SCIS 472 Software Engineering

Glass Ceiling Inc.

[Project Site](#)

[Glass Ceiling Site](#)

[GitHub](#)

December 7, 2019

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Contributions Matrix

		Team Member Name				
		Jaida Langham	**Zari McFadden**	**Margie Ruffin**	**Ulunma Egwim**	**Lelia Hampton**
R E S P O N S I B I L I T I E S	Project Management (16 points)	41%	41%	4%	4%	10%
	Sec. 1: Customer Statement of Requirements			50%		50%
	Sec. 2: Glossary of Terms	20%	20%	20%	20%	20%
	Sec. 3: System Requirements			10%	10%	80%
	Sec. 4: Functional Requirements			50%	50%	
	Section 5: Interaction Diagrams		12.5%	18.75%	6.25%	62.5%
	Sec. 6: Class Diagrams and Interface Specification				34%	66%
	Sec. 7: System Architecture and System Design			70%	30%	
	Sec. 8: Algorithms and Data Structures					100%
	Sec. 9: User Interface Design and implementation	50%	50%			
	Sec. 10: Design of Tests		12.5%	18.75%	6.25%	62.5%
	Sec. 11: History of Work	50%	50%			
	Sec.12: References	20%	20%	20%	20%	20%

Summary of Changes

Table. Itemized List of Key Revisions Since the Previous Two Reports

#	Section	Summary of Change
1	Customer Problem Statement	Added a character in the Problem Statement in order to motivate the problem and demonstrate the relationship between the customer's problem and the system.
2	System Requirements	Changed priority levels to a) ensure that a high or maximum priority was not assigned to more than half of all requirements and b) be more consistent throughout the report as well as be consistent with the current state of our system.
3	System Sequence Diagrams	A system sequence diagram that no longer reflects an actual component of the user experience within the system was eliminated.
4	Traceability Matrix	Requirements were updated from in progress to complete, and two new in progress requirements were added that are integral to making the system acceptable to the job candidate users.
5	Use Cases Descriptions	Updated use cases to properly reflect functionality of website
6	Use Case Diagrams	Fixed the diagrams to reflect and flow with the UC descriptions
7	Class Diagrams	The class diagrams were eliminated because they no longer applied to the architecture of the system.
8	Data Structures	The data structures section was updated to reflect that we are no longer using the complex data structures from the class diagrams.
9	Design of Unit Tests	The unit tests were changed to reflect the unit tests are run on the system now. These unit tests are different than the unit tests from Report #2 which are based on the class hierarchy from Report #2 which we are no longer using.

Section 1: *Customer Problem Statement*

Love Jones is a graduate of Spelman College with a B.A. in Economics and a minor in Mathematics, and she has interned at Bloomberg, J.P. Morgan and Chase, and Harvard Business School. Following her matriculation at Spelman College, she received her Master's in Business Administration from the #1 business program in the country The Wharton School of the University of Pennsylvania. Upon graduation from her Master's program, she began her search for employment at a consulting firm to take advantage of her problem-solving and communication skills. Although she has been extensively networking and interviewing for positions, she has yet to receive an offer. They simply thank her for her time and tell her that another candidate was better suited for the role. In the meantime, she works low-wage jobs to support herself until she can find a salaried position. After 25 months and 112 interviews, she finally receives an offer from a local consulting firm. However, she is hesitant to negotiate after her grueling employment search and imposter syndrome, and she chooses to accept the offer as is. She has an inkling from overhearing the conversations of her white male counterparts in the same role and entry level that she is not being compensated equally for her time, but she has already accepted the offer. Moreover, she has issues at her firm with microaggressions and bias that delay her from promotions. She wishes there was a way to find jobs that actually want to hire Black women and and a way to learn about other Black women's experiences at a company before accepting an offer.

Although the rate at which Black women obtain degrees increases, only 8 percent are employed in the private sector [3]. In 2017, 5.59% of college-educated Black women and men were underemployed in an occupation that did not require a degree, resulting in lower wages and less relief from than their counterparts [3]. The wage gap for women has continued into 2019 and is even more pronounced for Black women [7]. In general, a Black woman make 67 cents to a white man's dollar, meaning Black women are subjected to a gender pay gap and a racial wage gap [28]. Although Black women work more hours than white men and white women, and the hours they have worked have increased by almost 20 percent since 1979, Black women are still paid significantly less than both demographics [28]. Moreover, job searches take longer for Black women [28]. When Black women do receive job offers, they may not negotiate salary. Women are less likely to negotiate than men when it is not explicitly told to job seekers that salary is negotiable [2]. These statistics reflect some if not all of the challenges Love Jones faced in her search for an adequate career.

One of the most common ways job seekers today search for employment opportunities is through online portals, however, these job portals are not always ideal for job seekers. Jones' found this to be true in her 25 month long job search. Current job-posting websites are sometimes difficult to navigate. Overwhelming websites made it challenging for Jones to process information, which left her as a potential employee and maybe even employers she never met

frustrated and dissatisfied. Jones also found that many sites provide salary information, but they do not inform their users about salary negotiation techniques or provide information about diversity and inclusion - two issues that impact Black women the most.

Love Jones thought it would be wonderful if a site was offered that focused on catering to the needs of Black women seeking jobs. A plethora of issues can be found within the current site options including the lack of information about employee resource groups, work flexibility, specific benefits, wage gaps and more. She figured that she would like a site that accurately addresses these issues and stands out from other job portals in a way that allows for intuitive navigation. Information about salary negotiation and unconscious bias training, would also prove to be most helpful. Jones would like to be able to access this website on her laptop or her cell phone to make job hunting easy if she were on the go.

It would also be great if Love Jones did not have to worry about her personal information being openly available. To make sure this isn't an issue, users of the site should be required to register for an account. This way personal information is protected and only people participating fully in the website can see the sensitive information. Ideally, when creating a profile for the website, the job seeker should be able to enter various information that helps the company identify them as potential candidates such as their name, education background, work experience(s), etc. It would also be great if there was a way for users to enter information about organizations they are involved in to increase networking between potential employers and potential employees - specifically catered to organizations for [Black] women. Another feature that would be beneficial is for the website to connect to the applicants' LinkedIn profile.

Given the discrimination, Black women face during the job searching process and the fears they hold of how their identity is being perceived, much like Love Jones, they are already at a disadvantage. As mentioned before, the website should have a page dedicated to informing the candidates and employers of "unconscious" bias and how best to deal with it, as well as how to best avoid it within one's company. It would be helpful if companies that complete the unconscious bias training could have some flag or identifier of completion that would give them a boost in status on the website, so that candidates would know that the company has taken the extra step to cater toward their general concerns of discrimination.

As for the employers finding good candidate matches, Love Jones found that when setting up a company profile the employer should provide the company history, company mission statement, and a few fun facts that would draw potential employees, like herself to them. This information should be visible in every job post for the company. The potential employee also needs to know many specific details about the position, which is why it should be a fairly simple process for an employer to enter information pertaining to a job role, for example, job description, responsibilities, requirements, salary, etc.

Ideally the search processes for both the job seekers and employers should be straight forward, so that Love Jones and others can intuitively navigate the job portal. The candidate should be able to search for a job or company by using keywords and filters to narrow down the

options. In the same token, employers should be able to search for candidates using keywords pertaining to skill preferences and education. Within both processes, both the job seekers and employers should have the option to favorite roles and/or candidates for reference later. On the employer's side, they should be able to contact candidates via email from the search results similar to how Handshake and Linkedin enable direct contact through their platforms.

The ultimate goal of this website is to be of use to women like Love Jones. Its purpose is to allow for a more streamlined and informative approach to the job search process for both candidates and employers, with a specific emphasis on improving the overall employment experience of Black Women. This goal would be accomplished by providing vital information around salary negotiation, unconscious bias, and the importance of diversity and inclusion, while also connecting potential employers with potential employees.

Glossary of Terms

User: A person that is utilizing our site. May be used interchangeably with candidate and employer.

Candidate: A person that is seeking a job; is also considered a user of the site

Employer: A company, or person acting on behalf of the company, that is looking for candidates to hire for jobs.

System: Refers to the job site.

Foreign key: A unique code given to a company to ensure that only authorized employees are posting jobs on behalf of the company.

User Icon: An image that represents the user profile page. Different from the user themselves.

Section 2: *System Requirements*

Categorical Scale for Priority Weight [19]

| Priority	Semantics
high	A critical requirement without which the product is not acceptable to the stakeholders.
medium	A necessary but deferrable requirement which makes the product less usable but still functional.
low	A nice feature to have if there are resources but the product functions well without it.

Enumerated Functional Requirements

REQ-x	Priority Weight	Requirement Description
REQ-1	high	The system shall allow the job seeker to search for companies or job postings by keywords.
REQ-2	high	The system shall allow job posters and job seekers to register for an account on the site and the ability to login once they are registered.
REQ-3	high	The system shall allow job posters and job seekers to complete profiles on the site.
REQ-4	high	The employer shall be able to post jobs if they are a registered user and their company is also registered on the site.
REQ-5	low	The job seeker should be able to upload their resume if they are a registered user.
REQ-6	low	The job seeker users who are registered users shall be able to give reviews of companies who list on the site.
REQ-7	medium	The system shall provide a page that contains information on salary negotiation.
REQ-8	low	The system shall provide the ability for job seekers and job posters to post blogs on their experience with the site, experience with job searching/recruiting, etc.
REQ-9	medium	The system shall provide a page for unconscious bias training for job posters who wish to do the training.
REQ-10	low	The system shall signify on employer profiles whether or not they have completed unconscious bias training so that job seekers have that information when using the site.
REQ-11	low	The system shall provide access to data about salaries to job seekers.
REQ-12	medium	The system shall provide search filters so job seekers can customize their job search.
REQ-13	low	The system shall save the job seeker's selected companies and job postings as favorites if they are a registered user.

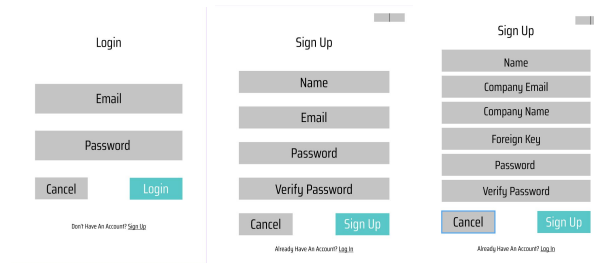| REQ-14	low	The system shall allow a job poster to access and view resumes of potential candidates.
REQ-15	medium	The system should have a verification process to ensure job posters have the authority to post jobs on a company's behalf.
REQ-16	medium	The system shall allow job posters to search for candidates by filters.
REQ-17	low	The system shall allow job seekers to apply for jobs posted on the site if they are registered users.

Enumerated Nonfunctional Requirements

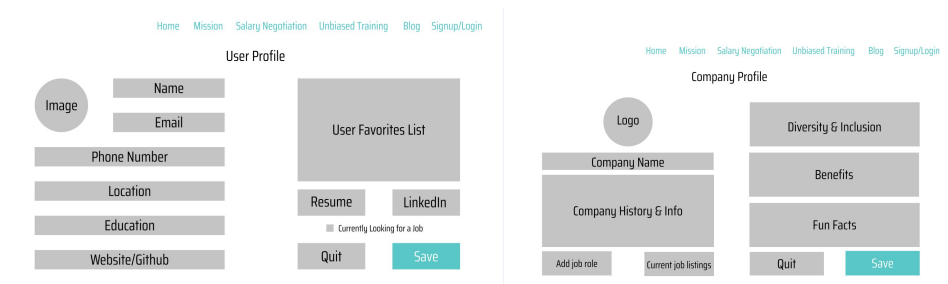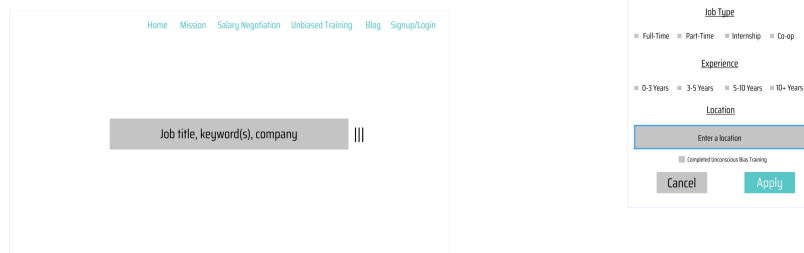| REQ-x	Priority Weight	Requirement Description
REQ-18	medium	The system should be able to deliver a response time to the user in 0.25 seconds.
REQ-19	medium	The system should be a website which accessible across various computing devices.
REQ-20	low	People who are differently abled should be able to use the system unassisted.
REQ-21	low	People who are differently abled should be compatible with their assistive technology.
REQ-22	high	There should be a user authentication system where they identify themselves using their email and password in order to protect the user's information.
REQ-23	medium	All data stored in databases must be encrypted to ensure customer privacy and trust.
REQ-24	medium	The system should have a clean layout and be visually appealing to the user.
REQ-25	medium	The user should be able to intuitively navigate the system.
REQ-26	medium	The system should comply with Internet privacy laws.
REQ-27	low	In the future, the system should be implemented to utilize the LinkedIn application program interface (API).
REQ-28	high	The user's privacy should be protected.
REQ-29	high	No data in the system should be sold to third parties; data in the system should only be used to enhance the user's experience.

