A6: Indices, triggers, user functions and population

SegFault is a collaborative platform for programmers to learn, discuss different approaches, present ideas and share knowledge in a Q&A style.

To this end, the following sections provide detailed insight into the inner workings of the project's database. The first section depicts the expected workload on the system, the second section specifies and explains the proposed indices to the database, and the third section comprises the database's triggers.

1. Database Workload

A study of the predicted system load (database load), organized in subsections.

1.1. Tuple Estimation

Estimate of tuples at each relation.

Relation reference	Relation Name	Order of magnitude	Estimated growth
R01	Category	units	dozens
R02	QuestionCategory	units	dozens
R03	Question	units	dozens
R04	Answer	units	dozens
R05	Commentable	units	dozens
R06	Comment	units	dozens
R07	Message	units	dozens
R08	MessageVersion	units	dozens
R09	Vote	units	dozens
R10	User	units	dozens
R11	Moderator	units	dozens
R12	Notification	units	dozens
R13	CommentableNotification	units	dozens
R14	BadgeNotification	units	dozens
R15	BadgeAttainment	units	dozens
R16	Badge	units	dozens
R17	ModeratorBadge	units	dozens
R18	TrustedBadge	units	dozens

1.2. Frequent Queries

SELECT01

Query reference	SELECT01
Query description	Select all comments of a Message, order by their descending score
Query frequency	magnitude per time

```sql
SELECT *
FROM (
  SELECT DISTINCT ON (comment.id) comment.id, commentable.id, score, is_banned, author, cont
  FROM commentable, comment, message, message_version
  WHERE
    commentable.id = $messageId AND
    commentable.id = comment.commentable_id AND
    comment.id = message.id AND
    message.id = message_version.message_id
  ORDER BY
    comment.id,
    creation_time DESC
  ) updated_comments
ORDER BY
  updated_comments.score DESC;
```

SELECT02

Query reference	SELECT02
Query description	Select the first 25 questions, ordered by descending date of the last edition
Query frequency	magnitude per time

```sql
SELECT *
FROM (
  SELECT DISTINCT ON (question.id) question.id, title, correct_answer, score, is_banned, aut
  FROM question, commentable, message, message_version
  WHERE
   question.id = commentable.id AND
   commentable.id = message.id AND
   message.id = message_version.message_id
  ORDER BY
    question.id,
    message_version.creation_time DESC
  LIMIT 25
  ) unordered_questions
ORDER BY
  unordered_questions.creation_time DESC
```

SELECT03

Query reference	SELECT03
Query description	Select the 25 questions with most answers (the most discussed questions)
Query frequency	magnitude per time

```
SELECT question.id, COUNT(answer.question_id) AS num_answers
FROM question, answer, message
WHERE
  question.id = message.id AND
  answer.question_id = question.id
GROUP BY
  question.id
ORDER BY
  num_answers DESC
LIMIT 25;
```

SELECT04

Query reference	SELECT04
Query description	Select the contents ot the 25 most answered questions
Query frequency	magnitude per time

```
SELECT * FROM (
  SELECT question.id, COUNT(answer.question_id) AS num_answers
  FROM question, answer, message
  WHERE
    question.id = message.id AND
    answer.question_id = question.id
  GROUP BY
    question.id
  ORDER BY
    num_answers DESC
  LIMIT 25
) most_answered
JOIN (
  SELECT DISTINCT ON (question.id) question.id, title, correct_answer, score, is_banned, aut
  FROM question, commentable, message, message_version
  WHERE
   question.id = commentable.id AND
   commentable.id = message.id AND
   message.id = message_version.message_id
) info
ON
  most_answered.id = info.id
ORDER BY
  most_answered.num_answers DESC;
```

SELECT05

Query reference	SELECT05
Query description	Select the categories ordered by number of posts/questions in each category
Query frequency	magnitude per time

```
SELECT name, num_posts
FROM category
ORDER BY
  num_posts DESC;
```

SELECT06

Query reference	SELECT06
Query description	For a given category, select the 25 most recent questions and their contents (and select only those that aren't banned)
Query frequency	magnitude per time

```
SELECT *
FROM (
  SELECT DISTINCT ON (question.id) category.id, question_id, title, content, correct_answer
  FROM category, question, question_category, message, message_version
  WHERE
    category.id = $categoryId AND
    question_category.question_id = question.id AND
    question_category.category_id = category.id AND
    question.id = message.id AND
    message.id = message_version.message_id
  GROUP BY question.id, category.id, question_category.question_id, title, content, correct_
  HAVING
    is_banned = FALSE
  ORDER BY
    question.id,
    creation_time DESC
  LIMIT 25
) category_questions
ORDER BY
 category_questions.creation_time DESC
```

SELECT07

Query reference	SELECT07
Query description	Select all the answers of a given question, from newest to oldest
Query frequency	magnitude per time

```
SELECT *
FROM (
  SELECT DISTINCT ON (answer.id) answer.id, content, creation_time, is_banned, author
  FROM question, answer, message, message_version
  WHERE
    question.id = $questionId AND
    question.id = answer.question_id AND
    answer.id = message.id AND
    message.id = message_version.message_id
  GROUP BY
    answer.id, content, creation_time, is_banned, author
  ORDER BY
    answer.id,
    creation_time DESC
  ) question_answers
ORDER BY
  question_answers.creation_time;
```

SELECT08

Query reference	SELECT08
Query description	Select all of a User's questions
Query frequency	magnitude per time

```
SELECT *
FROM (
  SELECT DISTINCT ON (question.id) question.id, title, content, score, creation_time, is_ba
  FROM "user" u, message, message_version, question
  WHERE
    u.id = $user.Id AND
    u.id = message.author AND
    message.id = question.id AND
    message.id = message_version.message_id
  GROUP BY
    question.id, title, content, score, creation_time, is_banned
  ORDER BY
    question.id,
    creation_time DESC
  ) updated_questions
ORDER BY
  updated_questions.creation_time DESC;
```

SELECT09

Query reference	SELECT09
Query description	Select all of a User's answers
Query frequency	magnitude per time

```
SELECT *
FROM (
  SELECT DISTINCT ON (answer.id) answer.id, content, score, creation_time, is_banned
  FROM "user" u, message, message_version, answer
  WHERE
    u.id = $user.Id AND
    u.id = message.author AND
    message.id = answer.id AND
    message.id = message_version.message_id
  GROUP BY
    answer.id, content, score, creation_time, is_banned
  ORDER BY
    answer.id,
    creation_time DESC
  ) updated_answers
ORDER BY
  updated_answers.creation_time DESC;
```

