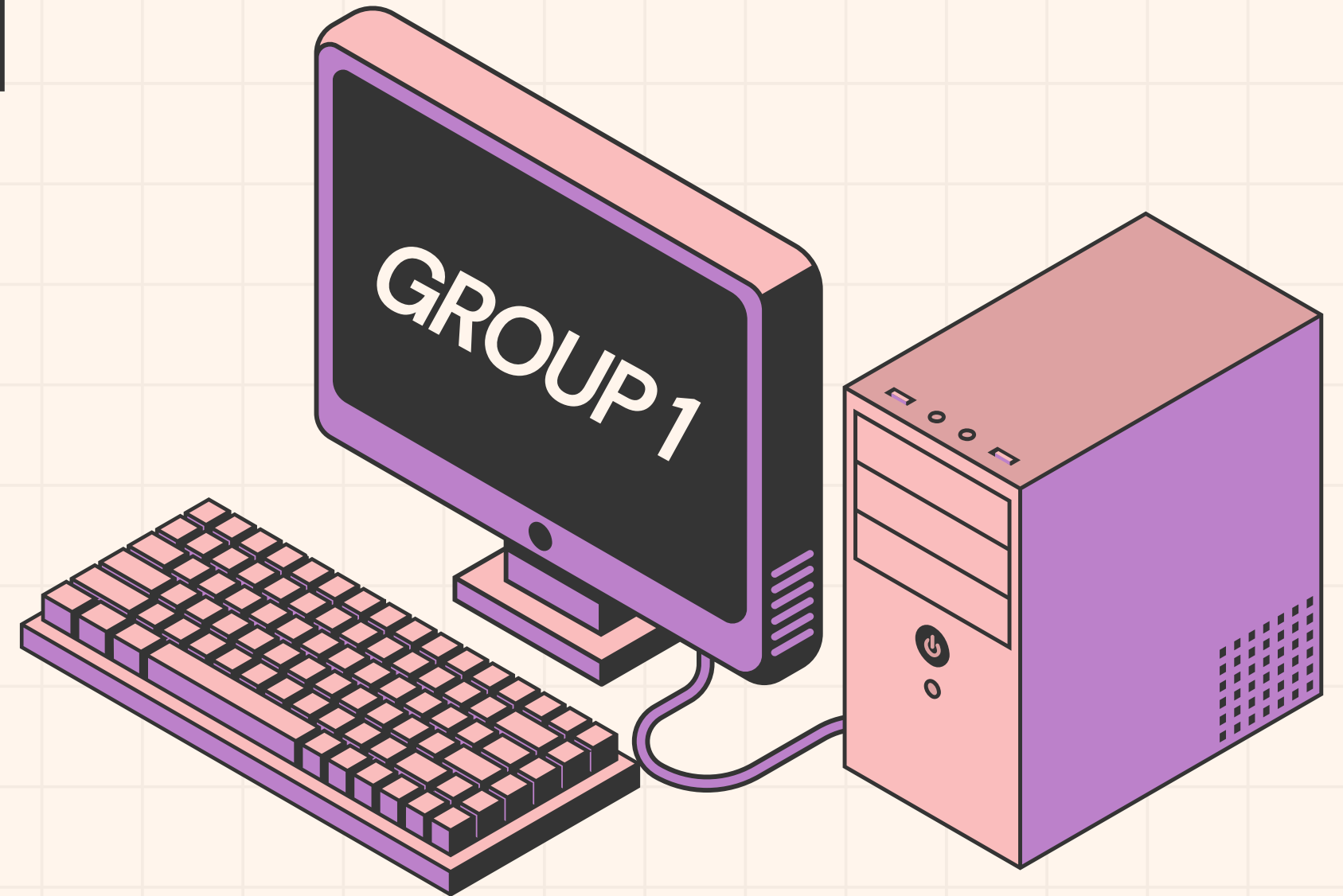


AD CLICK PREDICTION USING CLOUD-BASED MACHINE LEARNING

Group 1– Minju Kim, Peijing Lin, Wynter Lin



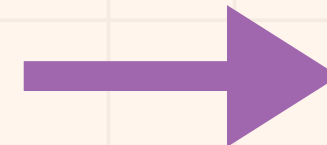
PROBLEM STATEMENT & BUSINESS CONTEXT

PROBLEM STATEMENT

- Advertisers face low CTRs and inefficient targeting
- Cross-channel data is complex to integrate in real-time
- High-dimensional data needs significant preprocessing
- Hard for business teams to act on technical insights

