Medical Exam Preparation Platform — Complete Technical Blueprint

This document describes a syllabus-intelligent, analytics-driven medical examination preparation platform. It consolidates the complete product vision, learning science foundations, system architecture, development pathway, and the optimal technology stack required to build a defensible, high-quality product.

1. Project Vision & Core Concept

The platform is designed as a modular assessment and learning intelligence system rather than a simple question bank. It tracks what a student has studied, how well they understand each concept, how their knowledge decays over time, and what they must revise next to maximize exam performance.

2. Content & Syllabus Ontology

All content is mapped to a strict hierarchical syllabus ontology: Subject → System → Chapter → Topic → Subtopic → Concept Node. Each MCQ is anchored to standard textbooks, tagged by exam pattern, difficulty, and cognitive level. This structure enables precision testing, mastery analytics, and intelligent revision planning.

3. Testing & Learning Engine

The platform supports learning mode, exam mode, adaptive mode, and revision mode. Adaptive selection is driven by deterministic algorithms that incorporate mastery scores, difficulty progression, recency, and historical mistakes. AI is used only as an assistive layer, not as the decision authority.

4. Analytics & Decision Intelligence

Analytics operate at concept-level granularity. Dashboards display mastery heatmaps, forgetting risk indices, response time trends, mistake categorization, and predictive rank ranges. These metrics are explainable, stable, and auditable.

5. Development Pathway (End-to-End)

Development proceeds in carefully ordered phases: syllabus ontology finalization, content pipeline construction, core backend services, analytics engine, adaptive logic, user-facing dashboards, mock exams, and finally AI augmentation. Architectural correctness precedes speed.

6. Microservice Architecture

Services are separated by responsibility: authentication, syllabus, question bank, test engine, attempt logging, analytics, adaptive logic, ranking, AI explanations, and notifications. This isolation ensures scalability, auditability, and system safety.

7. Product Phases (MVP → V2)

The MVP validates learning value with static tests and basic analytics. Version 1 introduces adaptive testing, mock exams, and rankings. Version 2 adds predictive modeling, concept graphs, AI explanations, and institutional licensing.

8. Complete Tooling & Technology Stack

- Frontend: TypeScript, React (Next.js), Tailwind CSS, GSAP, D3.js
- Mobile: React Native with offline caching
- Backend: Python (FastAPI), Go (high-performance services)
- APIs: REST, GraphQL, gRPC
- Databases: PostgreSQL, Neo4j (concept graph), Redis
- Analytics & Warehousing: Snowflake
- Search: Elasticsearch
- ML & AI: PyTorch, TensorFlow, Hugging Face, OpenAI/Claude APIs
- Testing: pytest, Hypothesis, k6
- DevOps: Docker, Kubernetes, GitHub Actions
- Cloud: AWS, Azure, Cloudflare
- Security: OAuth2, JWT, Firewalls, Zero Trust architecture
- Monitoring: Prometheus, Grafana, OpenTelemetry
- Content Pipeline: Internal CMS, Markdown, LaTeX, faculty review workflow