We chose to study the office hour management software used by UIUC and Brown because their source code was readily available and the two schools have different sizes (UIUC is very large, Brown is smaller and more similar to Mudd), giving us a look at different approaches to solving the problem. We examined Zoom, Piazza, and the combination of Slack and Google Sheets because these are the three ways we have seen remote grutoring being done at Mudd. Finally, we looked at MyDigitalHand because it is a commercially available product that also manages office hours, and we wanted to see the strengths and weaknesses of a product that major colleges, like Duke University and Harvard University, are actually paying for.

Illinois Queue

- Description: The Queue developed by UIUC is a tool to facilitate lining up for office hours and help develop small studying groups in large courses. Professors can request queues for their classes and students can use this web service to ask questions during office hours. The questions will be collected and analyzed to help professors determine what topics might need to be reinforced.
- Key strengths:
    - Provide a platform for students to ask questions, and the students can see their position in the queue and how long people in the queue have been waiting for.
    - Students get a notification when they are next in line, which is very convenient and students do not have to pay large amounts of attention to see whether it's their turn yet.
    - Help develop studying groups
        - Students who go to a certain session of office hours may be grouped together and by joining the study groups, these students are committed to the sessions at the designated time.
    - Aesthetic, easily understood user interface
    - Many queues could be held concurrently by this web service, then this can be utilized in many classes
    - Collect the questions student ask, which be used to help instructors identify common questions
    - Requires no additional application, only internet access is needed
- Key weaknesses:
    - **Developed internally for UIUC, cannot be utilized by other institutions**
    - Developed to facilitate office hours, not equipped to allow students and professors/grutors to video call. The queue is not like a forum, so the professors cannot respond to the students' questions online. The interface only shows students' questions.
    - The study group forces students to go to the same office hour each week, or else their position will be given to others. Students cannot just make study groups with classmates currently in the queue.
    - Notification is only provided for students and not for professors/grutors, since this web service was written to facilitate office hours
- Lessons:
    - Positive

        - The UI allows students to see the queue and how long people have been waiting for. This is a great feature that we can also implement in our product.
        - The user interface and the documentation are really easily understandable, we should do something similar
    - Negative
        - On the Issues section of the Queue Github, someone suggested a new feature: Queue sends a student an automated email when it's their turn, regardless of whether notification was on or off. We are trying to implement this feature such that students/grutors can get notifications in their preferred methods of communication.
        - A professor using the Queue suggested in the Issues that they would like to specify the time that the queue is available. We think that is a fair requirement that our product should have
        - Many of the features are developed for large courses (500 - 1000) and may not be useful for HMC
- Improvements:
    - Develop a queue that can be utilized by HMC
    - Provide notifications for grutors such that grutors do not have to keep refreshing the queue to see if anyone asked a question
    - Provide a platform that not only allows students to ask questions, but that professors and grutors can respond to the questions and set up video calls to discuss those questions with the students
    - Students can form study groups with other classmates in the queue and do not have to commit to a study group that meets at a specific time. Students have more flexibility in when they would like to attend grutoring sessions.
    - The queue would only be active during grutoring hours

Piazza

- Description: Piazza is a website/app that allows students to ask questions and professors to respond in a forum type format. It is utilized in many Harvey Mudd computer science classes as the priority platform of communication between students, professors and grutors. Notifications are sent out when there are new posts or responses to keep both parties informed. In addition to providing the forum style platform, Piazza also provides career services for students.
- Key strengths:
    - Notifications are sent out via email, keeping all parties informed
    - All the past questions and responses are saved
    - Allow responses to be endorsed, have indications for all posts and comments that the instructors find valuable (would show up as "instructors think this is a good note")
    - Separate forum-style platform for each class, can be utilized for multiple classes
    - Posting on the forum is very simple for students, and other students may be able to provide insights for the question
- Key Weaknesses

