Resume and Cover Letter Generator Using LLMs Research and Applications

Zhou Zhou (zz3237), Pengyu Tao (pt2649)

1. Introduction

Recently, many job seekers struggle with crafting effective cover letters and resumes. The process is time consuming, requiring applicants to modify their materials for different job descriptions. At the same time, they also face the pressure of preparing for the interview. Also, many people were screened out by companies because of resume issues before they even had an interview opportunity. Since writing resumes and cover letters is a crucial step in the job application process, our project aims to research and develop an AI-powered Cover Letter and Resume Generator using Large Language Models to simplify this process.

By using LLMs, our system will generate personalized resumes and cover letters that meet specific job descriptions in high qualities. Unlike existing templates, our solution will adapt the content based on every job requirement. That is to say, the system will also optimize the text and utilize the advantage of each job seeker. Overall, our project will explore how LLMs can improve the effectiveness of job applications while ensuring the outputs for job seekers across various industries.

2. Literature review and Motivations

Several AI-powered writing tools like ChatGPT and Resume.io provide templates for resume and cover letter generation, but they often lack the ability to generate personalized content that aligns with specific job descriptions. According to Zinjad et al. (2024), their project 'Resume Flow' demonstrated the capability of LLMs to generate contextually relevant resume content by fine-tuning the model on job description datasets.

Tallapragada et al. (2023) proposed using BERT to extract contextual information for resume parsing, aiming to improve candidate selection. While their approach demonstrated high accuracy in identifying relevant skills and qualifications, it did not address the generation of resume content but rather focused on candidate screening.

Achiam et al. (2023) discussed the technical specifications of GPT-4 and its advanced language processing capabilities. This paper studies GPT-4's ability to generate contextually aligned content based on structured prompts. However, the study emphasizes on the ability of GPT-4 instead of exploring its application in resume generation specifically.

Zinjad, S. (2025) develops a user-friendly interface by applying GPT to generating resumes. However, they did not compare other models and explain why they choose GPT as a base tool for their user-friendly interface.

Therefore, three papers discuss the strong content generation capabilities of AI and have tested the ability of AI-generated text, but none have specifically studied the feasibility and effectiveness of AI in generating resumes. One paper examined the feasibility of using AI in generating resumes but didn't do the comparison of different models.

Building upon the literature reviews, our motivation aims to further explore the feasibility and effectiveness of AI in resume generation. Additionally, we intend to develop a user-friendly tool that streamline the resume writing process, making it accessible to a broader audience.

3. Objectives and Approaches

Objectives:

Our primary objective is to examine a user friendly fine-tuned model for resume and cover letter generation with personalization. We aim to compare the effectiveness of three models: GPT-2, GPT-4o-mini, and google T5. Additionally, concurrent models are too large and user unfriendly for the public. We seek to optimize the training process while maintaining the same model accuracy. We also seek to provide a user convenience experience for generating their own resumes.

Approaches:

To address the target stated above, we employ a structured approach consisting of four key phases:

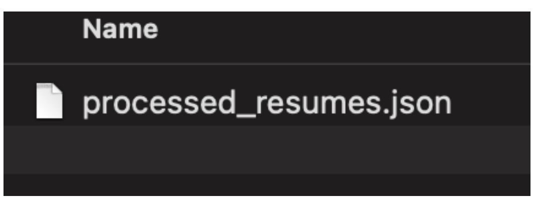
- **Data preprocessing and User Interactions:** Users will upload their own data and follow simple instructions to input their job descriptions and resume content. The provided code will then guide them through the data preprocessing steps, converting the uploaded files into JSON format, making it easier for the AI model to interpret and proceed with subsequent steps.
- **Data Collection and Generations**: Data was sourced from Kaggle's resume and job description dataset. Text data was cleaned, tokenized, and formatted into JSON files to facilitate training and evaluation, making it ready for the fine-tuning process.
- **Model Implementation**:
    - GPT-2: Fine-tuned to align resume content with job descriptions using structured data pairs. The model was trained using the collected resume-job description.
    - GPT-4o-mini: Employed without additional fine-tuning, focusing on prompt engineering to guide the generation of resume content.

