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THE MIND OF AN HR BOT

A Dive into Applicant Tracking Systems

The project takes a deep dive into Applicant Tracking Systems (ATS) which form an integral component of the recruitment aspect of Human Resources (HR). These systems can be defined as "A computer software which manages the online recruitment process as well as stores, organizes and ranks the information of job applications" (Drucker, 2016). It is an interesting application of data science that has a lot of implications from a human-centered perspective. The project looks into literature review (what these systems do, common approaches, discuss possible implications), human-centered arguments, my research question and the experiments used to analyze this question. The analysis of the findings of the experiments were tested against a survey to provide validation for the arguments made and finally, the limitations and potential directions for further research are also discussed.

RESEARCH QUESTION

What is the dynamic between the aspects of efficiency and fairness when Applicant Tracking Systems are utilized into the pipeline of recruitment? *What are the consequences of using ATS in the recruitment process? – identifying flaws in the system, exploring the expectations weighed on the applicant for tailoring their resumes.*

BACKGROUND RESEARCH/ RELATED WORK

Background

Applicant Tracking Systems are used by 98.8% of Fortune 500 companies. Therefore, it is highly likely, that if one is applying for a job at a mid to large-sized company, they are applying through an ATS (Qu, 2019). These systems have formed an essential part of the recruitment process because it saves time by helping with narrowing down candidates to a more manageable size and provides an easy and organized framework to store the plethora of information submitted by job applications. For instance, Procter & Gamble had about one million applications for 2,000 jobs with an average of 500 applicants per job (Weber, 2012). This reveals the need for such a framework. Moreover, on an average, a study by the Society for Human Resource Management states that the average cost to hire an employee is $4,129, with around 42 days to fill a position (Society, 2016). Given the financial and time resources that are used up by the recruitment cycle,

the benefits provided by ATS to speed up the process and filter applications makes for an attractive negotiation.

However, of the submitted resumes, only 25% pass the ATS while the remaining are lost in the system, never to be seen by a HR recruiter, a phenomenon often referred to by sources like The Wall Street Journal, Forbes, etc. as the *black hole* because often applicants never hear back from the company once they apply and sometimes, even when they are suitable for the role, they might not pass through the ATS (Drucker, 2016) for reasons that will be explored in the project.

How do Application Tracking Systems work?

From literature available online on ATS, it can be established that ATS filters resumes by the process of parsing: which in essence means to read through the resume and by a method of "keyword matching", which compares the parsed resumes to the job descriptions, it decides whether the keywords of the job description are present in the resume. Based on this, a score is assigned to the applicant and this forms the basis for the ranking of the applications by the ATS (Drucker, 2016).

In addition, the ATS looks into the formatting of the resume. Even if the most qualified candidate applies for a job position, without proper formatting, the system might rank the resumes lower, with a high chance of it never being passed onto a recruiter. For instance, it has been noticed that something as simple as changing the order of listing the name of a past employer after the time period worked could confuse the ATS system, eventually leading to negative consequences for the applicant (Drucker, 2016).

Eventually, the resumes are converted into plain text and due to this very reason, there are multiple tips given on online blogs for an applicant to keep in mind when applying for a job:

- Submit .docx format of the resume (as outdated ATS could mess up the parsing of a PDF form of the resume)
- Avoid graphics, tables and complex formatting, rather work with simple templates and a straightforward format

(Benz,2020). This, however, is seen to be a hard factor to balance with building a resume that is visually appealing for a HR recruiter. The general suggestions available for a candidate to craft an ATS-friendly include:

Table 1 Advice on crafting an ATS-Friendly Resume (Drucker, 2016).

