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**Faculty of Computer Science
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BACHELOR'S THESIS
Research project
Tri-cluster in the Analysis of Advertisements of Working Vacancies

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Abstract

In this work we conduct the analysis of requirements, responsibilities and working

conditions presented by IT companies based on vacancies advertisements featured on portal Glassdoor [1].

Extraction of relevant requirements, responsibilities and work conditions is done using the so-called "annotated suffix-tee" method. Upon extraction of such lists, we compute a 3-dimensional relevance matrix for requirements-responsibilities-working conditions triplets and then apply tri-clustering methods to extract tri-clusters of strong interconnections.

Resulting tri-clusters are then to be interpreted as IT standards for job applicants

Keywords—tri-cluster, IT-vacancy, relevancy, annotated suffix tree

1. INTRODUCTION

The IT sphere has seen rapid increase in recent years as more people and businesses start applying technologies in their workflow, thus providing market with an increasing number of job vacancies. This, however, makes it harder and harder for young specialists and students to comprehend the requirements needed to be met, which might affect their career path greatly, as trends in IT-industry, in companies and colleges might severely differentiate. This raises a few questions:

- The requirements to fit
- Universal skills every specialist should acquire
- Work environments on the job

Thus, the analysis comes down to Automation of job vacancies in IT.

The purpose of this work is to analyze requirements, responsibilities and working environment in IT, based on open sources of job vacancies.

For this analysis we need to make following steps:

- Vacancies data collection
- Information extraction of requirements, responsibilities and work environment from collected data
- Use of Annotated suffix tree method to evaluate the co-relevance of text – string and forming three matrices, corresponding to co-relevancy of our vacancy's texts to each list of requirements, responsibilities, working conditions
- Formalizing the tri-way matrix connecting requirements, responsibilities and working conditions, implementation 3-clustering methods and their further use on our data to group up clusters
- Analysis of results

2. ANALYSIS OF EXISTING METHODS

2.1. Different Types of IT Jobs

In article [3] from one of the top jobs finding sites in IT industry the authors make a list of 21 most common jobs to consider, as well as relevant for the profession duties, requirements

and USA national average salary. This helps us to narrow down our exploration to most common/interesting for job finders resumes and provide a deeper understanding of market needs and requirements to candidates.

2.2 *Most needed skills in IT*

From the same source in article [2] we can find an analysis of skills needed to land a job and become a more preferable employee. As the industry grows, so do the requirements and number of skills companies are looking for in candidates. Nowadays coding job is not always about algorithms alone, including such things as soft skills as of need of improvement all the time with ever changing coding languages, their libraries and new directions of research.

2.3 *Most needed skills in IT*

In project [20] one of the mentor's student made a similar job analyzing Russian IT vacancies market. This help a lot as many times newer jobs are not as well formulated in their requirements and responsibilities as in the West. Thus, finding a job only by its name in Russia is made harder as HRs' many times may need someone different as well as different skill set.

2.4 *Vacancies text as data source*

In [12] authors analyze vacancies texts as their content. One of the main points to be agreed with is that not all skills required in the vacancy are bound to be utilized in the following work. Also, authors underline that vacancies paint the ideal candidate employers are looking for, which makes it hard to match with real world candidates.

3. VACANCIES DATA COLLECTION

In this part we would dive in methods used to gather data, as well as extraction of requirements and characteristics we are interested in:

3.1 *Data source choice*

To get us data on IT vacancies we've looked through multiple sites which provide such data, but unfortunately couldn't find any which provides users with open API to download vacancies easily. The choice fell on Glassdoor.com [1] as it allows us to differentiate vacancies not only by their name, but also by the city as it offers its service all over the world, which we would consider comparing data from different points in the world.

3.2 *Data collection*

For data collection we would use code in programming language Python [14] utilizing the github sources as starting code [23], although the main point of the code is same, but it needed some changes due to difference in site version and our need to go through different job names, as well as different cities. The main point of parsing text is using Selenium [22] Python library to imitate user actions by code, this allowed us to download data without

usage of APIs, but also presented with limitation, code needed to be slown down and number of vacancies for each job was limited to a few hundreds, as otherwise the site would block us for some time or completely block the IP. Using our sources for jobs [3] and cities [5] we downloaded 10500 texts with 200-300 vacancies for each combination of city/jobs.

3.2.1 *Dataset description*

Date of data collection: 11.11.20-16.11.20

Names of job vacancies considered from [3]:

- "Cloud System Engineer"
- "IT Coordinator"
- "Help Desk Technician"
- "Data Quality Manager"
- "Applications Engineer",
- "Web Administrator"
- "Management Information Systems Director"
- "IT director",
- "Data scientist"
- "IT security specialist", "Software engineer"
- "Computer scientist"
- "Database administrator", "User experience designer"
- "Network engineer"
- "System analyst"
- "IT technician"
- "Web developer"
- "Quality assurance tester"
- "Computer programmer"
- "Support specialist"

3.2.2 **Structure of vacancies**

Glasdoor.com [1] allows its' users, either job hunters or companies posting those vacancies, access or provide more than just vacancy text in the post, such as companies ratings on the site, reviews, medium salary for the job, if not present for a specific vacancy. We are mostly concerned about the description of the vacancy, but also will store some additional information for possible further analysis.
Our data then looks as following in form of a table row:

Table 3.2.2.1 Parsed vacancy representation

Position	Applications Engineer
City	London
Job Title	Application Support Engineer

Salary Estimate	-1
Job Description	… Key Responsibilities - Liaise with JATO customers to resolve application support issues Be responsible for critical applications and take Ownership of Incidents and Service Requests raised by the customer As part of the support team, you will work towards and meet internal Service Level Agreements as well as meeting customer Service Level Agreements Create and maintain detailed service support documentation relevant to the applications where required Proactively work closely with other support and development teams within JATO Identify continual service improvement initiatives Work with newly built applications on cloud technologies Ensure reports are sent out for any anomalies and write automation scripts Key Requirements - Excellent communication skills, verbal and written Self-motivated and strong self-awareness…
Company Name and Rating	JATO Dynamics 3.4
Location	Uxbridge, England
Headquarters	-1
Size	501 to 1000 Employees
Founded	1984
Type of ownership	Company – Private
Industry	Research & Development
Sector	Business Services
Revenue	$50 to $100 million (USD)

As some of the information is either not given in some vacancies, or might be contained in text body itself, we give those values -1 as unknown as we parse the contents of the page.