    - google T5: Implemented with FAISS indexing for rapid, few-shot content generation with minimal training.
- **Evaluation Metrics**:
    - BLEU Score: measures structural alignment between generated content and reference text.
    - ROUGE-L: tests for sentence-level structural alignment and content organization.
    - BERTScore: evaluates how well the generated content aligns with the intended meaning.

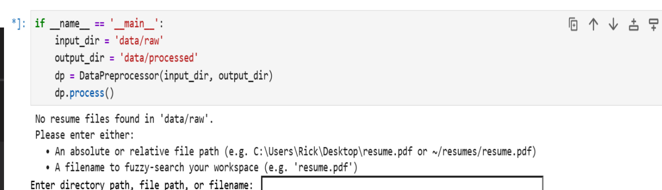
4. Methodology

Data Preprocessing:

Data preprocessing involved segmenting resumes into distinct sections such as skills, work experience, and education to streamline the training process. JSON files were generated to ensure consistent formatting and facilitate model training.

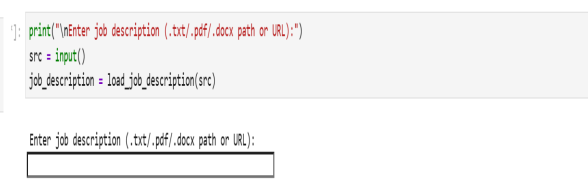


Step1: Ask User to upload their Resume using required file path



Step2: Ask User to enter their own Api Key

Step3: Ask User to put their own job description with required format needed



Then, as shown in above graphics, users will upload their own data and follow simple instructions to input their job descriptions and resume content. The provided code will then guide them through the data preprocessing steps, converting the uploaded files into JSON format, making it easier for the AI model to interpret and proceed with subsequent steps. After completing the data preprocessing phase, we manually reviewed the generated JSON documents to ensure it is consistent with the kaggle dataset(no additional and redundant data). This step was crucial to confirm that the output format aligned with the content structure of the Kaggle dataset. Later, we will directly use the Kaggle dataset as the sample dataset for testing. Before doing that, the model training is processed for the three target models.

Model Training:

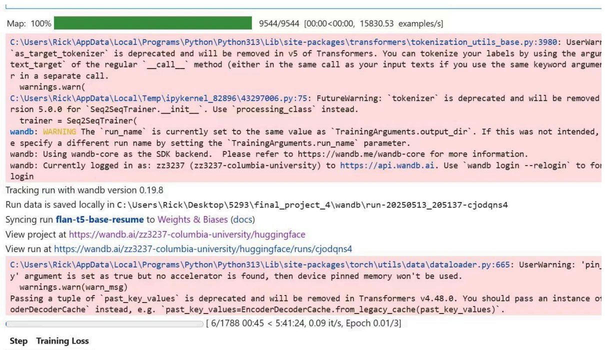
The training process for the GPT-2 model was designed to generate ATS-focused resume content by aligning user data with specific job descriptions. A dataset from kaggle website comprising resume-job description pairs, was preprocessed by segmenting and tokenizing text data, ensuring uniform formatting across all inputs. As setting a learning rate of 2×10^-5 over three epochs, we start to fine tune the model. The target is to let the model learn specific resume structures and content alignment strategies. During training, the model aimed to generate resume content that closely to the structure and terminology of the provided job descriptions, focusing on lexical overlap and structural consistency. After approximately 1.5 hours, the model training is completed with the following outputs:

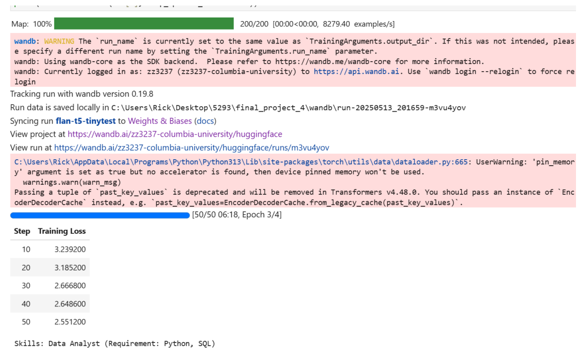
[1193/1193 1:27:26, Epoch 1/1]

