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6.170 Software Studio
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Huh?

Real-Time Student Feedback for Professors

Idea

Lecture Dashboard is a web application that provides a simple way for lecturers to gather feedback from students in realtime by providing the lecturer with quantitative data. Students will be able to mark that they are confused. Lecturers will be able identify shared places of student confusion and will be able to effectively course-correct a lecture.

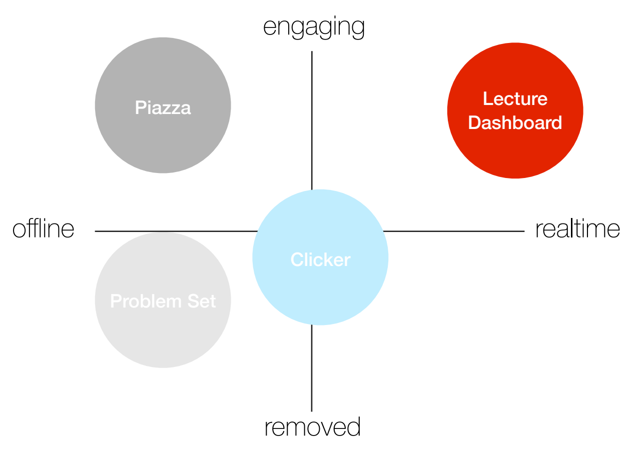
Purpose

The purpose of LectureDashboard are as follows:

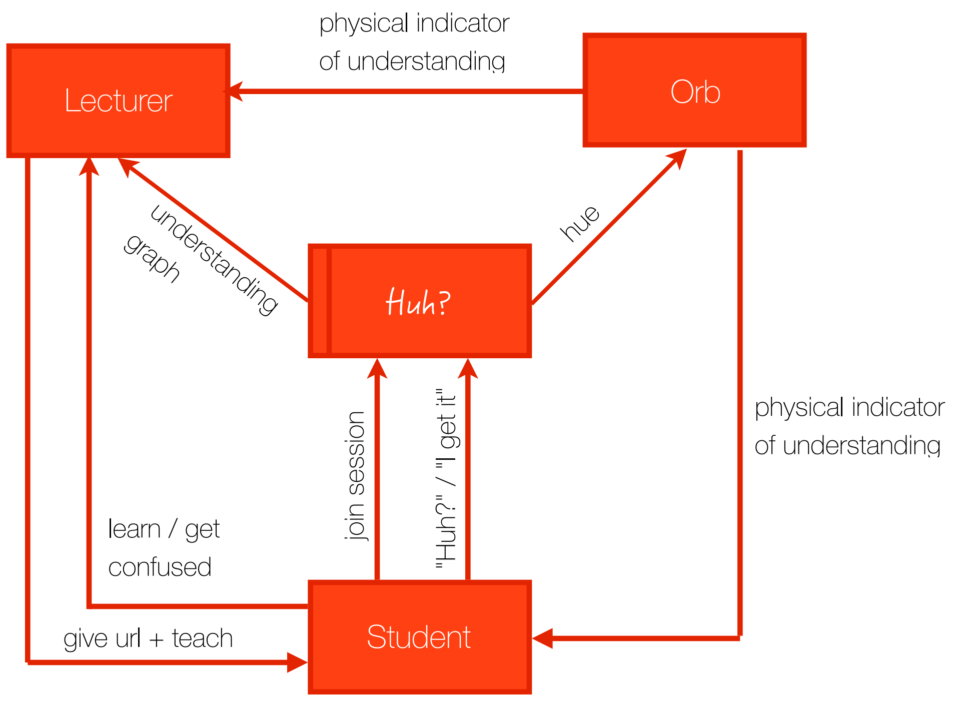
1. **Provide the professor with data about the classroom.** Currently, many solutions require lecturers to pause lecture to get feedback from the students. Additionally, students do not feel comfortable telling the classroom that they do not understand a topic. Huh? allows students to give anonymized feedback in real-time without pausing the lecture.