SELECT10

Query reference	SELECT10
Query description	Select all of a User's comments
Query frequency	magnitude per time

```sql
SELECT *
FROM (
  SELECT DISTINCT ON (comment.id) comment.id, content, score, creation_time, is_banned
  FROM "user" u, message, message_version, comment
  WHERE
    u.id = $usedId AND
    u.id = message.author AND
    message.id = comment.id AND
    message.id = message_version.message_id
  GROUP BY
    comment.id, content, score, creation_time, is_banned
  ORDER BY
    comment.id,
    creation_time DESC
  ) updated_comments
ORDER BY
  updated_comments.creation_time DESC;
```

SELECT11

Query reference	SELECT11
Query description	Select all of a User's correct answers
Query frequency	magnitude per time

```sql
SELECT answer.id, score, is_banned
FROM answer, question, message, "user" u
WHERE
  u.id = $ usedId AND
  u.id = message.author AND
  message.id = answer.id AND
  answer.id = question.correct_answer;
```

SELECT12

Query reference	SELECT12
Query description	Select all of a User's unread notifications
Query frequency	magnitude per time

```sql
SELECT notification.id, notification.date
FROM "user" u, notification
WHERE
  u.id = $userId AND
  u.id = notification.user_id
```

```
GROUP BY
  u.id, notification.id
HAVING
  notification.read = FALSE;
```

SELECT13

Query reference	SELECT13
Query description	Select all of a User's badges
Query frequency	magnitude per time

```
SELECT badge.id, description, attainment_date
FROM "user" u, badge_attainment b_a, badge
WHERE
  u.id = b_a.user_id AND
  b_a.badge_id = badge.id;
```

SELECT14

Query reference	SELECT14
Query description	Select a User's profile information
Query frequency	magnitude per time

```
SELECT username, email, biography, reputation
FROM "user" u
WHERE
  u.id = $userId;
```

SELECT15

Query reference	SELECT15
Query description	Select a User's total number of questions
Query frequency	magnitude per time

```
SELECT u.id, COUNT(*)
FROM "user" u, message, question
WHERE
  u.id = $userId AND
  u.id = message.author AND
  message.id = question.id
GROUP BY
  u.id;
```

SELECT16

Query reference	SELECT16
Query description	Select a User's total number of answers
Query frequency	magnitude per time

```
SELECT u.id, COUNT(*)
FROM "user" u, message, answer
WHERE
  u.id = $userId AND
  u.id = message.author AND
  message.id = answer.id
GROUP BY
  u.id;
```

SELECT17

Query reference	SELECT17
Query description	Select a User's total number of comments
Query frequency	magnitude per time

```
SELECT u.id, COUNT(*)
FROM "user" u, message, comment
WHERE
  u.id = $userId AND
  u.id = message.author AND
  message.id = comment.id
GROUP BY
  u.id;
```

SELECT18

Query reference	SELECT18
Query description	Select all tags that partially match a given string
Query frequency	magnitude per time

```
SELECT *
FROM category
WHERE
  name LIKE "%$search%";
```

SELECT19

Query reference	SELECT19
Query description	Select all questions whose title partially matches a given string
Query frequency	magnitude per time

```
SELECT *
FROM question
WHERE
  title LIKE "%$search%";
```

1.3. Frequent Updates

Most important updates (INSERT, UPDATE, DELETE) and their frequency.

Query reference	INSERT01
Query description	Adding a new message version, either meaning the message was edited or is being added
Query frequency	magnitude per time

```
INSERT INTO message_version (id, content, message_id, creation_time, moderator_id)
 VALUES (nextval('message_version_id_seq'::regclass), $content, $message_id, now(), $moderat
```

Query reference	INSERT02
Query description	Insert a new Question
Query frequency	magnitude per time

```
 INSERT INTO question (id, title, correct_answer)
 VALUES ($id, $title, $correct_answer);
```

Query reference	INSERT03
Query description	Create a new Answer
Query frequency	magnitude per time

```
INSERT INTO answer(id, question_id)
 VALUES ($id, $question_id);
```

Query reference	INSERT04
Query description	Create new Comment
Query frequency	magnitude per time

```
INSERT INTO comment(id, commentable_id)
```

```
 VALUES ($id, $commentable_id);
```

Query reference	INSERT05
Query description	new user registered
Query frequency	magnitude per time

```
INSERT INTO "user"(id, username, email, password_hash, biography, reputation)
 VALUES (nextval('user_id_seq'::regclass), $username, $email, $password_hash, $biography, 0
```

Query reference	INSERT06
Query description	Vote in a Message
Query frequency	magnitude per time

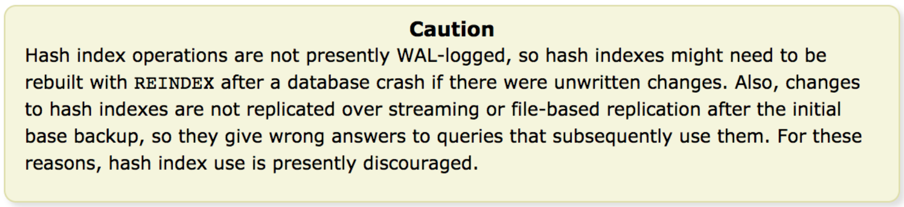
```
INSERT INTO vote(message_id, user_id, positive)
 VALUES ($message_id, $user_id, $positive);
```

Query reference	UPDATE01
Query description	Update User Info
Query frequency	magnitude per time

```
INSERT INTO message_version (id, content, message_id, creation_time, moderator_id)
 VALUES (nextval('message_version_id_seq'::regclass), $content, $message_id, now(), $moderat
```

2. Proposed Indices

This section presents the proposed indices on the database. It is important to note that many indices, mainly on high cardinality, would theoretically be better off being implemented as hash indices. We purposefuly did not choose these, because the PostgreSQL documentation actively discourages the usage of hash indices, as seen on the warning below.



Caution

Hash index operations are not presently WAL-logged, so hash indexes might need to be rebuilt with `REINDEX` after a database crash if there were unwritten changes. Also, changes to hash indexes are not replicated over streaming or file-based replication after the initial base backup, so they give wrong answers to queries that subsequently use them. For these reasons, hash index use is presently discouraged.

