

# Automated Resume Parsing: A Natural Language Processing Approach

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**Abstract**— The extraction of critical information from resumes, such as contact information, skills, education, and job experience, requires the use of resume parsing. In this work, we propose a resume parser that integrates two methodologies: a Named Entity Recognition (NER) model approach and a Keyword and Pattern Matching model approach using Regular Expressions (Regex), utilizing certain NLP libraries and methods. The NER model makes use of NLP libraries to precisely recognize and categorize named entities—such as names, phone numbers, and email addresses—in the resume text. In order to provide a thorough profile overview, it also organizes the parts on talents, education, and job experience. In addition, the Keyword and Pattern Matching model makes use of Regex and pre-established rules to extract certain information, such job titles, firm names, and years of experience. Our resume parser uses NLP-based approaches to increase accuracy and performance, allowing it to handle various resume formats and deliver trustworthy results. Performance assessments show how well the parser extracts crucial information, even from resumes with various layouts and formats. Our resume parser seems to be a useful tool for processing huge numbers of resumes in real-world applications due to its use of NLP libraries and methodologies, together with excellent accuracy and processing speed.

**Keywords**— *Natural language processing (NLP), Named Entity Recognition (NER), pattern matching, Regular Expressions.*

## I. INTRODUCTION

Companies get abundant resumes for each job possibility in today's competitive job market. These resumes must be manually checked and gathered in a time-consuming, error-prone, and non-scalable process. Automated resume parsing systems have become an essential tool for recruiters and HR specialists to handle these issues. The term "resume parsing" describes the structured extraction of relevant data from resumes, such as contact information, skills, education, and work experience. Faster candidate evaluation, better acquisition of talent, and better hiring decision-making are made possible. Employers and job seekers may both profit substantially from automated resume processing. By automatically retrieving and categorizing candidate information, it speeds up the resume screening process for companies. By automatically retrieving and structuring

candidate information, it speeds up the resume evaluation procedure for companies enabling hiring managers to concentrate on assessing competent opportunities. In addition, resume parsing systems offer a standard structure for storing and comparing candidate data, facilitating effective candidate database management and application monitoring.

Systems for resume processing are useful for job searchers as well. These systems make sure that their resumes are correctly processed and that the right abilities and qualifications are highlighted. Candidates improve their chances of being shortlisted for job possibilities by formatting their CV data. Additionally, resume parsing tools let job seekers modify their applications to stand out in a crowded field by personalizing their resumes to specific job needs. This improves candidates' visibility to potential employers and enables them to successfully display their qualifications.

To correctly identify and categorize named elements, including names, contact information, skills, education, and work experience, the NER model makes use of machine learning algorithms and NLP approaches. By extracting precise information based on structured patterns and relevant keywords utilizing Regex and defined rules, the Keyword and Pattern Matching model enhances the NER method. This combined technique ensures excellent efficiency and precision while processing resumes offers customization possibilities. The work's unique performance in accurately extracting information from resumes with various layouts and formats has been demonstrated through a thorough assessment utilizing distinct resume datasets. A resume parser is a useful tool for handling huge quantities of resumes in real-world situations, saving time and effort while promoting educated hiring decisions. The parser's exceptional accuracy and processing speed enable recruiters to quickly find the most appropriate candidates.

The following describes the way the paper is structured: A thorough analysis of relevant work on the topic of resume parsing is provided in Section 2. The methodology for our

resume parser work is presented in Section 3, which goes into depth about the NER model approach and the Keyword and Pattern Matching model approach. The output of the models and the evaluation results are shown in Section 4, which also highlights the efficiency and performance of our system. The work is concluded in Section 6, which summarises the most important findings and suggests new paths for future research on automated resume processing.

## II. LITERATURE SURVEY

The study of resume parsing gained importance from multiple research papers that have proposed various techniques to address the difficulties in extracting appropriate data from resumes. The methodology that has been outlined in [1] by Amit Pimpalkar et al. involves several phases, including text extraction from files, pre-processing to remove unnecessary components, feature extraction, label encoding, resume classification model construction using machine learning algorithms, and ranking based on the extracted information. To determine the effectiveness of the method, performance evaluation requirements including precision, recall, F1, and accuracy have been used.

