AI Native Dev

Week 4

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TraderPulse

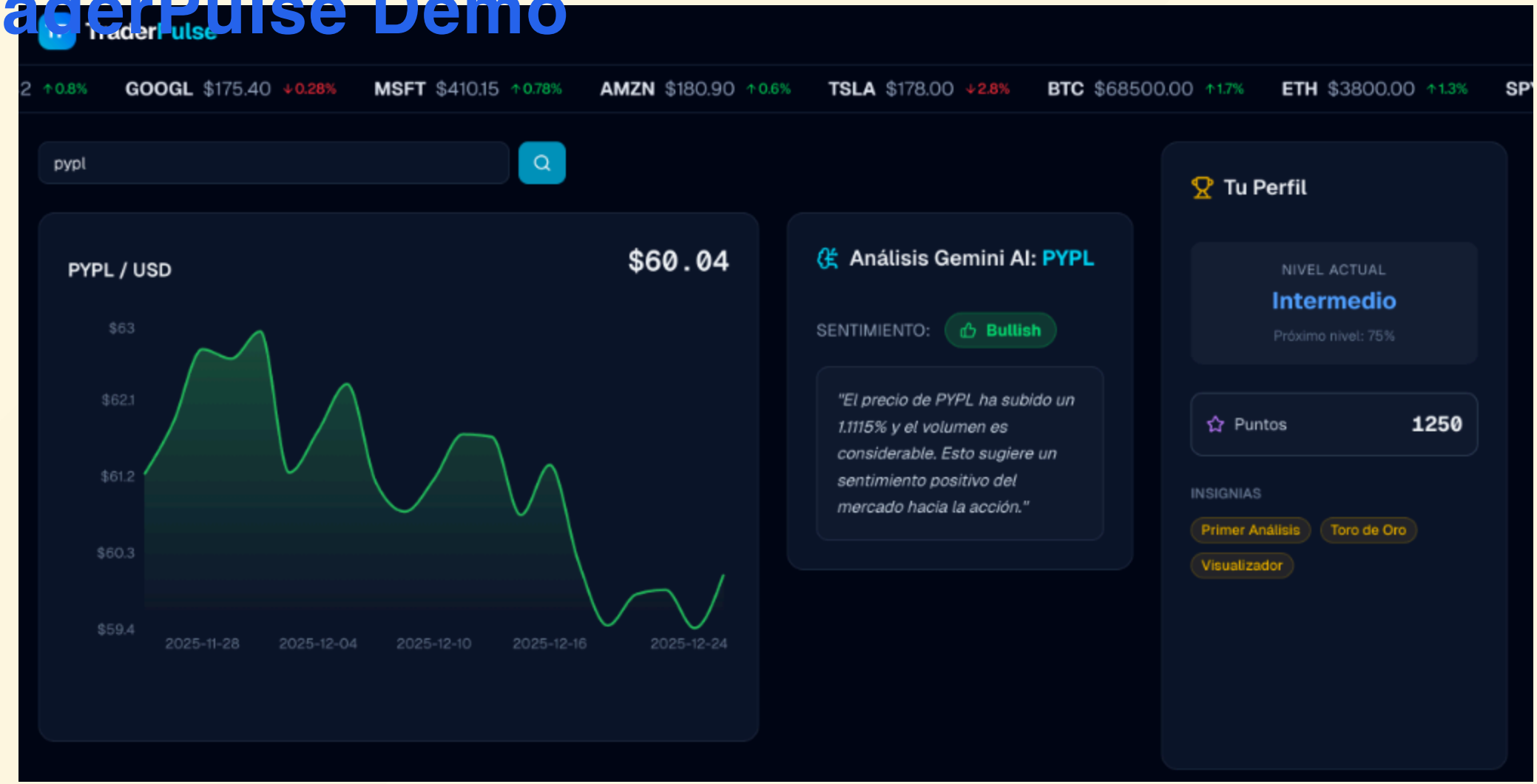
Real-Time SaaS Dashboard

The Application

"TraderPulse" is a **Financial SaaS Dashboard** that combines real-time market data with AI-driven sentiment analysis.

