Tech Stack

Data Layer

Primary Data Access

- FastF1 (Python library for F1 telemetry and timing)

- Pandas/NumPy (data manipulation)

- SQLite/PostgreSQL (caching historical data)

Data Processing

- Scikit-learn (feature engineering, preprocessing)

- SciPy (interpolation for telemetry alignment)

ML/AI Layer

Prediction Models

- PyTorch/TensorFlow (tire degradation LSTM/GRU models)

- XGBoost/LightGBM (pit timing classification)

- Isolation Forest (anomaly detection in telemetry)

LLM Infrastructure

- Groq API (primary inference engine)

- groq-python SDK (official Python client)

- LangChain + Groq integration (multi-agent orchestration)

- LlamaIndex (RAG for historical race context)

Models

- Llama 3.3 70B Versatile (main reasoning)

- DeepSeek-R1 Distill Llama 70B (complex strategy reasoning)

- Qwen QWQ 32B (tire degradation analysis)

- Mixtral 8×7B (fast real-time commentary)

Vector Stores for RAG

- ChromaDB or Pinecone (storing race history embeddings)
- SentenceTransformers (embeddings generation)

Agent Framework

- LangChain LCEL (agent chains and parallel execution)
- LangGraph (agent state management)
- Custom Mixture of Agents architecture

Agent Framework

Multi-Agent System

- LangGraph or AutoGen (agent coordination)
- CrewAI (specialized agent roles)
- Custom agent orchestration with async Python

Agent Communication

- Message queues (Redis/RabbitMQ) for agent coordination
- JSON schema for structured agent outputs

Backend

API & Services

- FastAPI (REST API endpoints)
- Celery (async task processing for predictions)
- WebSockets (real-time updates)

Caching & Storage

- Redis (caching predictions and telemetry)
- S3/MinIO (storing race sessions)

Frontend

UI Framework

- React/Next.js (web interface)

- Plotly/D3.js (telemetry visualization)

- Tailwind CSS (styling)

Real-time Communication

- Socket.io (live updates)

MLOps

- MLflow (experiment tracking)

- Weights & Biases (model performance monitoring)

- Docker (containerization)

- GitHub Actions (CI/CD)

Monitoring

- Prometheus + Grafana (system metrics)

- Sentry (error tracking)

- LangSmith (LLM call tracing)