

Homework that Helps You

Augmented Humans Studio, CS147 Autumn 2018

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### **Problem and Solution Overview**

The main need we were trying to address was the difficulty to locate and access relevant resources. In our needfinding, we found that many people, students and professors alike, spent a large portion of their academic time looking up resources and scouring the web for information they needed. At stanford, many classes will have hours of recorded lecture and hundreds of slides to sift through for a single problem set. Our goal was to alleviate these pains by providing the right resources at the right time. Along with this, we found that a big issue in university came from large classes with an inability to provide personal feedback. Students are often times confused on what material would be most beneficial to study and where to look to find problems that could help them shore up their weaknesses. Therefore, we also sought to create an Artificial Intelligence that can provide individuals with relevant feedback and applicable review materials to what that individual needs. Finally, we wanted to help students connect with each other to help explain complex problems in a more personal manner. Therefore, we created a system that connects students that can mutually benefit each other to understand different problems.

We make the process of learning personalized and efficient through the use of a cleanly organized hub for all your academic needs. We seek to provide the most important information to our users up front while still providing clean navigation and resources so that they can accomplish or locate anything they might need.

	Se 🖗 10:10
Home	
Upcoming Assignments	
CS 103	Start >
PSET 3	2 Days
Upcoming Exams	
PSVCH 1	Start >
MIDTERM 1	9 Days
Recently Graded	
CS 103	Start >
PSFT 1	99/100
d O □	

Home screen of our app

### **Tasks & Final Interface Scenarios**

# Simple: Look at an upcoming assignment and get access to relevant material

We chose this task as it covered the main pain-point we found in our needfinding. Currently, resources and information are scattered across the web with the necessary material taking hours to locate and digest. Our simple task is simply to provide those resources in a cleaner and more efficient manner.

≡ Home		E Home
Home Upcoming Assignments		csio3 PSET 3
CS 103 PSET 3	Start > 2 Days	Welcome! This homework has 10 questions.
Upcoming Exams		- Binary Relations
MIDTERM 1	Start > 9 <sub>Days</sub>	- Functions - The properties of both BEGIN
Recently Graded		
CS 103 DCFT 1 ⊲ ○ □	Start >	⊲ o □

Click on "Start" for PSET 3

Click on "Begin"



"binary relations"



Click on the link under "Video"

Redirects to a video at the exact moment that the concept is discussed

# Moderate: Review a problem that you got wrong and connect with a student who got it right

This task solves another issue we found in our needfinding which is the lack of personal feedback. By allowing students to connect with each other on problems where one student got it wrong and the other got it right, we can create personalized and human feedback systems where students will help each other learn the material and answer personal questions.

		£ •		Sel 🔒 8:13
≡ Home		≡ Home		
Upcoming Assignments			cs 103 PSET 1	Score: 88/100
CS 103	Start >		On Gradescope	
PSET 3	2 Days	1. What is 2 + 2?		20/20
Upcoming Exams		Your answer: 4	Expand v	
PSYCH 1	Start >			
MIDTERM 1	9 Days	2. What is 300 + 300?		10/20
		Your answer: 6		
Recently Graded			Expand v	
CS 103	Start >			
PSFT 1	88/100	3. What is 10 + 9?		18/20
I DET 1	00/100	Your answer: 21		
			< 0 □	
Click on "Start" for P	SET 1	Click o	on "Expand" for PS	SET 2



Click on "Connect with another student"

# Complex: Review for a test with our auto-generated and personalizable review sheet

We categorized this task as complex because it requires a long-term history of use so that "our Al algorithms" could process results from previous assignments and combine this data with information on exam content to generate a tailored review sheet for the user. We chose this task as there is currently no system out there for reviewing material for exams. While sometimes classes will provide past tests to practice on, it can be very difficult to study the sections one finds hard or relearn material that one got wrong on a problem set. Therefore, this task seeks to help users create personalized study systems to help students both understand the material and get a better grade.