    - Most people have email notifications set to once every four hours, so grutors and students are likely to not see the question immediately. Grutors must continue refreshing Piazza during grutoring sessions to see if there are any new posts, which is very inconvenient.
    - Grutors must go back and forth between Zoom and Piazza to communicate with students and to figure out a meeting room. Also, students have no way of figuring out how many people are ahead of them. They may have to wait a long period of time in the Zoom waiting room
    - Not many students actively check Piazza, so even if a student asks a question publicly, the chance of another student answering the question is quite low.
    - Generally do not have an active forum for each grutoring session, so it is hard for students to find classmates who are also working on the assignment at the same time and are waiting for help
    - Piazza phone app is not well implemented and crashes often (Has a rating of 2.4 on the Apple App Store)
- Lessons:
    - Positive
        - Forum-style question asking works well. Having the ability to endorse a response also helps students in identifying the best answer. We should also have this feature
    - Negative:
        - Not having active forums dedicated to each grutoring session prevent students waiting in line from interacting with each other. Also, there is no UI on Piazza to check the student's position in the queue. We should implement something that takes account of that.
        - Piazza has some features that students barely use, such as Piazza Careers. We will not implement that.
        - Notification setting is not well customized and can cause a delay of response from grutors. Email may not be the notification tool for everyone. We should implement something that allows people to pick their preferred methods of communication.
- Improvements:
    - Allow students to be on a queue and see their position on the queue through a GUI
        - This will allow students to work on other things while waiting to be helped and give a student better sense of how long the wait will be
    - Have customized notification settings
        - Grutors during their grutoring session will get notifications immediately and in their preferred methods of communications
        - Outside of Grutors' grutoring session, notifications will be sent based on a different setting (Maybe once per hour)
    - Students will get notifications when they are next in line, along with the zoom call link, grutors will also receive a notification with the zoom call link attached as well
    - Have an active forum for students in the queue
        - Allow classmates to work together at real time

SignMeUp (created at Brown University)

- Description: SignMeUp is a web application that allows teaching assistants to hold hours and labs, and students to sign up for them. In essence, it is an online queue. The instructor or teaching assistant can sign in on the website and start the queue for a particular course. Students can also sign in and click into the queue block for the queue they are interested in, where they can then press "join queue" to enter the queue.
- Key Strengths
    - Very simple and user friendly UI; very easy to use with a single click to join queue
    - Ticket system: each person in queue has a ticket and the instructor "opens" a ticket to show that a session is ongoing with a student
    - Shows number of people in queue, what video calling platform the meeting will take place with, what time the queue closes, and who are in the queue
    - Require Google sign-in with school-specific domain to use, which serves as a security factor
- Key Weaknesses
    - Lacks documentation and user support. The readme file gives a very general rundown of the app, but there is no further instruction on how the web app works. This makes it difficult for users to know what to do and how to use the application
    - Does not have any notification mechanism; students will not know it is their turn to join the video call with the instructor, which can lead to time wastage
    - There does not exist any scheduling functionality for the queue blocks
        - instructors also have to manually log on to create queue blocks and set up meeting information, which can cause confusion if the instructor shows up late
        - It is inconvenient for students to plan ahead without a schedule UI that lists the queue blocks for the week
    - Although the queue UI mentions the video call platform used for the meeting, the video call must be initiated outside the web application as the app does not have the function to initiate a call
    - Does not support communication between students, which can reduce the number of questions and facilitate discussion
- Lessons
    - Positive
        - Having a user friendly interface along with a queue interface allows users to easily maneuver through the app
        - Display information (course name, meeting time, etc.) for the queue allows the user to have a clear understanding of the queues, so we will make sure to implement functionality that allows information display
        - Requiring strict-domain sign in for security purposes is a good practice, so we can implement this after basic functionality is finished
    - Negative
        - Not having a notification system to alert students when it is their turn and instructors when a student joins the queue will delay interaction between the two. Therefore, we will need a notification system to reduce such time wastage

