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## Mobile Solution for Organic Chemistry Practice



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## Abstract

The purpose of this project is to aid students in the learning process for Organic Chemistry by creating an interactive smart phone app and website to practice compound-ranking problems. The decision to implement a web and mobile-friendly interface to practice Organic Chemistry problems stemmed from the fact that the current method for studying depends on a traditional text document with images. By utilizing a database to store various organic chemistry ranking questions and compounds, the product will allow students to answer an unlimited number of questions from a variety of organic chemistry topics at any time of day and from whatever environment best suits their studying habits. Developing a device-friendly interface to practice compound-ranking problems, a crucial portion of the Organic Chemistry curriculum, will now enable organic chemistry students to strengthen their knowledge in mobile situations.

**Keywords:** Android, iOS, UI/UX, Mobile App, MySQL, AWS

## Application Design

### Question Format

- Ranking questions consist of a question stem and 5 compounds to be ranked by some chemical property.
- Every question was categorized by class (Organic Chemistry I or II) and primary topic (acidity, basicity, resonance, etc.)
- There are 120 different questions to choose from.

### Design Guidelines

- The app works on Android, iOS, PC, and MacOS devices.
- Portrait and landscape modes are supported on mobile devices.
- Hint pages are shown per category when the user enters an incorrect answer.

### React

- React is an application-building library that utilizes a combination of JavaScript and CSS to create viewable, customizable components.
- JavaScript and HTML were used to determine what components should be displayed, and CSS was used to design those components (color, sizing, position, etc.)

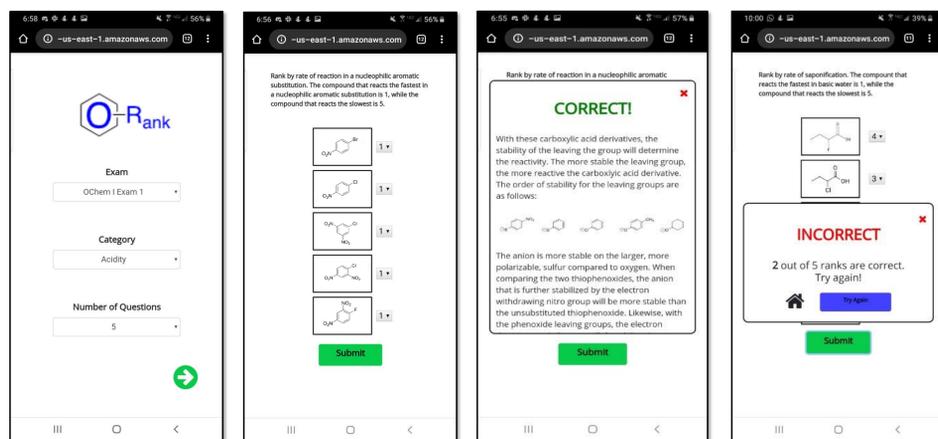


Figure 5. Home Screen

Figure 6. Question

Figure 7. Correct Answer

Figure 8. Incorrect Answer

## Implementation

### Back-End Development

- The server-side APIs provide a channel between the front-end and the database. Two major APIs are in place.
- The first is "Put Questions"; it is used to push new questions to the database, allowing for the population of the database.
- The second is "Get Questions"; it is used by the application to retrieve questions from the database. The function returns a set of questions matching the given parameters to be displayed one-by-one to the user.

### Resources

- The following cloud infrastructure were used to host our system: Amazon S3, AWS Lambda, Amazon RDS, Amazon VPC, AWS Cloud9, Amazon CloudFront, Amazon API Gateway, and Amazon EC2.
- An independent account was created for the clients to host the completed application detached from the developers' original testing environment.

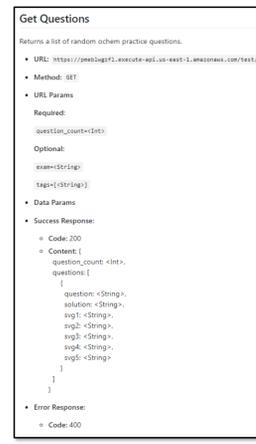


Figure 6. Documentation for the "Get Questions" API

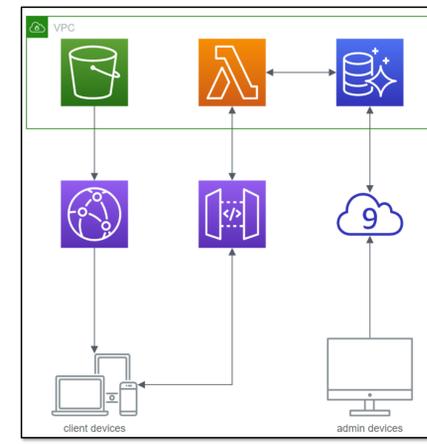


Figure 6. Interaction of the cloud resources being utilized for development.

