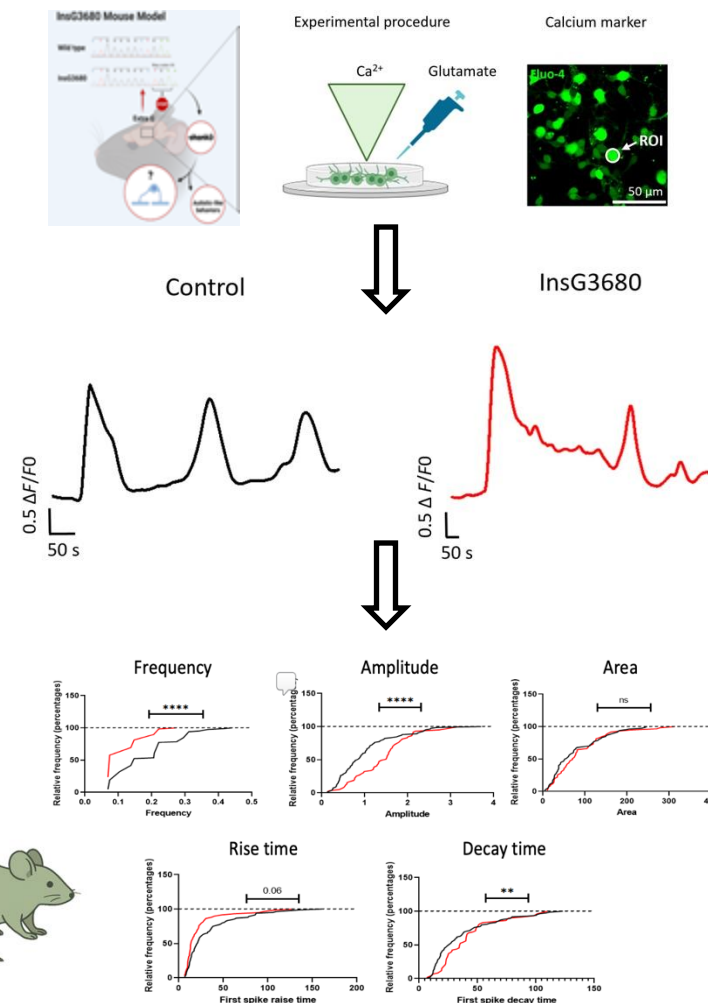| Source	Data Type	Dimensions
Boaz Barak's Lab	Time-Series (Calcium Traces)	810 Frames (15 min) x 1000 ROIs

The Baseline

- **Existing analysis:** relies on static averages

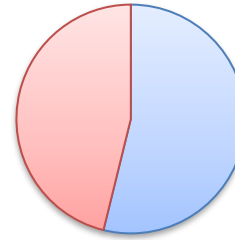- **The Current Limitation:** High information loss.

Feasibility Analysis

Curation Pipeline:

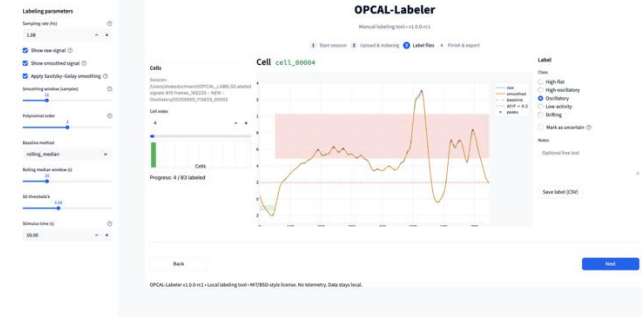Legacy CSVs → New Recordings → Cleaning & ID Mapping → Unified Dataset

Initial Data Exploration

- **Total Samples (ROIs):** N = 4,600

- **Time Series Length:** 810 frames (15 mins) @ 1.1s interval.

- **Key Event:** Glutamate Injection at frame ~102.

□ WT □ Mutant

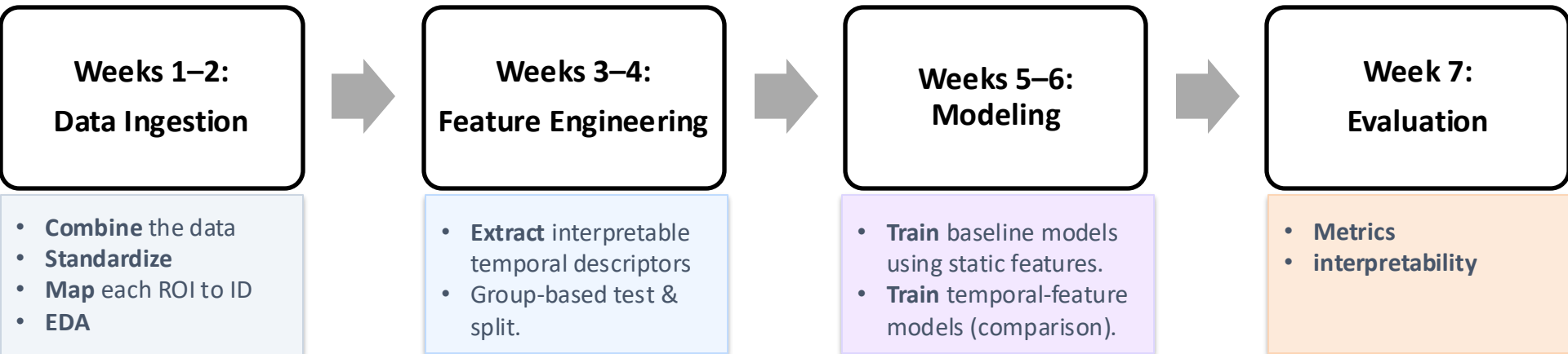## Our DS Innovation: Temporal Feature Engineering

- **Proposed Features**: Decay Slope (rate of decline), Early-vs-Late activity ratio, Stability across time.

- **Group-level split** by animal to prevent data leakage.

Why is this Feasible?

- **Scientific Validity:** The "Fading" effect is a documented biological mechanism.

- **Baseline Evidence:** Baseline showed that even simple achieve partial separation.

Methodology

Project Work Plan

Weeks 1–2: Data Ingestion	→	Weeks 3–4: Feature Engineering	→	Weeks 5–6: Modeling	→	Week 7: Evaluation

Weeks 1–2: Data Ingestion
- **Combine** the data
- **Standardize**
- **Map** each ROI to ID
- **EDA**

Weeks 3–4: Feature Engineering
- **Extract** interpretable temporal descriptors
- Group-based test & split.

Weeks 5–6: Modeling
- **Train** baseline models using static features.
- **Train** temporal-feature models (comparison).

Week 7: Evaluation
- **Metrics**
- **interpretability**

Success Criteria

- **Quantitative:** Improvement over the static baseline.

  Better generalization across animals in group-based test splits.

- **Qualitative :** Identification of **new** temporal features that capture the fading signature.