

Design (IB Computer Science IA)

Purpose and scope

This document describes the design of the **Offline Quiz Application** from an IB Computer Science IA perspective. It focuses on:

- User interaction and navigation through the web interface.
- Core system behaviour and control flow.
- Data structures / data model derived from the CSV question bank.
- Use cases (UML use case diagram).
- Data flow diagrams (context + level 1).

The application is an **offline** FastAPI + Jinja2 web app. Questions are stored in a local CSV file and loaded into memory for the duration of the program.

Design overview

User interaction and navigation

Primary user: Student

Navigation is single-page driven (the app re-renders the same template `quiz.html` with different state):

1. **Open home page (GET /)**
 - The page displays:
 - Topic dropdown (derived from CSV)
 - Difficulty dropdown (derived from CSV)
 - “Start quiz” button
2. **Start a quiz (POST /api/quiz/start)**
 - Inputs:
 - `topic`
 - `difficulty`
 - Output:
 - A new quiz session is created (UUID session id).
 - The first question is displayed.
 - The page shows “Question X of 10”.
3. **Answer questions (POST /api/quiz/{session_id}/answer)**
 - Inputs:
 - `question_id` (hidden input)
 - `chosen_option` (radio selection)
 - Output:
 - Immediate feedback (“Correct!” / “Incorrect.”)
 - Next question is displayed until quiz is finished.
4. **View summary and review** (rendered when finished)
 - Summary includes:
 - Total attempted (number of questions answered in the session)
 - Correct / incorrect counts

- Percentage score
- Time spent
- Review section lists incorrect questions with:
 - Question text
 - Student's chosen option
 - Correct option

Usability considerations (IA-oriented):

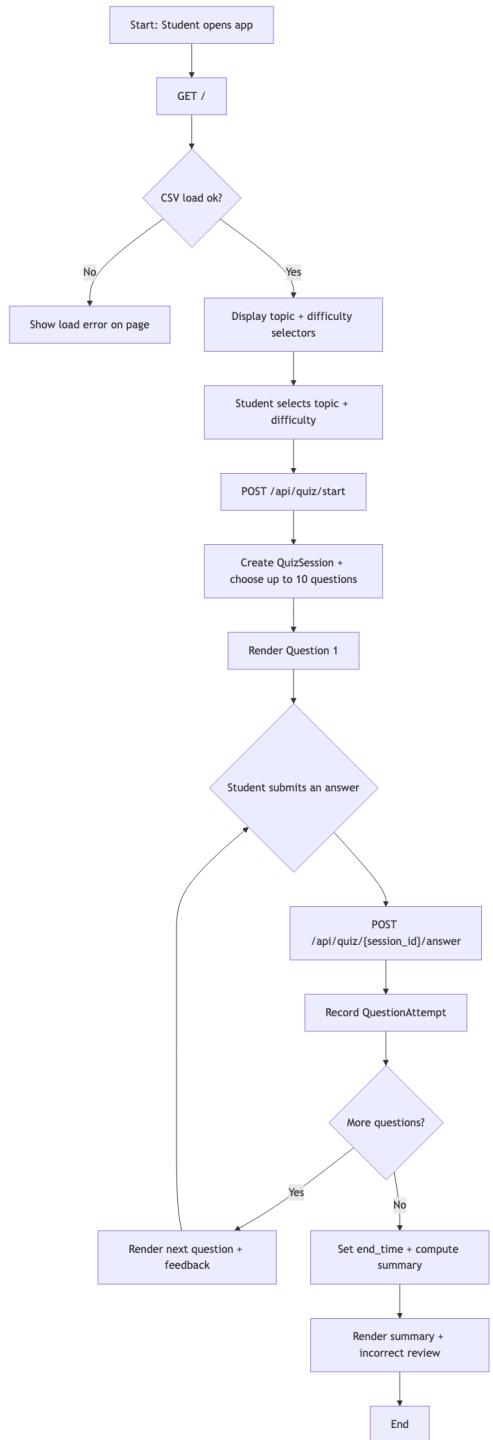
- **Constraints / validation:** Required dropdown selections and required radio answer before submit.
- **Feedback:** Each answer returns correctness feedback immediately.
- **Consistency:** Same layout used for selection, quiz, and summary.
- **Offline-first:** No external API calls; all data read from local disk.