2. **Reduce student confusion during lectures.** Often times, when a student is confused by a concept, it results in a long period of confusion because lecture concepts progressively build. Huh? empowers students to take an active role in their learning, and stop their confusion by requesting clarification.

3. **Improve the quality of lectures for both professors and students.** Huh? is a mutually beneficial system that aims to equip students with the ability to let their professors know in realtime when they are not following. Lecturers will use this feedback to get a better sense of what topics confuse students, which improves the quality of lectures for both professors and students.



Context Diagram



Concepts

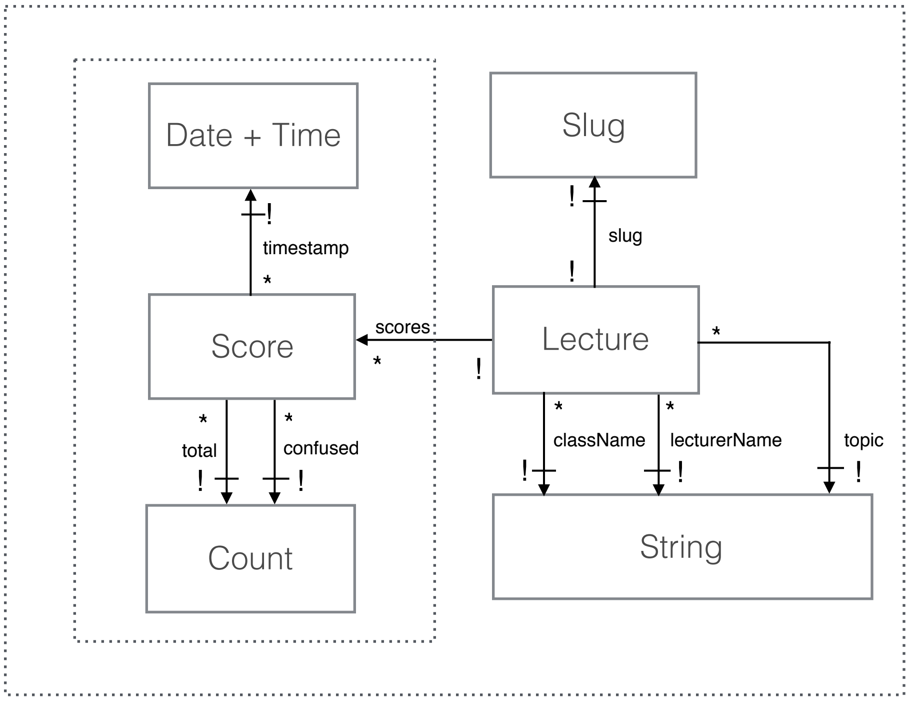
Understanding Score: a quantitative score inversely proportional to student confusion that is displayed to the professor to give them a sense of understanding at a given time for the lecture

Lecture Session: a url generated and provided by the lecturer for students to ask questions and indicate their understanding status in realtime

Student Status: toggle switch adjusted by the student to indicate if they are confused or not at the current time

Orb: internet connected orb that reflects the lecture's understanding score with its hue, green

Data Model



Security

Threat Model: We assume that malicious users would either be attempting to interfere with the data gathered by our app in order to skew results or try to overload our servers to bring our service down. There is no data that a user could try to access or interfere with other than the current understanding score, so that is the only possibly vulnerable data.

Security Requirements:
Protect against the following attacks with the following strategies:

Injection Attack: Stringify and sanitize all database input to protect against MongoDB injection attacks

Cross-Site Request Forgery: Use CSRF tokens as hidden fields in our forms to ensure all requests are user initiated and legitimate.

