TerraGuard

AI-Driven Sinkhole Susceptibility Application

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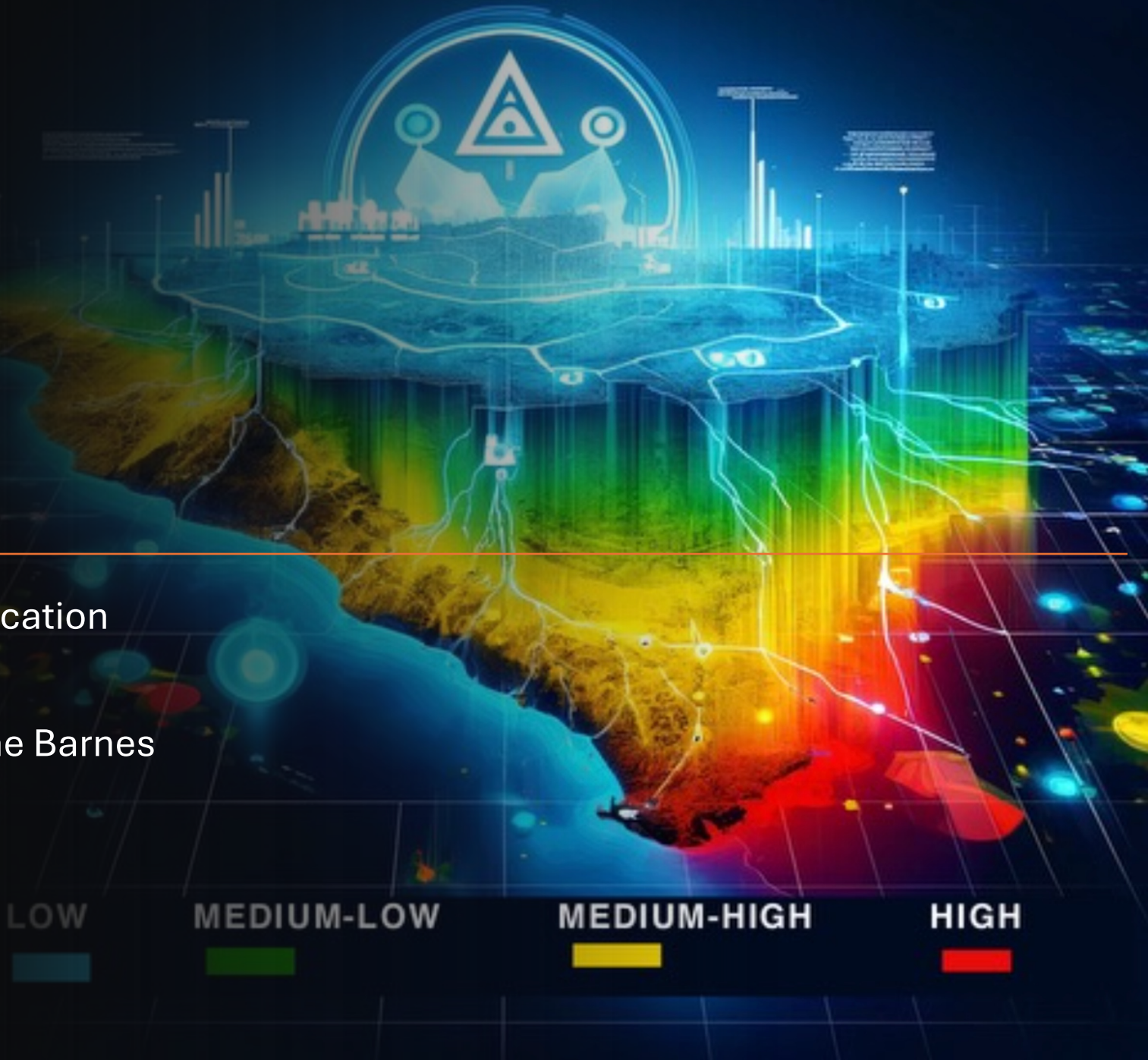


Project Goals

1. Predict Sinkhole Susceptibility
   - Use AI and machine learning to predict areas at risk of sinkhole formation
2. Prevent Risks
   - Provide insights to help prevent and reduce the impact of sinkholes on communities and infrastructure
3. Data-Driven Decision Making
   - Enable stakeholders to make informed decisions based on predictive analytics
4. Enhance Public Safety
   - Increase awareness and preparedness for potential sinkhole hazards

Solution Components and Architecture

Data Sources

Sinkhole Data

- The Sinkhole Data in the *.csv* file is sourced from public databases of sinkholes in Missouri
- This data forms the basis for training the ML model and predicting future sinkholes

Raster Files

- The Raster Files in the *.tiff* file are sourced from various public databases
- This data represents detailed geological, geophysical and topographical information crucial for analyzing and predicting sinkhole susceptibility.

