⭐ BEGINNER-FRIENDLY TECH STACK TABLE (Complete ChronoShift System)

(Simple, clear, practical, realistic for students)

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1. FRONTEND — UI / Dashboard / Visualizations

Feature / Module	What It Does	Beginner-Friendly Tech Stack	Why This Tech?
Main Web UI	Shows dashboard, price charts, status	**React + Vite**	Easy, popular, huge community
4D Command Center Map	Shows global trades + routes	**Leaflet.js (Maps)** + **D3.js (Charts)**	Lightweight, easy compared to WebGL
Trade Timeline Player	Replay "buy → ship → sell"	**React + Framer Motion**	Simple animations
Counterfactual Viewer	Show "what-if" graphs	**Chart.js** or **Recharts**	Easiest chart libraries
Forms / Settings	User inputs	**TailwindCSS**	Easiest styling system

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2. BACKEND — Core Logic & APIs

Feature	What It Does	Beginner-Friendly Tech Stack	Why Suitable for Students
API Gateway	Entry point for front-end	**FastAPI (Python)**	Easiest backend framework EVER
Authentication	Basic login	**JWT + FastAPI**	Simple & secure
Data Fetch / API Calls	Fetch external prices/news	**Requests / HTTPX**	Easy Python HTTP client
Ingestion Pipeline	Stream data into DB	**Celery + Redis**	Easier than Kafka for students

Opportunity Detector	Profit calculation	**Python service**	Simple math, easy debugging
Execution Orchestrator	Runs steps (buy→ship→sell)	**Temporal.io OR Django Celery Tasks**	Celery = very beginner-friendly
Compliance Validator	Legal rule checking	**RuleEngine (Python)**	Simple Python rules
LLM-Based Parser	Extract rules from PDFs	**OpenAI API OR Llama-3**	Easy one-call API
Counterfactual Simulator	Evaluate alternate outcomes	**Numpy + Pandas**	Ideal for calculations

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3. DATA & DATABASE LAYER

Feature	What It Stores / Does	Beginner Tech Stack	Why It Fits Students
Price History	Store all price updates	**PostgreSQL + Timescale**	Timescale is Postgres-based (easy)
Raw Payload Store	Store raw PDFs/HTML	**AWS S3 Free Tier / Local FS**	Simple file storage
Features (ML Input)	Store calculated features	**Postgres JSONB**	Easy & flexible
Logs	Keep actions & errors	**ElasticSearch OR simple Postgres table**	Postgres is enough for MVP
Counterfactual Ledger	Immutable logs	**Postgres + SHA256 hash column**	Blockchain not required for MVP

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4. MACHINE LEARNING LAYER

Module	What It Does	Beginner-Friendly Tech Stack	Why This Tech
Time-Series Forecast	Predict future price	**Facebook Prophet** or **ARIMA (statsmodels)**	Very easy to use

Basic ML Model	Predict trends	**Scikit-Learn (RandomForest/XGBoost)**	Beginner-friendly
Deep Learning (optional)	More accurate forecasts	**PyTorch (only if needed)**	Optional for advanced team
Event Detection	Detect strikes/news	**HuggingFace Transformers (tiny models)**	Easy with pre-trained models
LLM Legal Parser	Extract regulatory rules	**OpenAI GPT-4 mini OR Llama-3**	One-line API calls

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5. INFRASTRUCTURE & DEPLOYMENT

Feature	Purpose	Beginner-Friendly Stack	Why Good For Students
Cloud Provider	Host everything	**Render.com / Railway.app / AWS Free Tier**	Free / Easy deployment
Containerization	Run microservices	**Docker**	Basic skill, highly useful
Task Queue	Background jobs	**Celery + Redis**	No Kubernetes required
File Storage	Save PDFs, logs	**AWS S3 Free Tier**	Simple, reliable
CI/CD	Auto-deployment	**GitHub Actions**	Very simple YAML files
Monitoring	Basic system metrics	**Grafana Cloud Free Tier**	Plug-and-play

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6. AUTOMATION & ORCHESTRATION

Module	What It Does	Beginner Stack	Why Suitable
Multi-Step Trade Workflow	buy→ship→sell tasks	**Celery Task Chains**	MUCH easier than Temporal.io

Retry Logic	Retrying failed tasks	**Celery Retry + Exponential Backoff**	Built-in simple retries
Notification System	Alerts on failure	**Telegram Bot API / Slack API**	Easiest alerting

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7. COMPLIANCE & DOCUMENT HANDLING

Feature	What It Does	Beginner Tech	Why Good For Students
PDF parsing	Extract tables	**PyPDF2 + Tesseract OCR**	Beginner-friendly
LLM doc parser	Interpret rules	**GPT-4o Mini**	One API call
Indian Export Rules Validation	Check legality	**Python rule engine**	Simple to update
Document Generator	Create export forms	**Jinja2 Templates (HTML/PDF)**	Very simple

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8. ANALYTICS, LOGGING, AUDIT

Module	Purpose	Beginner Stack	Why Suitable
Event Tracking	Log all decisions	**PostgreSQL tables**	Easy, simple queries
Audit Trails	Track compliance actions	**Hash-based logs**	No blockchain needed
Replay Engine	Show “what-if” outcomes	**Python simulation + CSV logs**	Very student-friendly
Dashboard Analytics	Visualizations	**Grafana or custom React charts**	Minimal setup

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9. OPTIONAL ADVANCED STACK (Use Only if You Want Extra Marks)

Module	Why Use	Tech
Vector Search	Search legal rules	Pinecone / Weaviate
Event Stream	Real-time feed	Kafka (only if needed)
Tokenization	Represent assets as tokens	Polygon (optional)
WebGL UI	High-end visuals	Three.js

None of these are required for student MVP.

⭐ SUPER SIMPLE SUMMARY TABLE (Use This in PPT / Document)

Layer	Technology
Frontend	React, Tailwind, D3.js
Backend APIs	FastAPI (Python)
Data Pipelines	Celery + Redis
ML Models	Prophet, ARIMA, Scikit-Learn
LLM	GPT-4o Mini / Llama-3
Database	PostgreSQL + Timescale
Storage	AWS S3
Orchestration	Celery Chains
Infra	Docker + Railway/Render
Monitoring	Grafana Cloud
Audit Ledger	Postgres + SHA256
Docs Parser Generator	Tesseract + Jinja2