≣ Home	5 B M	E Home
Upcoming Assignments		PSYCH 1 MIDTERM 1
CS 103 PSET 3	Start > 2 Days	Recommended Order: ?
Upcoming Exams		Perception Est. Time: 3 Hours
PSYCH 1	Start >	Expand v
MIDTERM 1	9 Days	Unit 3
Recently Graded		The Brain
CS 103	Start >	Expand v
PSET 1	88/100	Unit 1 Est. Time: 1 Hour
		Introduction



### Click on "Expand" for Unit 2

≡ Home	≡ Study Guide
PSYCH 1 MIDTERM 1	PSYCH 1 MIDTERM 1
Recommended Order: ?	Past Perception Exam Questions
Unit 2	
Perception	Sensation is?
Est. Time:	Expand v
30 min +1 2 + 11 +1 2 + 11	What is the process called in which one form of energy is changed into another. In sensation, the transforming of stimulus energies, such as touch and smells, into neural impulses our brain can interpret?
60 min Past HW Problems View>	Expand v

# Scroll and click on "View" for "Past Exam Questions"

Click on "Add/Edit" to personalize

Study Guide     E     Study Guide       PSYCH 1     PSYCH 1       MIDTERM 1     MIDTERM 1	
PSYCH 1 PSYCH 1 MIDTERM 1 MIDTERM 1	
Past Perception Exam Questions     Control     Past Perception Exam Questions     Control	Confirm
Sensation Questions:     Sensation Questions:       Energy Questions:     Energy Questions:       Threshold Questions:     Threshold Questions:	
Sensation is?     Sensation is?       Expand v     Expand v	
What is the process called in which one form of energy is changed into another. In sensation, the What is the process called in which one form of energy is changed into another. In sensation, the	

Click on the checkbox next to "Sensation Questions" Click "Confirm"

all a Study Guide	E Study Guide
PSYCH 1 MIDTERM 1	PSYCH 1 MIDTERM 1
Past Perception Exam Questions	Past Perception Exam Questions
What is the process called in which one form of energy is changed into another. In sensation, the transforming of stimulus energies, such as touch and smells, into neural impulses our brain can interpret?	Sensation Questions: 🗧 Energy Questions: 🗧 Threshold Questions: 🔤
Expand v	Sensation is?
If i am testing your sound absolute threshold what percentage of the time must you hear the minimum	Expand v
stimutus in order for the absolute threshold to have been found?	What is the process called in which one form of energy is changed into another. In sensation, the

The Sensation question that was at the top of the page is now removed. Click "Add/Edit" to add it back. Click on the checkbox next to "Sensation Questions" and then "Confirm"

≡ Study Guide	
PSYCH 1 MIDTERM 1	
Past Perception Exam Questions	Add/Edit
Sensation is? Expand v	
What is the process called in which one form of energy is changed into another. In sr transforming of stimulus energies, such as touch and smells, into neural impulses ou interpret?	ensation, the Ir brain can
Expand v	
↓ 0 □	

The sensation question reappears again

### **Design Evolution**

### **Initial Sketches**

First, we brainstormed multiple realizations of our application across different devices and a wide variety of input/output modalities.



Web interface

Wearable interface



Native Phone menu interface

AR interface



Bubble pop phone interface

At the end of this exercise, combined the design of the web app and the native phone interface to create a native phone interface with a side menu, in which students can access Course Content, look through Assignments, and Review for an exam. We chose this interface because it allowed for easy navigation, it would be good for visual learners and it would have potential for widespread use since many students have phone already.



Native phone side menu interface

### Low-Fi Prototype

The full storyboard of the interface chosen from the previous step can be seen below:



Full storyboard

#### The task flows for each task on our prototype can be seen below:

Simple - Find content relevant to an assignment



Moderate - Review questions that the user had gotten wrong in previous assignments

Click on "Assignments"	Click on "CS103"	Click on "PSET 1"	Click on "Q2"	2 7+4=5
Home Upcoming Assignments CS 203 Start PSET Due: 2 Days Upcoming Exams Psych 1 Review MIDT ERM1 (BAR: 9 Days MIDT ERM1 (BAR: 9 Days) Graded Assignments CS 203 View West PSET 1 Grade: School	Assignments CS 103 PSYCH 1	Assignments CS 103 PSET 1 View Governited PSET 2 Submitted PSET 3 Shart IDDE: 2 Days PSET 4 Not released PSET 5 Not released	Assignments       CS 103     88/100       PSET 1     (88 %)       1     (1010 %)       2     8/10 %       3     10/10 %)       4     10/10 %)       5     9/10 %       6     10/10 %)       7     5/10 %	$\begin{array}{c} \chi = -2 \\ y = ? \\ Your answer: \\ \chi = -y + 5 \\ y = boost from looks like the subtract from both g = 2 solds. \\ Relevant clips from lecture: \\ \hline $