- **Stack**: Next.js 16 (Global Frontend), FastAPI (Python Backend).
- **Data**: Live stock quotes via Yahoo Finance (`yfinance`).
- **AI**: Gemini 3 Flash for "Bullish/Bearish" sentiment detection.
- **Architecture**: Decoupled Monorepo (Frontend + Backend).

TraderPulse Demo



Topic 1: Decoupled Architecture

Why Separate Frontend & Backend?

The "Monolith" vs "Decoupled"

- **Frontend (Next.js)**: Needs "Edge" speed, SEO, and fast iteration. Best on **Vercel**.
- **Backend (FastAPI)**: Needs raw compute, heavy libraries (Pandas, yfinance), and long-running threads. Best on **Cloud Run**.

The AI Advantage:

- AI Agents thrive on "Separation of Concerns".
- You can assign one Agent to the "API Contract" and another to the "UI Implementation".

Decoupled Architecture: High Level

Separate concerns, separate scale.

```
graph LR
    User[Connectivity] -->|HTTPS| CDN[Vercel Edge Network]
    CDN -->|Next.js App| Frontend[Frontend Container]
    Frontend -->|API Call| API[Google Cloud Run]
    API -->|Validation| Pydantic[Pydantic Settings]
    API -->|Logic| Python[FastAPI (Python 3.12+)]
```

- **Frontend**: Handles User State, UI rendering, and SEO.
- **Backend**: Handles Business Logic, Heavy Compute, and Data Security.

The "Contract First" Approach

How do we keep them in sync? **OpenAPI (Swagger)**.

1. **Backend Agent**: "Create a FastAPI endpoint `GET /sentiment` returning `{ sentiment: string }`."
2. **Frontend Agent**: "Read the `openapi.json` from the backend and generate a typed TypeScript client."

Result: Type-safe integration without the monolith headache.

Design Pattern: Backend for Frontend (BFF)

In **TraderPulse**, our FastAPI Service is not just a data API, it's a **BFF**.

- **Aggregator**: It calls Yahoo Finance (Source A) + Gemini AI (Source B).
- **Transformer**: It merges "Price" + "Sentiment" into a single JSON response for the UI.
- **Simplifier**: The Frontend makes *one* call to `/api/v1/sentiment`, not multiple calls to external services.

Backend Architecture

Modern Python for AI (FastAPI + Python 3.12+)

1. **Validation First**: `Pydantic Settings` (v2+) reads `.env` and crashes early if configs are missing.
2. **Security**: Strict CORS Middleware. Only the specific Vercel URL is allowed to talk to us.
3. **Performance**: Python 3.12+ has significant speed improvements over older versions.

Prompt: Backend Specification

We explicitly ask for these standards to avoid "Hello World" quality code.

> "Create a **FastAPI** backend using **Python 3.12+**.
>
> - **Environment Validation**: Use **Pydantic Settings** to validate `FRONTEND_URL`.
> - **CORS**: Middleware that strictly allows `FRONTEND_URL`.
> - **DevOps**: `Dockerfile` using `python:3.12-slim` multi-stage build."

Frontend Architecture (Next.js 16)

Safety at the Edge

1. **Runtime Validation**: `Zod` checks environment variables at build time. No more `undefined` API calls.
2. **Server Components**: Fetch data on the server (close to the DB/API), send HTML to the user.
3. **Client Components**: Handle the interactive bits (Buttons, Optimistic Updates).

Prompt: Frontend Specification

Directing the Agent on Architecture.

> "**Data Consumption**:
>
> - Implement a **Server Component** to fetch the `/health` status.
> - Implement a **Client Component** using `shadcn/ui` to display status.
> - **Environment**: Use **Zod** to validate `NEXT_PUBLIC_API_URL`."

