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FairIntern: An AI-Powered Smart Allocation Engine for PM Internship Scheme

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Abstract: The introduction of the Pradhan Mantri Internship Scheme (PMIS) was aimed at bridging the gap between the students and the employers.The current method of assigning has both practical and rule-based operations, which in turn make the whole process rather translucent and often lead to bias. All these issues have been considered in the proposed paper, and hence, the FairIntern, an AI-based smart allocation engine is introduced that will make up with an internship match that is more accurate, proper and explainable.

The FairIntern system merges Natural Language Processing (NLP) which is used to read and understand the student resumes and the internship descriptions with Machine Learning (ML) that does multi-factor matching based on skills, qualifications, and preferences. Besides, fairness-aware constraints are used to handle the issue of balancing across the gender, region, and other important factors while the system consistently follows an increment based development strategy allowing matching accuracy polished as the data becomes available.

Experimental studies demonstrate that the FairIntern system involves a reduced amount of manual work, better relevant matching, and is more transparent in comparison to the methods of allocating funds traditionally. The proposed system offers a scalable and non-profit internship allocation framework that not only complies with the digitalization of India and Skill development program but at the same time guarantees that internships are distributed in a fair and data-driven manner.

Keywords: Artificial Intelligence, Internship Allocation, Fairness-Aware Machine Learning, Resume Parsing, Natural Language Processing, PM Internship Scheme.

I. INTRODUCTION

The importance of internship in the transition between the theoretical learning contexts of the academic setting and the working world is real. Students will be enabled to apply academic training where they get a chance to undertake an internship. The experience they get in an internship will help many students understand better their field of study and also prepare them to their career life.[10]. This made government programs like the PMIS developed to allow students of diverse background to have an opportunity to have internship.

There are however some operational problems in the process of allocation, which is progressive. Current technology (mostly), is based on manual filtering or rule-based filtering and hence is prone to problems that can cause scalability in the event that the application count increases. Moreover, the process is not always transparent and this may result in the inability of the students to infer how a specific decision was reached when allocating a certain amount of funds. Moreover, the allocation system based on rules is likely to neglect the nuanced talent that could be demonstrated by the candidates, and this aspect could lead to the development of disparity between the skills and internship characteristics.

Evidently, currently, with new technological advances in the field of Artificial Intelligence, it is possible to reform the systems of internship placement in a more unbiased and evidence-based manner. The technology of Natural Language Processing will enable a computerized interpretation of non-structured data held in resumes. In addition, a number of internship placement criteria can be processed using Machine Learning models. However, the efficiency should not be the sole parameter of the public benefit schemes.

In a bid to deal with these challenges, the given paper presents FairIntern, an AI-powered smart internship matching system. resume analysis, machine learning multi-criterion matching, and fairness constraints and is designed for effective internship matching using PMIS.

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II. RELATED WORK

Past studies in the recommendations and allocation systems have highly documented the use of AI in areas like internships, recruitment, and allocation of resources. The studies have given many examples of how the models of ML and neural networks can be utilized to provide the appropriate job matching the skills and qualifications, as well as the preferences of the people.[1]

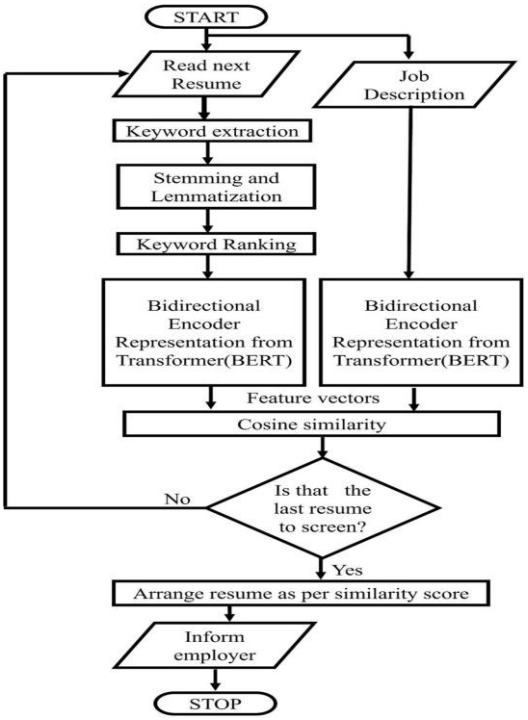
Beyond this, it has been in several researches revealed that the application of Natural Language Processing (NLP), information may be mined in diverse forms of documents like resumes/job descriptions which may be utilized to enhance the procedure of matching candidates with the job. NLP can be used to analyze and index very vast volumes of unstructured text, and to find the circumstances relevant to the piece of work that the user submitted an application to, how much the user knows regarding his or her experience, and their educational background; which helps maximize the chances of receiving a successful match.

