RADGRAD: USING DEGREE PLANNING, SOCIAL NETWORKING, AND GAMIFICATION TO IMPROVE ACADEMIC, PROFESSIONAL, AND SOCIAL ENGAGEMENT DURING THE UNDERGRADUATE COMPUTER SCIENCE DEGREE EXPERIENCE

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By

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ABSTRACT

A casual analysis of the Hawaii technology community site, TechHui, suggests that over the past decade, recent alumni and current undergraduates of the Information and Computer Science (ICS) program at the University of Hawaii at Manoa (UHM) have experienced several problems with various academic, professional, and social aspects of their ICS experience. Existing degree planning systems such as STAR, Starfish by Hobsons, Blackboard Planner and Coursicle fail to provide the specific support that ICS students need to create a complete and comprehensive degree plan. Existing academic social networks such as LinkedIn, TechHui and Rate My Professors fail to connect students closely with professors and alumni. Current popular video games suggest that several gamification features could encourage ICS students to achieve higher goals. A new system called RadGrad combines degree planning, social networking, and gamification in a novel way that aims to give ICS undergraduates the support they need to succeed and redefines what it means to have a successful degree experience. The overall goal of this thesis is to justify the initial RadGrad system design and establish baseline values for future studies. A baseline student survey conducted in Spring 2017 reveals current and more detailed student perceptions on the academic, professional, and social aspects of the ICS degree experience prior to using RadGrad. These baseline results can be used in a future study to measure if RadGrad has had any effects on the students.

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CHAPTER 1
INTRODUCTION

Getting a college degree is an investment that many people make, with the expectation that once they get their degree, they will have the basic skills needed to start a career in the field of their choice. However, what happens if a student does everything they are told to do (takes required courses, gets a high GPA, and graduates on time), but once they start applying for jobs, they are constantly turned down and told that their coursework and high GPA are not enough? If colleges promise to prepare students for the workforce, they should be doing everything they can do deliver this promise, even if it means redefining what it means for a student to be "successful."

For ICS students in 2017, it is hard to land a job when the only thing on your resume is a couple of standard programming courses and 3.8 GPA. Several ICS alumni have told me that they realized too late that employers are scouring incoming resumes for other things like internships, independent projects, and hackathons. It is also difficult for ICS students to find jobs in new industries that may not have existed, or may have been far less prominent four years ago when they began their ICS degree. How can these students prepare for these new fields, when they had no concept of it during their degree experience? Furthermore, is it reasonable to expect colleges to create new courses each time there is an advancement in technology?

These initial observations made me wonder if other ICS students over past decade were experiencing similar problems. To answer this question, I navigated to the Hawaii technology community site, TechHui [23], and found a forum question entitled "Three bad things about being an ICS student." I gathered responses from 199 ICS students from 2008 to 2016, and compiled a list of the ten most common complaints over the past 8 years:

1. The ICS department needs to offer classes more frequently.
2. The ICS department needs to offer a wider variety of classes.
3. The ICS department needs a better sense of community.
4. Some of the professors in the ICS department need to improve their teaching.
5. The ICS department should offer more focused areas of study.
6. ICS classes are too time consuming and take up more time than anticipated.
7. The ICS department should offer more classes that meet focus requirements.
8. ICS books are too expensive.
9. ICS courses should involve more group work

10. ICS should encourage more interaction among students.

Complaints 1, 2, 5, 6, 7, and 8 suggest problems with degree planning and coursework itself and complaints 3, 4, 9, and 10 suggest social and communication related problems within the department. There were also some other complaints among students on TechHui that were not as common but stuck out to me nonetheless. There were at least eight students who mentioned that they felt intimidated when they started out in ICS, due to the impressions they got from their classmates and the major overall. This caused them to feel discouraged and had an overall negative impact on their ICS experience. These sentiments further suggest social problems with the ICS community, as well as with how the department is perceived outside of the community.

Overall, the TechHui complaints reveal several academic and social problems in the ICS department, while recent alumni struggling to find jobs suggest problems with helping ICS students to develop professionally. As ideal as it would be, it is hard to meet the needs of all current, past and present students in a department. However, after taking student and alumni feedback into consideration, several of these problems could potentially be alleviated by creating an online platform that provides students with the help they need to become a truly successful student–academically, professionally, and socially. Creating a useful degree planner that helps students get all the information they need to create an ideal plan for their personal goals could help students both academically and professionally. Creating an online social network for the ICS community could help encourage students to connect with others in the department and become more supported socially, which could potentially lead to both academic and professional advancements. Adding gamification aspects to the degree experience could help give students the extra incentives they need to go beyond the UHM graduation requirements, and take the initiative to become overall more well prepared both academically and professionally for finding a job after graduation.

In the following section, I investigate existing degree planners, social networks, and games. I summarize what is currently available for students, and whether their features have the potential to meet students' academic, professional, and social engagement needs. Next, I describe the baseline survey I designed and deployed in Spring 2017 to establish initial values for students before using RadGrad. Finally, from September 2016 to May 2017, I worked with the RadGrad team to develop the initial version of the RadGrad system, and the last section of the paper describes how RadGrad combines degree planning, social networking, and gamification in a new way that potentially addresses many of the aforementioned student problems and needs.

CHAPTER 2
RELATED WORK

My vision of addressing ICS student problems through an online platform involves three major parts: degree planner, social network, and gamification. All three of these parts combine to create a robust, interactive, and effective system to enhance the academic journeys of current and future ICS students. In this section I discuss existing software in each of these categories, what they aim to accomplish, and why they do not fully satisfy the needs of ICS students.

2.1 Degree Planners

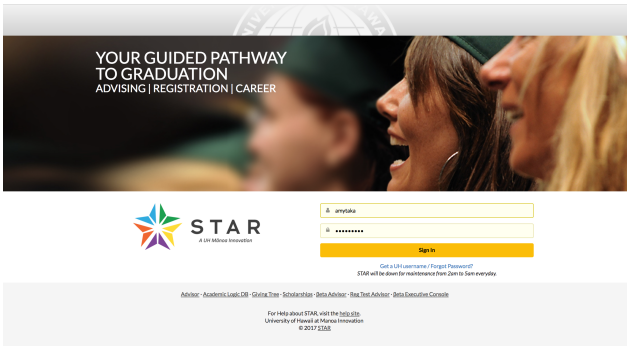


Figure 2.1: STAR homepage. *Source: www.star.hawaii.edu*

2.1.1 STAR

STAR is the degree planning system currently used by the University of Hawaii system [12] (Figure 2.1). As of June 2017, the student interface provides five main capabilities: Academic Essentials, Graduation Pathway, What If Journey, Transcripts, and Scholarships.

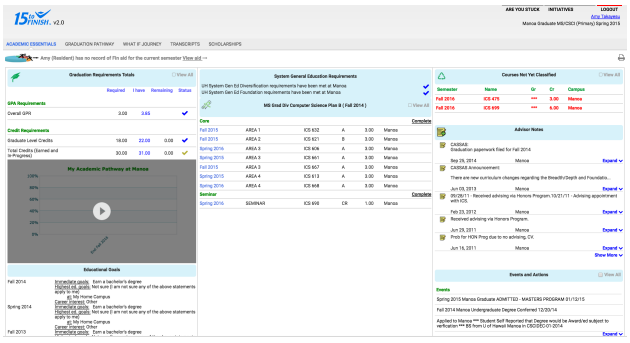


Figure 2.2: STAR Academic Essentials page. *Source: www.star.hawaii.edu*

2.1.1.1 Academic Essentials

This interface provides information about the student's academic progress, and compares it to the student's academic requirements to show the student's progress towards graduation (Figure 2.2). This information includes credit totals, grades, and required courses. This interface also includes a section for "Advisor Notes", which is filled out during advising sessions. There is another section for "Events and Actions" which lists important student academic events such as college applications, admittance, and graduation, and student academic actions such as Deans List award. A third section is called "Educational Goals", which provides the student's "immediate goals" and "highest ed goals" on a semester-by-semester basis. This information is provided by the student through occasional assessments upon log-in to STAR. The top of the page also has a section for students with financial aid.

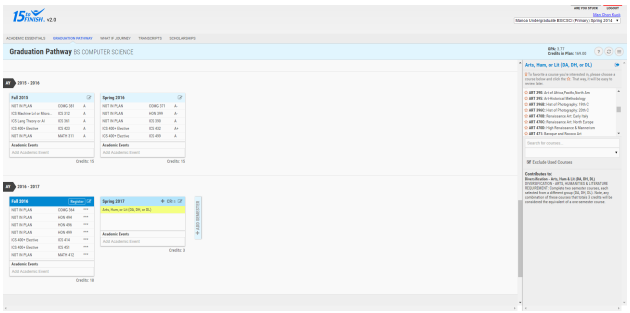


Figure 2.3: STAR Academic Graduation Pathway page.*Source: www.star.hawaii.edu*

2.1.1.2 Graduation Pathway

This interface is provided for certain programs or exploratory or pre-major students (Figure 2.3). It displays the course information for the courses that the student has taken previously and is currently enrolled in, and shows which requirements each course fulfills. It also lets students view future semesters and suggests future types of classes that the student should enroll in, in order to fulfill their major requirements. This interface does not suggest specific classes, but only lists the requirement that the class will need to fulfill.

2.1.1.3 What If Journey

This interface is provided for undergraduates at UH Manoa. It allows students to choose a different major than their current one (Figure 2.4), and shows an altered version of their STAR homepage, which displays the requirements of the chosen major. This helps students visualize where they would be in the program if they were to switch majors.

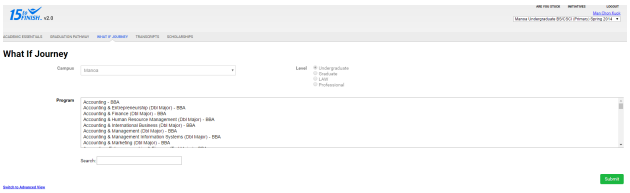


Figure 2.4: STAR What If page. *Source: www.star.hawaii.edu*

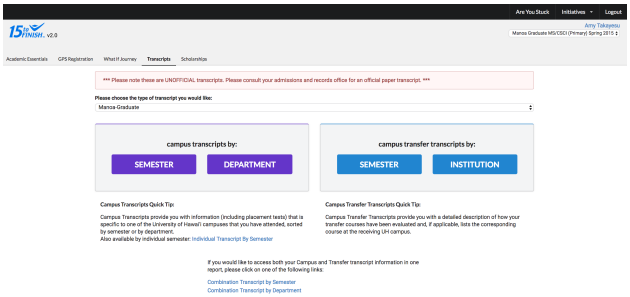


Figure 2.5: STAR Transcripts page. *Source: www.star.hawaii.edu*

2.1.1.4 Transcripts

This interface allows students to access their campus transcripts by semester and by department (Figure 2.5). It also allows transfer students to access their transfer transcripts by semester and by institution.

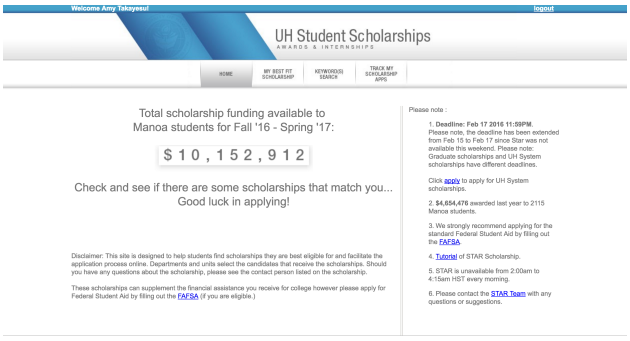


Figure 2.6: STAR Academic Scholarship Home page. *Source: www.star.hawaii.edu*

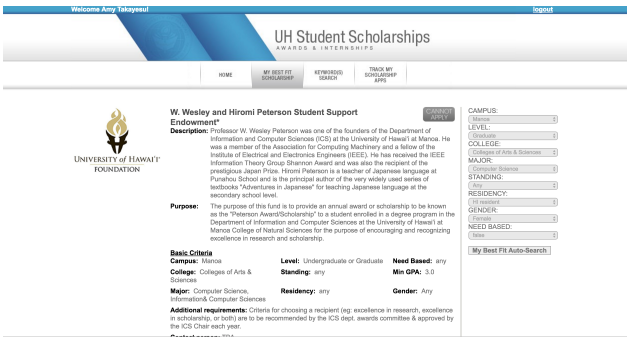


Figure 2.7: STAR Academic Scholarship Best Fit page. *Source: www.star.hawaii.edu*

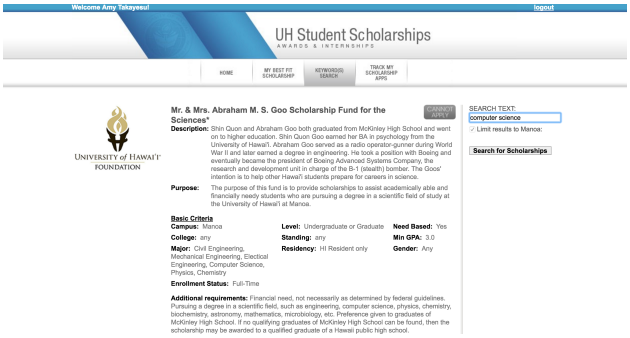


Figure 2.8: STAR Academic Scholarship Keyword Search page. *Source: www.star.hawaii.edu*

2.1.1.5 Scholarships

This interface allows students to find scholarships by either using a keyword search or by selecting the "My Best Fit Scholarship" tab, which presumably gathers student academic data and compares it with scholarship data to find matches (Figure 2.6, Figure 2.7, Figure 2.8).

2.1.1.6 STAR and Academic/Professional/Social Engagement

STAR is the all-in-one place for UH students to check on their progress in general education and major courses, University status in terms of enrollment and tuition payment, and their official transcripts. Since STAR is designed to fit the general academic needs of all students at UH, it is unrealistic to expect STAR to provide specialized and detailed support for each department. Each department is different in terms of courses and requirements, and STAR does not offer any features that go into depth in each individual department's idiosyncrasies. To get more detailed information about major requirements, students must access separate department websites or contact the department's academic adviser. In features such as Academic Essentials, Graduation Pathway, and Scholarships, STAR only offers baseline information. For instance, in Academic Essentials, STAR focuses on the student's broad academic goals (e.g. graduation date and highest degree goal) rather than their arguably more helpful and specific major-related goals. In Graduation

Pathway, STAR notifies students which course categories they are missing, but does not suggest the specific classes that they are missing. In Scholarships, STAR lists relevant scholarships but does not provide detailed information about how to apply or how to prepare for them. Although STAR succeeds at being a University-wide, cross-departmental degree planner system, it lacks the detailed department-specific support that is crucial for a student's success and growth within his/her major.

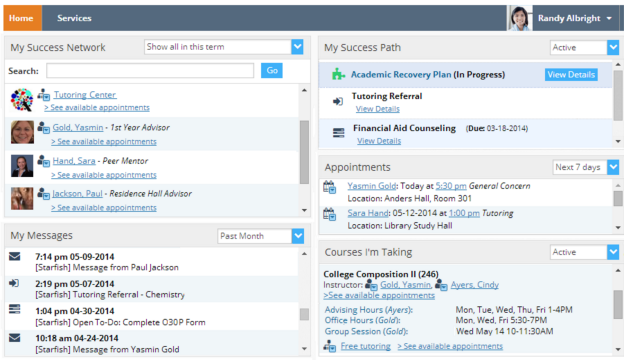


Figure 2.9: Example Starfish Connect page. *Source: Starfish CONNECT gallery*

2.1.2 Starfish by Hobsons

The slogan for Hobsons is "Education Advances: Imagine a world where all students find their best fit [13]." Hobsons offers a wide range of educational solutions, ranging from students K-12 to college students. Starfish by Hobsons is one of their platforms which focuses on success, support, and retention initiatives, and engaging students more effectively with the campus community. There are three main parts of the Starfish Enterprise Success System: Early Alert, Connect, and Degree Planner.

2.1.2.1 Early Alert

Early Alert is a early warning and student tracking model which mines student performance data from existing technologies at the particular institution to detect at-risk students. These students are detected early enough, such as at the first sign of a problem, so that there is enough time to make a difference. There is a type of reward system called Kudo (a positive feedback note), which is used to encourage students and reward them for improvement or good work.

2.1.2.2 Connect

Connect is an online appointment scheduling and case management system (Figure 2.9). This system promotes communication between students and their advisers, instructors, and tutors by means of in person meetings, phone calls, or virtual meetings. Connect includes a kiosk to allow easily scheduled walk-in meetings. These kiosks can help staff to manage a student queue and

also allows students to check wait times remotely, which can save a lot of time and frustration. Connect also includes a road map for each student, which documents the steps a student must take to achieve his or her goals. This map is created by an adviser and is visible to all members of the student's support network.

2.1.2.3 Degree Planner

Degree Planner provides academic templates which advisers can use to easily edit to adjust to a particular student's needs. It also focuses on students' constantly changing goals and ability to adjust the student's plan to accommodate these goals. When a student deviates from their given plan, the student's adviser is notified so that they can plan a meeting with the student to check on their status and re-identify their goals.

2.1.2.4 Starfish by Hobsons and Academic/Professional/Social Engagement

Starfish by Hobsons provides integrated systems that can keep track of students and keep students on track [13]. Its integration into different departments and customization of more specific goals fulfills the academic goals of RadGrad more than STAR. However, this system is concerned only with academics and does not take other factors into consideration such as internships, outside work and projects, and other extracurricular activities. While a student may seem to be on track based off their academic record, there are other factors that come into play when it comes to "staying on track." Traditionally, an "on track" student may have completed all of the coursework within 4 years with at least a 3.0 GPA. However, what if "on track" were redefined to be much more complex, and include other factors outside of coursework? Although these factors may not technically be requirements to graduate, they may be highly recommended, and a system that could help encourage students to pursue these other factors, without them being technically required, would create a different class of graduates entirely.

2.1.3 College Scheduler

The College Scheduler company has two products: Schedule Planner and Pathway Planner [4]. The Schedule Planner focuses on optimizing the way students can plan their schedules, and the Pathway Planner focuses on optimizing the way students progress towards graduation.

2.1.3.1 Schedule Planner

Schedule Planner allows students to easily schedule (or automatically generate) their classes around outside obligations (Figure 2.10). It also helps students to maximize their credit hours and graduate on time. Schedule Planner also analyzes student preference data to predict the optimal number of course sections to offer and helps to evenly distribute class fill rates. It enables advisers to create

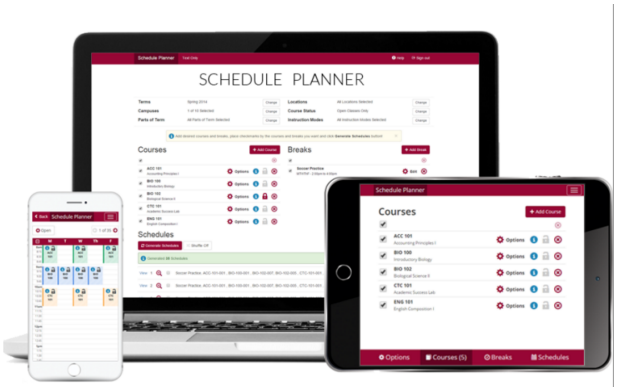


Figure 2.10: Example of Schedule Planner. *Source: http://www.collegescheduler.com/schedule-planner/*

course schedules for groups of students at a time. One of their main goals is to allow students to focus on which courses to take rather than worrying about when they are being offered.

Figure 2.11: Example of Pathway Planner. *Source: http://www.collegescheduler.com/pathway-planner/*

2.1.3.2 Pathway Planner

The Pathway Planner allows students to plan their schedules in a multi-year format to encourage seeing the bigger picture and to plan ahead (Figure 2.11). It provides visuals to show students how their predicted course loads will affect their graduation date. Administrators can also see the courses that students plan on taking before registration. This allows for the addition and elimination of courses to best fit student needs.

2.1.3.3 College Scheduler and Academic/Professional/Social Engagement

College Scheduler focuses on the scheduling aspect of degree planning. However, it views scheduling as a long term event, and allows students and administrators to work together to offer courses in an optimal manner. While College Scheduler addresses the needs to students as a whole, it does not

offer individualized support based off individual needs. Every student has different goals, plans, and schedules, and there is no one master schedule that can accommodate them all. However, if it were to offer individual support on a case by case basis, it would be able to help a larger amount of students to reach their unique goals.

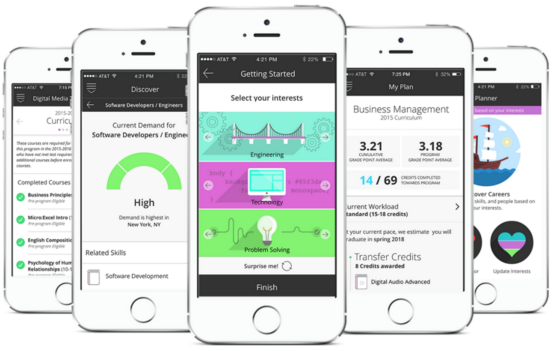


Figure 2.12: Example student view of the Blackboard Planner mobile application screens. *Source: http://www.blackboard.com/mobile-learning/planner.aspx*

2.1.4 Blackboard Planner

Blackboard recently bought out the college planning system MyEdu to create a new mobile student planning application called Blackboard Planner [3] (Figure 2.12). The main goals of Blackboard Planner are to improve student outcomes, simplify planning, and provide better support. Since the system was released in October 2016, at the time of writing, there is currently minimal information regarding the system and it's usage.

2.1.4.1 Improve Student Outcomes

Blackboard Planner aims to improve student outcomes by providing students with real labor demand information from Burning Glass and Roadtrip Nation, which can ideally allow students to make better academic and career decisions.

2.1.4.2 Simplify Planning

Blackboard Planner aims to simplify planning by offering customized scheduling, hassle-free registration, and an academic plan tracker. These features are aimed at helping students graduate on time.

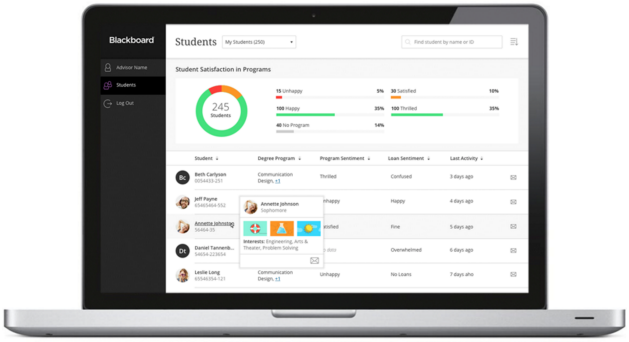


Figure 2.13: Example adviser view of Blackboard Planner. *Source: http://www.blackboard.com/mobile-learning/planner.aspx*

2.1.4.3 Provide Better Support

Blackboard Planner provides an adviser view which allows advisers to combine their insight into the student's academic plans, student sentiment, and predictive analysis together to offer well-informed support to students (Figure 2.13).

2.1.4.4 Blackboard Planner and Academic/Professional/Social Engagement

With the limited information available about Blackboard Planner, it seems to address many degree planning problems that older degree planners, such as STAR, Starfish by Hobsons, and College Scheduler do not. For instance, Blackboard Planner uses job market analytic services to provide students with the most relevant and up to date information regarding careers. However, while Blackboard Planner seems to excel at offering post-graduation advice, it seems to be lacking in pre-graduation advice. Blackboard Planner does not offer course advice to fit the student's current lifestyle, taking work and extracurricular activities into consideration. Planning for the future is important, but students must remember to plan for the present as well.

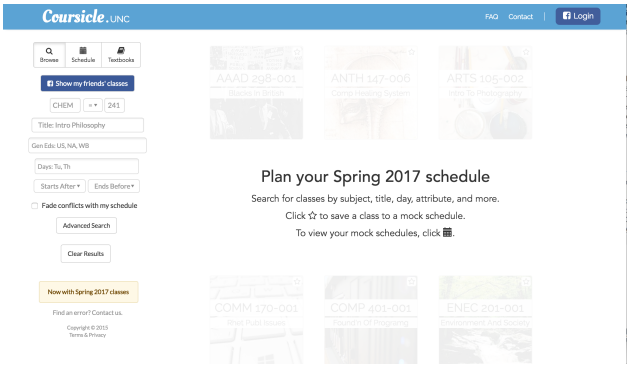


Figure 2.14: The Coursicle page for the University of North Carolina. *Source: https://www.coursicle.com/unc/*

2.1.5 Coursicle

The slogan of Coursicle is "Course registration sucks but Coursicle makes it better [5]." The features of Coursicle are: students can receive text or email notifications when a seat opens up in class, students can schedule their courses using an attractive schedule planner, students can search through courses more easily with a variety of filters, students can create schedules with all prospective classes and then narrow them down to one workable schedule, students can easily compare textbook prices online through Coursicle, and students can view what classes their classmates are signed up for via Facebook (Figure 2.14).

2.1.5.1 Coursicle and Academic/Professional/Social Engagement

Coursicle is focused on making students happy by making registration easier and more enjoyable. However, although Coursicle makes it easier, it does not suggest classes to students based off their goals and previous coursework. Coursicle definitely helps alleviate the psychological pain of registration, but it does not alleviate the overall ongoing pain of degree planning.

2.1.6 Individual Student Software and Academic/Professional/Social Engagement

There are other types of download-able software currently available for students to use individually. These systems are for individual use, and are not tailored for institutional implementation. To use these systems, students input information about their education, such as classes, credits, and requirements. This data is then used to create organized visualizations to help students to better see their goals and pathway. A popular general use system is the Microsoft Office College Credit Planner Template. Many individual colleges and universities have their own custom download-able course planning spreadsheets as well. While these systems help students to organize the data they have, they do not offer any new ideas or suggestions for further improvement.

2.2 Social Networks

2.2.1 LinkedIn

LinkedIn is widely known for being the world's largest professional network [8]. It sets itself apart from other popular social media sites by being focused solely on building professional identities and forging professional relationships. There are six major components to LinkedIn: Home, Profile, My Network, Learning, Jobs, and Interests.

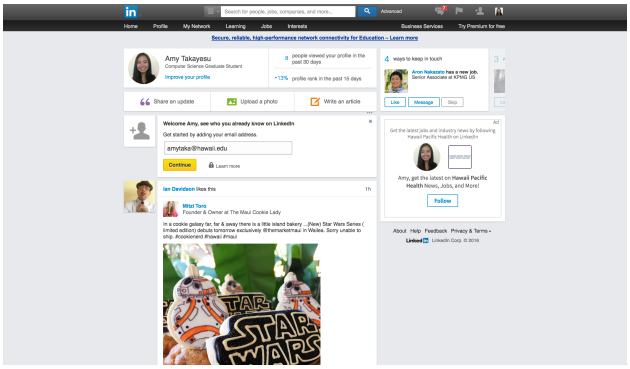


Figure 2.15: LinkedIn homepage. *Source: http://www.linkedin.com*

2.2.1.1 Home

A user's homepage is arranged in a feed type format, with quick information about your profile, profile views, and incoming messages (Figure 2.15). The feed section contains recent updates from connections and companies related to your interests. There are also sections that encourage engagement–for instance, quick ways to "share an update", "upload a photo", or "write an article" and suggestions to "reconnect with your colleagues" and to add someone you may know.

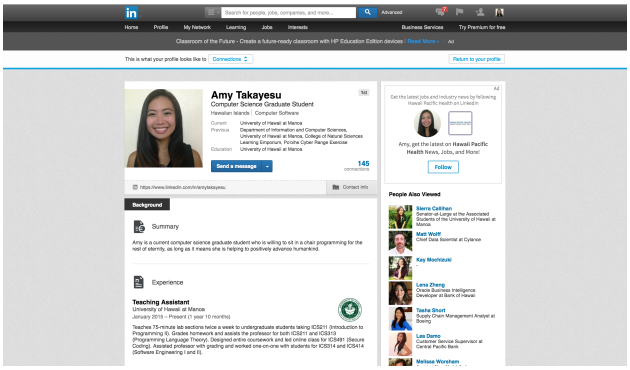


Figure 2.16: LinkedIn profile. *Source: http://www.linkedin.com*

2.2.1.2 Profile

A user's profile page is available for other LinkedIn users to see (Figure 2.16). Users can decide what information they would like to share about themselves, but it is all limited to professional related categories such as education, work experience, volunteer work, and skills and endorsements.

2.2.1.3 My Network

A user's network includes current connections, recommended connections, connections added through outside contact information, and contacts added through an alumni network (Figure 2.17).

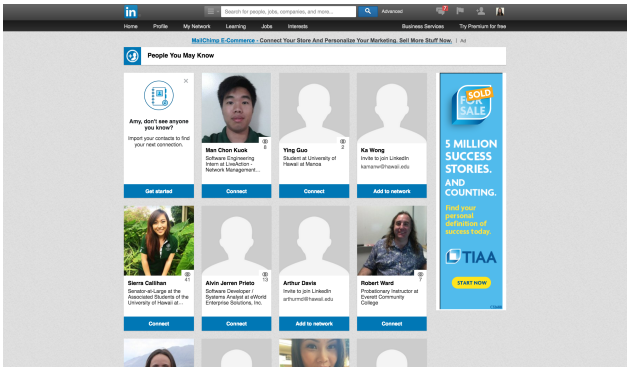


Figure 2.17: LinkedIn network page. *Source: http://www.linkedin.com*

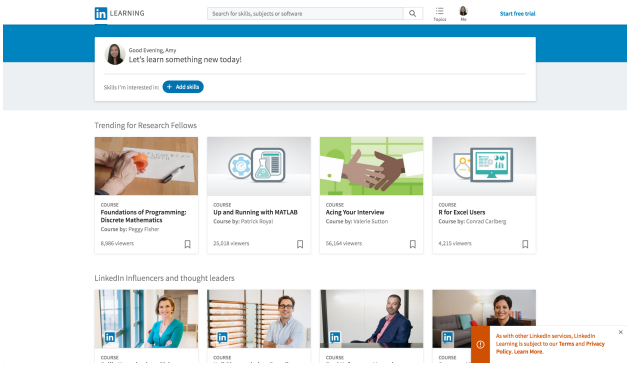


Figure 2.18: LinkedIn learning page. *Source: http://www.linkedin.com*

2.2.1.4 Learning

LinkedIn offers online courses on professional development topics such as leadership, storytelling, creating alliances with employees, and winning back a lost customer (Figure 2.18). There are also field-related courses, such as online code courses. These courses are often in the form of videos, and can be accessed by premium LinkedIn members.

2.2.1.5 Jobs

Jobs on LinkedIn automatically suggest jobs for users based off the information on their profile (Figure 2.19). Jobs can also be searched for using keywords such as job title, company, and location. Users can set preferences to refine their automatic suggestions.

2.2.1.6 Interests

In the Interests section, users can follow companies and groups based off their personal interests (Figure 2.20). There are also links to SlideShare and ProFinder, which offer services for creating professional presentations and hiring local freelancers, respectively.

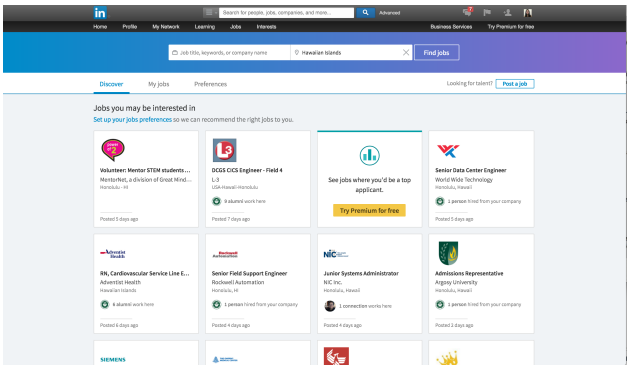


Figure 2.19: LinkedIn jobs page. *Source: http://www.linkedin.com*

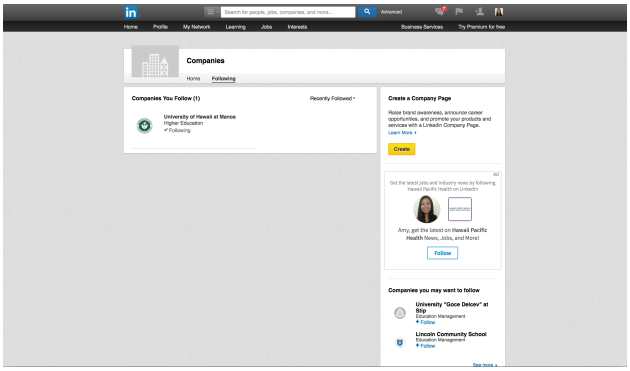


Figure 2.20: LinkedIn companies page in the Interests section. *Source: http://www.linkedin.com*

2.2.1.7 LinkedIn and Academic/Professional/Social Engagement

LinkedIn is a large global professional network. The more people it reaches, and the more diverse it becomes, the more successful it will be. This works on a large scale. LinkedIn inherently fails to provide the intimate support of a smaller and more personal community. It is easy to become overwhelmed with the breadth of LinkedIn, but if there were a place that offered a smaller and more specific community with a lot more depth, people would be able to create stronger and deeper connections (with the trade-off being having less connections overall). For students who have not graduated college yet, having strong connections with the people they are surrounded by (colleagues, professors, alumni, etc.) is arguably more important than having many loose connections with a wider network.

2.2.2 TechHui

The TechHui page describes itself as being "Hawaii's Technology Community [14]." The TechHui site has ten main sections: Profile, Members, Events, Forum, Groups, Photos, Videos, Blogs, Directory, and Coders.

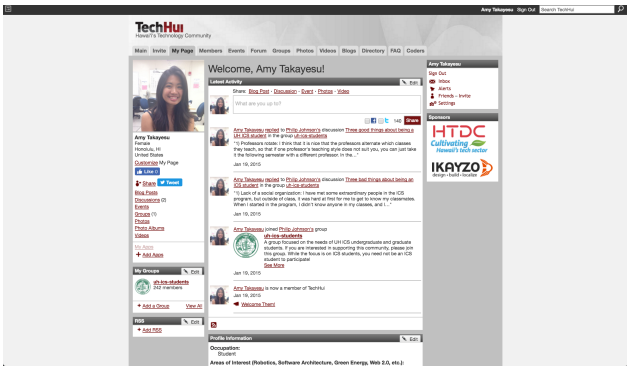


Figure 2.21: TechHui profile page. *Source: http://www.techhui.com*

2.2.2.1 Profile

Each user has a profile page which contains information such as a name, profile picture, occupation, areas of interest, software language proficiency and interests, and recent activity (Figure 2.21).

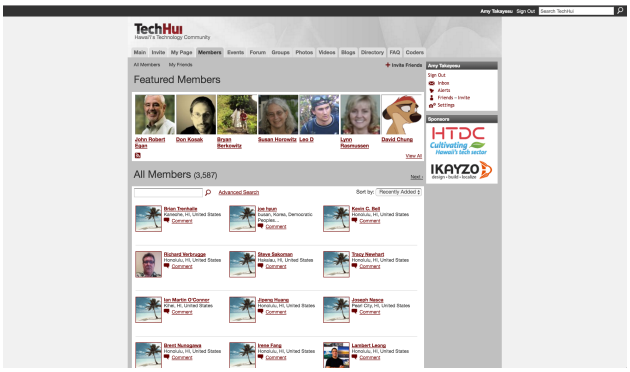


Figure 2.22: TechHui members page. *Source: http://www.techhui.com*

2.2.2.2 Members

The members page lists all members, including a section at the top for featured members (Figure 2.22). Each member is listed by their name, with their profile picture and location. Through this page, users can communicate with other users by commenting on other user's profile pages.

2.2.2.3 Events

The events page lists upcoming events and featured events (Figure 2.23). The event snippets include an imagine, a name, a time and date, a location, the name of the organizer, the type of event, and a brief description of the event. Users can click on these snippets to go to an event page, which includes more detailed information and allows users to respond to events with "will attend", "might attend" and "will not attend."

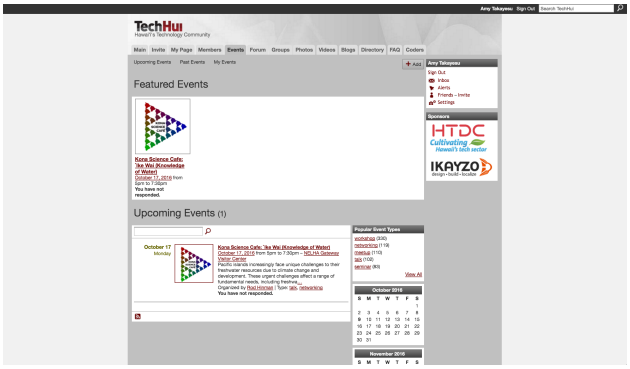


Figure 2.23: TechHui events page. *Source: http://www.techhui.com*

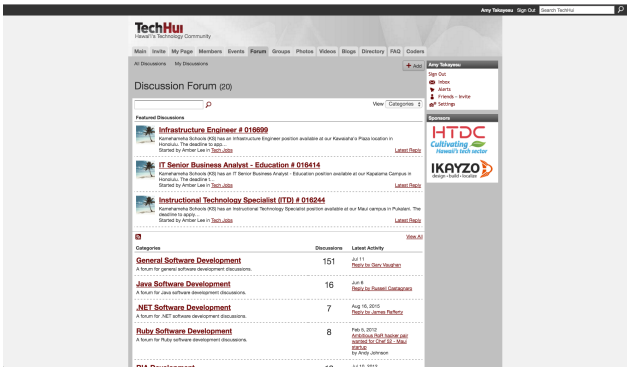


Figure 2.24: TechHui forum page. *Source: http://www.techhui.com*

2.2.2.4 Forum

The forum page includes a list of technology related categories, which can be clicked on to access a list of related forums (Figure 2.24). It also includes some featured forums at the top. Some of these categories include "General Software Development", "Java Software Development", "Funding Technology Startups", "Software Design Patterns", "Tech Jobs", "Tech Resumes", "Web Design", "Tech Humor" and more. Users can both start discussion forums and respond to other users' forums.