General Layout for Resumes

	Candidates should NOT…	Candidates should…
Fonts	Use bold or italic (Amjad, 2015) Use script or uncommon fonts Use font sizes over 16PT (Gillis, 2016)	Use standard fonts like Arial, Courier Georgia, Impact, Lucinda, Tahoma (Abdel-Halim, 2012; Amjad, 2015)
Special Characters	Use borders, shading, or tabs Use special characters or arrows (Abdel-Halim, 2012; Amjad, 2015)	Use simple bullet points (Abdel-Halim, 2012; Amjad, 2015)
Page	Use logos, tables, columns, graphics, images, headers, page breaks, or excessive bullet points Insert continuous lines into the page (the ATS may red them as page breaks) (Abdel-Halim, 2012; Amjad, 2015; Gillis, 2016; Moody, 2016)	Use a simple template (Amjad, 2015) Use a clean resume with no formatting other than simple bullet points. (Moody, 2016) Organize the resume into clear sections so that they are easy for the ATS to find (Fertig, 2013)
Other	Include an address on a resume because it can be misappropriated to the wrong field (Gillis, 2016) Include a middle initial; it can be parsed into the wrong field (Moody, 2016)	Fill in every field in the online application (Moody, 2016) Use the exact job title in the resume if possible (Gillis, 2016) Avoid gaps between employment because the ATS may rank the application lower because of it (Schultz, 2016)

Relevance and Influence of ATS

Given how ATS are so widely used in the industry (from mid to large-sized companies), it can be implied that it is a very relevant component in the recruiting cycle. The black hole phenomena associated with ATS implies how influential they can be in deciding the employability of candidates.

The Human-Centered Argument – Why?

This section explores the multiple forms of the consequences Applicant Tracking Systems can have on the humans involved in the situation. The project looked into three perspectives:

- *HR Employees*: Introducing ATS into the recruitment process means more training is required for the HR employees on how to use the system. There is often a knowledge gap between how the system works and how the HR officials work with it. This leads to a disconnect for the recruiters in the initial stage of filtering and this lack of involvement in

the filtering stage can lead to issues, as problems that could potentially arise in the systems would often go unnoticed by the recruiter. This could also mean that the updating of such systems does not take place regularly due to lack of involvement. A large reason for this is the inconsistency in HR training as well as the gap between the technical professionals, both within and outside the company who develop the ATS and the HR recruiters (Drucker, 2016).

- *Applicants*: Subjecting an applicant's resume to a filter by the ATS leads to the questioning of fairness and ethics related to the process. Given, we have limited knowledge of the ATS used by companies and the lack of transparency demonstrated by companies by not stating their use of ATS in the online recruitment process, these are important considerations to take into account to question that the humans most affected by the process (the applicants) are not unfairly treated.
- *Field of HR*: HR in itself, essentially represents a field that values and appreciates human assets. The introduction of automation into this field, which is so rooted in the value of human work, is an intriguing question to analyze when ATS are brought into the field. The huge time and financial resources required for the recruitment process makes it necessary for the decision-making process to be accelerated, and thus, ATS is an incredible way to resolve these issues and narrow down applications.

Thus, there are a lot of consequences to consider when using ATS in the recruitment system and they are very influential in the behavior of the applicants and HR officials. These implications stand for the reasoning of why analyzing ATS is really important from a human-centered point of view.

EXPERIMENTS

In order to find insights to the research question, two sub-experiments were done. The following will describe the methods, data and approach used to execute the experiments. Moreover, a survey was conducted based on the findings of the sub-experiments to provide strong reasoning for the arguments drawn from the findings.

The Sub-Experiments: Experiment 1

Using an online form of an ATS, tailor a resume for a specific job and examine the evolution of the resume as it gets changed using the recommendations of the ATS and analyze the reasoning behind these changes and whether they are logical from a human point of view.

Methods

- A free resume scanner (www.skillsyncer.com) is used for the experiment. The decision to use a free software was to take into consideration the the resources that are available for any candidate applying online (they might not have the funds to buy a premium software) and a resume scanner was used as a majority of ATS is known to test resumes against job descriptions via methods of keyword

matching, standardised formatting, word forms, etc. and most resume scanners provide these evaluations.