Nonetheless, the current systems are usually interested in maximizing the accuracy of the recommendations or efficiencies of the system. The question of Fairness, Transparency and Ethical distribution of resources are often regarded as the secondary, or lacking, need to be considered. Since the results of massive government efforts like Government internship programs may tend to favor unfair results to particular groups.

FairIntern is different from traditional allocation systems by directly incorporating Fairness-aware constraints into its allocation process, and thereby balancing the desire for accuracy with an inclusive system. This allows the proposed allocation system to achieve a transparent and equitable distribution of internships while still maintaining a high level of skill-based matching performance.

III. PROPOSED METHODOLOGY

The FairIntern system was designed in a manner that is more scalable, transparent, and efficient based on an incremental, modular design to allocate internships.The modularity of the FairIntern design gives developers the opportunity to create, test, and improve each component independently; thus, any changes made to one component will not affect the overall functionality of the system. Such methodological steps are the data acquisition, Intelligent Matching process that is aided by AI and the Fair Allocation process.. All three of these methodological areas work together to produce the most accurate, efficient, and fair decisions when it comes to who gets an internship at any point during the internship matching process.



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A. *Data Acquisition and Preprocessing*

Stage 1 is the process of gathering & preparing the data which is the basic fundamental building block of the system. A central database collects both resumes and internship descriptions using one common input and collects data securely & systematically, as all pieces of data will be collected in a structured way. Since both resumes and job descriptions are primarily composed of unstructured text, Natural Language Processing (NLP) will be used to extract useful information from the text.[4]

Important attributes (e.g., educational qualifications, technical skills, certifications, work experience, and domain-specific keywords) will be identified with the help of NLP parsing methods. Preprocessing procedures to enhance quality and consistency include: 1) Normalizing the text, 2) Tokenizing the text, 3) Removing stop words and 4) Extracting keywords from the text. Through automation of parsing resumes, the amount of manual intervention required will be reduced and therefore potential bias introduced by human reviewers will be minimized allowing for uniform evaluations of all candidates using the same extraction criteria. Additionally, this is required for increasing transparency and equality during the similar process in future iterations.

B. *AI Techniques and Intelligent Matching*

In Stage 2 of FairIntern, the extracted textual information from student resumes/appraisal, and description of internship are converted to numerical data and analyzed through machine learning (ML). This is normally initiated by the process of feature encoding in which the qualitative aspects (e.g. skills, qualifications, experience) are transformed into numeric form. It enables FairIntern to conduct a comparison of student profiles and internship positions in a coherent manner as it converts qualitative data into an organized form of numerical representation. [3]

A multi-factored evaluation using 'ML models' is then used to examine the relationship between each of the student's attributes (i.e., skills, etc.) and the internship's requirements. Traditional evaluation methods such as 'rules', which use one or two filters to determine whether a student is a fit for a position, do not qualify a student based on multiple weighted factors. For example, a student may be determined to be a good fit for a particular internship if their experience level and educational background were good matches. By using these weighting schemes to determine the compatibility of students and internships, FairIntern is able to assign more weight to the most important factors while remaining flexible in its evaluation of various types of internship roles.[6]

A composite score is computed on the basis of the summation of the weighted evaluation factors of each combination of the student and internship. This composite sum score is then projected to rank the candidates in terms of their general fitness to the internship opportunity. The ranking algorithm is created to rank candidates according to their general appropriateness and not according to a single factor.[5]

By taking advantage of machine learning and the evaluations and rankings provided by machine learning models, FairIntern allows for greater accuracy, less subjectivity, and improved matching capabilities over current job-matching services.

C. *Fairness-Aware Allocation*

The last phase involves ensuring fairness concerns that are incorporated in the allocation process to facilitate inclusiveness and equitable allocation of opportunities. These limitations provide equitable representation among key dimensions, e.g. gender, geographical area, and other social-economic or inclusivity variables. The logic of allocation is constructed in such a manner that fair considerations do not override merit-based matching, but are good.[8]

The system provides ethical and transparent results in the allocation process by relying on fairness constraints incorporated in the ranking and selection mechanism without much loss in matching accuracy.

Additionally, the system maintains a track record of allocating decisions,which increases trust and relation among stakeholders.

The growing character of the FairIntern architecture enables the system to constantly learn new information, changes in the policy, and responses of stakeholders provided and thus refines itself and continuously improves the performance, as well as the enforcement of fairness.

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IV. SYSTEM ARCHITECTURE

FairIntern has a multi-tier architecture and is a web application that is scalable, modular, secure, and long-lasting (maintainable It isolates concerns and responsibilities in layers in order to have independent development/testing.There are four main layers in FairIntern's overall architecture; User Interface Layer, Application Logic Layer, AI Processing Layer and Data Storage Layer.[10]

A. User Interface Layer

FairIntern has developed a Dashboard for each category of user, including Students, Administrators, and Organizations who provide internships. A Student can upload his/her resume, see and take action on his/her application(s), receive updates on his/her placement, and manage his/her application for internships in a clear manner.