User Interface Requirements

You are...
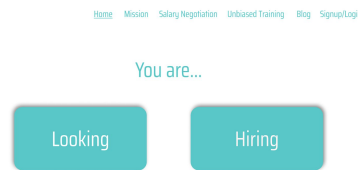
| Looking | Hiring |

Landing page for our site that ask the user whether they are looking for a job or hiring for a job.

Login

Email

Password

Cancel   Login

Don't Have An Account? Sign Up

Sign Up

Name

Email

Password

Verify Password

Cancel   Sign Up

Already Have An Account? Log In

Sign Up

Name

Company Email

Company Name

Foreign Key

Password

Verify Password

Cancel   Sign Up

Already Have An Account? Log In

When the user clicks the signup/login link, the login page on the left pops up. If the user doesn't have an account, they can sign up for one using the sign up page on the right. If the user is acting as a hiring manager, the sign up page contains different fields and allows the user to toggle between signing up as a candidate or hiring manager.

Home   Mission   Salary Negotiation   Unbiased Training   Blog   Signup/Login

User Profile

Image

Name

Email

Phone Number

Location

Education

Website/Github

User Favorites List

Resume   LinkedIn

☐ Currently Looking for a Job

Quit   Save

Home   Mission   Salary Negotiation   Unbiased Training   Blog   Signup/Login

Company Profile

Logo

Company Name

Company History & Info

Diversity & Inclusion

Benefits

Fun Facts

Add job role   Current job listings   Quit   Save

Once the user signs up, they get navigated to the respective profile page (user - candidate vs. company) where they are prompted to enter more information about themselves or their company.

Home   Mission   Salary Negotiation   Unbiased Training   Blog   Signup/Login

Job title, keyword(s), company |||

Filter

Job Type

☐ Full-Time   ☐ Part-Time   ☐ Internship   ☐ Co-op

Experience

☐ 0-3 Years   ☐ 3-5 Years   ☐ 5-10 Years   ☐ 10+ Years

Location

Enter a location

☐ Completed Unconscious Bias Training

Cancel   Apply

Once the user signs up, they get navigated back to the search page. Beside the search bar is a filter where the user can filter the search results by job-type, experience level, location, and whether or not the employer has completed the unconscious bias training.

After the user completes a search, a new page with the search results comes up. When the user clicks on one of the search results, the page shifts to move the search results to the left side and expand the company information on the right side.
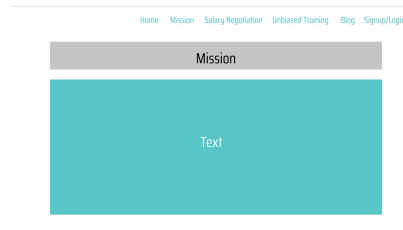
If the user clicks on any of the tabs available on the landing page (mission, salary negotiation, unbiased training, and blog), it will take the user to a page that features a respective text box of information.
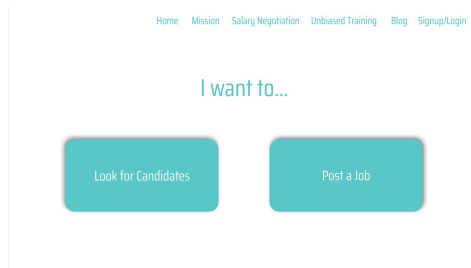
For the hiring sequence of the main dashboard, this page allows the user to choose whether they are looking for candidates for jobs or looking to post a job.
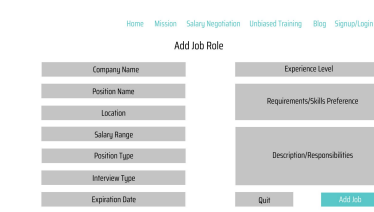
If the user clicks post a job, the user is taken to the **Add a Job Role** page.

Section 3: *Functional Requirements Specification*

This section derives the use cases based on the requirements from Section 1 and Section 2 above.

Stakeholders

This system is focused on Black women professionals and recruiters or hiring managers from any company. People of other demographics are welcome to join the site and search for positions, but the system is catered to black women. The candidates would be able to find full-time opportunities, internships or co-ops, and the employers would be able to post job listings for their companies.

Actors and Goals

All of the users the site have the ability to view a large amount of information. They can view the site's mission statement and information about the unconscious bias training that we offer to the companies that register. There is a page on the site dedicated to assisting in salary negotiation, and a blog that holds reviews and success stories of the website. While these functions are available to anyone who visits the site, the target audience are candidates like Love Jones and employers.

As a candidate, Love would use the system to find a career. She would be able to do the following:

- View job listings.
- Make a profile to:
  - List her skills.
  - Specify if she is actively looking for a position.
  - Connect her LinkedIn.
- Search for a job using keywords that correspond with either her desired job or with the discipline she wants to join.
- Filter through her search results by job type, experience level, location, and whether or not a company has completed the unconscious bias training.
- View salary graphs for each position, benefits the company offers, company diversity scales, and reviews from other users on the company and/or position.
- View diversity information about the companies that have posts on the site.
- Apply for a position.
- Favorite a job to view later
- Leave a review.

The employers would use the system to seek talent. They would be able to:

- Create an account
- Post a job listing including:
  - The name of the position.
  - The position type (i.e, part-time, full time, intern).
  - The experience level they are looking for.
  - The location(s).
  - Interview type.
  - The salary range.
- Provide details for each position.
- Have the option to go through bias training. After creating a profile.
- Search through candidates they might be interested in.

The candidates and the employers have different goals for using the website. The candidate would benefit more from looking through job listings to try to achieve their goal. The employer is posting the listing, hoping to find a viable candidate to fill the position. As candidates can search through jobs using keywords, employers can search through candidates who have a desired skill set. The system caters to the needs of both actors, implementing similar functions, in ways that are unique to each one.

Use Cases

Casual Description

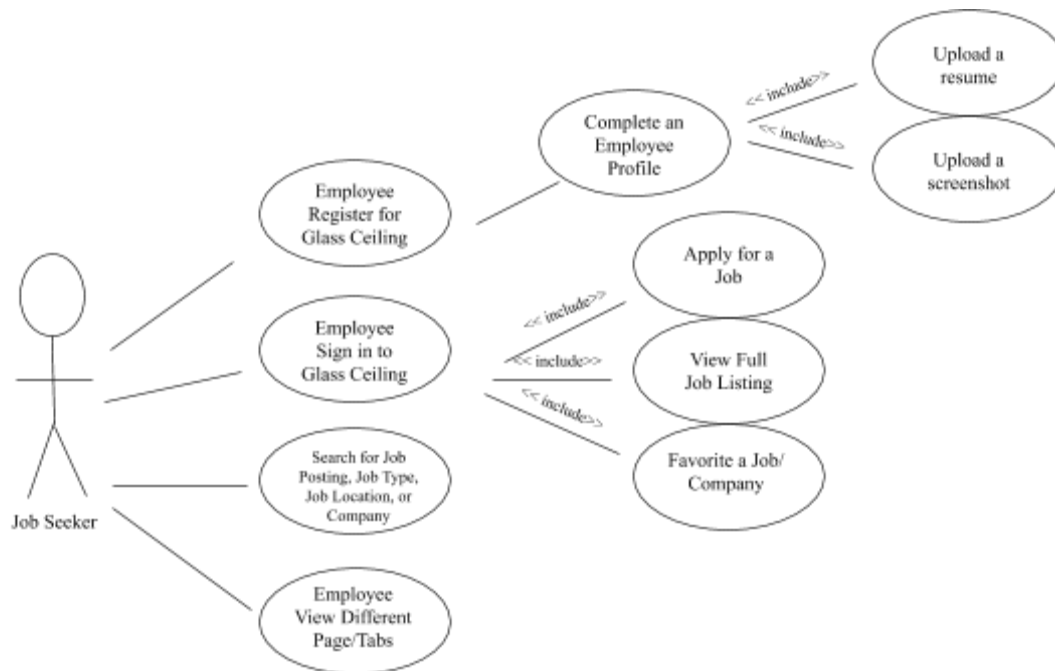| Employee Use Cases			
Use Case	System Req.	Priority Weight	Description
Employee Register for Glass Ceiling	REQ-2	High	Registering for the system gives the job seeker access to extended descriptions of job postings, the ability to favorite a job or company. The user selects the the **SignUp/Login** button on the screen, and is redirected to a page where they can register for the website. They will be prompted to enter their name, email , and their desired password (twice for verification). The user can save the information to the system by pressing the **Save** button at the bottom of the screen.
Employee Log in to Glass Ceiling	REQ-2	High	To Log into the Glass Ceiling system the job seeker will navigate to the top right hand corner of the main page to a **SignUp/Login** button. They will be redirected to a page that prompts the user to enter the email and password. Once verified they will be signed into the system and have the ability to favorite a job/company and apply to jobs.
Complete an Employee Profile	REQ-3	High	Completing the Employee profile allows the job seeker to provide more information that can help employers identify them as potential candidates. One the employee registers they will be redirected to a page where they can edit their profile. At the bottom of the page will be a save button, that saves the information inputted to the system.
Search for Job Posting, Job Type, Job Location, or Company	REQ-1	High	Searching for a job posting allows the employee to enter keywords referring to occupation title, field of work, and company name. A list of job options will appear on the screen. These options can be further refined by applying filters such as location, salary range, experience level, and when the job was poste, the type of job (Full-time/ Part-Time), completion of unconscious bias training. The postings that are presented on the screen will appear because they match with a keyword.
Employee View Different Page/Tabs	REQ-7 REQ-8 REQ-9	Medium	To visit a page on the website the user will navigate to the appropriate tab located at the top of the page and click. The respective page will display the material associated with the tab on the screen.
Employer Use Cases			
Use Case	System Req.	Priority Weight	Description
Employer Register for Glass Ceiling	REQ-2	Medium	Registering for the system gives the job poster access to search for a candidate and post a job. The user selects the the **Sign Up/Login** button on the screen. The user selects the the **SignUp/Login** button on the screen, and is redirected to a page where they can register for the website. They will be prompted to enter their name, email , and their desired password (twice for verification). The user can save the information to the system by pressing the **Save** button at the bottom of the screen.
Employer Log in to Glass Ceiling	REQ-2	Medium	To sign into the Glass Ceiling system the job poster will navigate to the top right hand corner of the main page to a **SignUp/Login** button. A popup box will appear that prompts the user to enter the company email and password. Once they are signed into the system and they will have the ability to post jobs and search for candidates.