Complex - Review relevant material for an upcoming exam

Click on "Review"	Click on "Midterm 1"	Click on "Unit 1"	K Raview
Home Upcoming Assignments CSA03 Start PSET3 Due: 2 Days Upcoming Exams PSYCH I Review MIDTERMI PAT: 9 Due Graded Assignments CS 103 View New PSET 1 Ernde: 88/00	Review PSYCH 1 MIDTERM 1 CG 103 MIDTERM 2 CG 103 FINAL	Review PSYCH1 MIDTERM1 Unit <u>1</u> <u>3</u> <u>4</u> <u>5</u>	Psych 1 MIDTERM 1 UNIT 1 The Brain Notes: Notes: Missed HW Problems FSET1 1. Past Exam Queations 1.

### All Screens



### Medium-Fi Prototype

### Updated tasks

We got feedback that all our tasks felt very similar, both in the functionality that they provided as well as the task flows that were implemented for each. We modified our tasks to take this feedback into account. The updated tasks were:

### • Simple

You can use MagicHW to look at an upcoming pset, and easily get access to relevant material

### • Moderate

OLD: You can receive personalized feedback on graded pset. NEW: When you get a question wrong you can connect with someone who got it right.

### • Complex

OLD: You can receive a review sheet comprised of past missed problems and problems from previous exams NEW: You can create a custom review sheet that covers multiple units with recommendations from our Al

### Major Design Changes

### • Mobile to Tablet

Our biggest change between the low-fi sketches and the new sketches was moving from a mobile application to a tablet application. We modified all the design elements to adapt to a tablet interface (eg: menu on the side, as opposed to on the top, bigger menu items) <u>Rationale</u> - The tablet application has more screen space which provides a better interface for a homework application. Students are more likely to do their homework on a tablet, as opposed to on their phone.

Home Upcoming Assignments CS103 Start PSET3 Due: 20		SATAM Home Upcoming Assignments	-
Upcoming Exams PSyCH 1 Review	Home	CS 103 PSET 3	Start > Due: 2 Days
Graded Assignments	🕍 Assignments	Upcoming Exams	
CS 103 View NEW!	Review		Review >
PSET 1 Grade: 88/100	Resources		9 Days
		Recently Graded	
		CS 103	View >
		PSET 1 Ne	w! Score: 88%
Home Assignments Learn Review	Settings		
Before		After	

• Simplified Analytics

We switched from complex analytics showing time taken to study a topic, recommended review breakdown, progress, importance on midterm etc to a simple interface that sorts units as "recommended".

<u>Rationale</u> - Through all our interviews, we got the feedback that the analytics we presented were very confusing and hard to interpret. They did not help the students in any decisions about which modules to pick.



Before

After

#### • Previews/ Time taken

Another recurring feedback that we got from our users was it was hard to know what problem/PSET they should start working on (given their time constraints). The app interface also provided no knowledge about a problem/PSET before it's clicked on To remedy these issues, we added "Estimated time taken" to each problem/PSET as well as each midterm review unit. In addition, we added short snippets of text describing the content of each PSET/ problem, along with useful information such as number of points for each question.



The task flows for each of our new task on our medium-fi prototype can be seen below:

Simple: Access material relevant to upcoming PSET



Click on grey button at top

Click on first pin



Moderate: Get feedback when you get a problem wrong and connect with a student



Click on "Connect with Another Student"

Complex : Create a custom review sheet



Exam: 9 Days Magic PSYCH 1 Midterm 1 -1 New Study Guide Home Massignments Auto-generate Create your own Review ▶ Resources In Progress **STUDY GUIDE 1** Review > Settings

Click on "Review" for Midterm 1



![](_page_16_Figure_5.jpeg)

	Pod 🕈	< PSYCH 1 Midterm 1	-
		Past HW Problems	
С		What is the frontal lobe? 7/9	Remove
		Number of parts in the brain 3/9	Remove
	~	Add Problems 🕂	

Click on "Review" next to "Study Guide 1"

![](_page_16_Picture_8.jpeg)

Click on "Expand" next to "Past HW problems"

### Final Design

After incorporating the feedback from the heuristic evaluation tests (discussed in the section below), we implemented our final design in Android Studio. The final design and task flows are described in the section "Tasks and Final Interface Scenarios".

