CS5224 Cloud Computing

Select Ideal Candidates Based on Personality Insights

Team PIA

Members:

HAN, BING	A0186003N
XU YIMING	A0133972B
ZHAO GUANLUN	A0194922X
WANG YUANHONG	A0136022M

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1. Executive Summary

Different job positions usually require different personality traits, but it would be time-consuming and even infeasible for HR to manually assess the personality of many applicants. Thus, an automated application should be developed to mitigate the conflict between recruitment expectation and HR capability. In our project, we propose an innovative service, Personality Hacker, to obtain the applicants' personality traits and rank them accordingly from the textual data available for the candidates. Based on IBM personality insights service, we provide SaaS service that achieve individual personality analysis and candidates ranking for assessors of HR departments and school's admission office.

1.1 Objectives

The key objective of this application is to make recruitment process automatic and efficient. To provide refined and comprehensive quality services, we also consider the following functions or capacities.

- Make users access the service easily from a web browser and use without any technical skills.
- Infer personality traits from textual data pertaining to personal statement or cover letter and then visualize the results.
- Take personality traits into account in ranking process and export the results easily.
- Ensure the scalability and availability of this application to accommodate diverse user demands.

1.2 Innovative Contribution

Using information technology to automate business cycle has always been a hot issue. Several great service providers have involved in E-recruitment area and developed awesome applications from applicant tracking system to AI-driven talent discovery [1]. However, adding personality analysis into recruitment process is quite a new idea and there is no application combining Big 5 personality model with AI in this particular area. Therefore, we make creative contribution by **applying psychological theory into auto-recruitment process**, so that enterprises and schools can view their candidates in another way.

1.3 Big 5 Personality Model

According to personality-job fit theory, a person's personality traits will reveal insight as adaptability within an organization. This is also referred to as a person-environment fit [2]. For example, people organizing social-activities are expected to be friendly, and candidates for a creative job are supposed to have desire to generate ideas. In addition, some personality traits are just admiring in HR's eyes, such as trustworthy, carefulness and collaborativity.

The big 5 personality model is widely considered to be the most robust way to describe personality differences. This theory is based on the association between descriptors of language and personality traits. The 5 broad dimensions of personality and the respect common descriptors are shown below.

Table 1: Big 5 Personality Model

Big 5 Factor	Dimension	Sample PPRF Item
I. Extraversion	A. General Leadership	…delegate to others the authority to get something done
	B. Interest in Negotiation	…work with dissatisfied customers or clients to achieve a mutually agreeable solution
	C. Achievement Striving	… persevere in the pursuit of his or her own work goals even when unsuccessful
II. Agreeableness	A. Friendly Disposition	…arrange and host work-related social activities
	B. Sensitivity to Others	…listen attentively to the work-related problems of others
	C. Collaborative Work Tendency	…work with one or more co-workers to complete assigned tasks
III. Conscientiousness	A. General Trustworthiness	…manage large sums of money on behalf of the organization
	B. Adherence to Work Ethic	…work effectively and consistently with little or no supervision
	C. Attention to Details	…examine all aspects of written reports to be sure that nothing has been omitted
IV. Emotional Stability		…work under conditions that are potentially emotionally stressful
V. Openness to Experience	A. Desire to Generate Ideas	…suggest new products, product lines, or new types of services
	B. Tendency to Think Things Through	…review all relevant information about previous projects to be sure that planning for new ones considers important prior experiences.

2. Business Case Identification

When an admin of school office is faced with a mountainous pile of materials of applicants and he/she actually values some certain personality traits heavily, is there any application that can help he/she out of this situation? As a SaaS application, Personality Hacker can push the limit of manual recruitment and generate adding values for the target users. Such automation innovation will generate significant benefits for users, business and economies, lifting productivity and economic growth.

