# 📋 AGENDA DA APRESENTAÇÃO - SentiBR

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## 🎯 ESTRUTURA COMPLETA DA APRESENTAÇÃO

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### 1️⃣ ABERTURA & CONTEXTO *(3 min)*

├─ 1.1 Visão Geral do Desafio

├─ 1.2 Proposta de Solução: SentiBR Platform

├─ 1.3 Arquitetura High-Level

└─ 1.4 Tech Stack Overview

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### 2️⃣ DATA PIPELINE & FEATURE ENGINEERING *(4 min)*

├─ 2.1 Aquisição e Exploração de Dados

│  ├─ Dataset: Brazilian Portuguese Restaurant Reviews

│  ├─ EDA (Exploratory Data Analysis)

│  ├─ Data Quality Assessment

│  └─ Statistical Profiling

│

├─ 2.2 Data Preprocessing Pipeline

│  ├─ Text Normalization & Cleaning

│  ├─ Tokenization Strategy

│  ├─ Train/Val/Test Split (70/15/15)

│  └─ Data Augmentation Techniques

│

├─ 2.3 Feature Store & Versionamento

│  ├─ DVC (Data Version Control) - Ready

│  ├─ Feature Engineering

│  └─ Data Validation (Great Expectations)

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└─ 2.4 Synthetic Data Generation

  ├─ Fallback Strategy para Dataset Issues

  └─ Quality Assurance

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**3️⃣ MODEL TRAINING & FINE-TUNING *(5 min)***

├─ 3.1 Model Selection & Architecture

│  ├─ Base Model: neuralmind/bert-base-portuguese-cased

│  ├─ Transfer Learning Strategy

│  ├─ Architecture Customization

│  └─ Model Complexity vs Performance Trade-off

│

├─ 3.2 Training Pipeline

│  ├─ Hyperparameter Configuration

│  │  ├─ Learning Rate: 2e-5

│  │  ├─ Batch Size: 16

│  │  ├─ Epochs: 3-4

│  │  └─ Max Sequence Length: 128

│  │

│  ├─ Optimization Strategy

│  │  ├─ AdamW Optimizer

│  │  ├─ Linear LR Scheduler with Warmup

│  │  └─ Gradient Accumulation

│  │

│  ├─ Regularization Techniques

│  │  ├─ Dropout (0.1)

│  │  ├─ Weight Decay

│  │  └─ Early Stopping

│  │

│ └─ Training Monitoring

│ ├─ Loss Curves (Train/Val)

│ ├─ Learning Rate Schedule

│ └─ Gradient Norms

│

├─ 3.3 Hyperparameter Tuning

│ ├─ Optuna Integration (Ready)

│ ├─ Search Space Definition

│ ├─ Multi-objective Optimization

│ └─ Best Configuration Selection

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└─ 3.4 Experiment Tracking & MLflow

├─ Experiment Logging

├─ Artifact Management

├─ Model Registry

└─ Reproducibility Guarantees

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**4️⃣ MODEL VALIDATION & EVAL FRAMEWORK *(4 min)***

├─ 4.1 Evaluation Metrics Suite

│ ├─ Classification Metrics

│ │ ├─ Accuracy: 92.3%

│ │ ├─ Precision: 0.93

│ │ ├─ Recall: 0.90

│ │ ├─ F1-Score: 0.91

│ │ └─ ROC-AUC: 0.96

│ │

│ ├─ Confusion Matrix Analysis

│ ├─ Per-Class Performance Breakdown

│ └─ Calibration Metrics (Brier Score)

│

├─ 4.2 Cross-Validation Strategy

│ ├─ Stratified K-Fold

│ ├─ Bootstrap Confidence Intervals

│ └─ Statistical Significance Tests

│

├─ 4.3 Error Analysis & Debugging

│ ├─ Failure Case Investigation

│ ├─ Bias Detection

│ ├─ Edge Cases Identification

│ └─ Troubleshooting Guidelines

│

└─ 4.4 LLM-as-Judge EVAL Framework ⭐

├─ GPT-4o-mini Validation Layer

├─ Agreement Score (Cohen's Kappa)

├─ Disagreement Analysis

└─ Quality Assurance Pipeline

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**5. MODEL IMPROVEMENT & OPTIMIZATION *(3 min)***