### **Major Usability Problems Addressed**

### Level 3: Sidebar is always visible; it should be able to be opened and closed.

This was mainly a limitation associated with the tool we used for our medium-fi prototype- Marvel, and we have a fully functioning opening and closing side drawer navigation bar in our hi-fi prototype.

Med-Fi

	,	Assig	nments	-
НW	CS103 Upcoming:	Due:	Graded:	Grade:
Assignments	PSET 3	2 Days	PSET 1	88% ss/100
E Review	PSYCH 1			
Resources	Upcoming: PSET 2	Due:	Graded: PSET 1	Grade: 75% 15/20
				More >

#### Sidebar always open

### <u>Hi-Fi</u>

≡ Assignr	ments			
		Assign	ments	
	CS 103			
	Upcoming: PSET 3	2 Days	Graded: PSET 1	2 Days
				More >
	PSYCH 1 Upcoming: <b>PSET 2</b>	2 Days	Upcoming: PSET 1	2 Days
				More >
		۵ (		
			3	

Sidebar closed

![](_page_18_Picture_3.jpeg)

Sidebar open

### Level 3: Review tab doesn't group the classes in the way that the Assignments tab does.

This was an oversight in our medium-fi prototype, and we added an additional class-organized page. We also changed the name of the Review tab to Study Guide to be clearer to the purpose of the tab.

![](_page_19_Picture_2.jpeg)

### Review landing tab

![](_page_19_Picture_5.jpeg)

Study Guides landing tab

# Level 4: The app should have a tab called Classes, with a section for assignments and a section for review, like Canvas.

We decided not to implement this suggestion as part of our goal of MagicHW was to make the experience efficient and relevant to the students. We were frustrated with the class structure of Canvas and Gradescope, as it requires many steps to get to the relevant information: the assignments and exams. The purpose of our Assignments and Review tabs is to get the students the information they need easily.

	Ass	Assignments		
Home	CS103 Upcoming: PSET 3 Due: 2 may	Graded: Grade: 88% PSET 1 87%		
Assignments		More >		
Review	PSYCH 1			
Kesources	PSET 2	Graded: Grade: <b>PSET 1</b> <sup>75%</sup> <sub>15/20</sub>		
		More >		

![](_page_20_Figure_3.jpeg)

### Assignments tab

![](_page_20_Picture_5.jpeg)

Assignments tab (Unchanged)

# Level 4: It's unclear if the student completes and submits their homework assignments with the app.

We decided that it would make more sense in terms of merging with current class designs to interface with Gradescope instead of submitting through MagicHW. We removed the time estimates and added messages such as "Submitted through Gradescope". We also added a button at the bottom of the PSET 3 page that states "Submit through Gradescope" that links to the website.

![](_page_21_Figure_2.jpeg)

### No submit button

![](_page_21_Picture_5.jpeg)

Submit with Gradescope added

![](_page_22_Figure_0.jpeg)

Appears to have been submitted through the app

<u>Hi-Fi</u>

![](_page_22_Figure_3.jpeg)

Submitted "On Gradescope"

#### Level 3: The Magic Help button looks unclickable.

Rather than relying on iconography that is likely not familiar to first-time users, we decided to simplify the representation of the button and have text reading "Turn Help On" and "Turn Help Off". This button is initially yellow so that it appears clickable, then once the button is clicked and help is on, it turns to grey. In addition, the magic help popup icons obstructed the text, so we changed those to clickable highlights in the text.

![](_page_23_Figure_2.jpeg)

Help On

1 11-1 1
----------

![](_page_24_Figure_1.jpeg)

![](_page_24_Figure_2.jpeg)

![](_page_24_Figure_3.jpeg)

Help On

## Level 3: There's no place to mark if the resources that come up when the Magic Help button is clicked are actually correct and useful.

We felt that this was more of a feature that would be nice to have than was necessary to achieve our tasks. Furthermore, since we have not actually implemented the AI algorithms, this additional information was not integral for the function of the app. Thus, we did not add this to our resources popup. As an aside, due to our skill limitations in Android Studio, we were not able to embed the videos and slides as shown in our medium-fi prototype, but our video link does send users to a Youtube video at the moment when binary relations are taught.