2.1 Motivation & Problem Statement

When an interviewer is deciding for a position, professional skills and work experience are only part of what they want to see. Harder to show, but many times more crucial for actually landing the job, are the personality traits that decide the final candidate [3]. Now, personality traits cannot be captured until the applicants are invited to an interview. What if interviewers can get the personality scores of each applicant before the interview? In this way, they could not only save time for interviewing unqualified people but also obtain professional personality analysis based on matured experience.

2.2 Target Users

Our target clients are staffs of HR departments and school's admission office, but actually everyone interested in finding out personality insights can be our user. Personality Hacker provides different services for different customer group. For ordinary users, the application provides analysis on textual material. For enterprise or organizational level users, Personality Hacker provides uniform application but allows customization for setting ranking rules.

3. Business Model

3.1 Service to be Developed

Two functions will be provided in one web-based SaaS service, including:
1) Detailed Big Five personality analysis for a single candidate. Once the user uploads a personal statement or cover letter onto the web server, results of Big Five personality analysis will automatically display, including:

- A pentagon chart representing scores of a candidate's Big Five personality dimension, which give users a clear sense of a candidate's most significant & most weak characteristic. Scores are displayed when the mouse cursor is put on the chart.
  ** Note that "scores" here means percentile of the candidate among all the candidates in IBM Watson Personality Insights' database.*
- 5 more detailed hexagon charts representing scores of the Big Five's sub-dimensions. Each of the Big Five has 6 sub-dimensions, leading to a total of 30 sub-dimensions. Each hexagon chart provides users with a detailed investigation into the Big Five Dimensions.
- Detailed definition of Big Five personality traits and of the 30 sub-dimensions.

This "Analyse" function enables users to have a quick glimpse of a candidate's personality attributes, without looking at his/her personal statement or cover letter.

2) Ranking, filtering, and recommendation of most suitable candidates for the job/ academic program. For a folder of personal statements / cover letters uploaded, each of the files will be analyzed, and the Big Five scores will be used to rank the candidates. Users are offered the choice to rank the importance of each Big Five dimension, which will then be used to rank and filter the candidates.
This "Ranking" function empowers users to find out the most suitable candidates for further examination.

3.2 Services Comparison

The existing services that automate the process of filtering suitable candidates include: CVViZ, ResuWe, Whozwho and Brilent etc. These services combine automating technologies into recruitment process, and provide features such as job requisition and resume parsing. Below is a summary chart comparing these services.

Table 2: Service Comparison

	CVViZ	ResuWe	whozwho.com	BRILENT
Introduction	An AI-powered, cloud-based solution that helps users identify the most suitable candidates for the job	Offer service to pinpoint the best applicants quickly, as resumes are automatically parsed, ranked,	A behavioural based smart recruitment software, shortlisting candidates using HR's ideal	Bring AI to talent acquisition in candidate prospecting

		with keywords highlighted	candidates qualities	
Starting Price	$69.00/year	$99.00/month	Not provided by vendor	Not provided by vendor
Product Features	1. Interview Management 2. Job Posting 3. Job Requisition 4. Resume Parsing	1. Interview Management 2. Assessments 3. Job Requisition 4. Resume Parsing 5. CRM 6. Self Service Portal	1. Assessments 2. Job Posting	1. Assessments 2. Job Requisition
Training	1. In Person 2. Live Online 3. Documentation	Not provided by vendor	1. In Person 2. Live Online 3. Documentation	Not provided by vendor

Although these services enable users to rank candidates, they suffer from the following limitations:

- They do not emphasize importance of personality traits.
- They do not provide immediate in-depth analysis of a candidate's Big Five personality, as well as visualization charts.

Our service Personality Hacker counters these limitations by:

- Rank candidates using scores of Big Five personality.
- Provide "Analyse" function for detailed personality analysis of a candidate.