Javascript Injection: Using Handlebars will protect our site from this by escaping any injected scripts

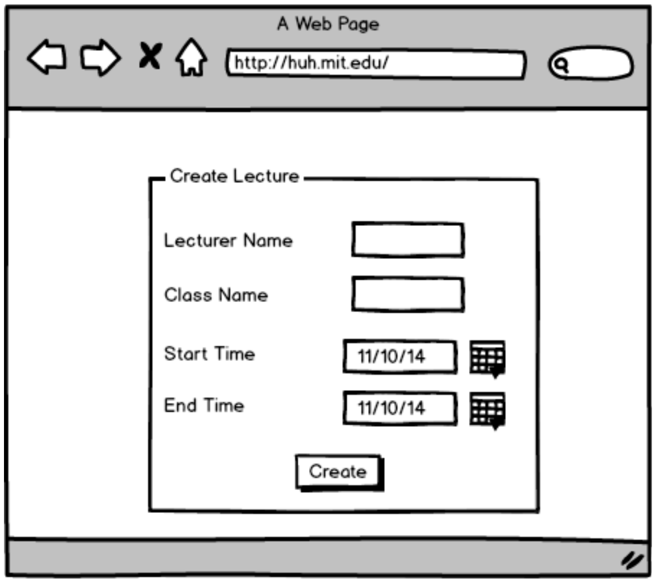
Undesired Traffic: The teacher will provide the url at the beginning of Lecture. This ensures only the students attending the lecture have access to the Huh? Lecture.

Skewing Results: Abusive users can skew the understanding score of a class by opening the lecture session in many tabs. Theoretically an abusive user can then keep a lecture at near 0% understanding with many tabs regardless of real student understanding. Our scheme requires no authentication and no actual login, so there are some security considerations about abuse. To prevent a user from hitting the "I don't get it" button thousands of times, we will use a cookie to track a user who has visited the page and store them for persistency. If a user erases their cookies, they will automatically be logged out, so even if they hit the "I don't get it" button again, their vote will only count once. A malicious user could potentially open up multiple browsers and vote multiple times. We could check MAC or IP addresses to prevent this misuse, but the implementation complexity is not worth it. Additionally as we intend to support mobile browsers, we cannot use MAC addresses as this is made unavailable in iOS8. We determined that using IP address is the best solution. However, we have decided not to implement this security feature as it would make it impossible to test the application for both us and the grader.

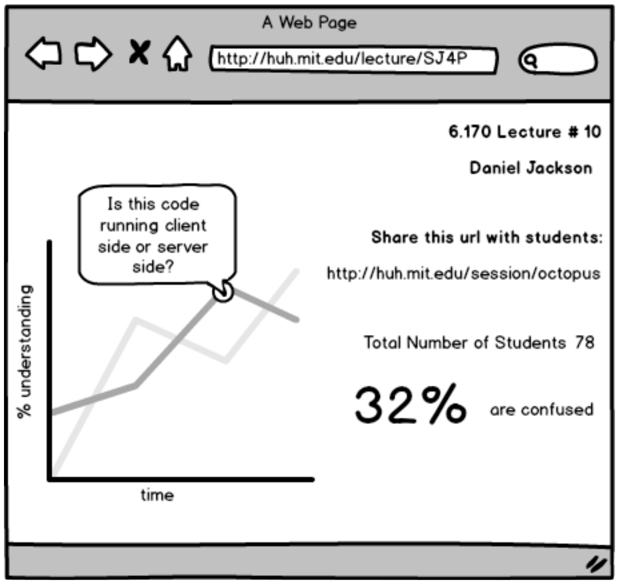
DDoS: Our website opens a socket to each user in a lecture session. This leaves open the possibility of malicious users opening so many connections that valid users are unable to connect. Protection from these kind of attacks is usually provided by hosting services and we are not deploying this to world, so we will not not have mitigation for DDoS attacks.