Figure 1: Hash Indices - Caution

2.1. Performance Indices

IDX01

Index reference	IDX01
Related queries	SELECT01
Index relation	comment
Index attribute	commentable_id
Index type	B-tree
Cardinality	medium
Clustering	yes
Justification	The Table is very large, and query SELECT01 must run efficiently as it is executed several times. It doesn't need range query support, and is a good candidate for clustering as its cardinality is medium.

```
CREATE INDEX comment_commentable ON comment USING btree(commentable_id);
```

(This index could be implemented as a hash index, but, as explained in this section's introduction, this is actively discouraged.)

IDX02

Index reference	IDX02
Related queries	SELECT01, SELECT02, SELECT04, SELECT06, SELECT07, SELECT08, SELECT09, SELECT10
Index relation	message_version
Index attribute	message_id
Index type	B-tree
Cardinality	medium
Clustering	yes
Justification	The Table is very large, and the corresponding queries are abundant and recurrent, thus must run efficiently. It doesn't need range query support, and is a good candidate for clustering as its cardinality is medium.

```
CREATE INDEX message_version_message ON message_version USING btree(message_id);
```

IDX03

Index reference	IDX03
Related queries	SELECT10
Index relation	message
Index attribute	author

Index type	B-tree
Cardinality	medium
Clustering	yes
Justification	The Table is very large, and the corresponding queries are abundant and recurrent, thus must run efficiently. It doesn't need range query support, and is a good candidate for clustering as its cardinality is medium.

```sql
CREATE INDEX message_author ON message USING btree(author);
```

IDX04

Index reference	IDX04
Related queries	SELECT12
Index relation	notification
Index attribute	user_id
Index type	B-tree
Cardinality	medium
Clustering	yes
Justification	The Table is very large, and the corresponding queries are abundant and recurrent, thus must run efficiently. It doesn't need range query support, and is a good candidate for clustering as its cardinality is medium.

```sql
CREATE INDEX notification_user ON notification USING btree(user_id);
```

2.2. Full-text Search Indices

IDX05

Index reference	IDX05
Related queries	SELECT18
Index relation	tag
Index attribute	name
Index type	GIN
Clustering	no
Justification	To improve the performance of full text searches on the tag's name. GIN because the table is infrequently updated, and this type of indices takes longer to create/update but lead to faster lookups. No ts_vector encoding is used because the tag's name is just one word long, and it's lemma is rarely identifiable.

```
CREATE INDEX tag_name ON tag USING gin(name);
```

IDX06

Index reference	IDX06
Related queries	SELECT19
Index relation	question
Index attribute	title
Index type	GiST
Clustering	no
Justification	To improve the performance of full text searches on the question's tile. GiST because it's better for dynamic data.

```
CREATE INDEX question_title ON question USING gist(to_tsvector('english', title));
```

2.3. Contraint-enforcing Indices

The following indices are used to enforce special unique constraints, such as guaranteeing uniqueness of case insensitive usernames and emails.

```
CREATE INDEX unique_lowercase_username ON "user" (lower(username));
CREATE INDEX unique_lowercase_email ON "user" (lower(email));
```

3. Triggers

| Trigger reference | TRIGGER01 | | Trigger description | A message is banned if the amount of reports exceeds the limit define in BR08 | | ——————- | ———————————————————— |

```
CREATE FUNCTION ban_message() RETURNS TRIGGER AS $$
  BEGIN
    UPDATE message
      SET is_banned = TRUE
      WHERE NEW.id = message.id;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER ban_message
  AFTER UPDATE OF num_reports ON message
  FOR EACH ROW
    WHEN ( NEW.num_reports >= 5 + NEW.score^(1/3) )
      EXECUTE PROCEDURE ban_message();
```

| Trigger reference | TRIGGER02 | | Trigger description | An answer can only be marked as correct if it's an answer of that question | | ——————- | ————————————————————————— |

```
CREATE FUNCTION check_correct() RETURNS TRIGGER AS $$
  BEGIN
    IF NEW.correct_answer IS NOT NULL AND
      NOT EXISTS (SELECT * FROM answer WHERE NEW.correct_answer = id AND NEW.id = questio
        RAISE EXCEPTION 'An answer can only be marked as correct if it is an answer of the
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER check_correct
  BEFORE UPDATE OF correct_answer ON question
  FOR EACH ROW EXECUTE PROCEDURE check_correct();
```

| Trigger reference | TRIGGER03 | | Trigger description | A question must have between 1 and 5 categories | | ——————- | ————————————————————————— |

```
CREATE FUNCTION check_categories() RETURNS TRIGGER AS $$
  DECLARE num_categories SMALLINT;
  DECLARE current RECORD;
  BEGIN
      IF TG_OP = 'INSERT' THEN
        current = NEW;
      ELSE
        current = OLD;
      END IF;
      SELECT INTO num_categories count(*)
      FROM question_category
      WHERE current.question_id = question_category.question_id;
    IF num_categories > 5 THEN
      RAISE EXCEPTION 'A question can only have a maximum of 5 categories';
    ELSIF num_categories < 1 THEN
      RAISE EXCEPTION 'A question must have at least 1 category';
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER check_categories
  AFTER INSERT OR DELETE ON question_category
  FOR EACH ROW EXECUTE PROCEDURE check_categories();
```

| Trigger reference | TRIGGER04 | | Trigger description | Update the number of

posts a category is tagged in when another one is inserted | | ————————- | ——————————————————————————— |

```
CREATE FUNCTION insert_category() RETURNS TRIGGER AS $$
  BEGIN
    UPDATE category
      SET num_posts = num_posts + 1
      WHERE NEW.category_id = category.id;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER insert_category
  AFTER INSERT ON question_category
  FOR EACH ROW EXECUTE PROCEDURE insert_category();
```

| Trigger reference | TRIGGER05 | | Trigger description | Update the message's score once a vote is modified | | ————————- | ——————————————————————————— |

```
CREATE FUNCTION update_score_vote() RETURNS TRIGGER AS $$
  BEGIN
    IF NEW.positive AND NOT OLD.positive THEN
      UPDATE message
        SET score = score + 2
        WHERE NEW.message_id = message.id;
    ELSIF NOT NEW.positive AND OLD.positive THEN
      UPDATE message
        SET score = score - 2
        WHERE NEW.message_id = message.id;
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER update_score_vote
  BEFORE UPDATE ON Vote
  FOR EACH ROW EXECUTE PROCEDURE update_score_vote();
```