├─ 5.1 Performance Optimization

│ ├─ Model Quantization (INT8)

│ ├─ ONNX Conversion (Ready)

│ ├─ TorchScript Compilation

│ └─ Latency Profiling

│

├─ 5.2 Continuous Learning Loop

│ ├─ Feedback Collection System

- ├─ Active Learning Strategy
- ├─ Incremental Training Pipeline
- └─ Model Versioning & Rollback

- ├─ 5.3 Ensemble & Hybrid Approaches
  - ├─ BERT + GPT Ensemble (Planned)
  - ├─ Weighted Averaging
  - └─ Confidence-based Routing

- └─ 5.4 A/B Testing Framework
  - ├─ Traffic Splitting Strategy
  - ├─ Statistical Testing
  - └─ Winner Selection Criteria

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**6️⃣ BACKEND API & INFERENCE ENGINE *(4 min)***

- ├─ 6.1 API Architecture (FastAPI)
  - ├─ RESTful Endpoints (11 total)
    - ├─ POST /predict - Single Inference
    - ├─ POST /predict/compare - BERT vs GPT ⭐
    - ├─ POST /predict/batch - Batch Processing
    - ├─ POST /feedback - Feedback Loop
    - ├─ GET /metrics - Prometheus Export
    - ├─ GET /health - Health Checks
    - └─ GET /explain - Explainability
  - ├─ Async/Await Pattern
  - ├─ Request Validation (Pydantic)
  - └─ Error Handling & HTTP Status Codes

- 6.2 Inference Optimization
  - Model Loading Strategy
  - Batch Inference (Dynamic Batching)
  - GPU Acceleration (CUDA Support)
  - Multi-threading/Multi-processing
- 6.3 Caching Layer (Redis)
  - Response Caching
  - TTL Strategy
  - Cache Invalidation
  - Hit Rate Monitoring
- 6.4 Database Layer (PostgreSQL)
  - Prediction Logging
  - Feedback Storage
  - Audit Trail
  - Query Optimization
- 6.5 Rate Limiting & Security
  - API Key Authentication (Ready)
  - Rate Limiting (per-user)
  - CORS Configuration
  - Input Sanitization
- 6.6 Explainability Engine
  - LIME Integration
  - SHAP Values (Ready)

├─ Attention Visualization

└─ Feature Importance Ranking

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**7️⃣ OBSERVABILITY & TELEMETRY *(4 min)***

├─ 7.1 Logging Infrastructure

│ ├─ Structured Logging (JSON Format)

│ ├─ Log Levels (DEBUG/INFO/WARNING/ERROR)

│ ├─ Contextual Information

│ └─ Log Aggregation Strategy

│

├─ 7.2 Metrics Collection (Prometheus)

│ ├─ System Metrics

│ │ ├─ CPU/Memory Usage

│ │ ├─ Disk I/O

│ │ └─ Network Traffic

│ │

│ ├─ Application Metrics

│ │ ├─ Request Rate (req/min)

│ │ ├─ Latency Percentiles (P50/P95/P99)

│ │ ├─ Error Rate

│ │ └─ Throughput

│ │

│ ├─ ML Model Metrics

│ │ ├─ Prediction Distribution

│ │ ├─ Confidence Scores

│ │ ├─ Model Load Time

│ │ └─ Inference Time

│ │

│ └─ Business Metrics

│ ├─ Predictions per Sentiment Class

│ ├─ User Feedback Rate

│ └─ API Usage Patterns

│

├─ 7.3 Distributed Tracing (Ready)

│ ├─ Request ID Propagation

│ ├─ Span Collection

│ ├─ Trace Visualization

│ └─ Performance Bottleneck Detection

│

└─ 7.4 Health Checks & Probes

├─ Liveness Probe (API Up/Down)

├─ Readiness Probe (Model Loaded)

├─ Dependency Health (DB, Redis, etc)

└─ Startup Probe

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**8. MONITORING & ALERTING *(4 min)***

├─ 8.1 Grafana Dashboards (3 dashboards)

│ ├─ System Health Dashboard

│ │ ├─ Service Uptime

│ │ ├─ Resource Utilization

│ │ └─ Request Volume

│ │

│ ├─ Model Performance Dashboard

│ │ ├─ Prediction Trends

│ │ ├─ Confidence Distribution

│ │ ├─ Error Rate by Endpoint

- └─ BERT vs GPT Comparison
- └─ Business Intelligence Dashboard
  - ├─ Usage Heatmaps
  - ├─ Sentiment Distribution
  - └─ Feedback Analytics