High-level component design

- **Presentation layer (Browser + Jinja2 templates)**
 - Renders forms and displays quiz state.
- **API / controller layer (FastAPI routes)**
 - Validates user inputs and coordinates rendering.
- **Service layer (quiz_service.py)**
 - Loads CSV, manages quiz sessions, checks answers, computes summaries.
- **Model layer (question.py)**
 - Dataclasses representing questions, attempts, and sessions.
- **Data source (CSV)**
 - Local question bank used to create MCQQuestion instances.

System flowchart

The diagram below shows the main logic from the user's perspective.



Data design (CSV schema and in-memory model)

CSV question bank (persistent data)

File: `src/data/question-bank.csv`

The file contains one row per question. The current dataset uses this schema (“schema_v2” in `quiz_service.load_question_bank()`):

- `topic` (string)
- `question` (string)
- `option1` (string)
- `option2` (string)
- `option3` (string)
- `option4` (string)
- `answer` (string, must match one of the 4 options)
- `difficulty` (string: easy | medium | hard)

Additional columns exist in the CSV (e.g., `asked_in_this_session`, `got_right`, `tag`) but the current implementation does **not** use them.

In-memory data structures (program data)

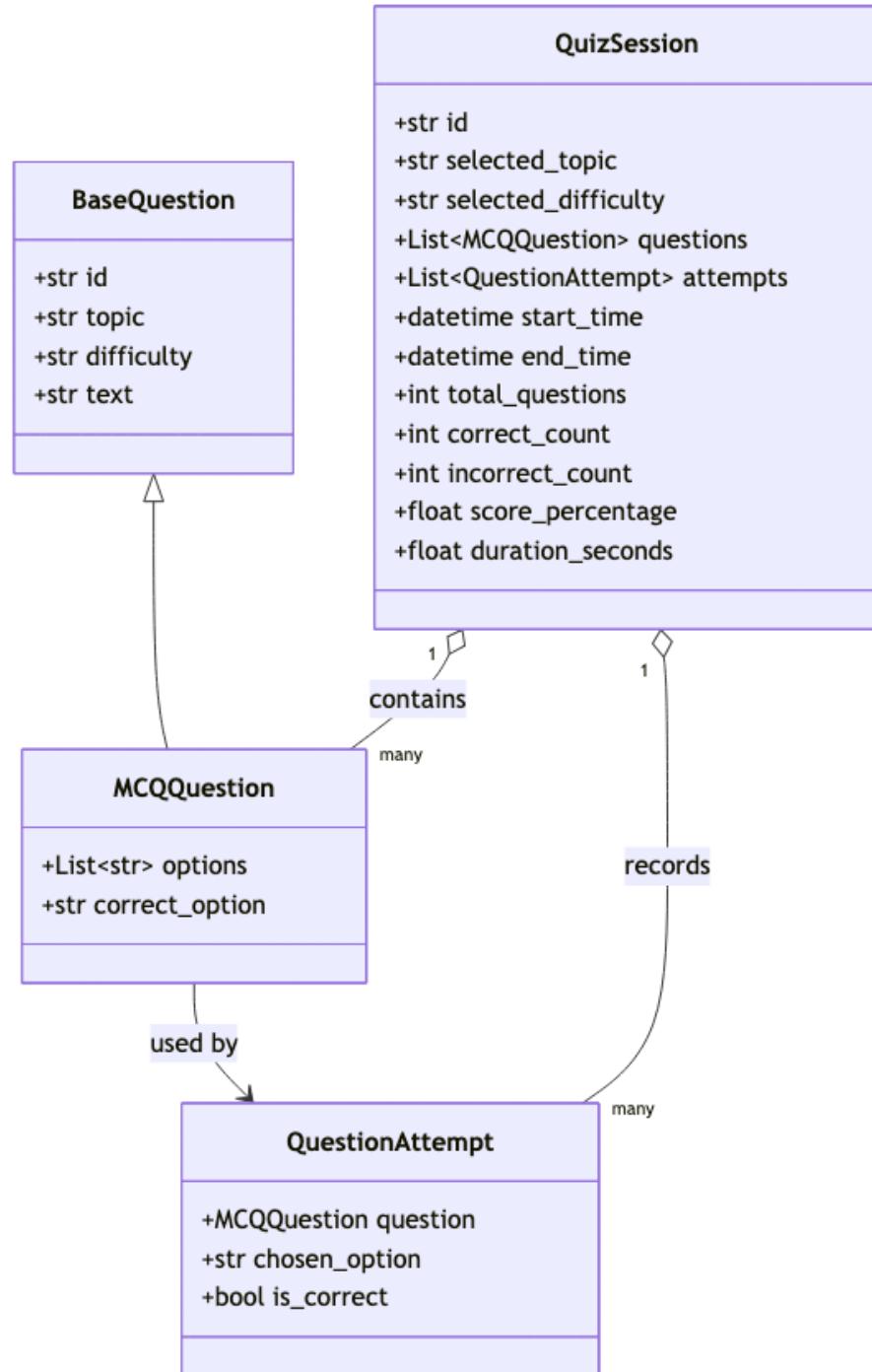
The program converts each CSV row into an `MCQQuestion` dataclass and stores:

- A cached list of questions: `_QUESTIONS_CACHE: List[MCQQuestion]`
- A session store: `_SESSIONS: dict[str, QuizSession]` keyed by session UUID

Rationale:

- Caching avoids re-reading the CSV on every request.
- The in-memory session dictionary is enough for an offline IA-sized project and avoids database complexity.

Data model (classes)



Key derived collections

During execution the service derives:

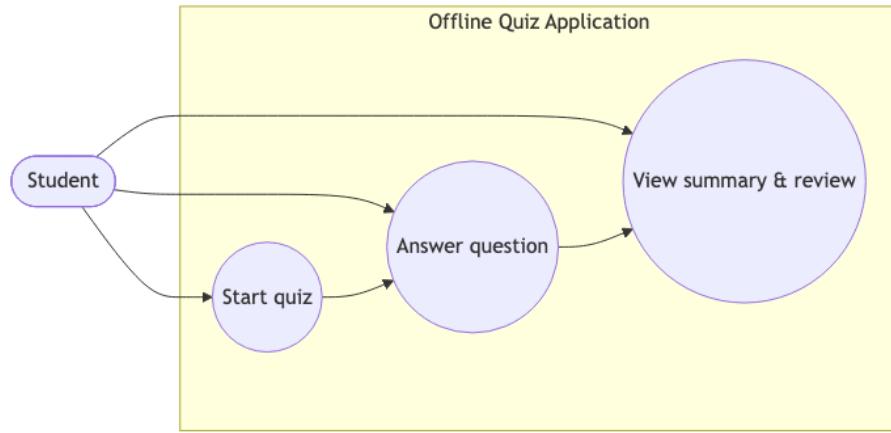
- **Topics set:** `sorted({q.topic for q in questions})`
- **Difficulties set:** `sorted({q.difficulty for q in questions})`
- **Filtered question list:** questions matching selected topic + difficulty
- **Progress index:** `len(session.attempts)` to select the next question

Use case model

Use cases (text)

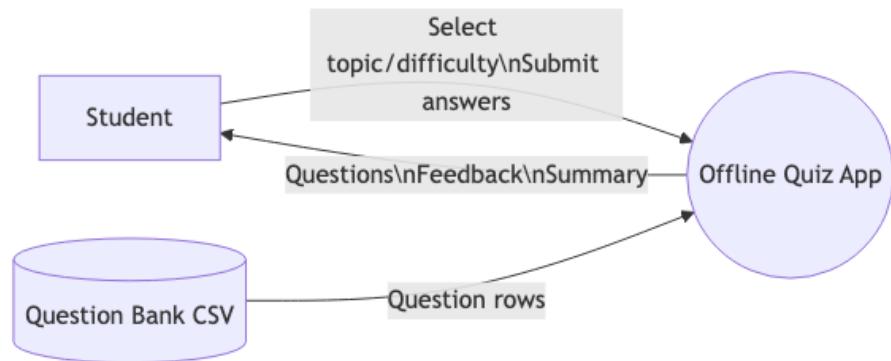
- **UC1: Start quiz**
 - Actor: Student
 - Preconditions: CSV loads successfully
 - Main success scenario:
 - * Student selects `topic` and `difficulty`
 - * System creates a new QuizSession
 - * System displays first question
- **UC2: Answer question**
 - Actor: Student
 - Preconditions: Quiz session exists
 - Main success scenario:
 - * Student selects an option and submits
 - * System records attempt and indicates correct/incorrect
 - * System shows next question OR summary if finished
- **UC3: View summary and review incorrect answers**
 - Actor: Student
 - Preconditions: Quiz finished
 - Main success scenario:
 - * System computes totals and duration
 - * System displays summary and incorrect review list