Shujaat Hussain et al. have concentrated on an input and output pipeline for resume parsing [2]. It highlights the value of text extraction from resumes, distinct of font styles, sizes, or document layouts. Text block categorization is seen as an essential step since resumes often have hierarchical structures with associated subjects. For classifying text blocks, machine learning methods and neural network models are considered, with the suggested pipeline depending on the Boolean Naive Bayes algorithm. This probabilistic model enables the categorization of various resume information blocks, such as education, skills, experience, hobbies, and personal data.

A CV parser model that tries to extract information from posted resumes on job portals has been suggested by Pandey et al. in [3]. The concept involves the digitalization of manually supplied resumes and the extraction of relevant details, including educational history and personal information. Recruiters utilize this information to make decisions once it has been retrieved. The CV parsing method lowers bottlenecks and improves application management systems.

Shingal et al. specified a model that was developed in three phases [4]. The initial phase focuses on cleansing the data and extracting text from PDF resumes. The skills in the dataset are converted into tokens, which are then vectorized. The K-Means clustering technique is used in the following phase to group the skills and predict the category or rank for new resumes. The program then identifies the top candidates for recruiters by comparing resumes with job requirements.

Ishtiyag et al. focused on developing Named Entity Recognition (NER) as a part of Information Extraction to categorize words and phrase segments into pre-defined entities such as GPE, CARDINAL, and EVENT in [5]. The

study involves scraping news articles on possible viral outbreaks. To accomplish this, the article uses the SpaCy library's "en\_core\_web\_sm" NER model, which evaluates the input text and classifies words into various entities. The entities of interest, namely GPE, CARDINAL, and EVENT, are then filtered and arranged using keywords based on relevancy. When compared to standard methods such as summarization, the new NER methodology outperforms them in detecting relevant elements related to potential viral outbreaks.

Sabareesh et al. described their work for extracting medical terminology such as symptoms, diseases, and substances using Named Entity Recognition (NER) in [20]. The Bio-Creative Chemical Disease Relation (BC5CDR) dataset is used in the study, coupled with extra medical phrases acquired from online pages. The BC5CDR collection contains annotated text data for chemicals and disorders, however it lacks symptom labels. As a result, the symptoms were manually labelled in the paper by changing the dataset. The SpaCy package was used to train the NER models on this labelled data, which included architectures such as Tok2Vec, NER, and pre-trained transformer models like as BERT and RoBERTa. To reliably recognise medical items, these models were fine-tuned and put into a proprietary NER pipeline. The research shows how the NER approach, combined with manual annotation and transformer models, efficiently finds relevant medical information from text descriptions provided by patients during their interactions with doctors.

These studies highlight the significance of text extraction, pre-processing, feature extraction, machine learning techniques, and assessment measures in resume parsing. The approaches proposed provide useful insights into dealing with various resume forms, enhancing accuracy, and allowing informed decision-making during the recruitment process.

## III. METHODOLOGY

The developed resume parser is able to extract different information from a given resume. It uses two different extraction techniques, one based on the Named Entity Recognition (NER) model and the other on the Keywords and Pattern Machining using Regular Expressions (Regex) model. This section provides an overview of the technologies employed and the paper's overall structure.

### A. Technologies used:

- a. **SpaCy:** SpaCy library has been used in our study since it has strong natural language processing (NLP) capabilities. For applications like tokenization, part-of-speech tagging, and entity identification, SpaCy provides pre-trained models. The English language model offered by SpaCy is loaded to carry out the NLP Tasks.
- b. **Python:** Python and its libraries are used to create resume parser models because they offer frameworks for data processing, text manipulation,

and machine learning. Python was chosen for our work because of its simplicity and wide infrastructure.

- c. **Pandas:** Pandas is a popular library for handling and analyzing data. It enabled us to check the columns and make sure that the information provided was consistent.
- d. **Regular Expressions (Regex):** Regular expressions were essential for pattern matching and extracting particular data from the text of the resume. To detect components like email addresses, mobile numbers, educational backgrounds, experience sections, and language proficiency, regex patterns have been used.
- e. **YAML:** A configuration file format, YAML (YAML Ain't Markup Language) is utilized. The predicted columns and other required parameters for data processing and validation may be defined using YAML. It ensured the provided data's integrity and structure.
- f. **PDFMiner:** Using the PDFMiner library, it was possible to extract text from PDF documents. The ability to go through PDF pages and convert them into plain text format was offered. It enabled to process resumes that were contained in PDF files.
- g. **docx2txt:** This library has been used to extract text from Microsoft Word documents (DOC and DOCX). For easier processing, it made the process of transforming the document's content to plain text simpler.