3.3 **Extraction of requirements lists**

From example above we can see a pattern of three lists, containing:

- List of requirements
- List of responsibilities

• List of work conditions

First, we tried to find most "interesting" phrases from text collection by utilizing nltks' [16] built-in Pointwise Mutual Information measure for bigrams, as experience shows more than 2 words n-grams usually contain less informative word collocations. This allowed us to find some of the phrases, especially for requirements, but responsibilities and work environment phrases usually carry more commonly used words, so that method couldn't be used solely to fill our needs. Thus, we used a combination of nlp and simple frequency analysis:

1. Combine all texts and split them by sentences, including newline symbol, as nltks' [16] builtin tokenizer for sentences doesn't reconginze it as a divider.

2. Clear all sentences of puncuation, stop words, tokenize words and lemmatize them to get them to computer friendly form, saving the original form in dictionary to have some way to restore meaning.

3. Calculate cleared sentences by their frequency and try to find most commonly used key-phrases which start sections with lists or requirements/responsibilities/work-environments.

4. Use an already pretrained BERT [19] model to encode embeddings for our key-phrases and then calculate cosine similarity between them and every sentence in the text, which calculates as $1 - \frac{u \cdot v}{||u||_2 ||v||_2}$, where u and v are vectors (in our case – numerical embeddings of sentence)

5. Sentences with high enough similarity are then suggested as key-phrases and flagged correlating to their class (requirements/responsibilities/working conditions)

6. Going through each text and using flags, we extract sentences that follow them to corresponding lists

7. Find the most frequent sentences in each list, as we might get some unwanted garbage sentences, and get the final lists for further co-relevancy calculations

This approach yielded great result to finding most common working conditions in a pre-phase, where we tried finding flag-phrases, as they are usually not separated by flag-phrase and really common among vacancies. But finding responsibilities and requirements wasn't as easy, this approach doesn't give 100% security that every flag-phrase has been identified, so in the end multiple garbage phrases were found by frequency calculations and needed to be filtered by hand.

4 BUILDING THE CO-RELEVANCY MATRICES AND TRI-CLUSTERING METHODS

To get the most relevant to each text phrases found in chapter 3 we need to use annotated suffix tree method [13].
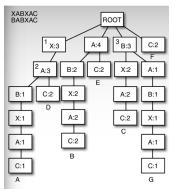
4.1. Co-relevancy matrices building using annotated suffix trees

4.1.1 Annotated suffix tree method explanation

The method we will use is described in article [13] to evaluate text to phrase relevancy.

To build annotated suffix tree we build a tree like structure where branches are paths for every suffix of our primordial sentence (word), for an example "phrase" "XABXAC" correlates to suffixes "XABXAC", "ABXAC", "BXAC", "XAC", "AC", "C". For every element its frequency is calculated, while parents' frequency equals to sum of its children. An example of AST [17] for two phrases can be seen in Picture 1.

Picture 4.1.1.1 An example of AST [17] for two phrases, XABXAC and BABXAC.

To get the co-relevancy of phrase to text (set of its sub strings) we need to:

1. Build the AST for text by its sub-strings.
2. Superpose phrases' suffixes on the AST
3. For every suffix of the phrase calculate *of concurring suffixes, where p(m) – suffixes' "m" probability, which is calculated as its' frequency divided by its' parents frequency.*
4. Calculate full phrase relevancy score to the AST, which is summmarization of scores of its suffixes divided by the length of the phrase:

The co-relevancy of text – phrase is going to be calculated with use of AST by EAST [14] library for Python [15] programming language.

4.1.2 Building two-way matrices of co-relevancy vacancy text – phrase

We'll use AST method [17] to build three co-relevancy matrices, by going through each text and calculating AST score for every phrase in our lists.

We get the following:

- Matrix of "vacancy – requirements list" co-relevancy
- Matrix of "vacancy – responsibilities list" co-relevancy
- Matrix of "vacancy – working environments list" co-relevancy

Code for matrices calculations can be found in Appendix 1 as well as matrices can be found in the Appendix 1, as they have very big dimensions (10000x100 at least), so wouldn't fit here.

While we have calculated every text-phrase relevancy, not all of phrases relevant to each text, so to get most significant phrases for each text we will drop requirements with relevancy scores lower than 0.3, responsibilities lower than 0.27 and working environments lower than 0.23. Such a decision comes from our lack to find all of the phrases contained in respective list and, thus, making our lists of responsibilities and working environments not specific enough for some clusters of jobs.

By doing so we can then compose lists and their corresponding indexes for each group of phrases requirements/responsibilities/working environments, which are coded in Appendix

As we can suggest, if vacancy text contains lots of relevant phrases it might be generic to our dataset, so we will try to medicate its effect on our calculations by calculating weights of every text by the number of its relevant phrases and later using it to smooth out our three-way matrices.

Picture 4.1.2.1 Code for vacancies texts weights

```
# weight of vacancy is an average sum of number of extracted requirements, responsibilities, conditions
w =[]
for el in weights.values:|
    temp = round((len(re.findall("\d+", el[1]))+len(re.findall("\d+", el[2]))+len(re.findall("\d+", el[3])))/3.0)
    w.append(temp)
```

4.1.3 Building the three-way matrix of relations of requirements, responsibilities, working environments

Algorithm for building the three-way matrix can be seen in picture below:

1. Go through vacancies lists of requirements/responsibilities/working environments, for every triplet of present cell value is increased by 1

2. After going through all permutations of temporary matrix is added to resulting with division by weight of the text (number of requirements/responsibilities/working environments present in it) to smoothen the data

3. Repeat from step 1 for each text.

Picture 4.1.3.1 Code for three-way matrix calculations

```python
# build a 3d matrix
import numpy as np
res= np.zeros((n,m,l), dtype=float)
for i in range(len(w)):
    temp= np.zeros((n,m,l), dtype=float)
    for el in reqs[i]:
        for el2 in resps[i]:
            for el3 in conds[i]:

                # if combination (el,el2,el3) is in vacancy's (requirements, responsibilities, conditions),
                # then add 1 to the (el,el2,el3)-th element of 3d matrix
                temp[int(el)][int(el2)][int(el3)]+=1.0
    # after we iterated over all requirements, responsibilities, conditions sets of a vacancy,
    # add this 3d adjacency matrix to the r-matrix, but divide by the weight of the vacancy
    # Divide - because the larger the weight is, the more requirements, responsibilities and conditions
    # were exctracted
    # for the vacancy - thus it's less important and more general
    res+=temp*1.0/w[i]

res = [[[np.round(el*1.0,2) for el in el2] for el2 in el3] for el3 in res]
```

After calculating this matrix we need to apply modularity transformation as suggested in [21] and apply it to our three-way matrix with , where each is sum of elements of row/column/axis correspondingly.