3.3 Revenue Model

Revenue of Personality Hacker is expected to come from:

1) Service fee from users, according to the number of files uploaded. For "Analyse" & "Rank" function, users enjoy free trial for 100 files in total. Any amount larger than that will be charged.
2) Advertisement fee from companies posting advertisements on the website. As website traffic increases, several recruitment websites and head-hunting companies may want to post advertisements for HR to see.

3.4 Cost Analysis

Personality Hacker brings about much less cost compared to those on-premise services. Reduction in cost is because of the characteristics of typical cloud service. Firstly, it is implemented on IBM cloud platform so no hardware cost is required. Secondly, cloud services can rapidly respond to demand elasticity, which

significantly reduce planning effort and save cost when demand drops. Lastly, this service is hardware independent, so it is compatible across different systems and can be easily transplanted to other platforms with minimized cost and effort.

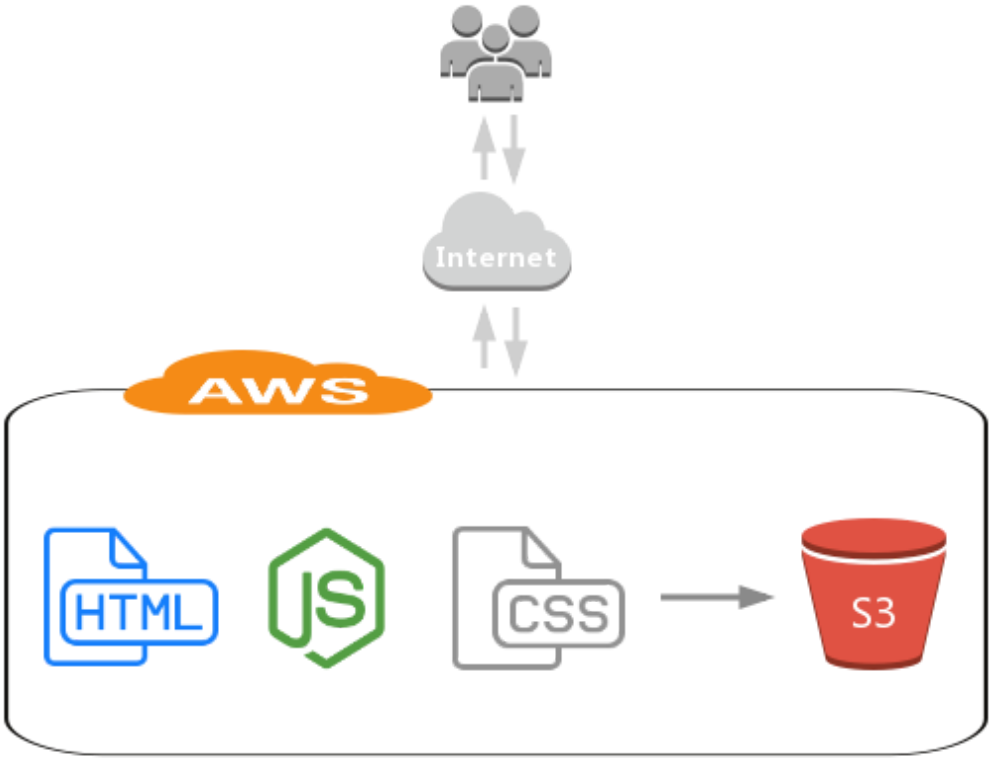
By incurring much less cost, Personality Hacker is able to set a lower price for users (See the part of “Pricing Model”). To conclude, Personality Hacker aims to provide candidate personality analyse and candidate ranking with the minimal cost possible.