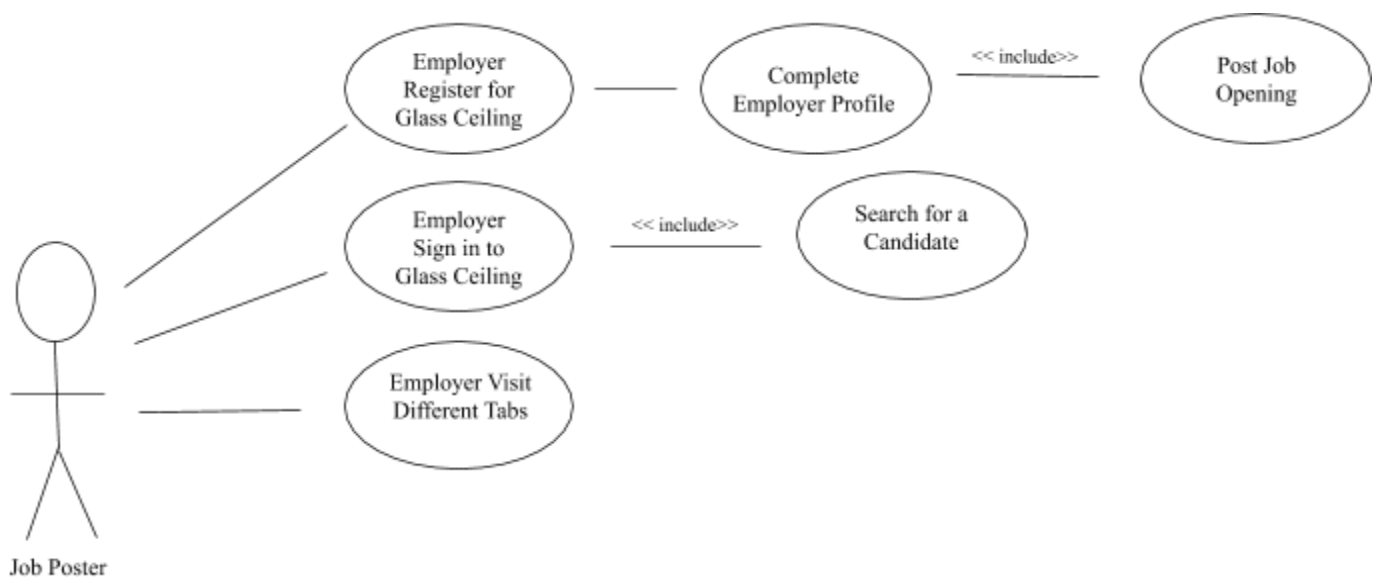|			
Complete Company Profile	REQ-3	High	After the employer has successfully signed up and logged in, they will be automatically directed to their company profile with several information fields to fill out. In addition to this, they will have access to post job roles and view current job listings. Once the employer is done completing their profile, they have the option to either press the **Quit** button to close the profile or the **Save** button to save changes to their profile prior to closing it.
Post Job Opening	REQ-4	High	Creating Job postings gives employers the opportunity to display a position for hire in their company. Once the post is initiated, the employer will be directed to enter all necessary information for the position. At the bottom of the page will be an **Add Job** button that saves the information to the system. Once completed, the final job post will be uploaded to the website database.
Search for a Candidate	REQ-16	Low	Searching for a candidate in the system allows the employer to have access to all candidates who flagged they are currently looking for a job. Employer will be allowed to enter keywords referring to field of work and skill sets to filter through the list of candidates provided. The employer will be able to click on the candidate's block within the list and a new page will load. This new page is a split page, on the screen will appear the original list of candidates (left), and an expansion of the candidate's profile (right) which will give access to further information on the candidate including their resume and website links. Employer is able to favorite a candidate for a role via **save** (star)button. Employer is also able to contact the candidate via email via the **contact** button.
Employer Visit Different Tabs	REQ-7 REQ-8 REQ-9	Medium	To visit a page on the website the user will navigate to the appropriate tab located at the top of the page and click. The respective page will display the material associated with the tab on the screen.

Use Case Diagrams

This section provides use case diagrams for job seekers and job posters.

Use Case Diagram for Job Seeker

Use Case Diagram for Job Poster

Traceability Matrix

REQUIREMENTS TRACEABILITY MATRIX				
Project Name:		Glass Ceiling		
National Center:		Atlanta, GA		
Project Manager Name:		Jaida Langham and Zari McFadden		
Project Description:		This project seeks to develop a job portal for educated Black women that serves their specific needs.		
ID	*Assoc ID*	*Technical Assumption(s) and/or Customer Need(s)*	*Functional Requirement*	*Status*
001	1.1.1	The job seekers need to be able to present themselves in the best light, and they need to be able to communicate their experience, skills, and other relevant information to potential employers.	The system shall allow job seekers to complete profiles on the site.	Complete
002	2.2.2	Employers need to be able to inform job seekers about their company in order to attract people to apply for positions in their company.	The system shall allow job posters to complete profiles on the site.	Complete
003	3.3.3	The job seekers need to be able to search for jobs and companies that are relevant to their career goals and aspirations. They need to be able to find and/or discover opportunities in their chosen domain.	The system shall allow the job seeker to search for companies or job postings by keywords.	Complete
004	4.4.4	Employers need to be able to post jobs in order to receive candidates for jobs and fill positions, and they may also need to find diverse candidates.	The system shall allow employers to be able to post jobs.	Complete
005	5.5.5	Employees need to be able to discover jobs in order to make use of the job portal.	The system shall provide search filters so job seekers can customize their job search.	In progress
006	6.6.6	Employees need to be able to discover candidates on the site in order to provide job opportunities to the candidate users.	The system shall allow job posters to search for candidates by filters.	In progress

Fully-Dressed Description

Use Case Section	Comment
Use Case Name	Complete a candidate profile
Scope	Glass Ceiling job portal
Primary Actor	Job seeker in Glass Ceiling
Stakeholders & Interest	Job seekers - want to be fully listed on Glass Ceiling website
Preconditions	Job seeker must be registered in the system
Success Guarantee	On successful completion the employee will have a complete profile including their resume submission and headshot. This information

	will be stored in the system's database.
Main Success Scenario	Job seeker visits the website Job seeks selects **Looking** Job seeker registers for an account The page will redirect to the profile page System displays fields to be edited Job seeker fills out fields/ uploads necessary documents Job seeker presses **Save** button at the bottom of the page.

Use Case Section	Comment
Use Case Name	Search for Job Posting, Job Type, Job Location, or Company
Scope	Glass Ceiling job portal
Primary Actor	Job seeker in Glass Ceiling
Stakeholders & Interest	Job Seekers - want to search job listing to potentially apply for positions Recruiters/ Hiring Managers - wants their job posts to be visible to potential employees.
Preconditions	No precondition
Success Guarantee	Successful completion of the job search displays relating job posts on page in a readable and accessible manner.
Main Success Scenario	Job seeker visits the website Job seeker selects **Looking** button System displays the search engine Job seeker enters in keywords System generates job/ company matches based on keywords

Use Case Section	Comment
Use Case Name	Complete employer profile
Scope	Glass Ceiling job portal
Primary Actor	Employer using Glass Ceiling
Stakeholders & Interest	Recruiters/ Hiring Managers - wants to complete required pieces of profile to post jobs
Preconditions	Employer's Company must be registered in system
Success Guarantee	Successful completion of the employer profile includes all filling in all required and non required information and saving such to the system's database.
Main Success Scenario	Recruiter visits the website Recruiter selects **Hiring** Recruiter registers for an account

	The page will redirect to the profile page System displays fields to be edited Recruiter fills out fields/ uploads necessary documents Recruiter presses **Save** button at the bottom of the page.

Use Case Section	Comment
Use Case Name	Post Job Role
Scope	Glass Ceiling job portal
Primary Actor	Employer using Glass Ceiling job portal
Stakeholders & Interest	Recruiters/ Hiring Managers- wants to post jobs which will lead to new hires for their company Potential candidates- wants to view job posts which will lead to a new job offer
Preconditions	Employer must be registered in the system. Employer must be logged into the system
Success Guarantee	Upon successful completion the Recruiters/ Hiring Manager will have filled out all necessary fields for the job post. They will have saved this listing to the system's database.
Main Success Scenario	Recruiter visits the website Recruiter selects **Hiring** Recruiter logs into the system Recruiter selects **Post a Job** System redirects fields to be edited Recruiter fills out fields Recruiter presses **Add Job Role** button at the bottom of the page. Recruiter is redirected to home page

System Sequence Diagrams
System Sequence Diagram for Searching for a Job/Company

Search for a Job/Company
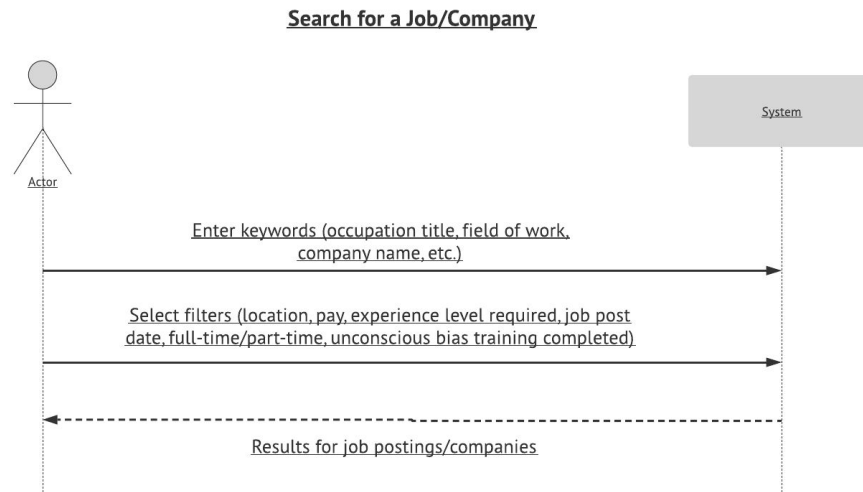
As demonstrated above, the actor (job seeker) enter keywords, such as occupation, field of work, company name, etc. into the search engine. They then select filters to customize their job search, such as location, pay, experience level required, job post date, full-time/part-time position, unconscious bias training, etc. The system then returns results for job posting and/or companies that match the search and filter criteria.

System Sequence Diagram for Posting a Job

Post a Job
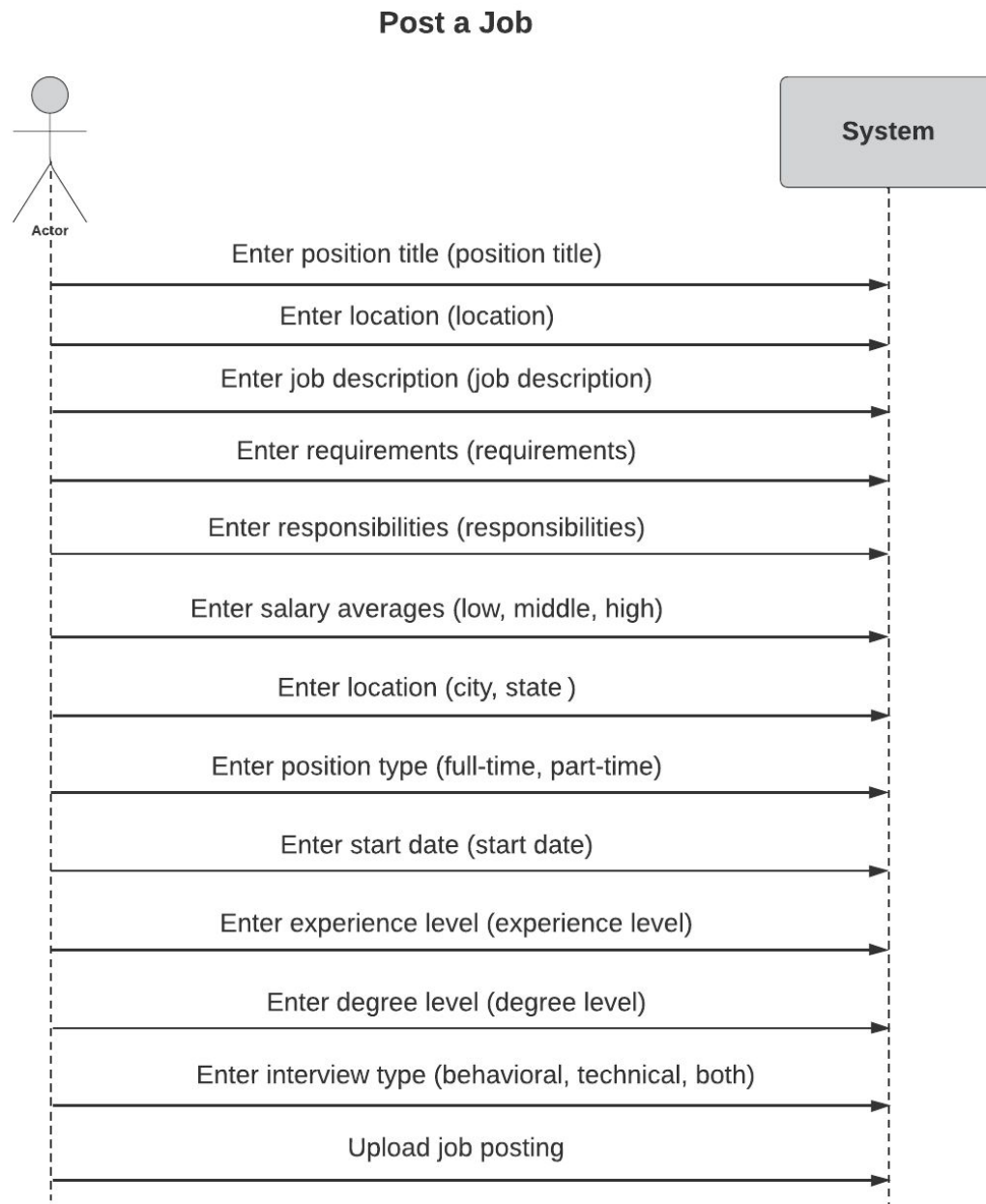
As demonstrated in the above diagram, the actor (job poster) enters a position title, job description, responsibilities, requirements, salary averages, location, position type, start date, experience level, degree level, and the interview type. Then they upload the job posting.

