Technical Specification: "Options Oracle" Algorithmic Trading System

1. System Architecture and Data Flow

The "Options Oracle" is a multi-layered, event-driven system designed for high-frequency, auto-intraday scalping of Indian index options (Nifty, BankNifty, Sensex). Its core strength is the synthesis of quantitative metrics with a sophisticated AI decision engine, all built on the Zerodha Kite Connect ecosystem.

1.1 Data Ingestion Layer (Kite Ticker WebSocket)

- **Source:** `wss://ws.kite.trade` (Kite Ticker WebSocket)
- **Mode:** Full Mode subscription for all relevant instruments (Index Spot, India VIX, and a basket of ± 3 ATM options).
- **Data Points:** Real-time LTP, OHLC, Volume, Open Interest (OI), and **5-level Market Depth** (Bid/Ask Price, Quantity, Orders).
- **Function:** Broadcasts raw tick data to the Metrics Calculation Layer.

2. Metrics Calculation Layer (The Signal Engine)

This layer transforms raw ticks into actionable, weighted scores, prioritizing predictive indicators for scalping.

2.1 Core Index Metrics (Standard)

- **Put-Call Ratio (PCR):** Calculated from total OI. Used for sentiment classification (e.g., BEARISH, NEUTRAL, BULLISH, EXTREME FEAR/GREED).
- **Trend Direction:** Based on Spot Price vs. VWAP and Previous Close.
- **Liquidity Grade:** Initial check based on Bid-Ask Spread and Depth.

2.2 Weighted Scoring System

The system uses a **Combined Score** to determine trade viability, with a strong bias towards leading indicators.

Plain Text

```
\text{Combined Score} = (\text{Leading Score} \times 0.65) + (\text{Lagging
```

```
Score} \times 0.35) + \text{PDR Penalty}
```

Score Component	Max Points	Metrics Included	Technical Basis
Leading Score	**65**	VIX Momentum, OI Dynamics, Volume Impulse, **IV Skew (IVS)**, **Liquidity Momentum (LMS)**, **VALP Factor**.	Predictive, options-specific, and dynamic indicators.
Lagging Score	**35**	RSI (14), Moving Average Crossover (9/21), Historical Volatility.	Confirmatory, time-series based indicators.
PDR Penalty	**-10**	**Premium Decay Rate (PDR)**.	Real-time theta/IV crush risk management.

2.3 Enhanced Options-Specific Metrics (New)

These are calculated client-side to overcome Kite API limitations and improve OTM accuracy:

- **Implied Volatility Skew (IVS) Score (0-15):** Calculated by back-solving for IV using a Black-Scholes-Merton model on OTM Call and Put LTPs. A high $\text{IV}_{\text{Call}} > \text{IV}_{\text{Put}}$ indicates a bullish options market bias.
- **Premium Decay Rate (PDR) Penalty (0 to -10):** Measures the percentage drop in option LTP over the last 5 minutes. Acts as a critical constraint; a high penalty forces a `HOLD` or `EXIT_ALL` regardless of the directional score.
- **Liquidity Momentum Score (LMS) (0-10):** Measures the rate of change in the 5-level Market Depth over the last 5 minutes. A positive score confirms institutional liquidity inflow, validating the trade entry.

3. Contextualization and Adaptive Risk

The system's risk management is dynamic, adapting to market conditions before the AI is consulted.

Contextual Factor	Mechanism	Adaptive Action

VIX Regime	Classifies market as `ULTRA_LOW`, `NORMAL_LOW`, `SPIKING`, or `PANIC` based on India VIX level.	Dynamically adjusts the required **AI Confidence Threshold** (e.g., 75% in `ULTRA_LOW` to 55% in `PANIC`).
Market Phase	Classifies time of day (e.g., `OPENING_VOLATILITY`, `MIDDAY_LULL`).	Adjusts the **AI Decision Interval** (e.g., 90s in high volatility, 240s in low volume) and applies penalties (e.g., +10% threshold penalty in opening volatility).
Failure Constraints	Historical analysis of win rates by VIX regime, market phase, and liquidity grade.	**Blocks trade execution** if current conditions have a historical win rate below 40%.

4. AI Decision Engine (ATC-AI Service)

The AI acts as the final arbiter, synthesizing the entire context into an actionable decision.

- **Model:** GPT-4o-mini (or equivalent LLM).
- **Input:** A comprehensive `MarketContext` JSON object containing all 20+ metrics, including the new IVS, PDR, and LMS scores, plus historical performance data and global macro context.
- **Communication Protocol:** Uses OpenAI's **Structured JSON Output Mode** (`response_format: { type: "json_object" }`) to ensure the AI's output is always machine-readable and prevents "language" mismatches.
- **Output Schema:** Strict JSON object with fields: `action` (`TRADE_CE`, `TRADE_PE`, `HOLD`, `EXIT_ALL`, `REVERSE`), `confidence` (0-100), `reasoning`, and `strikeGuidance`.
- **Safety Fallback:** On AI failure (malformed JSON, API error), the system defaults to a `HOLD` action with 50% confidence, which is below the execution threshold.

5. Trade Execution Layer (Auto-Trade Service)

This layer is responsible for risk-controlled order placement and position management.

5.1 The 7-Step Validation Chain

Every AI decision must pass a 7-step sequential validation before an order is placed:

1. **AI Gating Check:** Verifies decision age, confidence $\geq$ adaptive threshold, and action validity (including the newly integrated `REVERSE` logic).

2. **Strike Alignment Check:** Confirms the selected strike adheres to the AI's `strikeGuidance` (e.g., $\text{Delta} \geq 0.25$, $\text{IV} \leq 25\%$).
3. **Margin Check:** Confirms sufficient free margin via Kite API.
4. **Position Limits:** Checks against user-defined max positions.
5. **Market Hours Check:** Confirms trade is within 9:20 AM - 3:28 PM IST.
6. **Circuit Breaker Check:** Verifies daily loss and drawdown limits are not breached.
7. **Order Execution:** Places the order via `kite.placeOrder()` and immediately sets up a two-leg **GTT** (Good Till Triggered) for Stop-Loss and Target.

5.2 Audit and Synchronization

- **Audit Trail:** Every trade is logged in the `auto_trade_log` table, linked by `ai_decision_id` to the exact `atc_decision_log` entry that approved it. This creates an immutable, traceable audit trail for post-mortem analysis and the learning loop.
- **Synchronization:** Real-time updates (AI decisions, position P&L) are pushed to the frontend via **WebSocket** (`ws://host:PORT/ws`), with a REST polling fallback for redundancy.
- **Standardization:** All index symbols are standardized to the short form (`NIFTY` , `BANKNIFTY`) across the entire stack to ensure seamless data flow and synchronization.

6. Conclusion

The "Options Oracle" system is a **state-of-the-art, closed-loop algorithmic trading framework**. It moves beyond simple indicator-based trading by integrating a sophisticated, adaptive AI decision layer. The recent additions of **IVS, PDR, and LMS** metrics specifically address the high-risk nature of OTM options, transforming the system into a highly specialized and robust tool for capturing high-momentum scalping opportunities while managing the critical threat of theta decay.