

Quant Developer Interview Task: Cup and Handle Pattern Detection (99% Accuracy)

Cup and Handle Pattern Detection Task

Objective:

Design and implement a system that identifies "Cup and Handle" patterns in Binance Futures data (1-minute timeframe, from 2024 to 2025) with at least 99% accuracy. The candidate must detect and crop 30 valid pattern images using the Kaleido library (for smooth rendering) and validate each instance based on defined logic.

1. Pattern Formation Logic

Cup:

- A smooth, rounded bottom shape.
- Left and right rims (swing highs) at roughly similar price levels.
- Volume may decrease towards the bottom of the cup and pick up near the rim.

Handle:

- A short consolidation after the cup.
- Typically sloped downward or sideways.
- Lower high than cup rims.

Breakout:

- Bullish breakout occurs above the handle's upper resistance.

2. Validation Rules

- Cup depth must be at least 2x average candle size (1m).
- Cup duration: 30 to 300 candles.
- Handle duration: 5 to 50 candles.
- Handle high must be below or equal to left/right rim.
- Handle must retrace no more than 40% of cup depth.
- Smooth curve fit for the cup with a parabolic shape ($R^2 > 0.85$).
- Price breakout must exceed handle high with at least 1.5x ATR(14).

Quant Developer Interview Task: Cup and Handle Pattern Detection (99% Accuracy)

- Volume spike on breakout preferred (optional but a bonus).

3. Invalidation Rules

- Handle breaks below cup bottom.
- Handle lasts longer than 50 candles.
- Cup is V-shaped, not U-shaped (low R^2 fit).
- No breakout after handle formation.
- Rim levels differ more than 10%.

4. Required Deliverables

1. Cup and Handle Detection Code:

- Should run on Binance Futures 1-minute OHLCV data (2024-01-01 to 2025-01-01).
- Must identify at least 30 distinct valid Cup and Handle patterns.

2. Pattern Plotting and Cropping:

- For each valid pattern:
 - Smooth arc plot for cup.
 - Clearly marked handle and breakout zone.
 - Save cropped image using `kaleido`.
 - Filename format: cup_handle_<pattern_id>.png

3. Validation Summary Report:

- JSON/CSV file with stats for each pattern:
 - Start and end time
 - Cup depth, duration
 - Handle depth, duration
 - R^2 value
 - Breakout candle timestamp
 - Valid/Invalid flag with reason (if invalid)

Quant Developer Interview Task: Cup and Handle Pattern Detection (99% Accuracy)

5. Evaluation Criteria

- Accuracy of pattern detection (target: 99%).
- Code quality: structure, clarity, and efficiency.
- Visual clarity of the plotted charts.
- Correct application of validation/invalidation logic.
- Robustness in handling edge cases and noisy data.

6. Tools and Libraries Required

- Python (3.9+)
- pandas, numpy, scipy
- matplotlib, plotly (for visualization)
- kaleido (for image export)
- TA-Lib (for ATR and volume filters)

7. Bonus Points

- Interactive HTML visualization of each pattern with plotly.
- Unit tests for pattern detection logic.
- Use of ML model to enhance pattern classification confidence.

Submission Format:

- GitHub or zipped code with:
 - /data folder with raw and preprocessed data.
 - /patterns folder with 30 cropped images.
 - main.py, pattern_detector.py, plot_utils.py files.
 - report.csv summarizing patterns.

Note:

Candidate should demonstrate mathematical understanding of curve fitting (parabola for cup arc) and precise rule-based detection. Smooth rendering and clearly labeled outputs are mandatory.