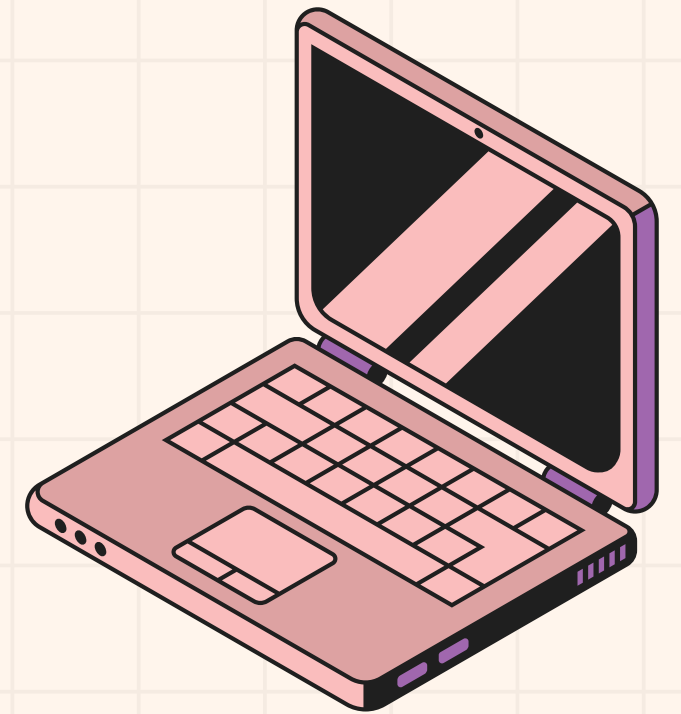
BUSINESS CONTEXT

- Ad engagement = revenue in media & entertainment
- Need to optimize ad spend with better predictions
- Model goal: predict who will click, in real-time



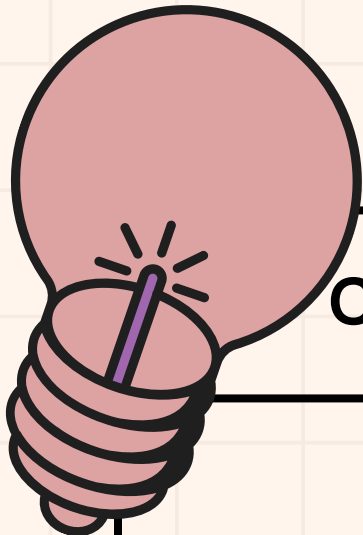
BENEFITS

↑ ROI via precise targeting
Personalized ad experiences
Actionable insights for business users



CLOUD STRATEGY OVERVIEW

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COMPONENT	DESCRIPTION/TOOL	PURPOSE
GOAL	Real-time ad click prediction	Maximize campaign ROI
DEPLOYMENT MODEL	Fully Cloud-Native	No hybrid / on-perm components
SERVICE MODELS	PaaS: Azure ML, Stream Analytics, Data Factory SaaS: Power BI	Fast deployment + analytics
SECURITY & GOVERNANCE	Azure RBAC, encryption, compliance	Safe & compliant data handling
TRADE-OFFS	Latency-cost balance, interpretability	Focus on business-friendly insights

CLOUD-BASED AD CLICK PREDICTION SOLUTION

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◁ARCHITECTURE FLOW▷

User Data (Web / App / Email)