Use case diagram

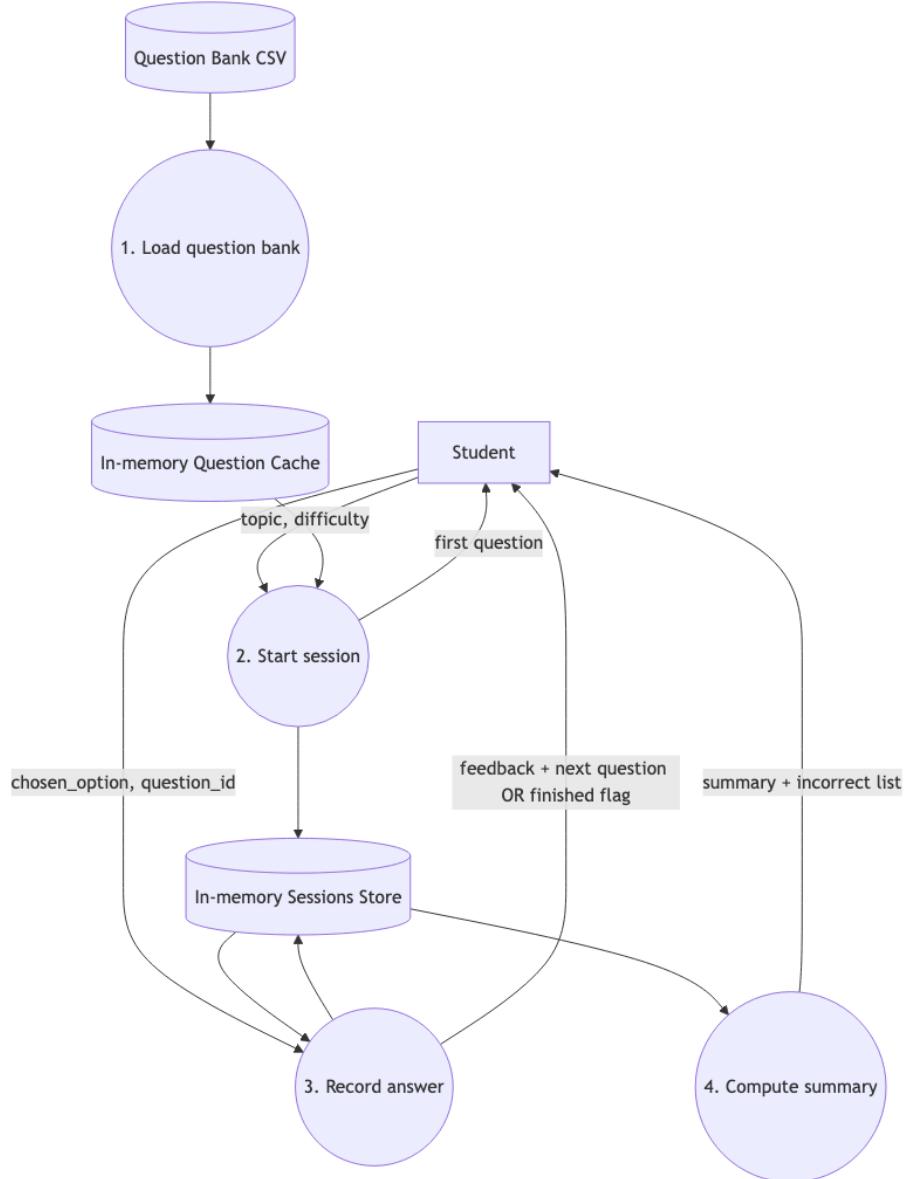


Data flow diagrams (DFD)

DFD Level 0 (Context diagram)



DFD Level 1 (Main processes)



Traceability to implementation

This design maps directly to the existing repository structure:

- **UI template:** `src/web/templates/quiz.html`

- **Routes/controllers:** `src/api/routes.py`
- **Business logic:** `src/services/quiz_service.py`
- **Data classes:** `src/models/question.py`
- **Data source:** `src/data/question-bank.csv`

Notes for marking criteria:

- The UI shows “Question X of Y” where `Y = len(session.questions)` (the selected set, up to 10).
- The summary field `total_questions` comes from `len(session.attempts)` (questions actually answered).