An Organization has a special Dashboard from which to post internship opportunities, create eligibility requirements, identify skills required for the internship position, and track applicant information. An Administrator manages all aspects of the ecosystem using a central Dashboard to manage Users, validate User information, track the Ecosystem's performance, enforce Fairness policies, etc.

By having separate Dashboards for each Role/User Type, FairIntern provides secure access to the system, makes it easier to navigate and interact with, and allows Users in different Roles to interact without the possibility of creating Conflicts or Overlaps.

B. Application Logic Layer

The application logic layer is the primary component of the fairintern platform, where it encapsulates many facets and maintains the ability to monitor and execute business processes across a variety of operational workflows. This application logic layer will also provide support for the management of user authentication, resume validation, internship postings, application due dates, and intern allocation cycles.

The application logic layer will directly connect the user interface layer to the AI processing layer through the use of structured communicating inputs and output. Thus, centralizing this control point will not only help to improve system consistency; it will also reduce duplicate application processing, simplify debugging and maintenance of application functionality.

C. AI Processing Layer

FairIntern's AI Processing layer is the most important and intelligent aspect of the application.It uses the latest AI and ML technologies as well as NLP to automatically manage the entire internship allocation process.

NLP is applied to resumes to extract the skills, the education, experience and other certifications of the individual candidates. have. Both student profiles and internship requirements are transformed into structured forms through the use of feature extraction processes, and then match scores are generated by applying Machine Learning models to determine how well suited a student is for a given internship.[4]

The AI Processing Layer is not simply another way of matching people with jobs. It employs equitable approaches that consider the backgrounds of students and inequality in the society in provision of internships. This implies that students are aligned to the internships not only on the basis of their skills and qualification, but also on their race, gender and other issues that may influence the process of selection. Smart decision rules have the potential of establishing more accurate, clear and reliable results on the assignment of internships in FairIntern.

D. Data Storage Layer

The data stored in the system are grouped and safely stored in the data layer. The user profile information, resumes, internship, extracted attributes, applications and allocations are stored with a lot of safety, data can be quickly accessed and processed without compromising on the performance even in the event of an exponential growth in user usage through an indexing methodology that is used to enable fast access and processing.

The design requirement of this layer is mostly related to the future scalability; hence, it will not require any impact on the architecture since it will enable both data attributes and analytics/reporting modules to grow further. More so, the needs of privacy and data integrity are also covered by the means of secure handling practices, that encompasses the observation of appropriate legislation.

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E. Architectural Benefits

FairIntern adopts a multi-tier architecture that fosters outstanding scale-ability, maintainability as well as extendability. Each layer works on its own and is integrated with the rest of the layers to provide easy and smooth updates and upgrades. Therefore, the specified type of architecture will allow developing FairIntern at the national level and contend with vast counts of users and data retrieved and offering Fairness, Transparency, and Performance to the User Base.

V. EXPERIMENTAL RESULTS AND DISCUSSION

To see how well the FairIntern system works some tests were done. These tests used resumes from students and internship listings from schools and training programs. The FairIntern system was compared to a method that uses rules to match students with internships. This comparison was done to check if the FairIntern system is better at matching students with internships and if it is more fair and open. The FairIntern system was evaluated to see if it is really effective.

A. Performance Comparison

The comparison table shows how well traditional rule-based systems compare to FairIntern on some major performance metrics. The data shows that FairIntern has better performance in every measure - accuracy, scalability, fairness, and efficiency.

On the contrary, FairIntern offers Quick Analysis View to offer greater accuracy with NLP based contextual resume analysis and multi-parameter machine learning reviews.The traditional rule-based methods also require lots of manual work to screen applicants and make decisions. In comparison, FairIntern has reduced the amount of manual work required through its automation capabilities.

Additionally,they are not able to handle the volume of applications required for a national programme, while FairIntern is designed to effectively support large volumes of applications, and therefore can consistently provide good performance at a large scale.

FairIntern is also more transparent than traditional rule-based systems. The allocation decisions made by FairIntern are based on easily verifiable and traceable scores, with well-defined evaluation criteria.

Unlike the traditional methods, which do not explicitly address bias in allocations, FairIntern has fairness constraints built-in to promote equitable allocation of opportunities among applicants regardless of gender, region and other inclusiveness criteria. Other features of FairIntern include fast processing, incremental learning, and increasing explainability. These characteristics make FairIntern an excellent choice for government-sponsored large-scale internship programmes.