4.2 **Method of three-cluster analysis**

4.2.1 **Tricluster Box Method**

This method has been implemented by Gujarina A. [20] from article by Mirkin B. and Kramenko A. [4]. Code can be viewed in APPENDIX

Lets say our lists of requirements/responsibilities and working conditions are named X, Y and Z accordingly. Then on a cycle of the algorithm we have (V, W, U), which is a three-way cluster and where , In the article [4] a new variable Diff is suggested by authors: , where co – income of a three-way claster in data scatter and i – element which is calculated to be added or deleted from the three-way cluster. If is positive then the element is added to the cluster, if it's not already in, otherwise – delete, if it's in the cluster.

is calculated by formula:

where = 1, if element i does not a belong to the cluster and -1 otherwise. J and K elements are calculated in the same manner.

Algorithm:

1) Start with a random cell of the three-way matrix with positive value, build a starting three-way cluster (V, W, U), containing elements i, j, k accordingly.

2) For each element of calculate and the element with maximum value of is either added or deleted from the three-way cluster.

3) Repeat step 2 until isn't lower than 0 for every element

In the end we should get first three-way cluster.

Usually three-way clusters shouldn't intersect, so we could use method proposed in [12], which is to delete elements that already belong to some cluster – this will provide us with very different cluster. The problem here is that most of the IT-industry jobs such as developers, data scientists, machine learning engineers and so on might have very close correlation between their requirements and responsibilities. Such method then, might help us to get differentiable clusters with key requirements and responsibilities for each job, but we would also like to have some type of generalization of vacancies to find out if they are really that different in real world environment and which can be interchangeable.

By looking at it this way we can use the algorithm in two ways:

1) Repeat algorithm for every cell of our three-way matrix, as proposed in article [12]. The pseudo code is provided in the picture.

2) After we found a cluster – delete all corresponding member of the cluster from three-way matrix.

Picture 4.2.1.1 Algorithm Tribox [12]

Algorithm 6 TriBox algorithm

Input: $\mathbb{K} = (G, M, B, I)$ — tricontext;
$\quad\lambda_0$ — similarity shift value parameter for $\mathbb{K}$
Output: $\mathcal{T} = \{T = (X, Y, Z)\}$
1: $\mathcal{T} := \emptyset$
2: **for all** $(g, m, b) \in G \times M \times B$ **do**
3: $\quad r^*_{gmb} = [(g, m, b) \in G \times M \times B] - \lambda_0$
4: **end for**
5: **for all** $(g, m, b) \in I$ **do**
6: $\quad T = (g, m, b)$
7: $\quad$ **repeat**
8: $\quad\quad e^* = \arg \max\limits_{e \in G \sqcup M \sqcup B} D(e)$
9: $\quad\quad D^* = D(e^*)$
10: $\quad\quad$ **if** $D^* > 0$ **then**
11: $\quad\quad\quad$ **if** e^* $inside$ T **then**
12: $\quad\quad\quad\quad$ remove e^* from T
13: $\quad\quad\quad$ **else**
14: $\quad\quad\quad\quad$ add e^* to T
15: $\quad\quad\quad$ **end if**
16: $\quad\quad$ **end if**
17: $\quad$ **until** $D^* < 0$
18: $\quad$ $Tkey = hash(T)$
19: $\quad$ **if** $Tkey \notin \mathcal{T}.key$ **then**
20: $\quad\quad$ $\mathcal{T}[Tkey] := T$
21: $\quad$ **end if**
22: **end for**

Although we would also like to calculate three-way clusters by the first method, the code is estimated to run for at least a few days because, compared to previous work, our requirements/responsibilities/working environment lists came out to be quite long, so we basically have to look through every possible permutation of in our lists.

4.2.2 **"Overlap" method**

Overlap method developed in [20] is based on an assumption that if elements , belonging to set correspond to similar subsets of elements from , then elements , can be combined in subset V, with , thus creating bi-cluster

Same heuristic can also be used for third set to get three-way cluster .

As for subsets similarity measure, we will use Jaccard's' similarity:

4.3 **Calculations and results interpretation**

In this work we conducted the following calculations and experiments:

1. Calculation of three-way clusters with «Tricluster Box on updated matrix» method.
2. Calculation of three-way clusters with «Overlap» method.
Code is available in Appendix 1
«Tricluster Box on updated matrix» method experiment yielded 25 clusters, which is

even more than original number of specialties taken for analysis.

«Overlap» method yilded 6 clusters, some of which summarize a few specialties.

We'll start with analysis of «Tricluster Box on updated matrix» method results:

1. «DS/developer» - this cluster includes multiple major skills needed for modern data scientist ('AWS', 'computer science experience'), but also skills needed for developers, such as 'software testing', 'agile development cycle' and others from many software and development field. Overall, this is a very general representation of coding jobs.

Table 4.3.1 Requirements, responsibilities, working conditions
«DS/developer»

['automation', 'Excellent communication, presentation, interpersonal and analytical skills.', 'Computer Science', 'experience in Bioinformatics', 'Good communication skills', 'Epic implementation experience', 'related work experience', 'Experience working in a dynamic fast-paced environment.', '8D Training', 'Experience delivering to enterprise customer standards', 'Experience with modern Software Development Life Cycle tools', 'working on user-experiences', 'JS Application deployment using Github', '4+ years of software development experience', 'Software Test', 'Planning/organizational skills', 'Automation', 'IoT technologies', 'possessing strogn organizational abilities', 'Defect Management', 'Excellent written and verbal communications skills', 'Experience with the mobile app infrastructure', 'Expert understanding of database technologies', 'years of experience', 'Ability to troubleshoot technical applications', 'Experience building user interfaces', 'Knowledge of the Agile Development

['Implements, supports and maintains Epic clinical and/or financial applications', 'documentation creation', 'Testing', 'Document and communicate clearly architecture and implementation solutions', 'perform technical administration', 'Site Reliability Engineering', 'Scaled Agile Development', 'responsive design', 'provide support for ad hoc projects', 'Provide ad hoc operational support', 'technical evaluation', 'Take product ideas from ideation to implementation', 'maintenance functions', 'virtualization', 'VPN technologies', 'Coaching and mentoring the testing community to support their professional development', 'Supporting Android', 'Developing an understanding of KPMG's broader offerings to enable identification of business opportunities', 'assess the design and operational

['Flexible Working', 'We are an equal opportunity employer.', 'Life Insurance', 'Competitive Salary', 'LOCATION', 'Flexible spending account', 'Wellness Programmes', 'Employer contributory pension plan', 'We are an equal opportunity employer and we value diversity at our company.', 'Working Locations:', '7% Company Pension', 'One location', 'will consider for employment qualified applicants with arrest and conviction record', 'Reasonable accommodations may be made to enable individuals with disabilities to perform the essential functions.', 'employee discounts.', 'Retirement plans', 'Employee Assistance Program', 'Work Authorization', 'Health Insurance', 'Flexibility in scheduling', '4/10 Schedule', 'OUR OPPORTUNITY', 'third party service providers', 'Studio community activities', 'Vision insurance', 'career