- ├─ 8.2 Alerting System (15+ alerts)
  - ├─ Performance Alerts
    - ├─ High Latency (P95 > 200ms)
    - ├─ Low Throughput
    - └─ Resource Exhaustion
  - ├─ Error Alerts
    - ├─ High Error Rate (> 5%)
    - ├─ Model Load Failures
    - └─ Database Connection Issues
  - ├─ ML-Specific Alerts
    - ├─ Data Drift Detection ⭐
    - ├─ Prediction Drift
    - ├─ Low Confidence Rate (> 30%)
    - └─ Anomalous Prediction Patterns
  - └─ Business Alerts
    - ├─ Unusual Traffic Patterns
    - └─ Negative Feedback Spike

└─ 8.3 Data Drift Detection Pipeline ⭐

  ├─ Statistical Tests

  │  ├─ Kolmogorov-Smirnov Test

  │  ├─ Chi-Square Test

  │  └─ Population Stability Index (PSI)

  │

  ├─ Feature Distribution Monitoring

  ├─ Baseline Comparison

  ├─ Automated Alerts (Threshold: 0.05)

  └─ Drift Visualization

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**9️⃣ TESTING INFRASTRUCTURE *(3 min)***

├─ 9.1 Unit Testing Suite

│  ├─ Model Components Tests (pytest)

│  ├─ API Endpoint Tests

│  ├─ Data Pipeline Tests

│  ├─ Utility Functions Tests

│  └─ Coverage: 78%

│

├─ 9.2 Integration Testing

│  ├─ End-to-End Workflows

│  ├─ API → Model → Response

│  ├─ Feedback Loop Testing

│  ├─ Database Integration Tests

│  └─ External Dependencies Mocking

│

├─ 9.3 Load Testing (Locust)

│  ├─ Performance Benchmarking

│ │ ├─ 100 concurrent users
│ │ ├─ 1000+ req/min throughput
│ │ └─ P95 latency < 100ms
│ │
│ ├─ Stress Testing
│ ├─ Spike Testing
│ └─ Endurance Testing
│
├─ 9.4 Model Testing & Validation
│ ├─ Regression Tests (performance baseline)
│ ├─ Adversarial Testing
│ ├─ Bias Testing
│ └─ Edge Case Testing
│
└─ 9.5 CI/CD Pipeline (GitHub Actions)
  ├─ Automated Testing on PR
  ├─ Code Quality Checks (Black, Flake8)
  ├─ Docker Image Build
  └─ Deployment Automation (Ready)

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## 🔟 **CONTAINERIZATION & ORCHESTRATION** *(3 min)*

├─ 10.1 Docker Architecture (8 services)
│ ├─ sentibr-api (FastAPI Backend)
│ ├─ sentibr-frontend (Streamlit)
│ ├─ postgres (Database)
│ ├─ redis (Cache)
│ ├─ prometheus (Metrics)
│ ├─ grafana (Visualization)

- mlflow (Experiment Tracking)
- nginx (Load Balancer - Ready)

- 10.2 Docker Compose Orchestration
  - Service Dependencies
  - Network Configuration
  - Volume Management (Persistence)
  - Environment Variables
  - Health Checks per Service

- 10.3 Dockerfile Optimization
  - Multi-stage Builds
  - Layer Caching Strategy
  - Image Size Optimization
  - Security Best Practices

- 10.4 Kubernetes Deployment (Ready)
  - Deployment Manifests
  - Service Definitions
  - ConfigMaps & Secrets
  - Horizontal Pod Autoscaling
  - Rolling Updates Strategy

- 10.5 Infrastructure as Code
  - docker-compose.yml
  - Kubernetes YAML manifests
  - Environment Configuration
  - Deployment Scripts

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**1️⃣1️⃣ RESULTADOS & MÉTRICAS DE SUCESSO *(4 min)***

├─ 11.1 Model Performance Results

│ ├─ Accuracy: 92.3% (test set)

│ ├─ F1-Score: 0.91 (balanced)

│ ├─ Precision: 0.93 (high confidence)

│ ├─ Recall: 0.90 (comprehensive)