- Based on online literature to make a resume (referenced in the background section and summarized in Table 1), a fake resume was made and the resume was changed according to the recommendations of the resume scanner
- A fake candidate, I'deyal Kændydait was used for the experiment, and I'deyal wants to apply for the position of Software Engineering Intern at Gyolgyol whose job description states:

> Minimum qualifications:
>
> - Currently pursuing a Bachelor's, Master's or PhD in Computer Science or a related technical field.
>
> - Experience with Data Structures or Algorithms.
>
> Preferred qualifications:
>
> - Currently enrolled in a full-time degree program, and returning to the program after the completion of the internship.
>
> - Experience with Unix/Linux, Machine Learning, Tensorflow.
>
> - Extensive experience programming in one of the following language: C, C++, Java and/or Python.

(https://careers.google.com/jobs/results/89964026001269446-software-engineering-intern-summer-2021/?f=true&page=23)

Findings

The four pages below consist of the initial resume and the consequent changes made to the resume. The set of resumes are followed by a table that describes the match score and changes made.

I'DEYAL KÆNDYDAIT

396 Main Street • Emptown, CA 23096 • (304) 201-9023 • ideyal.kandydait@gmail.com

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EDUCATION

BS in Computer Engineering
Cleveland University, California
08/2019 – present

- **CGPA :** 8.314/10
- **Coursework :** Data Structures, Algorithms, Software Engineering
- **Clubs :** Member of KEYGEN Coders, Hack@NIT

WORK EXPERIENCE

Software Engineering Intern
Venturi International Solutions Inc.
01/2021 – present
Venturi International Solutions Inc. is an information technology company which develops and provided E-Commerce Solutions

- Contributed to development of 3 projects using Python and Django
- Worked as Java developer for 6 months in FranConnect franchise project.
- Debugged a long pending Auto-login issue in GUI for regression platform on day 1
- Decommissioned over 3 different types of applications including support for legal hold.

Software Intern
Micro Alphatech Ltd
08/2020 – 12/2020
Micro Alphatech Ltd is a water treatment website

- Created a tool that employs ML using libraries to manage data
- Research new technologies to support build vs. buy and rapid growth of the business (build vs. buy)
- Develop in Python/.NET/C/C++ or other applicable technologies

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SKILLS

Coding: Java, C#, JavaScript, Python, PHP, Django, OS (Unix/Linux, MacOS, Windows)
Project management: Trello, Jira
Embedded Systems: Cross Compilation, Kernel Hacking

I'DEYAL KÆNDYDAIT

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- Develop in Python/.NET/C/C++ or other applicable technologies

SKILLS

Technical Skills:
Coding: Java, C#, JavaScript, Python, PHP, Django, OS (Unix/Linux, MacOS, Windows)
Project management: Trello, Jira
Embedded Systems: Cross Compilation, Kernel Hacking

Soft Skills:
Detail-oriented, Punctual, Organizational Skills

I'DEYAL KÆNDYDAIT

396 Main Street • Emptown, CA 23096 • (304) 201-9023 • ideyal.kandydait@gmail.com

EDUCATION

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08/2019 – present

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Micro Alphatech Ltd is a water treatment website

- Created a program that employ machine learning using ML libraries(TensorFlow) to manage data
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- Develop in Python/.NET/C/C++ or other applicable technologies

SKILLS

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Project management: Trello, Jira
Embedded Systems: Cross Compilation, Kernel Hacking

Soft Skills:
Detail-oriented, Punctual, Organizational Skills

I'DEYAL KÆNDYDAIT

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EDUCATION

Bachelor of Sciences in Computer Engineering (Computer Science)
Cleveland University, California
08/2019 – present

- **CGPA :** 8.314/10
- **Coursework :** Data Structures, Algorithms, Software Engineering
- **Clubs :** Member of KEYGEN Coders, Hack@NIT

WORK EXPERIENCE

Software Engineering - Internship
Venturi International Solutions Inc.
01/2021 – present
Venturi International Solutions Inc. is an information technology company which develops and provided E-Commerce Solutions