Methodology.', 'Strong communication skills', 'Excellent communication Skills', 'Software design experience', 'Engineering', 'Experience with forecasting', 'Experience of database design', 'XMLExpert understanding of web technologies', 'Time-management skills', 'VPN technologies', 'computer science', 'experience which provides the requisite knowledge, skills, and abilities', 'success in web development', 'experienced Vice President', 'Experience of EDC systems', 'Experience working with awarding bodies', 'relevant experience in data science', 'You will have excellent verbal and written communication skills.', 'Replication', 'Current Epic certification', 'experience working with AWS']

effectiveness', 'Automation', 'Web-based research to collate business information', 'Create and maintain documentation for network environments and user documentation for utilizing network services.', 'Collaborate with internal and external, technical and non-technical teams to build and support development platforms', 'Security Systems', 'Troubleshoot and support current platform in production', 'Continuously improve software engineering practices', 'Managing a quality service', 'Understand performance and scalability principles and apply when developing software', 'Defect Management', 'Problem Solving', 'micro-service architectures', 'fast paced environment', 'perform technical administration, technical implementation of infrastructure projects, low level design, maintenance functions and documentation creation', 'technical implementation of infrastructure projects', 'Designing and managing large-scale networks in a global environment', 'IP Networks', "effectively communicate and 'translate' quantitative findings", 'Software Test',

development programs, tuition reimbursement, or audit a course', 'affirmative action employer', 'Disability insurance', 'Dental insurance', 'We do not discriminate on the basis of race, religion, color, national origin, gender, sexual orientation, age, marital status, veteran status, or disability status.', 'Benefit Conditions:', 'Working from Home', 'Company Events', 'noise level in the work environment is usually loud']

'Automation Tester']

2. This cluster mostly involves skills, which professionals like Data Scientist and Development and Operations need, such as 'data modeling', 'supply chain management', 'cloud technologies' and 'communication skills' needed to deal with their clients, although, it also involves multiple skills and requirements needed for jobs such as Network Engineer and a general Help desk technician, so this cluster is too noisy to decipher.

Table 4.3.2 Requirements, responsibilities, working conditions

['Experience in data modeling', ' Knowledge of modern engineering best practice', 'Understands basic supply chain management', 'Experience building customer-facing websites', 'Knowledge of Cloud', 'Problem Solving skills', 'Strong analytical skills', 'micro-services', 'Customer Service: 2 years (Preferred)', 'JavaScript', 'virtualization', 'Driving (Required)', 'possessing strong interpersonal abilities', 'Public sector experience', 'Bi-Lingual (Preferred)', 'Automation Tester', 'certification in a technical financial accounting discipline', 'bash understanding of Google cloud technologies', 'Working knowledge of revision control systems', 'Network Authentication Systems', "Bachelor's (Preferred)", 'Strong Customer Service skills', 'MS/PhD preferred',

['firewalls', 'Supporting particularly iOS operating systems', 'Provides hands-on execution and implementation of data science models', 'Develop and build a network', 'regularly required to stand', 'Firewalls', 'JavaScript libraries', 'Collaborate with Product and Design to iterate on our product', 'Effectively communicate with third parties regarding technical issues', 'Install, configure, administer, and maintain', 'Lights out management, maintenance, and administration of HPE servers', 'support product commercialisation and reimbursement', 'Lead engineering discussions and mentor others on engineering best practices', 'Mobile Testing', 'Remain current on information security best practices.', 'perform complete install

['Pension ', 'Work remotely:', 'Weekends', '25 days' holiday;', 'reasonable accommodations', 'diverse workforce', 'Job Types: Contract', 'UK Visas and Immigration service', 'Full-time, Permanent*', 'Private medical insurance', 'Monday – Friday ', 'On-site Parking', 'sharing our employee engagement dashboard', 'Overtime']

'Making Effective Decisions', 'Testing', 'any equivalent combination of education', 'High Availability', 'Perforce', 'Experienced with packet capture analysis and troubleshooting', 'Ansible', 'Engineering and L4 troubleshooting', 'test automation frameworks', 'UIAutomation', 'InVision', 'Communicating and influencing', 'Firewalls', 'good server knowledge', 'passionate about working on cutting edge technology', 'experience in revenue cycle processes', 'GCSE or equivalent (Required)', 'constraint programming', 'Salesforce certifications', 'Excellent problem-solving skills', 'Experience with time series analysis', 'Strong analytical and problem solving skills.Administration: 1 year (Preferred)', 'experience in supporting Trusts with restructuring of ICT', 'modern software engineering practices', 'specialized training', 'High school or equivalent (Preferred)', 'Advanced knowledge of network layer security including', 'Machine Learning', 'IT support: 5 years (Preferred)', 'Security Policy generation', 'Bachelors Degree', 'Problem-Solving skills', 'Previous experience with using different software, applications and websites.', 'attainment of Epic and programming', 'automation with Ansible/bash', 'Keep it running – Help troubleshoot application operational issues', 'Engage with customers in a friendly and professional manner', 'work successfully with multi-functional teams across organizational boundaries', 'Performing software and hardware upgrades', 'Management of workflow including artwork approvals, production planning and logistics', 'Active Directory', 'Troubleshoot and resolve infrastructure inefficiencies and other problems', 'effective root cause analysis', 'Communication with internal and external customers to ensure compliance with IT Helpdesk requirements and update on progress of existing web support projects', 'Supporting Windows Mobile', 'Oversees resolution of complex projects and programs.', 'Support users by trouble shooting hardware and software issues', 'Palo Alto Networks hardware', 'Work with product owners to understand desired application capabilities and testing scenarios', 'ensuring

certification', "Bachelor's (Required)", 'Active Directory', 'High calibre professional'] | the operation and ability to release products', 'Develop deep understanding of business drivers and financial levers to provide strategic decision support.', 'throughput', 'Creates shared process models, business objects, activity diagrams and process documentation to effectively articulate multiple views of the business solutions that support technical architecture.', 'Provide reporting to measure activity']

3. This cluster combines too many skills and requirements to give it any meaning

Table 4.3.3 Requirements, responsibilities, working conditions

['Strong background in statistics', 'PostgreSQL', 'scalable platforms', 'Mobile Testing', 'containerisation', 'decision trees', 'Python', 'Experience building prototypes from wireframes and designs', 'Terraform', 'fast paced, high throughput team environment', 'online learning', 'automated regression', 'statistics', 'database shrink operations', 'Experience maintaining, optimizing, and performing