System Sequence Diagram for a Job Poster Completing a Profile

Job Poster Complete Profile
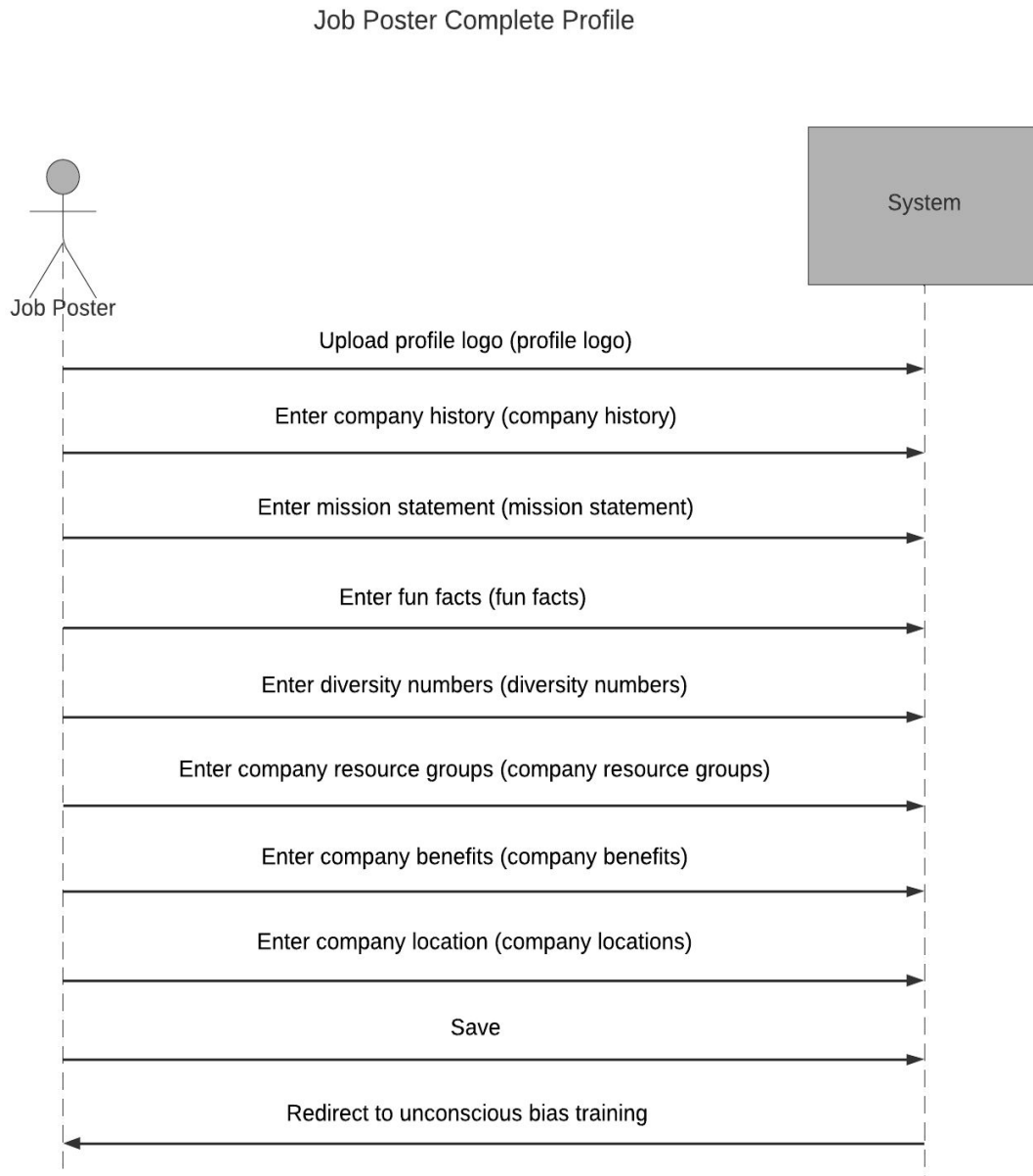
As demonstrated in the above diagram, the actor (job poster) completes a profile. They upload a profile logo. They enter company history, the company's mission statement, fun facts about the company, diversity statistics, company resource groups, company benefits, and company locations. They save the information. They are redirected to unconscious bias training.

Section 4: *User Interface Specification*

Preliminary Design

Page 1: (REQ# 24)

When a user is visiting the website, the homepage displayed is a decorated, but mostly empty dashboard. The body of the dashboard includes a prompt of "You are…", as well as two hover button options of "Looking" and "Hiring". At the heading level of the webpage, there are 5 tabs with hover effects available, displaying: "Home", "Mission", "Salary Negotiation", "Unbiased Training", and "Blog" as well as a signup/login icon in the upper-right hand corner of the webpage. All of the 4 tabs are readable for everyone, but to post on the blog, the user must have an account.

Home   Mission   Salary Negotiation   Unbiased Training   Blog   Signup/Login

You are...

Looking   Hiring

Each button, tab and icon is a different pathway for the user to take when interacting with the website. For simplicity in this explanation, each pathway will be assigned a letter 2A-G:
Looking(A), Signup/Login Icon(B), Hiring(C), Mission(D), Salary Negotiation(E), Unbiased Training(F), Blog(G).

Home was not given a pathway assignment because when that button is pressed at any point it will bring the user back to this page - Page 1.

Page 2A: (REQ # 1, 12, 24)

When a user presses on the Looking button on page 1, a new page opens. This new page is a mostly empty dashboard, with a search bar in the middle of the page with a filter icon to the right of it. Within this search bar, users will enter keywords pertaining to an optimal position (i.e. software engineering, full stack, analytics, business analyst, finance, computer science, business management, consulting, etc.). After entering their words into the search bar, the user can then

interact with the filter icon. When the user hovers and clicks on the filter icon, a filter pop-up appears (semi-transparent design), with the following filtering options:

- a location field: that populates suggestions as the user types
- experience level: that has checkbox options (0-3 years, 3-5 years, 5-10 years, 10+ years)
- job type: that has checkbox options (intern, part time, full time, co-op)
- unconscious bias training: a checkbox that allows the user to only see companies who have completed the training

There are save and quit hover buttons available at the bottom of the pop-up as well. The save button will apply the filters to the tabulated results based on the keywords, and the final results will be displayed on the job results page - via page 3A. The quit button results in the minimization of the filter pop-up.

Page 3A: `(REQ# 17, 24)`

This page is displaying the results of job roles for the candidate. Visually, the top of the body of this page displays the search bar and filter icon from the previous page, where the results are listed below in a block-list format. Each block displays the role title, company name, location, description, as well as a *see more* hyperlink. The user must have an account to see more information on the job role, so when a user presses the *see more* link, if they are not already logged in, the signup/login pop-up window (page 2B) appears to allow them the opportunity to do so, and returns them back to this page. If they have an account, after pressing the *see more* link, a new page loads - via page 4A.
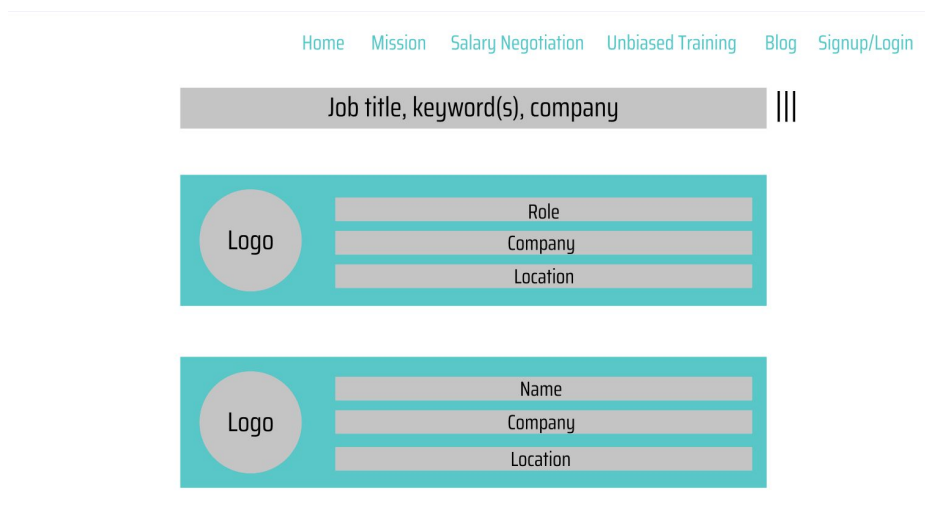
Page 4A: (REQ# 13, 17, 24)

This page is displaying the results of the *see more* hyperlink for a specific job role. Visually, this page is a split-page, similar to the glass door results page in the image screenshot below. The left side of the page (smaller in size) contains the same results block-list, the right side of the page (larger in size) contains the expansion on the job role. At the top of the page, there is are *apply* and *save* role - represented by a star - buttons. The *apply* button is a hyperlink to the company's application link; the *save* star button highlights when pressed, and the job is added to the user's favorite list. As seen in the image below, there on the right side of the page shows the following information: the company logo, job title, company name, and location(s) in its own block below the *apply/save* buttons. The area below this block contains tabs which are: Jobs, Company, Salary, D&I, Reviews, and Benefits. For each of these tabs, when clicked, their respective information populates the available space for the right side of the page.

- Jobs tab contains the job description, requirements, skillset preferences.
- Company tab contains the company mission statement, company history, company fun facts.
- Salary tab contains the low to high graph of salary for that specific role*
- D&I tab contains the Employee Resource Groups available at the company, company diversity statistics, and (Black) Women focused national organizations with a presence at the company (like any Divine 9 sororities/fraternities, NCNW, NSBE, SWE, AWSA, AEFA, NWPC, etc.)
- Reviews tab contains company reviews via website blog.
- Benefits tab contains a series of representative icon w/ Benefit name pairs, displaying benefits including but not limited to: vacation time, 401k/savings, paternity leave policies, travel, work flexibility / ability to work remotely, etc.

Page 2B: (REQ# 2, 22, 24)

When the user presses the signup/login icon in the upper right corner of page 1, a pop-up window appears titled *Log In*. On this Log In window, there's a field available email (which was used to register the account), a field for the password (which was used to register the account), a *login* button, as well as a *sign up* hyperlink option. Login will only work if the user has registered an account with the website. Once the user logs in, the pop-up window will close and the signup/login icon will change to a user icon to display that the user has logged in.
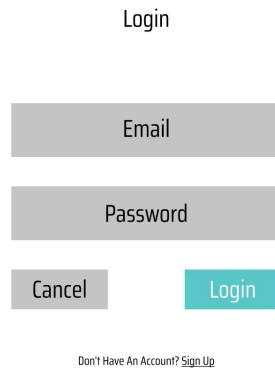
Login

Email

Password

Cancel   Login

Don't Have An Account? Sign Up

If the user presses the *sign up* hyperlink, the login pop-up window closes and a sign up pop-up window appears. On this Sign Up window, there is a toggle in the upper right hand corner, with the options of candidate vs. employer.

Page 2B.1: Candidate (REQ# 2, 22, 24)

If the user toggles to candidate, then the signup window stays the same; on the window, there's a field available for the user to enter their name, email, password, and verify password. Under the input fields are two buttons, *cancel* and *sign up*, as well as a hyperlink to return back to the Login window.

Sign Up

Name

Email

Password

Verify Password

Cancel   Sign Up

Already Have An Account? Log In

When the user presses *cancel*, the popup closes and take the user back to the page they were originally on. When the user presses *sign up*, the popup closes and takes the user to their candidate profile to finish entering their information - via page 3B.1.

Page 3B.1: (REQ# 3, 5, 24, 27)

Home   Mission   Salary Negotiation   Unbiased Training   Blog   Signup/Login

User Profile

Image | Name
Email
Phone Number
Location
Education
Website/Github

Organizations List
User Favorites List
Resume | LinkedIn
☐ Currently Looking for a Job
Quit | Save

As seen in the image above, the page following the candidate signup is the user's profile page. The options on the user profile page include: A field for a headshot or professional profile picture, full name, contact information - phone number and email, current location, education information (school, degree level, major), A field for personal website links and/or GitHub repository, and a connection to their linkedin. There will also be an optional section for organization affiliations (Divine Nine organizations, NCNW, NSBE, SWE, AEFA, NWPC, AWSA, etc.), as well as access to their job role favorites list. Towards the bottom of the right side of the page above the *Quit* and *Save* buttons is a checkbox for the user to indicate that they are currently looking for a job.

