

Car Analysis Suite: Technical Deep Dive

- Subtitle: Cloud-Based Analysis Platform on AWS EC2 Free Tier
- Date: December 30, 2024
- Team: (Insert names or roles)
- Mission: Empowering data-driven decision-making in the automotive industry through cloud-based machine learning and real-time analytics.

Project Overview & Architecture

- AWS Integration:
 - – EC2 Free Tier (t2.micro) hosting
 - – S3 for secure file storage
 - – DynamoDB for audit logging
 - – CloudWatch for monitoring
 - – KMS for encryption

Technical Infrastructure

- Security Implementation:
 - – EnhancedSecurityManager for access control
 - – AuditEventType tracking system
 - – SecureStorageService for file handling
 - – Encryption using AWS KMS
 - – Session management & timeout handling
- Memory Optimization:
 - – SHAPCache implementation
 - – Batch processing with ThreadPoolExecutor

RAG System Architecture

- Document Processing:
 - – PDF extraction with memory constraints
 - – CSV processing with chunking
 - – Error handling & recovery
 - – OCR integration for images
- QASystem Components:
 - – FAISS vector store implementation
 - – BalancedRetriever for document retrieval
 - – DocumentLoader with batch processing
 - – MarketAnalyzer integration

Price Prediction Engine

- Model Architecture:
 - – CarPricePredictor class implementation
 - – Ensemble model approach
 - – Memory-efficient training
 - – SHAP value analysis
 - – Feature importance tracking
- Feature Engineering:
 - – Automated categorical encoding
 - – Numerical transformations
 - – Memory-efficient processing

System Integration

- Combined Workflow:
 - – CombinedCarApp architecture
 - – Component interaction patterns
 - – State management
 - – Error handling strategy
 - – Resource optimization
- Cloud Integration:
 - – AWS service interaction
 - – Security layer integration
 - – Monitoring setup

Performance Optimization

- EC2 Free Tier Considerations:
 - – CPU utilization management
 - – Memory usage optimization
 - – Storage efficiency
 - – Batch processing implementation
- Resource Management:
 - – Cache cleanup strategies
 - – Temporary file handling
 - – Session state optimization
 - – Memory monitoring

Live Demonstration

- Core Features:
 - – File upload & processing
 - – Price prediction workflow
 - – RAG-powered chat interaction
 - – Market analysis generation
- Visualization Features:
 - – Interactive market trends
 - – SHAP value analysis
 - – Feature importance plots
 - – Price prediction confidence intervals

Error Handling & Recovery

- Implementation:
 - – CloudWatch logging integration
 - – Error recovery procedures
 - – User feedback mechanisms
 - – Automatic cleanup processes
- Monitoring:
 - – Resource usage tracking
 - – Performance metrics
 - – Error rate monitoring
 - – System health checks

Security Deep Dive

- AWS Integration:
 - – KMS encryption workflows
 - – S3 secure storage patterns
 - – DynamoDB audit logging
 - – IAM role management
- Application Security:
 - – Input validation
 - – File validation
 - – Session management
 - – Access control

Future Enhancements

- Planned Improvements:
 - – Distributed processing capabilities
 - – Enhanced caching system
 - – Advanced analytics features
 - – Real-time market data integration
- Scalability:
 - – Component isolation strategy
 - – Service separation
 - – Resource optimization
 - – Performance monitoring

Q&A Session

- Technical discussion on implementation details:
 - – AWS optimization strategies
 - – Security considerations
 - – Memory management techniques
 - – Scalability approaches