['Develop backend services that expand the capabilities of our analytics product', 'multi-factor authentication', 'Define the blueprints and evolutionary road maps for WPP data centres, infrastructure, distributed cloud, networks, applications, data and digital workplace technologies', 'resiliency', 'Assesses business implications associated with modeling assumptions, inputs,

['subsidised gym membership', 'Maternity and Paternity leave', 'outer fringe allowance', 'Frequent visits to our facilities', 'arrest and conviction records', 'Parental Leave']

in-place upgrades', 'automation with Ansible/bash', 'At least 5-15+ years of industry experience', 'Postgress', 'data pipeline', 'Delivering at pace', 'Understands logistics fulfillment business operations', 'Knowledge of machine learning algorithms', 'Automated Testing', 'Highly experienced in UI tools', 'Proven ability to maintain focus and commitment.', 'supervised learning', 'Physics', 'Jenkins', 'knowledge of revision control systems', 'Data Scientist', 'familiarity with pandas', 'Kubernetes', 'linear regression', 'deep learning', 'Android', 'Discrete optimisation', 'work independently under pressure of deadlines']

methodologies, technical implementation, analytic procedures and processes, and advanced data analysis.', 'Designing and evaluating experiments monitoring key product metrics', 'Refine our approach to infrastructure-as-code, evolving our architecture to meet future needs', 'Performs collaborative work on data science problems and mentor junior data scientists.', 'Collect and report customer feedback', 'expanded our product portfolio', 'Optimize the performance of our data ingestion and processing pipelines', 'be responsible for configuring / optimising the network', 'understanding root causes of changes in metrics', 'low level design', 'Supporting test engineers and software developers to identify test scenarios', 'Participate in design and code reviews', 'ad hoc financial analyses', 'Pixel perfect front-end development', 'review qualitative and quantitative data and build businesses cases', 'Android', 'Recommend and implement security tools, policies and procedures.']

4. «Networking engineer» - Juniper Mist is one of the companies making hardware and services to companies networking

Table 4.3.4 Requirements, responsibilities, working conditions

<div align="center">«Networking engineer»</div>

['Routing']	['Juniper Mist', 'Routing']	['401(k) matching']

5. «Database engineer» or «Network administrator» - both of which require professionals to constantly be able to support their clients in case of disasters of any kind.

<div align="center">Table 4.3.5 Requirements, responsibilities, working conditions</div>
<div align="center">«Database engineer»/«Network administrator»</div>

['Support Disaster Recovery', 'Disaster Recovery']	['Support Disaster Recovery', 'High Availability and Disaster Recovery']	['May require unscheduled after-hours work', 'Tuition Reimbursement']

6. «Web and mobile tester»

<div align="center">Table 4.3.6 Requirements, responsibilities, working conditions</div>
<div align="center">«Web and mobile tester»</div>

['Browser Stack', 'bootstrapping', 'mercurial']	['Browser Stack']	['Cycle 2 Work Scheme']

7. Very general skills in requirements and what look like «Data Quality Manager», but overall, not very informative.

<div align="center">Table 4.3.7 Requirements, responsibilities, working conditions</div>

['Reliable, with high work standards and the willingness to meet and exceed expectations.', 'Flexible and adaptable to different LQA tasks and projects.', 'High proficiency with Microsoft Office.']	['Consistency of terminology and imagery.']	['massage therapy', 'Summer and Christmas parties', 'Christmas Party']

8. This one describes general «work conditions» concerning workers ability to deliver, which is quite common in our vacancies.

<div align="center">Table 4.3.8 Requirements, responsibilities, working conditions</div>

['Ability to communicate clearly and concisely.', 'Ability to perform under pressure', 'multi-tasking skills']	['account & item set up and management, order processin', 'produce clear, concise and accurate documentation and job notes']	['Casual dress', 'Casual Dress', 'Salary: per year']

9. «Data base administrator» - describes core requirements most fitted for the job, when databases fail.

Table 4.3.9 Requirements, responsibilities, working conditions
«Data base administrator»

['Bitbucket', 'Strong attention to detail']	['Identifying, mitigating and resolving root causes']	['able to hire remotely', 'fixed term contract']

10. Describes something between «Database administrator» and «Mobile developer», as multiple apps nowadays need consistent development with databases.

Table 4.3.10 Requirements, responsibilities, working conditions
«Database administrator» /«Mobile developer»,

['Java', 'NoSQL']	['Agile', 'Java']	['in-year bonus scheme', 'temporarily due to COVID-19', 'Bonus Pay']

11. «Data scientist»

Table 4.3.11 Requirements, responsibilities, working conditions
«Data scientist»

['Tensorflow Training models on AWS', 'implement customised algorithms', 'Strong background in linear algebra', 'tensorflow']	['Working towards fixed weekly/monthly targets']	["core values is 'Authentic'", "The data teams each meet weekly for a 30m 'Fika' break (borrowed from Swedish culture) where work talk is forbidden", 'buzzword bingo']

12. «Data scientist»

Table 4.3.12 Requirements, responsibilities, working conditions
«Data scientist»

['understanding root causes of changes in metrics', 'Designing and evaluating experiments monitoring key product metrics', 'time series forecasting']	['systematic root cause analysis']	['We strongly encourage people of colour, lesbian, gay, bisexual, transgender, queer and non-binary people, veterans, parents, and individuals with disabilities to apply.']

13. «Web applications tester»

['Selenium', 'ActionScript']	['Selenium']	['we do not accept unsolicited resumes', 'New renovated branded office', 'coffee', 'Childcare vouchers']

14. «Network engineer»

['logistic regression', 'Successful candidates must pass a disclosure and barring security check.', 'Disclosure and Barring Service Check', 'Learning and development tailored to your role']	['Ensure the security of the trading and corporate networks.', 'Identify and resolve network failures on both switches and servers and network performance within both the trading environment and corporate network.']	['Open to UK, Commonwealth and European Economic Area (EEA) and certain non EEA nationals', 'Childcare Voucher']

15. This one is probably a «Data scientist in biology», as some of our scrapped vacancies had a very distinct major in bioinformatics

['Diligently maintains a molecular biology laboratory environment', 'numbers testing for calculations']	['conducting user research and running workshops', 'supervising research and PhD students']	['pool table']

16. «Web developer»

['attention to pixel perfect detail', 'Marvel', 'PyTorch', 'Photoshop']	['rigging and enveloping hero to background creature', 'reate sitemaps, customer journey maps, wire frames, and	['State/Region: London']

prototypes']		

17. «Web-developer» - this cluster focuses on skills and requirements need to make a good site for the client.