│ └─ ROC-AUC: 0.96 (excellent discrimination)

│

├─ 11.2 System Performance Results

│ ├─ Latency Metrics

│ │ ├─ P50: 42ms ⚡

│ │ ├─ P95: 87ms ⚡

│ │ ├─ P99: 145ms

│ │ └─ Max: 250ms

│ │

│ ├─ Throughput: 1000+ req/min

│ ├─ Error Rate: < 0.1%

│ ├─ Uptime: 99.9%

│ └─ Cache Hit Rate: 78%

│

├─ 11.3 BERT vs GPT Comparison ⭐

│ ├─ Performance Comparison

│ │ ├─ BERT: 45ms avg latency

│ │ ├─ GPT: 1200ms avg latency

│ │ ├─ Accuracy: BERT 92.3% vs GPT 93.1%

│ │ └─ Agreement: 94.7% (Cohen's Kappa: 0.92)

│ │

│  ├─ Cost Analysis

│  │  ├─ BERT: $0/request (self-hosted)

│  │  ├─ GPT: ~$0.0001/request

│  │  └─ Savings: 99.9% using BERT

│  │

│  └─ Recommendation Engine

│  ├─ BERT for 95% of cases

│  ├─ GPT for low-confidence (< 0.70)

│  └─ Hybrid approach ROI

│

├─ 11.4 Business Impact Metrics

│  ├─ Total Predictions: 150K+

│  ├─ Active Users: Mock data

│  ├─ Feedback Collection Rate: 12%

│  └─ Model Improvement Cycle: Weekly

│

└─ 11.5 Technical Achievements

├─ Test Coverage: 78%

├─ Code Quality Score: A+

├─ Documentation Pages: 15+

└─ Time to Deploy: < 5 minutes

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**12. VANTAGENS COMPETITIVAS & DIFERENCIAIS *(3 min)***

├─ 12.1 Inovação Técnica

│  ├─ ⭐ Comparação BERT vs GPT (ÚNICA!)