Step	Training Loss
100	1.821800
200	1.096200
300	0.832800
400	0.745700
500	0.679800
600	0.652400
700	0.621700
800	0.557600
900	0.533500
1000	0.511200
1100	0.486500

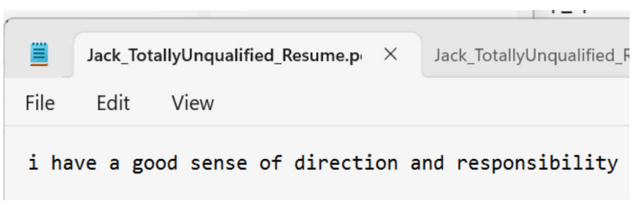
```
Resume:
jack t. somewhere | totallynotjack@email.zzz | 000-000-0000 | instagram.com/partyjack99 objective looking for a chill job where i don't
have to do much. risk management sounds kinda cool. education columbia online? or university? not sure degree: something in math i think,
maybe graduated? 2022ish? - took stats class once. pretty hard. - played poker every friday. won a few times. - gpa: forgot to check,
probably fine. experience none officially, but - gave investment advice to my uncle once, he didn't lose much - watched bloomberg for like
10 minutes - played a lot of monopoly (learned about risk vs reward!) - held leadership position in discord server skills - excel (but
just for checking football stats) - strong intuition (i can *feel* when something's risky) - great at avoiding responsibility -
comfortable using google to look up most finance terms certifications - almost signed up for a udemy course - read the cfa reddit page a
few times - certified vibes analyst (unofficial) projects risky business (2023): tried shorting tesla, bought dogecoin instead unpaid risk
consultant (2022): warned friends about ftx crash after it happened references - mom (she says i'm very responsible) - kevin (we used to
trade crypto) - a guy i met on reddit (wallstreetbets expert)
```

During the training process, we tried the same training logic for T5 models. However, compared with the time efficiency of the Gpt2 model, the T5 model's training duration is over 5 hours as shown in the following provided images. It highlights the computational intensity and inefficiency for the T5 model. Even though the training result is similar to the fine-tuned GPT2 model, it creates saved files for 175 gigabytes in its memory file, failing to meet our project objectives.





As a result, we applied a minimal fine-tuning approach utilizing FAISS indexing to implement a few-shot content generation strategy. Unlike the regular rag process, which was rigorously trained on structured resume-job description pairs, the T5 model relied on retrieving the top three similar examples from the dataset to construct a few-shot prompt. This approach minimized training time to 6 minutes while enabling the model to generate rapid responses based on contextual cues. However, due to the limited training configuration, T5 struggled to produce coherent, job-specific content, often generating brief, generic responses like the following:



The GPT-4o-mini model was not fine-tuned in the conventional sense but rather employed prompt engineering to control content generation. This model leveraged pre-trained capabilities to produce more creative and contextually rich resume content without adhering strictly to the provided job descriptions. By adjusting the prompt structure, the model aimed to diversify its outputs and produce content that was less repetitive and more engaging.

[Your Name]
[Your Address]
[City, State, ZIP Code]
[Email Address]
[Phone Number]
[Date]

Hiring Manager
Company XYZ
[Company Address]
[City, State, ZIP Code]

Dear Hiring Manager,

I am writing to express my enthusiasm for the Human Resources Assistant position at Company XYZ as advertised. While my background may initially appear unconventional, I believe that my unique blend of skills and experiences aligns well with the empowering and high-performance culture at your esteemed organization.

During my time engaging in various activities that sharpened my analytical abilities, I discovered a keen interest in understanding risk management. Although my formal education in this field is not traditional, I completed courses in mathematics, which provided a strong foundation in data analysis and statistics. These skills are crucial for maintaining accurate HRIS database management and recordkeeping, tasks I am eager to excel in.

My experience in managing and participating in online communities, such as a leadership role in a Discord server, has honed my communication and facilitation skills. These experiences have equipped me with the ability to engage effectively with diverse groups, a key requirement for facilitating company-wide committees and participating in HR meetings.

Moreover, my intuitive understanding of risk versus reward has been developed through strategic gameplay in both poker and Monopoly. This intuition, coupled with my proactive approach in advising on financial matters, demonstrates my capacity to contribute to strategic planning processes and objective development within your HR team.

