

Conut AI: Chief of Operations Agent

Operational Intelligence & Prescriptive Analytics

Prepared for: **Professor Ammar Mohanna**

American University of Beirut

Course: AI Engineering (AI Systems & MLOps)

George Habib , John Lahoud, Carl Amine

Executive Summary

This system transforms Conut's raw operational data into a digital **Chief of Operations Agent** that delivers prescriptive business intelligence across demand forecasting, staffing optimization, expansion feasibility, combo optimization, and growth strategy.

The platform functions as an operational AI system, converting structured data into explainable, actionable business decisions through modular tools, reproducible pipelines, and agent-based execution.

Technical Architecture

- **Framework:** FastAPI + Uvicorn for asynchronous tool execution
- **Data Layer:** Pandas, NumPy, PyArrow, parquet caching
- **Validation:** Pydantic schema enforcement
- **Analytics:** Heuristic models, rule systems, benchmarking logic, statistical smoothing

Pipeline:

Raw CSV → Clean/Normalize → Parquet Cache → Feature Builders → Tools → FastAPI → OpenClaw / UI

Operational Objectives

1. Combo Optimization

Association-rule mining using support, confidence, and lift with strategic weighting: +35% cross-category boost, -65% redundancy penalty, hidden-gem detection.

2. Demand Forecasting

Period weighted moving average:

$$(0.5y_t + 0.3y_{t-1} + 0.2y_{t-2})$$

with stability constraints and non-negative enforcement.

3. Expansion Feasibility

Multi-factor internal scoring model: Growth (30%), Stability (25%), Scale Readiness (30%), Cost Proxy (15%). Decision logic: **Go** ≥ 75, **Conditional Go** ≥ 55, else **Hold**.

4. Shift Staffing Estimation

Productivity model:

$$\text{Revenue}/\text{Labor Hours}$$

with shift buckets, demand-to-capacity ratios, and staffing pressure detection.

5. Growth Strategy

Live transaction intelligence using category detection, attachment heuristics, combo-driven growth logic, and product-mix balancing focused on Coffee and Milkshake verticals.

OpenClaw Integration

Manifest-driven AI tool discovery with schema-based registration. Each tool returns: *result, evidence metrics, assumptions, and data coverage notes*, enabling explainable agent reasoning and operational execution.

Data MLOps & Lineage

Stateful ingestion of nested report-style CSVs with hierarchical context preservation. Features include: `is_peak_rush`, `attachment_rate`, `day_velocity`. Parquet caching ensures reproducibility and performance.