        - Having a chat system built in for students and general discussion can facilitate queue and problem resolution
        - Should not lack documentation and instructions for using the application as it can lead to user confusion; not all the users will be willing to spend time to look at the source code or even have the knowledge to understand the code to know how the application works
- Improvements
    - Develop a robust notification system for both instructors and students
        - Alert instructors when students are in queue and alert students when it is their turn can greatly reduce time wastage
    - Implement a video chat interface within the application
        - Students and instructors will not have to manually start another session, which may cause technical difficulties and waste time
    - Implement a chat system where students and instructors can form discussions outside of the one-on-one meetings through the queue
        - Students may have their problems resolved through discussion with other students (or instructors if they join), saving time for those who require face-to-face interaction
    - Write good documentation and instructions for using the application and also provide good user support
        - Users may be confused about how the application works, leading to technical difficulties that cannot be resolved easily without good user support

MyDigitalHand

- Description: A web application that allows instructors to hold “online office hours” for courses. Students can monitor office hour usage remotely and come only when staff members are available. They can log onto the app, submit online forms with their questions, and join the waitlist. The instructor will have a number notification next to the waitlist tab indicating the number of tickets in the waitlist. Then, the instructor can notify the next student on the waitlist and “open the ticket”, which indicates a session in progress with the student. The instructor will write suggestions and follow up activities on the ticket and submit it back.
- Key Strengths
    - Has data collection built in.
        - All office hour usage is recorded, so students and instructors know what times are the busiest.
        - All data is downloadable and can be used for further analysis
    - Has a notification system for both alerting instructors when students submit a question ticket and students when the instructors are ready to respond to their tickets
    - Has optional feedback in a simple multiple choice fashion, which may be used for instructors’ purposes
    - Has interaction timers to limit interaction per student to allow interaction with all students in waitlist

    - Virtual form for submitting questions make sure students have questions prepared before joining queue, which reduces communication and time friction
    - Records semantic information for each session for instructor's and student's future references
- Key Weaknesses
    - Does not offer video calls or face-to-face interaction, which makes it difficult for students to get sufficient feedback from each ticket they submit.
    - The online forms are private between the student and instructor.
        - Students with the same or similar questions will take up more time in queue
    - Notification system is ineffective
        - The small number indication for students in the waitlist is not visible enough most of the time for instructors to notice
    - Does not support communication between students, which can reduce the number of questions and facilitate discussion
- Lessons
    - Positive
        - Having a notification system to alert students if it is their turn or if a student is in queue can reduce time lost
        - We can ensure time is not wasted by having students have questions prepared before entering the queue
        - Requiring time-limited interaction between each session can ensure all students get their questions answered
        - Record each session so students and instructors can refer back to the recorded information
        - Use data collection to inform students about how busy the queue is in a time distribution graph
    - Negative
        - Not having a strong enough interaction interface (like a video chat interface) can limit interaction and possibly result in unresolved questions
        - Can have scheduling functionality implemented for students to plan their schedules ahead of time
        - Having a more robust notification system is important for alerting students when it is their turn and for alerting instructors when a student is in queue
- Improvements
    - Notification system can be more robust
        - Ensures that students and instructors will not miss notifications when it is meeting time to reduce time wasted
    - Implement a chat system where students and instructors can form discussions outside of the one-on-one meetings through the queue
        - Students may have their problems resolved through discussion with other students (or instructors if they join), saving time for those who require face-to-face interaction
    - Implement a scheduling system and UI displaying what time office hours/grutoring sessions are being held for the week

        - Allows students to plan their week ahead to reduce schedule conflicts through a clear and visualizable interface