**Fig 1: Keyword Cloud of Resume attribute values**

### B. Role of Natural Language Processing in Resume Parser:

Both the NER-based extraction model and the Keyword and Pattern Matching Regex-based extraction of our study in resume parser heavily rely on Natural Language Processing (NLP). Using NLP tools, which allow us to understand and modify human language, we can extract useful data from resumes. The SpaCy library is the main form of NLP utilized. Advanced NLP features offered by SpaCy include entity recognition, part-of-speech tagging, and tokenization. To carry out these tasks, we use SpaCy's pre-trained models, particularly the English language model. The NER model offered by SpaCy has been taught to identify and categorize items of interest, including names, phone numbers, abilities, grades, and job titles, as well as companies and experiences. To analyse the resume content, identify pertinent entities, and properly extract the needed information, NLP methods are used.

The NER model is trained on a dataset of annotated resumes where items are manually labeled before being used in the NER-based extraction strategy. In order to train the model to anticipate resume texts that have not yet been read, NLP techniques are used to analyze and learn patterns from the labeled data. The NER model's

### C. Flow of our study:

**a. Reading YAML Configuration:** Model processing begins with reading the YAML configuration file, which contains information like the likely column names and the file type. This step made the input data match the predefined structure.

**b. Preprocessing the Text:** Text preprocessing was carried out before any extraction techniques were used. In order to do this, the text had to be lemmatized, all capital letters removed, contractions grown, and special characters and line breaks removed. Preprocessing enhanced the precision of the next extraction stages.

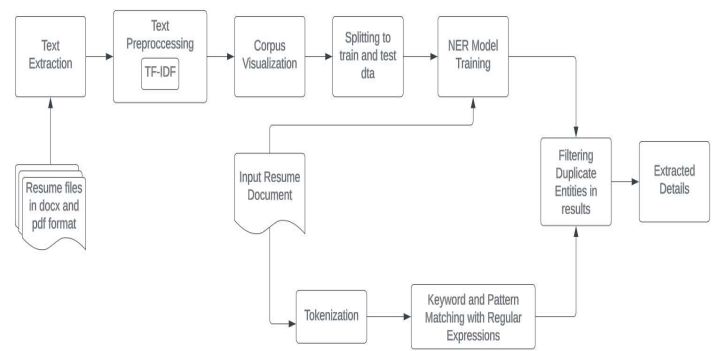
**c. NER-based Extraction Model Approach:**

- i. Dataset Preparation: A Collection of annotated resume data was used where entities of interest were manually labeled. The training set and a testing set were created from the dataset.
- ii. Training the NER Model: SpaCy's NER model is trained using the training set. The model was honed to identify particular entities, including names, phone numbers, abilities, grades, and job titles, as well as employers and experiences.
- iii. Model Evaluation: The trained model's performance was assessed on the testing set to gauge its effectiveness and guarantee that it correctly identified the intended entities.

**d. Keyword and Pattern Matching from Regex-based Extraction Approach:** To extract particular information from the resume text, regular expressions and pattern-matching approaches were used in combination with the NER-based extraction. To recognize and extract items like email addresses, mobile numbers, educational backgrounds, experience sections, and language proficiency, regex patterns were developed.

**e. Combining and Filtering:** After receiving the outputs from both the models, the collected data was combined while making sure that any overlapping items were removed. Additionally, empty or pointless values were eliminated, leaving just a collection of distinct entities as the final set of retrieved information.

**f. Displaying the Results:** The extracted information is finally shown, with the exception of the "name" and "phone number" values, which were already shown individually.



**Fig 3: Flow chart of the Resume Parser for extracting Details.**

Input for the model is either a PDF or DOC/DOCX file, from which the text is extracted and pre-processed to train the NER model to recognise various entities like Name, Phone Number, Designation, Years of Experience, Work Location, Email ID, Skills, and other details of the candidate. The working flow of the resume parser using both models is shown in Fig. 3.

The proposed resume parser in this research combines strategies for regex pattern matching and extraction based on NER models. Accurate identification of items including names, phone numbers, talents, grades, designations, companies of employment, and experiences was made possible by the NER model, which was trained on annotated resume data. By extracting additional information like email addresses, mobile numbers, qualifications for employment, and language proficiency, the regex patterns improved the NER model.