In addition to these fields and attributes of the page, there are *Save* and *Quit* buttons. Both of which, result in returning back to the user's original page prior to signing up, which in this example pathway is Page 1.

Page 2B.2: Employer (REQ 2, 22, 15, 24)
If the user toggles to employer, then the signup window respectively adjusts; on the window, there's a field available for the user to enter their full name, company affiliated email, company name - drop box/suggestions-, foreign key field, password, and verify password. Under the input fields are two buttons, *cancel* and *sign up*, as well as a hyperlink to return back to the Login window.
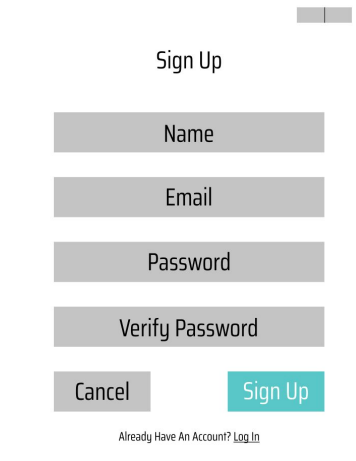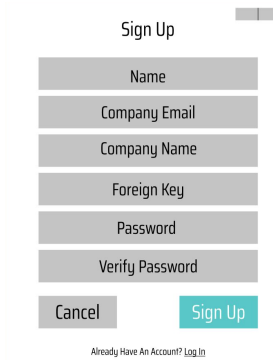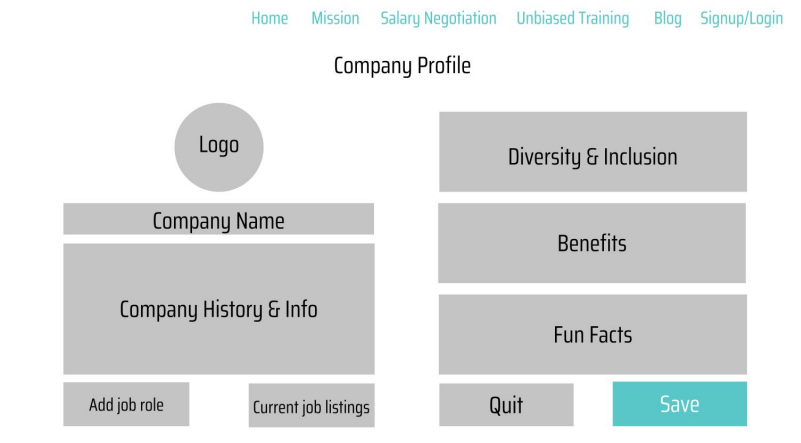
This pathway is followed by new companies and by new recruiters for companies already in the system. If a company is not in the system already, the UI stays the same, but there is more reliance on the email verification process. i.e. for a new company, their company name would not appear in the drop box, also they would not have a foreign key. After pressing the *sign up* button, the system will notice the company not being in the system, and once the email is verified, the foreign key will be sent via email, and the company will be added to the system for future sign-in processes. User can then populate the foreign key field and successfully sign in. When the user presses *cancel*, the popup closes and take the user back to the page they were originally on. Once the user enters the proper foreign key and the *sign up* button, the signup box minimizes and takes the user to the company profile page - via Page 3B.2.

Page 3B.2: (REQ# 3, 10, 24)

On the Company Profile Page, this gives recruiter(s) the opportunity to impact how their company is viewed by our users. There are many fields available:
- Company Logo
- Company Name
- Company History and Information

- Diversity and Inclusion section includes: Employee Resource Groups, Organization Presence at the Company (Divine 9, NSBE, NCNW, School Alumni), D/I percentages, attrition and retention rates, and accessibility/disability catering information. As well as, a banner for completion of the unbiased training available on Page 2F (which cannot be edited by the user, will be populated by the site).
- Benefits section includes (in checkbox form): 401k/savings, vacation time, paternity leave, travel, flexibility/ability to work remotely
- Company Fun Facts

In addition to these fields, there are 4 buttons: Add Job Role, Current Job Listings, Quit, and Save. *Add Job Role* takes the user to the page to post a job role on behalf of a company - via Page 4B.2. *Current Job Listings* results in a popup showing all job roles posted on behalf of the company so far - via Page 5B.2. *Quit* takes the user back to the original page they were on. *Save* saves the profile information and takes the user back to the original page they were on.

Page 4B.2: (REQ# 4, 11, 24)

When a recruiter or employer presses on the *Add Job Role* button on the company profile page-3B.2 (or *Post a Job* button on the hiring expansion page via Page 2C), a new page appears allowing the user to post specific information on the job role on behalf of the company.

The available fields are: Company Name (autofill), Position Name, Location, Salary Range (slider), Position Type (check box: full-time, part-time, intern, co-op), Interview Type, Posting expiration date, Experience Level, Preferences, and Description/Responsibilities for the job role. In addition to the fields on the page, there are two buttons available: *Quit* and *Add Job*. When *Quit* is pressed, the job role is not added and user will return to the original page. When *Add Job* is pressed, the job role is added to the system, and the user will return back to the original page.

Page 5B.2: (REQ# 24)

When a recruiter or employer presses on the *Current Job Listings* button on the company profile page - 3B.2, a popup appears allowing the user to see all of the current jobs that are listed. In each job listing, there is a *Favorites* link and an *Edit* link. The *Favorites* link displays another popup that lists all of the candidates that have been favorited for a job. The *Edit* link takes the user back to the add a job role page - Page 4B.2 - where they can edit the existing listing.

Current Job Listings   Candidate Favorites

Favorites   Edit
Role
Logo   Company
Location

Favorites   Edit
Role
Logo   Company   List of Favorites for Each Role
Location

Favorites   Edit
Role
Logo   Company
Location

Close   Close
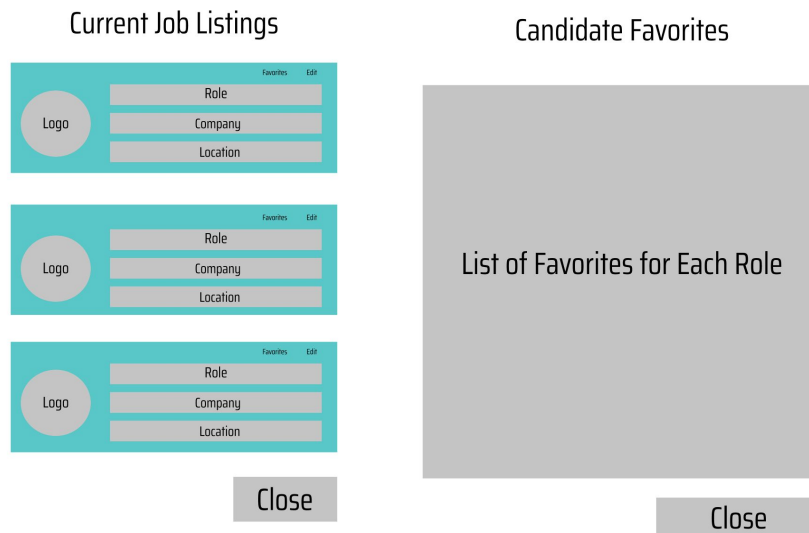
After a user has logged in or signed up, the signup/login icon adjusts to a user icon. When the user presses the user icon, two options appear: view profile and sign out. When a user presses on view profile, it takes them to their respective profile with the opportunity to edit any information as well as view their respective favorites list. When a user presses sign out, it signs the user out and returns them to the homepage - Page 1.

Page 2C: (REQ# 4, 24, 28)

When a user presses on the Hiring button on page 1, a new page opens - the Hiring Expansion Page. The page displayed is a decorated, but mostly empty dashboard (similar to Page 1). The body of the dashboard includes a prompt of "I want to…", as well as two hover button options of "Look for Candidates" and "Post a Job". At the heading level of the webpage, there are 5 tabs with hover effects available, displaying: "Home, "Mission", "Salary Negotiation", "Unbiased Training", and "Blog", as well as a signup/login icon in the upper-right hand corner of the webpage.

To access this page, the user must be logged in, so if the user is not signed in prior to pressing the hiring button on Page 1, then the user will go through the respective processes labeled in 2B/2B.2 and then return to the original page - this page.
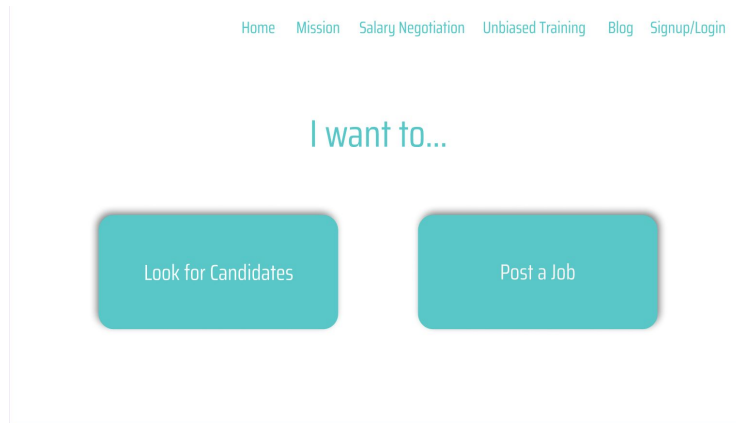
There are two new main pathways from this page which can be accessed by the two buttons *Look for Candidates* and *Post a Job*.

Page 2C.1: `(REQ# 16, 24)`
When the user presses the *Look for Candidates* button, a new page loads.
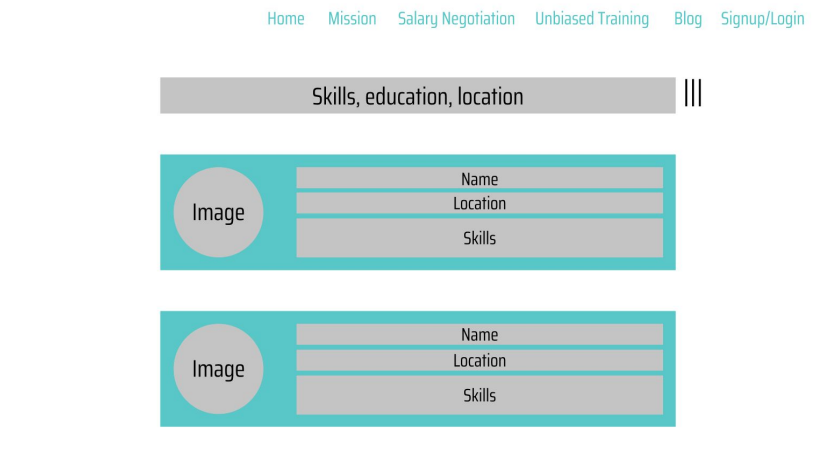
On this page, appears a search bar, filter icon, and a list of ALL potential candidates in block form. These candidates are aggregated based on the box checked off on Page 3B.1 on the candidate's profile indicating the candidate is currently looking for a job. Each block displays the candidate's image, name, location, and skill sets which were entered on their profile. When the user clicks on an individual block, a new page loads via Page 3C.1.

Page 3C.1: `(REQ# 14, 24)`
Visually, this page is a split-page, similar to the glass door results page in the image screenshot in section 4A. The left side of the page (smaller in size) contains the same results block-list from Page 2C.1 and the right side of the page (larger in size) contains the expansion on the candidate's profile, giving the employer access to information entered in the candidates profile (name, location, education, experience, skills, organizations, website/github link(s), and resume).

At the top of the page, there are *Contact* and *Save* - represented by a star - buttons. When the *Contact* button is pressed, a contact pop up appears as seen in the image below (left), displaying a template for a message to be sent to the candidate requiring fields of employer/recruiter name, company name, message, and buttons to Quit and Send. Both buttons result in the pop up closing and resuming back to the original page, but the Send button results in a pop-up notification of the email being sent. When the user presses the *Save* (star) button to favorite a candidate, the star is filled, and an *Add a Favorite* popup appears that lists the current job listings that exist for their company as seen in the image below (right). From this list, the user picks a job that they want to save a candidate for and either presses *Save* to save the selection and close the popup, or *Quit* to close the popup.

Page 2D: `(REQ# 24)`

When the user presses the Mission tab in the header of page 1, a new page loads with a Mission Header and a body of text. This page's purpose is only to be read by the user. Images of the founders of Glass Ceiling Inc are shown as well.

