Q1: Domain Model

1. Entity Definitions and Attributes

Hybrid approach of PostgreSQL and MongoDB

1.1 PostgreSQL Entities

- **user:** Stores user account information who are form creator and editors.
    - id (UUID, Primary Key): Unique identifier for a user.
    - username (String, Unique): User's unique username.
    - password_hash (String): Hashed password.
    - email (String): User's email address.
    - registration_date (Timestamp): Registration datetime.

- **permission:** Manages user permissions on documents.
    - id (UUID, Primary Key): Unique identifier for a permission.
    - user_id (UUID, Foreign Key to User): User to whom the permission is granted.
    - document_id (UUID, Foreign Key to Document): Document to which the permission applies.
    - permission_type (Enum: READ, WRITE, ADMIN): Type of permission.

- **respondent_details:** Stores details about respondents (when provided).
    - id (UUID, Primary Key): Unique identifier for a respondent.
    - respondent_data (JSONB): Flexible storage for respondent details (e.g.,*"name": "gana", "email": "gana@gmail.com"}*).
    *Note: PostgreSQL's robust querying capabilities (especially with JSONB) are perfect for analyzing **RespondentDetails.respondentData** data.*

- **response:** Stores responses from respondents to forms.
    - id (UUID, Primary Key): Unique identifier for a response.
    - document_version_id (UUID, Foreign Key to Document_Version): Form version to which the response belongs.
    - respondent_id (UUID, Foreign Key to RespondentDetails, Nullable): Respondent who submitted the response. Nullable for anonymous responses.
    - submitted_at (Timestamp): Timestamp of submission.
    - response_data (JSONB): Flexible storage for response data (answers to questions). (e.g: *{"Q1": 5, "Q2": "text answer"}*)

    *Note: PostgreSQL's robust querying capabilities (especially with JSONB) are perfect for analyzing **response.response_data** data.*

1.2 MongoDB Entities

- **documents:** Represents a form.
  - id (UUID, Primary Key): Unique identifier for a form.
  - title (String): Form title.
  - creationDate (Timestamp): Form creation date.
  - lastModifiedDate (Timestamp): Last modified date.
  - ownerUserId (UUID, Foreign Key to User): User who owns the form.
  - currentCRDTState (CRDT Data): Current state of the form data.

- **crdt_operations:** Stores CRDT operations for real-time collaboration.
  - id (UUID, Primary Key): Unique identifier for an operation.
  - documentId (UUID, Foreign Key to Document): Form to which the operation applies.
  - userId (UUID, Foreign Key to User): User who performed the operation.
  - operationType (Enum: INSERT, DELETE, UPDATE): Type of CRDT operation.
  - operationData (CRDT Data): Data associated with the operation.
  - versionVector (JSON): Version vector for causal order. (e.g: *{S1: 2, S2: 1}*)
  - timestamp (Timestamp): Operation timestamp.

- **document_versions:** Stores form versions for history and snapshots.
  - id (UUID, Primary Key): Unique identifier for a version.
  - documentId (UUID, Foreign Key to Document): Form to which the version belongs.
  - versionNumber (Integer): Version number.
  - timestamp (Timestamp): Version creation timestamp.
  - userId (UUID, Foreign Key to User): User who created the version.
  - snapshot (CRDT Data): Snapshot of the form data.

- **document_distributions:** Stores information about how a form is distributed.
  - id (UUID, Primary Key): Unique identifier.
  - documentVersionId (UUID, Foreign Key to Document_Version): Form version being distributed.
  - distributionChannel (Enum: LINK, EMAIL, EMBED): Distribution channel.
  - anonymousResponses (Boolean): Whether responses are anonymous.
  - distributionLink (String): Distribution link.

- **last_processed_version:** Tracks the last processed CRDT operation for server recovery.
  - id (UUID, Primary Key): Unique identifier.
  - userId (UUID, Foreign Key to User): User associated with the version vector.
  - documentId (UUID, Foreign Key to Document): Document associated with the version vector.
  - versionVector (JSON): Last processed version vector.
  - uniqued (UUID): Last processed Unique Identifier of the summarised CRDT Operation from Client.
  - lastProcessedTimestamp (Timestamp): Timestamp of the last processed version.