2.2.2.5 Groups

There are many different groups listed on this page, including some featured groups (Figure 2.25). Each group snippet has an image, a name, the amount of members in the group, the date of the group's latest activity, and a brief description of the group. Users can click on these snippets to learn more about the group and to join the group as well. Once in the group, users can participate in commenting on the group wall and creating and responding to group discussion forums.

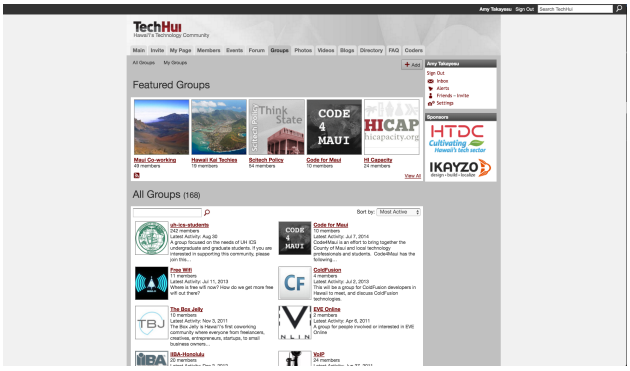


Figure 2.25: TechHui groups page. *Source: http://www.techhui.com*

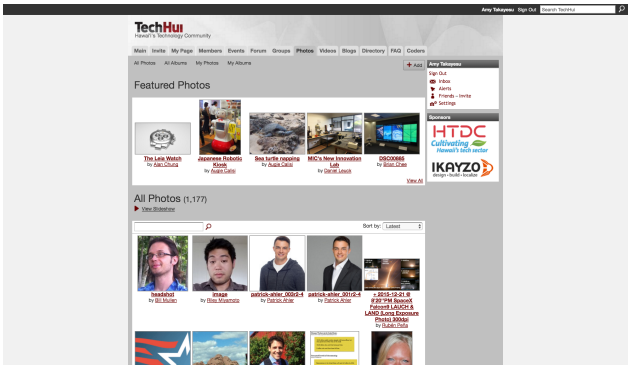


Figure 2.26: TechHui photos page. *Source: http://www.techhui.com*

2.2.2.6 Photos

On the Photos page, users can easily view all public photos uploaded by users (including profile pictures) (Figure 2.26). Featured photos are included as well. Users can view these photos and comment on them as well.

2.2.2.7 Videos

On the Videos page, users can easily view all public videos uploaded by users (Figure 2.27). Featured videos are included as well. Users can view these videos and comment on them as well.

2.2.2.8 Blogs

This page displays a feed of all users' blog posts (Figure 2.28). Posts are also organized by featured posts, latest posts, most popular posts, and monthly archives. Users can click on blog posts to read them in their entirety and can comment on them as well.

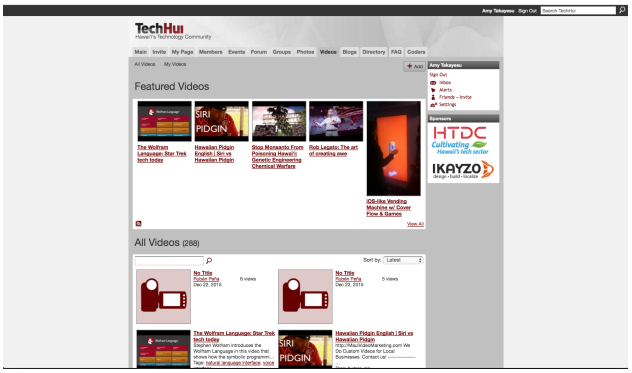


Figure 2.27: TechHui videos page. *Source: http://www.techhui.com*

Figure 2.28: TechHui blogs page. *Source: http://www.techhui.com*

2.2.2.9 Directory

This page includes a listing of technology related jobs in Hawaii, organized into 21 subcategories (Figure 2.29). Users can click on these listings to view more details about the jobs, and also to access external websites.

2.2.2.10 Coders

This page lists web startups that are writing code in Hawaii (Figure 2.30). The list contains just the names of the startups, which can be clicked on to learn more at the startup website.

2.2.2.11 TechHui and Academic/Professional/Social Engagement

TechHui caters to a community much smaller than LinkedIn. However, it remains too broad to cater to the specific needs of undergraduate students. TechHui aims to satisfy the needs of a variety of people, with only a small portion of them being current undergraduate students. It is unreasonable to expect TechHui to add features specifically for one group of members. However, if it were reasonable, TechHui ideally could suggest events and people to students based off their goals

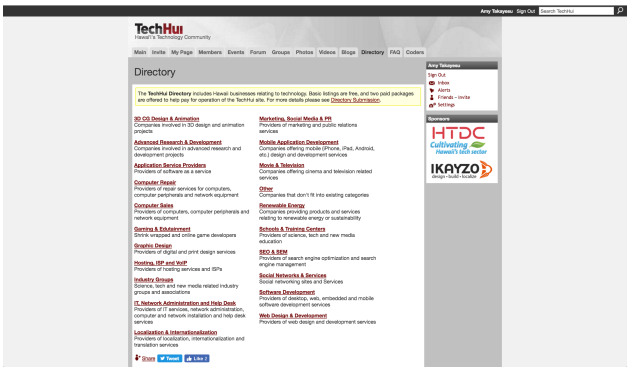


Figure 2.29: TechHui directory page. *Source: http://www.techhui.com*

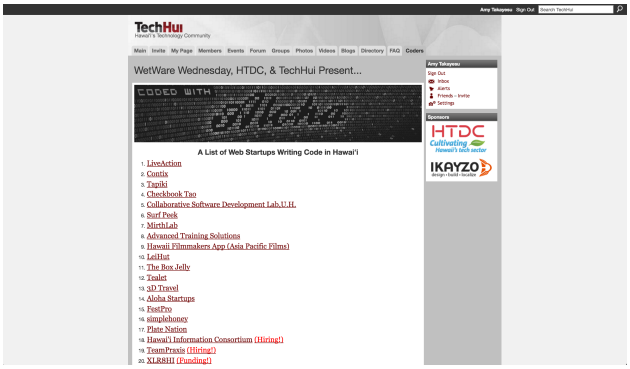


Figure 2.30: TechHui coders page. *Source: http://www.techhui.com*

and interests. It could find ways to encourage students to engage with these events and people, and cultivate strong and healthy relationships between students and the rest of the community. It could provide ways for members to easily know what projects others are working on, and allow members to join projects that they are interested in. In this way, it would be more than just a discussion site, but a strong social network as well.

2.2.3 Rate My Professors

Rate My Professors allows users to communicate and share content with each other by posting reviews of colleges and professors [11] (Figure 2.31). Although users can create accounts, the reviews are listed as anonymous. Other users can provide feedback on reviews with either a thumbs up (user found this to be useful) or thumbs down (user did not find this to be useful). The site also contains site-generated blog posts and videos, but users cannot directly interact with these.

2.2.3.1 Rate My Professor and Academic/Professional/Social Engagement

Rate My Professor aims to be very disconnected from universities by allowing users to be anonymous and share openly without any direct association to the institution. While this allows users to

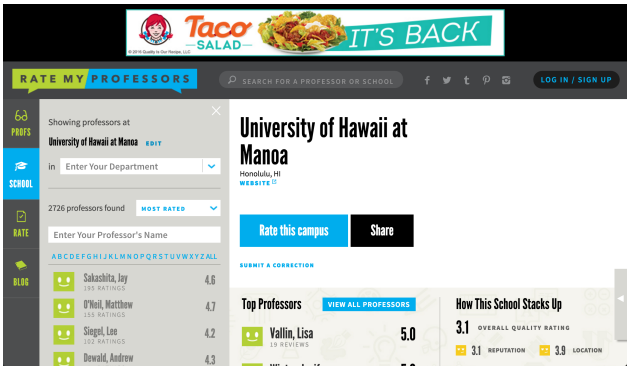


Figure 2.31: Example Rate My Professor page for UH Manoa. *Source: http://www.ratemyprofessor.com*

post without fear of repercussions, it may encourage negative relationships between students and professors. It distances the two groups of people, and instead of providing constructive criticism to the professor, it simply encourages the perpetuation of the opinions of past students. In this way, it does not encourage forward movement. Rate My Professor could improve by becoming integrated with the university so that reviews are no longer anonymous, and students can take full responsibility of their opinions. Additionally, professors will be able to view informative data about their teaching effectiveness, which may allow them to improve over time. In this way, the goal should be to improve all members of the community, rather than to create more distance between them.

2.2.4 Other Popular Social Networks and Academic/Professional/Social Engagement

Social networks have become extremely popular and there are too many of them to describe in detail here. The top fifteen most popular social networks as of September 2016 [15] are Facebook, Instagram, YouTube, Twitter, LinkedIn, Pinterest, Google+, Tumblr, Reddit, VK, Flickr, Vine, Meetup, Ask.fm, and ClassMates. While most of these are not academically focused, they could potentially host an academic environment. Additionally, while RadGrad could be integrated directly into one of these existing social networks (e.g. become a Facebook application), creating a standalone application does not exclude members who do not have a Facebook or are not active on Facebook, it does not depend on the continuing popularity of Facebook, and I believe it may develop a stronger sense of brand.

2.3 Gamification

To get an idea of the game mechanics that attracted ICS students, I conducted a brief informal survey of some ICS students (both undergraduate and graduate students) regarding their current favorite video game. I was able to solicit sixteen responses shown in the table below. In the following section I will discuss four different video games, with each one from a different genre: League of Legends (multiplayer online battle arena), Hearthstone (collectible card), Overwatch (first person shooter), and Pokemon Go (augmented reality). Each one was listed as a current popular video game according to the surveyed ICS students. While RadGrad may use some game mechanics from these games, RadGrad is not considered a pure entertainment video game. Instead, RadGrad will include some gamification characteristics of a serious game, which will also be discussed in the following section.

Table 2.1: ICS Students' Favorite Games

Gender	Degree	Favorite Game	Game Genre
Male	Undergraduate	Seven Knights	RPG
Male	Undergraduate	Kerbal Space Program	Space Flight Simulation
Male	Undergraduate	League of Legends	MOBA
Female	Undergraduate	League of Legends	MOBA
Male	Undergraduate	Monster Hunter	RPG
Male	Undergraduate	NBA2k7	Sports
Male	Undergraduate	Hearthstone	Collectible Card
Male	Undergraduate	RimWorld	Construction Management
Male	Undergraduate	Geometry Dash	Arcade
Male	Undergraduate	Overwatch	FPS
Female	Undergraduate	Pokemon Go	Augmented Reality
Female	Graduate	Pokemon Go	Augmented Reality
Female	Undergraduate	Minecraft Sky Factory 2.5	Sandbox
Female	Graduate	Call of Duty	FPS
Female	Undergraduate	Assassin's Creed	Action/Adventure
Female	Graduate	Summoner's War	RPG

2.3.1 League Of Legends

League of Legends is a multiplayer online battle arena (MOBA) type of video game and also follows a freemium business model [7] (Figure 2.32). In this game, the player assumes the character of a summoner who controls a champion with unique abilities, and they battle with a team of other champions against another team of champions (either other live players or computer controlled). The main goal of the game is to destroy the opposing team's nexus, which is a structure at the middle of the team's base and is protected by defensive structures. At the start of each match, all

Figure 2.32: League of Legends gameplay. *Source: https://www.youtube.com/watch?v=6SdiN5jxgR4*

champions start off weak, but they can increase in strength throughout the game by accumulating items and experience. Each match typically lasts from 20-60 minutes. There are three different game modes: Summoner's Rift, Twisted Treeline, and Howling Abyss. Each game mode is similar in that a team of players must work together to accomplish a terminal objective and a victory condition. Each mode also includes smaller intermediate objectives that can help teams to get closer to victory. Gold gathered during the match and items purchased with that gold only last for that match, and do not carry over to future matches. Each match begins with each player being more or less equal in terms of advantage, regardless of how much time or effort the player has put in beforehand. However, the game does include other incentives to continue to win games and see personal development. Players get player experiences from playing matches on a single account. As their experience increases, they can ascend from level 1 to 30. Higher level players are given access to different maps, game modes, and additional abilities and features which give players a small boost in battle.

Figure 2.33: Hearthstone gameplay. *Source: https://www.youtube.com/watch?v=WvjvH4fimns*

2.3.2 Hearthstone

Hearthstone is a free to play online collectible card video game (Figure 2.33). It is turn based between two opponents, who use constructed decks of thirty cards, and a selected hero with a unique power [6]. Players can attack the opponent using mana points. The main goal is to reduce the opponent's health to zero. If the player wins, they can earn in-game gold, new cards, or other in-game prizes. Players can use the gold or microtransactions to purchase new cards to improve their decks. There are several different game modes: casual and ranked matches, daily quests, and weekly challenges. Unlike many other popular collectible card games, Hearthstone does not allow players to trade cards. Instead, players can disenchant their unwanted cards into arcane dust, which can then be used to craft new cards of the player's choice.

Figure 2.34: Overwatch gameplay. *Source: https://gamesharkreviews.com/*

2.3.3 Overwatch

Overwatch is a team based multiplayer first person shooter (FPS) (Figure 2.34). Each team has six players, and each player may select one predefined hero character [9]. Each hero character has unique movements, attributes, and skills. As the team is being set up, the game will provide advice if the team is unbalanced. However, once the game starts, players can still switch characters after a death or after returning to their home base. The team of heroes work together to secure and defend certain control points and/or escort a payload across the map in a certain amount of point. As players continue to play matches, they can gain rewards that do not affect gameplay, such as character skins and poses. At the end of each match, a server-determined Play of the Game (PotG) is replayed for all players. This play is based off certain factors such as a high scoring moves or effective use of a skill. Up to four individual achievements per team are highlighted, and afterwards players can vote for one to promote. The player who wins the most votes get a reward of experience points. As players gain experience points, they can earn a loot box, which provides certain in-game prizes and in-game currency. If players do not have enough experience points for a loot box, they also have the option to obtain one through a microtransaction. The game supports several different

gameplays such as tutorial and practice modes, casual matchmaking, weekly brawls, custom games, and competitive play. Casual matchmaking allows players to play alone or with friends, and are randomly matched against others with similar skill levels. The weekly brawl gameplay was inspired by Hearthstone, and features matches with unique rules, which change weekly. Custom games allow users to have private or public games and can edit different options for that specific match. Competitive mode allows players within a certain region and on a certain platform, to become ranked. This mode is run in 2.5 month seasons. Only players at level 25 or above can participate. Participants also much first play ten preliminary matches which will assign the player a skill rating from 1 to 5000, which is used to create ideal matches. There are seven skill ranking tiers: Bronze, Silver, Gold, Platinum, Diamond, Master, and Grandmaster. Players can be demoted to a lower tier or promoted to a higher tier based on their performance. Each competitive win awards a player with in-game currency. Players will also get an additional award based on their final ranking at the end of the season.

Figure 2.35: Pokemon Go gameplay. *Source: http://www.ibtimes.co.uk/what-pokemon-go-watch-how-play-nintendos-hit-mobile-game-we-try-catch-em-all-london-1570062*

2.3.4 Pokemon Go

Pokemon Go is a free-to-play, location-based augmented reality game for mobile devices [10] (Figure 2.35). Players use their device's GPS to locate, capture, battle, and train virtual monsters known as Pokemon. The Pokemon appear through the device's camera as though they were in the same real-world location as the player.

Players can customize an avatar, which is displayed throughout the game on a map using the player's current geographical position. The map will show game related locations such as PokeStops and Pokemon gyms. Players can get items from PokeStops such as eggs, Poke Balls, berries, and potions. Users can also equip PokeStops with lures, which can attract wild Pokemon. Pokemon gyms are where players can battle and take over the gym in a "king of the hill" style. These PokeStops and Pokemon gyms are usually located at real-world places of interest.

Different types of Pokemon are located in different areas of the world. For example, water-type Pokemon are typically found near bodies of water. Players can capture wild Pokemon by "throwing a Poke Ball" (making a swiping motion on the device) at the Pokemon. When the Pokemon is caught, the player additionally receives stardust and/or candies, depending on the type of Pokemon. These items can be used to raise the Pokemon's combat power (CP).

The ultimate goal of the game is to capture and evolve all possible Pokemon. However, throughout the game, there are also many other ways for players to gain experience points. Players can increase in level, and at level 5, they can join one of three teams: Team Valor, Team Mystic, or Team Instinct. These teams play a role when battling at the Pokemon gyms.

2.3.5 Serious Games

Gamification is defined as "the use of game design elements in non-game contexts [20]." Gamification focuses on game elements and design, rather than a complete game. Games that have a primary purpose other than pure entertainment are called serious games [2]. Serious games attempt to use game mechanics to engage and entertain players in a way that accomplishes the game's main purpose. Some common categories of serious games are defense, education, scientific exploration, health care, emergency management, city planning, engineering, and politics [**?**]. Below is a list of commonly used game mechanics from Gamification.org [1].

1. Levels *(reward system that becomes unlocked as players progress)*
2. Points *(a running numerical value given for any action(s))*
3. Achievements *(a badge given for completing tasks)*
4. Progression *(success is displayed as players complete tasks, such as with a progress bar)*
5. Appointment Dynamics *(predetermined times or places users must return to for a positive reward)*
6. Countdown *(players are given a time limit to complete a task)*
7. Quests *(a journey with obstacles that a player must overcome)*
8. Reward Schedules *(a fixed or variable time frame and delivery of rewards)*
9. Loss Aversion *(actions players must take to avoid losing)*
10. Lottery *(a winner may be determined by chance)*
11. Status *(the level or rank of a player)*
12. Community Collaboration *(a community works together to overcome a challenge)*

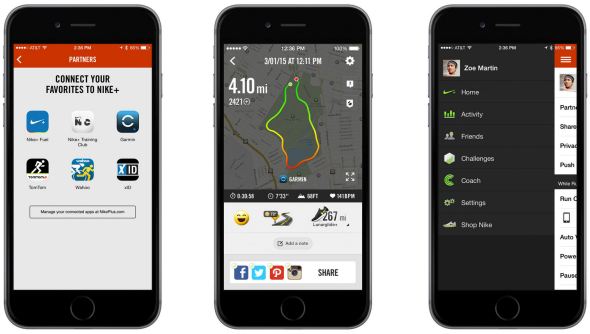


Figure 2.36: Nike+ mobile app. *Source: http://news.nike.com/news/nike-running-expands-global-partnerships-to-motivate-more-runners-around-the-world*

A popular example of gamification and serious games is Nike+, which is a system that employs several game elements in order to provide a game playing experience to participants [16] (Figure 2.36). Nike+ encourages players to use Nike+ equipment (e.g. Nike+ FuelBand, Nike+ shoes, or Nike+ Run Club mobile application) to keep track of and upload their exercise data (points and levels) to online leaderboards, which can be used to compete with themselves and their friends. Nike+ also keeps players motivated by playing motivational messages from their friends and elite Nike athletes (community collaboration). While Nike+ encourages players to have fun, the main goal of the game is to help players become motivated enough to improve their health through exercise. Players use these game mechanics to achieve this more serious goal. Nike+ uses

Another example of gamification and serious games are gamified online courses at Khan Academy. Khan Academy teaches traditional subject matter through educational videos, and keeps users engaged through various game mechanics [17]. For example, subjects are organized with skill growth trees, which show users how different skills build on top of each other. As users go through the course, they get the feeling of "leveling up" and progressive knowledge building (progression). Mundane tests are also replaced with challenges (quests), which reward players for quick problem solving and getting answer "streaks." Players will have to answer ten questions correctly to pass the challenge. If they get stuck, they have several options–they could sacrifice their streak and ask for the solution, or they could review the material with no penalty. Additionally, Khan Academy keeps track of your progress using several different statistics–how many points or badges you have earned, how many minutes you've spent watching instructional videos, and how many minutes you've spent solving problems–and displays them with attractive infographics, that help users keep track of their progress.

2.3.6 Gamification and Academic/Professional/Social Engagement

Clearly there are certain aspects about popular video games that make them so enjoyable, addictive, and satisfying to so many people. Even the two students who initially declared that they "don't

Figure 2.37: Khan Academy keeps track of user statistics such as badges earned and minutes spend accessing the content. *Source: https://phys.org/news/2015-03-gamification-harnesses-power-games.html*

have time for games" or simply just don't play games eventually admitted that they did play Pokemon Go at one point. Studies have shown that this human attraction to games may be caused by regular releases of dopamine that get released while playing games [26].

The four popular video games and the two serious games discussed above have a few things in common: multiplayer, small and large rewards throughout the game, additional rewards given simply for putting in time, and the persistence of the player. Many of the games also include a team aspect which encourages players to work together to advance individually.

The multiplayer aspect of the games allows players to interact with and become competitive with other players. Rather than only beating one's own score, these games allow players to compare themselves with others and advance relative to other players, rather than simply advancing relative to their past selves. Multiplayer games encourage healthy competition, which can cause players to become more motivated.

The format of the rewards in these games suggest that small rewards as well as large rewards throughout the game, given for a diverse amount of tasks, continues to motivate players and make sure that they do not get discouraged. These awards are often just ranks or an in-game item that

can help the player to improve.

Another similarity in the games discussed above is the rewards given to players simply for putting in time to play (e.g. EXP points, or amount of minutes put in to watching videos for Khan Academy). While players who constantly lose may feel unmotivated and lose interest, if they are given some kind of point just for trying, it makes their attempts seem less fruitless. Players should be encouraged to play, and even more so if they encounter problems.

The persistence of the player in these video games allows players to continuously improve over time, rather than starting anew with each game. When players can see their improvements, they can be reminded of their past progress, and be encouraged to continue the progress, regardless of how grueling it may be. Once users see that they have done it before, they will know that they can do it again.

Finally, the team aspect of many of these games suggest that many players enjoy working together with other players to achieve both team and individual goals. This shows that when people work together, they can become stronger both as a team and individually (e.g. working together to complete a mission in Overwatch, or sending motivational messages to friends in Nike+).

CHAPTER 3
SURVEY

In order to measure if RadGrad has any academic, professional, or social effects on the students, I designed a baseline survey. Unlike the open-ended TechHui data, this survey will ask specific and measurable questions about students' academic, professional, and social experiences in the ICS department, and the results will be used in the future to compare against a similar post-survey. This survey was given to 100 current undergraduate ICS students between January and April 2017. This represents roughly 22% of the current ICS student population. It was deployed electronically via Google Forms and students completed the survey on an iPad either immediately before or immediately after an advising session with an ICS advisor. These students are taking advantage of the current department resources available to them, which suggests that they may be the same types of students who would participate in RadGrad. Ultimately, the main goal of the baseline survey is to establish a more specific idea of the state of the ICS undergraduate experience before the integration of RadGrad.

There are three different versions of the survey: prospective students, current students, and graduating students. The prospective students version was given to students who indicated that they were either currently in their first semester of ICS or were planning on taking an ICS course the following semester. The current students version was given to students who indicated that they had completed at least one ICS course and were not planning on graduating within the next year. The graduating students version was given to students who indicated that they were planning on graduating within the next year. Therefore, each baseline survey contains a subset of the following questions. Each question will indicate which group of students were given that question. The full assessment can be found in Appendix A.

3.1 Demographics

1. *What is your gender?* All participants were given this question (100 total students). In Fall 2016, there was a total of 445 ICS students. Of the 445, 366 identified as male and 79 identified as female (Figure 3.1). This means that there was roughly 18% females and 82% males. The distribution of my survey has close proportions: 15% female, 84% male, and 1% other.

   Goals: This question provides information about the student gender distribution in the ICS department. Since the ICS program currently has significantly more male students than female students, what are are the differences between the experiences of the two genders? Could this give any insight into why there are so little female students? Is this something RadGrad could address? The post survey should investigate if RadGrad has caused any

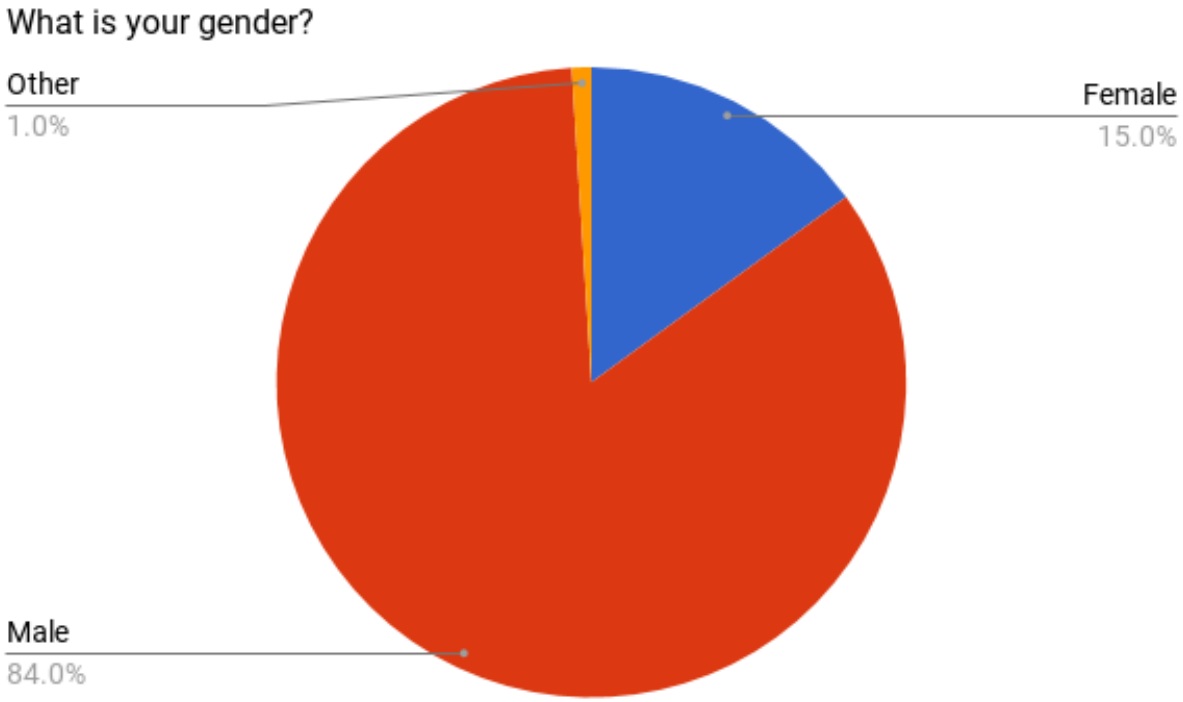


Figure 3.1: Gender distribution *N=100*

differences in the gender ratio or the disparity between the experiences of the two genders? Ideally, after using RadGrad, both genders should have equally positive experiences in the ICS program.

2. *What is your current status in the ICS degree program?* All participants were given this question (100 total students). The two most represented groups in the survey are those that had completed 1-2 ICS courses (current students) (35%) and those that had completed 5 or more courses and expected to graduate within 3 or less semesters (graduating students) (29%) (Figure 3.2). Fifteen percent of students surveyed were either in or about to start their first semester of ICS (prospective students). Together, students who completed 3-4 courses, and students who completed 5 or more courses and expected to graduate within 3 or more semesters (current students) comprised of 21% of the total population surveyed. The fact that most of the students surveyed were either in the beginning of the program or about to graduate can be attributed to the fact that these are the students that physically go in for advising the most.

   Goals: This question provides information that can be used with other questions, to see how student experiences evolve as they progress through the ICS degree program. Are there any patterns? Does RadGrad have any effect on this? The post survey should investigate if

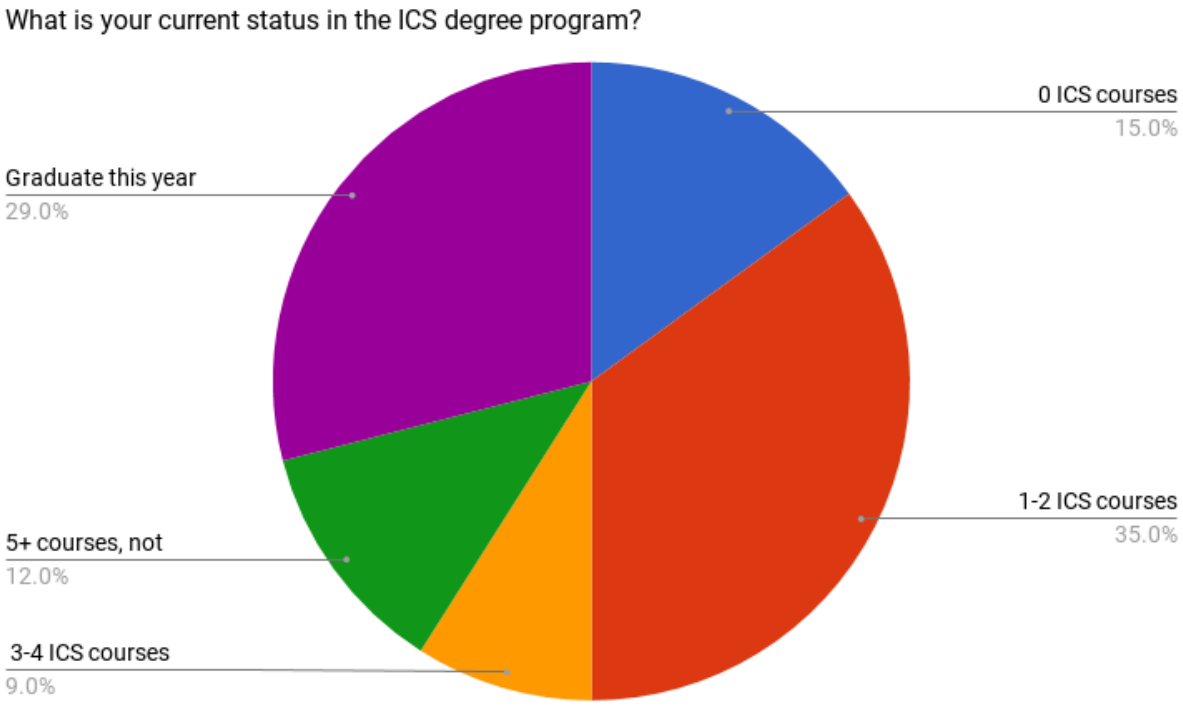


Figure 3.2: ICS program status distribution *N=100*

RadGrad has certain affects on students in particular stages of the program. Ideally, after using RadGrad, students from all levels should have equally positive experiences in the ICS program.

3.2 Prospective ICS Students

1. *How EXCITED are you about entering the ICS program? Rank from 1-5.* Only prospective students were given this question (15 total students). The results of the survey show that all of the students surveyed felt either neutral or excited about entering the ICS program (Figure 3.3). No students stated that they were not excited.

   Goals: This question will provide information regarding how students view the ICS department, based solely on outside information and their first semester experiences. The post test should investigate the outside factors that affect incoming students' feelings towards the department, and to understand if there are any differences in feelings between genders. Ideally, after using RadGrad, prospective students will feel more excited due to the appearance of a strong, supportive, and diverse community, satisfied alumni, and an appealing program overall.

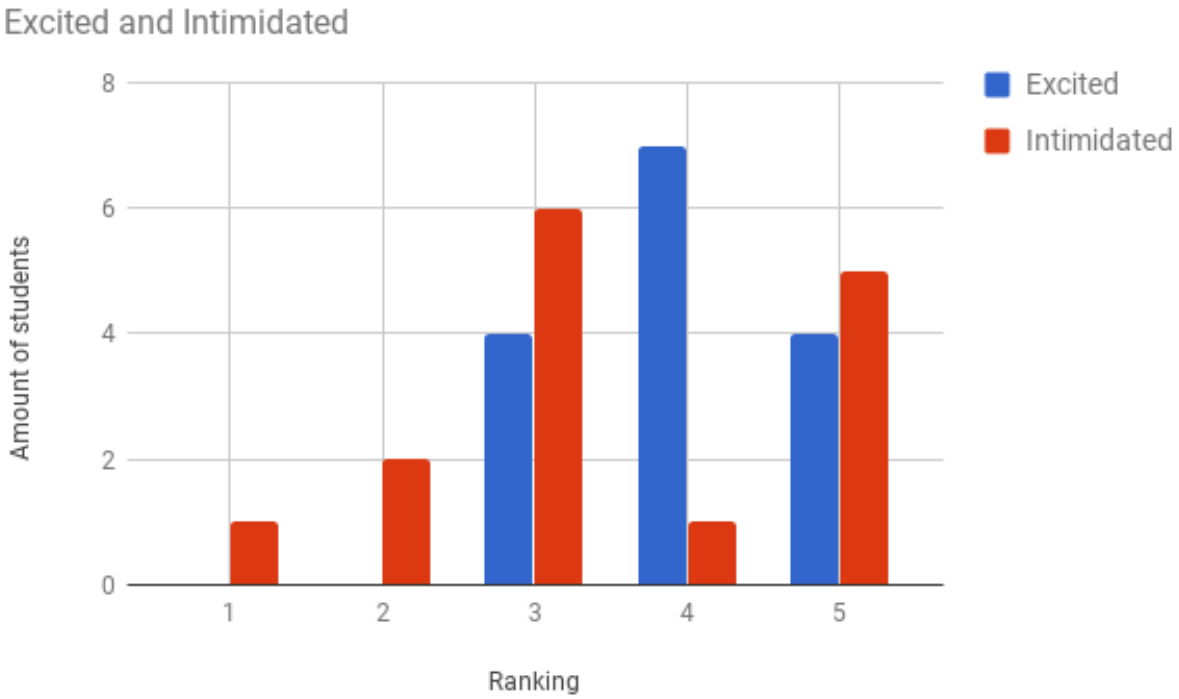


Figure 3.3: Results for prospective ICS Students survey *N=15*

2. *How INTIMIDATED do you feel about entering the ICS program? Rank from 1-5.* Only prospective students were given this question (15 total students). The results of the survey show that a majority of the students surveyed (12 out of 15) felt either neutral or intimidated about entering the ICS program (Figure 3.3). None of the females surveyed felt less than neutral in regards to intimidation, while three males did feel less than neutral.

   Goals: This question will provide information regarding how students view the ICS department, based solely on outside information and their first semester experiences. The post test should investigate the outside factors that affect incoming students' feelings towards the department, and to understand if there are any differences in feelings between genders. Ideally, after using RadGrad, prospective students will feel less intimidated due to the appearance of a strong, supportive, and diverse community, satisfied alumni, and an appealing program overall.

3.3 Current ICS Students

1. *Which of the following extracurricular activities, if any, pertain to you?* Only current and graduating students were given this question (85 total students). Survey results show that

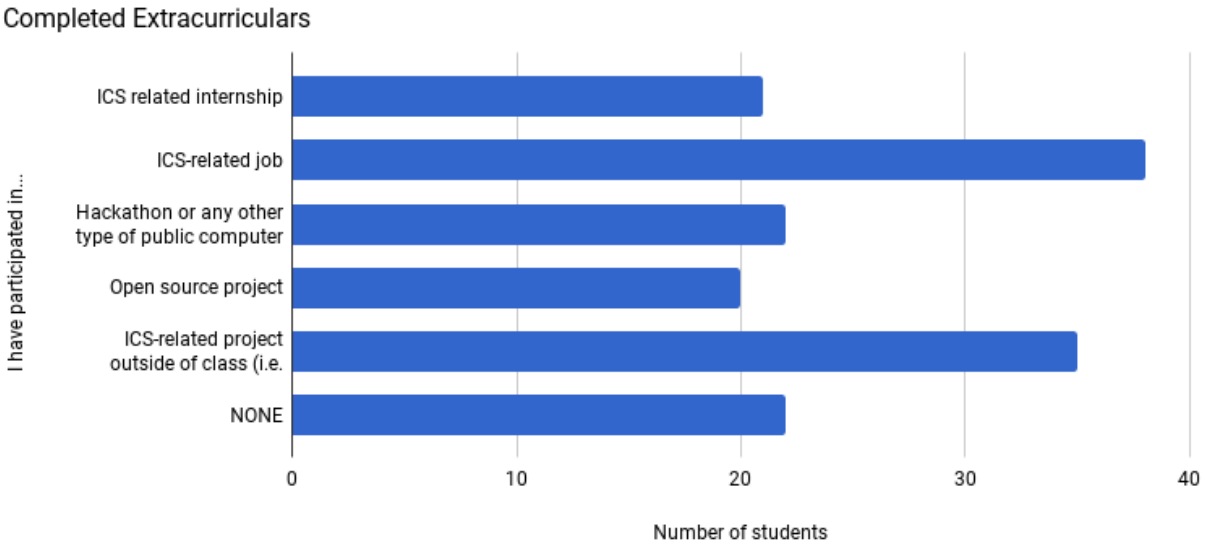


Figure 3.4: Results for extracurricular participation by event type *N=85*

out of all the extracurricular activities, the most common was having an ICS related job (38 students), with a close second being doing an ICS-related project outside of class (35 students)(Figure 3.4). Participating in an ICS-related internship, hackathon, or open source project each had about 20 students (21, 22, and 20, respectively). Another 22 students hadn't participated in any extracurricular activities.

Another way to view this data is by the amount of extracurricular participation. In Figure 3.5, the results show the amount of extracurricular activities that each student participated in. A quarter of students (25.9%) participated in zero extracurricular activities. About a third of students (32.9%) participated in just one extracurricular activity. Overall, the data suggests that the amount of extracurricular activities could be negatively correlated to the amount of students participating in them. To account for the fact that students in their first year of ICS are at a disadvantage when it comes to extracurricular participation (due to the lack of time and experience), Figure 3.6 looks at only those students who have completed at least 5 ICS courses. This graph shows that a majority of these students have participated in one extracurricular activity (40.6%). 21.9% of students have participated in two extracurricular activities, 15.6% of students have participated in 0 extracurricular activities, 15.6% of students have participated in five extracurricular activities, and 6.3% of students have participated in four extracurricular activities. While this data shows higher levels of participation with mid to graduating students, there are still a significant amount of students who are not participating in any extracurricular activities or participating in only one or two.