Mission   Salary Negotiation   Unbiased Training   Blog   Signup/Login

Mission
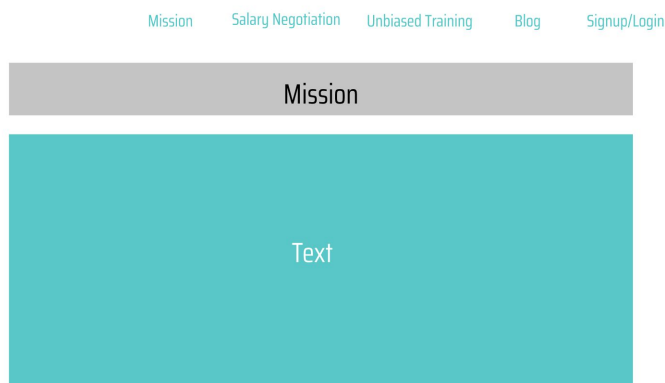
Text

Page 2E: `(REQ# 7, 24)`

When the user presses the Salary Negotiation tab in the header of page 1, a new page loads with Salary Negotiation information and a body of text. This page's purpose is only to be read by the user.

Mission   Salary Negotiation   Unbiased Training   Blog   Signup/Login

Salary Negotiation
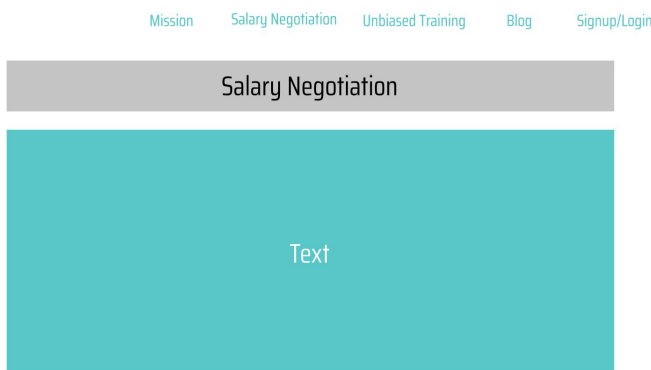
Text

Page 2F: `(REQ# 9, 10, 24)`

When the user presses the Unbiased Training tab in the header of page 1, a new page loads with an Unbiased Training header and a body of text. This page's main purpose is to be read by the users. If a user is logged in and categorized as an employer, it is suggested that the user interacts with the text/videos present within the body segment. A completion box will appear at the bottom of the page via the system to allow the user to confirm completion of the training, which will be reflected on the employer's profile.

Mission   Salary Negotiation   Unbiased Training   Blog   Signup/Login

Unbiased Training

Text

.
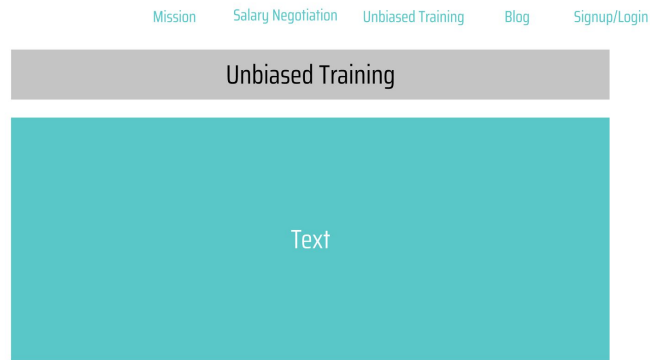
Page 2G: (REQ# 6, 8, 24)
When the user presses the Blog tab in the header of page 1, a new page loads with Blog as the header and a body of text explaining the purpose of the blog. On the blog, the user will have the option for two types of posts:
- Type 1 is any review, feedback and experience testimony the user has pertaining to the website
- Type 2 is a review of a company - dropbox- that is a client of our website, these reviews will be visible on the company's review tab via Page 4A.

Mission   Salary Negotiation   Unbiased Training   Blog   Signup/Login

Blog

Text

User Effort Estimation

User effort estimation based on the most intensive website navigation scenarios for both job seekers and employers.

Scenario Type	Total Mouse Clicks	Clicks for Input	Clicks for Navigation	Input/Total Clicks	Navigation/ Total Clicks
Job seeker creating an account and searching for a job	44	24	20	24/44	20/44
Employer creating an account and adding a job	59	34	25	34/59	25/59

Section 5: *System Architecture and System Design*

Architectural Styles

The architectural style that we employ is the layered pattern, which is commonly used in web applications. This pattern is used to structure our software which can be broken down into three sublayers, Presentation Layer (Front End/ UI), the Application Layer (Service/Middle), and the Data Access Layer (Database/ Backend), each of which is at a particular level of abstraction. Each layer also provides services to the next higher level. This style best fits our application because each of our sublayers services another. The presentation layer presents services (displays content) to the end-user through a GUI. This tier can be accessed through a desktop and laptop client devices. In order for the content to be displayed to the user, the relevant web pages will be fetched by the web browser which is running in the client-server, hosted in the application layer. For this to work, the Presentation Layer interacts with the Application Layer directly beneath it. The Application Layer is the layer in which a number of reusable subsystems are ran, ours being the Firebase Hosted client-server and the Algolia software searching algorithm. These systems pull information directly out of the cloud database which is held in the Data Access Layer beneath it.

Identifying Subsystems

In the Glass Ceiling web application, multiple functionalities are implemented through subsystems. The Figma website is used to create the wireframes for the web applications user interface. The wireframes are coded in HTML/CSS and are given functionality through the Javascript code that lies in the Application Layer. The Algolia API, in the Application Layer, is used to implement several use cases including; Search for Job Posting, Job Type, Job Location, or Company, and Search for a Candidate. Through Firebase Hosting we are able to deploy the application and have it operate in real-time. The Firebase server offers a Cloud based database and a built-in authentication which are hosted the Data Access Layer.
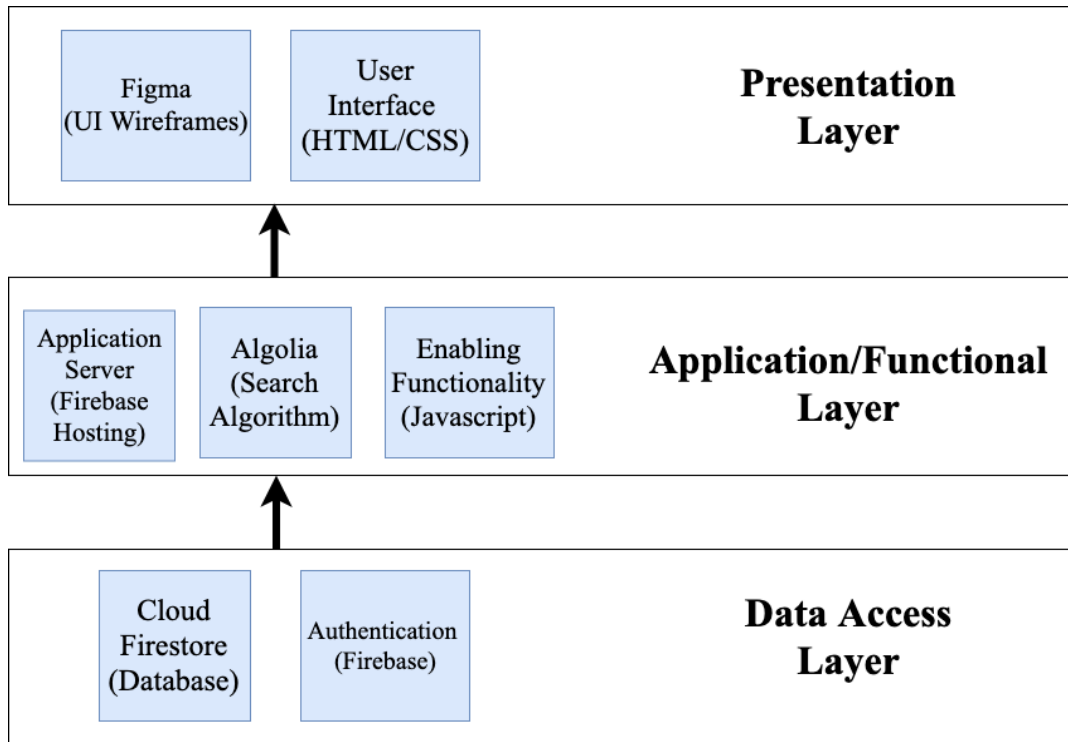
Mapping Subsystems to Hardware

NO: The system does **not** need to run on multiple computers.

Persistent Data Storage

There exists data in our system that needs to outlive a single execution of the system. This data includes Employer and Employee log-in information, profile data, job posts, favorited jobs, and reviews. This data will be stored in Firebase's Cloud Firestore, a document-oriented database. Cloud Firestore is a flexible and scalable cloud database used to store and sync data for client- and server-side development. Data is stored in Cloud Firestore in collections. Data collected from the users is stored in documents which make up a collection. Each document contains a set of key, value pairs (fields). Unlike MySQL, Cloud Firestore is schemaless, so there's freedom for each document. In the diagram seen below, one can see how the data is nested under a collection. In this case a collection is an Employee Profile. A document will represent an individual profile (Employee and Employer). The fields that are filled in below represent all of the attributes that would be filled in for the profile to be considered complete.
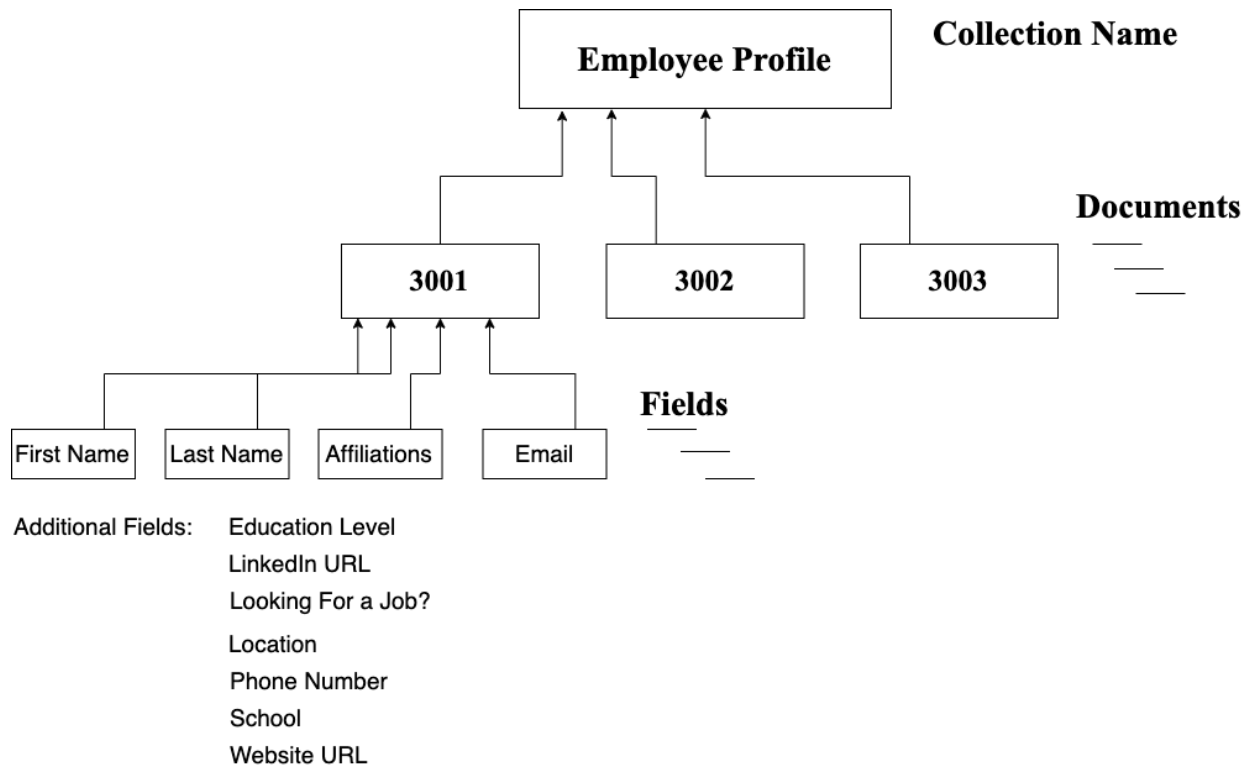
Figure: Draw.io depiction of a Collection Model from Firebase's Cloud Firestore

Network Protocol

Our website is ran through Firebase Hosting, which is a cloud server. Firebase supports static files such as CSS, HTML, JavaScript, which are all files used throughout our project, and it also offers support through Cloud Functions. The service that we as a group chose delivers files over a Content Delivery Network (CDN) through Secure Sockets Layer encryption (SSL) and Hypertext Transfer Protocol Secure (HTTPS), which is the encrypted/ secure version of HTTP. To ensure confidentiality and secure communication over a network, HTTPS is used. We chose Firebase because it offered this built-in network structure and its extensive variety in functionality.