While my proficiency in Excel has primarily been applied to analyzing football statistics, I am eager to expand this skill set to support HR functions such as employee orientation logistics and benefit management. I am also committed to maintaining a high level of confidentiality, ensuring sensitive information is handled with the utmost care.

I am drawn to Company XYZ's dedication to employee empowerment and continuous improvement, values I share and am excited to support. I am confident that my diverse experiences, coupled with my enthusiasm for learning and development, make me a strong candidate for this internship.

Thank you for considering my application. I look forward to the prospect of contributing to your team and growing within the dynamic environment at Company XYZ. Please feel free to contact me at your convenience to discuss how I can contribute to your HR initiatives.

Warm regards,

Jack T. Somewhere

[Attachment: Resume]

Jack T. Somewhere
Email: totallynotjack@email.zzz | Phone: 000-000-0000 | LinkedIn: linkedin.com/in/jacktsomewhere

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Objective
Seeking a Risk Management opportunity where analytical skills and intuition can be leveraged to contribute to organizational success.

Education
Bachelor's Degree in Mathematics (Pending Verification)
Columbia University (Online)
- Completed coursework in Statistics
- Engaged in strategic decision-making and probability through extracurricular activities

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Experience

Investment Strategy Advisor (Unofficial)
- Provided investment insights to family members, leading to minimal losses
- Enhanced understanding of market dynamics through active observation of financial news and trends
- Developed strategic thinking through simulation games, focusing on risk vs. reward scenarios

Leadership and Community Engagement
- Held a leadership role in an online community, fostering team collaboration and decision-making

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Skills
- Proficient in Microsoft Excel for data analysis
- Strong analytical and intuitive decision-making skills
- Excellent adaptability and quick learning of financial concepts
- Effective communication and interpersonal skills
- Ability to use online resources for continuous learning in finance

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Certifications & Courses
- Engaged in online financial education platforms and communities
- Regular contributor to finance discussions on social media, including Reddit's WallStreetBets

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Projects

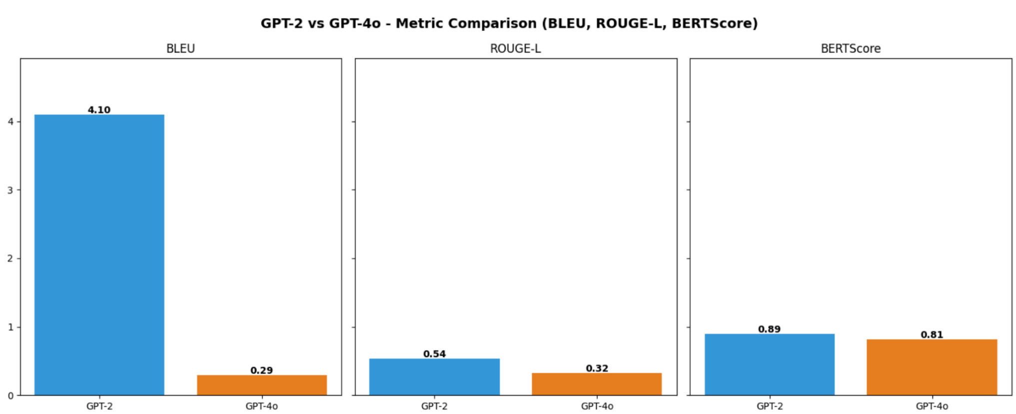
Risky Business (2023)
- Experimented with investment strategies, analyzing high-risk markets such as cryptocurrency

5. Evaluation Analysis

After verifying the output results, we decided to discard the T5 model data as it only produced single-sentence outputs and lacked the capability for comprehensive resume generation. Subsequently, we focused on the fine-tuned GPT-2 model and the modified prompt-based GPT-4o model. Utilizing the database information, we filtered out duplicate job descriptions from similar industries and automatically generated 20 resumes for different personas. With these generated resumes, we compared the model-generated data with several official dataset testing methods: BLEU Score, ROUGE-L, and BERTScore metrics.