User Interface

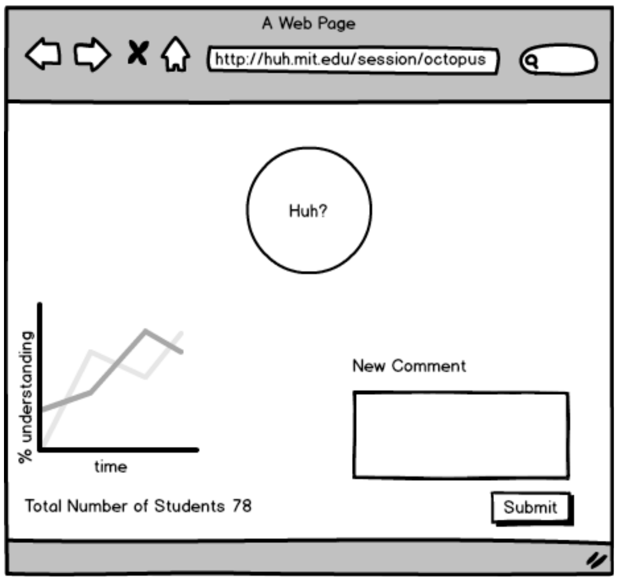
Create Lecture



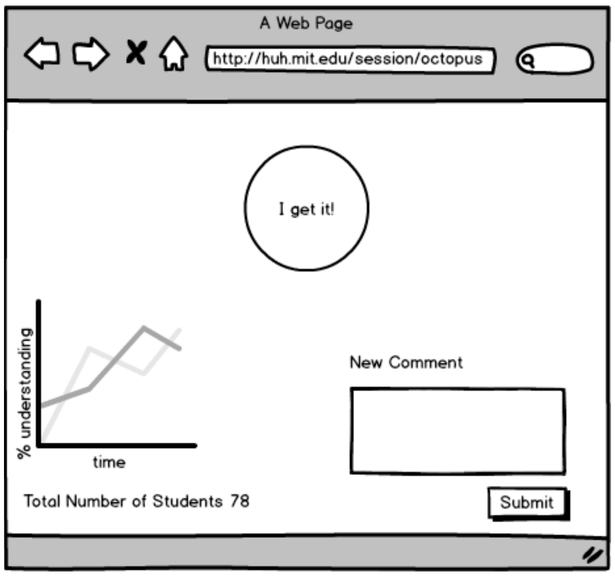
Lecture Dashboard


A Web Page
http://huh.mit.edu/lecture/SJ4P
6.170 Lecture # 10
Daniel Jackson
Is this code running client side or server side?
% understanding
time
Share this url with students:
http://huh.mit.edu/session/octopus
Total Number of Students 78
32%
are confused

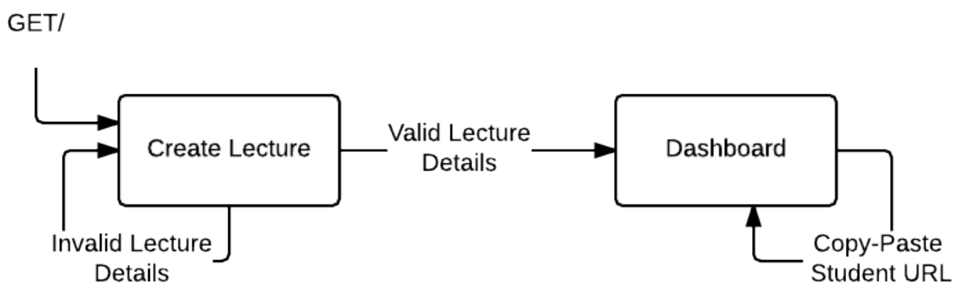
Student Dashboard (Not Confused)


A Web Page
http://huh.mit.edu/session/octopus
Huh?
% understanding
time
New Comment
Total Number of Students 78
Submit

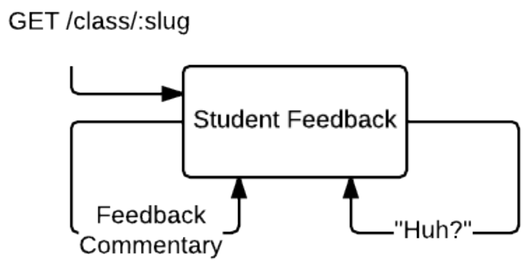
Student Dashboard (Confused)


A Web Page
http://huh.mit.edu/session/octopus
I get it!
% understanding
time
New Comment
Total Number of Students 78
Submit

Lecturer Flow



Student Flow



Design Challenges

Should we include the ability to comment?

