Submitter Database Quality Assessment

A. Normalization Form Analysis

This section analyzes the database structure in terms of its compliance with established normalization forms.

First Normal Form (1NF):

The database fulfills the requirements of 1NF. Each column in every table contains atomic values, preventing repeating groups. Every table represents a distinct entity, and its attributes describe that entity without nested or repeating data.

Second Normal Form (2NF):

While the majority of the tables conform to 2NF, the person table presents a potential violation due to a partial dependency:

- **person Table:** The composite primary key (email, vname, vid) incorrectly implies that all attributes depend on the entire key. However, a person's role as an author, editor, or reviewer (isAuthor, isEditor, isReviewer) depends only on the person's email and not on the specific volume (vname, vid) they are associated with. This partial dependency on email violates 2NF.

Third Normal Form (3NF):

The database exhibits a 3NF violation in the article table due to a transitive dependency:

> **article Table:** The volname (volume name) attribute depends on the volid (volume ID). This relationship creates a transitive dependency where the volname indirectly depends on the article's id through the volid, violating 3NF.

Boyce-Codd Normal Form (BCNF):

The same dependency in the article table also cause to violation of BCNF:

> **article Table:** As volname depends on volid and volid is not a superkey (the primary key is id), the BCNF rule requiring that for any dependency A → B, A must be a superkey, is broken.

B. Database Improvement Recommendations

1. Normalization:

- **person Table:** There should be a separate table for user roles, containing columns for email and role. This new table would resolve the partial dependency on the person table, ensuring compliance with 3NF.
- **article Table:** There should be a dedicated volume table to store the volname attribute. The article table should retain the volid as a foreign key referencing the volume table, eliminating the transitive dependency and achieving BCNF.

2. Indexes:

Indexes should be implemented on frequently queried columns to enhance query performance. This includes:

An index on person.email for efficient user lookups.

An index on article.volid to speed up the retrieval of articles belonging to a specific volume.

Indexes on both articlereviews.email and articlereviews.id to optimize retrieval of reviews by reviewer or by article.

3. Constraints:

- Foreign key constraints should be implemented to enforce referential integrity and maintain the relationships between database tables. Especially:
  - A foreign key constraint should be placed on article.volid, referencing volume.id.
  - Foreign key constraints should be there on articlereviews.id referencing article.id and on articlereviews.email referencing person.email.
  - Foreign key constraints are necessary on articlekeywords.aid referencing article.id and on articlekeywords.email referencing person.email.
  - Foreign key constraints should be implemented on writtenby.id referencing article.id and on writtenby.emailreferencing person.email.

4. Query Optimization:

- Existing queries should undergo a review process, focusing on optimizing those with multiple joins. For instance, retrieving the publication date by joining article and volume should be replaced with a more efficient subquery that gets the date directly from the volume table using article.volid.

5. Special Improvements:

- **Login Functionality:** The system should incorporate a secure login system that utilizes password hashing and session management for enhanced security and a personalized user experience.
- **Email Verification:** A process for verifying user-provided email addresses via confirmation emails should be in place to ensure data accuracy.
- **Error Handling:** The GUI's error handling mechanisms should be improved to provide users with clear and informative messages in situations such as invalid login attempts or other system errors.