To sum up, the results of this comparison indicate that FairIntern is superior to its rule-based predecessors regarding accuracy, transparency and fairness in the allocation of internship opportunities.

Table. I

Metric	Rule-Based System	FairIntern (Proposed)
Accuracy	Moderate	High
Manual Intervention	High	Low
Scalability	Limited	High
Transparency	Low	High
Fairness Consideration	Not Explicit	Explicitly Integrated
Resume Understanding	Keyword-based	NLP-based Contextual Analysis
Processing Time	High	Reduced
Suitability for Large Schemes	Low	High

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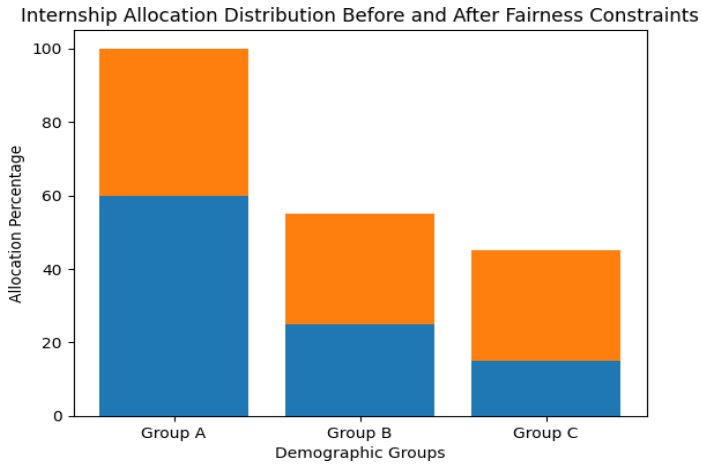
The results show that FairIntern does a better job than the old way in every area that was looked at. By using natural language processing and machine learning FairIntern is able to make better matches between students and internships. FairIntern also makes sure that everyone has a chance, which makes the whole process more fair, for students and internships.

B. Allocation Distribution Analysis



The figure shows us what happens to internship allocation when we compare before and after using fairness rules.
The graph really shows that things get more balanced between groups of people when we use FairIntern.
Figure for Internship allocation distribution with and without fairness constraints

The pictures we get from analyzing data show that being fair helps to stop some people from getting a lot more than others. So what this means is that we can make sure artificial intelligence systems are fair, without making them work any well. Fairness is really important.

C. Discussion

The conducted experiments reveal that FairIntern can offer scalable and transparent allocation of internships at large scale, by decreasing the reliance on manual screening and directly introducing the principles of fairness into the allocation process, the system can assist in allocating opportunities equally.[8]

VI. CONCLUSION AND FUTURE WORK

A. Conclusion

The FairIntern system was designed with the goal of improving upon the age-old issues associated with allocating interns for large-scale government schemes like the Pradhan Mantri Internship Scheme.[9]

The traditional system used for allocating interns tends to have issues with inefficiency, lack of transparency, human intervention, as well as biases.

The Fair Intern system shows that using Artificial Intelligence for automation with a focus on fairness can lead to highly efficient as well as fair allocation systems.

By combining a resume analysis feature using Natural Language Processing (NLP) algorithms with Machine Learning algorithms for multi-criteria optimization.

Fair Intern gives a systematic driven approach to candidate assessment. Apart from automating the candidate selection process, candidates for internship placement are assessed in a fair manner, in a manner consistent with predefined fairness constraints, so as to keep human biases at a minimum.[10]

The experimental assessment carried out for the system tends to reveal a significant amount of reduced manual effort that goes into the screening and short-listing process.
Furthermore, the quality of job matches for internships has also improved, considering that students are provided an appropriate match based on their skills, background, as well as personal preferences.

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A third important aspect of FairIntern is its scalability and architecture design. The tiered architecture allows for easy interaction with the existing platforms within the government and for smooth handling of a high number of applicants. Thus, FairIntern would be an effective system for implementation at the national level for government-driven programs concerning internships and skill enhancement initiatives.

B. Future Work

Although the present form of implementing the FairIntern system yields promising outcomes, several ways can be identified that would further improve this system. First and foremost, the future direction with regard to increasing the explainability of AI systems would be an engagement worth pursuing.[7]

Future upgrades of the system can be combined with a feedback tool that allows students, organizations, and administrators to feed their input to enhance the efficiency of the matching algorithm of the system.

Moreover, additional criteria for the concept of fairness may be considered. This can be further expanded to include socio-economic factors such as income levels, rural/urban indicators, disabled persons, as well as educational institution types.

At last, the future could see the employment of more advanced models in the area of deep learning, dashboards for real-time analytics, as well as customization based on policy-oriented rules to increase decision-making flexibility.

FairIntern could thus have the ability to grow into an effective, transparent, and scalable AI-based allocation system that could support different programs for public welfare and employment.

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