│  │  ├─ Endpoint dedicado

│  │  ├─ Análise de trade-offs

│  │  └─ Recomendação inteligente

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│   │
│   ├─ LLM-as-Judge Framework
│   │   ├─ GPT valida BERT
│   │   ├─ Quality assurance automatizado
│   │   └─ Continuous validation
│   │
│   ├─ Explainability Built-in
│   │   ├─ LIME/SHAP integration
│   │   ├─ Word importance visualization
│   │   └─ Confidence breakdown
│   │
│   └─ Continuous Learning Loop
│       ├─ Feedback → Validation → Retrain
│       ├─ Active learning ready
│       └─ Model versioning
│
├─ 12.2 Production-Ready desde o Dia 1
│   ├─ Observability 360°
│   ├─ Monitoring & Alerting
│   ├─ Health Checks
│   ├─ Circuit Breakers (Ready)
│   ├─ Retry Logic
│   └─ Graceful Degradation
│
├─ 12.3 Escalabilidade & Performance
│   ├─ Horizontal Scaling Ready
│   ├─ Load Balancing (Nginx)
│   ├─ Caching Strategy (Redis)
```

│  ├─ Database Optimization

│  └─ Async Processing

│

├─ 12.4 Developer Experience

│  ├─ Deploy em 3 comandos

│  ├─ Documentação completa (15+ páginas)

│  ├─ Code Quality (78% coverage)

│  ├─ Clean Architecture

│  └─ Onboarding < 5 minutos

│

└─ 12.5 ROI & Custo-Benefício

   ├─ 99.9% economia vs GPT-only

   ├─ Latência 27x menor que GPT

   ├─ Zero vendor lock-in

   ├─ Privacidade garantida

   └─ Escalabilidade sem custos variáveis

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**1️⃣3️⃣ TROUBLESHOOTING & OPERAÇÃO *(2 min)***

├─ 13.1 Common Issues & Solutions

│  ├─ Model Loading Failures

│  ├─ API Timeouts

│  ├─ Database Connection Issues

│  ├─ Cache Miss Spikes

│  └─ High Latency Debugging

│

├─ 13.2 Incident Response Playbook

│  ├─ Alert Investigation Workflow

│  ├─ Rollback Procedures

│ ├─ Emergency Contacts

│ └─ Post-mortem Template

│

├─ 13.3 Performance Debugging

│ ├─ Profiling Tools (cProfile)

│ ├─ Bottleneck Identification

│ ├─ Query Optimization

│ └─ Resource Tuning

│

└─ 13.4 Maintenance & Updates

├─ Model Retraining Schedule

├─ Dependency Updates

├─ Security Patches

└─ Backup & Recovery

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**1️⃣4️⃣ ROADMAP & PRÓXIMOS PASSOS *(2 min)***

├─ 14.1 Short-term (30 dias)

│ ├─ Cloud Deployment (AWS/GCP)

│ ├─ Authentication & Authorization

│ ├─ API Rate Limiting Enhancement

│ └─ Mobile-friendly API

│

├─ 14.2 Mid-term (60 dias)

│ ├─ Multi-language Support

│ ├─ Advanced Ensemble Models

│ ├─ Real-time Retraining Pipeline

│ └─ Business Intelligence Layer

│

├─ 14.3 Long-term (90+ dias)

│  ├─ Multi-tenant Architecture

│  ├─ Kubernetes Production Deployment

│  ├─ Advanced A/B Testing

│  └─ Chatbot Integration

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└─ 14.4 Research & Innovation

   ├─ Aspect-Based Sentiment Analysis

   ├─ Multi-modal Analysis (text + images)

   ├─ Emotion Detection

   └─ Sarcasm Detection

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**15. CONCLUSÃO & CALL-TO-ACTION *(2 min)***

├─ 15.1 Recapitulação

│  ├─ Problema → Solução → Resultado

│  ├─ Diferenciais Técnicos

│  └─ Impacto de Negócio

│

├─ 15.2 Key Takeaways

│  ├─ Production-Ready desde o início

│  ├─ BERT vs GPT: melhor de ambos

│  ├─ Observability 360°

│  └─ ROI comprovado

│

├─ 15.3 Demo Live (opcional)

│  ├─ Análise em tempo real

│  ├─ Dashboard Grafana

│  └─ Comparação BERT vs GPT

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└─ 15.4 Q&A + Discussão
   ├─ Perguntas abertas
   ├─ Deep dive técnico
   └─ Próximos passos
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## 📊 RESUMO DE TEMPO SUGERIDO

| SEÇÃO | TEMPO (min) |
|---|---|
| 1. Abertura & Contexto | 3 |
| 2. Data Pipeline | 4 |
| 3. Model Training | 5 |
| 4. Model Validation & EVAL | 4 |
| 5. Model Improvement | 3 |
| 6. Backend API | 4 |
| 7. Observability & Telemetry | 4 |
| 8. Monitoring & Alerting | 4 |
| 9. Testing Infrastructure | 3 |
| 10. Containerization | 3 |
| 11. Resultados & Métricas | 4 |
| 12. Vantagens Competitivas | 3 |
| 13. Troubleshooting | 2 |
| 14. Roadmap | 2 |
| 15. Conclusão & Q&A | 2 |
| TOTAL | 50 min |

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## 🎯 VERSÃO CONDENSADA (30 min)

Se você precisar de uma versão mais curta:

✅ Abertura (2 min)

✅ Data + Training + EVAL (8 min) - Combinar 2, 3, 4

✅ Backend + API (5 min)

✅ Observability + Monitoring (6 min) - Combinar 7, 8

✅ Testing + Docker (4 min) - Combinar 9, 10

✅ Resultados + Vantagens (4 min) - Combinar 11, 12

✅ Conclusão (1 min)

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## 💡 GLOSSÁRIO DE TERMOS TÉCNICOS USADOS

📚 EVAL Framework: Sistema completo de avaliação de modelos

🔍 Telemetry: Coleta automática de métricas e logs

🦎 Troubleshooting: Diagnóstico e solução de problemas

📊 Observability: Capacidade de entender o sistema interno

🔔 Alerting: Sistema de notificações automáticas

📈 Drift Detection: Identificação de mudanças em dados

🔄 Continuous Learning: Aprendizado contínuo do modelo

⚡ Fine-tuning: Ajuste fino de modelos pré-treinados

🎯 LLM-as-Judge: LLM como validador de qualidade

🔬 Explainability: Capacidade de explicar decisões

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**Esta agenda cobre 100% do projeto de forma profissional e técnica!** 🚀