The suggested study produced a strong and effective resume parser capable of precisely extracting crucial information from resumes by integrating the advantages of both techniques. The study was successful in part because of the usage of tools including SpaCy, Python, Pandas, Regular Expressions, YAML, PDFMiner, and docx2txt. Our approach enabled efficient entity extraction and filtering utilizing regex patterns, as well as successful NER model preparation, training, and assessment. The collected information offers helpful insights for processing and analyzing resumes, enabling a variety of applications in the sphere of hiring and talent management.

## IV. RESULTS

Basic information including name, email, mobile number, skills, education details, job experience, languages known, and CGPA are correctly identified and retrieved by the parser. Overall, the resume parser is a reliable and efficient tool for automatically extracting and comparing essential data from resumes.



```

DEG: Master of Sciences in IS Stratford University
COMPANY: Oracle
SKILLS: ['Documentation', 'Jad', 'Mortgage', 'Distribution', 'Research', 'Queries', 'Mining', 'Sql server', 'Content', 'Consulting', 'Requests', 'Audit', 'General ledger', 'Architecture', 'Ms project', 'Xml', 'System', 'Conversion', 'Analyze', 'Analysis', 'Swift', 'Banking', 'Database', 'Isora', 'Gap analysis', 'Schedule', 'Profiling', 'Matrix', 'Design', 'Security', 'Retail', 'Process', 'Specifications', 'Html', 'Test plans', 'Sharepoint', 'Reporting', 'Reconciliation', 'Oracle', 'Receivables', 'Mobile', 'Etl', 'Regulatory', 'Payments', 'Standardization', 'Technical', 'Sql', 'Visio', 'Reports', 'Modeling', 'Investigation', 'Zava', 'Strategy', 'Lifecycle', 'Workflows', 'Information system', 'P', 'Operations', 'Prototype', 'Sales', 'Tableau', 'Sourcing', 'Agile', 'Unix', 'Analytical', 'Writing', 'Workflow', 'Ibm', 'Scrum', 'Data analysis', 'Test cases', 'Sas', 'Warehouse', 'Salesforce', 'Compliance', 'Testing', 'Project management', 'Automation', 'Aes', 'Sdlc', 'Ms excel', 'Marketing', 'Jira', 'Change management', 'Improvement', 'Excel', 'Money', 'Access', 'Front-end']
EXPERIENCE: { 'experienced in evaluation of trading systems for mutual funds and brokerage created business process models via workflow diagrams and system modeling using experienced in SDC and Project management for projects with medium complexity', 'Operational Created Business Requirement Document', 'Created Use Case Diagrams', 'PROFESSIONAL EXPERIENCE capital one inc', 'Created Business Requirement Document', 'MS Project', 'Base II Created', 'Business Analyst/Project Manager/Data Analyst', 'Performing preliminary investigation for Performed data analysis with SQL queries for retrieving, maintaining and organizing PROFESSI ONAL EXPERIENCE Capital One Inc, McLean, VA June 2016 to July 2017 Sr. Business and Data Analyst The Project was about multi-level report management specially that of an RBR reported to Senior Management and Stakeholders in the Mortgage, Loan and deposit sides of the bank', 'Created narrative Risk Manuals', 'Business Analyst/Project', 'Developed SAS Program converting Large', 'Experienced Project', 'Abhishek Bhushan Professional Summary Industry- specializing Information Technology Business Analyst for Capital One system data conversion to Amazon Web Service worked on system decommission and replacement of legacy systems with new Automated FX and Fixed Income, Exchange traded derivatives workflows for worked as Business Analyst on Regulatory compliance projects for automation on Project management and Project document management', 'Developed Test', 'Business Analysts and Operational Created Business Requirement Document', 'Experienced SDC Project', 'Project', 'Facilitated Project Scope', 'UAT TECHNOLOGY MS Project', 'Risk Weight Asset Basel II Created', 'MS Project Visio Confidential', 'Business Analyst/Project Manager/Data Analyst with over 11 years of experience in Enterprise Risk Management, the Documentation and system/data conversion', 'Sequence Diagrams ER Diagrams MS Project', 'Process Modeling Use Cases Asset Management', 'AHL Bro kerage Risk Analysis Project', 'Created functional specifications, Requirement Traceability Matrix', 'Project Scope', 'Analyzed As Is and To Be Business processes and experience in converting these Conducted User Acceptance Testing (UAT)', 'Developed SAS Program for Converting Large volume of Text file into Teradata Tables by Importing the text file from Enterprise and database Integration with middle ware experience.'}
NAME: Abhishek Bhushan Professional