Key Takeaway: Decoupled Architecture

Separate stacks allow separate velocities.

- **Teams**: One team can deploy the Frontend (Vercel) 10 times a day, while the Backend team (Cloud Run) ships weekly stable releases.
- **Scale**: The Frontend scales on the Edge (globally). The Backend scales on Compute (regionally).
- **Complexity**: Higher initial setup (CORS, JWT, Git Ops), but infinite scalability.

Topic 2: Deployment

The AI Deployment Paradox

Traditional DevOps:
Write Code -> Push -> CI/CD -> Build -> Deploy.

- *Bottleneck*: Configuration (YAML hell, Secret management).

AI-Native DevOps:
Prompt -> Config Generation -> Deploy.

- *Advantage*: Agents understand the *infrastructure* code (Terraform, Dockerfiles) better than most devs.

Prompt: Dockerizing Python

We need to containerize the FastAPI backend for Cloud Run.

> **Prompt**: "Create an optimized `Dockerfile` for a FastAPI application using Python 3.12-slim.
>
> 1. Use multi-stage builds to minimize image size.
> 2. Install production dependencies (gunicorn/uvicorn).
> 3. Ensure the container runs as a non-root user for security.
> 4. Expose port 8080."

Example: The Optimized Dockerfile

The agent generates a production-ready Dockerfile.

```
# Generated by Agent
FROM python:3.12-slim as builder
WORKDIR /app
COPY requirements.txt .
RUN pip install --no-cache-dir -r requirements.txt

FROM python:3.12-slim
WORKDIR /app
COPY --from=builder /usr/local/lib/python3.12/site-packages /usr/local/lib/python3.12/site-packages
COPY . .
# Security: Run as non-root
RUN useradd -m appuser && chown -R appuser /app
USER appuser
CMD ["uvicorn", "main:app", "--host", "0.0.0.0", "--port", "8080"]
```

Cloud Architecture: Serverless

We use a **Serverless** approach for cost efficiency and scale.

```
graph LR
    User[User Browser] -->|HTTPS| Vercel[Vercel (Frontend)]
    Vercel -->|Next.js Proxy| CloudRun[Google Cloud Run (Backend)]
    CloudRun -->|SDK| Gemini[Gemini 3 Flash]
    CloudRun -->|Library| Yahoo[Yahoo Finance]
    CloudRun -->|Secrets| GSM[Bóveda de Secretos]
```

- **Frontend**: Hosted on Edge (Vercel).
- **Backend**: Hosted on Container (Cloud Run).
- **Secrets**: Managed by GSM (Google Secret Manager).

Prompt-Driven Operations

Instead of clicking buttons in the console, we prompt the deployment steps.

> **Prompt**: "Deploy the **TraderPulse** SaaS to production...
>
> 1. **Secret Creation:** Create one secret in GSM: `traderpulse-gemini-key`.
> 2. **Cloud Run Deploy:** Service name `traderpulse-api`, map GSM secret to env var `GEMINI_API_KEY`.
> 3. **Frontend:** Deploy to Vercel and set `NEXT_PUBLIC_API_URL`."

Note: This isn't strict "IaC" (Terraform), but "Ops via Instruction".

Security: Managing Secrets

Never hardcode API keys.

1. **Local**: `.env` file (GitIgnored).
2. **Production**: Google Secret Manager / Vercel Environment Variables.

The Prompt connection:

> "**Security:** Google Secret Manager (GSM) for `GEMINI_API_KEY`. ensuring the Cloud Run Service Account has the 'Secret Manager Secret Accessor' role."

Git Ops: The Vercel Flow

Automation begins at `git push`.

1. **Connect**: Link GitHub Repo to Vercel Project.
2. **Trigger**: Push to `main` -> Vercel Start Build.
3. **Preview**: Push to `feature-branch` -> Vercel creates a **Preview URL** (e.g., `app-git-feat.vercel.app`).

Value: Zero-touch deployment for the Frontend.