Goals: This question provides information about how much initiative students are currently

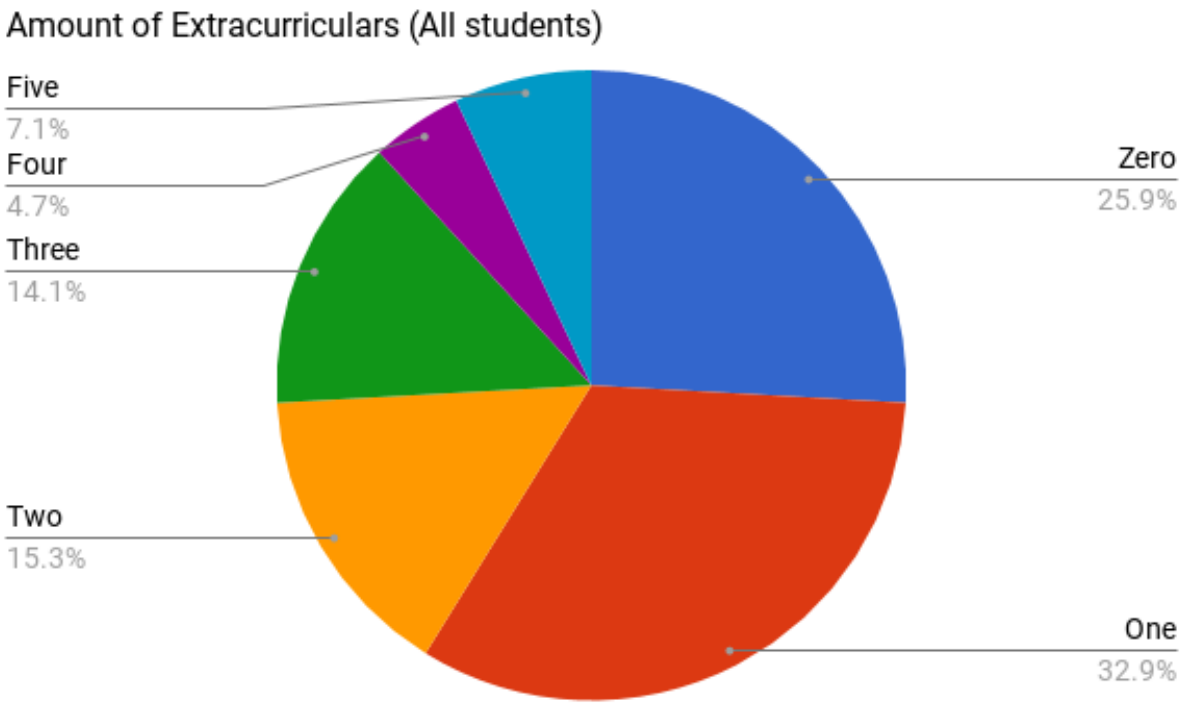


Figure 3.5: Results for extracurricular participation by amount of participation (all current and graduating students). *N=85*

taking to get additional ICS education and experience outside of the classroom. The post survey should investigate if RadGrad can increase the amount and diversity of student involvement in outside ICS-related opportunities due to providing students with stronger connections to the ICS community, and an easier accessibility to these opportunities. Ideally, after using RadGrad, at least 75% of students who have completed at least 5 ICS courses will have participated in 2 or more extracurricular activities, and close to 0% of these students will have participated in 0 extracurricular activities. Also, ideally after using RadGrad, students will participate in a wider variety of extracurricular activities.

2. *Do you feel that you get enough support from others in the ICS department?* Only current and graduating students were given this question (85 total students). Survey results show that a majority of students (45 students) feel adequately supported in the ICS department (Figure 3.7). However, significant amounts of students desire more support in various areas. 25 students desire more support from professors, 19 students desire more support from their peers, 18 students desire more support from TAs, and 5 students desire more support from advisors. Additionally, 9 students stated that they often feel completely alone in the ICS department and only depend on themselves.

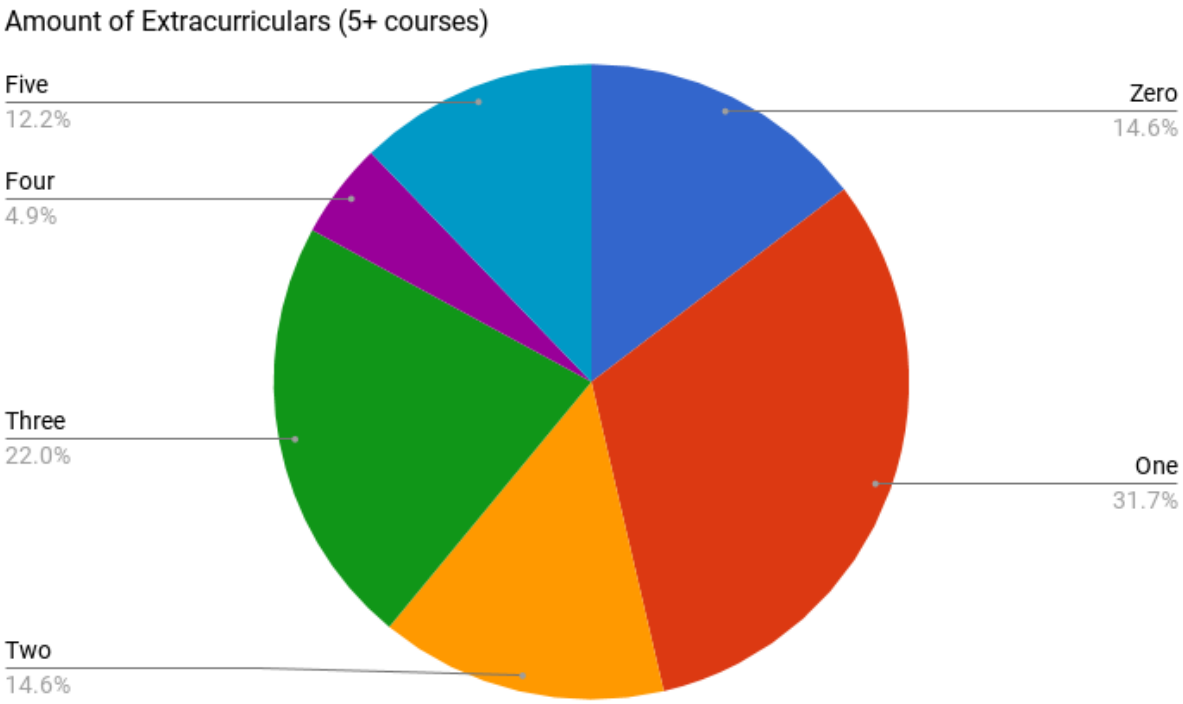


Figure 3.6: Results for extracurricular participation by amount of participation (only students who have completed 5+ ICS courses) *N=41*

Another way to view this data is by the extent of the support requested. In Figure 3.8, the results show the amount of support requested by each student. This graph shows that almost half of the students did not request any further support (49.4%), while the other half requested further support from at least one group. 21.5% of students requested further support from one group, 13.9% requested further support from two groups, 13.9% requested further support from four or more groups, and 1.3% requested further support from three groups.

Goals: This question provides information about how satisfied students are with the social aspects of the ICS department. Are students lacking support in certain areas? If so, how can RadGrad help to address these areas? The post survey should investigate exactly how students would like support to be given, and if the social aspects of RadGrad have changed the quality of socialization in the ICS department. Ideally after using RadGrad, at least 50% of students will feel adequately supported, and close to 0% of students will feel completely alone within the department.

3. *As a student, do you feel like you have a voice to make changes within the department?* Only current and graduating students were given this question (85 total students). Results show

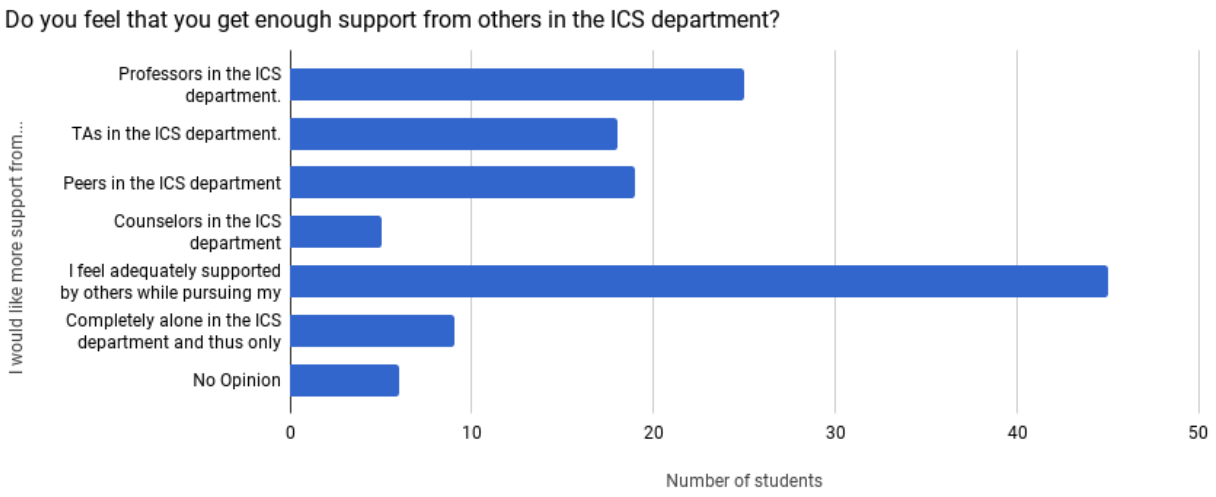


Figure 3.7: Results for support by types of support *N=85*

that only a quarter of the students surveyed (24.7%) definitely felt like they have a voice to make changes within the department (Figure 3.9). Another quarter (24.7%) feel like they definitely do not have a voice to make changes, while about half (50.6%) only somewhat feel like they have a voice to make changes. While the current version of RadGrad does not directly address this issue, it may be addressed in future expansions on RadGrad, such as with the petition feature.

Goals: This question provides information about how much power students feel like they have within the ICS department. What can RadGrad do to help more students feel like they have a voice within the department? The post survey should investigate whether RadGrad has an affect on whether students feel like they have a voice or not. Ideally, after using RadGrad, more than 50% of the students will feel like they definitely have a voice to make changes within the department.

4. *What makes you proud to be a part of the ICS department?* Only current and graduating students were given this question (85 total students). Survey results show that a majority of students had at least one reason to feel proud to be a part of the ICS department (Figure 3.10). The most popular reasons (in order of decreasing popularity) were working on ICS related projects, associating with the people in ICS, surviving the rigorousness of ICS, and the prospect of finding a high paying job after graduation. The least popular reason, with only 11 students, was receiving ICS awards. Another 5 students chose "other" without giving a specific reason.

   Goals: This question provides information about how current students view the department. A successful department should have a positive reputation among students, which can be

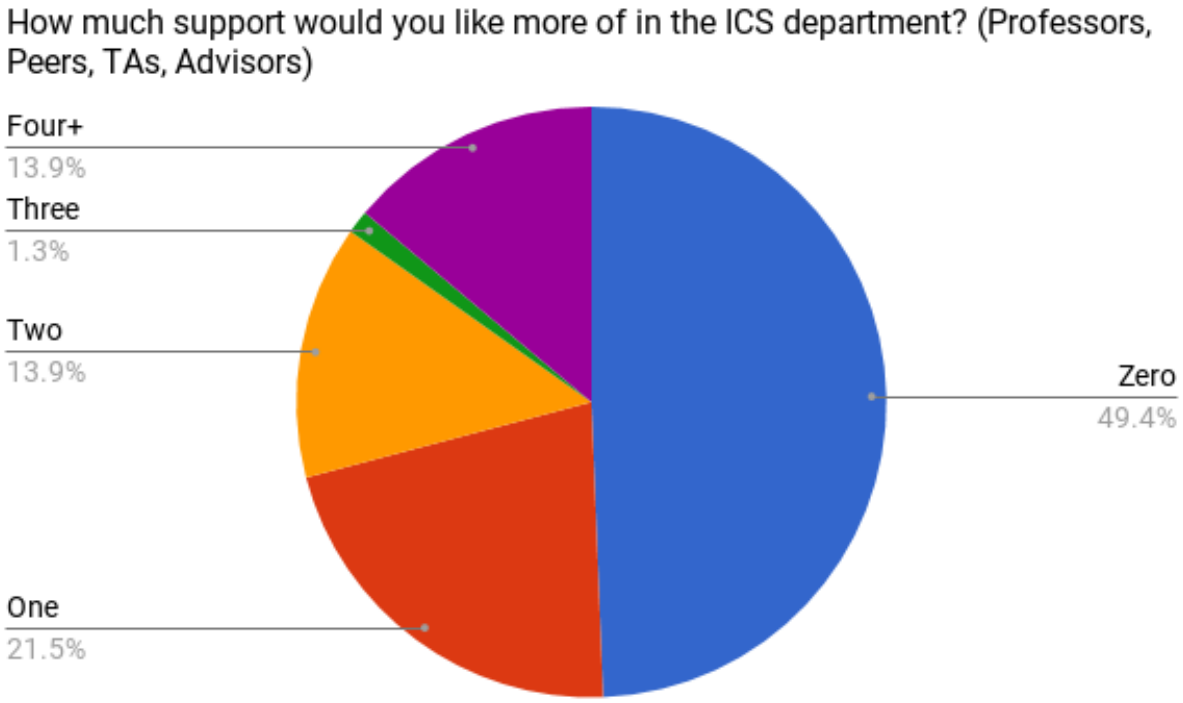


Figure 3.8: Results for support by amount of support desired *N=85*

manifested with a sense of pride. The post survey should investigate if RadGrad can cause positive changes in the ICS department's reputation, leading to a greater sense of pride among students, which may play a role in students' success. Ideally, after using RadGrad, a majority of students will express their pride for the ICS department in different ways.

3.4 Current ICS Students: Influences

1. *To what extent have ICS alumni influenced your development in the ICS program?* Only current and graduating students were given this question (85 total students). Survey results show that a majority of students (58 our of 84 students) have not been influenced by alumni in any professional or academic way, while 20 out of 84 students have been influenced by an alumni to improve professional development, and 14 out of 84 students have been influenced by an alumni to pursue a major in ICS (Figure 3.11). This suggests that many current ICS students are not interacting with ICS alumni.

   Goals: This question provides information about the extent of academic and professional interaction between ICS students and alumni. The post survey should investigate if RadGrad adequately provides a way for more students to easily interact with and gain influence from

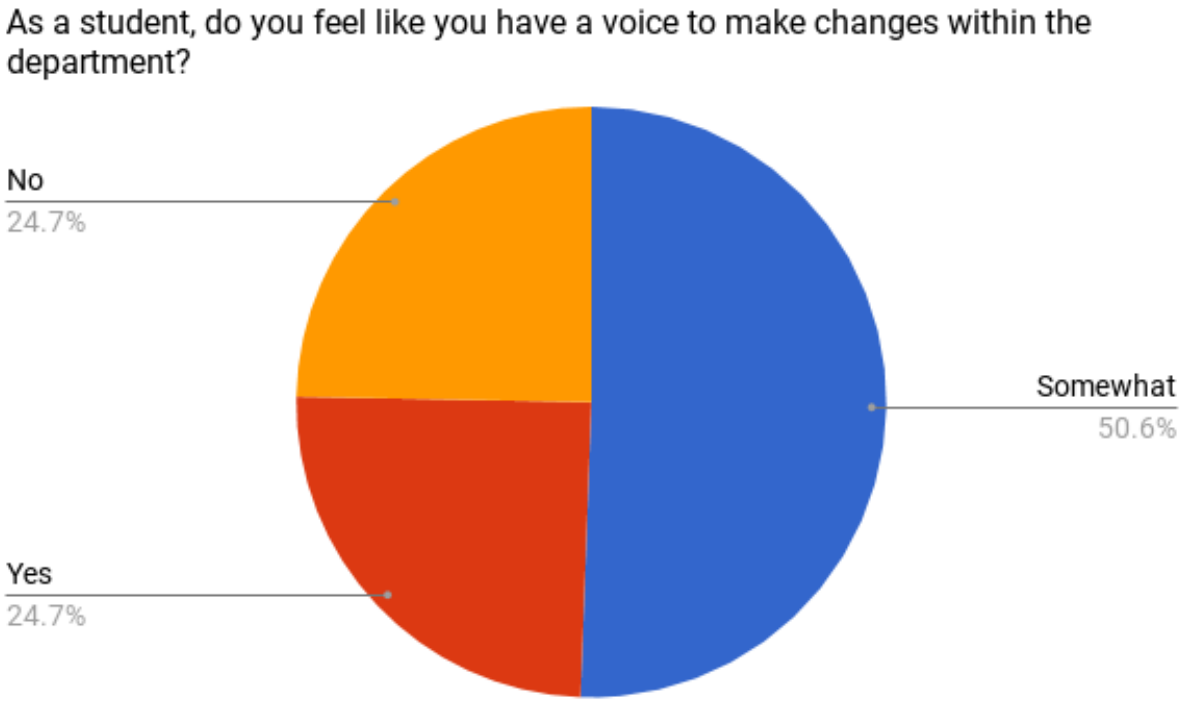


Figure 3.9: Results for feelings about having a voice to make changes *N=85*

alumni. Ideally, after using RadGrad, at least 75% of students will feel like they have been influenced by an alumni in either an academic or professional way.

2. *To what extent have ICS peers influenced your development in the ICS program?* Only current and graduating students were given this question (85 total students). Survey results show that a little less than half of students (37 out of 85 students) have not been influenced by their peers in any professional or academic way, while 33 out of 85 students have been influenced by a peer to pursue a major in ICS, and 29 out of 85 students have been influenced by a peer to improve professional development (Figure 3.12). This suggests that there is room for improvement when it comes to encouraging academic and professional collaboration among peers.

   Goals: This question provides information about the extent of academic and professional interaction between ICS students and their peers. The post survey should investigate if RadGrad adequately provides a way for more students to easily interact with and gain influence from their peers. Ideally, after using RadGrad, at least 75% of students will feel like they have been influenced by a peer in either an academic or professional way.

3. *To what extent have you influenced your ICS peers development in the ICS program?* Only

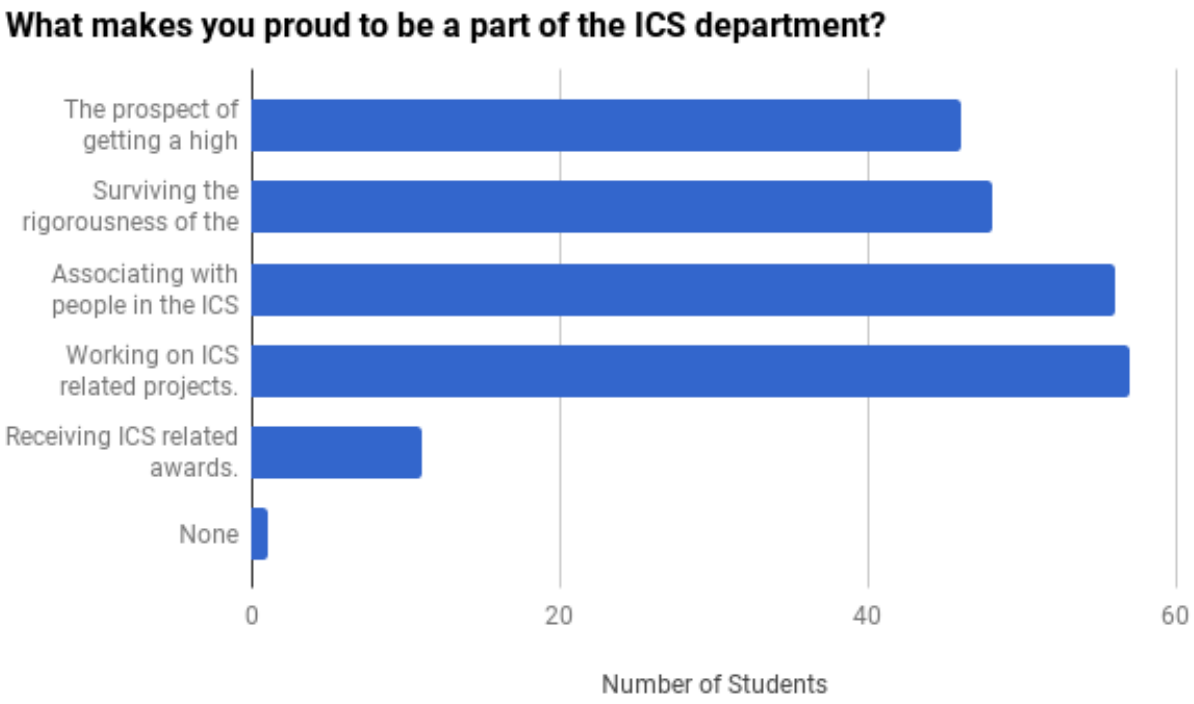


Figure 3.10: Results for reasons for being proud to be a part of the ICS department *N=85*

current and graduating students were given this question (85 total students). Survey results show that over half of students (49 out of 85 students) feel like they have not influenced their peers in any professional or academic way, while 27 out of 85 students feel like they have influenced a peer to improve professional development, and 25 out of 85 students feel like they have influenced a peer to pursue a major in ICS (Figure 3.13). This suggests that there is room for improvement when it comes to encouraging academic and professional collaboration among peers. *Goals:* This question provides information about how students perceive their academic and professional interactions with their peers. The post survey should investigate if RadGrad adequately provides a way for more students to easily interact with and influence their peers. Ideally, after using RadGrad, at least 75% of students will feel like they have influenced a peer in either an academic or professional way.

3.5 Graduating ICS Students

1. *Now that you are nearing the end of your ICS degree program experience, how well prepared do you feel to find a job after graduation?* Only graduating students were given this question (29 total students). Survey results show that only 20.7% of graduating students feel well

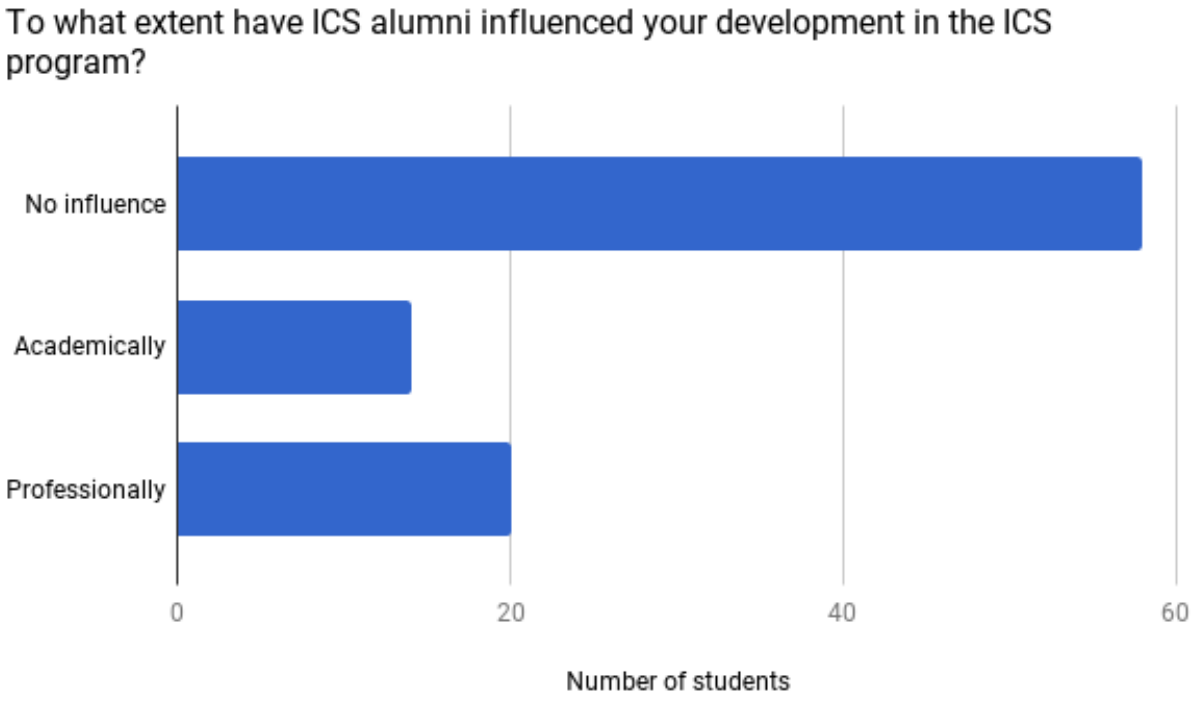


Figure 3.11: Results for alumni influence *N=85*

prepared to find a job after graduation (Figure 3.14). 65.5% of graduating students feel adequately prepared, and 13.8% of students feel unprepared. This suggests that there is room for improvement when it comes to preparing students for the workforce in a way that makes them feel more confident and prepared.

Goals: This question provides information about the amounts of students that feel well prepared. What can RadGrad do to help more students feel well prepared to find a job after graduation? The post survey should test to see if RadGrad's encouragement of collaboration and a well-balanced education (with both courses and opportunities) causes more students to feel well prepared to find a job after graduation. Ideally, after using RadGrad, more than half of graduating students will feel well prepared for the future.

2. *If you answered above that you feel unprepared to find a job after graduation, please explain why.* Only graduating students were given this question (29 total students). Figure 3.15 lists reasons that students have for not feeling well prepared to find a job after graduation. These reasons suggest that RadGrad could have a positive impact by encouraging students to pursue ICS related experiences outside of the classroom.

   Goals: This question provides information about problems or regrets that students realize

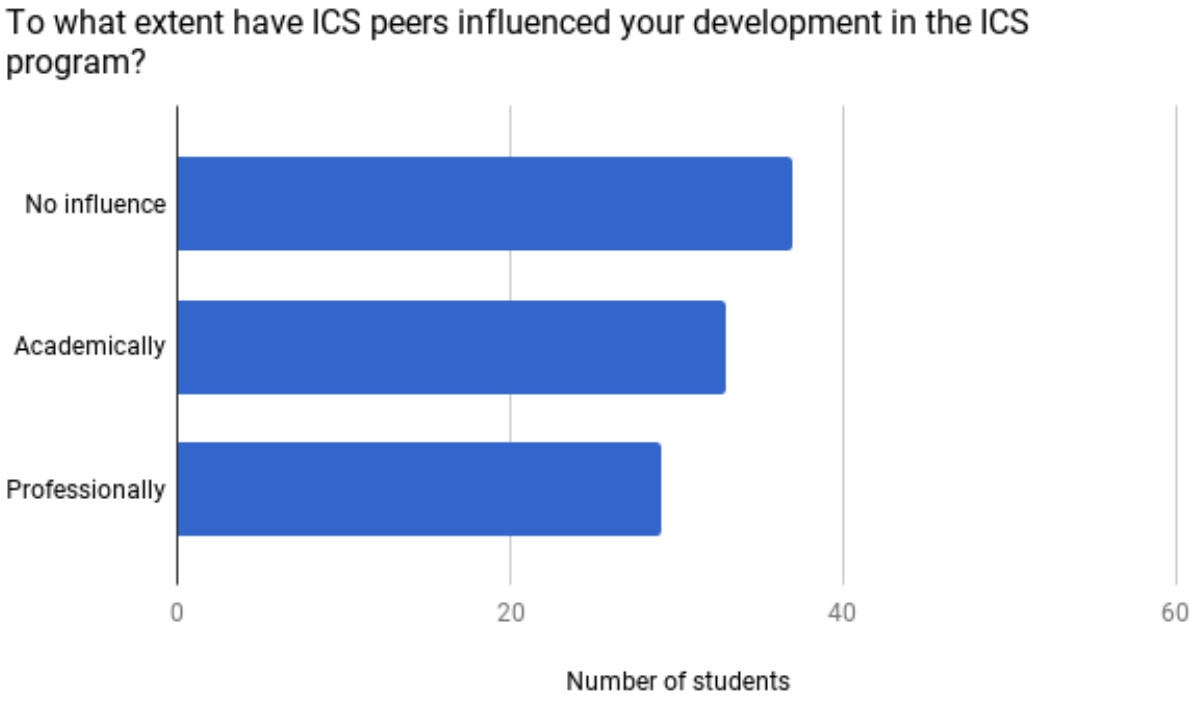


Figure 3.12: Results for peer influence *N=85*

right before they graduate. Are there any common reasons for students not feeling prepared? If so, is there anything RadGrad can do to address these problems? The post survey should reveal whether there has been any changes in the reasons given for students not feeling well prepared. Ideally, after using RadGrad, the reasons given for not feeling well prepared will no longer focus on the lack of outside experience.

Ideally, after RadGrad, future studies will show that there is less disparity between student expectations and reality, greater student satisfaction with the department, more student engagement, and more positive student feelings overall.

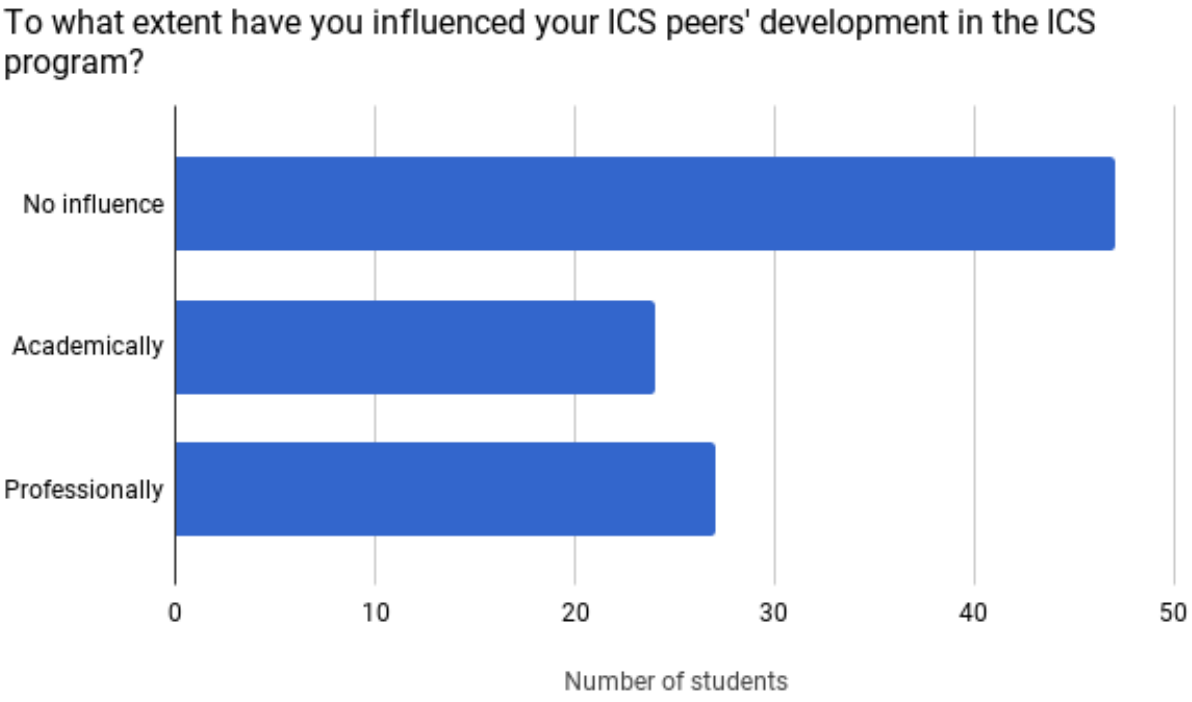


Figure 3.13: Results for student perceptions of their own influence *N=85*

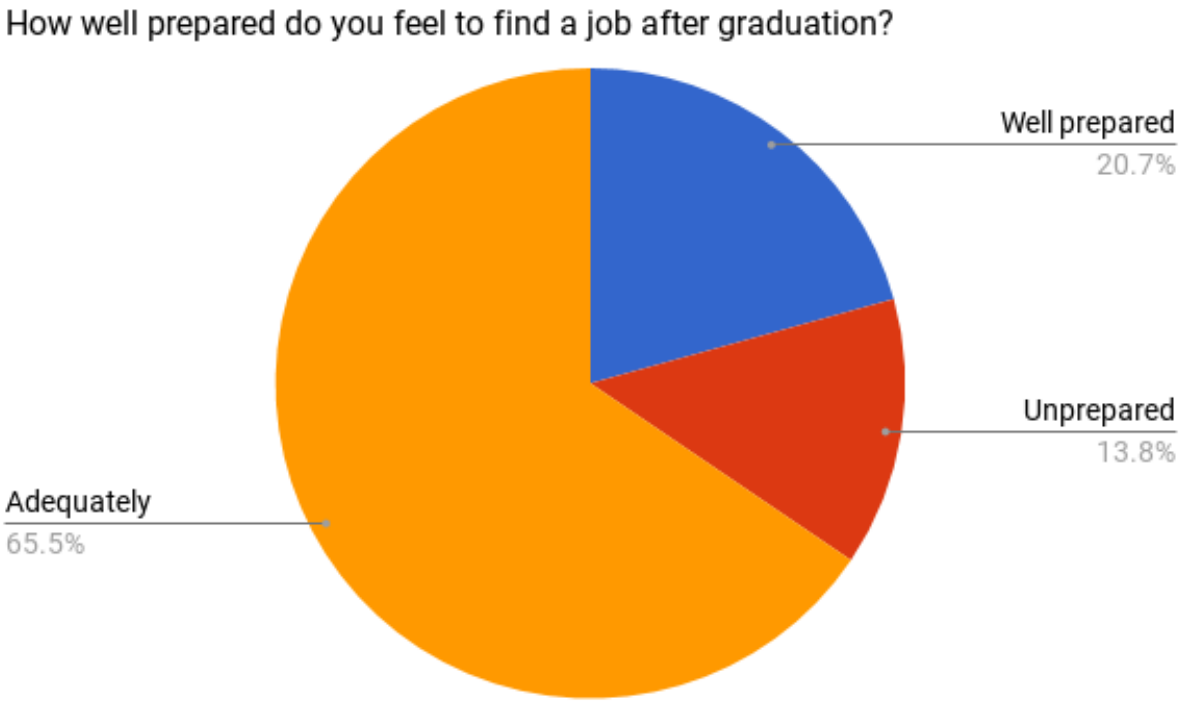


Figure 3.14: Results for graduation preparedness *N=29*

Slow coder
A lot of jobs require masters degrees or a high level of c++ knowledge.
No internship experiences, No big projects, No solid programming language skills (learned little bit of everything), Not much on resume :'(
I've been so busy with school and obligations at home that I haven't had time to look for employment after.
Unprepared because of interviews and lack of coding ability
The ICS program lacks classes that drill the core concepts of data structure manipulation for interviews. I also would like an undergrad systems design course. The ICS program needs work. It also does not teach Angular or React which are sought by many companies.
Quality expected in jobs may not be what was expected in classes
After taking a year long LOA, I have less interest in my once desired field of software engineering. I haven't pursued any internships and it would become more difficult post grad. However my advisors and teachers have given me many tools necessary to be prepared so it is much more the fault of my own.
Feel like there's a little more to like resume building and networking

Figure 3.15: Reasons for not feeling prepared for graduation *N=29*

CHAPTER 4
RADGRAD SYSTEM

I believe that the best way to address current ICS student issues is through an online system that combines degree planning, social networking, and gamification. The specific features of the system evolved over time through a process conducted in Fall 2015-Spring 2016 by Philip Johnson. This process incorporated feedback from the four major RadGrad user groups: students, faculty, academic program advisers, and alumni/local high tech community members. Spring 2015 students in Software Engineering II became directly involved in the design process by creating their own paper and HTML mockups and by doing user tests and analyses on their suggested systems. Faculty members and academic program advisers provided feedback through a RadGrad advisory board and through advising sessions. Alumni and local high tech community members became involved through RadGrad talks at local tech meetups.

Development of the current RadGrad system began in September 2016. We first created mock-ups based off the system requirements presented in the System Design section. We then decided on a few key design patterns to follow (i.e. color schemes, layouts, general site organization, etc.). Over the next few months, we continued to change and narrow down our design, until we were able to deploy a working beta version for students, advisors, and alumni. We were then able to test the system with real users, and use the feedback to further improve upon the system. In this chapter, I present the current state of the RadGrad system as of June 2017.

4.1 Development

4.1.1 Frameworks and Environments

RadGrad was built using the Meteor JavaScript web framework. Meteor is integrated with MongoDB and uses the Distributed Data Protocol and publish-subscribe pattern to create real time, responsive code that automatically updates data changes to the client. On the client side, RadGrad uses jQuery and Semantic UI to design and create the user interface. Due to excellent Meteor integration, RadGrad was developed using IntelliJ IDEA. In an effort to create clean and uniform code, RadGrad uses ESLint to confrom to the AirBnB Javascript Style Guide.

4.1.2 Project Management

We developed RadGrad using GitHub issues and GitHub projects. Development tasks are created as a GitHub issue, and each issue has an assigned developer and and assigned branch. Each issue also resides in a GitHub project, which groups issues together to mark larger milestones. We track

issues using a "Backlog", "In Progress", and "Done" column. The RadGrad developers typically communicate through Slack and in person meetings twice a week.

4.2 RadGrad Users

There are currently five different types of RadGrad users: administrators, advisors, faculty, mentors, and students. Administrators can be RadGrad team members, or UHM academic advisors or faculty that request access. Advisors are UHM academic advisors for ICS students. Faculty members include all professors in the ICS department. Mentors include any ICS alumni that desire to give back to the ICS community. Students include all currently enrolled ICS undergraduate students.

For each user, the three main RadGrad themes (degree planner, social networking, and gamification) are manifested through several different components throughout the system. In the following section, I describe all of these components from the student point of view. Refer to Appendix C to view these components from the point of view of other user types.

4.3 Student Components

4.3.1 Degree Planning

There are degree planner components on the degree planner page (Figure 4.1), explorer pages, the student home page (Figure 4.2). In the following section, I will describe the degree planner components in further detail.