## Database Management

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```
mysql> describe main;
+-----+-----+-----+-----+-----+-----+
| Field | Type | Null | Key | Default | Extra |
+-----+-----+-----+-----+-----+-----+
| num_questions | int(11) | YES | NULL | NULL | |
| total_num_questions | int(11) | YES | NULL | NULL | |
| total_num_questions | int(11) | YES | NULL | NULL | |
mysql> describe compounds;
+-----+-----+-----+-----+-----+-----+
| Field | Type | Null | Key | Default | Extra |
+-----+-----+-----+-----+-----+-----+
| compound_id | varchar(12) | NO | PRI | NULL | |
| name | varchar(200) | YES | NULL | NULL | |
| image | varchar(200) | YES | NULL | NULL | |
mysql> describe categories;
+-----+-----+-----+-----+-----+-----+
| Field | Type | Null | Key | Default | Extra |
+-----+-----+-----+-----+-----+-----+
| category | varchar(50) | NO | NULL | NULL | |
| question_id | int(11) | YES | NULL | NULL | |
mysql> describe exams;
+-----+-----+-----+-----+-----+-----+
| Field | Type | Null | Key | Default | Extra |
+-----+-----+-----+-----+-----+-----+
| exam | varchar(50) | YES | NULL | NULL | |
| question_id | int(11) | YES | NULL | NULL | |
mysql> describe questions;
+-----+-----+-----+-----+-----+-----+
| Field | Type | Null | Key | Default | Extra |
+-----+-----+-----+-----+-----+-----+
| question_id | int(11) | NO | PRI | NULL | |
| question_text | varchar(1000) | YES | NULL | NULL | |
| solution_text | varchar(1000) | YES | NULL | NULL | |
| solution_image | varchar(200) | YES | NULL | NULL | |
| rank_1 | varchar(12) | YES | NULL | NULL | |
| rank_2 | varchar(12) | YES | NULL | NULL | |
| rank_3 | varchar(12) | YES | NULL | NULL | |
| rank_4 | varchar(12) | YES | NULL | NULL | |
| rank_5 | varchar(12) | YES | NULL | NULL | |
mysql> describe hints;
+-----+-----+-----+-----+-----+-----+
| Field | Type | Null | Key | Default | Extra |
+-----+-----+-----+-----+-----+-----+
| category | varchar(50) | NO | NULL | NULL | |
| hint_text | varchar(200) | NO | NULL | NULL | |
| hint_image | varchar(200) | YES | NULL | NULL | |
```

```
mysql> select * from categories where category = 'Cyclohexane';
+-----+-----+-----+
| category | question_id |
+-----+-----+-----+
| Cyclohexane | 5 |
| Cyclohexane | 8 |
| Cyclohexane | 10 |
| Cyclohexane | 51 |
| Cyclohexane | 53 |
+-----+-----+-----+
5 rows in set (0.03 sec)
```

Figure 6. A sample SQL query. The query returns all question ID numbers that are classified as "Cyclohexane" OChem questions.

Figure 6. These tables describe how various components of the question and solution are stored.

## Impact

- This application worked to improve the method of delivery of existing questions. The major improvements were in [accessibility](#) and [variety](#). The application allows students to study more dynamically, in terms of time, place, and question type.
- Previously students had to physically access the questions from the professors and search through physical pages; this application allows students to access the questions whenever and wherever they desire and quickly input their needed question parameters so they can [study more frequently and more efficiently](#).
- The move to a digital format for the questions allows for shuffling of the questions and compounds. This [helps facilitate students to learn the concepts](#) behind the rankings, providing greater barrier to attempts to simply memorize order.
- The design of the application and database allows for [question set expansion](#), as well as immediate deployment of new questions to students. This allows the professors to easily adapt to any deficits in the curriculum and have more immediate impact on the ability of their students to prepare for exams.
- Overall, the [easily accessible, dynamic, and modifiable format](#) of the application interface and backend overcome the prior concerns of the sponsors over their former system to improve the learning experience of Organic Chemistry students in the future.

## Performance

- The app met 100% of our clients' criteria, with low API latency and high accuracy/precision
- Simple, intuitive interface is aesthetically pleasing and accessible for average user
- Exam scores of OChem Students can be taken before and after using this app to measure impact
- Feedback page was implemented for user suggestions/critique
- Consistent performance across Android, iOS, and PC/Mac (Web) devices

## Summary

**Overall, this project was a success for the developers in terms of meeting the required functionality as set by the clients at the start of the semester.**

- Questions are categorized by topic, semester, and exam; randomizing enhances retention
- Easy-to-use UI across multiple devices makes it an accessible learning tool
- Lowers student use of outdated and unreliable Organic Chemistry resources
- Convenient storage of images in SVG format allows simple translation from ChemDraw to database
- Flexible database and infrastructure allows for long-term support and improvements