4. SaaS Architecture & Implementation

4.1 Architecture Overview

Figure 1 below is the overall architecture design of our Personality Hacker application. The application is a web-based application hosted on the Amazon Web Service S3 Bucket. Users can access the website through http://cs5224-personal-insight-bucket.s3-website.ap-southeast-1.amazonaws.com

Figure 1: High Level Architecture



4.2 Data Acquisition & Pre-processing

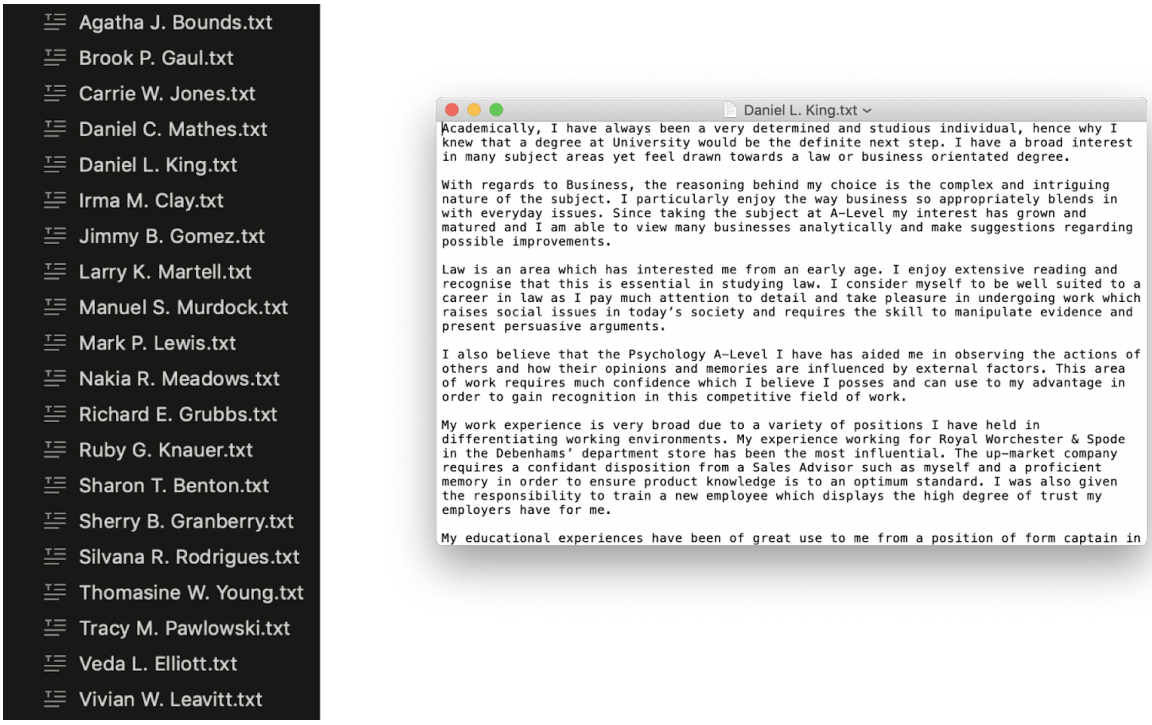
We retrieved candidate Personal Statement (PS) or Cover Letter (CV) data from internet to test our app and simulate how our app can be used by HR candidates to rank. We select personal statements of candidates from the following background to test performance and stability of our app: Economics, Maths, History, Medicine, Government, Pharmacy, Biology, Computer Science and Computer Games

Programming. We **used Python to help us crawl personal statements** from internet and store them locally (txt format) as our testing pool.

We undertook the following pre-processing steps:

- **Set file names:** For each personal statement of txt format, its filename is set to be the name of that candidate.
- **Ensure minimum word counts:** Since IBM personality insight API requires at least 500 words to get relatively accurate result, we used Python to validate PS or CV to make sure that minimum word counts requirement is met.

Figure 2: Personal statements we prepared and a sample's content



4.3 Data Analysis and Ranking

IBM personality insight API is used to analyse our data. The returned JSON file not only contains the score for each Big Five personality element (Conscientiousness, Agreeableness, Emotional Range, Extraversion, Openness), but also describes 30 sub-elements to characterise candidates' personality. Such information is used to visualize our candidate's personality holistically.

