Module 1: Authentication & User Management Module

Purpose

Handles secure login, registration, role-based access control, and user identity management.

Inputs

- Username / email
- Password
- User role (Student)
- API authentication tokens

Outputs

- JWT / OAuth tokens
- Authenticated session
- User profile information
- Access permissions

Dependencies

- User database
- Encryption library (bcrypt / Argon2)
- JWT/OAuth provider
- Admin panel for role management

Flow

1. User enters credentials
2. System verifies hashed password
3. Generates JWT token
4. Loads the appropriate dashboard
5. Applies role-based access control

Module 2: Student Data Ingestion & Processing Module

Purpose

Collects raw academic data and preprocesses it for analytics and model consumption.

Inputs

- Student Transcript
- Attendance data
- Course information
- Assessment breakdowns
- Uploaded CSV/Excel datasets (optional)

Outputs

- Cleaned, validated, standardized dataset
- Student performance vectors

- Stored records in the database

Dependencies

- Data validation engine
- ETL scripts
- University LMS/Registration system API
- Database storage

Flow

1. Receive raw academic data
2. Validate format, completeness
3. Clean & normalize data
4. Compute derived metrics (weights, percentages, GPA)
5. Store structured data

Module 3: Analytics & Visualization Module

Purpose

Generates charts, dashboards, and analytical summaries of student performance.

Inputs

- Clean student dataset

- Historical academic performance
- Attendance rates
- Course difficulty profiles

Outputs

- GPA trend charts
- Strength/weakness metrics
- Performance breakdown visualizations
- Comparative/charts dashboards

Dependencies

- Data processing module
- Visualization libraries (Chart.js / D3.js)
- Frontend user interface

Flow

1. Fetch student data from DB
2. Calculate performance metrics
3. Generate analytical summaries
4. Render visual charts on UI

Module 4: Predictive Intelligence (AI/ML) Module

Purpose

Runs machine learning models to predict grades, fail probability, GPA forecasting, and risk scoring.

Inputs

- Processed academic dataset
- Feature vectors (grades, attendance, difficulty, workload)
- Model configuration parameters

Outputs

- Predicted grades for each course
- GPA projection
- Probability of failure/risk
- Confidence scores
- Model explanation data (SHAP values, feature importances)

Dependencies

- Trained ML models (Random Forest, XGBoost, neural networks)
- Model versioning system
- Python ML environment
- Database for logging predictions

Flow

1. Receive student features from Data Processing module
2. Run prediction models
3. Generate risk scores and forecasts
4. Return predictions + explanations
5. Log model performance

Module 5: Recommendation Engine Module

Purpose

Produces personalized academic guidance based on analytics, predictions, and performance patterns.

Inputs

- AI predictions
- Student strengths/weaknesses
- Course difficulty data
- Performance trends
- Risk scores

Outputs

- Study strategy recommendations
- Alerts (e.g., “low attendance risk”)

- Course load suggestions
- Behavioral insights (e.g., “you do better in morning exams”)

Dependencies

- Analytics module
- AI module
- NLU/NLP component for generating text
- Rule-based engine (optional)

Flow

1. Receive prediction results
2. Analyze weaknesses, risks, and trends
3. Apply recommendation rules + AI personalization
4. Generate natural-language advice
5. Send insights to UI

Module 7: Intelligent Quiz Generation & Assessment Engine

Provides students with personalized quizzes that help reinforce weak areas and improve academic performance.

Inputs

- Course
- AI Core
- Student strengths/weaknesses
- Course difficulty data
- Performance trends

Outputs

- Personalized Quiz
- Answer Explanation
- Correction

Dependencies

- Analytics module
- Course Info
- AI module
- NLU/NLP component for generating text

Flow

1. Receive Course Info

2. Receive performance results
3. Analyze weaknesses, risks, and trends
4. Generate Quiz
5. Correct & Explain
6. Save results and measure performance
7. Update AI

Website (Frontend + Experience Layer)

1.1 Dashboard & Insights

- Personalized academic dashboard
- GPA, CGPA, course progress, and trajectory visualization

- Highlight strong/weak subjects
- Early warnings (risk flags)

1.2 Grade Tracking

- Automated grade import OR manual grade entry
- GPA forecasting (expected vs achieved)
- Grade improvement tracking

1.3 Personalized Recommendations

- Study improvement suggestions
- Weekly performance summaries
- Behavior-based learning patterns

1.4 Goal Setting

- Student sets targets (GPA goals, course goals)
- AI checks progress and notifies student if they are at risk or ahead

1.5 Study Plan Generator

AI uses historical patterns + current workload to produce:

- Weekly study plan
- Highlight overloaded weeks
- Recommend time allocation per course

2. AI Analytics & Intelligence Module

2.1 Academic Performance Insights Engine

Analyzes:

- Historical grade trends
- Difficulty of courses
- Student weaknesses
- Expected vs real performance gap

Produces:

- Personal insights
- Academic behavior interpretation

2.2 AI-Based Risk Prediction

Predicts:

- Probability of failing
- Probability of dropping in GPA
- Future performance per course

Uses:

- Logistic regression / random forest / neural model
- Real-case academic data patterns

2.3 Personalized Recommendation Engine

- Behavior-based recommendations
- Adaptive suggestions each semester

- Alerts when user enters risky behavior
- Insight explanations (why this recommendation?)

3. Course Intelligence Module

3.1 Course Difficulty Prediction

Learns from:

- Historical grades
- Pass rates
- Student profile similarity

Outputs:

- Expected course difficulty for this student
- Expected effort/time required
- Personalized workload estimator

3.2 Course Load Optimizer

Helps student choose best course bundle based on:

- Difficulty
- Prerequisites
- GPA goals
- Student strengths

4. Advisor-Student Interaction Module

4.1 Smart Advisor Chatbot

- Answer student academic questions
- Interpret student performance
- Suggest study techniques
- Explain insights
- Help with course planning

4.2 Message Threads

- Student and advisor have a conversation timeline
- Stored as private journaling-style threads
- Context-aware, not one-off replies

5. Data Processing & Normalization Module

Analyzing **global university grading systems**.

5.1 Grade Format Normalization

System understands and converts:

- Percentage
- Letter (A–F)
- 4.0 scale

- 5.0 scale
- Cairo system
- UK system
- US system
- ECTS (Europe)

5.2 Data Extraction & Cleaning

For systematic review:

- Extract data from research papers
- Clean inconsistencies
- Categorize typologies and flaws

6. Admin & Management Module

6.1 Admin Dashboard

- Manage student accounts
- View aggregated analytics

6.2 University/Faculty Integration

- Import academic data
- Manage course structure
- Set curriculum details

7. Security, Privacy & User Management

7.1 Authentication

- Login, registration
- Secure token sessions

7.2 Role Management

- Admin
- Student

7.3 Data Privacy

- Encrypted academic data
- “My AI data settings” panel

8. Reports & Visualizations Module

8.1 Smart Reports

- Student performance evolution
- Semester insights
- Course difficulty breakdown

8.2 Data Visualizations

- GPA time series

- Progress bars
- Risk indicators
- Pie charts & heatmaps

9. Overall Value Proposition

- Understands the student academically
- Learns from their history
- Predicts their future performance
- Advises them personally
- Helps them plan
- Uses AI to deliver meaningful insights
- Fixes the chaos of grading systems with a unified model
- Gives students personalized academic development tools