Azure Data Factory: Data Ingestion & orchestration



Azure Stream Analytics: Extracts real-time features



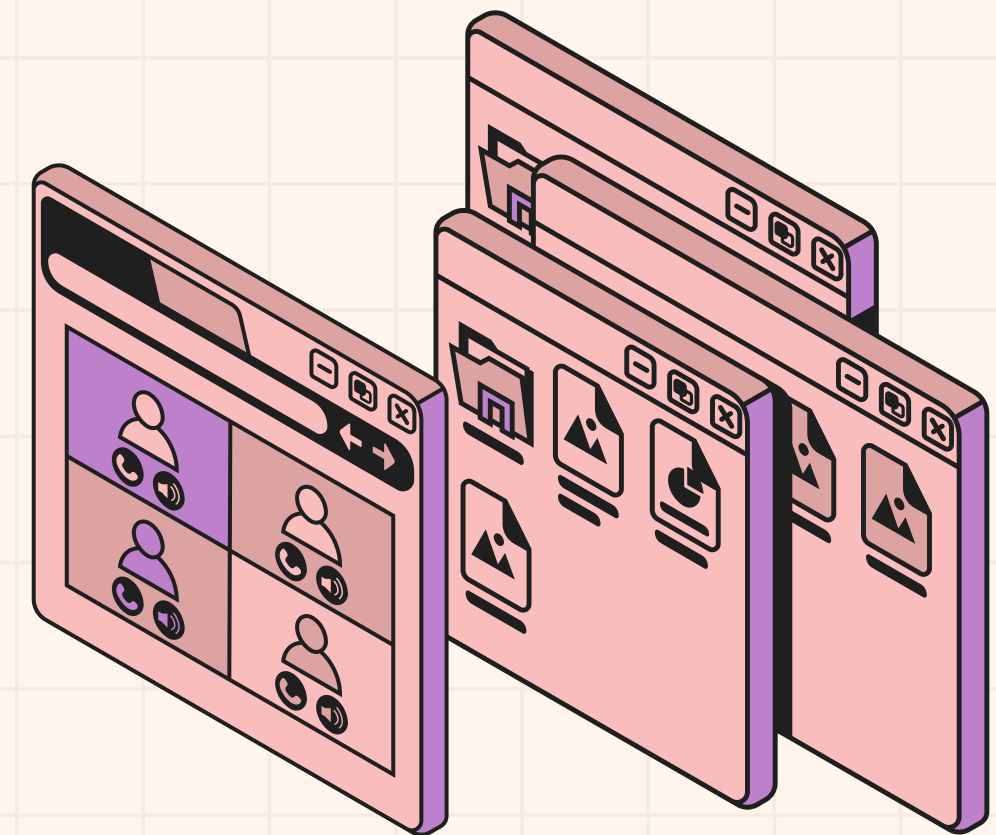
Azure ML Designer: Train & deploy classifier



Power BI: Live dashboards (A/B testing, reports)

