Al Trading Infrastructure – Master Notion Guide

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Database

Overview

- Mission: Build a low-latency, contradiction-aware trading infrastructure that unifies BICEP (Brownian Inspired Computationally Efficient Parallelization), Fusion Alpha (semantic-technical FusionNet pipeline), and the forthcoming Nimbus Book (research notebook + paper) into a single, reproducible codebase.
- Guiding Principles: Clarity ➤ Modularization ➤ Reproducibility ➤ Robustness ➤ Documentation-first.
- Quick Links: README | run_pipeline.py | docs/ | data/raw/.

🌃 Roadmap & Milestones

(Use a Notion **Timeline** or **Board** database with the following properties.)

- Milestone (title)
- Due Date (date)
- Owner (person)
- Status (select: Idea In Progress Blocked Done)

• Relevant Module (multi-select: BICEP, Fusion Alpha, Nimbus Book, Infra)

🐆 2025 Q2 Highlights

- June 15 BICEP v1.0 kernel passes unit tests
- June 30 Fusion Alpha walk-forward validation complete
- July 10 Nimbus Book initial chapters drafted
- July 31 Internal alpha of live router on Tesla+8-ticker dataset

Workspaces & Core Databases

- 1. **Backlog** Kanban of every task (Task, Description, Module, Priority, Points, Sprint, Status, Dependency).
- 2. **Experiments** Scientific record (Hypothesis, Variant ID, Metrics, Result IMG, Verdict, Merge-candidate?).
- 3. Research Library Papers/links with tags (Topic, Relevance, Read By, Notes).
- 4. **Decision Log** Architecture & trade-off log (Date, Decision, Context, Alternatives, Consequences).

Module: BICEP

- Goal: Ultra-efficient, Brownian-inspired data-parallel kernels for PyTorch & CUDA.
- **Key Files:** src/bicep/kernels/*.cu, train_bicep.py, tests/test_bicep.py.
- Implementation Checklist:
 - Finalise random walk bit-mapping logic
 - GPU parallelisation benchmarks (RTX 4090 vs A100)
 - Integrate into FusionNet as drop-in replacement
 - Document theoretical derivation (Nimbus Book §2)
- Validation Metrics: TFLOPS utilisation, epoch time, loss parity with baseline.

⊗ Module: Fusion Alpha

- **Goal:** Fuse FinBERT sentiment embeddings with technical indicators to detect price–sentiment contradictions and generate alpha.
- Key Scripts: prepare_dataset.py, train_fusion.py, tune_fusion.py, predict_fusion.py.
- Pipeline Stages:
 - 1. Data Ingest data/raw/*.csv → OHLCV + news scrape
 - 2. **Feature Build** technical_features, finbert_embeddings
 - 3. FusionNet Training Multi-head attention + contradiction severity
 - 4. **Evaluation** k-fold CV, walk-forward, benchmark strategies
 - 5. Live Router live_router.py auto-fetch + inference
- **KPIs:** Sharpe, max drawdown, hit-rate vs benchmark.

🛐 Module: Nimbus Book

- Form: Jupyter-Book in docs/, exported as static site & PDF.
- Sections:
 - Intro & Literature Survey
 - BICEP Theoretical Foundations
 - Fusion Alpha Methodology
 - Experiments & Ablation Studies
 - Future Work & PhD Directions

Development Workflow

1. Environment Setup

conda env create -f environment.yml # or pip install -r requirements.txt pre-commit install # enforce hooks

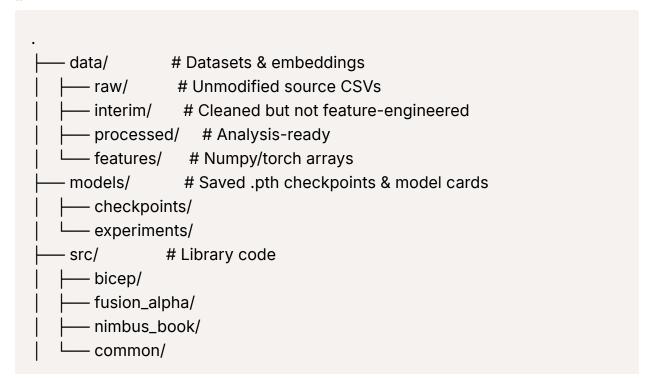
1.

- 2. **Branching Model** main | dev | feat/* | fix/* | exp/* (no direct commits to main).
- 3. **Commit Messages** Conventional Commits (feat(bicep): add cuda kernel #24).
- 4. CI/CD GitHub Actions: lint \rightarrow test \rightarrow build Docker \rightarrow deploy docs.
- 5. **Code Review** 1 approving review + green CI required.

🔡 Data Management

- Versioning: DVC with remote on S3 (dvc remote add -d s3 s3://ai-trading-data).
- Layers: raw → interim → processed → features → predictions.
- Schemas: store as Parquet w/ schema files in schemas/.
- Privacy: Strip PII, encrypt sensitive feeds with age-encryption.

TFolder Structure Explained



— notebooks/ # Exploratory analysis
— scripts/ # CLI helpers (e.g., run_pipeline.sh)
— tests/ # pytest suites
— docker/ # Dockerfiles & compose
— docs/ # Auto-generated site (Nimbus Book)

Usage Ritual

- 1. git pull --rebase
- 2. Activate env → dvc pull → python scripts/run_pipeline.py --stage ingest
- 3. Develop feature \rightarrow pytest -q \rightarrow pre-commit run --all-files.
- 4. Push PR \rightarrow code review \rightarrow merge.
- 5. Trigger deployment (docs + Docker image tag).

© CLI Reference

Tip:

- Run full pipeline
 - python run_pipeline.py --ticker TSLA --start 2015-01-01 --mode train
- Hyperparameter tuning
 - python tune_fusion.py --trials 50 --sampler tpe
- Live route
 - python live_router.py --tickers TSLA AAPL NVDA --interval 1m --log live.log
- Benchmark
 - python evaluate_strategy.py --baseline buy_and_hold

7 Daily Logs & Meeting Notes Template

Daily Stand-Up (YYYY-MM-DD)

- **Yesterday:**
- **Today:**
- **Blockers:**
- **Next Milestone:**

Glossary

Term	Meaning
BICEP	Brownian Inspired Computationally Efficient Parallelisation
Fusion Alpha	Sentiment-Technical fusion network for alpha generation
Nimbus Book	Comprehensive research notebook/documentation
Contradiction Score (CS)	Measure of sentiment-price divergence

X Quick-Access Checklists

- Conda env recreated after any environment.yml change
- · dvc push after adding data artefacts
- Draft decision logged within 24 h of change
- PR merged ≤ 250 LOC unless justified

Future Enhancements

- Integration with FPGA low-latency order gateway
- Real-time FinBERT inference via ONNX-Runtime
- Switch to duckDB for local columnar analytics
- Deploy on k8s cluster with GPU node autoscaling

End of Guide – happy building!