Table 4.3.17 Requirements, responsibilities, working conditions
«Web-developer»

['After Effects', 'unsupervised learning', 'valid practising certificate']	['understand our users motivations, pain points and behaviors', 'Develops and maintains up-to-date detailed project schedules and work plans.']	['Friendly, creative and relaxed working atmosphere, with sensibly managed projects and recognition of the importance of work-life balance']

18. «Mobile app developer»

Table 4.3.18 Requirements, responsibilities, working conditions
«Mobile app developer»

['Understanding of mobile F2P business practices, monetisation strategies and KPIs', 'completed education in a technical financial accounting discipline', 'Strong understanding of qPCR and amplification curve data']	['New Product and Supplier Sourcing']	['Salary up to ']

19. This one describes an interesting case, where Glassdoor [1] yielded «Security» job instead of IT-security

Table 4.3.19 Requirements, responsibilities, working conditions
«Security»

['High school diploma or equivalent.']	['lecturing undergraduate and postgraduate courses', 'Investigate and report maintenance and safety conditions which might endanger personnel, including fires, evacuations, hazardous situations, or other facility related events', 'provide back up to client personnel as needed']	['Job Type: Part-time']

20. Just a specific company cluster, made up because of parsing mistake

Table 4.3.20 Requirements, responsibilities, working conditions

['candidates must pass a disclosure and barring security check', 'Berkshire']	['Berkshire']	['civil union']

21. «Network engineer»

Table 4.3.21 Requirements, responsibilities, working conditions
«Network engineer»

['Network devices utilize Low Latency applications']	['small and medium sized businesses with varied IT requirements']	['Cash-back on treatment costs']

22. «Data scientist» with supply chain knowledge.

Table 4.3.22 Requirements, responsibilities, working conditions
«Data scientist»

['Statistical Quality Control processes']	['developing algorithms to optimise supply chains']	['Free breakfast every day']

23. Too little information given to assign any job title.

Table 4.3.23 Requirements, responsibilities, working conditions

['Windows']	['Windows']	['* 8 hour shift']

24. «Data scientist»

Table 4.3.24 Requirements, responsibilities, working conditions
«Data scientist»

['Negotiation skills']	['Predictive analytics – design, implement our analytics platform for our customers to discover potential new consumers']	['season ticket loan']

25. «Database administrator»

Table 4.3.25 Requirements, responsibilities, working conditions
«Database administrator»

['Strong knowledge of	['Coordinating hardware	['Pay: per hour']

backups', 'ISTQB Certified Agile Tester qualification']	maintenance and repairs with vendors']	

26. «Devops»

Table 4.3.26 Requirements, responsibilities, working conditions
«Devops»

['DevOps']	['DevSec Ops']	['Hours/Shift: Full Time']

Now, let's have a look at clusters calculated with «Overlap» method:

1. «Data Scientist»/«Data Quality Manager»/«Network engineer»/«Web developer» - this cluster represents mostly jobs, which need to work with networks and cloud technologies.

Table 4.3.27 Requirements, responsibilities, working conditions
«Data Scientist»/«Data Quality Manager»/«Network engineer»/«Web developer»

['documentation creation', 'Provide ad hoc operational support', 'virtualization', 'fast paced environment', 'perform technical administration, technical implementation of infrastructure projects, low level design, maintenance functions and documentation creation', 'technical implementation of infrastructure projects', 'VPN technologies', 'Document and communicate clearly architecture and implementation solutions', 'support product commercialisation and reimbursement', 'Site Reliability Engineering', 'Scaled Agile Development']

['Atlassian products', 'Experience in data modeling', 'Strong background in statistics', 'Understands basic supply chain management', 'At least 5-15+ years of industry experience', 'Knowledge of Cloud', 'Understanding of mobile F2P business practices, monetisation strategies and KPIs', 'Experience with modern Software Development Life Cycle tools', 'JS Application deployment using Github', 'Understands logistics fulfillment business operations', 'unsupervised learning', 'Mobile Testing', 'supervised learning', 'containerisation', 'logistic

['Working from Home', 'Working Locations:', 'third party service providers', 'One location', 'Studio community activities', 'noise level in the work environment is usually loud', 'reasonable accommodations', 'LOCATION', 'Disability insurance']

regression', 'numbers testing for calculations', 'database shrink operations', 'Python', 'fast paced, high throughput team environment', 'online learning', 'genetic algorithms', 'Familiarity with ML training concepts', 'Knowledge of Biological or the Life Sciences.', 'github/gitlab integration', 'root causesexperience in Statistical Genomics', 'experience working with Public Sector clients or law enforcement', 'Bitbucket', 'valid practising certificate']

2. «Database engineer»/«Data quality manager» - this cluster concentrates jobs, which require networks knowledge, as well as data management and database development.

Table 4.3.28 Requirements, responsibilities, working conditions
«Database engineer»/«Data quality manager»

['documentation creation', 'Provide ad hoc operational support', 'technical evaluation', 'Software Test', 'fast paced environment', 'technical implementation of infrastructure projects', 'VPN technologies', 'support product commercialisation and reimbursement', 'Scaled Agile Development', 'Managing a quality service', 'Defect Management']

['JQuery', 'knowledge of revision control systems', 'Active Directory', 'Experience delivering to enterprise customer standards', '8D Training', 'Experience with modern Software Development Life Cycle tools', 'Strong knowledge of backups', 'Defect Management', 'Windows Server 2012 – 2019', 'Python', 'Public sector experience', 'years of experience', 'Automation Tester', 'Experience building user interfaces', 'work independently under pressure

['Benefit Conditions:', 'Working from Home', 'Flexible Working', 'Flexibility in scheduling', '4/10 Schedule', 'Working Locations:', 'OUR OPPORTUNITY', 'One location', 'We are an equal opportunity employer.', 'third party service providers', 'Studio community activities', 'Retirement plans', 'LOCATION']

of deadlines', 'Excellent communication Skills', 'online learning', 'Software design experience', 'certification in a technical financial accounting discipline', 'Knowledge of Biological or the Life Sciences.', 'statistics', 'database shrink operations', 'Negotiation skills', 'Working knowledge of revision control systems', 'At least 5-15+ years of industry experience', 'decision trees', 'extensive experience in leading and delivering large scale, complex IT', 'Berkshire', 'ActionScript', 'Highly experienced in UI tools', 'supervised learning', 'Proven ability to maintain focus and commitment.', 'PostgreSQL', 'Strong analytical and problem solving skills.Administration: 1 year (Preferred)', 'time series forecasting', "Bachelor's Degree", 'Postgress', 'Statistical Quality Control processes']

3. Not a very informative cluster, because it looks like some kind of mix between DS and web-dev

Table 4.3.29 Requirements, responsibilities, working conditions

['documentation creation', 'fast paced environment', 'VPN technologies', 'Site Reliability Engineering', 'Software Test', 'Scaled Agile Development']	['Java', 'Data science models', "Bachelor"s Degree in Econometrics, Economics, Engineering, Mathematics, Applied Sciences, Statistics or job-related discipline or equivalent experience"]	['Flexible Working', '4/10 Schedule', 'OUR OPPORTUNITY', 'Working Locations:', 'One location', 'We are an equal opportunity employer.', 'Studio community activities', 'LOCATION', 'Disability insurance']

4. «Web administrator»/«Network engineer» - this one specifically points out requirements and working conditions meant for people who help businesses and other clients to maintain and develop their network ecosystems.