◁FEATURES & BENEFITS▷

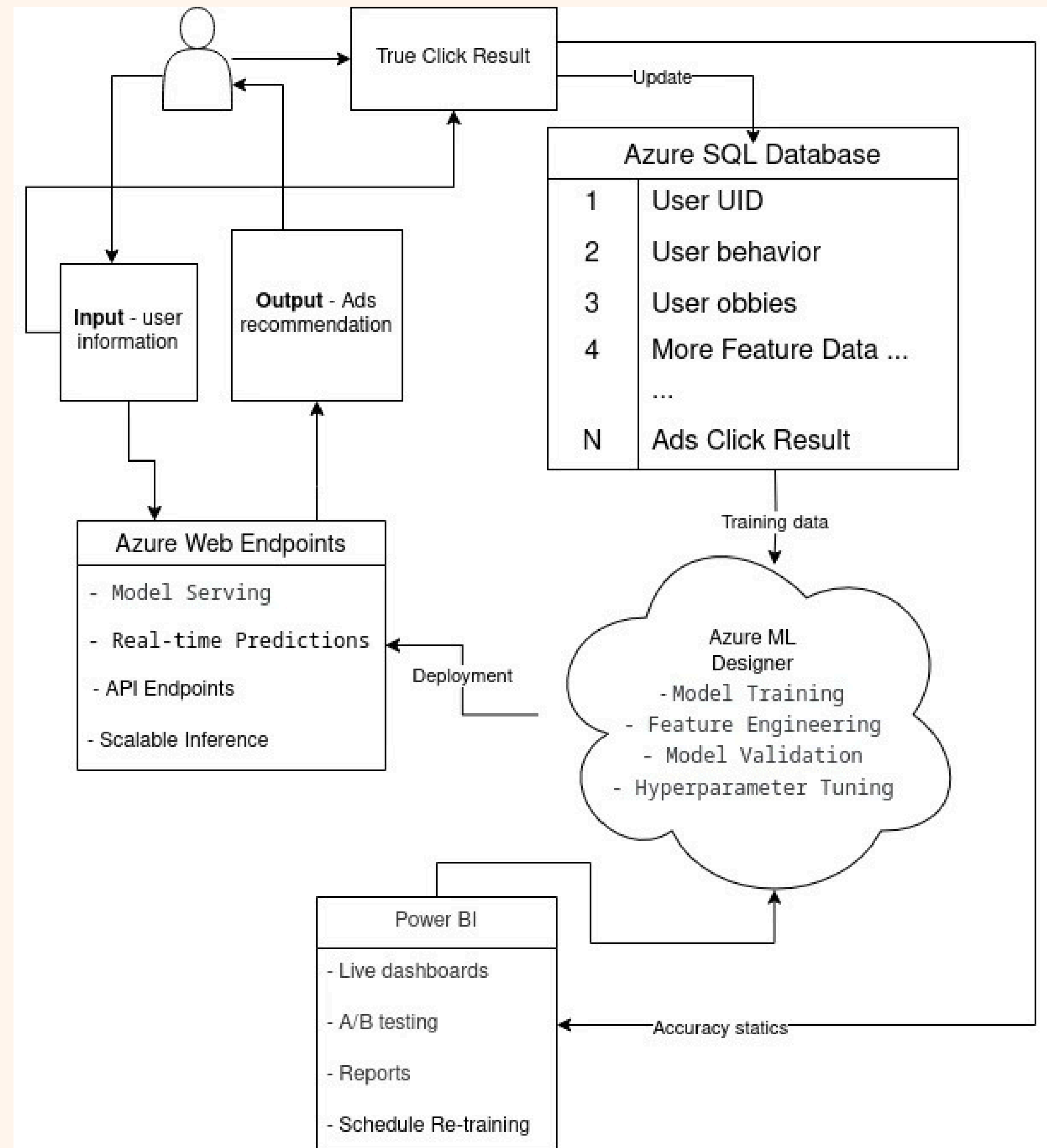
- Real-time insights (e.g., time since last click)
- Predictive model as web service
- A/B testing support
- Dashboards for non-technical users
- Better targeting = better ROI



Solution Summary

- ➊ Real-time decisioning
- ➋ Adaptive learning
- ➌ Scalable architecture
- ➍ Data-driven optimization
- ➎ Enterprise reliability

ARCHITECTURE DIAGRAM



AZURE SERVICES USED



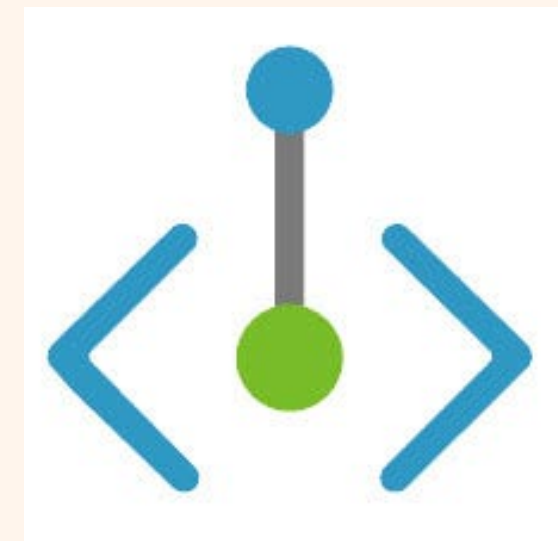
AZURE SQL DATABASE

- PROVIDES PRIVACY
- COMPLIANCE, HIGH AVAILABILITY
- SEAMLESS INTEGRATION WITH OTHER AZURE SERVICES



AZURE ML DESIGNER

- OFFERS LOW-CODE/NO-CODE INTERFACE FOR RAPID PROTOTYPING
- BUILT-IN ALGORITHMS FOR CLASSIFICATION TASKS
- INTEGRATED EXPERIMENT TRACKING



AZURE WEB ENDPOINTS

- PROVIDES AUTO-SCALING CAPABILITIES
- MANAGED INFRASTRUCTURE
- RESTFUL API INTERFACES.