| Trigger reference | TRIGGER06 | | Trigger description | Update the message's score once a vote is inserted | | ————————- | ——————————————————————————— |

```
CREATE FUNCTION insert_score_vote() RETURNS TRIGGER AS $$
  BEGIN
    IF NEW.positive THEN
      UPDATE message
        SET score = score + 1
        WHERE NEW.message_id = message.id;
    ELSIF NOT NEW.positive THEN
      UPDATE message
        SET score = score - 1
        WHERE NEW.message_id = message.id;
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER insert_score_vote
  BEFORE INSERT ON Vote
  FOR EACH ROW EXECUTE PROCEDURE insert_score_vote();
```

| Trigger reference | TRIGGER07 | | Trigger description | Update the message's score once a vote is deleted | | ————- | ———————————— |

```
CREATE FUNCTION delete_score_vote() RETURNS TRIGGER AS $$
  BEGIN
    IF OLD.positive THEN
      UPDATE message
        SET score = score - 1
        WHERE OLD.message_id = message.id;
    ELSIF NOT OLD.positive THEN
      UPDATE message
        SET score = score + 1
        WHERE OLD.message_id = message.id;
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER delete_score_vote
  BEFORE DELETE ON Vote
  FOR EACH ROW EXECUTE PROCEDURE delete_score_vote();
```

| Trigger reference | TRIGGER08 | | Trigger description | Update a user's reputation when one of its messages is reported as defined in BR03 | | ————- | ———————————————— |

```
CREATE FUNCTION update_reputation_reports() RETURNS TRIGGER AS $$
  BEGIN
    UPDATE "user"
      SET reputation = reputation - (NEW.num_reports - OLD.num_reports)*10
      WHERE NEW.author = "user".id;
    RETURN NEW;
  END;
```

```
$$ LANGUAGE plpgsql;

CREATE TRIGGER update_reputation_reports
  BEFORE UPDATE OF num_reports ON message
  FOR EACH ROW EXECUTE PROCEDURE update_reputation_reports();
```

| Trigger reference | TRIGGER09 | | Trigger description | Update a user's reputation when one of its messages is voted by another user as defined in BR03 | | ——————- | ——————————————————————— |

```
CREATE FUNCTION update_reputation_scores() RETURNS TRIGGER AS $$
  BEGIN
    IF EXISTS (SELECT * FROM commentable WHERE NEW.id = commentable.id) THEN
      UPDATE "user"
        SET reputation = reputation + (NEW.score - OLD.score)
        WHERE NEW.author = "user".id;
    ELSIF EXISTS (SELECT * FROM comment WHERE NEW.id = comment.id) THEN
      UPDATE "user"
        SET reputation = reputation + (NEW.score - OLD.score)/2.0
        WHERE NEW.author = "user".id;
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER update_reputation_scores
  BEFORE UPDATE OF score ON message
  FOR EACH ROW EXECUTE PROCEDURE update_reputation_scores();
```

| Trigger reference | TRIGGER10 | | Trigger description | A user is awarded a "trusted" badge when they've correctly answered at least 50 questions | | ——————- | ——————————————————————— |

```
CREATE FUNCTION award_trusted() RETURNS TRIGGER AS $$
  DECLARE answer_author BIGINT;
  DECLARE trusted_id SMALLINT;
  DECLARE num_correct_answers INTEGER;
  BEGIN
    SELECT INTO answer_author author
      FROM message
      WHERE message.id = NEW.correct_answer;
    SELECT INTO trusted_id id FROM trusted_badge;
    IF NOT EXISTS
      (SELECT *
        FROM badge_attainment
        WHERE answer_author = badge_attainment.user_id AND trusted_id = badge_attainment.b
    THEN
      SELECT INTO num_correct_answers count(*)
```

```
        FROM message, question
        WHERE message.id = question.correct_answer AND message.author = answer_author;
      IF num_correct_answers >= 50 THEN
        INSERT INTO badge_attainment (user_id, badge_id) VALUES (answer_author, trusted_ic
      END IF;
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER award_trusted
  AFTER UPDATE OF correct_answer ON question
  FOR EACH ROW EXECUTE PROCEDURE award_trusted();
```

| Trigger reference | TRIGGER11 | | Trigger description | A user is awarded a "moderator" badge when they've been awarded the "trusted" badge and then achieved at least 500 reputation points | | ——————- | —————————————————————————— |

```
CREATE FUNCTION award_moderator_reputation() RETURNS TRIGGER AS $$
  DECLARE moderator_id SMALLINT;
  DECLARE trusted_id SMALLINT;
  BEGIN
    SELECT INTO moderator_id id FROM moderator_badge;
    SELECT INTO trusted_id id FROM trusted_badge;
    IF NOT EXISTS
      (SELECT *
        FROM badge_attainment
        WHERE NEW.id = badge_attainment.user_id AND moderator_id = badge_attainment.badge_
      AND EXISTS
      (SELECT *
        FROM badge_attainment
        WHERE NEW.id = badge_attainment.user_id AND trusted_id = badge_attainment.badge_ic
      AND NEW.reputation >= 500 THEN
        INSERT INTO badge_attainment (user_id, badge_id) VALUES (NEW.id, moderator_id);
        INSERT INTO moderator (id) VALUES (NEW.id);
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER award_moderator_reputation
  AFTER UPDATE OF reputation ON "user"
  FOR EACH ROW EXECUTE PROCEDURE award_moderator_reputation();
```

| Trigger reference | TRIGGER12 | | Trigger description | A user is awarded a "moderator" badge when they've achieved at least 500 reputation points and

then were awarded the “trusted” badge | | ——————- | ——————————————————————— |

```
CREATE FUNCTION award_moderator_trusted() RETURNS TRIGGER AS $$
  DECLARE moderator_id SMALLINT;
  DECLARE trusted_id SMALLINT;
  DECLARE rep REAL;
  BEGIN
    SELECT INTO moderator_id id FROM moderator_badge;
    SELECT INTO trusted_id id FROM trusted_badge;
    SELECT INTO rep reputation FROM "user" WHERE "user".id = NEW.user_id;
    IF NEW.badge_id = trusted_id
    AND NOT EXISTS
      (SELECT *
        FROM badge_attainment
        WHERE NEW.user_id = badge_attainment.user_id AND moderator_id = badge_attainment.b
      AND rep >= 500 THEN
        INSERT INTO badge_attainment (user_id, badge_id) VALUES (NEW.user_id, moderator_ic
        INSERT INTO moderator (id) VALUES (NEW.user_id);
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER award_moderator_trusted
  AFTER INSERT ON badge_attainment
  FOR EACH ROW EXECUTE PROCEDURE award_moderator_trusted();
```