Vercel CLI: The Manual Alternative

Sometimes you want to test a deploy *without* a git commit.

The Command:
`vercel` (Preview) | `vercel --prod` (Production)

- **UseCase**: Quick iterations, debugging build errors locally, or deploying from a local folder without syncing to GitHub.
- **Mechanism**: Uploads the `.next` build (or source) directly to the Vercel Edge Network.

CI/CD: Reliability Pipeline

Before we deploy, we verify. **GitHub Actions** is our robot guard.

```
graph LR
    Push[Git Push] -->|Trigger| Test[Run Tests]
    Test -->|Pass| Build[Build Container]
    Build -->|Success| Registry[Artifact Registry]
    Registry -->|Image| Deploy[Cloud Run]
    Test -->|Fail| Block[Block Merge]
```

- **CI (Integration)**: "Did I break the build?" (Pytest/Vitest).
- **CD (Delivery)**: "Ship it to production."

Key Takeaway: Deployment

AI turns DevOps from "specialized knowledge" into "standard workflow".

- **Rule**: Let the AI write the Dockerfile and YAML. You review the Security.
- **Shift**: From "Configuring Servers" to "Defining Architecture".

Topic 3: Future of Software Engineering

The Shift: Coder to Architect

Yesterday:

- Value = Syntax knowledge + Typing speed.
- Task = "Write a function to sort this list."

Tomorrow (AI-Native):

- Value = System Design + Problem Solving + Review.
- Task = "Design a resilient payment processing system that handles 10k RPS."

The "On-Call" Developer

Coding is becoming simpler, but **Systems** are becoming more complex.

- You are no longer the *Manual Laborer* laying bricks.
- You are the *Site Foreman* directing a team of robot workers (Agents).
- **Responsibility**: When the robot builds a wall in the wrong place, **YOU** are responsible.

Code is Ephemeral

We used to treat code like a **Pet** (naming it, grooming it, loving it).
Now, code is **Cattle**.

- **Then**: Refactoring a legacy class took weeks.
- **Now**: "Rewrite this service in Rust" takes minutes.
- **Implication**: Don't get attached to implementation details. Get attached to **Interfaces** and **Business Logic**.

The Rise of "Agentic Dev"

- **Definition**: Building software by describing the *experience* and *outcome* relying on autonomous agents for implementation.
- **Tool**: Cursor / Replit / Antigravity.
- **Risk**: Building a beautiful house with no foundation.
- **Mitigation**: The **AI-Native SDLC** (Week 2) – Structural integrity checks.

Agentic Workflows at Scale

The future is multiple Agents collaborating.

```
graph TD
    Manager[PO Agent] -->|Specs| Arch[Architect Agent]
    Arch -->|Design| Back[Backend Agent]
    Arch -->|Design| Front[Frontend Agent]
    Back -->|PR| Review[Reviewer Agent]
    Front -->|PR| Review
    Review -->|Merge| Main[Production]
```

- **Human Role**: The "Manager" at the top and the "Reviewer" of the Reviewer.

Code as Commodity

Chris Messina's Hypothesis:
With Generative AI, code is becoming as abundant and cheap as salt.

- **The Shift**: The value isn't in *writing* the code anymore, but in **what** code you write and **why**.
- **New Skills**: Judgment, Taste, Orchestration, and Narration.
- **Reality**: "If you can describe it, you can build it." The barrier is no longer syntax, but **Imagination** and **Clarity**.

The New Archetypes

As the "Coder" role fades, three new roles emerge:

1. **The Mixologist**: Combines APIs and existing components to create novel solutions. Remixes ingredients to produce unique value.
2. **The Producer**: Brings "Taste" and "Judgment". Orchestrates the AI signals to separate the noise. Focuses on the *Experience*.
3. **The Architect**: Designs the *Environment* not just the function. Anticipates how users inhabit the system. Makes structure inevitable.

Key Takeaway: Future

The Evolution of Value:

- **From**: "How do I implement this loop?" (Syntax)
- **To**: "How does this system fail?" (Architecture) & "Is this worth building?" (Product).