4.3.1.1 Degree Planner

The student degree planner was created to help students increase their extracurricular engagement in a way that makes sense for their specific path and fits into their time constraints (Figure 4.3, Figure 4.1). The student degree planner is the main place that students will go to view and make changes to their entire degree plan. Students can view up to four academic years at a time, but they can view additional past or future years by clicking on the green arrows at the bottom. Semesters that are in the past are greyed out and cannot be changed by the student. Any present or future semesters can be changed by dragging and dropping courses or opportunities into that semester pane. The grades for a course can be changed with the drop down menus.

This page also includes an inspector pane on the top right hand corner, which the student can use to view brief details about a course or opportunity while planning their degree (Figure 4.1, Figure 4.4). The in-depth course and opportunity explorer pages can be accessed through the inspector, but the short descriptions in the inspector allows for quick and convenient assistance within the same view as the degree planner itself. The student can choose a course or opportunity

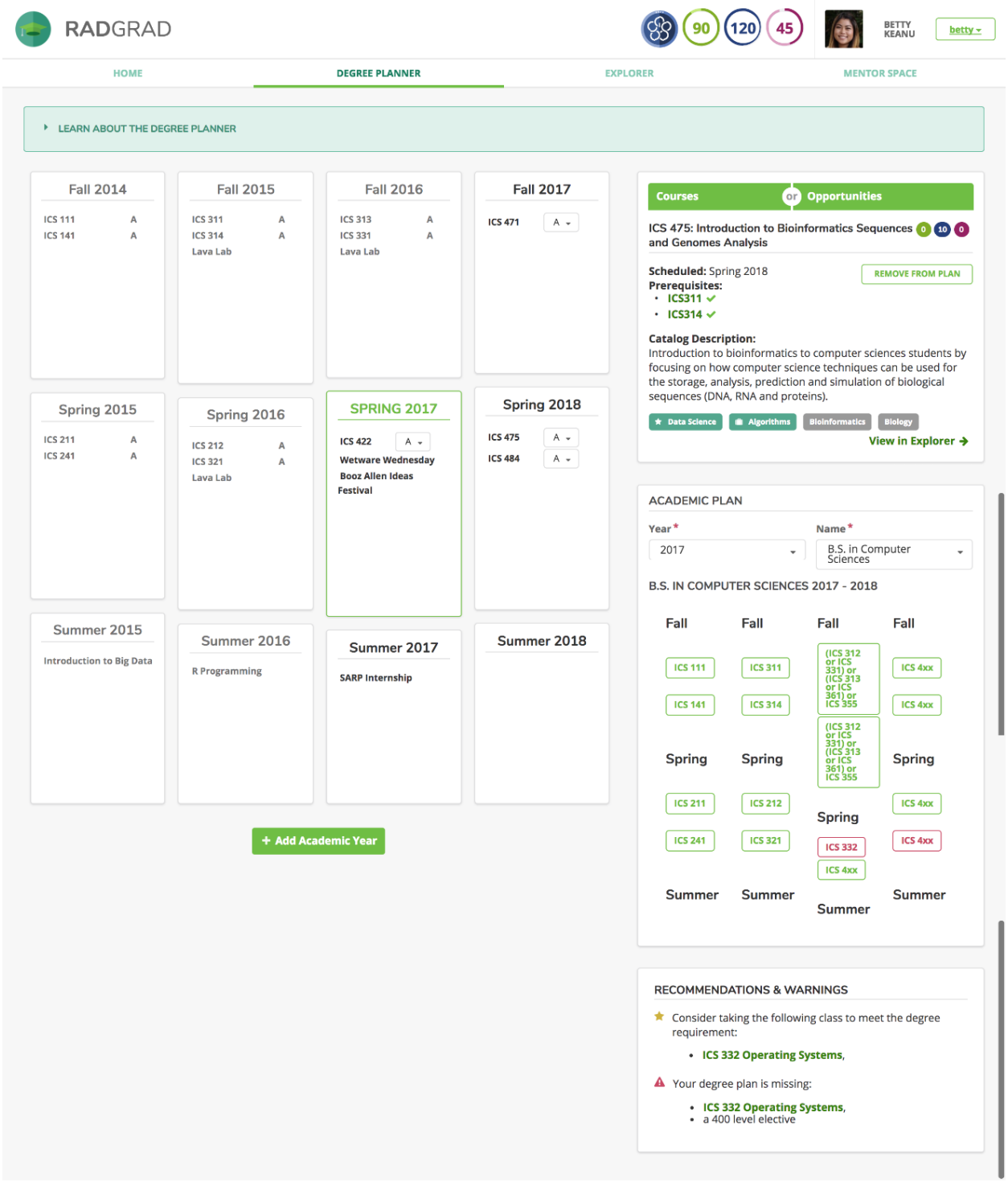


Figure 4.1: Degree planner page.

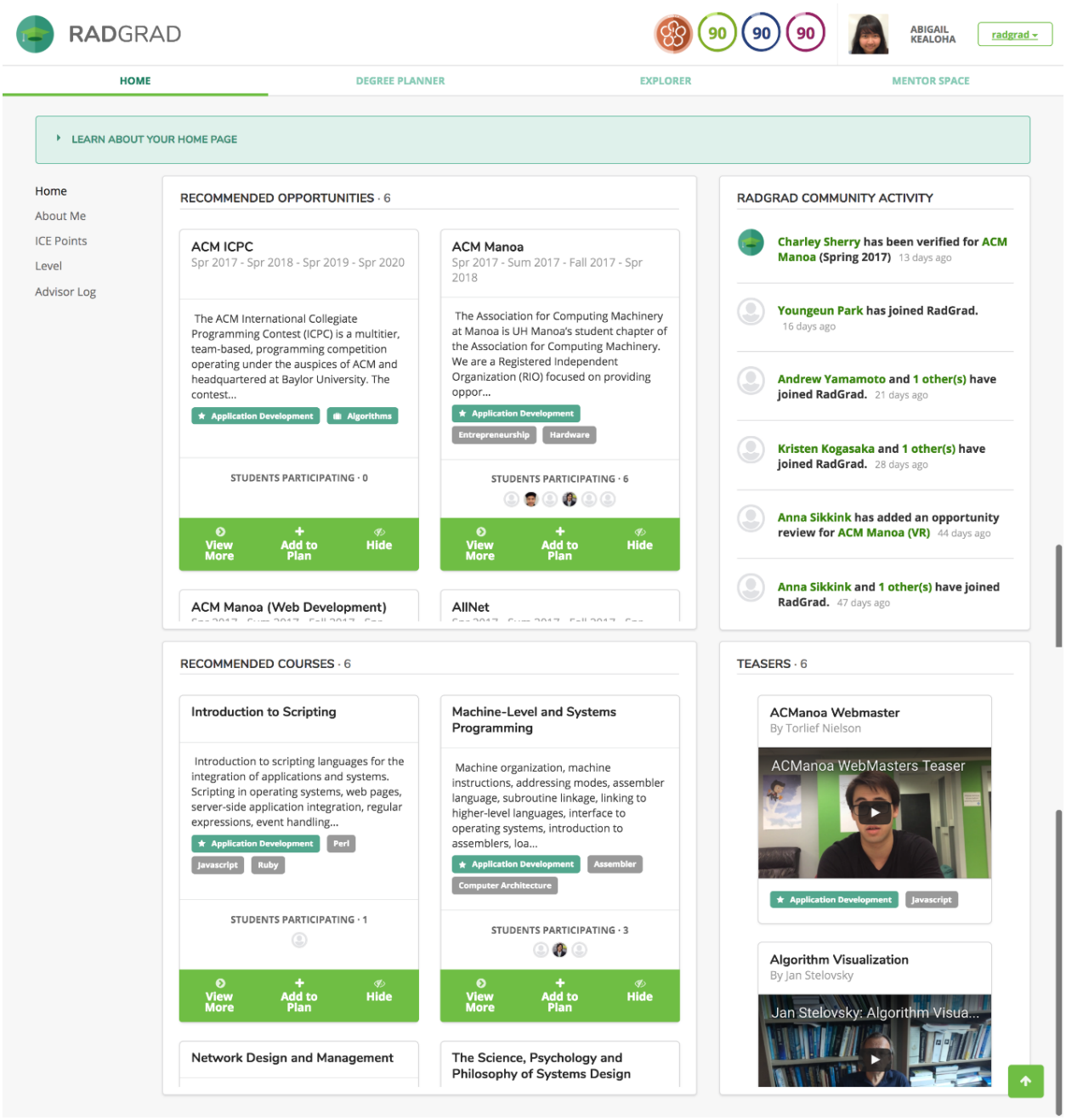


Figure 4.2: Student home page with teasers, feed, and recommended courses and opportunities.

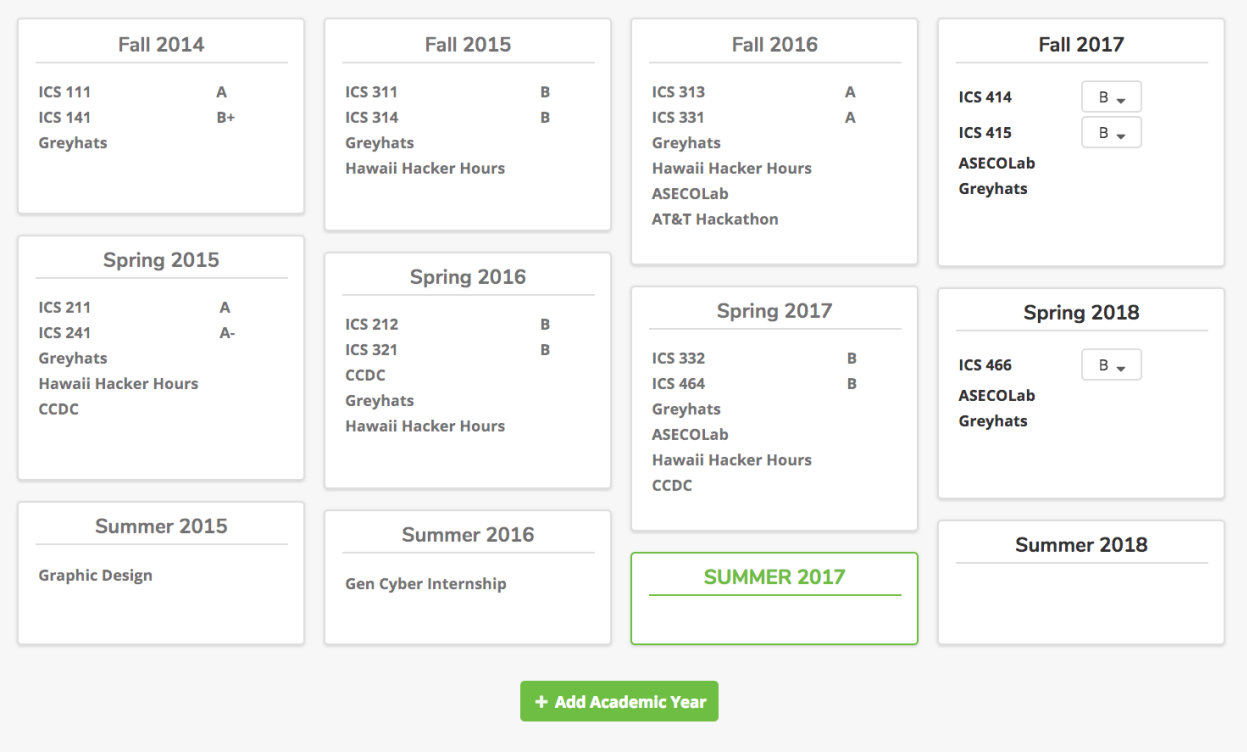


Figure 4.3: Close up of degree plan on the degree planner page.

to inspect by either choosing from the green dropdown menu at the top of the inspector, or by clicking on the course or opportunity name within the plan.

Below the inspector is the academic plan pane (Figure 4.5, Figure 4.1). In this pane, students can select a year and an academic plan name (i.e. B.S. in Computer Science Security Science) to indicate the degree plan that the would like to follow. The pane then displays the required courses for this plan, organized into the recommended semesters, and color coded (green for classes in the student's plan, and red for classes not in the student's plan). Students can use this display to easily drag their missing courses onto their plan.

4.3.1.2 Recommendations and Warnings

The student degree planner automatically generates warnings and recommendations on the bottom right hand corner (Figure 4.6, Figure 4.1). These warnings and recommendations change as a student's degree plan changes. Each time a student adds, moves, or removes a course or opportunity through the degree planner, explorer, or student home page, the warnings and recommendations will regenerate. All possible warnings and recommendations as of June 2017 are listed in Table 4.2. These recommendations and warnings were created to help make the process of integrating courses and opportunities into a chosen time frame easier.

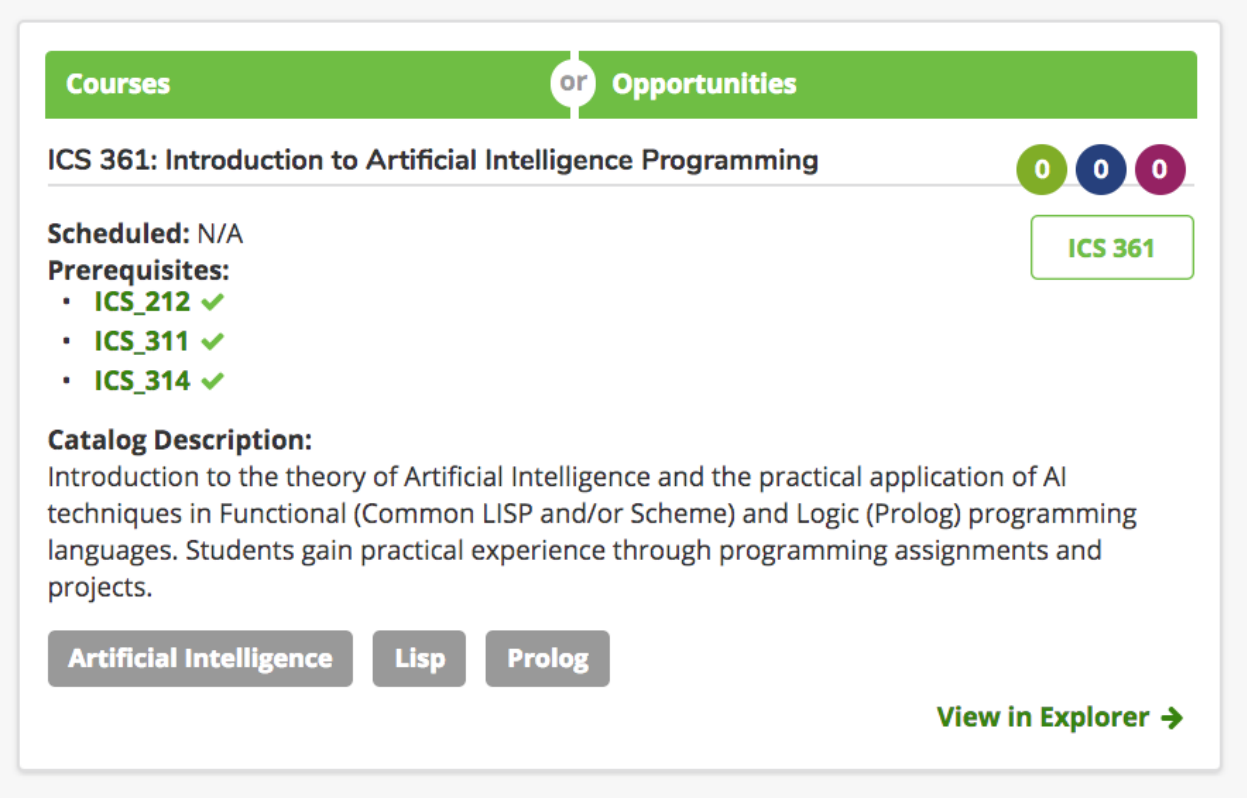


Figure 4.4: Close up of the inspector on the degree planner page.

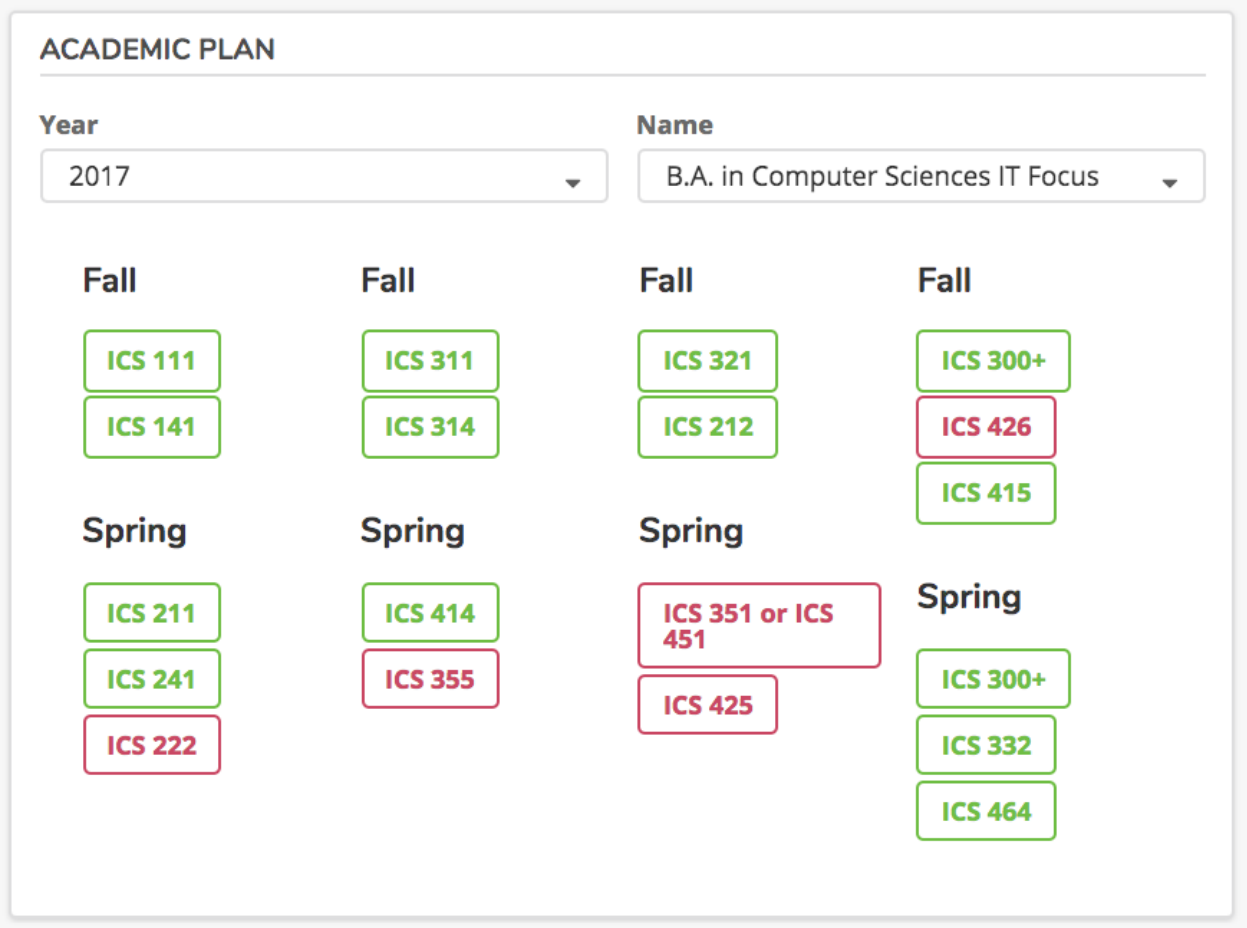


Figure 4.5: Close up of academic plans on the degree planner page.

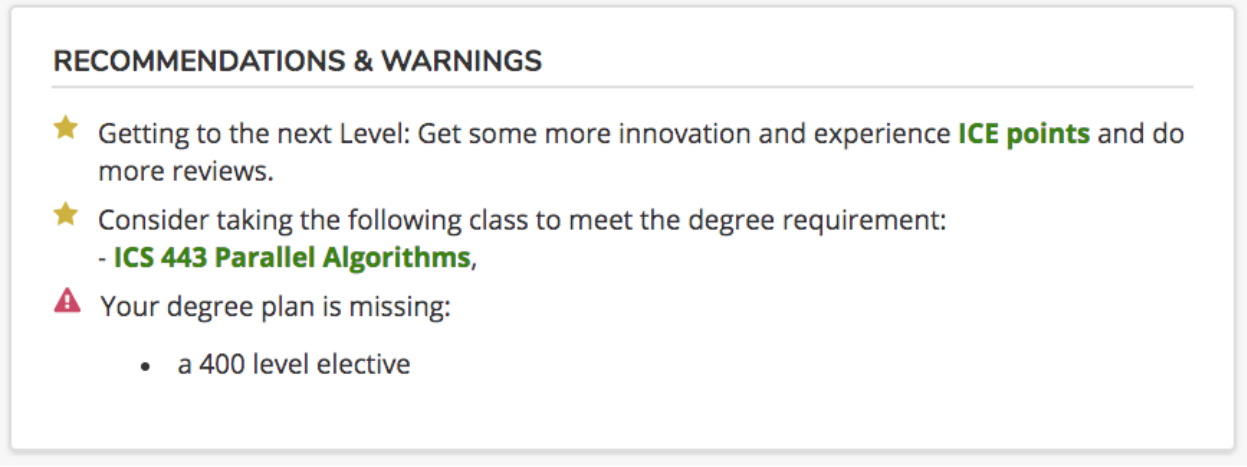


Figure 4.6: Close up of recommendations and warnings on the degree planner page.

Table 4.1: Potential Areas the Degree Planner Could Improve

TechHui Complaints	**Reasoning**
ICS department should offer classes more frequently	Advisors will be able to gather data about which future classes students are interested in, and advisors will be able to schedule these classes with the students' needs in mind.
Survey Questions	**Reasoning**
How many extracurriculars have you participated in?	The RadGrad degree planner encourages students to add both courses and opportunities to their schedules.
How well prepared do you feel to find a job after graduation?	The RadGrad degree planner encourages students to plan ahead, be more in control of their degree plans, and to include both courses and opportunities, which can make students more confident and competitive when finding jobs.
Existing Degree Planning Systems	**Reasoning**
STAR	Unlike STAR's degree planner, RadGrad degree planner is specific to ICS students and emphasizes including extracurriculars along with courses in degree plan
Starfish	Unlike Starfish's degree planner, RadGrad degree planner is specific to ICS students and emphasizes including extracurriculars along with courses in degree plan
College Scheduler	Unlike College Scheduler's degree planner, RadGrad degree planner is specific to ICS students and emphasizes including extracurriculars along with courses in degree plan
Blackboard Planner	Unlike Blackboard Planner's degree planner, RadGrad degree planner is specific to ICS students and emphasizes including extracurriculars along with courses in degree plan
Coursicle	Unlike Coursicle's degree planner, RadGrad degree planner is specific to ICS students and emphasizes including extracurriculars along with courses in degree plan

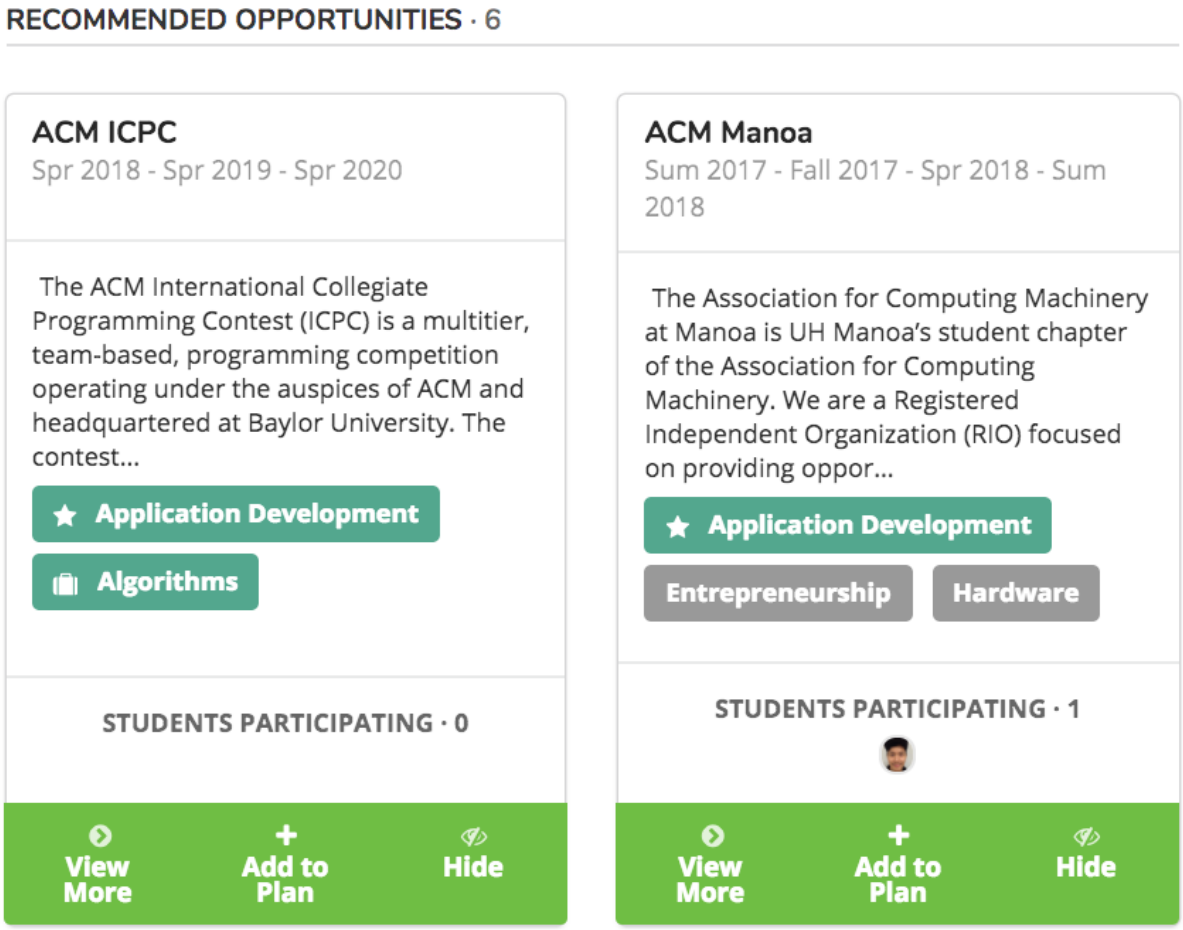


Figure 4.7: Close up of recommendations on the student home page.

On the student home page, students can see details about recommended courses and opportunities as soon as they log in (Figure 4.7, Figure 4.2). These are chosen based off the student's chosen interests and career goal related interests. If a student is interested in a particular course or opportunity, they can choose to view more in the explorer, add it to their plan, or leave it there to decide what to do with later. If a student knows they are not interested in a certain course or opportunity, they can choose to hide it by clicking the "hide" button. If the student later changes their mind, they can view and unhide the course or opportunity by clicking "Hidden Opportunities." These home page recommendations were created to help make the process of choosing and integrating interesting courses and opportunities easier and less overwhelming.

Table 4.2: Automatically generated warnings and recommendations as of May 2017

Warnings	**Recommendations**
A prerequisite course is missing	Course recommended based upon interests
Semester appears overloaded (more than 3 ICS courses)	Opportunity recommended based upon interests
A required course is missing	Recommendation for ICS innovation points
Course is not offered in chosen semester (future implementation)	Recommendation for ICS competency points
	Recommendation for ICS experience points
	Move towards achieving the next level
	See your ICS advisor to upload STAR data

Table 4.3: Potential Areas Warnings and Recommendations Could Improve

Survey Questions	**Reasoning**
How many extracurriculars have you participated in?	Recommendations encourage students to add opportunities to their schedules that match their individual interests, which could cause students to find and participate in more extracurriculars.
How well prepared do you feel to find a job after graduation?	Recommendations and warnings help students to take all the required courses, and also help students to add more courses and opportunities of interest to their degree plans, which can make students feel more confident and in control of how they prepare for life after graduation.
Existing Degree Planning Systems	**Reasoning**
STAR	Unlike STAR's generic warnings, RadGrad provides students with descriptive and personalized warnings and recommendations
Starfish	Starfish does not have any warnings or recommendations
College Scheduler	Unlike College Scheduler's time constraint-based warnings, RadGrad gives specific and personalized warnings and recommendations based off students' specified interests and career goals
Blackboard Planner	Blackboard Planner does not have any warnings or recommendations
Coursicle	Coursicle does not have any warnings or recommendations

4.3.1.3 Career Goal, Course, Desired Degree and Opportunity Explorers

Students can access the career goal, course, desired degree, and opportunity explorers to help them plan their degree. These explorers can be accessed through the "Explorer" top menu on the student home page. The specific explorer can be chosen using the dropdown menu on the left side. These explorers were created to help make the process of combining career goals, courses, degrees, and opportunities together into a cohesive degree plan faster and easier. Students can go to one place to find all of the information they need to piece their plan together, rather than having to depend on a number of external sources.

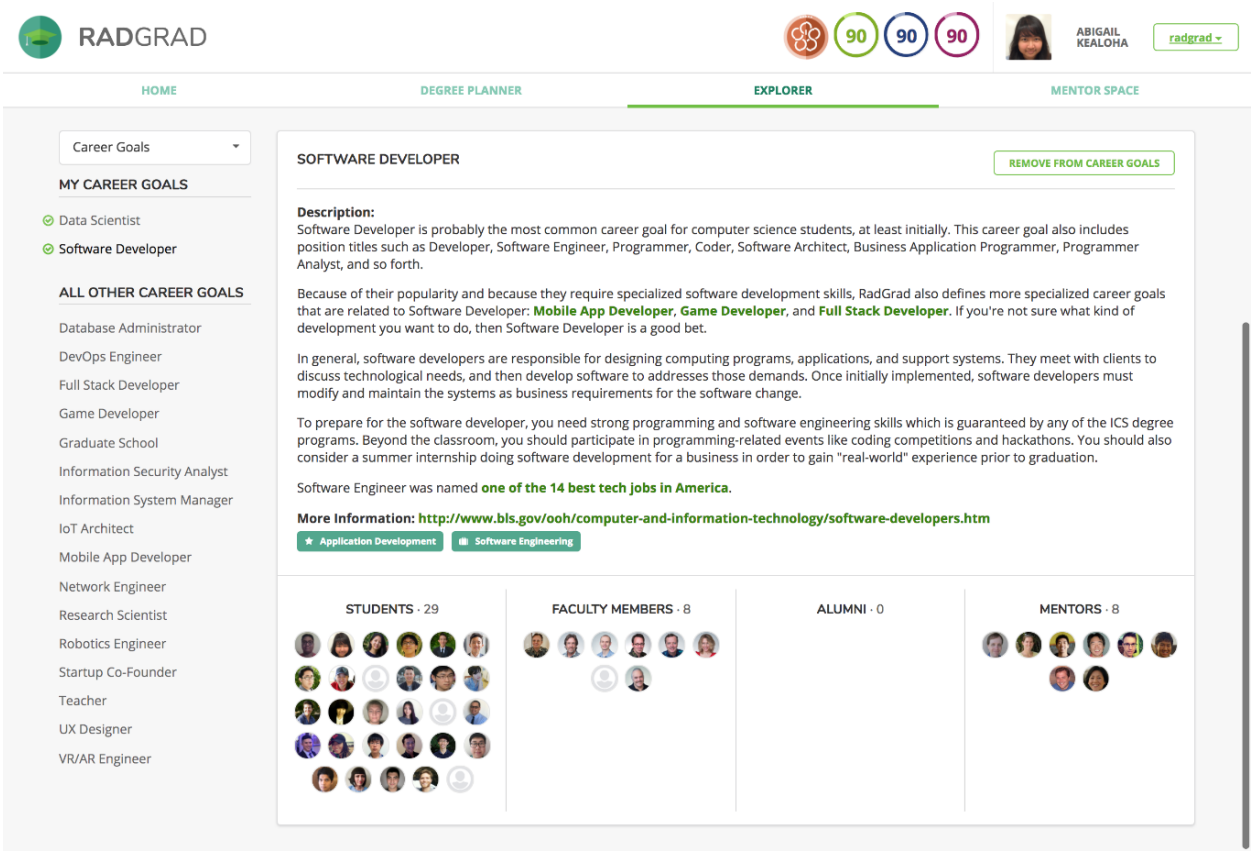


Figure 4.8: Career goal explorer page.

The career goal explorer lists all RadGrad career goals on the left side (Figure 4.8). These career goals are arranged by "My Career Goals" (career goals that the user has added) and "All other career goals" (career goals that the user has not added). The user can click on a career goal to view details about that career goal. These details include a description of the career goal, related interests, related courses and/or opportunities, a link for more information, interested students, interested faculty, interested alumni, and interested mentors. On this page, the user can also add or remove the career goal by clicking on the green button at the top right corner.

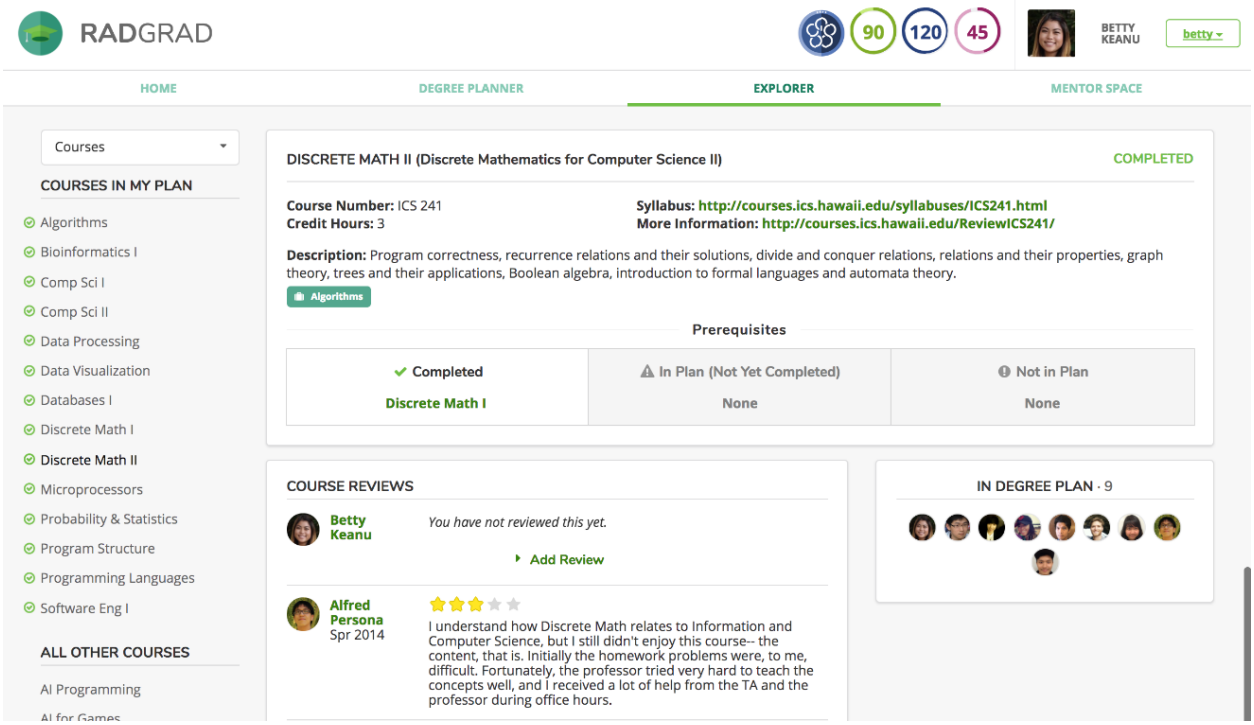


Figure 4.9: Course explorer page.

The course explorer lists all RadGrad courses on the left side (Figure 4.9). These courses are arranged by "Courses in my Plan" (all past, present or future courses in the student's degree plan) and "All Other Courses" (courses not in the user's degree plan). The user can click on a course to view details about that course. These details include course number, a link to the syllabus, credit hours, a description of the course, prerequisites, organized into three categories (completed, in plan but not yet completed, and not in plan), and a list of students with this course in their degree plan. On this page, users can also view course reviews from other students and add or edit their own course review. The user can add or remove this course from their degree plan by clicking on the green button at the top right corner. If the user has already taken and passed the course, they cannot add it again.

The degree explorer lists all possible ICS degrees on the left side (Figure 4.10). These degrees are arranged by "My Desired Degree" (the student can only have one desired degree at a time), and "All Other Degrees" (degrees not currently chosen as the user's desired degree). The user can click on a degree to view details about that degree. These details include a description, where to go for more information, and a list of students who have this degree listed as their current desired degree. On this page, users can set a new degree goal by clicking on the green button at the top right corner.

The interest explorer lists all possible RadGrad interests on the left side (Figure 4.11). These

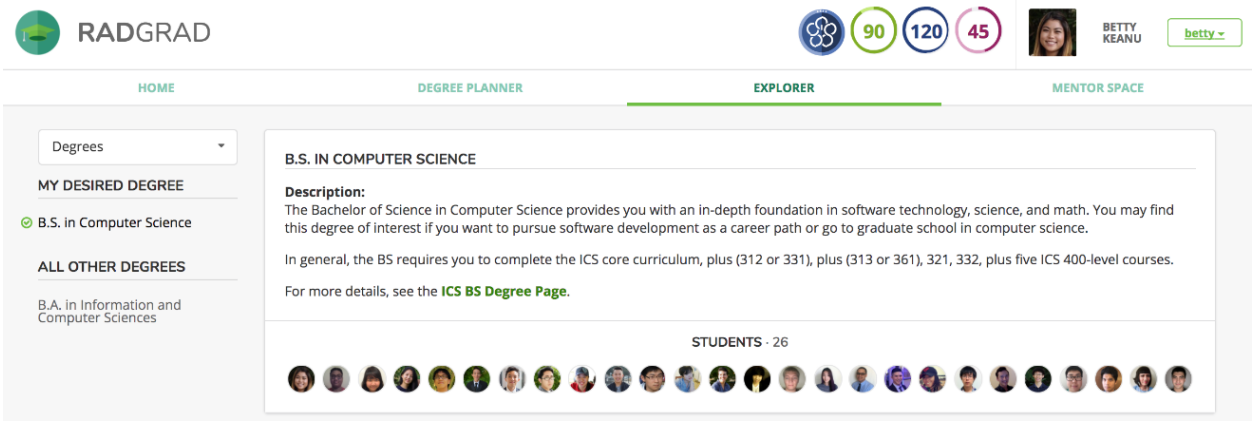


Figure 4.10: Degree explorer page.