In order to rank our candidate according to how similar his/her personality is to the ideal candidate's personality, we calculated a score for each candidate. The higher the score, the more suitable our candidate is for that position. This is the formula we used to calculate the score:

$$score = \frac{1}{(\overrightarrow{ideal\ score} - \overrightarrow{candidate\ score})^2}$$

where both ***ideal score*** and ***candidate score*** are vectors in the form of: (Conscientiousness, Agreeableness, Emotional Range, Extraversion, Openness).

The denominator is calculated by total squared error of ideal score vector and candidate score vector. It characterises the degree of deviation of that candidate's personality from desired personality. After ranking, HR can choose to export data table to Excel for record of future analysis.

4.4 Front End

After performing cost-benefit analysis on various web design frameworks such as React, Angular, Vue.js etc. we decided to use React as our chosen web framework due to following five reasons.

- It has built-in JSX support, an XML-like language built on top of JavaScript
- Virtual DOM functionality makes react-built web app much faster than traditional ones
- XSS protection
- Fetch for Ajax requests
- Popularity, simplicity and strong community support

In order to create professional-looking Big Five personality chart for better visualization, we used e-charts, a chart visualisation module for React. With JSON data returned by IBM personality insight API, we are able to show the user Big Five personality chart in real time. Also, we used Reactstrap which allows us to use Bootstrap 4 components that are compatible with React. Reactstrap is mainly used for widget creation and page layout which would be compiled to static HTML, CSS and JavaScript after build and bundling.

4.5 Back End

Our app provides two main functionalities: Analysing and ranking. Analysing allows for a single personal statement input, while ranking allows for multiple ones. Analysing functionality allows user to figure out a candidates' personality in detail to be able to match candidate to respective position more accurately.

In Analysing section, user uploads a personal statement / cover letter before clicking "Analyse" button. Subsequently, our web app would call IBM PI API and Big Five chart visualization would appear in real time.

In Ranking section, the web application will import all the personal statements / cover letters documents in selected folder and call IBM PI API for each one of them. After getting JSON return from IBM PI API, we would store it in application server.

In order to provide a more configurable functionality for HR / Committee, we allow users to configure the personality details of their target candidate personality information. Users would give each personality a score from 1 to 5 and the scores would be used by our system as a ranking weightage. For example, if an HR is recruiting candidates for computer science job, he/she might set a lower ranking for "Extraversion", and a higher ranking of "Conscientiousness" since the job has low tolerance for errors in codes.

We would return ranking result and HR would be able to pick most suitable candidates among the current candidate pool by our scoring system. If users want to

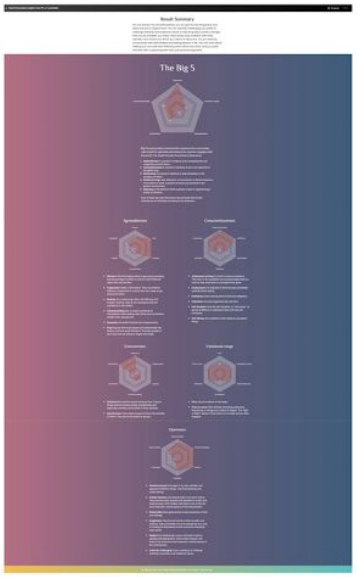
save our ranking results for further processing, they can click “Export” to export in Excel.

Personality Hacker App Workflow

Functionality 1: Analyse

Step 1: Press analyse button

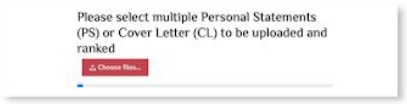
Step 2: Upload 1 Personal Statement (PS) or Cover Letter (CL) and Press “Analyse Now” Button