| Trigger reference | TRIGGER13 | | Trigger description | A user can’t vote their own messages as stated in BR02 | | ——————- | ——————————————————————— |

```
CREATE FUNCTION check_own_vote() RETURNS TRIGGER AS $$
  DECLARE message_author BIGINT;
  BEGIN
    SELECT INTO message_author author
      FROM message
      WHERE message.id = NEW.message_id;
    IF message_author = NEW.user_id THEN
      RAISE EXCEPTION 'A user is not allowed to vote their own messages';
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER check_own_vote
  BEFORE INSERT ON Vote
```

```
    FOR EACH ROW EXECUTE PROCEDURE check_own_vote();
```

| Trigger reference | TRIGGER14 | | Trigger description | Update the number of reports in a message when one is made to it | | ————————- | ———————————————————————————— |

```
  CREATE FUNCTION insert_report() RETURNS TRIGGER AS $$
    BEGIN
      UPDATE message
        SET num_reports = num_reports + 1
        WHERE NEW.message_id = message.id;
      RETURN NEW;
    END;
  $$ LANGUAGE plpgsql;

  CREATE TRIGGER insert_report
    BEFORE INSERT ON report
    FOR EACH ROW EXECUTE PROCEDURE insert_report();
```

| Trigger reference | TRIGGER15 | | Trigger description | Update the number of reports in a message when one is removed | | ————————- | ———————————————————————————— |

```
  CREATE FUNCTION delete_report() RETURNS TRIGGER AS $$
    BEGIN
      UPDATE message
        SET num_reports = num_reports - 1
        WHERE NEW.message_id = message.id;
      RETURN NEW;
    END;
  $$ LANGUAGE plpgsql;

  CREATE TRIGGER delete_report
    BEFORE DELETE ON report
    FOR EACH ROW EXECUTE PROCEDURE delete_report();
```

| Trigger reference | TRIGGER16 | | Trigger description | A comment made to commentable item generates a notification towards the author of said commentable item | | ————————- | ———————————————————————————— |

```
  CREATE FUNCTION gen_comment_notification() RETURNS TRIGGER AS $$
    DECLARE current_id BIGINT;
    DECLARE notified_user BIGINT;
    BEGIN
      SELECT INTO current_id nextval(pg_get_serial_sequence('notification', 'id'));
      SELECT INTO notified_user author FROM message WHERE message.id = NEW.commentable_id;
      INSERT INTO notification (id, user_id) VALUES (current_id, notified_user);
      INSERT INTO commentable_notification (id, notified_msg, trigger_msg) VALUES (current_
      RETURN NEW;
    END;
  $$ LANGUAGE plpgsql;

  CREATE TRIGGER gen_comment_notification
    AFTER INSERT ON comment
    FOR EACH ROW EXECUTE PROCEDURE gen_comment_notification();
```

| Trigger reference | TRIGGER17 | | Trigger description | An answer to a question generates a notification towards the author of the question | | ————————- | ——————————————————————————— |

```
CREATE FUNCTION gen_answer_notification() RETURNS TRIGGER AS $$
  DECLARE current_id BIGINT;
  DECLARE notified_user BIGINT;
  BEGIN
    SELECT INTO current_id nextval(pg_get_serial_sequence('notification', 'id'));
    SELECT INTO notified_user author FROM message WHERE message.id = NEW.question_id;
    INSERT INTO notification (id, user_id) VALUES (current_id, notified_user);
    INSERT INTO commentable_notification (id, notified_msg, trigger_msg) VALUES (current_i
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER gen_answer_notification
  AFTER INSERT ON answer
  FOR EACH ROW EXECUTE PROCEDURE gen_answer_notification();
```

| Trigger reference | TRIGGER18 | | Trigger description | When a badge is awarded to a user a notification to that user is generated | | ————————- | ——————————————————————————— |

```
CREATE FUNCTION gen_badge_notification() RETURNS TRIGGER AS $$
  DECLARE current_id BIGINT;
  BEGIN
    SELECT INTO current_id nextval(pg_get_serial_sequence('notification', 'id'));
    INSERT INTO notification (id, user_id) VALUES (current_id, NEW.user_id);
    INSERT INTO badge_notification (id, badge_id) VALUES (current_id, NEW.badge_id);
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER gen_badge_notification
  AFTER INSERT ON badge_attainment
  FOR EACH ROW EXECUTE PROCEDURE gen_badge_notification();
```