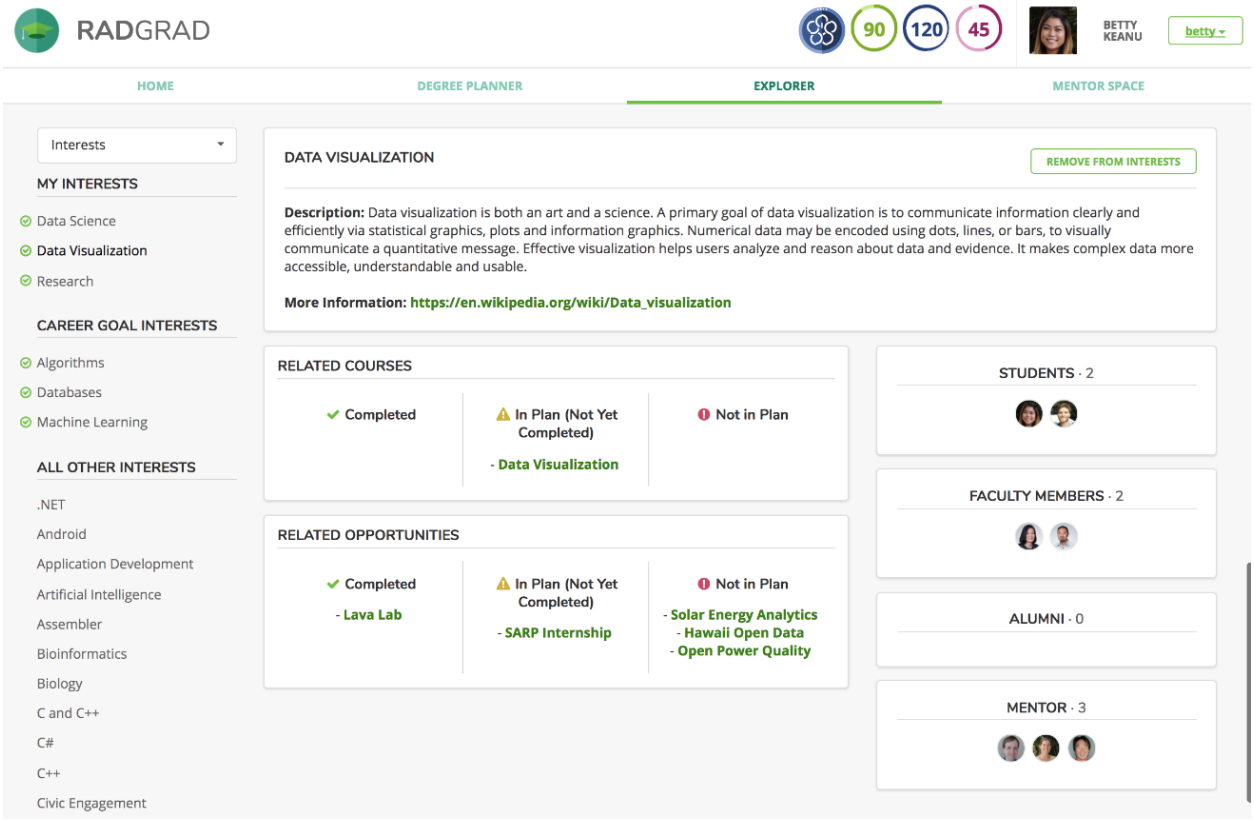


Figure 4.11: Interest explorer page.

interests are arranged by "My Interests" (interests that the user has added), "Career Goal Interests" (interests that have automatically been added due to their association with one or more of the user's chosen career goals), and "All Other Interests" (interests that the user has not added and are not related to any of the user's career goals). The user can click on an interest to view details about that interest. These details include a description of the interest, related courses and related opportunities, both organized into three categories (completed, in plan but not yet completed, and not in plan), and students, faculty, alumni, and mentors who have added this interest. On this page, users can also add or remove the interest by clicking on the green button at the top right corner.

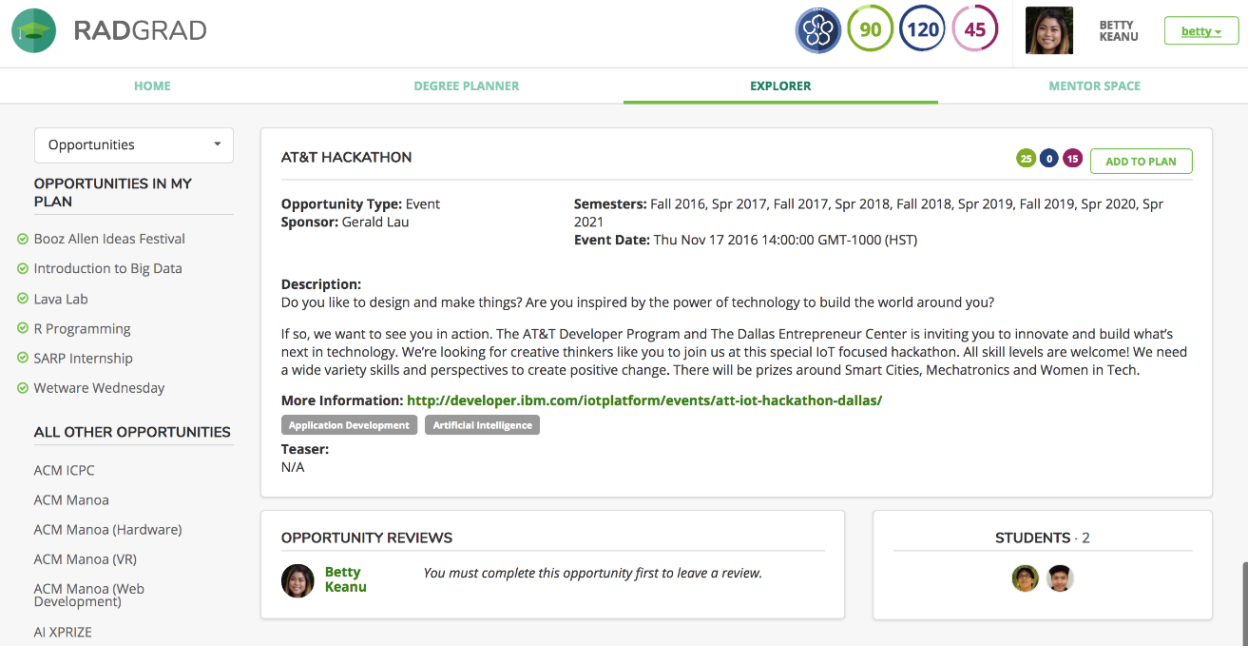


Figure 4.12: Opportunity explorer page.

The opportunity explorer lists all ICS opportunities on the left side (Figure 4.12). These opportunities are arranged by "Opportunities in my Plan" (all past, present or future opportunities in the user's degree plan) and "All Other Opportunities" (opportunities not in the user's degree plan). The user can click on an opportunity to view details about that opportunity. These details include the opportunity type, semesters offered, event date, faculty sponsor, a description of the opportunity, related interests, a teaser video, and a list of students with this opportunity in their degree plan. On this page, users can also view opportunity reviews from other students and add or edit their own opportunity review. The user can add or remove this opportunity from their degree plan by clicking on the green button at the top right corner. Unlike courses, users can add an opportunity to their plan as many times as they would like.

Table 4.4: Potential Areas the Career Goal, Course, Degree, Interest, and Opportunity Explorers Could Improve

TechHui Complaints	**Reasoning**
ICS department should offer a wider variety of classes	RadGrad explorers allow students to understand their interests, and find various ways to learn about them. Even if ICS does not offer a course in a specific area, students can use the explorer to find other ways to learn (i.e. online courses, interest groups, projects with a professor).
ICS department should offer more focused areas of study	RadGrad explorers allow students to understand their interests, and find various ways to learn about them. Even if ICS does not offer a focus in a specific area, students can use the explorer to create their own personalized degree plan (i.e. adding relevant courses and opportunities, and networking with professors in the area).
ICS classes are too time consuming and take up more time than anticipated	The RadGrad course explorer can help students to gather more information about courses before they take them, including reviews from other students. This type of information can help students to make better informed decisions when creating their degree plan, and they can plan their courses in a way that fits their individual time constraints.
Survey Questions	**Reasoning**
How many extracurriculars have you participated in?	The RadGrad explorers can help students easily find opportunities of interest to add to their schedules.
How well prepared do you feel to find a job after graduation?	The RadGrad explorers encourage students to learn more about computer science topics, careers, and opportunities, which can help students get a better idea of, and become better prepared for what they want to do after graduation.
Existing Degree Planning Systems	**Reasoning**
STAR	STAR doesn't provide any way for students to learn details about interests, career goals, degrees, courses, and opportunities.
Starfish	STAR doesn't provide any way for students to learn details about interests, career goals, degrees, courses, and opportunities.
College Scheduler	STAR doesn't provide any way for students to learn details about interests, career goals, degrees, courses, and opportunities.
Blackboard Planner	Unlike Blackboard's broad career explorer, RadGrad explorers provide a way for students to learn details about interests, career goals, degrees, courses, and opportunities and use them to design their degree plan.
Coursicle	STAR doesn't provide any way for students to learn details about interests, career goals, degrees, courses, and opportunities.

4.3.1.4 Teasers

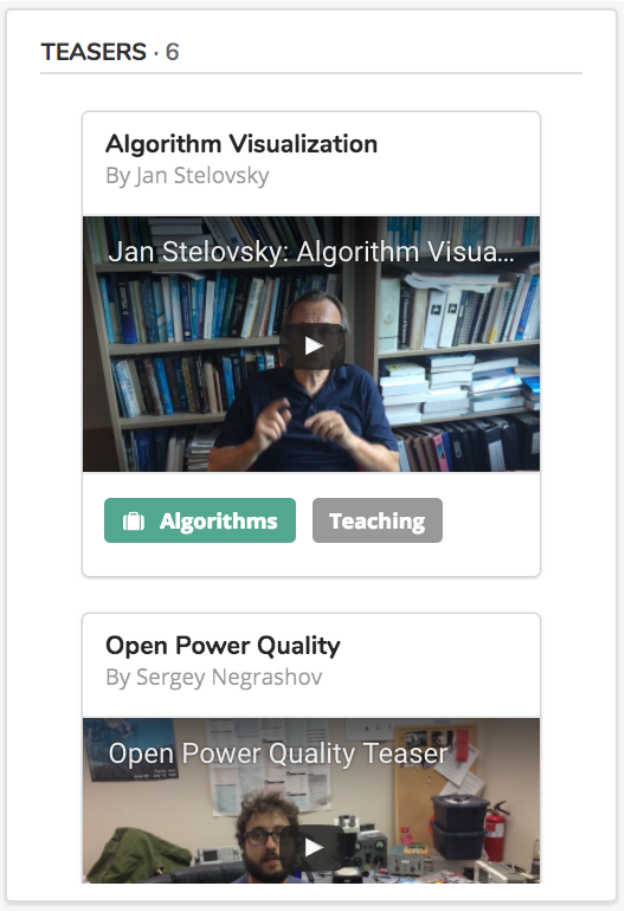


Figure 4.13: Close up of teasers on student home page.

Teasers are short (around 30 seconds) YouTube videos created by members of RadGrad to advertise their opportunity to the rest of RadGrad (Figure 4.13, Figure 4.2). Faculty members can create a teaser to help give students an idea of what their current research is about, and students can create a teaser to help give students an idea of what their club or event does and why other students should participate. These teasers supplement the textual opportunity descriptions in the explorer, and appear on the student's home page based off matching interests. Teasers were added on the student home page to serve as eye catching advertisements for opportunities, specifically targeted towards the user.

4.3.2 Social Network

The social network components appear on the student home page (Figure 4.2), explorer pages, mentorspace page (Figure 4.16), and several other pages listed below. In the following section, I

Table 4.5: Potential Areas Teasers Could Improve

Potential Areas Teasers Could Improve	
Survey Questions	**Reasoning**
How many extracurriculars have you participated in?	Teasers encourage students to add opportunities of interest to their schedules.
How well prepared do you feel to find a job after graduation?	Teasers reinforce the importance of opportunities in students' degree plans. If teasers successfully encourage students to participate in more opportunities, this can make students more confident and competitive when finding jobs.
Existing Degree Planning Systems	**Reasoning**
STAR	STAR doesn't incorporate any opportunities.
Starfish	Starfish doesn't incorporate any opportunities.
College Scheduler	College Scheduler doesn't incorporate any opportunities.
Blackboard Planner	Blackboard Planner doesn't incorporate any opportunities.
Coursicle	Coursicle doesn't incorporate any opportunities.

will describe the social network components in further detail.

4.3.2.1 User Explorer

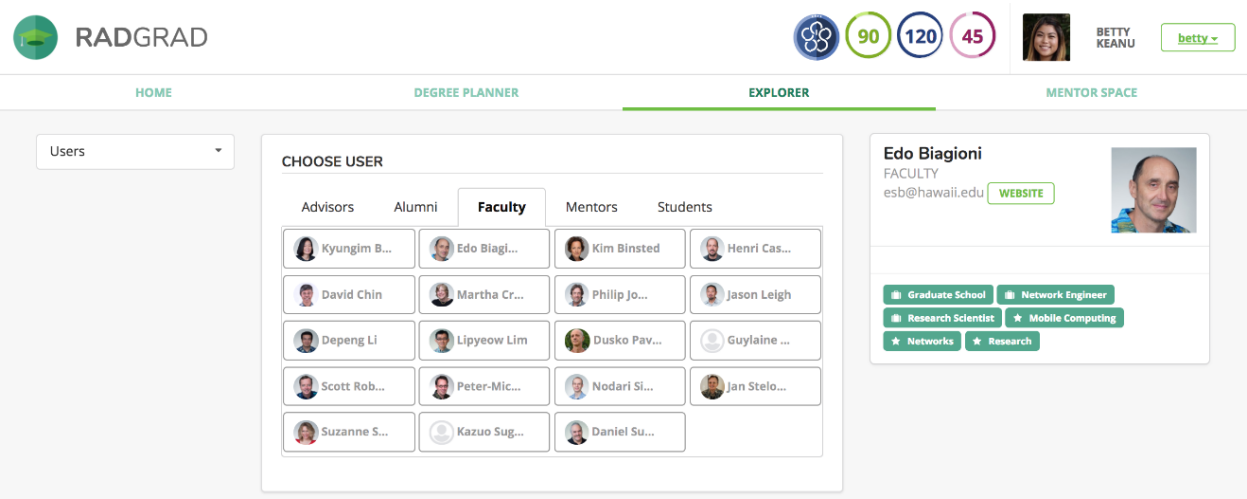


Figure 4.14: User explorer page.

The user explorer lists all RadGrad users with their first name, last name, and avatar (Figure 4.14). Users are arranged in tabs by user type (Advisor, Alumni, Faculty, Mentor, Student) and then listed alphabetically by last name. The current user can click on a user to view details about that user. For student users, these details include desired degree, email, level, taken and planned

courses, and completed and planned opportunities. For faculty users, these details include their email, a link to their website, and interests. For mentor users, these details include their email, their MentorSpace answers, and their interests. For advisor users, these details include their email and their interests. Students can use this explorer to learn more about other members of the RadGrad community, and figure out who might be beneficial to talk to (i.e. a higher level student with matching interests and interesting completed opportunities, or a faculty member with matching interests, or a mentor working at the student's dream company). The User explorer was created to encourage more and better social interactions among all members of the RadGrad community.

Table 4.6: Potential Areas the User Explorer Could Improve

TechHui Complaints	**Reasoning**
ICS department should have a better sense of community	RadGrad user explorer can help students learn more about all members of the ICS community, and could potentially facilitate off-RadGrad relationships.
ICS courses should involve more group work	RadGrad user explorer can help students easily find and reach out to other students who are in their class or share interests with them.
ICS department should encourage more interaction among students	RadGrad user explorer can help students learn more about each other and could help them to interact more both on and offline..
Survey Questions	**Reasoning**
Do you feel like you get enough support from others in the ICS department?	RadGrad user explorer can help students easily meet people with similar interests and degree plans, and get more support from all members of the community.

4.3.2.2 Feed

Another way RadGrad reminds users that they are not alone in using the system is by providing a feed on the student home page (Figure B.5, Figure 4.2). The feed is one of the first things that a user sees when they log in. Through this feed, users can see events occurring throughout RadGrad such as a new user joining RadGrad, a new course or opportunity is added on RadGrad, a user is verified for an opportunity, or a user has written a new course or opportunity review. The feed provides a single place for students to go to when they want to see what has changed since they have last logged in, and it constantly keeps students updated with the latest changes to the system. Since the feed also allows students to see what other students have been doing, they may be able to get a quick sense of what opportunities are popular among their classmates.

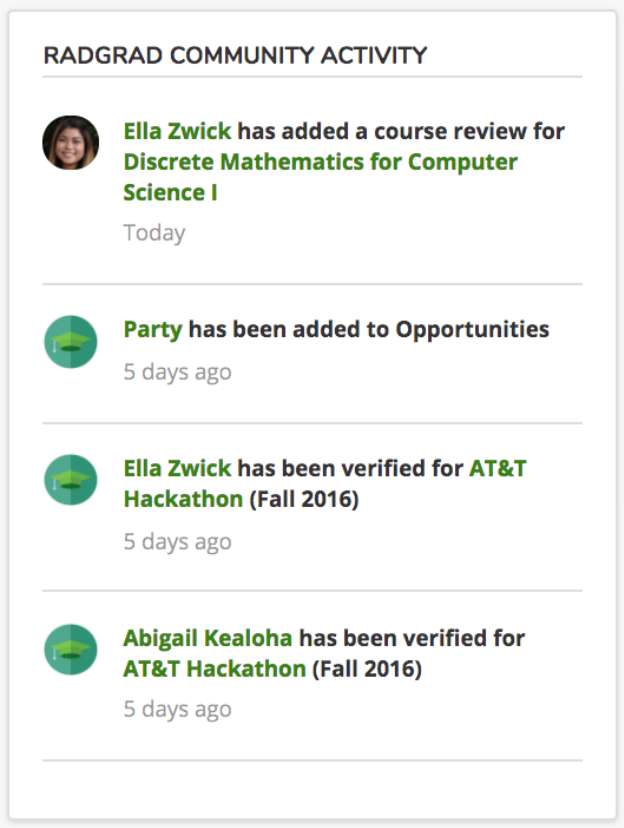


Figure 4.15: Close up of feed on student home page.

Table 4.7: Potential Areas the Feed Could Improve

TechHui Complaints	**Reasoning**
ICS department should have a better sense of community	The RadGrad feed help students to feel like they are part of a larger community and keep up with the latest ICS related events.

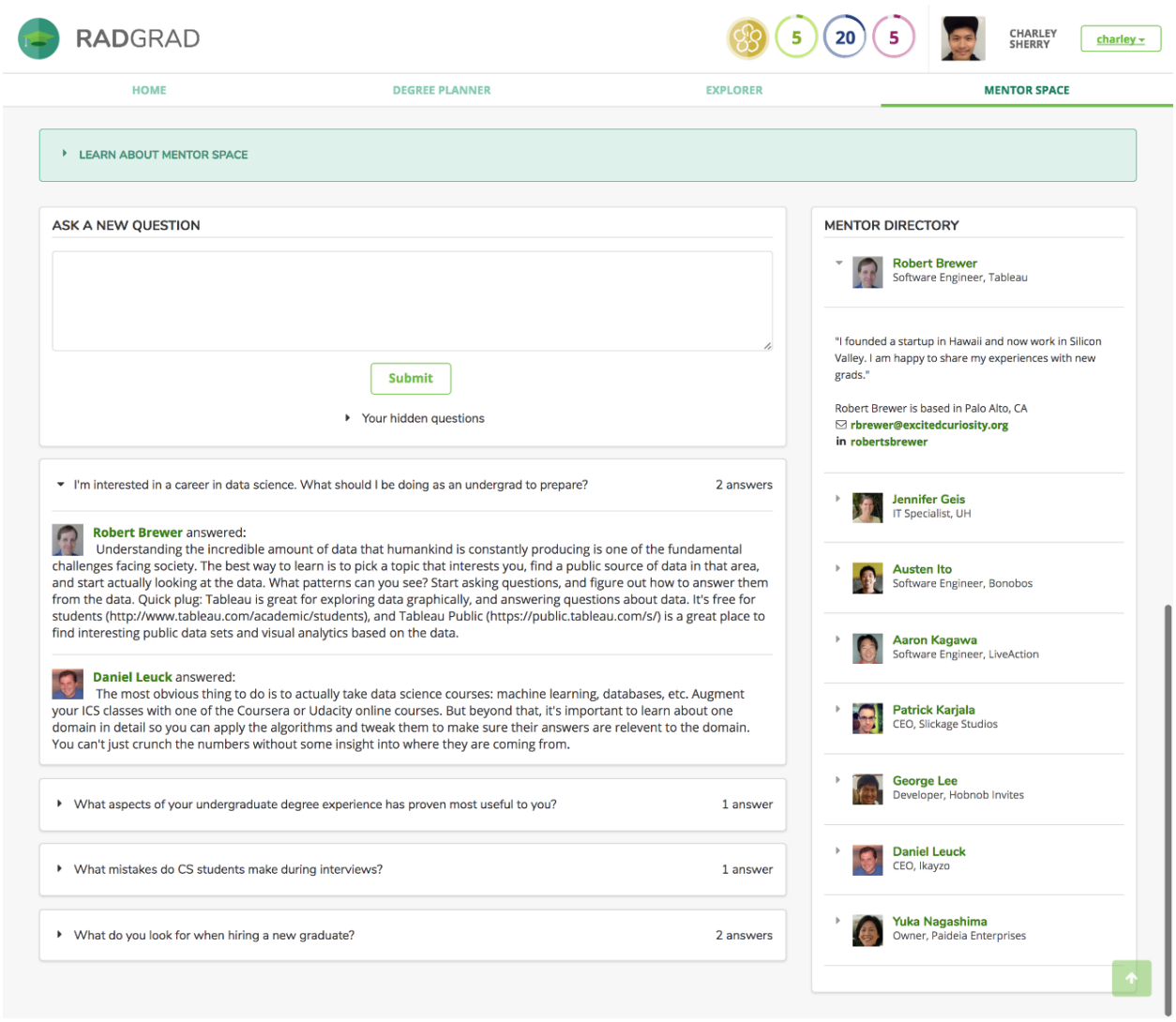


Figure 4.16: MentorSpace page.

4.3.2.3 Mentorspace

Mentors and students can interact with each other on the MentorSpace page (Figure 4.16). MentorSpace was created to encourage more academic and professional interactions between students and alumni. The mentors are listed in the Mentor Directory on the right side of the page. Students can explore who the mentors are by expanding their profile and viewing information about their current company, current location, current job title, email address, LinkedIn, and a description about what inspired them to become a RadGrad mentor. On the left side of the page, students can submit new questions that they have for a mentor. Once the question has gone through moderation (by Administrators), it will be posted on the MentorSpace for everyone to see. If a question is rejected, it can be edited and resubmitted as many times as desired. A question may be rejected if it contains profanity, is unclear, or is unrelated to ICS. Once a question is posted, mentors can leave an answer for the rest of the community to see. If a student has a specific question for a specific mentor, they can instead contact the mentor through the provided email rather than posting on MentorSpace, which is reserved for questions that can benefit the general ICS student community.

Table 4.8: Potential Areas MentorSpace Could Improve

TechHui Complaints	**Reasoning**
ICS department should have a better sense of community	RadGrad MentorSpace brings students and mentors together in one place and feel more connected.
Survey Questions	**Reasoning**
Do you feel like you get enough support from others in the department?	RadGrad MentorSpace can help students get the support they need through questions and answers with mentors who have been in their position before.
To what extent have ICS alumni influenced your development in the ICS program?	RadGrad MentorSpace can help students get influenced by alumni both academically and professionally.
Existing Social Networking Systems	**Reasoning**
LinkedIn	LinkedIn doesn't provide specific support for alumni to interact with students.
TechHui	TechHui doesn't provide specific support for alumni to interact with students.
Rate My Professors	Rate My Professor doesn't provide specific support for alumni to interact with students.

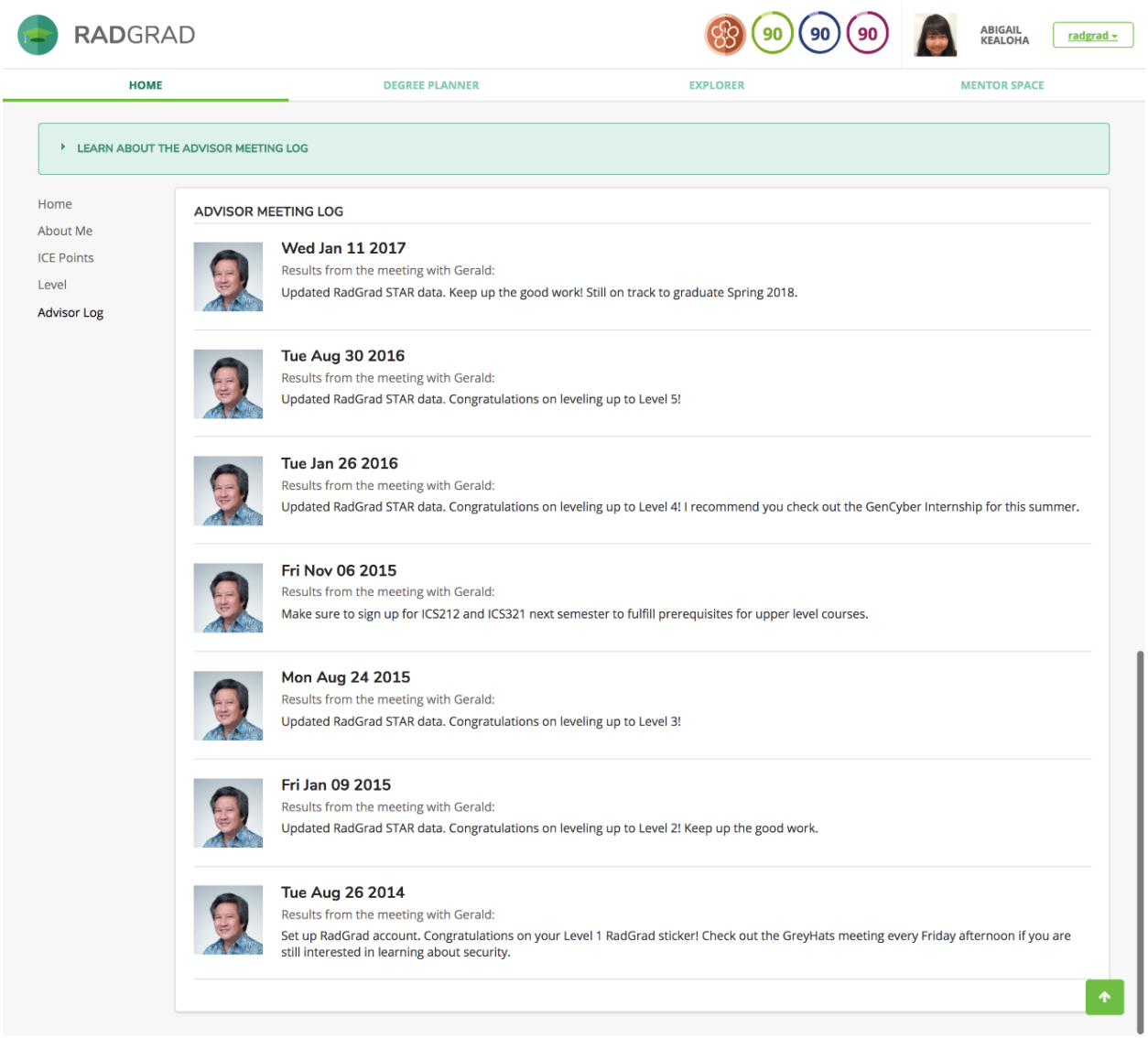


Figure 4.17: Student advisor log page.

4.3.2.4 Advisor Log

Advisors and students can interact with each other on the Advisor Log page (Figure 4.17). Advisor logs were created to help encourage and augment the interactions between students and advisors. When an advisor holds a meeting with a student, he can leave notes from the meeting on the student's Advisor Log. Each log includes a date, the name and avatar of the advisor, and the meeting notes. Advisors can use the log to keep track of their interactions with each student, and students can refer back to the log whenever they can't remember details about what their advisor had said.

Table 4.9: Potential Areas the Advisor Log Could Improve

TechHui Complaints	**Reasoning**
ICS department should have a better sense of community	RadGrad MentorSpace brings students and advisors together in one place and helps them communicate better and feel more connected.
Survey Questions	**Reasoning**
Do you feel like you get enough support from others in the department?	RadGrad advisor logs can help students to get more out of their advisors, and can hopefully improve the quality of advisor support and interaction.
Existing Social Networking Systems	**Reasoning**
LinkedIn	LinkedIn doesn't provide specific support for advisors to interact with students.
TechHui	TechHui doesn't provide specific support for advisors to interact with students.
Rate My Professors	Rate My Professor doesn't provide specific support for advisors to interact with students.

4.3.2.5 Reviews

Students can post two different types of reviews: course reviews and opportunity reviews (Figure 4.18). Students can leave reviews for a specific course or opportunity on the course or opportunity explorer page. Students can leave a 1-5 rating and reasons behind their rating. Students can edit or delete their review at any time. Any new or edited reviews immediately appear on the explorer page, but when they go through moderation, they may be removed if they do not abide by the guidelines. Reviews cannot be anonymous, which forces students to take full responsibility for the content of their post. This, along with the fact that all users on RadGrad can view reviews, allows for full transparency between professors and students. Students can view other students reviews to get additional, first hand and anecdotal information about a course or opportunity before they decide to add it to their plan. Faculty and advisors can view reviews to gather feedback about how

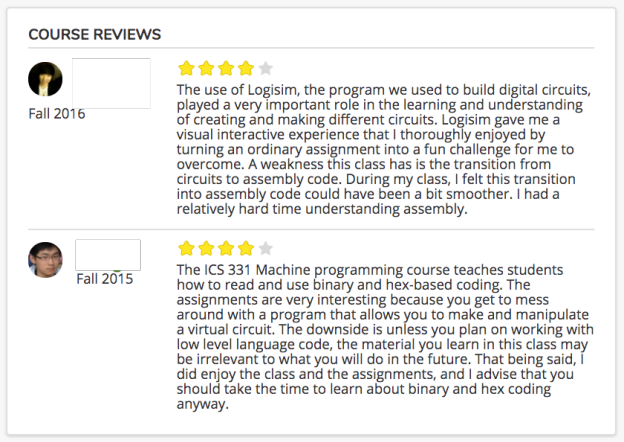


Figure 4.18: Close up of reviews on the course explorer page.

to improve the ICS program. Reviews encourage more open communication between students and the rest of the RadGrad community and encourages professors to improve, rather than encouraging other students to avoid a certain course, like on Rate My Professors.

4.3.2.6 Avatars

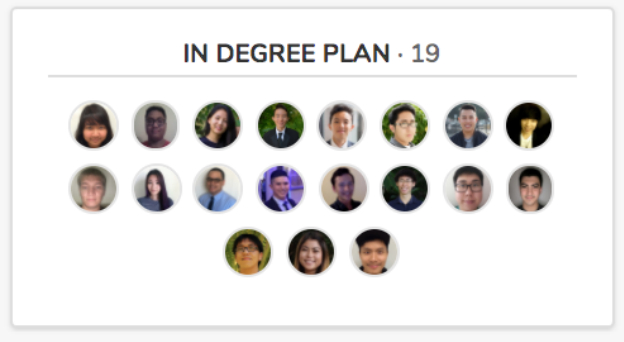


Figure 4.19: Example of avatars on the course explorer page.

RadGrad quietly reminds users that they are not alone in using the system–they are part of a large and diverse network of real people (Figure 4.19). One of the ways RadGrad does this is by incorporating user avatars throughout the site. These avatars appear on the student home page, explorer pages, the user explorer, the student levels page, and the MentorSpace page. These avatars appear to show users related to a certain interest, career goal, course, opportunity, degree, and level. They also are associated with feed items, reviews, and MentorSpace answers. All avatars can be clicked on to navigate to the user's profile in the user explorer.

Table 4.10: Potential Areas Reviews Could Improve

TechHui Complaints	**Reasoning**
ICS department should have a better sense of community	Non-anonymous RadGrad reviews help facilitate more open communication between students and the rest of the community.
Some ICS professors need to improve their teaching	RadGrad reviews help professors get honest and constructive feedback, which can be used to improve upon their teaching.
Survey Questions	**Reasoning**
To what extent have ICS peers influenced your development in the ICS program?	RadGrad reviews can help students help others students plan which courses to add to their degree.
To what extent have you influenced your ICS peers' development in the ICS program?	RadGrad reviews can help students help others students plan which courses to add to their degree.
Existing Social Networking Systems	**Reasoning**
LinkedIn	LinkedIn doesn't provide specific support for students to leave feedback for professors.
TechHui	TechHui doesn't provide specific support for students to leave feedback for professors.
Rate My Professors	Rate My Professor allows anonymous reviews, which reduces the validity of reviews, and focuses on a student audience, which means reviews may not actually be used by professors to improve their teaching quality.

Table 4.11: Potential Areas Avatars Could Improve

TechHui Complaints	**Reasoning**
ICS department should have a better sense of community	RadGrad avatars help students to feel like they are part of a larger community and help students to get a better idea of the people in the department (i.e. who shares interests with them, who has taken the same courses as them, etc.).
ICS department should encourage more interaction among students	RadGrad avatars help students to find other students that have common interests, and could potentially facilitate relationships off of RadGrad.

4.3.3 Gamification

The gamification components appear on the ICE page (Figure B.8), the levels page (Figure B.10), the explorer pages, and several other pages. These components are also constantly present for students to see on any page, on their top menu bar. In the following section, I will describe the social network components in further detail.

4.3.3.1 ICE (Innovation, Competency, Experience)

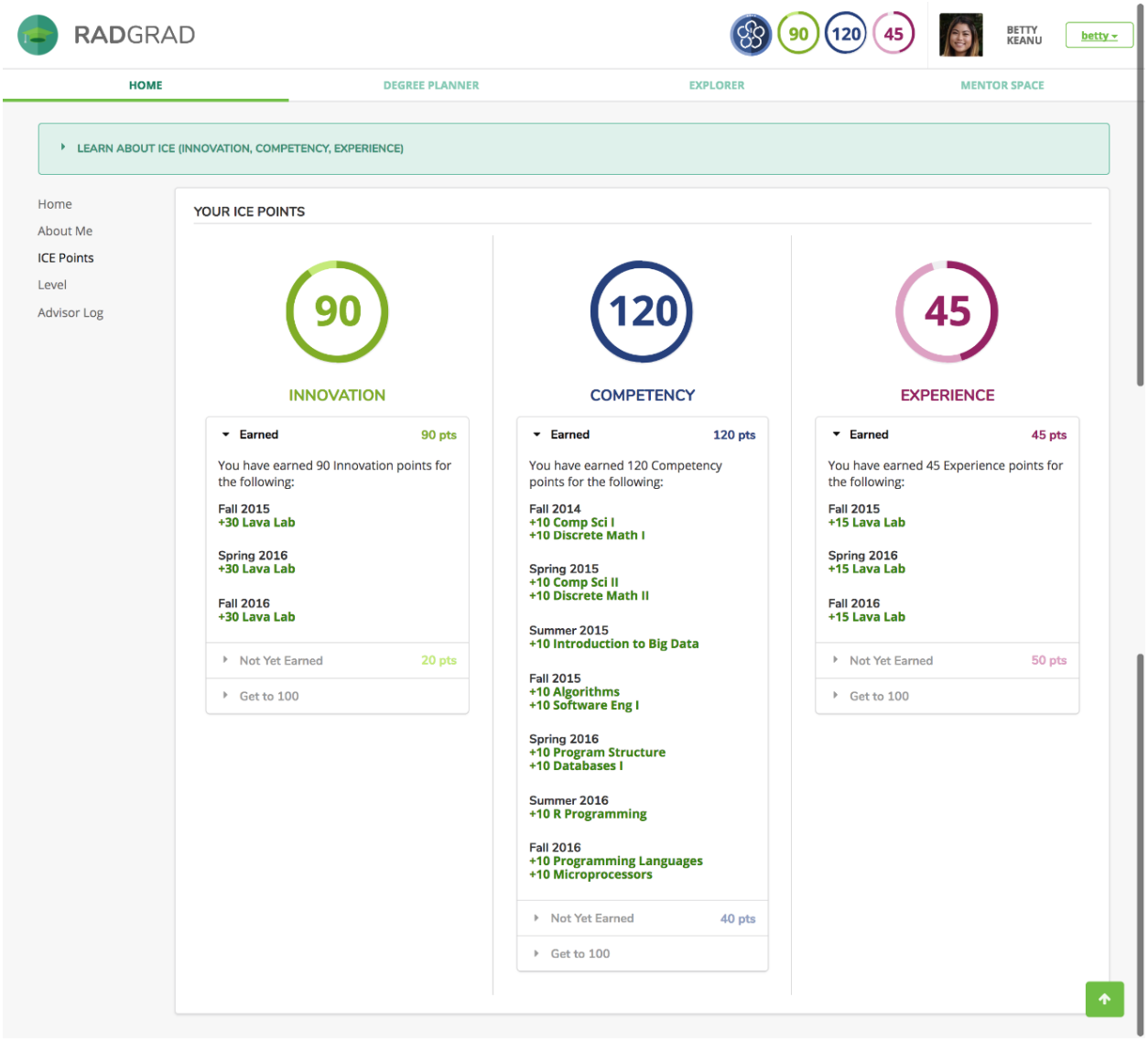


Figure 4.20: ICE page.