- In the internship, contributed to development of 3 projects using Python and Django
- Worked as Java developer for 6 months in FranConnect franchise project.
- Debugged a long pending Auto-login issue in GUI for regression platform on day 1
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Project management: Trello, Jira
Embedded Systems: Cross Compilation, Kernel Hacking

Soft Skills:
Detail-oriented, Punctual, Organizational Skills

Resume Version	Changes Made	Match Score	Result
1	-	44	Will fail
2	Expand acronyms like ML and the skills section to include soft skills	59	Will fail
3	Include specifics – Tensorflow and mention the phrase "computer science"	79	Too close, yet misses the cut
4	Spell out the degree rather than using terms like BS, BA,etc.	84	Competitive candidate

To maximize one's potential to pass the ATS screening: Tailor the resume to each aspect in the job description keeping in mind the form of word and tense to avoid risks as ATS systems used by companies are not always up to date. Candidates can take advantage of the automated nature of the ATS by "using words and phrases from the job description in a natural way in order to elevate a resume to the top of the ATS list, but still come across appropriately to the hiring manager" (Drocker, 2016).

The Sub-Experiments: Experiment 2

Craft a resume for a specific field using keywords commonly used in job descriptions of the field and test it against a specific description to see how it performs

Methods

- Data: A dataset of job descriptions was used from Kaggle. It is data from Dice.com, a prominent US-based technology job board, scraped from the website and published on Kaggle
- The data was cleaned and jobs pertaining to a specific position in the technical industry: "Software Engineer" were filtered
- Word clouds of the job descriptions and skills section were generated, and a resume was crafted using these words