Solution Components and Architecture

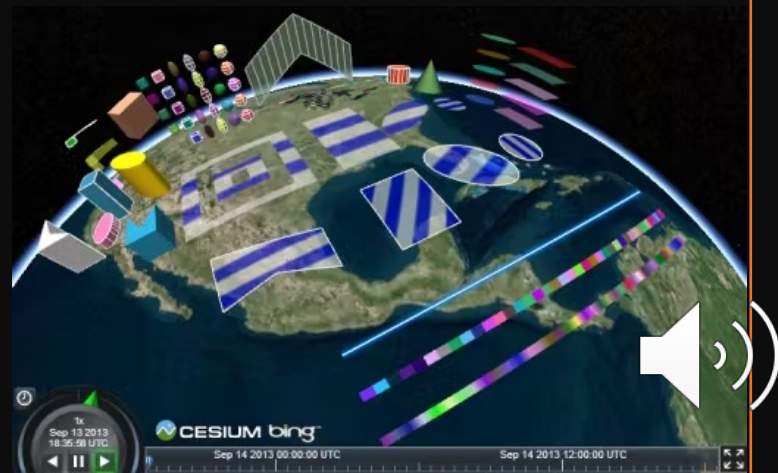
AI Model

- The CatBoostClassifier is used to train and apply models for classification problems
- The Classifier is being used to predict sinkhole susceptibility

Solution Components and Architecture

Web Applications

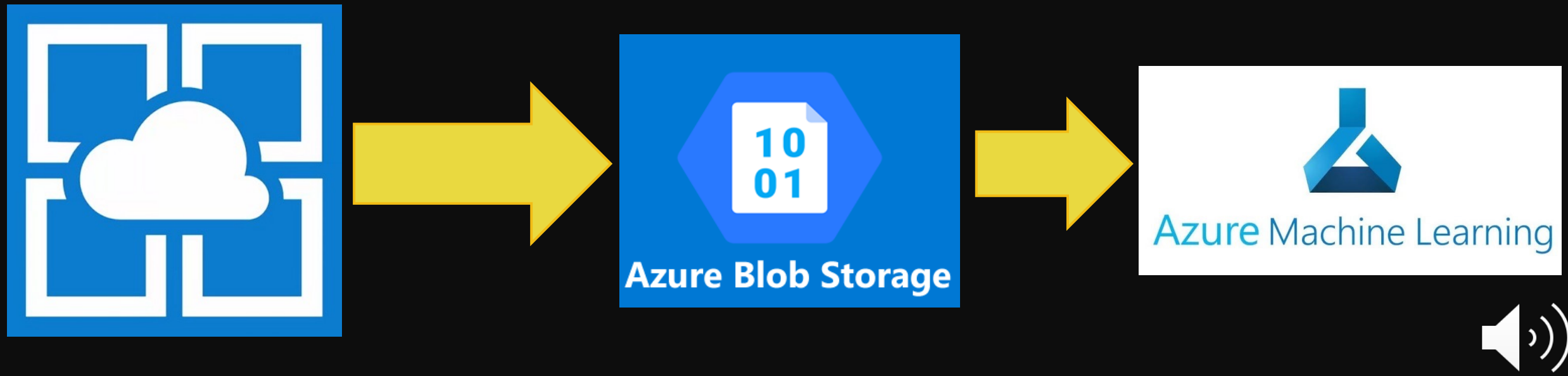
- Flask-based web app used for data upload, processing, and visualization within a Python Framework
- Leaflet and Cesium used for 3D Visualization of maps



Solution Components and Architecture

Deployment

- Hosted on Azure App Service
- GitHub Actions for Azure
- Machine learning model run on Azure Machine Learning workspace based on datasets managed and pulled from the Azure Blob Storage



Solution Components and Architecture

Approach and Thought Process

Data Collection:
- Gathered sinkhole and raster data from various sources

Model Development:
- Selected CatBoost for its performance with categorical data and robustness
- Trained and validated the model using historical sinkhole data

Web Application Design:
- Developed a user-friendly interface for data upload and analysis
- Implemented interactive visualizations for better insight

Deployment Strategy:
- Chose Azure ML for scalability and ease of deployment
- Used Docker for containerization and consistent environment setup

Solution Components and Architecture

Big Picture!

Solution Components and Architecture

Key Learnings

Data Quality is Crucial:

- High-quality and diverse data sources significantly improve model accuracy

Model Selection Matters

- Choosing the right machine learning model is essential for reliable predictions

User-Centric Design:

- Designing with end-users in mind ensures the application is practical and easy to use

Scalability and Flexibility:

- Leveraging cloud services like Azure enhances scalability and allows for future expansion

Continuous Improvement:

- Iterative development and feedback loops are vital for refining the solution and addressing new challenges