ICE is an acronym for Innovation (i.e. a student's involvement in research or other innovative

activity), Competency (i.e. a student's grades in ICS courses), and Experience (i.e. a student's involvement in high tech environments through internships or other professional activities). ICS alumni have expressed concern that employers have been looking for outside opportunities like hackathons and internships on resumes, instead of just a degree and a high GPA. While a high GPA (competency) showcases a student's work ethic, responsibility to get work done, and basic understanding of standard topics, hackathons showcase a student's ability to use the information they learned in class in a creative and innovative way (innovation), and internships showcase a student's experience working with others in a non-academic environment (experience). Arguably, all three of these aspects are equally important when preparing to enter the workforce.

ICE is a measurement of these three aspects, calculated using the information provided on the student's profile. Contrasting with traditional requirements that focus solely on GPA, ICE balances the three aspects to emphasize the importance of all three areas in an ideal ICS experience. The ICE point system can encourage students to become more competitive and give them more incentive to do better.

The student ICE page displays three circular graphs: one each for innovation, competency, and experience (Figure B.8). The number in the center of each graph represents the current amount of points earned for that category. The dark fill in the graph represents the same number. The light fill on the graph represents the amount of planned points. In addition to the student ICE page, these ICE graphs also appear in the top right corner of the menu bar.

ICE points are also represented for specific courses or opportunities. These ICE points are represented using three filled circles: one each for innovation, competency, and experience. Each circle has a number in the center which represents the amount of points that course or opportunity is worth for that particular ICE category. Students can use these ICE representations to decide which courses or opportunities they should add to their plan, in order to improve their ICE score. These representations appear on the degree planner inspector pane and in the course and opportunity explorer pages. ICE is incorporated in multiple places all over the site to emphasize the importance of well-roundedness, with equal emphasis on innovation, competency, and experience.

4.3.3.2 Levels

Students can view their current level badge on the student level page (Figure B.10). This page also includes leveling up hints and a list of other students who are at the same level (listed with avatars). This levels page was created to help students to feel a sense of progression throughout their program, and to help them to get to know their peers at the same level.

Levels also persist physically off of RadGrad in the form of stickers. These stickers can be obtained from an advisor or a RadGrad administrator, and a student will receive a new sticker each time they achieve a new level. Students are encouraged to display these stickers on their laptop, as a subtle way to communicate their current standing to their classmates. Using these

Table 4.12: Potential Areas ICE Could Improve

TechHui Complaints	**Reasoning**
ICS department should have a better sense of community	RadGrad ICE can help students to compete and worth with each other to achieve a common goal.
Survey Questions	**Reasoning**
How well prepared do you feel to find a job after graduation?	RadGrad ICE can help students to gain experience in more areas than just courses. With the "innovation" and "experience" opportunities added to their degree plan, students will have more to offer potential employers than just a decent GPA.
How many extracurriculars have you participated in?	RadGrad ICE can help students to participate in more extracurriculars and a wider variety of extracurriculars as they try to reach 100 points in each category.

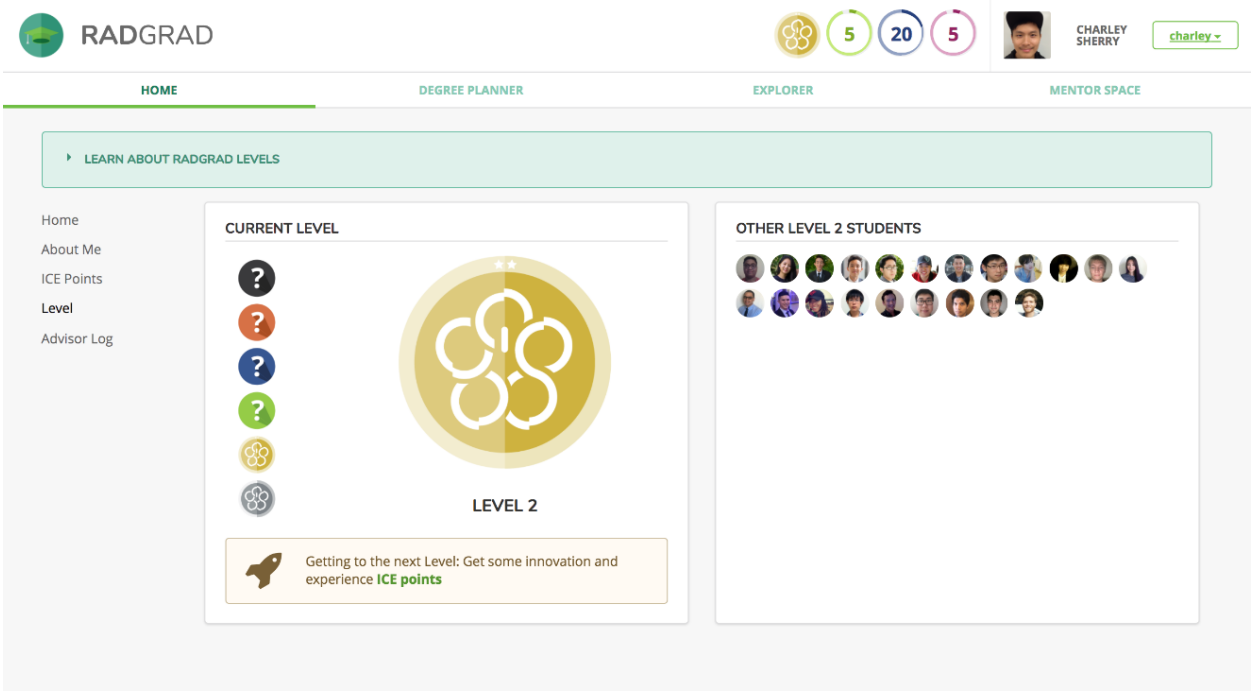


Figure 4.21: Levels page.

stickers, students can more easily identify students who are at the same level as them to mingle with, identify students at a higher level than them to get advice from, and identify students at a lower level who could use some peer mentoring. These stickers can also be used to identify current or former ICS students while off campus. In this way, these physical manifestations of RadGrad help to create a sense of ICS community offline as well.

Table 4.13: Potential Areas Levels Could Improve

TechHui Complaints	**Reasoning**
ICS department should have a better sense of community	RadGrad levels can help students find other students at the same level as them, and also find students who are more advanced and less advanced than them. In this way, students will get a better understanding of those around them.
ICS department should encourage more interaction among students	RadGrad levels can facilitate higher level students helping lower level students, and encourage more competition and interaction overall.
Survey Questions	**Reasoning**
To what extent have ICS peers influenced your development in the ICS program??	RadGrad levels can help students view other students' level achievements as personal goals, and the levels can also help students choose who they interact with in certain situations (i.e. who to help, or who to go to for help).

4.4 Testing

4.4.1 Interactive Testing

RadGrad uses interactive server-side testing with Mocha test runner and Chai Expect Assertions during code production in order to maintain correctness. Each collection class from the data model has tests in a corresponding testing file. These tests include checking if a new collection entity can be defined, if a collection entity can be removed, if a collection entity can be dumped from the database, and if a collection entity can be restored from a dump file to the database. If the collection class includes additional functions specific to that collection, the test file includes tests for those functions as well.

4.4.2 Personas

In order to ensure that a wide variety of students will be able to use RadGrad effectively, we created five personas, where each persona is represented with a student user account on RadGrad. Each persona represents a student at a different part of the degree program. Below are brief descriptions of each persona.

1. Ella Zwick: Ella is a Freshman who has just declared her BA ICS major. She has not taken any ICS courses yet, and she does not have a RadGrad degree plan yet either. She is at Level 1. Her career goal is to be a web developer, and her interests are in civic engagement and web development.

2. Charley Sherry: Charley is a Freshman who is in his second semester of the BS CS curriculum. He is currently enrolled in ICS211 and ICS241. He is at Level 2. His career goal is to be a data scientist, and his interest is in bioinformatics. He has at least 12 competency points for completing ICS111 and ICS141 during the previous semester.

3. Betty Keanu: Betty is a Junior who has completed the BS CS core curriculum (ICS111, ICS141, ICS211, ICS241, ICS311, ICS314) and is currently taking 300+ courses to fulfill the rest of her degree plan. She is at Level 4. Her career goals are graduate school and data scientist, and her interests are big data, visualization, and research. She has completed a few opportunities, and has at least 30 innovation points, at least 36 competency points, and at least 30 experience points.

4. Abigail Kealoha: Abigail is a Junior who is two semesters away from graduating with her BS in CS. She is Level 5. Her career goal is to be a web developer, and her interests are security and software engineering. She has completed several opportunities, and has at least 80 innovation points, at least 80 competency points, and at least 80 experience points. Abigail has also contributed one course review on RadGrad.

5. Alfred Persona: Alfred is a Senior in his last semester of the BS CS curriculum. He is at Level 6. His career goal is a software developer and his interests are in game design, hardware, and virtual reality. He has completed many opportunities, and has at least 100 points for each of the ICE categories. Alfred also contributed 6 course reviews on RadGrad.

The RadGrad team used these personas to test different scenarios while building the interface. For instance, these personas were useful when testing different how types of degree plans appear in the degree planner. Each student has their own degree plan based off their desired degree, interests, and career goals. Each student's degree plan also appears a little differently because of their different statuses in the program (e.g. freshman, sophomore, junior, senior). These personas were also useful when testing how the different components on the student home page would appear for different types of students (e.g. students with few versus many interests, students who have completed many versus few courses and opportunities, etc.)

We also used these personas when we calculated specific gamification aspects, in order to make sure the games were challenging enough, but not unreasonable. For instance, Alfred is in his last semester, and he has reached 100 points in each ICE category. Therefore, Alfred should represent a "RadGrad successful" student. To get to this point, he has a four year plan, and completed 1-2

opportunities and 2 ICS courses per semester. He also did one opportunity each summer for 3 summers. He received 14 As and 2 Bs in his ICS courses. If Alfred had managed to get 100 points in each ICE category while participating in only 1 opportunity per year and with 5 As, 4 Bs, and 7 Cs, he would not represent a "RadGrad successful" student, which would mean that the amount of ICE points given should be lower, making ICE more difficult. Alternatively, if Alfred at his current state had failed to reach 100 in each ICE category, it would suggest that even a "RadGrad successful" student will struggle to reach their ICE goals, so the amount of ICE points given should be higher, making ICE easier to obtain.

4.4.3 Beta Testing

In Spring 2017, after completion of the major Student, Advisor, and Administrator components and pages, we held RadGrad beta tests, which invited selected students and an advisor to view and use the system for the first time. The main goals of these tests were to identify user problems, identify common aspects users like, assess if parts of the user interface are more intuitive or more difficult to use, if there are missing features that should be implemented, if certain features could be improved, and to get a feel of whether users feel that the would use RadGrad and that it would improve their engagement in the ICS degree program. We hoped this data would help us decide if the system so far is going in a promising direction.

4.4.3.1 Student Beta Testing

Student subjects were solicited over email, and were selected in a way that provided us with a wide range of student levels. Each student was given $20 as compensation for 30 minutes of their time. Prior to the testing session, each subject provided their name and UH account, completed ICS courses, completed opportunities, interests, and career goals. Using this information, the student's RadGrad account was set up prior to the session. Each session involved one student and two RadGrad developers (an evaluator to lead the session, and an observer). At the start of the session, the evaulator briefly went over the basic ideas of the system and the different parts that they can interact with. During the second part of the session, the student was allowed to peruse the system and explore or comment on anything they found particularly interesting. During this time, students were given some basic tasks to accomplish (e.g. to find some courses of interest and add them to their degree plan), and were also given time for open exploration. During the third part of the session, the evaluator asked the student to describe what they liked about the system, what they disliked about the system, and whether or not they think they would use this system if it were available to them. The goal of the beta testing was to discover any basic functionality problems, and to get feedback from real students on whether they would find certain features appealing or not. See Table 4.14 for the student beta testing feedback.

Table 4.14: Student beta test results

Positive Feedback	**Problems with System**
Recommended opportunities are useful because otherwise students are only notified by Gerald's emails	ICE points display was confusing
Reduces the amount of work currently needed for students who try to find ways to succeed beyond the classroom.	List of opportunities was hard to view because it was partially off the screen
Degree planner helpful for visualizing pathway	Annoying to have to scroll to see all possible review ratings
Likes the levels and ICE gamification	Confusing to find some things without some kind of tutorial
Level stickers can help students see who they might want to talk to	Performance issue with page loading times
RadGrad and ICE are good at stressing the importance of activities outside of courses	Wish there were notifications for when new opportunities come up
RadGrad provides extra details about courses and opportunities that were previously unknown to the student	Recommended Courses and Recommended Opportunity widgets on the student home page have non-intuitive scrolling behavior
RadGrad helps degree plan to feel less "random"	Wish there were notifications for when new opportunities come up
Likes how RadGrad helps students understand the benefits of internships, which they learned too late would be helpful	Students should be allowed to opt out of showing their current and future courses and opportunities
RadGrad is a good way to keep track of a degree plan, which a student previously wrote on a paper and misplaced it	Wish there were notifications for when new opportunities come up
STAR does not work adequately for many students, and RadGrad could be a good supplement for that	Wish there was less unnecessary clicking while altering the degree planner
Student easily navigated degree planner UI with only some guidance	Wish there were support for specific focus areas
Mentorspace could help students to get an idea of what they can actually do with their degree after graduation	Would like to know ahead of time when certain courses are being offered
The fact that RadGrad helps you plan even if you have no idea what you want to do, whereas with STAR, you have to know what you want to do beforehand	Manual edits to one student's generated plan caused empty extraneous years in the degree planner
Rating courses seems helpful in planning	One student's STAR data included a long gap between years, which wasn't handled well in the degree planner without manual intervention
Liked how degree plan could be generated rather than manual	
Liked the idea of an individual ICS online space	

4.4.3.2 Advisor Beta Test

It was easier to solicit an advisor for the beta test, since Gerald Lau is currently the only ICS advisor. During his session, the evaluator briefly went over the system from the point of view of both students and the advisor. While Gerald did not actually get to interact with the system himself, he was able to see how it would be used, and he was able to give feedback about his perceived usefulness of the system. Gerald's response was positive overall, and he seemed interested in integrating it into future advising.

CHAPTER 5
CONCLUSIONS

The main goal of this thesis was to find evidence of a problem, gather baseline values for this problem, and attempt to address the problem with the initial design and implementation of a system. When I initially gathered TechHui data about the pros and cons of being an ICS student at UH Manoa, I found the first evidence of a problem: over the past eight years, students were not fully satisfied academically, professionally, or socially with their ICS experience. I then researched existing degree planning, social networking, and gamification systems to get an idea of what is currently available to students, and how they could be improved. I then designed and implemented an ICS experience baseline survey, which surveyed 100 current ICS students and asked more specific questions about their ICS experience. The results of this survey gave more concrete evidence that there is room for improvement in the ICS department when it comes to encouraging and enabling students to participate in extracurricular activities, giving students the support they need from all members of the department, and encouraging and enabling students to interact with each other and ICS alumni on an academic or professional level. The results of this baseline survey can be used in a future study that compares the undergraduate experience before and after using RadGrad to test the effectiveness of the system. Along with the rest of the RadGrad team, I have helped to design and implement the RadGrad system, which aims to address many perceived deficiencies within the ICS department. By combining degree planning, social networking, and gamification, RadGrad aims to improve the ICS student experience on academic, professional, and social levels.

With the current implemented features, RadGrad aims to solve the following eight out of the ten complaints from the TechHui data, and seven out of the eleven baseline survey questions (not including the demographic questions) 5.1. The social networking features encourage students to get to know and work with other members of the community, which aim to solve numbers 3, 4, 7, and 8 (TechHui) and 2, 3, 4, and 5 (baseline survey). The degree planner system, and explorers will help students become more aware of the different opportunities available to them, and allows students to create their own customized ICS experience based off their own interests, career goals, and time constraints which aim to solve number 1, 2, 5, and 6 (TechHui) and 1, 6, and 7 (baseline survey). Gamification also helps students motivate each other and enforces the importance of excelling in both courses and opportunities, which aims to solve 3 and 8 (TechHui) and 1, 4, 5, 6 ,and 7 (baseline survey). Although RadGrad doesn't currently address all of the problems that students have, it could potentially cover more issues in future deployments.

When comparing RadGrad to the existing degree planning systems discussed in Section 2, RadGrad implements many potentially degree experience enhancing features that these current systems do not 5.2.

When comparing RadGrad to the existing social networking systems discussed in Section 2,

Table 5.1: TechHui Complaints and Survey Questions Potentially Addressed by RadGrad

TechHui Complaints	**Survey Questions**
The ICS department needs to offer classes more frequently.	Which of the following extracurricular activities, if any, pertain to you?
The ICS department needs to offer a wider variety of classes.	Do you feel that you get enough support from others in the ICS department?
The ICS department needs a better sense of community.	To what extent have ICS alumni influenced your development in the ICS program?
Some of the professors in the ICS department need to improve their teaching.	To what extent have ICS peers influenced your development in the ICS program?
The ICS department should offer more focused areas of study.	To what extent have you influenced your ICS peers development in the ICS program?
CS classes are too time consuming and take up more time than anticipated.	Now that you are nearing the end of your ICS degree program experience, how well prepared do you feel to find a job after graduation?
ICS courses should involve more group work.	If you answered above that you feel unprepared to find a job after graduation, please explain why.
ICS should encourage more interaction among students.	

Table 5.2: Comparison of existing degree planner systems and RadGrad

	STAR	**Starfish**	**College Scheduler**	**Blackboard Planner**	**Coursicle**	**RadGrad**
Major specific						X
Provides personal degree plan recommendations			X			X
Helps students explore interests				X		X
Helps students explore career goals				X		X
Emphasizes extracurriculars in degree plans						X

RadGrad implements many potentially socially helpful features that these current systems do not 5.3.

Table 5.3: Comparison of existing social networking systems and RadGrad

	LinkedIn	**TechHui**	**Rate My Professors**	**RadGrad**
Special support for students			X	X
Encourages open and honest communication between professors, students, alumni, advisors		X		X
Computer science focused		X		X
Local community		X		X

When comparing RadGrad to the popular video games discussed in Section 2, RadGrad implements many of the same gamification features as several of these games 5.4.

Table 5.4: Comparison of popular games and RadGrad

	League of Legends	**Hearthstone**	**Overwatch**	**Pokemon Go**	**RadGrad**
Enjoyable/ addicting/ satisfying	X	X	X	X	Not yet determined
Multiplayer	X	X	X	X	X
Work together as a team to advance individually	X		X	X	X
Small and large rewards throughout	X	X	X	X	X
Rewards for putting in the time	X		X	X	X
Persistence of the player	X	X	X	X	X

When comparing RadGrad to the common game mechanics that many serious games use, as discussed in Section 2, RadGrad implements 8 of the 12 game mechanics as well. 5.5.

Comparing RadGrad to existing degree planning, social networking, and game systems suggests that RadGrad can potentially improve upon and combine aspects from these three areas together in a novel way. After completing this thesis, RadGrad development will continue, and is scheduled to be deployed within the ICS department in Fall 2017. Future studies will be necessary to test whether or not RadGrad is adequately addressing problems within the department. After students have integrated RadGrad into their life for around 18 months (the time needed to go through once

Table 5.5: Comparison of common game mechanics in serious games and RadGrad

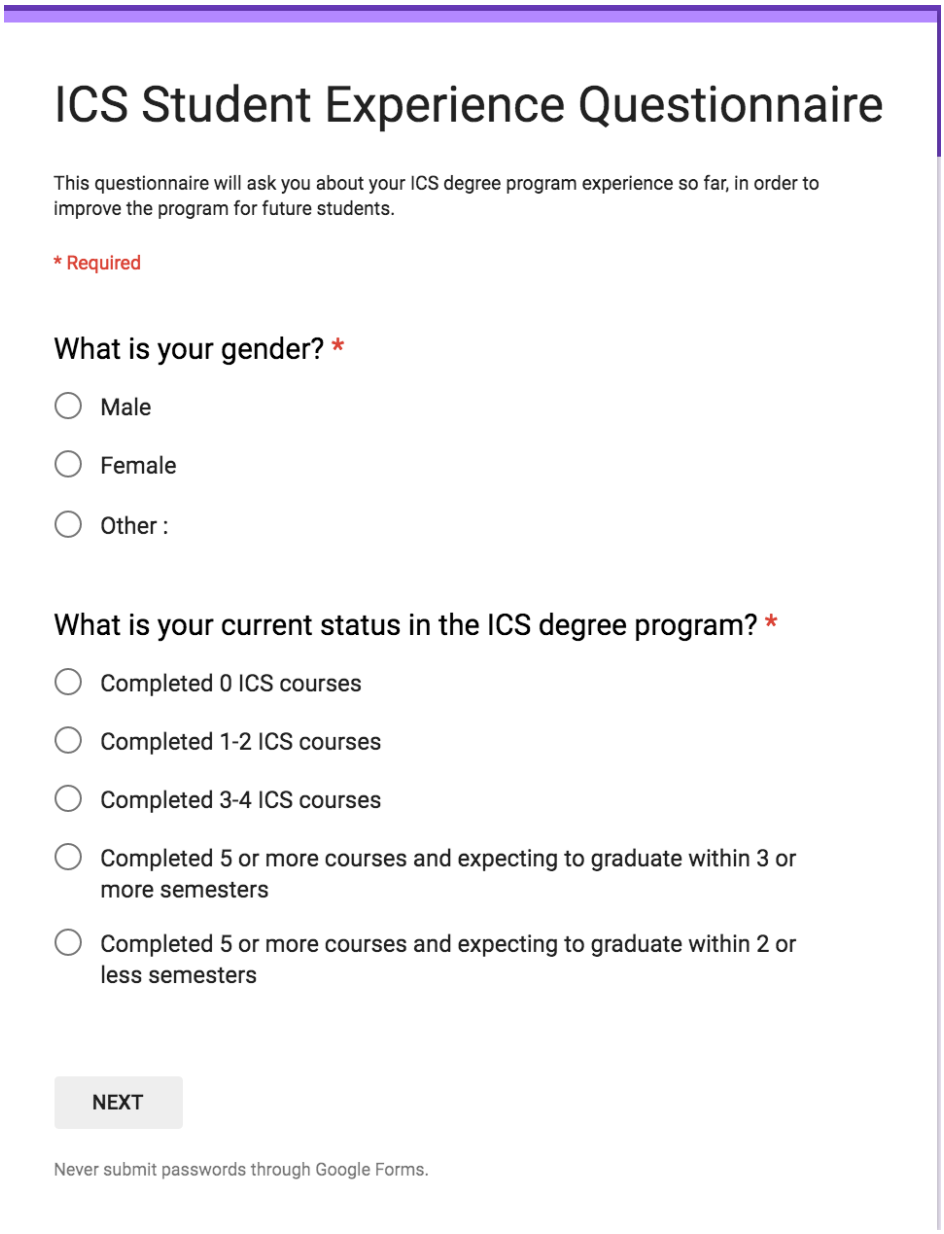
Game mechanics	**RadGrad Implementation**
Points	ICE points
Achievements	RadGrad levels award badges for certain achievements
Progression	ICE graphs change throughout the degree program to reflect progress
Countdown	Students must achieve 100 ICE points in each area before they graduate
Quests	Each semester in a student's degree plan represents a set of obstacles (courses and opportunities) that they must overcome
Loss Aversion	Students can maximize their ability to gain points and levels by choosing courses and opportunities that interest them, rather than courses or opportunities they believe they may not do well in.
Status	Levels establish a sense of status
Community Collaboration	Students can meet each other on RadGrad and work together to achieve ICE points and levels

registration process several times and have enough time to participate in several opportunities and courses), future studies may want to conduct another survey with ICS students. This survey could include similar questions to the survey conducted in my survey, which can then be used to compare and contrast pre- and post-RadGrad results. To account for possible confounding variables, this survey could also include more RadGrad specific questions, to get a more direct idea of how students feel about using the system. Furthermore, gathering usage statistics could possibly add valuable insight into how users are actually responding to and interacting with the system. Based on the results of these studies, RadGrad could either be further improved to better solve the perceived problems, or discarded if there is no evidence that RadGrad has any positive impact on the ICS community.

Assuming that RadGrad is successful within the ICS department, future possible expansions include integration into other departments at UH Manoa, being established as a staple UH system that will get its own funding and staff positions, being integrated at other universities, being available for high school students to learn more about the department before choosing a major, and finally being integrated in other environments, such as within tech companies.

This thesis marks the beginning of the RadGrad journey, and will hopefully be the first of many studies. After completing this thesis, the overall results suggest that RadGrad is progressing in a promising direction, and if it continues on that path, it will have the potential to positively revolutionize the lives of future students in many different ways.

APPENDIX A
BASELINE ASSESSMENT



ICS Student Experience Questionnaire

This questionnaire will ask you about your ICS degree program experience so far, in order to improve the program for future students.

* Required

What is your gender? *

- Male
- Female
- Other :

What is your current status in the ICS degree program? *

- Completed 0 ICS courses
- Completed 1-2 ICS courses
- Completed 3-4 ICS courses
- Completed 5 or more courses and expecting to graduate within 3 or more semesters
- Completed 5 or more courses and expecting to graduate within 2 or less semesters

NEXT

Never submit passwords through Google Forms.

Figure A.1: Baseline Assessment: Section 1.

ICS Student Experience Questionnaire

Prospective ICS Students

We are gathering information about the initial feelings of prospective ICS students. Please answer the following questions as honestly as possible. Current ICS students may skip to the next section.

How EXCITED are you about entering the ICS program? Rank from 1-5.

	1	2	3	4	5	
Not at all excited	○	○	○	○	○	Very excited

How INTIMIDATED do you feel about entering the ICS program? Rank from 1-5.

	1	2	3	4	5	
Not at all intimidated	○	○	○	○	○	Very intimidated

BACK NEXT

Never submit passwords through Google Forms.

Figure A.2: Baseline Assessment: Section 2.

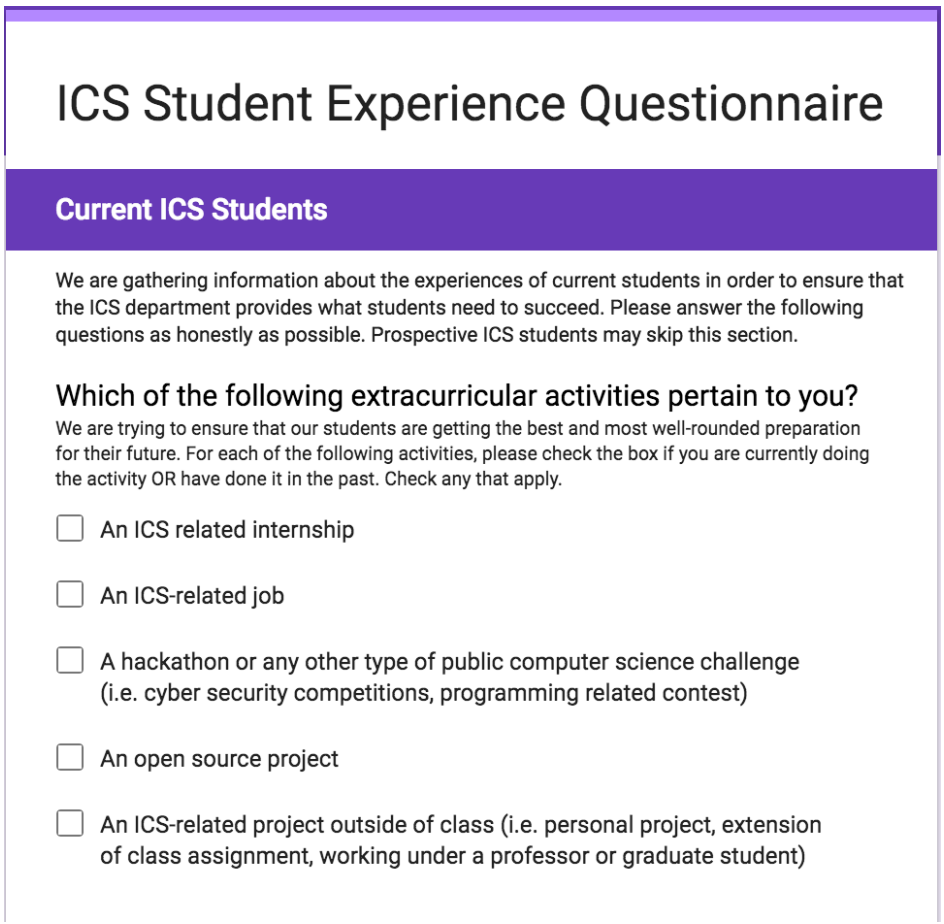


Figure A.3: Baseline Assessment: Section 3.

Do you feel that you get enough support from others in the ICS department?

Check any that apply.

- [ ] I would like more support from professors in the ICS department.
- [ ] I would like more support from TAs in the ICS department.
- [ ] I would like more support from my peers in the ICS department
- [ ] I would like more support from the counselors in the ICS department
- [ ] I feel adequately supported by others while pursuing my degree in the ICS department.
- [ ] I often feel completely alone in the ICS department and thus only depend on myself

As a student, do you feel like you have a voice to make changes within the department?

- ◯ Yes
- ◯ Somewhat
- ◯ No

Figure A.4: Baseline Assessment: Section 3.

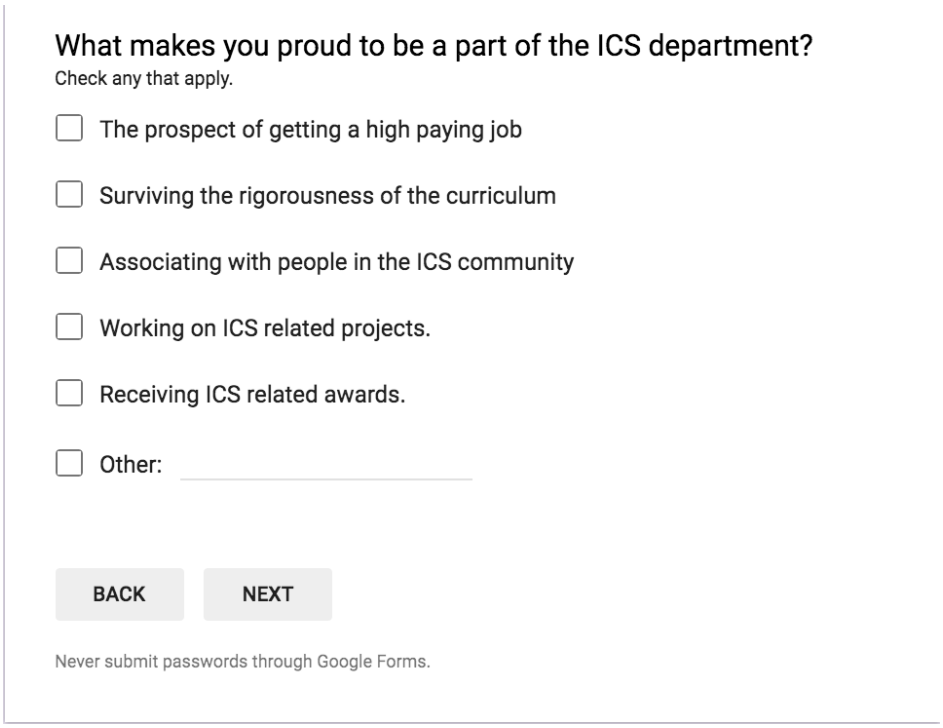


Figure A.5: Baseline Assessment: Section 3.

ICS Student Experience Questionnaire

Current ICS Students: Influences

We are interested to know more about who has influenced you in your ICS degree experience, and who you might have influenced. Prospective ICS students may skip this section.

To what extent have ICS alumni influenced your development in the ICS program?

Check all that apply. Influences include giving advice, answering questions, job recommendations, course recommendations, etc.

- [ ] I have not been influenced by any ICS alumni.
- [ ] An ICS alumni influenced me to pursue a major in ICS.
- [ ] An ICS alumni influenced me to improve my professional development.

To what extent have ICS peers influenced your development in the ICS program?

Check all that apply. Influences include giving advice, answering questions, job recommendations, course recommendations, etc.

- [ ] I have not been influenced by any ICS peers
- [ ] An ICS peer influenced me to pursue a major in ICS.
- [ ] An ICS peer influenced me to improve my professional development

Figure A.6: Baseline Assessment: Section 4.

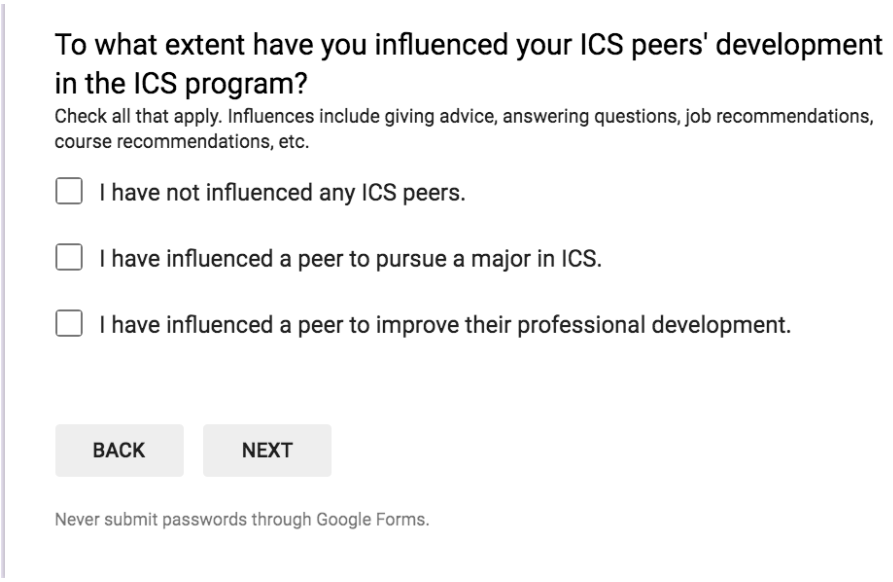


Figure A.7: Baseline Assessment: Section 4.

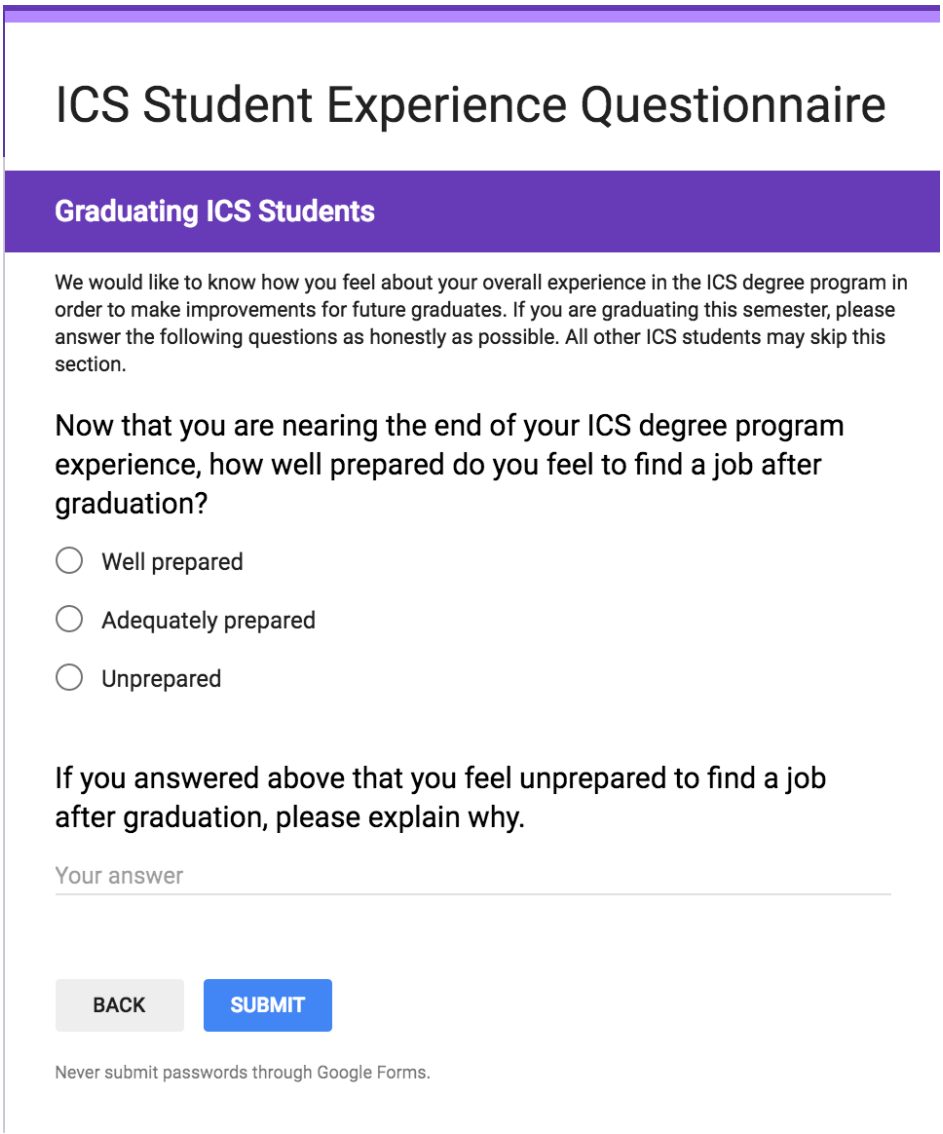


Figure A.8: Baseline Assessment: Section 5.