According to the results in the following graphical outputs, GPT-2 demonstrated strong structural alignment, achieving a BLEU Score of 40.96, indicating high lexical overlap with the reference text, but its rigid structure limited creative variability. GPT-4o-mini, while scoring lower in BLEU (2.93) and ROUGE-L (0.3233), produced more varied and creative content, suggesting its potential in generating contextually diverse outputs, albeit with less structural consistency. Both GPT-2 and GPT-4o-mini maintained similar BERTScores (0.8927 vs. 0.8126) for semantic alignment tests. It suggests that both models effectively preserved contextual relevance.

```
Lengths - References: 9544, GPT-2: 9544, GPT-4o: 9544
Aligned Lengths - GPT-2: 20, GPT-4o: 20
BLEU - GPT-2: 40.96, GPT-4o: 2.93
ROUGE-L - GPT-2: 0.5388, GPT-4o: 0.3233
BERTScore - GPT-2: 0.8927, GPT-4o: 0.8126
```



Due to limited training configuration, google T5 has the minimal content generation and brief responses. However, it also delivers several important observations. Firstly, the more compute power the model needed, the more accurate context the model will be able to generate. Faster training time brings accuracy loss. Gpt4o is more good at creativity than semantic alignment. Sometimes, it generates some fake skills to fulfill the requirements of the job description.

Overall, the statistical results underscore the trade-off between structural alignment and creative variability in AI-generated resumes. As shown in the bellowing graphical results, it highlights GPT-2's strength in structured outputs and GPT-4o's potential for diverse expression.

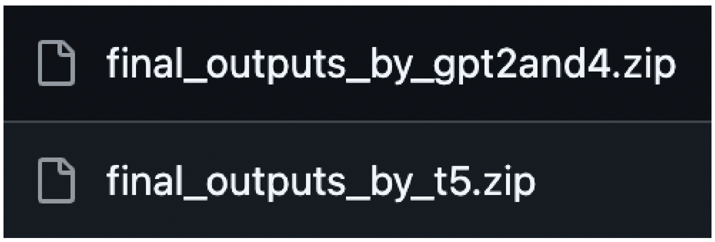
6. Current Challenges and Future Directions

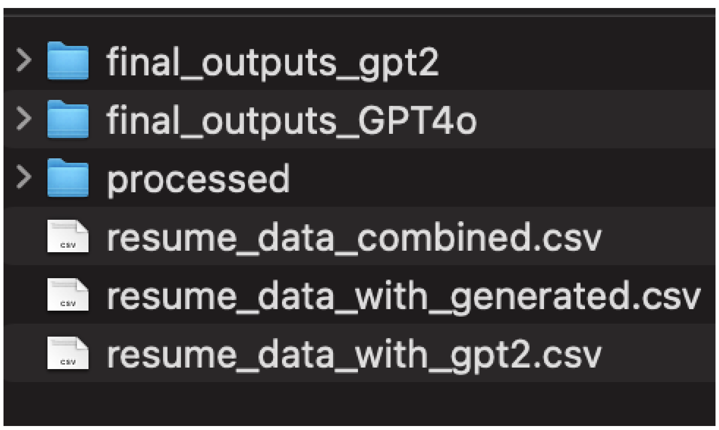
Throughout this project, we faced several challenges that highlighted areas for further improvement. The biggest challenge was the excessive training time for the T5 model, which took over 5 hours to complete. We have to remove the T5 model from further evaluation. Additionally, one of the initial objective is to develop a user-friendly web interface to make this project more accessible to job seekers. But after observing the unexpected results from our experiments, we decided to shift our focus away from developing a user interface. Instead, we concentrate on the first objective. We provide valuable insights for researchers and developers considering the feasibility of using open-source LLM-based resume generation tools. For instance, upon reviewing the open-source project ResumeFlow by Saurabh Zinjad and colleagues, we commend the authors for their impressive application development. However, as mentioned above in this paper, Gpt4o-mini occasionally exaggerates a candidate's qualifications to align with job descriptions. That is to say, the applicants sometimes need to do manual revisions to ensure accuracy. Hopefully, we will address all the above issues in future iterations through the continued refinement of fine-tuning model logic.