> "The specific language matters less. The fundamental understanding of Computing (Memory, Network, Latency) and the **Human Capacity for Creativity & Taste** matters more." - *Become the Architect of your own Tools.*

Deep Dive

The Cost of Intelligence

We are building apps that rely on expensive inference.

- **Traditional App**: Query DB -> Return JSON. (Micro-cents).
- **AI App**: Query DB -> **Inference (Gemini)** -> Return JSON. (Milli-cents).

The "Token Tax":
Every feature you add that uses AI increases the **Marginal Cost** per user.

- *Optimization*: Use smaller models (Gemini Flash) for specific tasks. Save "Pro" models for complex reasoning.

Latency vs Accuracy

Trade-off:

- **Gemini 3 Pro**: Higher reasoning, 1-2s latency.
- **Gemini 3 Flash**: Lower reasoning, 200ms latency.

In TraderPulse:
We use **Flash** because "Real-time" sentiment requires speed. We accept slightly less nuance for significantly faster updates.

Code Spotlight: The "Typed AI" Pattern

How do we prevent the AI from breaking our Frontend? **JSON Mode**.

```
# services/ai_service.py
response = client.models.generate_content(
    model="gemini-2.0-flash",
    contents=prompt,
    config=types.GenerateContentConfig(
        # CRITICAL: Force JSON output
        response_mime_type="application/json"
    )
)
```

- **Justification**: This turns the LLM into a **deterministic API**. We don't need regex. We parse `response.text` directly into a Python Dictionary (and then Pydantic).

Architecture: Dynamic Context Injection

We don't just ask "What do you think of Apple?". We **inject** the live data first.

```python
async def analyze_sentiment(symbol: str, market_data: dict):
    prompt = f"""
    Analyze the following market data for {symbol}:
    {json.dumps(market_data)}  <-- REAL-TIME CONTEXT

    Output JSON: {{ "sentiment": "Bullish", "justification": "..." }}
    """
```

- **Design Choice**: The Backend acts as the **Context Aggregator**. It fetches `yfinance` data (Cheap/Fast) and feeds it to Gemini (Smart), reducing hallucination risk.

The Challenge

Gamification & Engagement

The Challenge: Gamification

Context: Users visit the dashboard but don't stay. We need to "hook" them.

Objective: Implement a **Gamification System** into TraderPulse.

1. **XP System**: Users gain "Analysis Points" for every stock they analyze.
2. **Badges**: Award "Bull Market Expert" badge after 5 analyses.
3. **UI**: Updates to the Sidebar to show Level/Points.

Constraint: Reference the `create-app.md` prompt requirements for the "Gamification Sidebar".

Definition of Done

- [ ] **Backend**: `/api/v1/gamification` endpoint returns points.
- [ ] **Frontend**: Sidebar displays "Level" and a Progress Bar.
- [ ] **State**: Clicking a stock updates the local points counter (Client-side optimistic update).
- [ ] **Notification**: Sonner Toast "XP Gained!" on analysis.
- [ ] **Deploy**: Successfully deployed to Vercel/Cloud Run.

Resources

Resources: Deployment

- **Google Cloud Run Documentation** - The Serverless Container standard.
- **Twelve-Factor App** - The methodology for building SaaS apps (Config, Backing Services).
- **GitHub Actions for Python** - CI/CD pipelines.
- **Vercel Deployment Guide** - Next.js optimized hosting.

Resources: The Future

- **The End of Programming (Matt Welsh)** - Controversial but essential reading.
- **Code as Commodity (Chris Messina)** - The rise of the Mixologist, Producer, and Architect.
- **Jevons Paradox in AI** - Why AI won't reduce the demand for code, but explode it.
- **Prompt Engineering Guide** - Staying up to date with the "New Syntax".
- **Software 2.0 (Andrej Karpathy)** - The shift from explicit code to learned weights.