APPENDIX B
RADGRAD DATA MODEL

B.0.1 Career Goals

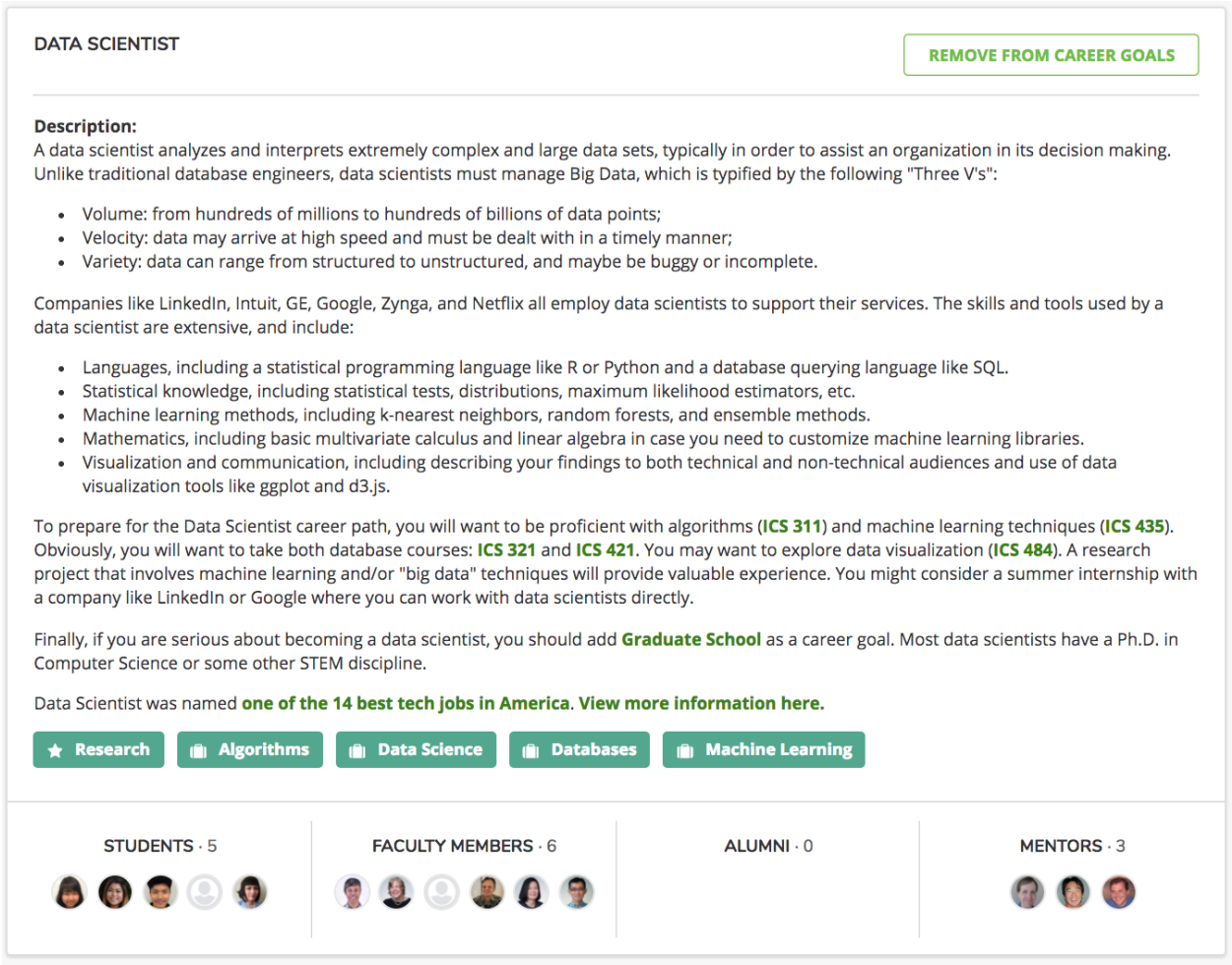


Figure B.1: Example of a career goal representation.

Career goals represent possible ICS related careers that ICS students can aspire to get after graduation (Figure 6.1). Each career goal has an associated name, slug, description, related interests, and an optional URL for more information. Students can choose as many career goals as they want. Faculty and mentors can choose career goals that they would like to be associated with as well. Possible career goals as of June 2017 are listed in Table B.1.

Data Scientist	Database Administrator	DevOps Engineer
Full Stack Developer	Game Developer	Graduate School
Information Security Analyst	Information System Manager	IoT Architect
Mobile App Developer	Network Engineer	Research Scientist
Robotics Engineer	Software Developer	Startup Co-Founder
Teacher	UX Designer	VR/AR Engineer

Table B.1: List of RadGrad career goals as of June 2017

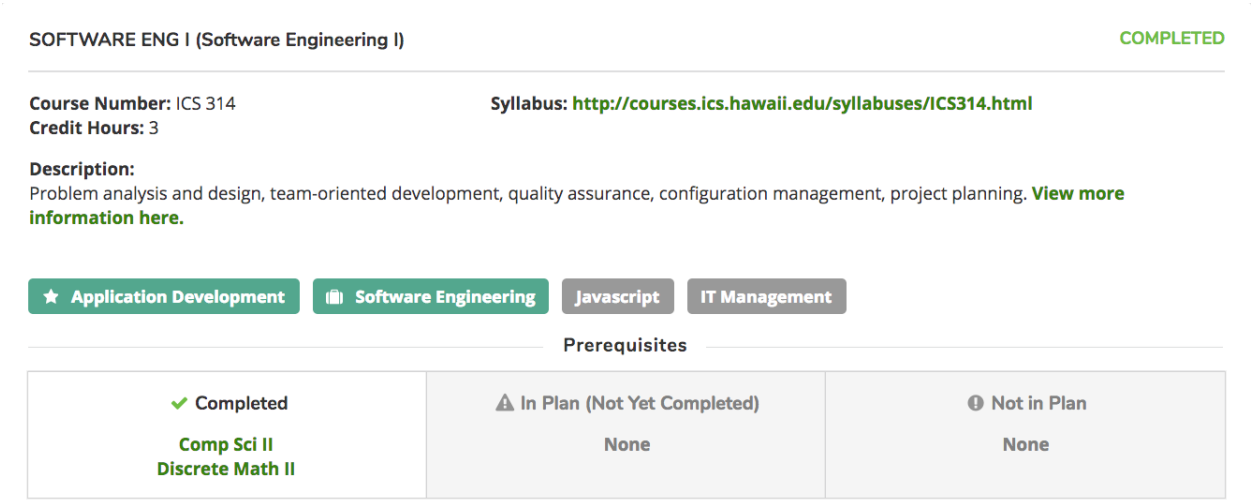


Figure B.2: Example of a course representation.

B.0.2 Courses

Courses represent all past, present, and future ICS courses (Figure B.2). Each course has an associated name, short name, slug, course number, description, credit hours, related interests, a syllabus URL, a URL for more information, and associated prerequisites. The course name is the official name appearing in the UH registration guide, and the course short name is used for display purposes. Students may add as many courses as they would like to their degree plan.

Course instances represent individual instances for each student. Each course instance has an associated semester, course, whether it has been verified or not, whether it came from STAR or not, grade, credit hours, note, student, and associated ICE points. A past course instance is always considered verified if it is from STAR. Course instances from STAR from the current or future semesters are not considered verified yet since there is no official grade. Special courses that are manually input (not from STAR) could also be considered verified by an advisor. A course instance has a note if it is not an ICS course. It is important to note that course instances on RadGrad are only valid on RadGrad, and students must use other methods to officially make UH course registration changes.

B.0.3 Desired Degrees

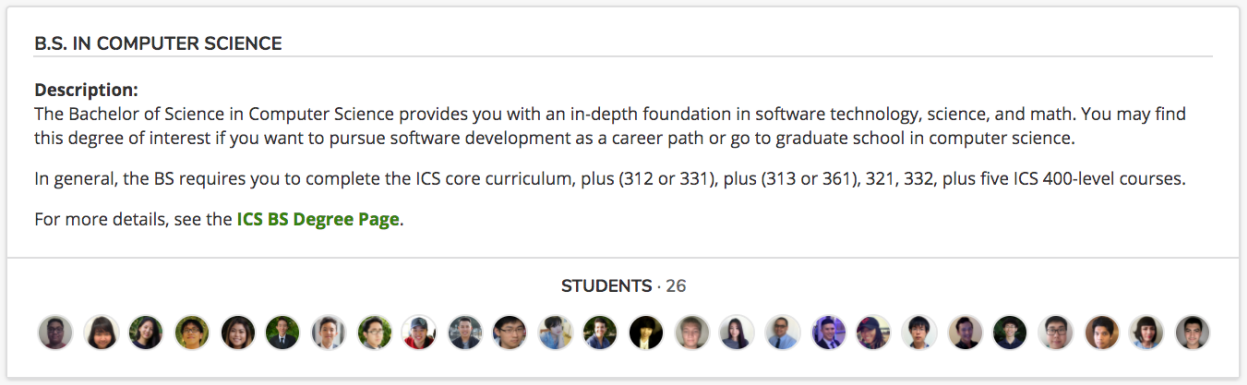


Figure B.3: Example of a desired degree representation.

Desired degrees represent all past, present, and future ICS degrees (Figure B.3). Each desired degree has an associated name, short name, slug, and description. Students can only choose one desired degree at any given time. However, they are free to switch desired degrees as many times as they want. It is important to note that desired degrees on RadGrad are only valid on RadGrad, and students must use other methods to officially change their declared degree at UH.

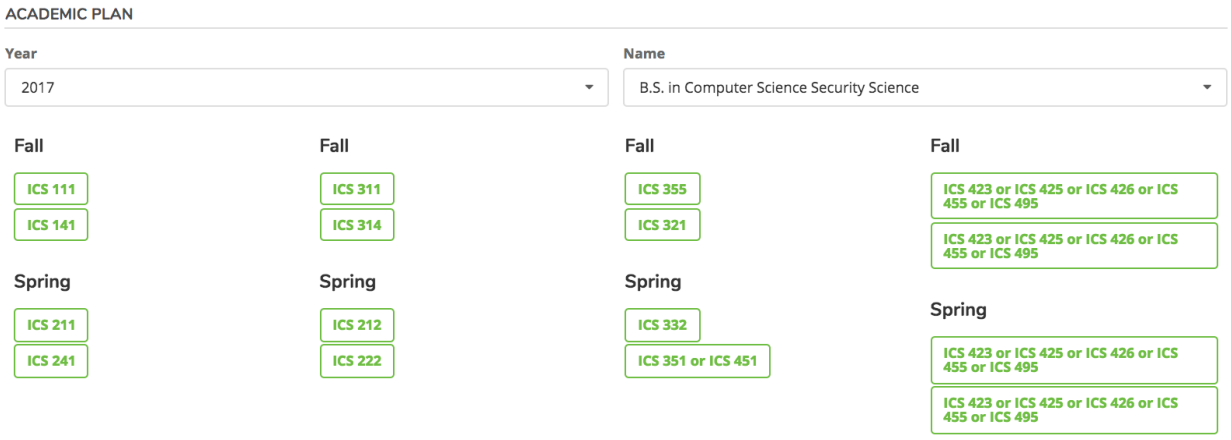


Figure B.4: Example of a degree plan representation.

B.0.4 Degree Plan

Degrees plans represent all past, present, and future ICS degree plans (Figure B.4). Each degree plan has an associated degree, name, effective semester, amount of courses per semester, and list of courses. Students can view degree plans if they would like a more specific focus than just a broad BS or BA degree. Examples of degree plans are "BS in Computer Sciences Security Sciences", "BA in ICS Security Science Focus", and "BA in Computer Sciences IT Focus." Students can look at any plan at any time to see what they would need to do to fulfill it. It is important to note that these degree plans change over time, and a "BS in Computer Sciences Security Sciences" may be different in 2016 than in 2018. This is why both year and plan name must be chosen when selecting a plan. Degree plans were created to help students to become more aware of and make sense of the different degree plans that they can choose from. Having these representations on RadGrad help students to see how different degree plans would work with their specific interests, career goals, courses, and opportunities. Overall, degree plans can help students to narrow down their interests into a more specific field.

B.0.5 Feeds

Figure B.5: Example of a feed representation.

Feeds represent select actions of RadGrad users (Figure B.5). Each feed has associated users,

opportunity, course, semester, description, time stamp of the action, picture, and feed type. A feed could have one or multiple users. There are currently six different feed types: a new RadGrad user is added, a new course is added to RadGrad, a new opportunity is added to RadGrad, a user has been verified for completing an opportunity, a new course review has been added, and a new opportunity review has been added. These particular actions have been selected because they could be useful and of interest to other RadGrad users.

B.0.6 Feedbacks

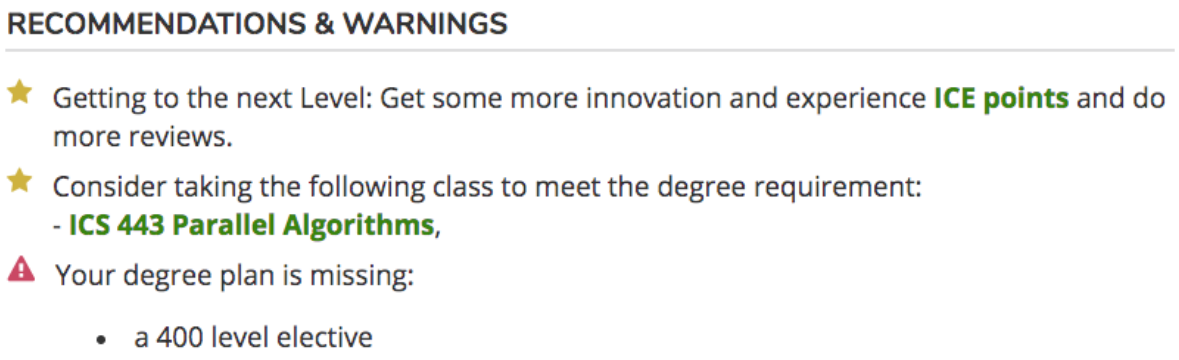


Figure B.6: Example of feedback representations.

Feedbacks represent recommendations and warnings for students (Figure B.6). Each feedback has an associated name, slug, description, and feedback type. There are currently two feedback types: recommendation and warning.

Feedback instances represent individual instances for each student. Each feedback instance has an associated feedback, user, description, and area. There are currently four different areas: interests, ICE, STAR, and degree plan. Each time the student's plan changes, feedback instances in these areas are deleted and recalculated.

B.0.7 Help Messages

Help messages represent guidance for a particular RadGrad page (Figure B.7). Each help message has an associated route name, title, and text. The text can contain actual text, images, and formatting. Each page (route name) can have at most one help message. These help messages are displayed at the top of the specified page, in a collapsible pane.

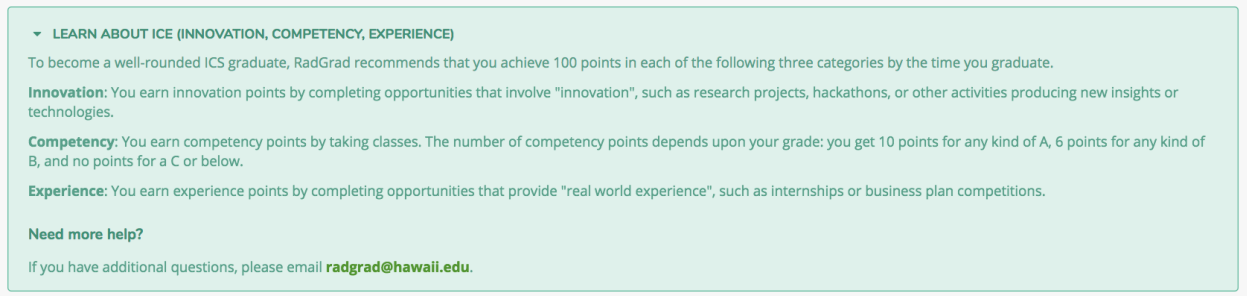


Figure B.7: Example of a help representation.

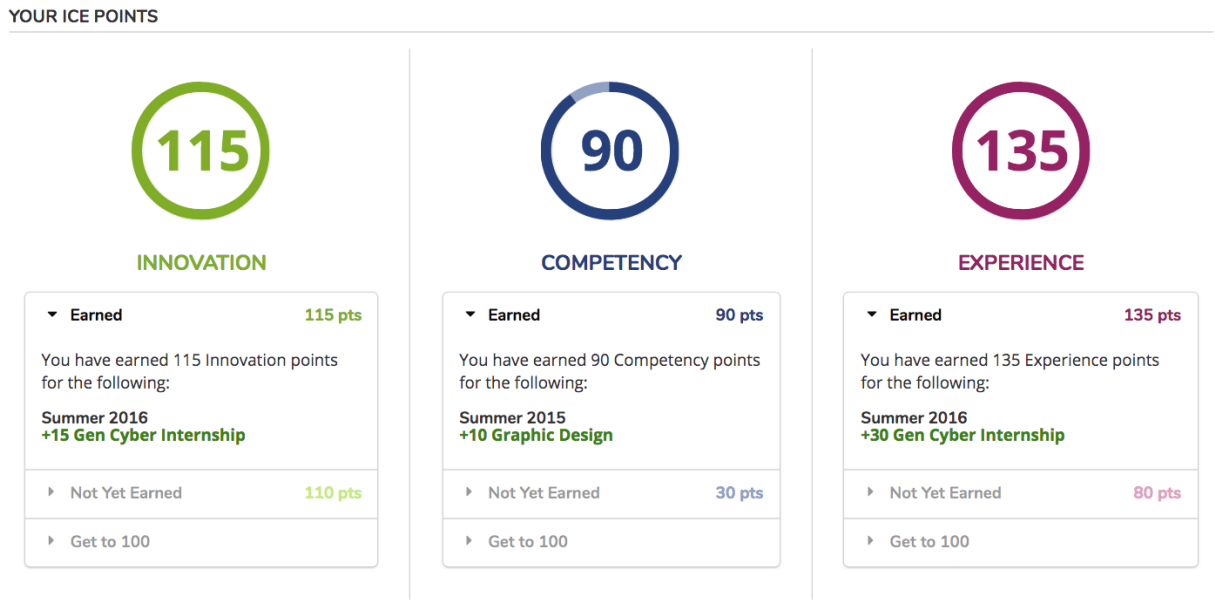


Figure B.8: Example of an ICE representation.

B.0.8 ICE

ICE represents a student's ICE points (Figure B.8). Each ICE has an associated number for "I", "C", and "E." There are two types of ICE points: earned and planned. Earned "I" and "E" points are calculated by adding the "I" or "E" points for each verified opportunity in the student's plan. Earned "C" points are calculated by adding the "C" points for each verified course in the student's plan. The amount of earned points for each course depends on the grade that the student received; A's represent more points than B's. Planned "I" and "E" points are calculated by adding the "I" or "E" points for each unverified opportunity in the student's plan. Planned "C" points are calculated by adding the "C" points for each unverified course in the student's plan. A student's earned and planned ICE points are updated each time there are changes to the student's degree plan.

B.0.9 Interests

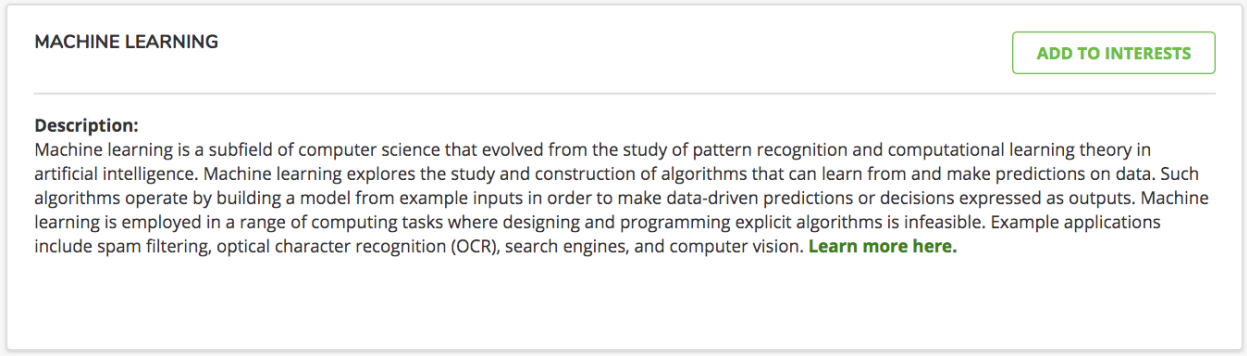


Figure B.9: Example of an interest representation.

Interests represent possible ICS related interests that RadGrad users could have (Figure B.9). Each interest has an associated name, slug, description, interest type, and a URL for more information. All RadGrad users may choose to be associated with as many interests as they would like. All current interests on RadGrad as of June 2017 are listed in Table B.2.

B.0.10 Levels

Levels represent a student's RadGrad level (Figure B.10). There are six possible levels, from Level 1 to Level 6. A student's level is calculated based off the amount of ICS courses they have passed, the amount of opportunities they have done, and the amount of reviews they have contributed on RadGrad. Levels can be recalculated for all users at any time through the administrator pages.

.NET	Algorithms	Android
Application Development	Artificial Intelligence	Assembler
Bioinformatics	Biology	C and C++
C#	Civic Engagement	Cognitive Science
Computer Architecture	Computer Ethics	Computer Graphics
Computer Vision	Cryptography	Data Science
Data Visualization	Databases	Entrepreneurship
Game Design	Graphic Design	Hardware
High Performance Computing	Human-Computer Interaction	IT Management
Java	Javascript	Linux
Lisp	Machine Learning	Mobile Computing
Networks	Operating Systems	Parallel Programming
Perl	Prolog	Psychology
Python	R	Research
Robotics	Ruby	Software Development
SQL	Security	Sustainability
Teaching	Theory of Computation	Unity
Virtual Reality	Web Development	iOS

Table B.2: List of RadGrad interests as of June 2017

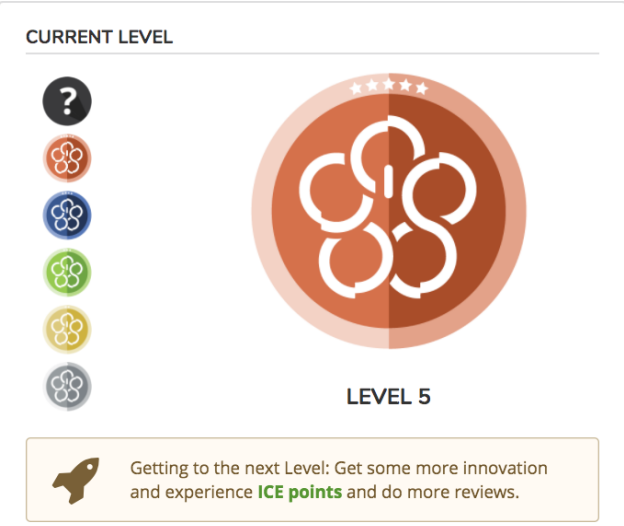


Figure B.10: Example of a level representation.

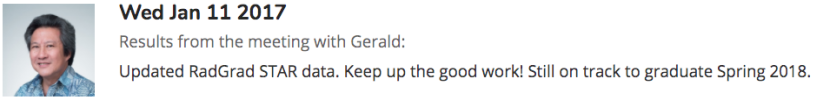


Figure B.11: Example of an advisor log representation.

B.0.11 Advisor Logs

Advisor logs represent an interaction between an ICS advisor and a student (Figure B.11). Each advisor log has an associated student, advisor, text, and date created. A new log can be created by the advisor whenever they have a meeting with a student. Advisors and students can use these logs to keep track of when meetings were held, and what occurred at these meetings.

B.0.12 Mentors

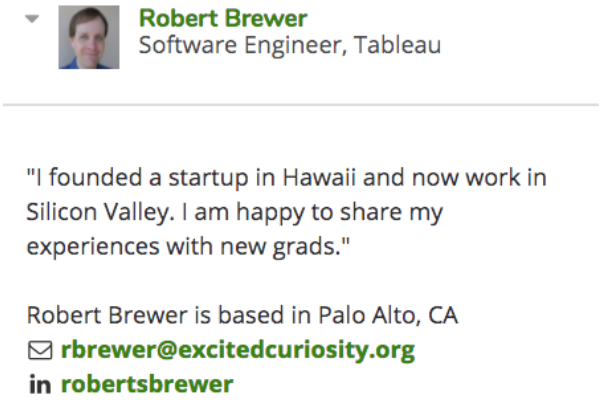


Figure B.12: Example of a mentor representation.

The mentor data model includes three parts: mentor profiles, mentor questions, and mentor answers (Figure B.12). Each mentor profile has an associated mentor, company, career, location, LinkedIn, and a message about what motivated them to become a mentor. Each mentor will have exactly one mentor profile.

Each mentor question has an associated title, slug, student, whether it is moderated or not, whether it is visible or not, and moderator comments. Students can create as many mentor questions as they would like. However, each question needs to be approved by moderation in order to be visible to the public. Advisors and administrators have the ability to moderate questions. If a question is declined by moderation, the moderator can add reasons for the decline in the moderator comments field. The student can then see the feedback, and they are able to either edit their question and send it back to moderation, or simply discard the question. There is no limit to how long the back and forth process between student and moderator can go on.

Each mentor answer has an associated question, mentor, and text. Each mentor question can have any amount of mentor answers, but each mentor answer can answer at most one mentor question. Each mentor question can only be associated with exactly one mentor. There is no moderation process for mentor answers, and submitted mentor answers are automatically visible

on RadGrad.

B.0.13 Opportunities

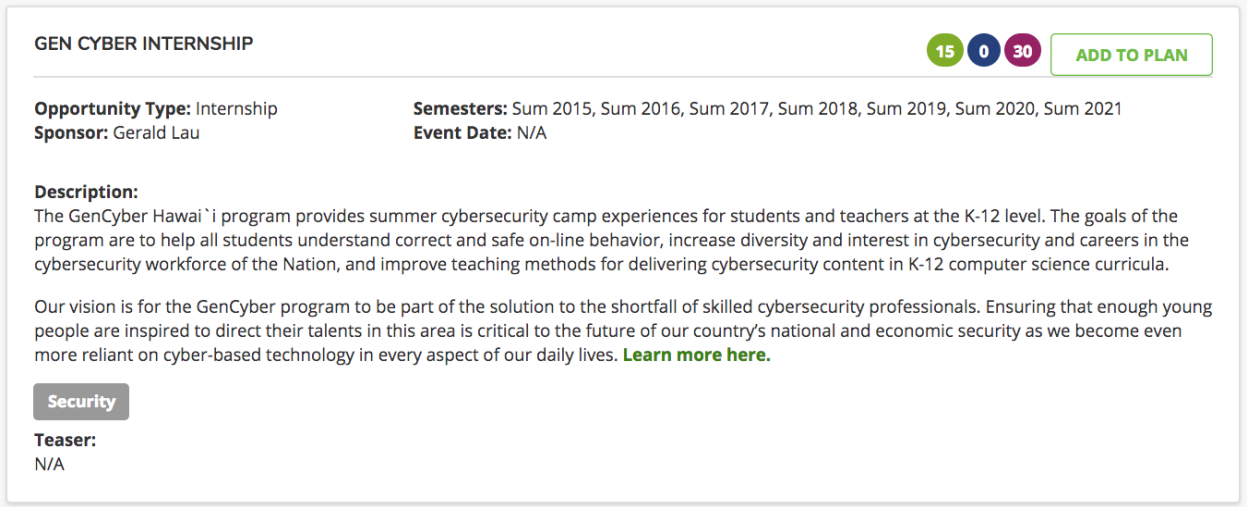


Figure B.13: Example of an opportunity representation.

Opportunities represent all past, present, and future ICS related opportunities (Figure B.13). Each opportunity has an associated name, slug, description, opportunity type, sponsor, related interests, icon, semesters available, event date, whether it is an independent study or not, URL for more information, and ICE points. Currently, there are five opportunity types: club, event, internship, online learning, and project. The opportunity sponsor is any faculty member who is the point of contact for the opportunity. If the opportunity occurs on a semester basis, it will have associated semesters. If the opportunity occurs on a specific date, it will have an associated event date. The amount of ICE points varies depending on the nature of the opportunity, and is determined by RadGrad administrators.

Opportunity instances represent individual instances for each student. Each opportunity instance has an associated semester, opportunity, whether it is verified or not, student, and ICE points. An opportunity instance can only be verified by a RadGrad advisor or faculty. Two students that each have an opportunity instance for the same opportunity could have different ICE points depending on the extent of their involvement in the opportunity.

B.0.14 Public Stats

Public stats calculate 24 different RadGrad statistics from the current database (Figure B.14). The statistics calculated are: total courses, total career goals, list of career goals, total desired degrees, list of desired degrees, total interests, list of interests, total opportunities, total project

Figure B.14: Example of a public stats usage on the landing page.

opportunities, list of project opportunities, total users, total students, total faculty, total mentors, list of mentor professions, list of mentor locations, total course reviews, list of courses reviewed, total level one students, total level two students, total level three students, total level four students, total level five students, and total level six students. Public stats are automatically recalculated once each day at midnight.

B.0.15 Reviews

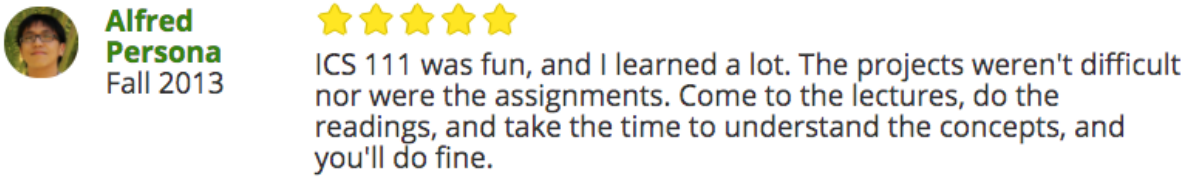


Figure B.15: Example of a review representation.

Reviews represent all course and opportunity reviews written by students on RadGrad (Figure B.15). Each review has an associated slug, student, review type, reviewee, semester, rating, comments, whether it is moderated or not, whether it is visible or not, and moderator comments. There are two review types: course and opportunity. The reviewee refers to the course or opportunity that is being reviewed. Each review must have a rating from one to five stars (Figure B.16). Each student may review a course once the semester they have taken it in has passed. Each student may review an opportunity once the opportunity has been verified. Each student can review each course or opportunity at most once. Each review is visible to the public by default, but can be removed by moderators. Advisors and administrators have the ability to moderate reviews. If a review is declined by moderation, the moderator can add reasons for the decline in the moderator comments

field. The student can then see the feedback, and they are able to either edit their review and send it back to moderation, or simply discard the review. There is no limit to how long the back and forth process between student and moderator can go on. A student can also update their review at any time, but this will mean that the review will go through the moderation process again.

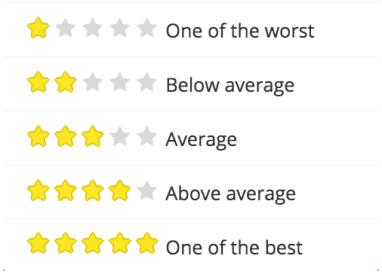


Figure B.16: Course and opportunity review ratings.

B.0.16 Roles

Roles represent the different user roles allowed in RadGrad. There are currently six roles: faculty, student, admin, alumni, advisor, and mentor. Currently, users are allowed to have exactly one role. All users except for admin and advisor can view only their own RadGrad pages. Advisors can also view student RadGrad pages, and admin can view all RadGrad pages.

B.0.17 Semesters

Semesters represent an academic semester at the University of Hawaii. Each semester has an associated term, year, number to sort by, semester number, and slug. There are three possible terms: Spring, Summer, and Fall. The number to sort by easily allows chronological comparisons between semesters. Semester number is another number used for sorting semesters, using 2010 as the earliest year.

B.0.18 Slugs

Slugs are strings used as part of a URL to uniquely identify an entity. These strings do not change with different instantiations of the database like docIDs do. Slugs are used in the RadGrad data model to represent relationships between different entities. Therefore, only collections that need to be referenced by other collections contain a slug.

B.0.19 Teasers

Teasers represent short videos that advertise an ICS opportunity (Figure B.17). Each teaser has an associated title, slug, author, URL, description, duration, related interests, and opportunity. Any

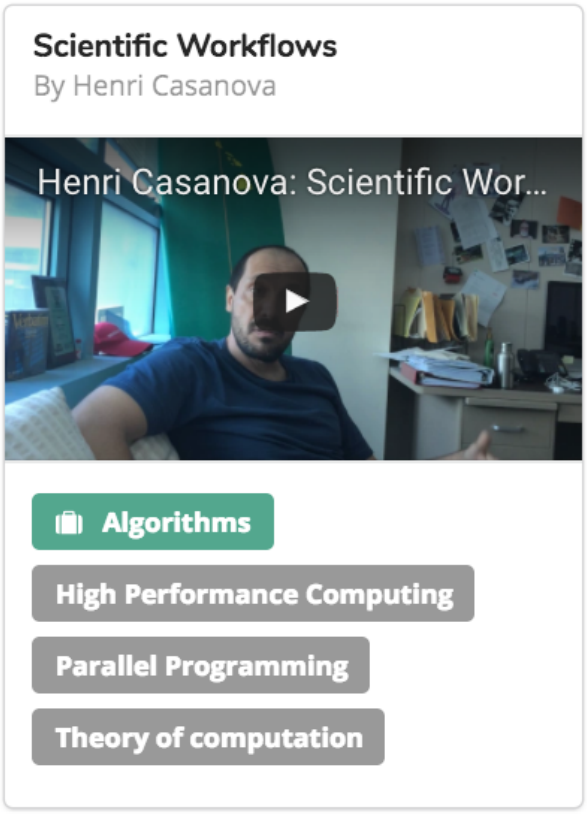


Figure B.17: Example of a teaser representation.

member of RadGrad can be an author of a teaser. Teasers are typically less than a minute long and function as a sort of quick advertisement to get potential students interested in participating in that particular opportunity.

B.0.20 Users

Figure B.18: Example of user representations.

Users represent anyone who has created an account on the RadGrad system (Figure B.18). Each user has an associated username, first name, last name, slug, email, password, UH ID, career goals, interests, desired degree, picture, level, website, hidden courses, and hidden opportunities. The user's RadGrad username is the same as their UH email name. This, along with their email, cannot be changed once the user's account is created. Only student users will have a desired degree and a level. Hidden courses and hidden opportunities are used to keep track of courses

and opportunities that students have actively "hidden" from their page. By keeping track of these hidden courses and opportunities, students can have the option to make them visible again.

B.0.21 Verification Requests

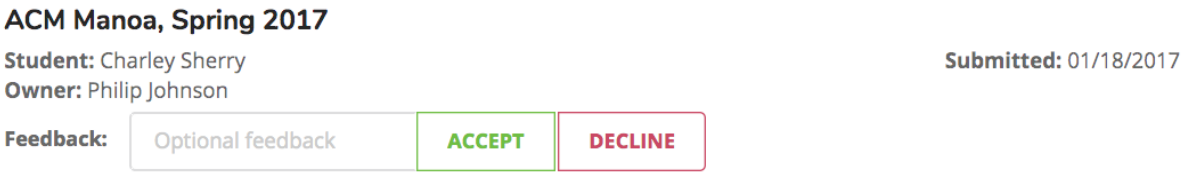


Figure B.19: Example of a verification request representation.

Verification requests represent a request from a student to get verification and ICE points for completing an opportunity (Figure B.19). Each opportunity has an associated date, status, verifier, and feedback. There are three possible statuses: accepted, rejected, and open. The verifier is the user who has verified the event. Only advisors, faculty, and admin can be a verifier. If a request is rejected, the verifier can add reasons for the rejection in the feedback field. The student can then see the feedback and the results of the verification. If the verifier wishes to reopen the verification request, they may do so at any time. A student who would like to reopen a request will need to contact the verifier.

B.0.22 Academic Years

Academic years represent an academic year at the University of Hawaii. Each academic year has an associated year, spring year, student, and semesters. Since academic years start in the Fall and end in the Summer, they span two years: year, and spring year. A student on RadGrad must have an academic year for each year, or portion of a year, that they are enrolled in an ICS course or participated in an ICS opportunity.

APPENDIX C
OTHER RADGRAD USER COMPONENTS

C.1 Advisor Mode

C.1.1 Student Configuration

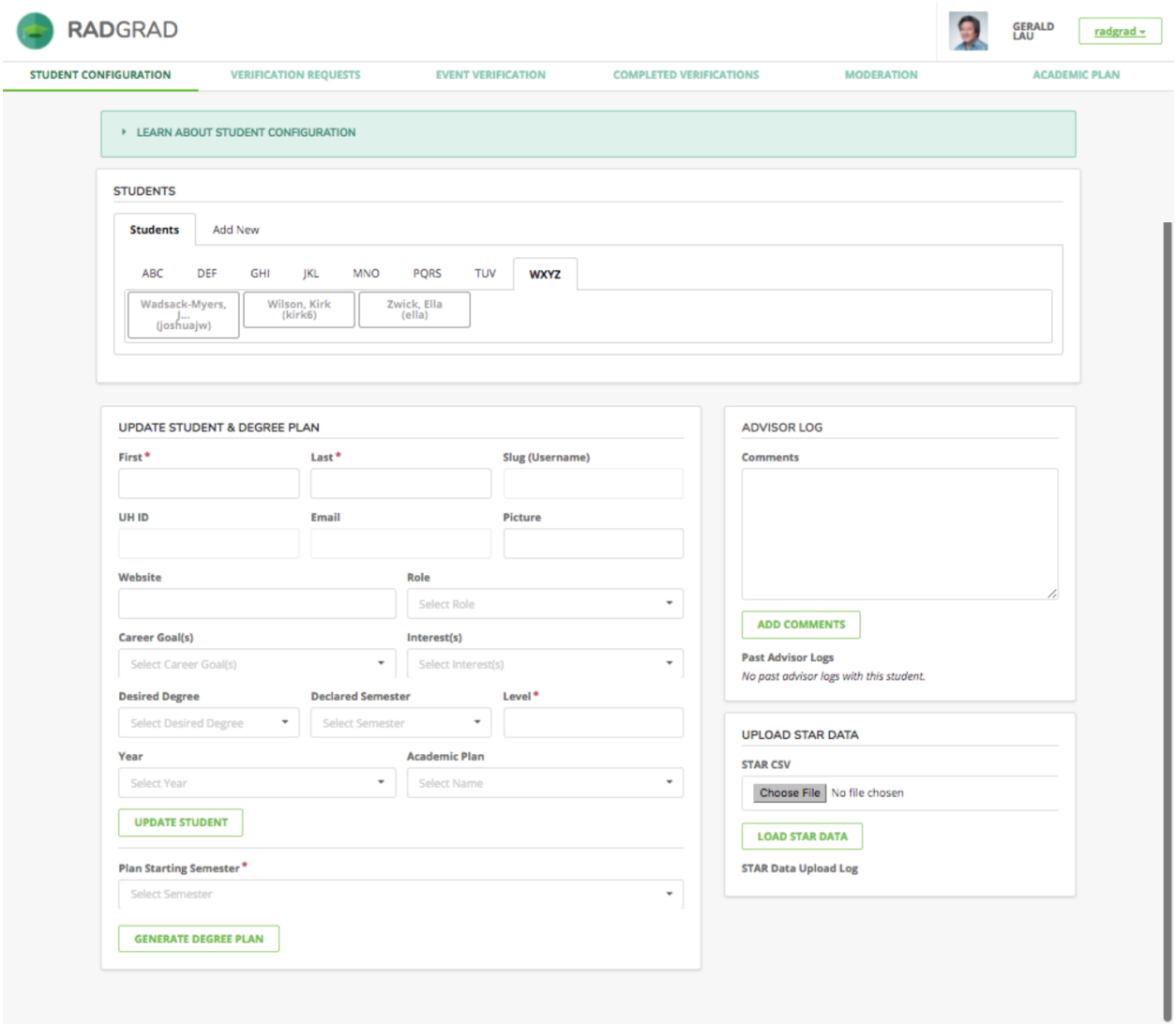


Figure C.1: Advisor student configuration page.