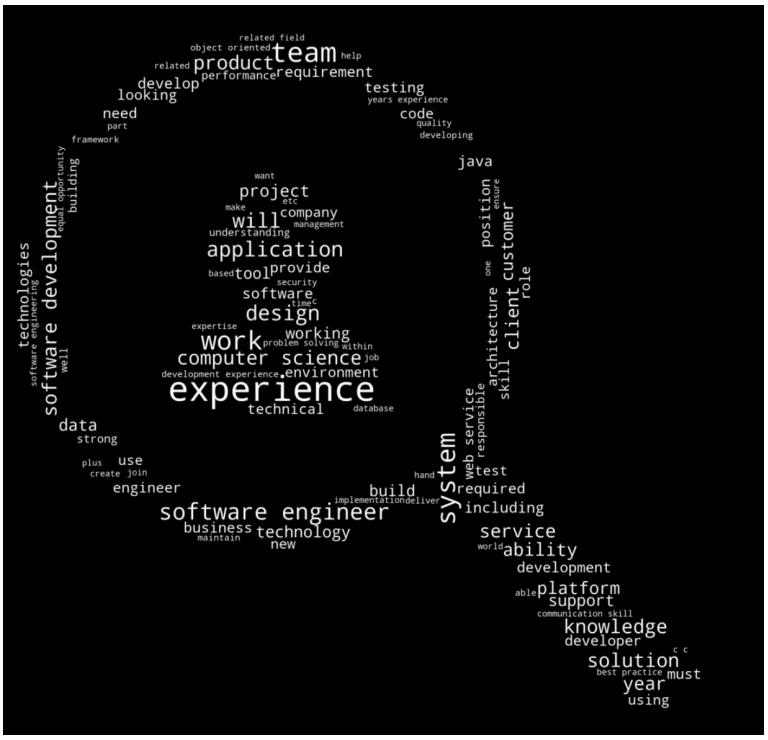

Figure 1 Word Cloud of Job Descriptions

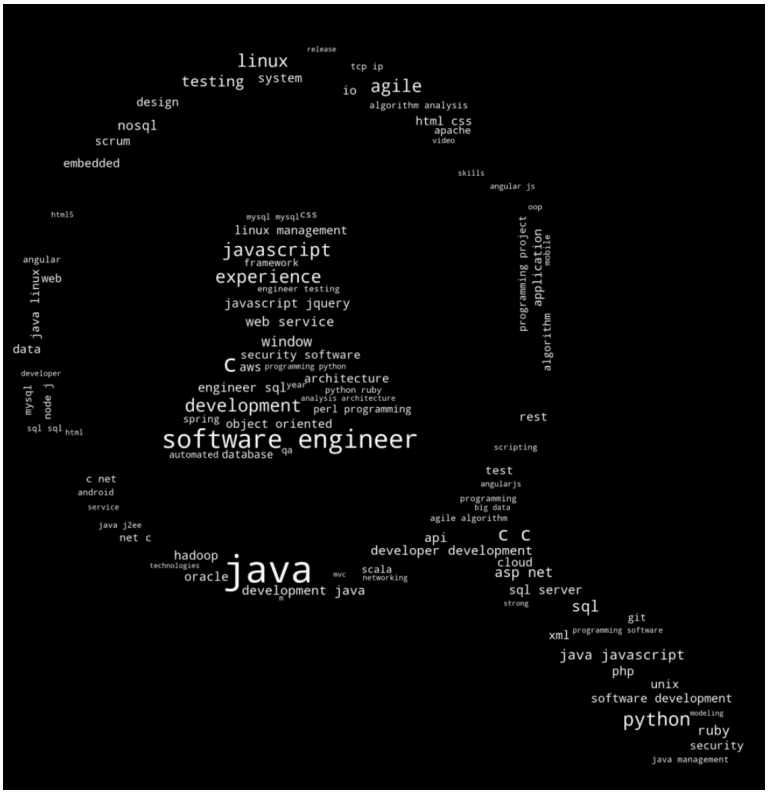

Figure 2 Word Cloud of Skills

Resume crafted based on word-clouds:

DHARMARAJ CHINNASWAMY

raj.swamy@hotmail.com

(304) 201-9023

LINKEDIN.COM/RAJSWAMY

SKILLS

Technical Skills:

Coding: Java, C, C#, JavaScript, Python, PHP, Django, OS (Unix/Linux, MacOS, Windows)

Project management: Trello, Jira, Agile

Embedded Systems: Cross Compilation, Kernel Hacking

Soft Skills:

Detail-oriented, Punctual, Organizational Skills, Teamwork

WORK EXPERIENCE

SOFTWARE ENGINEERING INTERN
VENTURI INTERNATIONAL SOLUTIONS INC.
01/2021 – present
Contributed to development of 3 projects using python and Django
Worked as Java developer for 6 months in FranConnect franchise project.
Debugged a long pending Auto-login issue in GUI for regression platform on day 1
Decommissioned over 3 different types of applications including support for legal hold.

SOFTWARE INTERN
MICRO ALPHATECH LTD
08/2020 – 12/2020
Created quality tool product for a system to standardize and simplify work processes for Aspire 400 required according to client
Taught Python and Django to the batch of 28 students in a project based learning environment
Developed a Industry Foundation Classes Parser for generating 3D Graphics using C++

EDUCATION

Bachelor of Technology Computer Engineering (Computer Science)
NIT Surathkal
08/2019 – present

- **CGPA :** 8.314/10
- **Coursework :** Data Structures, Algorithms, Software Engineering
- **Clubs :** Member of KEYGEN Coders, Hack@NIT

However, this received a match score of only 42/100. Thus, the resume wouldn't make the cut. The next part of this experiment involved carrying out a technique of using whitewords (using keywords from the job description not relevant to the candidate and adding them in the resume in white color. This lets the resume pass the filter and the HR will only see the skills and experiences that are applicable to the applicant only (Tonge, 2017). When this method was used,

the resume surprisingly went undetected by the ATS and the resume got a match score of 89/100 making the applicant receive "competitive candidate" status.

As seen from the findings, it can be concluded that it is a very hard task to generalize a one-fits-all resume, and the approach of tailoring a resume towards a particular job description is more helpful compared to the industry keywords itself.