4. Complete SQL Code

SQL Code available in files `create.sql` and `populate.sql`

create.sql

```sql
DROP TABLE IF EXISTS "user" CASCADE;
DROP TABLE IF EXISTS moderator CASCADE;
DROP TABLE IF EXISTS message CASCADE;
DROP TABLE IF EXISTS commentable CASCADE;
DROP TABLE IF EXISTS question CASCADE;
DROP TABLE IF EXISTS answer CASCADE;
DROP TABLE IF EXISTS category CASCADE;
DROP TABLE IF EXISTS question_category CASCADE;
DROP TABLE IF EXISTS comment CASCADE;
DROP TABLE IF EXISTS message_version CASCADE;
DROP TABLE IF EXISTS vote CASCADE;
DROP TABLE IF EXISTS badge CASCADE;
DROP TABLE IF EXISTS moderator_badge CASCADE;
DROP TABLE IF EXISTS trusted_badge CASCADE;
DROP TABLE IF EXISTS notification CASCADE;
DROP TABLE IF EXISTS commentable_notification CASCADE;
DROP TABLE IF EXISTS badge_notification CASCADE;
DROP TABLE IF EXISTS badge_attainment CASCADE;
DROP TABLE IF EXISTS report CASCADE;

CREATE TABLE "user" (
    id BIGSERIAL PRIMARY KEY,
    username TEXT NOT NULL UNIQUE,
    email TEXT NOT NULL UNIQUE,
    password_hash TEXT NOT NULL,
    biography TEXT,
    reputation REAL NOT NULL DEFAULT 0.0
);

CREATE TABLE moderator (
    id BIGINT PRIMARY KEY REFERENCES "user"(id)
);

CREATE TABLE message (
    id BIGSERIAL PRIMARY KEY,
    score INTEGER DEFAULT 0 NOT NULL,
    num_reports SMALLINT DEFAULT 0 NOT NULL,
    is_banned BOOLEAN DEFAULT FALSE,
    author BIGINT NOT NULL REFERENCES "user"(id)
```

```sql
);

CREATE TABLE commentable (
    id BIGINT PRIMARY KEY REFERENCES message(id)
);

CREATE TABLE question (
    id BIGINT PRIMARY KEY REFERENCES commentable(id),
    title TEXT NOT NULL,
    correct_answer BIGINT UNIQUE
);

CREATE TABLE answer (
    id BIGINT PRIMARY KEY REFERENCES commentable(id),
    question_id BIGINT NOT NULL REFERENCES question(id)
);

CREATE TABLE category (
    id SERIAL PRIMARY KEY,
    name TEXT NOT NULL,
    description TEXT,
    num_posts INTEGER DEFAULT 0 NOT NULL
);

CREATE TABLE question_category (
    question_id BIGINT REFERENCES question(id),
    category_id INTEGER REFERENCES category(id),
    PRIMARY KEY (question_id, category_id)
);

CREATE TABLE comment (
    id BIGINT PRIMARY KEY REFERENCES message(id),
    commentable_id BIGINT NOT NULL REFERENCES commentable(id)
);

CREATE TABLE message_version (
    id BIGSERIAL PRIMARY KEY,
    content TEXT NOT NULL,
    message_id BIGINT NOT NULL REFERENCES message(id),
    creation_time TIMESTAMP NOT NULL DEFAULT now(),
    moderator_id BIGINT REFERENCES moderator(id)
);

CREATE TABLE vote (
    message_id BIGINT NOT NULL REFERENCES message(id),
    user_id BIGINT NOT NULL REFERENCES "user"(id),
    positive BOOLEAN NOT NULL,
    PRIMARY KEY (message_id, user_id)
);

CREATE TABLE report (
    message_id BIGINT NOT NULL REFERENCES message(id),
    user_id BIGINT NOT NULL REFERENCES "user"(id),
    PRIMARY KEY (message_id, user_id)
);

CREATE TABLE badge (
    id SERIAL PRIMARY KEY,
    description TEXT NOT NULL
);

CREATE TABLE moderator_badge (
    id INTEGER PRIMARY KEY REFERENCES badge(id)
);

CREATE TABLE trusted_badge (
    id INTEGER PRIMARY KEY REFERENCES badge(id)
);

CREATE TABLE notification (
    id BIGSERIAL PRIMARY KEY,
    "date" TIMESTAMP WITH TIME ZONE DEFAULT now() NOT NULL,
    read BOOLEAN NOT NULL DEFAULT FALSE,
    user_id BIGINT NOT NULL REFERENCES "user"(id)
);

CREATE TABLE commentable_notification (
    id BIGINT PRIMARY KEY REFERENCES notification(id),
    notified_msg BIGINT NOT NULL REFERENCES commentable(id),
    trigger_msg BIGINT NOT NULL REFERENCES message(id)
);

CREATE TABLE badge_notification (
    id BIGINT PRIMARY KEY REFERENCES notification(id),
    badge_id BIGINT NOT NULL REFERENCES badge(id)
);

CREATE TABLE badge_attainment (
    user_id BIGINT NOT NULL REFERENCES "user"(id),
    badge_id SMALLINT NOT NULL REFERENCES badge(id),
    attainment_date TIMESTAMP WITH TIME ZONE DEFAULT now() NOT NULL,
    PRIMARY KEY (user_id, badge_id)
```

```
);

ALTER TABLE question
  ADD FOREIGN KEY (correct_answer) REFERENCES answer(id) ON UPDATE CASCADE;


DROP FUNCTION IF EXISTS ban_message();
DROP FUNCTION IF EXISTS check_correct();
DROP FUNCTION IF EXISTS check_categories();
DROP FUNCTION IF EXISTS insert_category();
DROP FUNCTION IF EXISTS delete_category();
DROP FUNCTION IF EXISTS update_score_vote();
DROP FUNCTION IF EXISTS insert_score_vote();
DROP FUNCTION IF EXISTS delete_score_vote();
DROP FUNCTION IF EXISTS update_reputation_reports();
DROP FUNCTION IF EXISTS update_reputation_scores();
DROP FUNCTION IF EXISTS award_trusted();
DROP FUNCTION IF EXISTS award_moderator_reputation();
DROP FUNCTION IF EXISTS award_moderator_trusted();
DROP FUNCTION IF EXISTS check_own_vote();
DROP FUNCTION IF EXISTS insert_report();
DROP FUNCTION IF EXISTS delete_report();
DROP FUNCTION IF EXISTS gen_comment_notification();
DROP FUNCTION IF EXISTS gen_answer_notification();
DROP FUNCTION IF EXISTS gen_badge_notification();

DROP TRIGGER IF EXISTS ban_message ON message;
DROP TRIGGER IF EXISTS check_correct ON question;
DROP TRIGGER IF EXISTS check_categories ON question_category;
DROP TRIGGER IF EXISTS insert_category ON question_category;
DROP TRIGGER IF EXISTS delete_category ON question_category;
DROP TRIGGER IF EXISTS update_score_vote ON vote;
DROP TRIGGER IF EXISTS insert_score_vote ON vote;
DROP TRIGGER IF EXISTS delete_score_vote ON vote;
DROP TRIGGER IF EXISTS update_reputation_reports ON message;
DROP TRIGGER IF EXISTS update_reputation_scores ON message;
DROP TRIGGER IF EXISTS award_trusted ON question;
DROP TRIGGER IF EXISTS award_moderator_reputation ON "user";
DROP TRIGGER IF EXISTS award_moderator_trusted ON badge_attainment;
DROP TRIGGER IF EXISTS check_own_vote ON vote;
DROP TRIGGER IF EXISTS insert_report ON report;
DROP TRIGGER IF EXISTS delete_report ON report;
DROP TRIGGER IF EXISTS gen_comment_notification ON comment;
DROP TRIGGER IF EXISTS gen_answer_notification ON answer;