```

Fig 1. Terminal Output of Entities Extracted from a Resume

```

CGPA : 8.23,

EMAIL : 'sneith.sai2002@gmail.com',
EXPERIENCE : {'Business Analyst Experience Finlatics',
               'Finlatics Projects 12/2021'},

LANGUAGES KNOWN : ['English', 'Telugu', 'Kannada'],
NAME : 'Sai Sneith K',
PHONE NUMBER : '+20029740950',
SKILLS : ['Machine learning',
          'Mysql',
          'C',
          'Linux',
          'Aws',
          'Matlab',
          'Nosql',
          'Windows',
          'System',
          'Computer science',
          'Python',
          'Autocad',
          'Java',
          'Ai',
          'Cloud',
          'Database',
          'Programming',
          'English',
          'Tensorflow']

```

Fig 2. Terminal output of Entities Extracted from another resume

The difference in the output is because of the difference in formats of resume. The above output is shown and implemented with GUI as shown in Fig. 3.

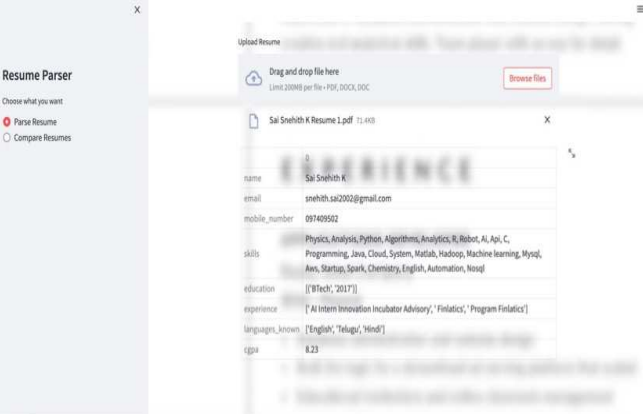


Fig 3. GUI Implementation of parsing a resume

This dictionary in the output of terminal is then made into a dataframe and is being displayed in a structured format.

We can now compare upto 5 resumes in the GUI implemetation. From the dropdown choose number of resumes that have to be compared. The minimum resumes that can be compared are 2 and a maximum of 5 resumes can be compared. Fig 4 shows the implementation of comparision of 3 resumes.

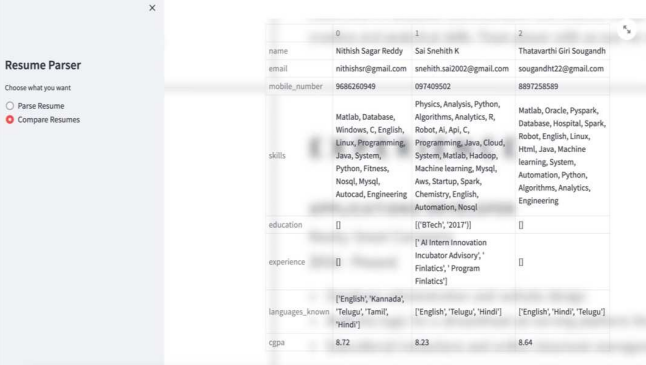


Fig 4. GUI Implementation of comparison of resume

## V. CONCLUSION

Finally, in order to extract crucial data from resumes, our resume parser software uses two separate approaches, the NER Model and Regex-based extraction. Throughout the research, we make use of Natural Language Processing (NLP) tools to successfully comprehend and modify human language.

The NER Model technique develops a model that can identify and categorize items including names, skills, phone numbers, grades, designations, companies, and experiences using SpaCy, an NLP library. This algorithm can accurately extract information from unseen resume texts because it was trained on annotated resumes. NLP approaches improve the text's context knowledge, which increases the precision of entity recognition. Regular expressions and NLP methods are used in the Regex-based extraction approach to extract information. To increase the precision of pattern matching, NLP techniques including tokenization, part-of-speech tagging, and preprocessing are utilized. We successfully extract information from resumes by using the advantages of Regex and NLP.

Through our study, we have shown how crucial NLP is for precise and effective resume processing. NLP methods make it easier to understand and take natural language, which makes it possible to extract useful information from resumes. A reliable method to handle various resume formats and extract important facts is provided by the combination of the NER Model and Regex-based extraction. By effectively putting these techniques to use, we can automatically extract crucial information from resumes, including names, phone numbers, talents, grades, designations, firms, and experiences. The productivity of resume screening and analysis in various personnel management software is increased thanks to this automation, which reduces the time and effort required for manual processing.

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