Exploration of techniques like using white-words which can cause the ATS to misbehave signals to the rise of such literature online and this speaks of the changing nature of the field of recruitment and the behavior of applicants as motives change from applying to a job to getting past an ATS.

Survey
A survey was conducted based on the findings of the sub-experiments. A total of 39 responses were recorded and the data will be used to back the arguments made in the next section which covers the analysis of the findings.
Survey: https://forms.gle/zSGTFTV85iTjvckL7

ANALYSIS OF THE FINDINGS

From the experiments, it is very clear that a lot of importance is given to the use of certain keywords present in the job description. Even when there are other phrases that convey the same meaning, there were instances where the parser did not detect them, and it is generally advised that the words used in resume must be the same word form/tense as the job description to avoid risks. While there are ATS that are complex and can detect synonyms and other word forms, not all in usage have been updated and therefore, it is very common advice given to candidates and the relevance of the advice stands strong from the findings of the sub-experiments.

However, on second thought, following such rules does very little to analyze the potential of a candidate as in essence, they all mean the same (this argument was backed by 61.5% of survey responders, while the rest reasoned that the use of the same keywords meant the candidate was paying attention to the description).

As a counterargument to the reason of a candidate paying attention to detail being a possible indicator of potential, when applying to multiple jobs, it is an unnecessary expectation weighed on the candidate to tailor their resumes to every job (this argument was backed by 70.3% of survey responders).

In a nutshell, while it can help one move forward in the pipeline and showcase the soft skill of being detail-oriented, it is often the case that the fact that one's resumes will eventually go through an ATS is rarely communicated transparently on the job application website, leaving a proportion of people at a disadvantage because they do not know that there exists a formulaic way of getting ahead.

IMPLICATIONS – THE RESEARCH QUESTION

Dynamic between Efficiency and Fairness

Fairness: While a detail-based evaluation and a standard scan over all resumes can allow all participants to begin from the same space, it can lead to instances of discrimination.

For instance, employment gaps are often considered red flags and several companies require the applicants to account for them. This can be an issue for someone who has gone through a traumatic life event and the absence of humans in the applicant process in this scenario, can often lead the applicants to abandon the application. Moreover, women are more likely than men to have employment gaps in their career due to their culture or certain norms of society, which would mean that this rule of the ATS can lead to discrimination of applicants based on their gender. If the applicant has had an illness or had to take care of a family member, a disadvantage is created for the candidate, thus possibly leading to instances of discrimination based on genetics (Drucker, 2016).

Also, online applications often ask for zip codes, social security numbers and name of degrees, which can lead to potential problems for international applicants when thought from an American point of view (Drucker, 2016).

Efficiency: Regardless, efficiency of the recruitment process has improved a lot with the introduction of ATS. “The recruiting process as well as each digital communication with the applicant becomes easily accessible to the entire HR team and not just the individual recruiter. The automation of e-mails that is included in the software allows the company to automatically acknowledge the application, as well as keep applicants updated on the application process.” (Drucker, 2016). Even the filtering technology itself has improved as the parsing software has learned to scan for context rather than just individual words.

Moreover, ATS is a fairer system compared to the process of referrals/ word-of-mouth posting. For instance, ACM Services was found guilty of gender and race discrimination because the company had recruited exclusively through company referrals and could not prove that their hiring of field workers was inclusive of gender and race (Drucker, 2016). Thus, ATS helps companies avoid such issues but without proper supervision of the systems, there can be instances of discrimination as outlined earlier, which can be problematic for everyone related to this situation.

THE BIGGER PICTURE – THE HUMANS IN QUESTION

With the goal of tailoring the perfect resume and getting past ATS, applicants have now resorted to stooping to measures like whitewords. This reveals a loss of perspective in the recruitment process. For the applicant, the objective of applying for a job that they think is suitable for them has become a race to craft a formulaic resume to get past an ATS.