POWER BI

- NATIVE INTEGRATION WITH AZURE SERVICES
- COLLABORATIVE FEATURES FOR STAKEHOLDERS
- ADVANCED ANALYTICS CAPABILITIES FOR A/B TESTING INSIGHTS

Why Public Cloud on Azure?

Existing components

High Security

Availability

Scalability (pay as you go)

Easy Integration



End-to-End Flow & Features

Data Ingestion & Preprocessing

- Multi-channel data collection: Web logs, mobile events, email engagement data
 - Feature engineering: Historical aggregates, temporal features, behavioral patterns, contextual data (device, location, referral source)
-

Model Training & Deployment

- Development: Azure ML Designer workflows, multiple algorithm testing (Logistic Regression, Random Forest, Gradient Boosting)
 - Optimization: Hyperparameter tuning, cross-validation, performance benchmarking
 - Deployment: Azure Web Endpoints, A/B testing, versioning/rollback, monitoring
-

Real-Time Prediction

- Inference pipeline: Real-time feature collection, edge preprocessing, RESTful API calls, sub-100ms response times
- Feedback loop: Click outcome tracking, data quality monitoring, automated retraining triggers, incremental learning



Deployment Strategy & Cloud Service Models

Cloud Service Architecture

- PaaS Foundation: Azure ML Designer, SQL Database, and Web Endpoints for fully managed infrastructure with auto-scaling
- SaaS Integration: Power BI for business intelligence and stakeholder collaboration

Strategic Deployment Pillars

Scalability & Performance

- Horizontal scaling for inference, vertical scaling for training workloads
- Auto-scaling policies for cost-optimized resource allocation

Security & Compliance

- Role-based access control (RBAC) across all services
- End-to-end encryption with Azure Key Vault integration

Business Continuity

- Multi-region deployment for high availability
- Automated backup and defined RTO/RPO objectives

Cost Optimization Approach

- Reserved instances for predictable workloads, spot instances for training
- Comprehensive monitoring with Azure Monitor and automated alerting



BOTTLENECKS & LIMITATIONS



HIGH DATA PREPROCESSING COST

Data comes from different sources with inconsistent formats. The cleaning and transformation process is complex, time-consuming, and error-prone before the data can be used for training.



INEFFECTIVE FEEDBACK MECHANISM AND LACK OF ADAPTABILITY

The system only updates the model on a fixed schedule, like once a day.

That means it doesn't quickly learn from user actions and can't respond when user interests change suddenly.

Eg. If a user stops clicking on travel ads in the morning, they might still keep seeing them all day—because the model won't retrain until the next day.

AD CLICK PREDICTION USING CLOUD-BASED MACHINE LEARNING

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Scalability

→ Automatically adjusts resources based on traffic and workload.