Global Control Flow

Execution order: Our website is event-driven. Actions are performed once the user clicks a button. Certain buttons lead to specific places on the website, but every user can generate actions in a different order. Our system uses conditionals and loops to execute the appropriate events. Event-driven programming is beneficial in this case because it allows our website to be user-friendly, rather than forcing each user down a path they might not desire to be in.

Time dependency: Our system does not have any timers. With event-driven programming, the system updates after each event is executed.

Concurrency: No : Our system does **not** use multiple threads.

Hardware Requirements

To run the Glass Ceiling web application, a user would need a common operating system preferably Windows 8, or Mac OS 10.10 or higher in order to execute the non-functional time constraints from report 1. The user's computer should also have processor (CPU) with 2 gigahertz (GHz) frequency or above and a minimum of 2 GB of RAM. These are standard functional requirements needed to run a web application. A color screen display with a monitor Resolution 1024 X 768 pixels or higher will provide them with a standard quality view of the page. It is necessary to have a high-speed internet connection with a speed of 4 Mbps and a minimum of 150-200 MB of available space on the hard disk. A keyboard and mouse or some other compatible pointing device for full interaction is needed as well.

Section 6: *Data Structures*

The system uses arrays of strings in several class implementations as well as the database implementation in order to store several values of strings. For instance, if a job seeker has several social and professional affiliations, they can list as many as they would like. These several affiliations will be stored in an array of strings. An array of strings is relevant to the system because of the Firebase implementation specifically. The array of strings enables us to insert and update the database since it is compatible with the Firebase API.

Section 7: *User Interface Design and Implementation*

The initial landing page has been implemented with links to each subsequent page working. None of the subsequent pages are full coded out, they just have empty HTML and CSS files associated with them. The signup/login functionality is currently implemented as a popup form, but that will be changed to be navigation to an external page. The popup form functionality has been pushed back as a reach goal for the sake of developing a minimal viable product and code cleanliness. We have detailed wireframe images of our site that we created with Figma and there have not been significant changes made to the UI since Report #1.

Our site design is minimalistic and well organized, so no changes have been made to minimize the user effort. User effort and intuitiveness was strongly considered in the initial creation of the wireframes for our site and we have not found any ways thus far to minimize user effort any further.
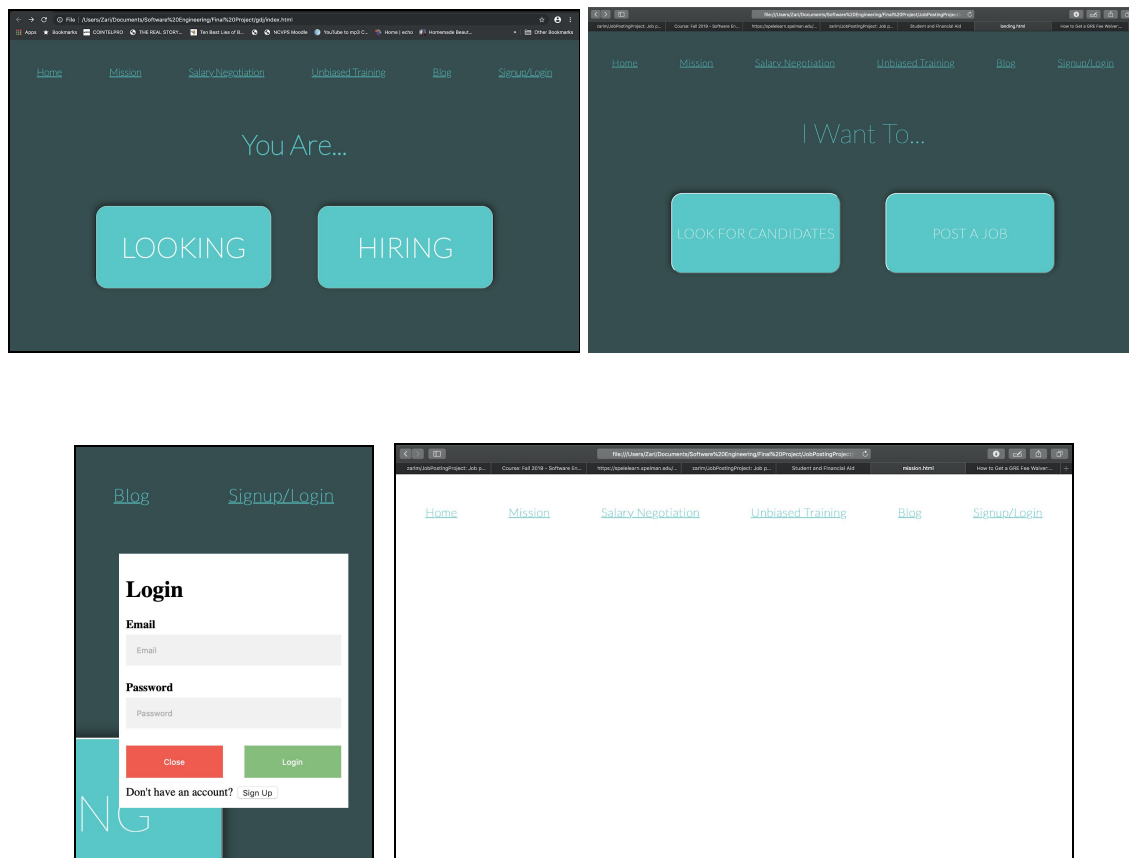
Section 8: *Design of Tests*

Alpha Testing Approach

The approach for Alpha testing is have each member of the group go through our site and make sure that everything works as expected. After that we will seek out other students in our class and Dr. Marshall to test our product. This will be used to test the user interface and receive feedback from the users as well as detect anomalies. This will aid in satisfying non-functional requirement REQ-24 which states that the system should have a clean layout and be visually appealing to the user and non-functional requirement REQ-25 which states that the user should be able to intuitively navigate the system.

Beta Testing Approach

The approach for Beta testing is to have friends outside of the computer science department to go through our site. While they are going through the site we will make observations about their interactions and make the necessary tweaks to improve the user experience and decrease the user effort. Again, this will be used to test the user interface and receive feedback from the users as well as detect anomalies in order to help satisfy non-functional requirements REQ-24 and REQ-25.

Approach for Acceptance Test

The approach for acceptance tests will follow the acceptance testing process with respect to our system as outlined in the below bullet points. We plan to pair our acceptance testing with agile methods by making the job seeker customer part of the development team. Tests will be defined by the customer and run automatically when changes are made. This approach works for our system because our system is being built in a short time span and we want to build it quickly but effectively. Additionally, our team is co-located with informal telecommunications, increasing the convenience of this method. However, a drawback is that the job seeker customer may not represent the employer and company stakeholders, but it is harder to find an employer and company to be heavily involved with the development team to determine the acceptability of the system. A testing report for the outcomes of the test results and subsequent acceptances/modifications will be available in Report #3 as well as on the project GitHub.

Acceptance Tests for Use Cases for Job Seeker

Use Case	Requirement(s)	Test Cases (Inputs)
Employee Register for Glass Ceiling	REQ-2: The system shall allow job	Enter an invalid email

		posters and job seekers to register for an account on the site and the ability to login once they are registered.	Enter numbers instead of characters for name and email.
			Enter an email that's already in the system
			Enter a valid email and name
Employee Log in to Glass Ceiling	REQ-2: The system shall allow job posters and job seekers to login to the system once they are registered.		Enter random email
			Enter email with incorrect password
			Enter incorrect email with valid password
			Enter random passwords with no email
			Enter only numbers for the emails, passwords & both
			Enter a valid email and password
Complete an Employee Profile	REQ-3: The system shall allow job posters and job seekers to complete profiles on the site.		Enter integers instead of Strings for the String fields (name, school, URL, etc.)
			Enter the correct data types for each input
Search for Job Posting, Job Type, Job Location, or Company	REQ-1: The system shall allow the job seeker to search for companies or job postings by keywords.		Input keywords that aren't in the system
			Input keywords that relate to multiple features (job type, location, company)
			Press search with no input
			Put random character in search box instead of valid keywords
			Input keywords that are in the system
Employee Post Review	REQ-6: The job seeker users who are registered users shall be able to give reviews of companies who list on the site.		Try to post a review from an unlogged-in view
			Try to navigate to the review page and post a review from the employer view

		Create a post from the employee's view
Employee View Different Page/Tabs	REQ-7: The system shall provide a page that contains information on salary negotiation. REQ-8: The system shall provide the ability for job seekers and job posters to post blogs on their experience with the site, experience with job searching/recruiting, etc. REQ-9: The system shall provide a page for unconscious bias training for job posters who wish to do the training.	Rapidly click back and forth between pages Click back and forth at normal speed between pages
Favorite a Job	REQ-13: The system shall save the job seeker's selected companies and job postings as favorites if they are a registered user.	Click on and off of the save button Click the save button to save job

Acceptance Tests for Use Cases for Employer

Use Case	Requirement(s)	Test Case (Inputs)
Employer Register for Glass Ceiling	REQ-2: The system shall allow job posters and job seekers to register for an account on the site and the ability to login once they are registered.	Enter an invalid email Enter numbers instead of characters for name and email. Enter an email that's already in the system Enter a valid email and name
Employer Log in to Glass Ceiling	REQ-2: The system shall allow job posters and job seekers to register for an account on the site and the ability to login once they are registered.	Enter random email Enter email with incorrect password Enter incorrect email with valid password Enter random passwords with no email Enter only numbers for the emails, passwords & both Enter an invalid Company ID Enter characters instead of numbers for Company ID Enter a valid email and password
Complete Company Profile	REQ-3: The system shall allow job posters and job seekers to complete profiles on the site.	Enter integers instead of Strings for the String fields (company name, history, mission)

		Enter valid data types for each field
Post Job Opening	REQ-4: The employer shall be able to post jobs if they are a registered user and their company is also registered on the site.	Enter integers instead of Strings for the String fields (company name, history, mission) Enter valid data types for each field
Search for a Candidate	REQ-16: The system shall allow job posters to search for candidates by filters.	Input keywords that aren't in the system Input keywords that relate to multiple features (job type, location, company) Press search with no input Put random character in search box instead of valid keywords Input keywords that are in the system
Employer Visit Different Tabs	REQ-7: The system shall provide a page that contains information on salary negotiation. REQ-8: The system shall provide the ability for job seekers and job posters to post blogs on their experience with the site, experience with job searching/recruiting, etc. REQ-9: The system shall provide a page for unconscious bias training for job posters who wish to do the training.	Rapidly click back and forth between pages Click back and forth at normal speed between pages

Analysis of Acceptance Test Coverage

Acceptance Tests have been created for each of the use cases presented in Project Report 1. In an effort to cover many possible edge cases, each test's purpose is to try to incur an error in the system so that we as developers may fix the bug. As subsystems are connected to the web application various functions are implemented by the customer representative. The tests created are meant to check the functionality of each layer in the architectural structure. The user-interface created by wireframes in HTML/CSS is being evaluated on its connectivity and direction. Upon selection of a tab, will the user be directed to the correct page? Will the pages be responsive in a reasonable amount of time? What happens if the user clicks back and forth in rapid succession? These operations must happen smoothly to ensure the user ease of access.

The search functionality that implements the Search for Job Posting, Job Type, Job Location, or Company, and the Search for a Candidate use cases must operate when the user inputs information that is expected to lead to a certain outcome. It must also redirect to a page that displays that their search has come up inconclusive based on what they input. This is

important because the search function is key to the employee whose primary goal for the website is to search for applicable jobs. The database should not allow entries of different data types into fields with specific types. This will be tested vigorously to ensure the database is allowing only numbers to go into spaces that take an integer or float, and accept characters and numbers in spaces that take Strings since these things can be represented as Strings. Taking in a resume to the web application was not high priority, as such, it was not included in the acceptance test cases. Once all of the use cases are thoroughly tested and verified to work efficiently and effectively will the developers add in and test the resume function if there is enough time.

Unit Tests for Modules/Classes

Modules/Classes	Test Cases (Input)
Candidate/Employer Signup	The unit tests will be used to simulate abnormal operations such as if the user inputs an invalid email address. All attributes for the sign up process will be tested by using varying inputs to ensure expected functionality with several typical and atypical input values and to discover which inputs cause defects in the program. The sizes of data types such as strings, arrays of strings, and integers will be of differing sizes in order to avoid as best as possible false positives of correct output because of characteristics of the input. Several test cases will be used that input a different type than is specified for an attribute in order to generate test cases that generate all error messages.
Candidate/Employer Login	The unit tests will be used to simulate abnormal operations such as if the user inputs an invalid email address. All attributes for the login process will be tested by using varying inputs to ensure expected functionality with several typical and atypical input values and to discover which inputs cause defects in the program. The sizes of data types such as strings, arrays of strings, and integers will be of differing sizes in order to avoid as best as possible false positives of correct output because of characteristics of the input. Several test cases will be used that input a different type than is specified for an attribute in order to generate test cases that generate all error messages.
Search Engine	Unit tests must be designed to ensure the individual functions of the search engine perform as expected, namely the database retrieval and the population of search results from indices. A test will be designed to ensure that the backend is retrieving collections from the database. The test will involve running the script that retrieves collections from the database for the search engine, and looking in the search engine API dashboard to see if the collections from the database appear in the appropriate indices. A test will be designed to ensure the search engine populates the user interface with answers . This test will involve typing into the search engine bar and observing the output or lack thereof.