Step 3: The Big Five analysis result will be shown

Functionality 2: Rank

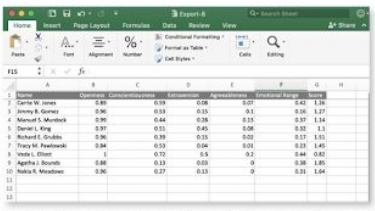
Step 1: Press Rank button



Step 2: Upload multiple PS or CL

Step 3: Type in desired candidate personality and press "Rank Now” Button

Step 4: Ranked result is shown and score is calculated



Step 5: Export as Excel file for record purpose

4.6 Future Improvement

Currently our application only supports txt format Personal Statement or Cover Letter. Our application can be improved by **adding support for pdf and word format** to cater to HR's needs.
Since txt format of candidate's PS and CV are relatively small which usually takes less than 50 KB per file, we store them in application server instead of database for the sake of convenience. But if the amount of service requests increased dramatically in the future, we would improve our application by **storing candidate's data in an encrypted database** (AWS S3 or IBM DB2 etc.).

5. Economic Factor

5.1 Economic Benefit & Key Considerations

There are plenty of economic benefits carried out by our application.

Firstly, when the users access our website, there will be profit generated from website due to the website traffic. The placement of advertisement on the website would be one source of economic benefits.

Secondly, since our application supports users to investigate the personality insight of their candidates and rank the candidates based on specific requirement, it contributes to the human resources activities in singapore job market associated to the economy, and improves the efficiency of allocating the right candidates into the right positions.

Key considerations of our application would be that, depending on the different seasons in a year, the number of users' call may turn out to be different. For example, March and April are peak seasons for graduating students to submit their resumes and for companies to hire potential employees. Therefore, there will be a request fluctuation for the website, and we **need to deal with the increase of demand**.

5.2 Pricing Models

We store the analysis result into react hoster in our project which cause zero dollar per month, since our test samples only contains a short amount of personal statements. As the amount of data increases, we shall move our data storage into IBM DB2 Warehouse service, which is $2.11 per instance hour if we choose flex plan. The flex plan is a storage-dense, elastic data warehouse configuration ideal for development and testing, or infrequently accessed data.

The cost of personality insight service is zero dollar per month because our database is less than 1000 API calls. As the number of data increase, we may consider changing the service plan into tiered plan, which is free for the first 100 API calls per month and $0.02 per call below 100000 calls, and $0.01 per call below 250000 calls, and $0.005 for the rest.

The variable cost like license fee using IBM Bluemix platform is considered. In terms of fix cost, it mainly comes from the development cost. Compared to the on-premise services, our service reduces the upfront cost and does not spend any money on facilities and maintenance. We aim to adopt flexible pricing model to satisfy the demand changes and workload fluctuation. Since the demand at initial stage is small and uncertain, we would like to apply on-demand pricing model for it. As the service demand increases, we may consider reversed pricing model as an alternative for reserving instance for users.

5.3 Tradeoff Between Cost and SLA

Different from other on-premise services, we reduce the cost to buy the IT resources for building the website and application. We use IBM Bluemix as the platform to develop, which can guarantee our service quality, save time and money spending on preliminary stage setup and machine supply. In the latter stage of development, we want to charge a considerably amount of fee from users to update the data storage, and provide multiple deployment of the application in order to increase the reliability and availability based on SLA.

6. Conclusion

Personality Hacker is an innovative automated application, which obtains the applicants' personality traits and rank them accordingly from the textual data available for the candidates. Based on IBM personality insights service, we provide SaaS service that achieve individual personality analysis and candidates ranking for assessors of HR departments and school's admission office. The application takes advantages of the elasticity of cloud platform, uses the minimal cost to provide ranking services, and benefits from website traffic & advertisements. In future work, our application can be improved by adding support for pdf and word format to cater to HR's needs and store candidate's data in an encrypted database.

Reference

[1] "Recruiters Use AI To Rediscover Talent In Their Own Backyards". SHRM, 2015, https://www.shrm.org/resourcesandtools/hr-topics/talent-acquisition/pages/recruiters-use-ai-rediscover-talent-ats.aspx. Accessed 18 Apr 2019.

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