- Yes, it allows students to give more feedback on the material.
- No, it introduces design risks for how questions are represented to the students and professor, which may lead to more confusion.

Resolution: We believe that questions will be useful to include, but not for the MVP, as we need more time to implement them and test their functionality

Should we model confusion as a state or event?

- State, probably more intuitive, but requires student to change their state back when they are no longer confused.
- Event, more difficult to model the current state of the class, and possibly more confusing for students, but students don't have to worry about maintaining their state.

Resolution: We will use the state model as, although it is something the student has to maintain, it is easier to understand. It will also be more simple for us to implement - the event model has several design risks we would have to solve.

How do we calculate understanding score? (Specifically, for calculating what percentage of students are confused, what do we use as the population size?)

- Have professor enter number of students when creating lecture. The professor knows the number of students enrolled, but lecture attendance is often far lower than enrollment numbers. Using this metric would either require the professor to guess what attendance will be or use a value that will be far too high. However, this would be fairly simple to implement.
- Use number of current student sessions. We may run into issues with skew if we find that users usually only open the site if they are confused.

Resolution: We will use the number of student sessions. We believe it is more likely to give an accurate result. We are not overly concerned with skew for now, and if it is a major problem, it is not difficult to change this.

Do we need user authentication?

- For professors. This would allow them to store data about their lectures in one place and prevent other users from accessing the lecture dashboard page.
- For students. This would allow classes to maintain lists of allowed users and allow students to look back on past data.
- None at all. This is simpler to implement and we don't have any particularly sensitive data or actions within our application.

Resolution: We will not have authentication. We will use a system similar to that used by Doodle or Whenisgood of having an admin link given to the professor and a participant link to be posted for students.

How will we prevent trolls from voting multiple times by opening multiple tabs?

Discussed in Security section

How will the Orb be updated?

- Phillips Hue has a simple RESTful API to change the hue of a lightbulb. We can have our server make requests to the Phillips Hue bulb to change its color. Unfortunately it costs over $100 for the starter kit and takes a week to ship. Furthermore, Phillips Hue requires its own IP address which we are unsure is possible on the MIT network.
- Mac App + arduino controlled LED + a local communication protocal to arduino control. We can create a Mac App that polls our api for understanding score, sends the score to the arduino over a local communication protocall, and have the arduino set the hue of the LED light.
  - Local Communication Protocal Options:
    - Buetooth for data transfer. Costs $30 for bluetooth shield. Bluetooth connection also adds connection complexity since bluetooth sometimes fails to connect. Benefits include a greater range of communication and the ability connect multiple lights
    - USB for data transfer. Benefits include an intuitive setup, fixed power source, and no extra cost.

Resolution: Mac App + arduino controlled LED + USB Data transfer. Simple, cheap, and straightforward to implement.

What library should we use for charting?

- Chart.js. Used in part 3.4. Chart.js very simple and easy to use. Unfortunately, as we learned in part 3.3, it does not natively support time series type graphs and is not easily extensible. Because of this, our time series graph is extremely ineffecient and considerably slows the browser as thousands of data points are added to the screen and redrawn.
- D3 + Cubism. D3 is a less opinioned charting library that is highly customizable, though less simple to use. Cubism is a D3 plugin that is very optimized for time series graphs. Instead of redrawing every datapoint, it simply shifts the canvas and draws the next point.

Resolution: Convert graph to use D3 + Cubism.

How should we implement our data model?

We ended up doing away with much of our originally proposed data model. We realized that all of the functionality we hoped to gain from a Student object - one example being the ability to keep track of how many student are logged in - could actually be fulfilled by other systems, so we removed that.
We nested Scores within the Lecture object as we have no need to reference them from other lectures.