![](_page_25_Picture_2.jpeg)

#### <u>Med-fi</u>

Help popup screen

<u>Hi-Fi</u>

Help popup screen

### Level 3: Giving all the students other students' phone numbers is a privacy concern and puts the effort onto the student to reach out and ask for help personally.

We agreed that this could be a privacy concern, so we removed the phone numbers from the contact screen. Implementing an in-app messaging system (as was suggested in the heuristic evaluation) was a bit more complicated than we had time to complete and was not a major focus of our task, so we only gave the students' email addresses. We also changed the wording of the screen and added a Help ("?") button that explained our matching algorithm so students have more insight as to how they are matched, since the previous matches seemed very one-sided. Now, it's much clearer that the relationship between the students is reciprocal.

![](_page_26_Figure_2.jpeg)

Med-fi

Contact screen with phone number and email

![](_page_26_Picture_6.jpeg)

Contact screen with email only

![](_page_27_Picture_0.jpeg)

Contact screen with help message

## Level 3: The user can remove sections from their study guide but can't add new ones or add back sections they may have accidentally deleted.

We changed the structure from our medium-fi prototype to our hi-fi prototype so that all of the possible sections are available on the review sheet, but the user can hide certain sections as they please. This gives the users the flexibility to hide the sections that they feel confident about.

![](_page_28_Figure_2.jpeg)

<u>Med-Fi</u>

Recommended tab,, no explanation

![](_page_28_Picture_5.jpeg)

Psych 1 Study Guide

![](_page_29_Picture_0.jpeg)

Past Psych 1 HW Problems

PSYCH 1 MIDTERM 1 Past Perception Exam Questions Add/Edd Sensation is? Expand v What is the process called in which one form of energy is changed into another. In sensation, the transforming of stimulus energies, such as touch and smells, into neural impulses our brain can interpret? Expand v			
PSYCH 1 MIDTERM 1 Past Perception Exam Questions and a series of the se	=	Study Guide	
Past Perception Exam Questions		PSYCH 1 MIDTERM 1	
Sensation is? Expand v What is the process called in which one form of energy is changed into another. In sensation, the transforming of stimulus energies, such as touch and smells, into neural impulses our brain can interpret? Expand v		Past Perception Exam Questions	Add/Edit
Expand v What is the process called in which one form of energy is changed into another. In sensation, the transforming of stimulus energies, such as touch and smells, into neural impulses our brain can interpret? Expand v		Sensation is?	
What is the process called in which one form of energy is changed into another. In sensation, the transforming of stimulus energies, such as touch and smells, into neural impulses our brain can interpret? Expand v		Expand v	
Expand v		What is the process called in which one form of energy is changed into another. In sensation, the transforming of stimulus energies, such as touch and smells, into neural impulses our brain can interpret?	
< ○ □		Expand v	

Psych 1 Study Guide

		12 G 1010
≡ Study Guide		
	PSYCH 1 MIDTERM 1	
Past Perception Exam	Questions	Confirm
	Sensation Questions: Energy Questions: Threshold Questions:	
Sensation is?	Expand y	
What is the process called i	n which one form of energy is changed into ano	ther. In sensation, the

Hiding Sections

![](_page_31_Picture_0.jpeg)

Psych 1 Study Guide (Sections Hidden)

# *Level 4: Clicking PSET 3 from the Home page and then the back button brings the user to assignments, not the home page.*

This also was a limitation of Marvel. In our hi-fi prototype, we use the functionality of the back button on the Android tablet to control this navigation, and it works on a history stack similar to web browsing. This makes the navigation experience more intuitive for the user.

IPa	Maaic <≡	Home			
	,HW	Upcoming Assignments			
		CS 103	Start >		
1	Home	PSET 3	Due: <b>2</b> Days		
1	Assignments	Upcoming Exams			
Review	Review	PSYCH 1	Review >		
	Resources	MIDTERM 1	Exam: 9 Days		
-		Recently Graded			
		CS 103	View >		
		PSET 1 New	Score: 88%		

<u>Med-Fi</u>

Home Screen, click PSET 3

Madic + <≡	CS 103 CS 103
Home	Welcome!
Sea Assignments	This homework has <b>10 questions</b> and is estimated to take <b>15 hours</b> to complete.
Review Resources	Tanics Covered:
	- Binary Relations - Functions - The properties of both
	Begin
Settings	