On the student configuration page, advisors can add new students or update existing students (Figure C.1). Existing students are listed alphabetically by last name. Advisors can update a student's first name, last name, picture, website, role, career goals, interests, desired degree,

declared semester, level, year, academic plan, and plan starting semester from this interface. (Slug, email, and UH ID cannot be changed once the student has been added to RadGrad). On this page, advisors can also add advisor log comments and view any past advisor logs for a particular student. Advisors can also use this page to upload new star data and view past star data uploads.

C.1.2 Verification

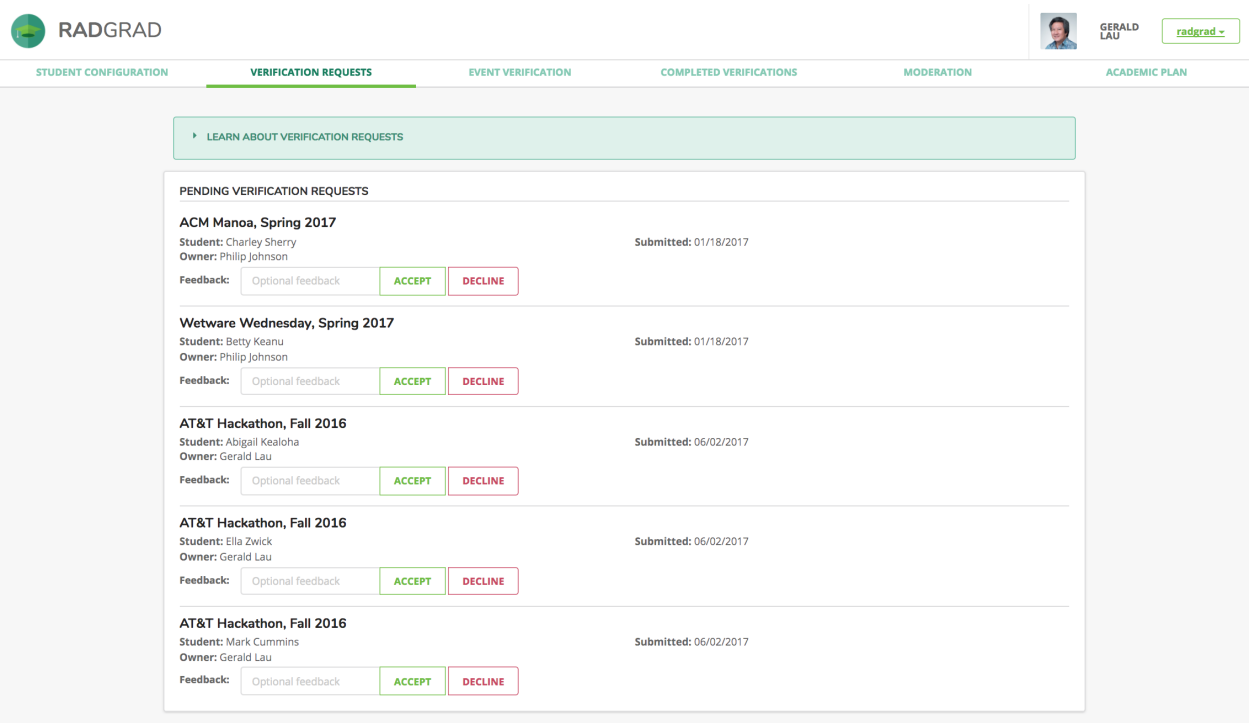


Figure C.2: Advisor pending verifications page.

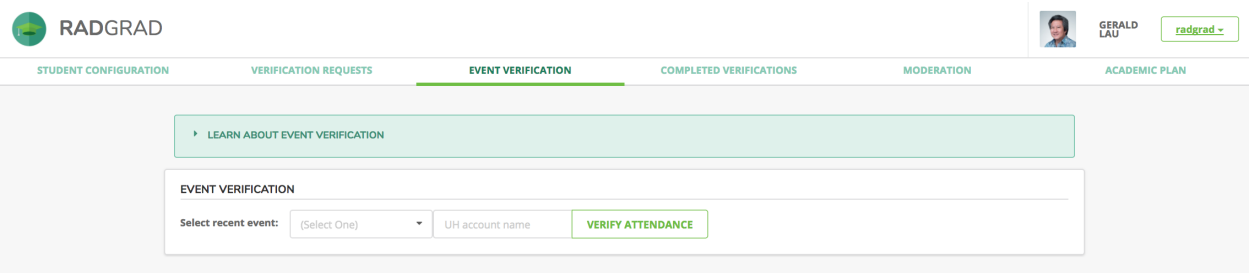


Figure C.3: Advisor event verifications page.

Advisors can verify a student's completion of an opportunity in two ways: with a pending verification (Figure C.2), and with an event verification (Figure C.3). If an advisor is physically at an event, and needs to quickly verify a large amount of students, he can use the event verification.

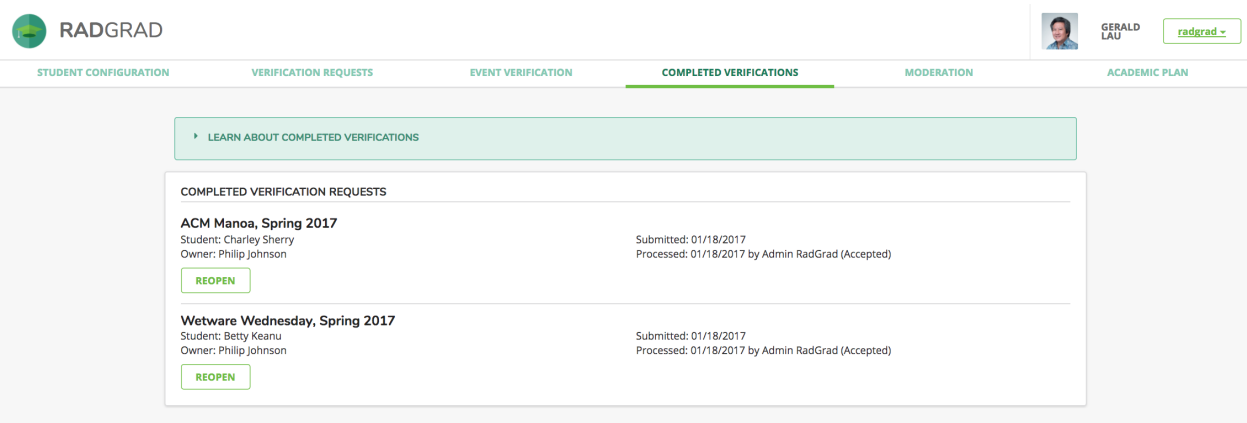


Figure C.4: Advisor completed verifications page.

In this interface, the advisor simply chooses the event from a dropdown selection of recent events, and then types in the student's UH account name and clicks "Verify Attendance." If an advisor is not physically present, a student can send a verification request through RadGrad. These requests show up as pending verifications. Advisors can choose to accept or decline these verifications. If they decide to decline, they can leave feedback for the student, and the student can resubmit as many times as they choose. Adivsors can view completed verifications (Figure C.4) to either simply check past verifications or to reopen a verification.

C.1.3 Moderation

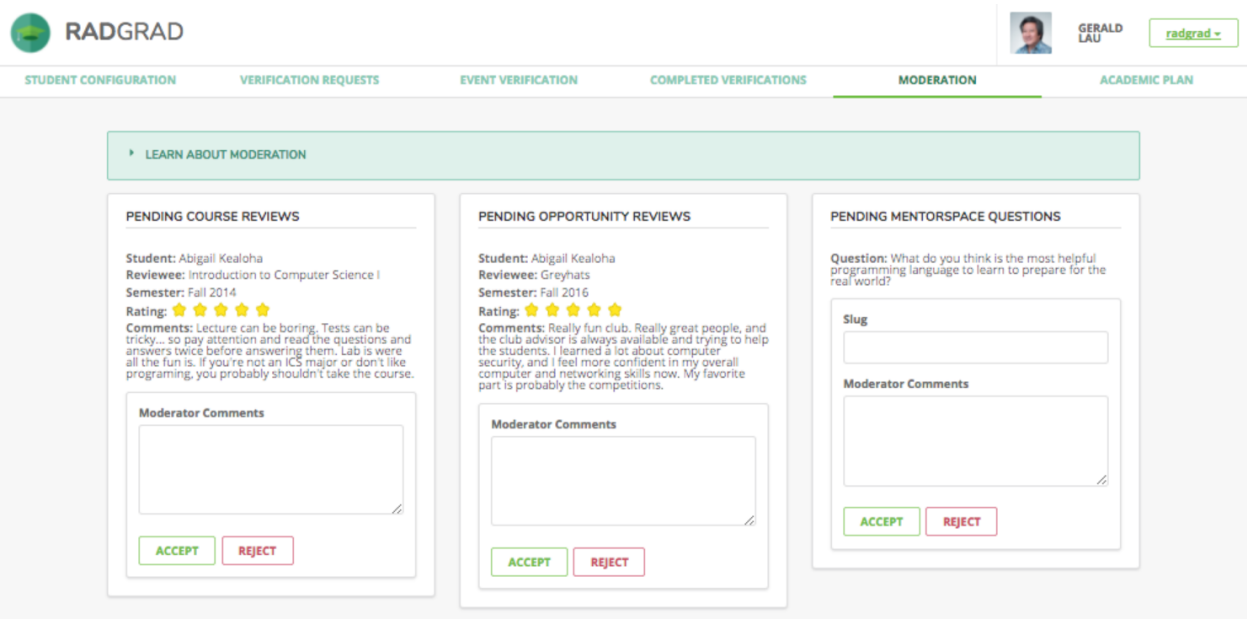


Figure C.5: Advisor moderation page.

Advisors can use the moderation page to moderate course reviews, opportunity reviews, and MentorSpace questions (Figure C.5). Advisors can choose to either accept or deny these posts. In the case of denial, advisors can leave reasons for denial so that the student can edit and resubmit their post accordingly.

C.1.4 Academic Plan

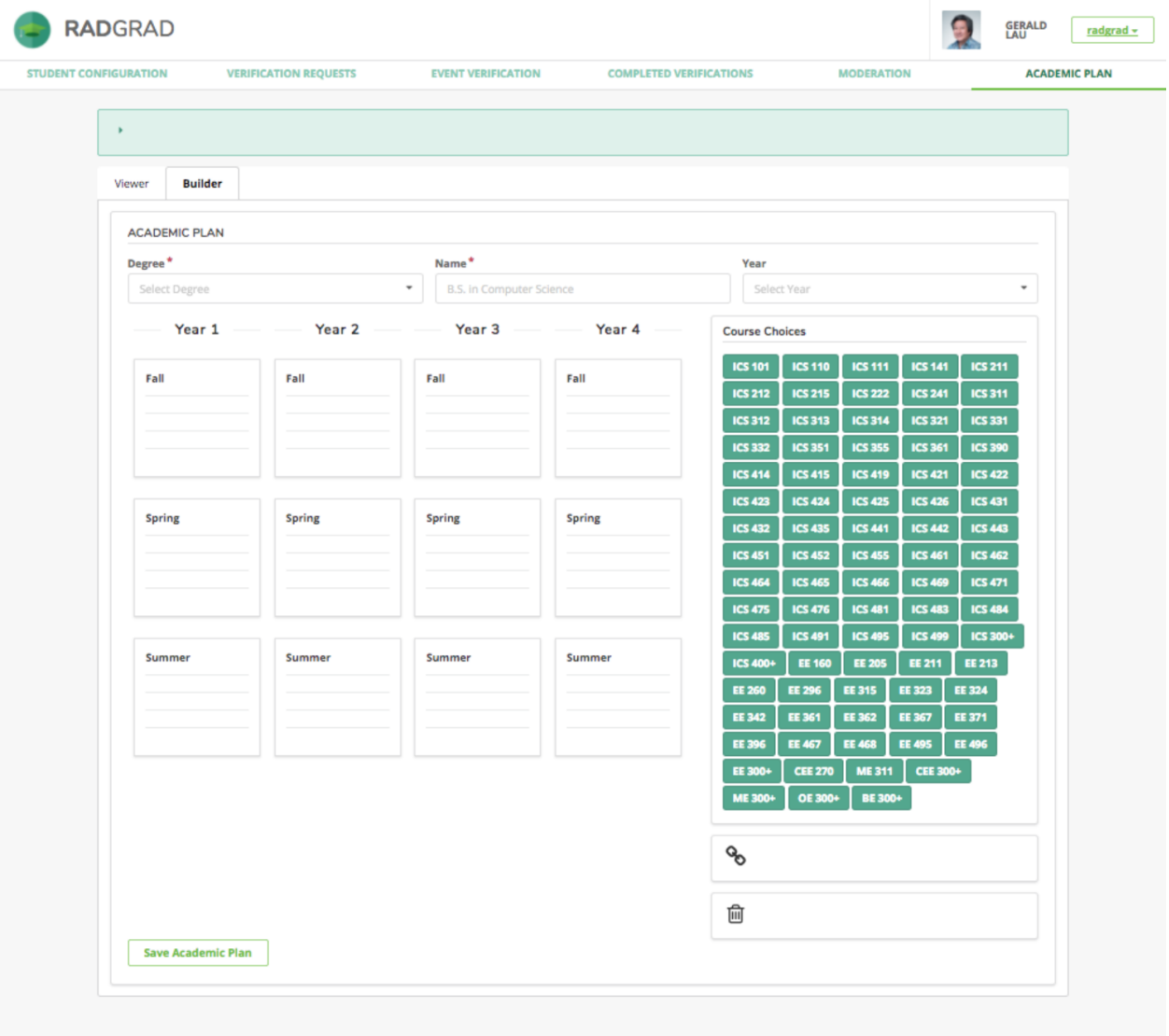


Figure C.6: Advisor academic plan page.

The academic plan page is the only place on RadGrad that allows the user to build academic plans (Figure C.6). There are two tabs: Viewer and Builder. The viewer allows the advisor to choose a year and a plan name, and view the four year plan for that plan. To make any edits to an

existing plan or add a new plan, advisors can go over to the builder, which allows them to name a new academic plan with a degree, name, and year. The advisor can then build the four year plan easily by dragging and dropping possible courses onto the initially empty plan. Some plans have more complex requirements than a single courses (i.e. a student must take one course from one of the four groups: ICS312 or ICS331, ICS 313 or ICS361, ICS351 or ICS451, or ICS355). For requirements like this, advisors can easily create groupings by dragging courses to the box with the link icon. Once a complex requirement is completely built, it can be dragged directly onto the plan. If an advisor no longer needs a certain requirement, they can delete it by dragging it to the trash can icon.

C.2 Faculty Mode

C.2.1 Profile

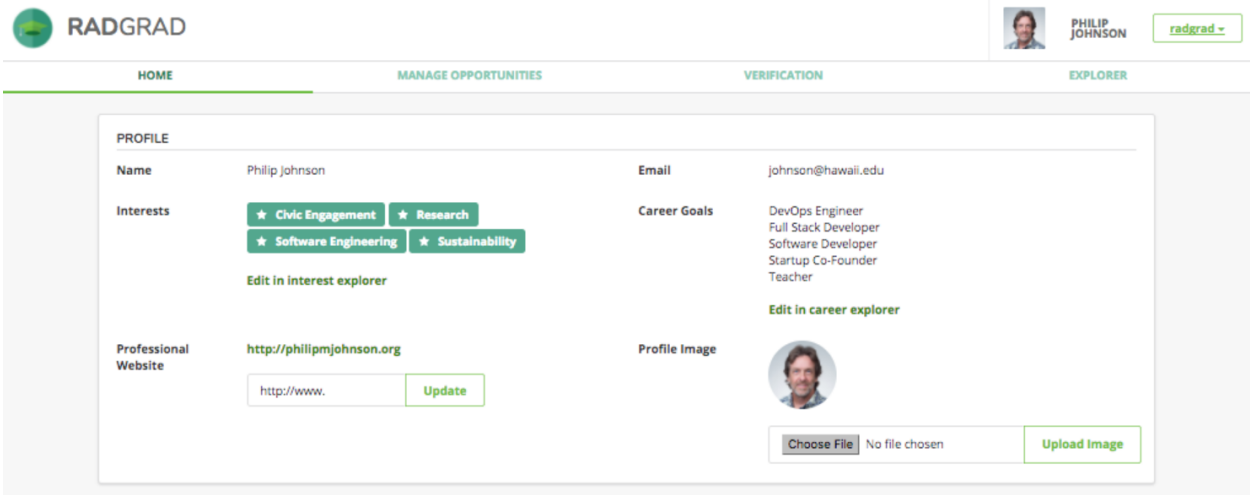


Figure C.7: Faculty profile page.

Faculty can use the profile page to view and edit their profile, which reflects how others will see them on RadGrad (Figure C.7). On this page, faculty can update their photo and information about their website. Faculty can personalize their profiles in a way that accurately communicates their background and research to students.

C.2.2 Manage Opportunities

Faculty can use the manage opportunities page to easily view, add, edit, or delete their sponsored opportunities (Figure C.8). They can also view other opportunities, but they can only edit their own. Faculty can edit their opportunities at any time.

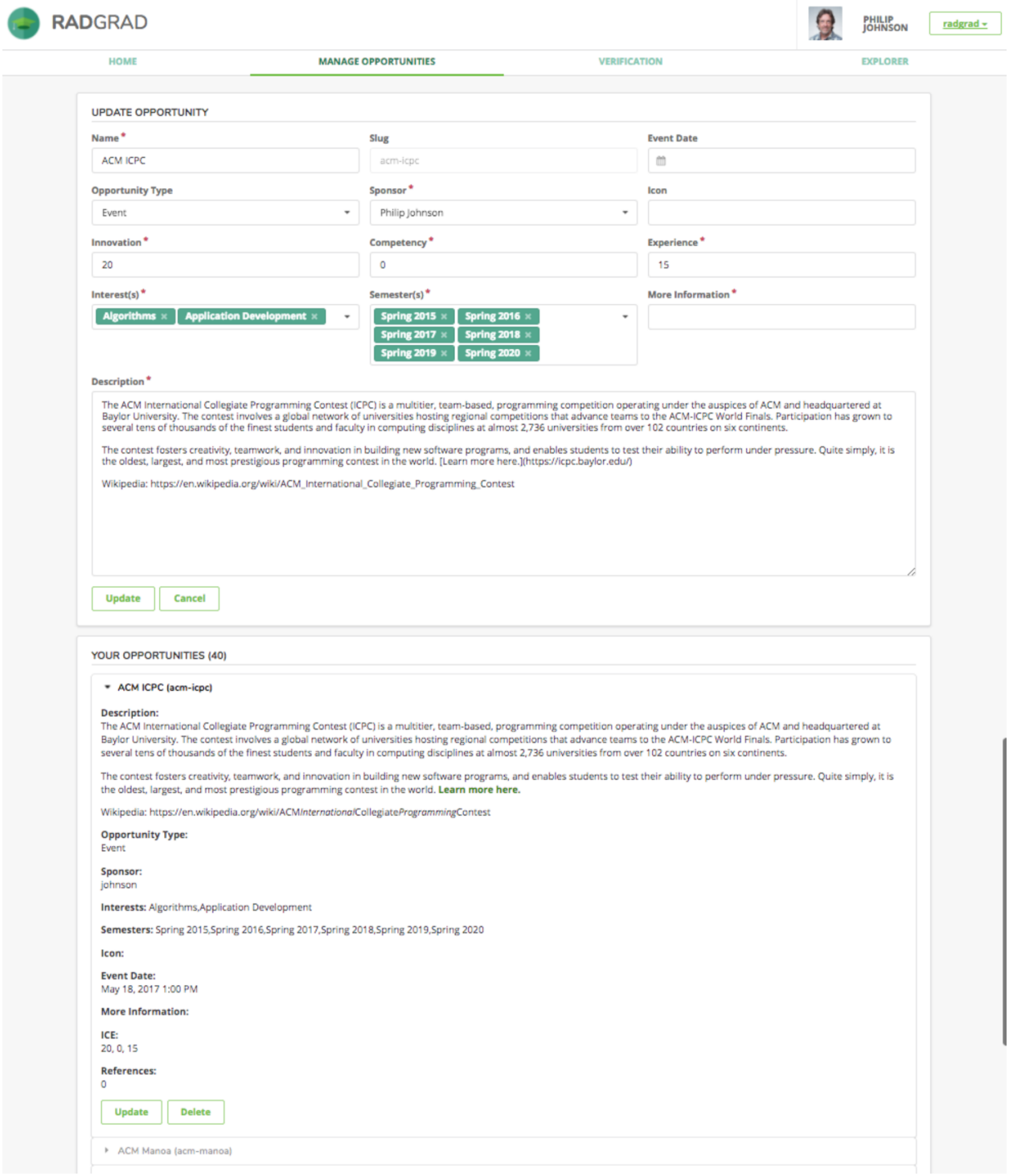


Figure C.8: Faculty Manage Opportunities page.

C.2.3 Verification

Faculty have the same verification interface as advisors, except they can only view their own verifications for their own sponsored opportunities.

C.2.4 Explorers

Faculty view the same explorer as students, except they cannot add courses or opportunities, and they cannot leave any type of review. However, they can use the explorer to add interests and career goals. Also, the opportunity explorer conveniently shows the faculty's sponsored opportunities at the top of their opportunity list for quick access.

C.3 Mentor Mode

C.3.0.1 Profile

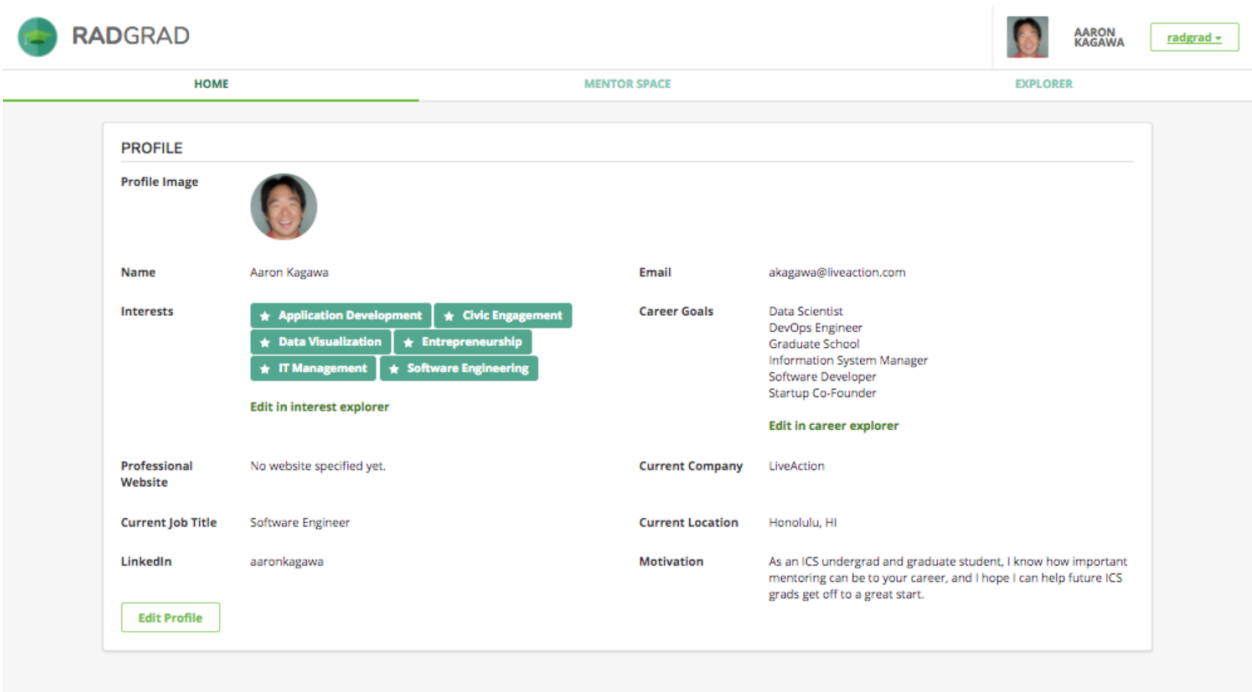


Figure C.9: Mentor profile page.

Mentors can use the profile page to view and edit their profile, which reflects how others will see them on RadGrad (Figure C.9). On this page, mentors can update their photo and information about their website, company, job title, location, LinkedIn, and motivation for becoming a mentor. Mentors can personalize their profiles in a way that accurately communicates their background and willingness to help to the students.

C.3.0.2 MentorSpace

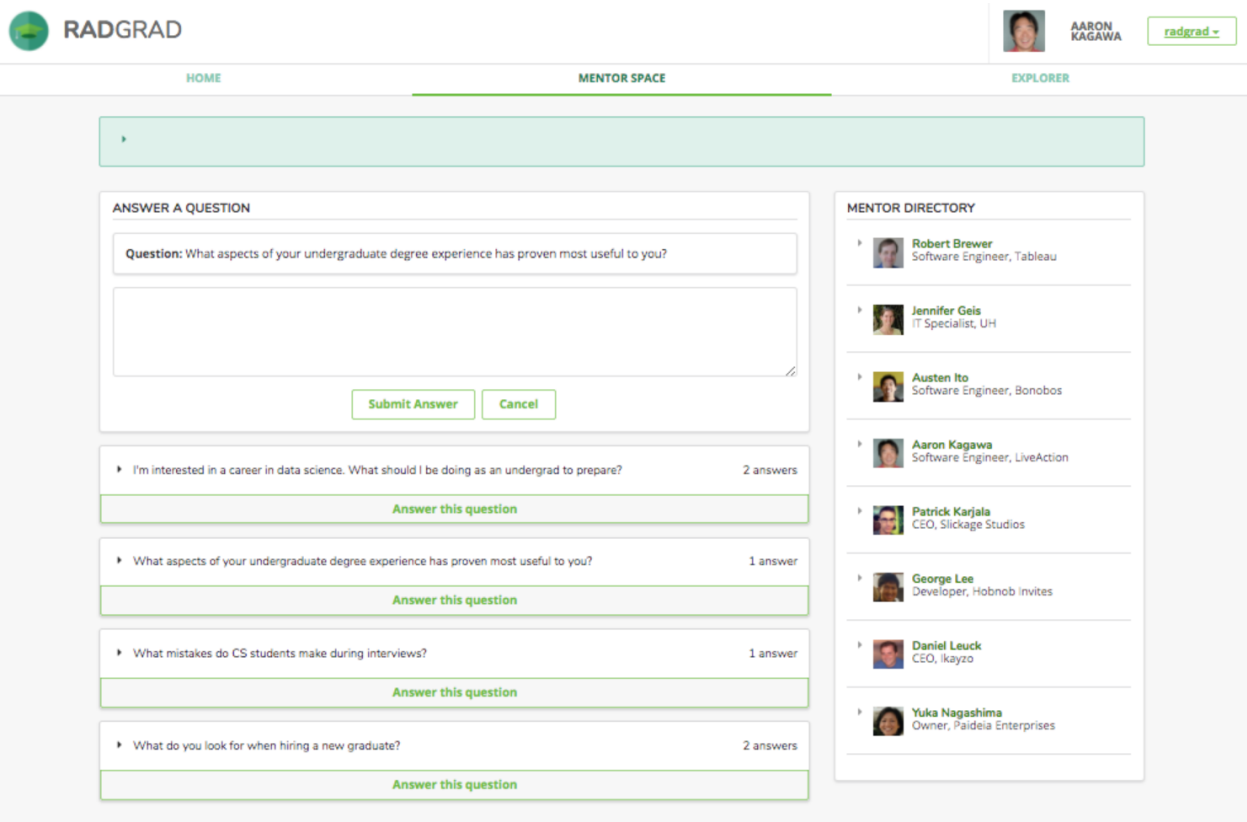


Figure C.10: Mentor MentorSpace Page.

Mentors view the same MentorSpace that students do, except each question has an "Answer this question" or "Edit your answer" button (Figure C.10). Clicking on this button brings up a form at the top of the page, which mentors can use to either submit a new answer or revise their existing answer.

C.3.0.3 Explorer

Mentors view the same explorer as students, except they cannot add courses or opportunities, and they cannot leave any type of review. However, they can use the explorer to add interests and career goals.

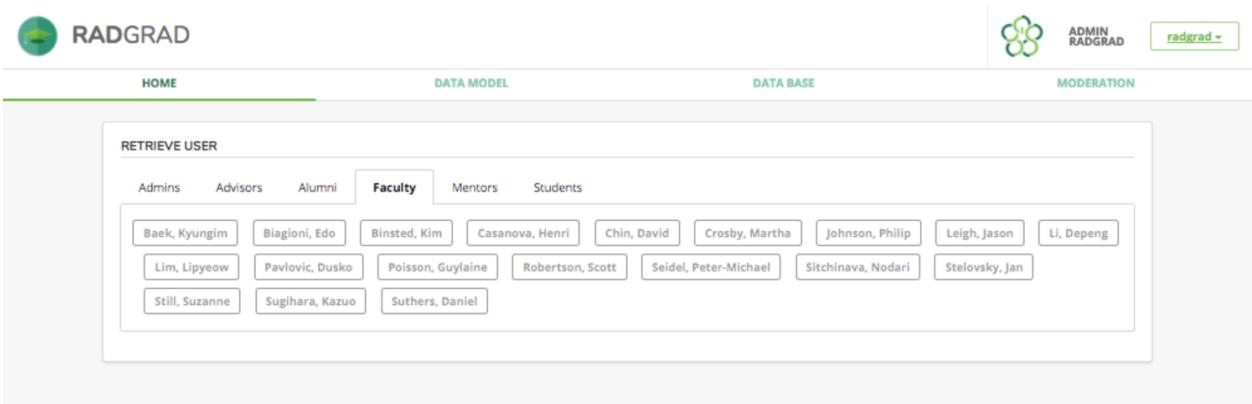


Figure C.11: Administrator Retrieve User page.

C.4 Administrator Mode

C.4.1 Retrieve User

On the Administrator home page, an administrator can access any user's account (Figure C.11). Users are organized by role (on tabs) and then alphabetically by last name. Clicking on the user's name will lead to their profile. Administrators can use this for testing or troubleshooting purposes. On the student tab, there is also a button to update student levels. Clicking this button will automatically recalculate and set the levels for all of the students.

C.4.2 Data Model

The data model page allows administrators to view, add, edit, and delete items from the data model (Figure C.12). The menu on the left lists all collections. When an administrator clicks on a collection, they will see a form, which they can use manipulate items in that collection. Below the form, they can view a list of all existing collection items.

C.4.3 Data Base

The database page allows administrators to easily run an integrity check on the database, dump the database, and restore the database (Figure C.13). The integrity check tests every item in the database to make sure that all parts of it are valid. Dumping the database saves the current state of the database to a JSON file and downloads it to your computer. Restoring the database deletes the current database and reloads an earlier version from a JSON file. Administrators can use this in backup and testing situations.

C.4.4 Moderation

Administrators have the same moderation page as advisors.

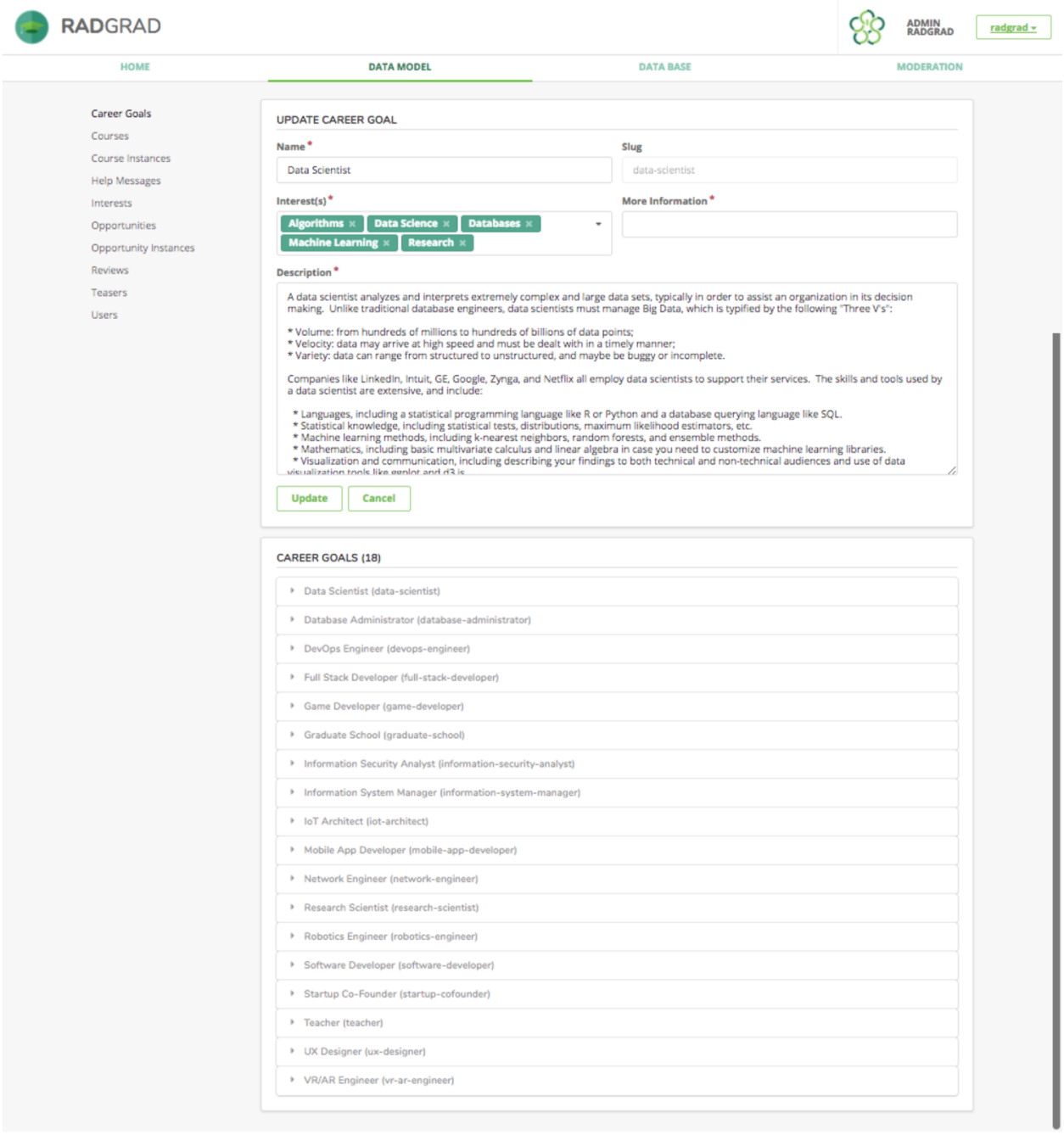


Figure C.12: Administrator Data Model page.

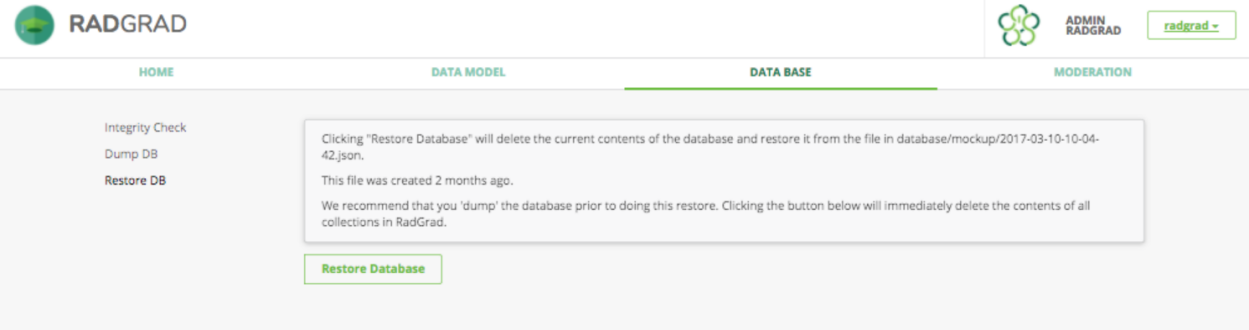


Figure C.13: Administrator Data Base page.

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