7. Conclusion

In conclusion, our project explores the effectiveness of three AI models(GPT-2, GPT-4o-mini, and T5) in generating resume and cover letter content tailored to specific job descriptions. As a result, GPT-2 is effective in producing structured, ATS-compliant content but lacks creative flexibility. GPT-4o generates more diverse content but at the expense of structural alignment. Google T5, while efficient in generation speed, requires further training to maintain contextual accuracy. Future work will fix problems remaining in section 6 and explore hybrid approaches that combine the structured output of GPT-2 with the creative potential of GPT-4o, alongside user-friendly interfaces to broaden accessibility to non-coding users.

8. Appendix

- Kaggle Resume Dataset: https://www.kaggle.com/datasets/saugataroyarghya/resume-dataset
- Our Project GitHub Repository: https://github.com/ZhouZhou12312/final_project.git
- All Graphical outputs and file outputs are generated by three main jupyter notebook file located in the project github repository:(resume_generate_gpt2.ipynb, resume_generate_gpt4o.ipynb, resume_generate_googleT5.ipynb)
- However it takes 2 hours to run the coding, So I pointed out the location of output files as the following screenshot:
- 




```
20 generated resumes saved to data/resume_data_with_generated.csv
```

```
Generating GPT-2 resumes...
20 GPT-2 generated resumes saved to data/resume_data_with_gpt2.csv
```

```
Embedding generation completed in 2006.62 seconds.
Number of zero vectors: 5
 FAISS index saved as: resume_index.faiss
 Metadata saved as: resume_metadata.csv
```

- Besides, there are some unused graphical outputs in this paper:

[1193/1193 1:27:26, Epoch 1/1]

Step	Training Loss
100	1.821800
200	1.096200
300	0.832800
400	0.745700
500	0.679800
600	0.652400
700	0.621700
800	0.557600
900	0.533500
1000	0.511200
1100	0.486500

```
Fine-tuning completed!
Model and tokenizer saved to ./fine_tuned_model
```

- Prompt Engineering Examples: Sample prompts used for GPT-2 to generate creative yet contextually aligned resume content.

```
"""
system_prompt = (
    "You are a professional career coach specializing in risk management roles. "
    "Rewrite the candidate’s resume to match the job description. "
    "Output format:\n"
    "1. Professional Summary (1–2 sentences)\n"
    "2. Key Skills (bullet list, max 6 items)\n"
    "3. Experience (bullet list, focus on quantifiable achievements, max 5 items)\n"
    "4. Education (degree, institution, year)\n"
    "Use a concise, professional tone."
)
user_prompt = (
    f"{system_prompt}\n\n"
    f"Original Resume:\n{clean_text}\n\n"
    f"Job Description:\n{jd}\n\n"
    "Rewritten Resume:"
)
return self._generate(user_prompt)
```

```
"""
Generate a targeted cover letter based on the resume and job description.
"""
system_prompt = (
    "You are an expert cover letter writer for entry-level risk management positions. "
    "Write a three-paragraph cover letter as follows:\n"
    "1. Opening paragraph: introduce the application motive, mention the job title and company name;\n"
    "2. Middle paragraph: highlight 2–3 most relevant experiences from the resume and explain how they pr
    "3. Closing paragraph: express enthusiasm for the opportunity and indicate next steps politely.\n"
    "Keep the total length between 250 and 300 words, in a professional and enthusiastic tone."
)
user_prompt = (
    f"{system_prompt}\n\n"
    f"Resume:\n{clean_text}\n\n"
    f"Job Description:\n{jd}\n\n"
    "Cover Letter:"
)
```

9. Reference

[1] Zinjad, Saurabh Bhausaheb, et al. ”Resume Flow: An llm-facilitated pipeline for personalized resume generation and refinement.” Proceedings of the 47th International ACM SIGIR Conference on Research and Development in Information Retrieval. 2024.

[2] Tallapragada, VV Satyanarayana, et al. ”Improved resume parsing based on contextual meaning extraction using bert.” 2023 7th International Conference on Intelligent Computing and Control Systems (ICICCS). IEEE, 2023.

[3] Achiam, Josh, et al. ”Gpt-4 technical report.” arXiv preprint arXiv:2303.08774 (2023).

[4] Zinjad, S. (2025). *ResumeFlow: An LLM-facilitated pipeline for personalized resume generation and refinement* [Source code]. GitHub. Retrieved from https://github.com/Ztrimus/ResumeFlow/tree/main