PSET 3 Welcome page, click back button

	Madic < =	<	Assignments	
	ЯW	<b>CS 103</b>		
	Home	CS 103		Start >
	🖅 Assignments	PSET 5		2 Days
)	Review	CS 103 <b>PSET 2</b>		View > Submitted
	Resources	CS 103		View >
		PSET 1	New!	Score: 88%

### Assignments page

<u>Hi-Fi</u>

= Home				<u>%</u> 8 10:10
		Home		
	Upcoming Assignments			
	CS 103		Start >	
	PSET 3		2 Days	
	Upcoming Exams			
	PSYCH 1		Start >	
	MIDTERM 1		9 Days	
	Recently Graded			
	CS 103		Start >	
	PSFT 1		00/100	
		0		

Home screen, click PSET 3

![](_page_34_Picture_0.jpeg)

PSET 3 Welcome page, click back arrow on tablet

≡ Home				
		Home		
	Upcoming Assignments			
	CS 103		Start >	
	PSET 3		2 Days	
	Upcoming Exams			
	PSYCH 1		Start >	
	MIDTERM 1		9 Days	
	Recently Graded			
	CS 103		Start >	
	PSFT 1	0	00/100	
	7			
		0		

Home screen

# Level 3: There should be an explanation of the Al's recommendations as users might not trust Al without reasoning yet.

We added a "?" button to the Study Guide page with an explanation of our recommendation algorithm.

![](_page_35_Picture_2.jpeg)

<u>Med-Fi</u>

Recommended Unit, no help message <u>**Hi-Fi**</u>

			% B 10.11
=	Home		
		PSYCH 1 MIDTERM 1	
I	Recommended Order:	?	
	Unit 2		Est Time: 3 Hours
	Perception		Est. Time. 5 Hours
		Expand v	
	Unit 3		Est. Time: 2 Hours
	The Brain		
		Expand v	
	Unit 1		Ect Time: 1 Hour
		< 0 □	LSt. TIME, 1 HOU

=	Home		
		PSYCH 1 MIDTERM 1	
	Recommende	d Order: 💡	
	Unit 2	Ert Time: 7 Hours	
	Perception	Est. Title, 9 Hours	_
		Expand v	
	Unit 3	Est. Time: 2 Hours	
	The Brain	Our state of the art AI has sorted the units based on an algorithm weighing your past performance on the material and the prevalence of that topic on the exam.	
	Unit 1	The material that the AI recommends for you has been presented first.	

Recommended Order, help message (undisplayed), click "?"

Recommended Order, help message (displayed)

### Level 3: The expand option on the recently graded problem set page takes the user to an entirely new page.

This was another limitation we had when using Marvel, and our current prototype has a working expand functionality.

![](_page_37_Figure_2.jpeg)

<u>Med-Fi</u>

PSET 3 Page, unexpanded, click "Expand" on Problem 1

iPad 훅	9:41 AM
≡	< <b>PSET 3</b>
<b>a</b> 1	
	1. So What Exactly Is a Binary Relation, Anyway?
	When we described binary relations in lecture, we gave an operational definition of a binary relation by saying what binary relations do, but we never actually said what binary relations are. Let's begin with a new definition of the Operations ensures of A denoted 0.1 if the opt of all were prior in the prior of the same prior of the optimisment of the prior of the same prior of the s
šЕ	that can be formed from elements of A. * Formally speaking, we define A 2 as
_	$A2 = \{ (a_1, a_2)   a_1, a_2 \in A \}$
	For example, if A = {1, 3, 7}, then
	$A2 = \{ (1, 1), (1, 3), (1, 7), (3, 1), (3, 3), (3, 7), (7, 1), (7, 3), (7, 7) \}.$
	We can use the Cartesian square of a set to rigorously define binary relations. Formally speaking, a binary relation R over a set A is a set R E A 2. The ordered pairs in R correspond to pairs of elements where the relation holds. For example, the < relation over the set would formally be defined as
	< = { (0, 1), (0, 2), (0, 3),, (1, 2), (1, 3), (1, 4),, (2, 3), (2, 4), (2, 5), }
	When we've talked about relations, we've used the notation xRy to denote that x relates to y by relation R. Formally speaking, the notation xRy is just a shorthand for $(x, y)$ R. This means that if you happen to stumble across a random set of pairs of things, you could interpret it as a binary relation.
	Visit the CS103 website and download the starter project files for Problem Set Three. In
¢	Binaryketations.n, there's a definition of a Relation type that represents a binary relation expressed as a set of ordered pairs. We'd like you to write some C++ code in BinaryRelations.cpp to analyze those relations.

