1. **Preprocessing & Cleaning**:  
   I cleaned the dataset, handled missing values, and normalized skewed features using Log transformations. Data was then standardized to prepare for modeling.
2. **Exploratory Analysis**:  
   I generated descriptive statistics, visualized distributions, and examined correlations to understand variable behavior. Key metrics like fixation count, pupil size, and saccade amplitude showed strong variability.

A screenshot of a graph

AI-generated content may be incorrect.

1. **Unsupervised Learning**:  
   I explored dimensionality reduction (PCA, t-SNE, UMAP) and clustering (KMeans), but cluster separability was limited. This suggested that performance differences may be more nuanced than captured by gaze metrics alone.

A diagram of a cluster of dots

AI-generated content may be incorrect.A diagram of a blue dot

AI-generated content may be incorrect.A red and blue dots

AI-generated content may be incorrect.

1. **Supervised Modeling**:  
   Using binary accuracy labels, we trained Random Forest models and identified key predictors. Metrics like fixation count and pupil dynamics contributed meaningfully to classification.

A screenshot of a black screen

AI-generated content may be incorrect.

1. **Conceptual Contributions**:  
   We framed new research questions around adaptive testing enhanced by eye-tracking, including detecting guessing behavior and modeling engagement for personalized item delivery.

    Q1: What eye movement patterns best distinguish high- vs. low-performing participants across item types? Compare eye-tracking metrics.

    Q2: How can machine learning models personalize item delivery based on momentary attentional states? Train supervised models to predict attentional engagement using gaze patterns. Use model outputs to dynamically adapt item sequencing or difficulty.

    Q3: Is adaptive testing based on both behavioral (gaze) and performance data more robust to guessing or gaming strategies? Identify markers of guessing (e.g., rapid response + shallow gaze). Simulate or detect strategic behaviors and test robustness of behavioral-based adaptation.