Analysis of Unit Test Coverage

The unit tests cover the basic functionalities of the site that are core to being acceptable to the user, namely the user must be able to sign up, login, and search jobs/candidates. The integration tests for the search engine ensure that they work on a high level, that is that the search engine can deliver performance to the user across the front end and back end. However, the unit tests ensure that each individual part is running smoothly so that when they are integrated there will be minimal defective behavior. The database retrieval that will be used to populate the indices and UI population from indices must both be running smoothly separately in order to pass the unit tests. In addition, we test the inputs for sign up and login to ensure that the users can smoothly enter the site and gain access to their information and the rest of the site's functionality, namely the search engine. As far as inputs, the unit tests cover both typical and atypical inputs as well as correct and erroneous inputs to observe defective behavior within the program. Sizes are also varied which allow for the testers to push the limits of the units.

Since we are using Firebase and Java, it is extremely difficult to create circumstances where the input buffer would overflow. For instance, the size of a Java string is 2,147,483,647 members long [5], and the maximum size of a string in Firebase is 2.5 million characters [1]. This is a similar situation with numbers. These are such extreme and improbable edge cases in our context that we will not account for them.

The unit tests are limited because they do not cover state transition sequences and do not account for all possible states. The justification for this is that the developers are using agile methods with rapid incremental development, and unit tests will be performed for all classes and their operations on a basic level. From this, we make the assumption that the modules function as expected in the system because there is only a limited amount of time for the project and we want to push out a project with the minimum functionality required for our system in order to hopefully shoot for our stretch goals later in the semester.

Integration Testing Strategy

We plan on using incremental integration to test the units of our system. With incremental testing, we can test the connectivity of our units as they become available. Once a unit is finished, it can be tested with a "dummy unit" that is it logically related to, in order to test its functionality [6]. The "dummy unit" would simulate a function that performs the task the completed unit needs to merge with, to make sure the finished unit works and can be connected later.

In particular, the units of our system are the front end (wireframes/HTML/CSS), the middleware (Java classes for site functionality), and backend (Firebase database/hosting, Algolia search engine). The Java classes will be tested individually with mock objects and automated test cases under the assumption that they function properly when tested as a single unit. Subsequently, the Java classes will be connected to the front end and tested to understand if the

Java classes are successful in most cases, including several edge cases, when user events occur on the front end. Following, the database will be integrated with the front end and middleware at which point the middleware and backend team will work together to test the functionality of the Java classes sending data entries successfully to the database. Henceforth, the search engine will be integrated, and the team will work together to test the success of the integration.

The incremental testing strategy for integration testing is best for our system because it allows us to test as we develop our application layers instead of waiting until every unit is finished to test them as a whole, so we know immediately if something does not work. Waiting until everything is complete would be more time consuming and would make testing difficult, since it would be challenging to trace the root cause of any errors or bugs.

History of Work

During the course of this semester, a plethora of milestones and objectives have been completed pertaining to the creation and implementation of The Glass Ceiling & Co. Job portal. The following use cases have been implemented: employer/employee sign up/login/build profile, employer post a job role, and employee ability to search for a job role. To enable the mentioned functionality, pivotal work has been completed pertaining to the building and maintenance of the database, connection the the Algolia search engine API, constant check-points and testing to make sure the front-end/back-end were merged properly as well as customization updates to the front-end for a cohesive web portal appearance.

Current Status

The current status of the Glass Ceiling & Co. job portal is active - meaning an updated prototype is running and available to the public via link.

Future Work

If the team was to continue developing this project, future work would consist of finalizing the implementation of high priority requirements and implementation of the remaining low/medium requirements as well as other objectives present in the original project scope that were benched due to time constraints for the course curriculum. Finalization examples include: implementing pop-up windows, rather than hyperlinks to new pages, avatar icons, website theme cohesion. Implementation examples include: specific site functionality like: favoriting of job roles and the ability to contact candidates directly from the portal.

References

[1] Alison Doyle. 2019. Top 10 Best Websites for Jobs. (June 2019). Retrieved September 19, 2019 from
https://www.thebalancecareers.com/top-best-job-websites-2064080.
This site provides general information on job sites which was used to inform the authors about how job sites are generally constructed.

[2] Andreas Leibbrandt and John. A. List. 2014. Do Women Avoid Salary Negotiations? Evidence from a Large Scale Natural Field Experiment.
Retrieved September 23, 2019 from
http://gap.hks.harvard.edu/do-women-avoid-salary-negotiations-evidence-large-scale-natural-field-experiment.

[3] Asha Dumonthier, Chandra Childers, Ph.D., and Jessica Milli, Ph.D. 2016. The Status of Black Women in the United States. Retrieved
September 23, 2019 from https://www.domesticworkers.org/status-black-women-united-states.

[4] Brittney Oliver. 2017. This Is What It's Like To Search For A Job As A Black Woman. (December 2017). Retrieved September 23, 2019
from
https://www.fastcompany.com/40504481/this-is-what-its-like-to-search-for-a-job-as-a-black-woman.
This work informed the customer problem statement for job seekers.

[5] Brittney Oliver. 2018. What It's Really Like To Be A Black Woman Job Hunting? Women Share How To Stay Motivated During A Job
Search. (August 2018). Retrieved September 23, 2019 from
https://www.essence.com/lifestyle/money-career/black-women-stay-motivated-job-search-process/.
This work informed the customer problem statement for job seekers.

[6] Carol Sankar. 2017. Why Don't More Women Negotiate? (July 2017). Retrieved September 23, 2019 from
https://www.forbes.com/sites/forbescoachescouncil/2017/07/13/why-dont-more-women-negotiate/#5646dd5ee769.
This work informed the customer problem statement for job seekers.

[7] Chandelis R. Duster. 2017. Leveling The Equal Pay Field: Negotiating While Black. (April 2017). Retrieved September 23, 2019 from
https://www.nbcnews.com/news/nbcblk/leveling-equal-pay-field-negotiating-while-black-n742271.
This work informed the customer problem statement for job seekers.

[8] Danielle Brown and Melonie Parker. 2019. Google diversity annual report 2019. Retrieved September 21, 2019 from
https://diversity.google/annual-report/#!#_new_demographic_data.

[9] Derek Avery. 2018. Interviewing while Black: How race affects salary negotiations. (December 2018). Retrieved September 23, 2019 from
https://www.cnn.com/2018/12/26/perspectives/black-job-candidates-bias-negotiate/index.html.
This work informed the customer problem statement for job seekers.

[10] Elise Gould, Zane Mokhiber, and Julia Wolfe. 2019. Class of 2019: College Edition. (May 2019). Retrieved September 23, 2019 from
https://www.epi.org/publication/class-of-2019-college-edition/.
This work informed the customer problem statement for job seekers.

[11] Glassdoor. Average Google, Inc Salary. Retrieved September 22, 2019 from
https://www.payscale.com/research/US/Employer=Google%2C_Inc./Salary.

[12] Glassdoor. Electrical Engineering/Computer Engineering/Computer Science Co-op. This reference is highlighted in the customer problem
statement
Retrieved September 24, 2019 from
https://www.glassdoor.com/job-listing/electrical-engineering-computer-engineering-computer-science-co-op-hunter-engineering-company-JV_IC
1131201_KO0,66_KE67,93.htm?jl=3332977670&ctt=1569542472801&srs=EI_JOBS.

[13] Glassdoor Team. 2016. 3 in 5 Employees Did Not Negotiate Salary. (May 2016). Retrieved September 19, 2019 from
https://www.glassdoor.com/blog/3-5-u-s-employees-negotiate-salary/.

[14] Glassdoor Team. 2018. Glassdoor Study Reveals What Job Seekers Are Looking For. (July 2018). Retrieved September 19, 2019 from
https://www.glassdoor.com/employers/blog/salary-benefits-survey/.
This work informed the customer problem statement for job seekers.

[15] Isabel Thottam. Do Race & Gender Play A Role in Salary Negotiations? A New Study Says Yes (October 2016). Retrieved September 23,
2019 from
https://www.glassdoor.com/blog/do-race-gender-play-a-role-in-salary-negotiations/.
This work informed the customer problem statement for job seekers.

[16] Janell Ross and National Journal. 2014. African-Americans with College Degrees Are Twice As Likely to Be Unemployed as Other
Graduates. (May 2014). Retrieved September 23, 2019 from

https://www.theatlantic.com/politics/archive/2014/05/african-americans-with-college-degrees-are-twice-as-likely-to-be-unemployed-as-other-gra duates/430971/.
This work informed the customer problem statement for job seekers.

[17] Jepera Puryear. 2018. Black college graduates face tougher job market. (April 2018). Retrieved September 23, 2019 from http://www.tigersroar.com/features/article_d0a3529a-3e8f-11e8-87da-1f309a6c5c12.html.
This work informed the customer problem statement for job seekers.

[18] Maggie Overholt. The Best Job Sites. Retrieved September 19, 2019 from https://www.reviews.com/job-sites/.
This work informed the customer problem statement for job seekers.

[19] Martin Schedlbauer. Requirements Prioritization Strategies. Retrieved September 24, 2019 from https://www.corpedgroup.com/resources/ba/ReqsPrioritization.asp.

[20] Morela Hernandez, Ph.D., Derek R. Avery, Ph.D., Sabrina D. Volpone, Ph.D., and Cheryl R. Kaiser, Ph.D. 2018. 'Bargaining While Black' May Lead To Lower Salaries. (October 2018). Retrieved September 23, 2019 from https://www.apa.org/news/press/releases/2018/11/bargaining-black.
This work informed the customer problem statement for job seekers.

[21] Non-functional Requirements. Retrieved September 23, 2019 from http://users.csc.calpoly.edu/~jdalbey/SWE/QA/nonfunctional.html.
This worked served as a resource for understanding non-functional requirements.

[22] Richard V. Reeves and Katherine Guyot. 2017. Black women are earning college degrees but that alone won't close race gaps. (December 2017). Retrieved September 23, 2019 from https://www.brookings.edu/blog/social-mobility-memos/2017/12/04/black-women-are-earning-more-college-degrees-but-that-alone-wont-close-r ace-gaps/.
This work informed the customer problem statement for job seekers.

[23] Robert Half. 2019. 12 Best Job Search Websites. (June 2019). Retrieved September 19, 2019 from https://www.roberthalf.com/blog/job-market/10-best-job-search-websites.

[24] Tanya Tarr. 2018. How to Negotiate for Equal Pay According to Twenty Black Women Leaders. (August 2018). Retrieved September 23, 2019 from https://www.forbes.com/sites/tanyatarr/2018/08/07/how-to-negotiate-for-equal-pay-according-to-twenty-black-women-leaders/#f8b6fc859b68.

[25] TemplateLab. 40 Use Case Templates and Examples (Word & PDF). Retrieved September 21, 2019 from http://templatelab.com/use-case-templates/.

[26] The American Association of University Women. 2018. Black Women and the Pay Gap. (August 2018). Retrieved September 23, 2019 from https://www.aauw.org/article/black-women-and-the-pay-gap/.

[27] Valerie Bolden-Barrett and Katie Clarey. 2018. Pay gaps for black jobseekers may be partly tied to salary negotiations. (October 2018). Retrieved September 23, 2019 from https://www.hrdive.com/news/pay-gaps-for-black-jobseekers-may-be-partly-tied-to-salary-negotiations/540553/.

[28] Valerie Wilson, Janelle Jones, Kayla Blado, and Elise Gould. 2017. Black women have to work 7 months into 2017 to be paid the same as white men in 2016. (July 2017). Retrieved September 23, 2019 from https://www.epi.org/blog/black-women-have-to-work-7-months-into-2017-to-be-paid-the-same-as-white-men-in-2016/.

[29] Yoni Blumberg. 2018. Race doesn't impact how job-seekers negotiate salaries—but it does affect how much money they get. (November 2018). Retrieved September 23, 2019 from https://www.cnbc.com/2018/11/13/study-black-employees-get-lower-offers-during-salary-negotiations.html.