Table 4.3.30 Requirements, responsibilities, working conditions
«Web administrator»/«Network engineer»

['documentation creation', 'Remain current on information security best practices.', 'fast paced environment', 'Coaching and mentoring the testing community to support their professional development', 'VPN technologies', 'Security Systems', 'Developing an understanding of KPMG's broader offerings to enable identification of business opportunities', 'Defect Management', 'Create and maintain documentation for network environments and user documentation for utilizing network services.', 'Managing a quality service', 'Scaled Agile Development']

['Learning and development tailored to your role', 'Disclosure and Barring Service Check', 'Successful candidates must pass a disclosure and barring security check.']

['Pension ', 'Flexible Working', 'We are an equal opportunity employer.', 'Life Insurance', 'Competitive Salary', 'Childcare vouchers', 'LOCATION', 'Flexible spending account', 'Wellness Programmes', 'Employer contributory pension plan', 'Maternity and Paternity leave', 'We are an equal opportunity employer and we value diversity at our company.', 'Working Locations:', '7% Company Pension', 'One location', 'will consider for employment qualified applicants with arrest and conviction record', 'Reasonable accommodations may be made to enable individuals with disabilities to perform the essential functions.', 'employee discounts.', 'Retirement plans', 'Employee Assistance Program', 'Work Authorization', 'Health Insurance', 'Flexibility in scheduling', 'OUR OPPORTUNITY', 'Open to UK, Commonwealth and European Economic Area (EEA) and certain non EEA nationals', 'third party service providers', 'Studio community activities', 'Vision insurance', 'career development

programs, tuition reimbursement, or audit a course', 'affirmative action employer', 'Disability insurance', 'sharing our employee engagement dashboard', 'Dental insurance', 'Benefit Conditions:', 'Working from Home', 'Cycle 2 Work Scheme', 'Childcare Voucher', 'noise level in the work environment is usually loud', 'reasonable accommodations']

5. «Network engineer»

Table 4.3.31 Requirements, responsibilities, working conditions «Network engineer»

['documentation creation', 'Palo Alto Networks hardware', 'Document and communicate clearly architecture and implementation solutions', 'perform technical administration', 'firewalls', 'Collaborate with customers and partner with technical teams to make changes to network connectivity.', 'Site Reliability Engineering', 'Provide ad hoc operational support', 'technical evaluation', 'virtualization', 'Take product ideas from ideation to implementation', 'VPN technologies', 'Coaching and mentoring the testing community to support their professional development', 'Firewalls', 'Developing an understanding of KPMG's

['Palo Alto Networks NGFW', 'Palo Alto Networks (PAN) NGFWs', 'Palo Alto Firewalls', 'Palo Alto Networks']

['Flexible Working', 'We are an equal opportunity employer.', 'Competitive Salary', 'LOCATION', 'We are an equal opportunity employer and we value diversity at our company.', 'Working Locations:', 'will consider for employment qualified applicants with arrest and conviction record', 'Reasonable accommodations may be made to enable individuals with disabilities to perform the essential functions.', 'Retirement plans', 'Employee Assistance Program', 'Work Authorization', 'OUR OPPORTUNITY', 'Studio community activities', 'Vision insurance', 'affirmative action employer', 'Disability insurance', 'We do not discriminate on the basis of

broader offerings to enable identification of business opportunities', 'Create and maintain documentation for network environments and user documentation for utilizing network services.', 'Remain current on information security best practices.', 'Security Systems', 'Palo Alto', 'Defect Management', 'Problem Solving', 'micro-service architectures', 'fast paced environment', 'perform technical administration, technical implementation of infrastructure projects, low level design, maintenance functions and documentation creation', 'technical implementation of infrastructure projects', 'IP Networks', 'Refine our approach to infrastructure-as-code, evolving our architecture to meet future needs', 'Communication with internal and external customers to ensure compliance with IT Helpdesk requirements and update on progress of existing web support projects']

race, religion, color, national origin, gender, sexual orientation, age, marital status, veteran status, or disability status.', 'Benefit Conditions:', 'Working from Home', 'noise level in the work environment is usually loud', 'reasonable accommodations']

6. «Web developer»/«DevOps»

Table 4.3.32 Requirements, responsibilities, working conditions «Web developer»/«DevOps»

['documentation creation', 'Provide ad hoc operational support', 'technical evaluation', 'fast paced environment', 'VPN technologies', 'technical

['specialized training', 'automation', 'Advanced knowledge of network layer security including', 'Machine Learning', 'Epic implementation experience',

['Pension ', 'Flexible Working', 'We are an equal opportunity employer.', 'Life Insurance', 'Competitive Salary', 'LOCATION', 'Wellness

implementation of infrastructure projects', 'support product commercialisation and reimbursement', 'Scaled Agile Development', 'Defect Management']

'Experience working in a dynamic fast-paced environment.', 'Automation', 'working on user-experiences', 'automated regression', '4+ years of software development experience', 'Previous experience with using different software, applications and websites.', 'attainment of Epic certification', "Bachelor's (Required)", 'possessing strogn organizational abilities', 'IoT technologies', 'High calibre professional', 'Excellent written and verbal communications skills', 'Experience with the mobile app infrastructure', 'Experience building customer-facing websites', 'Expert understanding of database technologies', 'Ability to troubleshoot technical applications', 'Knowledge of the Agile Development Methodology.', 'Problem Solving skills', 'Strong communication skills', 'micro-services', 'Engineering', 'Experience with forecasting', 'JavaScript', 'possessing strong interpersonal abilities', 'bashunderstanding of Google cloud technologies', 'Experience of database design', 'Bi-Lingual (Preferred)', 'familiarity with pandas', 'XMLExpert understanding of web

Programmes', 'Employer contributory pension plan', 'Full-time, Permanent*', 'We are an equal opportunity employer and we value diversity at our company.', 'Working Locations:', '7% Company Pension', 'One location', 'will consider for employment qualified applicants with arrest and conviction record', 'employee discounts.', 'Retirement plans', 'Work remotely:', 'Employee Assistance Program', 'Health Insurance', 'Flexibility in scheduling', '4/10 Schedule', 'OUR OPPORTUNITY', 'third party service providers', 'Studio community activities', 'Vision insurance', 'Salary: per year', 'career development programs, tuition reimbursement, or audit a course', 'Private medical insurance', 'Monday – Friday ', 'affirmative action employer', 'On-site Parking', 'Disability insurance', 'Dental insurance', 'Casual dress', 'Benefit Conditions:', 'Working from Home', '25 days' holiday;', 'Company Events', 'Casual Dress', 'reasonable accommodations']

technologies', 'Testing', 'Network Authentication Systems', "Bachelor's (Preferred)", 'PostgreSQL', 'MS/PhD preferred', 'IP Networks', 'Communicating and influencing', 'experienced Vice President', 'good server knowledge', 'Experience working with awarding bodies', 'Firewalls', 'Current Epic certification']

7. A general representation of «Tester» as this job can vary, dealing with web applications, mobile apps and machine models.