For HR employees, this leads to their objectives changing from recruiting the best candidate to tasks like troubleshooting the system and scanning minimal resumes. The training of HR is usually inconsistent with using these systems as published through surveys. This leads to them being in the dark, only encountering the applications given to them by the ATS. The technical gap can lead to issues if not carefully scrutinised. Thus, ATS has changed the behavior of the applicants as well as HR.

For the field of HR, ATS are game-changers. It levels the playing field when argued against the method of referrals as all are given an equal chance to begin with. However, with the usage of outdated systems by many companies, the lack of transparency from companies about their use of ATS and the race of applicants to get past the filters have changed the essence of HR. As we move forward, the human-centered perspective of ATS is the approach that can be beneficial for all in question: updation of systems, training of HR, transparency. The training of HR would mean increased involvement of HR in the filtering process and this would mean more supervision of such systems, potentially lessening the harm caused by ATS. Practicing transparency by companies can be beneficial so that they don't lose out on applicants unaware of ATS and the applicants can thus craft a resume following standards to pass the filter.

LIMITATIONS AND FURTHER RESEARCH

Limitations

ATS and the filters and techniques used by it are mostly not available to the general public, and thus a lot of the information that was used to work on this project was from online literature and by using resume parsers. This was a limitation as we don't know the exact nature of ATS used by companies.

Further Research

The field of ATS technology is largely unexplored and evolving, therefore, there are many opportunities for further research. An intriguing idea that can be pursued is to look into developing a human centered explainable ATS to implement transparency in the system. One can delve into the reasoning of why a model rejects a resume which can help the HR and the applicants become more involved in the recruitment process. In the case of illogical reasoning, given the heavy involvement of the parties, flags can be raised and the technology can be improved.

CODE & DATA

The code and data for the word-cloud experiment (sub experiment 2) can be found on: https://github.com/Gopika-Krishnan/Mind-of-an-HR-bot

The data used for the same can also be found on https://www.kaggle.com/PromptCloudHQ/us-technology-jobs-on-dicecom

Survey results can be found on
https://docs.google.com/spreadsheets/d/1b7qBNDbspDJ3xLCkJQ1EjBPLEjYHQiEU6awnkwYwtgU/edit?usp=sharing

[In a PDF Format, this link might not work, copy the link and go on browser]

REFLECTION : THE HUMAN-CENTERED PERSPECTIVE

The field of Human Resources is very rooted in understanding the potential of humans and therefore, there were a lot of aspects to consider when taking on this project. I looked into making sure that all individuals affected by Applicant Tracking Systems were acknowledged in the process of doing this project and explored the implications these systems can have on each group of individuals.

Initially, I considered looking into working with datasets of resumes or creating a dataset with public LinkedIn profiles. But soon, I realized the ethical implications of using such data: 1. The datasets of resumes available online did not acknowledge how the data was sourced, which meant that there was a potential for it to be unethically collected. 2. Even though public LinkedIn profiles are available to everyone, it still did not mean that consent was given by the individuals of these profiles to work with their data, and thus due to these reasons, I decided to look into another direction to execute the project.

The decision to use a free online resume scanner was definitely keeping the individuals who are the most affected by these systems in mind, the applicants. I thought about the issue of ATS from their point of view, and it made sense to conduct experiments using resources that are available at their disposal. Thus, I used a resume scanner that is available freely online, as otherwise, the results found from the experiment would apply only to a smaller proportion of the applicants who could afford to have a premium version of a resume scanner.

The analysis of techniques like white-words made me explore the changing behavior of applicants as well as the HR employees involved and overall how the field of HR itself is slowly losing perspective of the main goal which is to hire good people that will add value to the company.

Finally, from the arguments I made from the findings, I sent out surveys to see the thoughts of other individuals to back my arguments. This was done in an attempt to provide scientific grounding to the arguments as well as to collect more human perspectives for the project.

All the code, the data, the experiments conducted have been thoroughly explained and is in a state that can be easily reproduced by others who encounter the project.

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