DROP TRIGGER IF EXISTS gen_badge_notification ON badge_attainment;
```

```
-- A message is banned when it exceeds the report limits
CREATE FUNCTION ban_message() RETURNS TRIGGER AS $$
  BEGIN
    UPDATE message
      SET is_banned = TRUE
      WHERE NEW.id = message.id;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER ban_message
  AFTER UPDATE OF num_reports ON message
  FOR EACH ROW
    WHEN ( NEW.num_reports >= 5 + NEW.score^(1/3) )
      EXECUTE PROCEDURE ban_message();


-- Check if the correct answer is an answer to that question
CREATE FUNCTION check_correct() RETURNS TRIGGER AS $$
  BEGIN
    IF NEW.correct_answer IS NOT NULL AND
      NOT EXISTS (SELECT * FROM answer WHERE NEW.correct_answer = id AND NEW.id = question_i
        RAISE EXCEPTION 'An answer can only be marked as correct if it is an answer of the q
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER check_correct
  BEFORE UPDATE OF correct_answer ON question
  FOR EACH ROW EXECUTE PROCEDURE check_correct();


-- Ensure questions have one to five categories
CREATE FUNCTION check_categories() RETURNS TRIGGER AS $$
  DECLARE num_categories SMALLINT;
  DECLARE current RECORD;
  BEGIN
      IF TG_OP = 'INSERT' THEN
        current = NEW;
      ELSE
        current = OLD;
      END IF;
      SELECT INTO num_categories count(*)
      FROM question_category
      WHERE current.question_id = question_category.question_id;
    IF num_categories > 5 THEN
      RAISE EXCEPTION 'A question can only have a maximum of 5 categories';
    ELSIF num_categories < 1 THEN
      RAISE EXCEPTION 'A question must have at least 1 category';
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER check_categories
  AFTER INSERT OR DELETE ON question_category
  FOR EACH ROW EXECUTE PROCEDURE check_categories();


-- Ensure number of posts per category is always updated
CREATE FUNCTION insert_category() RETURNS TRIGGER AS $$
  BEGIN
    UPDATE category
      SET num_posts = num_posts + 1
      WHERE NEW.category_id = category.id;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER insert_category
  AFTER INSERT ON question_category
  FOR EACH ROW EXECUTE PROCEDURE insert_category();


CREATE FUNCTION delete_category() RETURNS TRIGGER AS $$
  BEGIN
    UPDATE category
      SET num_posts = num_posts - 1
      WHERE OLD.category_id = category.id;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER delete_category
  AFTER DELETE ON question_category
  FOR EACH ROW EXECUTE PROCEDURE delete_category();


-- Update score on vote changes
CREATE FUNCTION update_score_vote() RETURNS TRIGGER AS $$
  BEGIN
```

```
    IF NEW.positive AND NOT OLD.positive THEN
      UPDATE message
        SET score = score + 2
        WHERE NEW.message_id = message.id;
    ELSIF NOT NEW.positive AND OLD.positive THEN
      UPDATE message
        SET score = score - 2
        WHERE NEW.message_id = message.id;
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER update_score_vote
  BEFORE UPDATE ON Vote
  FOR EACH ROW EXECUTE PROCEDURE update_score_vote();

CREATE FUNCTION insert_score_vote() RETURNS TRIGGER AS $$
  BEGIN
    IF NEW.positive THEN
      UPDATE message
        SET score = score + 1
        WHERE NEW.message_id = message.id;
    ELSIF NOT NEW.positive THEN
      UPDATE message
        SET score = score - 1
        WHERE NEW.message_id = message.id;
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER insert_score_vote
  BEFORE INSERT ON Vote
  FOR EACH ROW EXECUTE PROCEDURE insert_score_vote();

CREATE FUNCTION delete_score_vote() RETURNS TRIGGER AS $$
  BEGIN
    IF OLD.positive THEN
      UPDATE message
        SET score = score - 1
        WHERE OLD.message_id = message.id;
    ELSIF NOT OLD.positive THEN
      UPDATE message
        SET score = score + 1
        WHERE OLD.message_id = message.id;
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER delete_score_vote
  BEFORE DELETE ON Vote
  FOR EACH ROW EXECUTE PROCEDURE delete_score_vote();


-- Update reputation: reports
CREATE FUNCTION update_reputation_reports() RETURNS TRIGGER AS $$
  BEGIN
    UPDATE "user"
      SET reputation = reputation - (NEW.num_reports - OLD.num_reports)*10
      WHERE NEW.author = "user".id;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER update_reputation_reports
  BEFORE UPDATE OF num_reports ON message
  FOR EACH ROW EXECUTE PROCEDURE update_reputation_reports();


-- Update reputation: message scores
CREATE FUNCTION update_reputation_scores() RETURNS TRIGGER AS $$
  BEGIN
    IF EXISTS (SELECT * FROM commentable WHERE NEW.id = commentable.id) THEN
      UPDATE "user"
        SET reputation = reputation + (NEW.score - OLD.score)
        WHERE NEW.author = "user".id;
    ELSIF EXISTS (SELECT * FROM comment WHERE NEW.id = comment.id) THEN
      UPDATE "user"
        SET reputation = reputation + (NEW.score - OLD.score)/2.0
        WHERE NEW.author = "user".id;
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER update_reputation_scores
  BEFORE UPDATE OF score ON message
  FOR EACH ROW EXECUTE PROCEDURE update_reputation_scores();
```

```
-- Award trusted badge
CREATE FUNCTION award_trusted() RETURNS TRIGGER AS $$
  DECLARE answer_author BIGINT;
  DECLARE trusted_id SMALLINT;
  DECLARE num_correct_answers INTEGER;
  BEGIN
    SELECT INTO answer_author author
      FROM message
      WHERE message.id = NEW.correct_answer;
    SELECT INTO trusted_id id FROM trusted_badge;
    IF NOT EXISTS
      (SELECT *
        FROM badge_attainment
        WHERE answer_author = badge_attainment.user_id AND trusted_id = badge_attainment.bac
    THEN
      SELECT INTO num_correct_answers count(*)
        FROM message, question
        WHERE message.id = question.correct_answer AND message.author = answer_author;
      IF num_correct_answers >= 50 THEN
        INSERT INTO badge_attainment (user_id, badge_id) VALUES (answer_author, trusted_id);