Slack + Google Sheets

- Description: In CS70, students must fill out a Google form describing their question. This adds an entry to a Google sheet and sends a message in a grutoring Slack channel. Grutors have to mark the students as helped in the Google sheet and then message the students on Slack to set up a video call.
- Key strengths
    - If notifications are turned on in Slack, grutors can get notifications when students sign up on the queue.
    - Using a Google sheet to keep track of the number of students on the queue is simple and easy.
    - Filling out a Google form is also convenient for the students.
- Key weaknesses
    - Grutors have to turn notifications on at the beginning of each shift and off at the end, otherwise their phone will constantly be buzzing with Slack notifications.
    - Students have no knowledge of how many people are on the queue.
    - Grutors have to go between Slack and Google Sheets to manage and communicate with students, which can be inconvenient.
    - If there are students and grutors concurrently modifying the Google Sheet, there could be some entries that accidentally get deleted because of lag or some other issue.
    - Grutors have to fill out a form at the end of each shift talking about how many students were helped. This creates more work for grutors and they might also forget to fill out the form.
- Lessons
    - Positive
        - As part of the Google form that students fill out, they can supply a Zoom link that the grutor can use to join them. We could incorporate a similar idea into our product to reduce the number of hoops the grutors have to jump through when helping students.
        - Slack messages are an easy way to send notifications to grutors when a student signs up. We should also create an easy way to send notifications to students and grutors.
    - Negative:
        - Students don’t have any way of knowing how many people are ahead of them in the queue. We should figure out a way to display someone’s position in line so they have a better understanding of how long they need to wait.
        - Google Sheets is an imperfect way to manage students. It can get overloaded when there are many people editing it at once, so we should make something simpler and more streamlined for both students and grutors.
- Improvements

    - Consolidate the process of managing students on the queue, communicating with students, and setting up a Zoom call all into one platform.
        - This would make it much simpler for the grutor to keep track of students and they would not have to jump between multiple platforms.
    - Send notifications to grutors only during their shifts, eliminating the need to manually turn notifications on/off.
        - Reduces the work that grutors have to do so they can focus on helping students.
        - Can be another functionality within the platform.
    - Give students a visual indication of their place in the queue.
        - This would give them an idea of how long they need to wait, allowing them to focus more on their work instead of constantly wondering when a grutor will help them.
    - Record the number of students that show up per shift and make the data viewable so that professors can analyze the results and reallocate grutors if necessary.

Zoom

- Description: Another common grutoring method is putting all the students in a single Zoom room and answering their questions one at a time. There are variations on this, such as putting groups in breakout rooms if the class has group work or using a Google Sheets queue for students who need help, but these have the same problems as the queues in CS70.
- Key strengths
    - Keeping all the students in one Zoom room makes it simpler for the instructor.
    - Instructors no longer need to hop between platforms; everything can be done during Zoom.
    - If multiple students have the same question, the instructor can help all of them at once.
    - Students have an idea of how many people are ahead of them in line because they can see the number of people in the room.
- Key weaknesses
    - All the students have to wait in the same room, but if one group of students is ahead of the other students and asks a question, this might unintentionally give people the answers.
    - Students have to wait in the room to be helped - there is no way to put down your name in a line and go work.
    - The grutor doesn't have an easy way to keep track of the order of people's questions. They could use a Google Sheet, but that adds another platform to use. If they don't keep track of the order and there are a lot of students, this can create confusion as to whose turn it is to talk.
- Lessons
    - Positive
        - Zoom is a good platform to use because it offers capabilities like screen sharing and breakout rooms. Instead of reinventing the wheel, we can connect students and grutors using Zoom, whether through links or the API.

        - Having students with the same question in the same Zoom room saves time for the grutor because they don't have to reexplain everything. We should find a way to duplicate this functionality by either enabling students with the same question to communicate or grutors to help multiple students at once.
    - Negative
        - Zoom does not offer a convenient way to manage multiple students lining up for help within the platform. You have to resort to using another service, like Google Sheets, to track how many students there are. We will make this a functionality of our platform so that grutors don't have to switch between multiple different platforms.
        - Students can be forced to wait in a room even when the question being answered is not relevant to their question. We should allow students to put their names down and then work without having to check if it is their turn.
- Improvements
    - Implement a system that consolidates managing the queue with setting up video calls.
    - If multiple students have the same question, add the ability for students to discuss amongst themselves, whether through chat or video calling.
    - Alternatively, automatically create a room for all the students that have the same question so the grutor can help them at the same time. This room would be under the control of the grutor, and the grutor would be able to choose who to let in at a time based on their view of the queue.