Real-time Inference

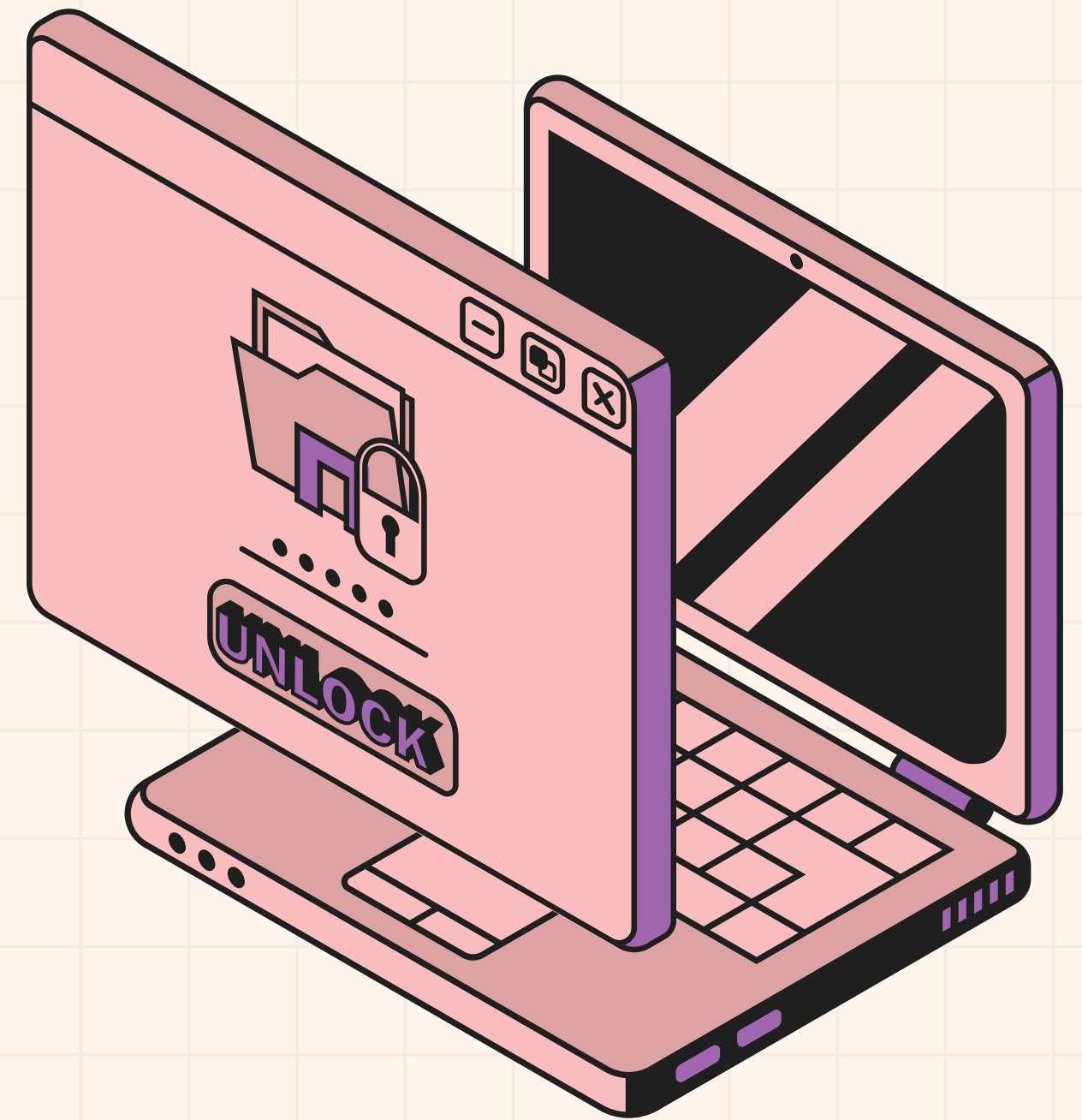
→ Delivers instant ad predictions through Azure Web Endpoints.

Automation

→ Enables end-to-end automation of training, deployment, and data workflows.

Simplified Operations

→ Built-in monitoring, security, and backup reduce operational effort.



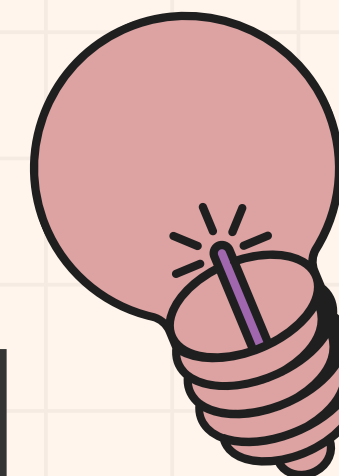
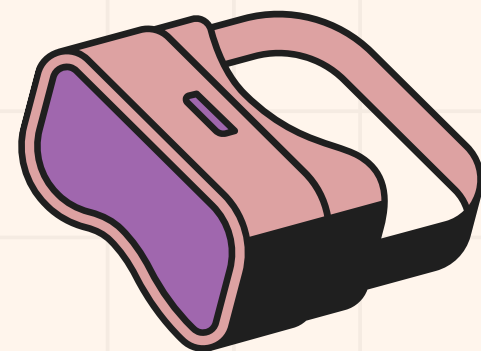


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THANK YOU