      END IF;
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER award_trusted
  AFTER UPDATE OF correct_answer ON question
  FOR EACH ROW EXECUTE PROCEDURE award_trusted();


-- Award moderator badge
CREATE FUNCTION award_moderator_reputation() RETURNS TRIGGER AS $$
  DECLARE moderator_id SMALLINT;
  DECLARE trusted_id SMALLINT;
  BEGIN
    SELECT INTO moderator_id id FROM moderator_badge;
    SELECT INTO trusted_id id FROM trusted_badge;
    IF NOT EXISTS
      (SELECT *
        FROM badge_attainment
        WHERE NEW.id = badge_attainment.user_id AND moderator_id = badge_attainment.badge_ic
      AND EXISTS
      (SELECT *
        FROM badge_attainment
        WHERE NEW.id = badge_attainment.user_id AND trusted_id = badge_attainment.badge_id)
      AND NEW.reputation >= 500 THEN
        INSERT INTO badge_attainment (user_id, badge_id) VALUES (NEW.id, moderator_id);
        INSERT INTO moderator (id) VALUES (NEW.id);
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER award_moderator_reputation
  AFTER UPDATE OF reputation ON "user"
  FOR EACH ROW EXECUTE PROCEDURE award_moderator_reputation();

CREATE FUNCTION award_moderator_trusted() RETURNS TRIGGER AS $$
  DECLARE moderator_id SMALLINT;
  DECLARE trusted_id SMALLINT;
  DECLARE rep REAL;
  BEGIN
    SELECT INTO moderator_id id FROM moderator_badge;
    SELECT INTO trusted_id id FROM trusted_badge;
    SELECT INTO rep reputation FROM "user" WHERE "user".id = NEW.user_id;
    IF NEW.badge_id = trusted_id
    AND NOT EXISTS
      (SELECT *
        FROM badge_attainment
        WHERE NEW.user_id = badge_attainment.user_id AND moderator_id = badge_attainment.bad
      AND rep >= 500 THEN
        INSERT INTO badge_attainment (user_id, badge_id) VALUES (NEW.user_id, moderator_id)
        INSERT INTO moderator (id) VALUES (NEW.user_id);
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER award_moderator_trusted
  AFTER INSERT ON badge_attainment
  FOR EACH ROW EXECUTE PROCEDURE award_moderator_trusted();


-- Users can't vote their own messages
CREATE FUNCTION check_own_vote() RETURNS TRIGGER AS $$
  DECLARE message_author BIGINT;
  BEGIN
    SELECT INTO message_author author
      FROM message
      WHERE message.id = NEW.message_id;
    IF message_author = NEW.user_id THEN
```

```
      RAISE EXCEPTION 'A user is not allowed to vote their own messages';
    END IF;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER check_own_vote
  BEFORE INSERT ON Vote
  FOR EACH ROW EXECUTE PROCEDURE check_own_vote();


CREATE FUNCTION insert_report() RETURNS TRIGGER AS $$
  BEGIN
    UPDATE message
      SET num_reports = num_reports + 1
      WHERE NEW.message_id = message.id;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER insert_report
  BEFORE INSERT ON report
  FOR EACH ROW EXECUTE PROCEDURE insert_report();

CREATE FUNCTION delete_report() RETURNS TRIGGER AS $$
  BEGIN
    UPDATE message
      SET num_reports = num_reports - 1
      WHERE NEW.message_id = message.id;
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER delete_report
  BEFORE DELETE ON report
  FOR EACH ROW EXECUTE PROCEDURE delete_report();

CREATE FUNCTION gen_comment_notification() RETURNS TRIGGER AS $$
  DECLARE current_id BIGINT;
  DECLARE notified_user BIGINT;
  BEGIN
    SELECT INTO current_id nextval(pg_get_serial_sequence('notification', 'id'));
    SELECT INTO notified_user author FROM message WHERE message.id = NEW.commentable_id;
    INSERT INTO notification (id, user_id) VALUES (current_id, notified_user);
    INSERT INTO commentable_notification (id, notified_msg, trigger_msg) VALUES (current_id,
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER gen_comment_notification
  AFTER INSERT ON comment
  FOR EACH ROW EXECUTE PROCEDURE gen_comment_notification();

CREATE FUNCTION gen_answer_notification() RETURNS TRIGGER AS $$
  DECLARE current_id BIGINT;
  DECLARE notified_user BIGINT;
  BEGIN
    SELECT INTO current_id nextval(pg_get_serial_sequence('notification', 'id'));
    SELECT INTO notified_user author FROM message WHERE message.id = NEW.question_id;
    INSERT INTO notification (id, user_id) VALUES (current_id, notified_user);
    INSERT INTO commentable_notification (id, notified_msg, trigger_msg) VALUES (current_id
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER gen_answer_notification
  AFTER INSERT ON answer
  FOR EACH ROW EXECUTE PROCEDURE gen_answer_notification();

CREATE FUNCTION gen_badge_notification() RETURNS TRIGGER AS $$
  DECLARE current_id BIGINT;
  BEGIN
    SELECT INTO current_id nextval(pg_get_serial_sequence('notification', 'id'));
    INSERT INTO notification (id, user_id) VALUES (current_id, NEW.user_id);
    INSERT INTO badge_notification (id, badge_id) VALUES (current_id, NEW.badge_id);
    RETURN NEW;
  END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER gen_badge_notification
  AFTER INSERT ON badge_attainment
  FOR EACH ROW EXECUTE PROCEDURE gen_badge_notification();
```

indices.sql

```
-- We do not use hash indices, due to it being actively discouraged on the PostgreSQL docum

CREATE INDEX comment_commentable ON comment USING btree(commentable_id);
CREATE INDEX message_version_message ON message_version USING btree(message_id);
CREATE INDEX message_author ON message USING btree(author);
CREATE INDEX notification_user ON notification USING btree(user_id);
```

```sql
CREATE INDEX tag_name ON tag USING gin(name);
CREATE INDEX question_title ON question USING gist(to_tsvector('english', title));


-- Uniqueness Constraints for Case Insensitive Username and Email
CREATE INDEX unique_lowercase_username ON "user" (lower(username));
CREATE INDEX unique_lowercase_email ON "user" (lower(email));
```

Revision history

Changes made to the first submission: 1. Item 1 1. Item 2

GROUP1763, 03/04/2018

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