PSET 3 Page, Problem 1 expanded

![](_page_38_Picture_1.jpeg)

PSET 1 Page, unexpanded, click "Expand" on Problem 2

6.0			51	10:14
≡	Assignments			
	1. What is 2 + 2?		20/20	
	Your answer: 4	Expand v		
	2. What is 300 + 300? Your answer: 6	10/20		
	Smart feedback: You forg	got to add two zeros!		
	Still confused?	Textbook Chapter		
		Connect with another student		
	• • • • • • • • • • • • • • • • • • •	Collapse ^		
	<			

PSET 1 Page, Problem 2 expanded

# Level 3: There are two buttons that look like back buttons, and they seem to appear/disappear randomly. One of them is actually a back button and one is to push the menu to the side.

We agreed that having the two back buttons was confusing, so we removed the navigation bar arrow. Furthermore, since we used the Android back button functionality, the back button on the screen was unnecessary, so we removed it.

Maqic ,<≡	<	Assignments	
ЯW	CS 103		
Home	CS 103		Start >
Assignments	PSET 3		Due: 2 Days
Review			View >
	PSET 2		Submitted
Resources	CS 103		View >
	PSET 1	New!	Score: 88%

<u>Med-Fi</u>

Two back buttons in upper left corner

![](_page_39_Figure_5.jpeg)

### <u>Hi-Fi</u>

No back buttons

### **Prototype Implementation**

### Tools

After developing our medium-fi prototype for iOS, we decided to pivot our efforts towards android development. This decision was made due to the fact that Android uses the Java programming language, of which all members were familiar with. Additionally, Richard had experience in Android programming and had educational resources for the rest of the members to use in learning.

In order to make the application, all group members programmed in Android Studio, and used its built-in emulator to test our application. Android Studio was a great platform because it had many built-in tools to help us accomplish our goals. For example, Android Studio's use of xml files meant that most of our screens (except our login) will be able to accommodate to tablets of all sizes. Additionally, android made it very easy for us to implement external functionality (like linking users to websites or videos outside of our application).

Android Studio was unable to help with creating a beautiful logo, so we leveraged Adobe Illustrator in order to create something that we were happy with. Moreover, in order to effectively collaborate as a group, we used Github in order to work in parallel and use a common code-base.

### Wizard of Oz

In developing our application, we made use of some Wizard of Oz techniques. We give users recommendations on how much time they should spend studying certain topics, which is based on their performance on exams and previous assignments. We tell the user that this recommendation is derived from an algorithm using artificial intelligence, although it is worth noting that the actual recommendations given in our application are hard-coded time values that we came up with.

### Hard-coded Data

We explicitly hard-coded all of the classes that the user is enrolled in, in addition to all of the midterms, assignments, and grades corresponding to those classes. In theory, our application is supposed to be pulling these resources from Gradescope and Canvas, but because we could not implement this functionality, we hard-coded them in. Additionally, all of the links, videos, and student profiles (for peer-to-peer connections) were also hard-coded in.

### Missing functionality/ Future Work

Currently, the application is missing fully-fleshed out assignments and exam pages. For example, we allow the user to fully view Problem Set 3 and Problem Set 1 for CS103, but did not code in Problem Set 2. In order to compensate for this, however, we created messages that pop up when an unpopulated assignment/exam is clicked on.

In the future, we would like to add the ability to complete assignments within our application. Since our application is on tablet, we think it would great idea to allow users to be able to handwrite or type out their answers to assignments within MagicHW.

### **Summary**

After 10-weeks of much hard-work in this class, the MagicHW team is very happy with the design process we were able to learn throughout the quarter. We began by interviewing individuals of all ages, from college students to elementary school students to retired individuals. Across these interviews, we found that a lack of resource centralization was very common, allowing us to devise and iterate through various solutions to this issue. After many iterations and evaluations (user testing, heuristic, etc), we were able to leverage our technical skills to realize our solutions through the development of our MagicHW application. After going through this process, our team team has a much greater appreciation for all the work that goes into the everyday products and applications that we use, and we all hope to continue using the skills learned in this class in the future.