Table 4.3.33 Requirements, responsibilities, working conditions
«Tester»

['documentation creation', 'Provide ad hoc operational support', 'Testing', 'multi-factor authentication', 'technical evaluation', 'provide support for ad hoc projects', 'fast paced environment', 'technical implementation of infrastructure projects', 'VPN technologies', 'support product commercialisation and reimbursement', 'Defect Management', 'Managing a quality service', 'Scaled Agile Development']	['Excellent communication, presentation, interpersonal and analytical skills.', 'constraint programming', 'Excellent problem-solving skills', 'Good communication skills', 'related work experience', 'automated regression', 'Planning/organizational skills', 'Software Test', 'experience which provides the requisite knowledge, skills, and abilities', 'success in web development', 'Experience of EDC systems', 'Experienced with packet capture analysis and troubleshooting', 'Engineering and L4 troubleshooting', 'InVision', 'experience working with AWS']	['Benefit Conditions:', 'Working from Home', 'Flexible Working', 'Flexibility in scheduling', '4/10 Schedule', 'OUR OPPORTUNITY', 'Working Locations:', 'third party service providers', 'We are an equal opportunity employer.', 'Studio community activities', 'Vision insurance', 'One location', 'will consider for employment qualified applicants with arrest and conviction record', 'Company Events', 'reasonable accommodations', 'Retirement plans', 'LOCATION', 'Disability insurance', 'Work Authorization', 'Full-time, Permanent*']

5 CONCLUSION

In the end, we can say that both of the methods explored have their own strong points: Tribox cluster on updated matrix shows great level of separation between its' clusters, although it lacks generativity and sub divides many classes; «Overlap», on the other hand, shows great generativity, as we can guess that such jobs as Data Scientist and Data Quality manager should be quite close to each other in their respective requirements and responsibilities, Web developer ,Software engineer, Computer programmer and Web administrator with Database administrator. Such results can be viewed as a compilation of a few problems: 1) Our data is noisy, and our lists retrieval methods aren't effective enough;
2) Our methods might be noisy because of their lack of sentence meaning understanding, because they look at natural language as pure strings. This raises two main points for future improvement: 1) a better algorithm for requirements/responsibilities/working environment lists retrieval, as current method does help us retrieve some of them, but, as we could see in «Overlap» method, they are not specific enough and resulting clusters looks fuzzy; 2) we might try new algorithms for three-way clusterization, as we might find be better a way, which would be flexible enough to decide where to allow intersections between clusters and where it will hurt our results, but most importantly implement some kind of way to decipher the meaning of our lists of phrases.

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APPENDIX 1: CODE SCRAPPING AND RELEVANCY MATRICES

Code for data scrapping, relevancy calculations can be viewed in Github repository [18] by URL: https://github.com/THNTS/three-way_clustering

All relevant files are marked as _appendix_1

Here are represented the requirements, responsibilities and working conditions lists parsed from the job vacancies texts.

Requirements list:

R
Red Hat Enterprise Linux
Ability to communicate clearly and concisely.
Experience in data modeling
Strong background in statistics
Understands basic supply chain management
ARIMA
ability to interrogate data logicallyability to assess data quality
Good knowledge of video games across multiple platforms.
Knowledge of Cloud
Flex
STLC
SQL
Experience delivering to enterprise customer standards
8D Training
experience working as a high-speed analog & mixed signal IC CAD
Java
Experience with modern Software Development Life Cycle tools
JS Application deployment using Github
Tensorflow Training models on AWS
Databricks Notebooks
Adobe creative suite knowldge
understanding root causes of changes in metrics
Possess BLS (Heartsaver) Certificate American Heart Association
Mobile Testing
PROs
containerisation
logistic regression
tensorflow
DBFS
DNS
Defect Management
Capable of processing and deriving novel insights from large chemical data resources
Xcode
Python
hierarchical models

Diligently maintains a molecular biology laboratory environment
Bazel
Successful candidates must pass a disclosure and barring security check.
fast paced, high throughput team environment
Cardinal Curriculum 1 & 2 Certified
Public sector experience
working on bringing them to scale
years of experience
Automation Tester
Experience building user interfaces
GARCH
proliferation
Excellent communication Skills
attention to pixel perfect detail
online learning
High School diploma required
Juniper
Software design experience
certification in a technical financial accounting discipline
Pulse Secure
statistics
database shrink operations
JIRA
React Native
Working knowledge of revision control systems
Math
Real World Data analytics
Cox proportional hazard analysis
OpenShift
mixed signal
At least 5-15+ years of industry experience
After Effects
VPN Tunnels
Making Effective Decisions
WLAN
Flexible and adaptable to different LQA tasks and projects.
Roku TVs
DBConnect
Understanding of mobile F2P business practices, monetisation strategies and KPIs
Perforce
opposed to using standard, off the shelf methods
Delivering at pace
data pipeline
Sklearn

K-means
eye for simple, intuitive design
Understands logistics fulfillment business operations
ability to write clean, maintainable and shippable production code
unsupervised learning
TCP/IP
Computer literacy – particularly with Excel.
Highly experienced in UI tools
supervised learning
Proven ability to maintain focus and commitment.
passionate about working on cutting edge technology
candidates must pass a disclosure and barring security check
Native level fluency in English
High school diploma or equivalent.
experience in revenue cycle processes
Network devicesutilize Low Latency applications
svn
AJAX
computer science
GCSE or equivalent (Required)
Strong analytical and problem solving skills.Administration: 1 year (Preferred)
Salesforce certifications
SciPy
Experience in high-content imaging data analysis Columbus
Agile
cytokine
possess a valid driver's license
XHTML
Pandas
experience in supporting Trusts with restructuring of ICT
relevant experience in data science
React
modern software engineering practices
Self motivated and self aware
Replication
Robust Internet research skills.
Familiarity with ML training concepts
Strength to lift objects weighing
github/gitlab integration
test flight
experience working with Public Sector clients or law enforcement
Bitbucket
Knowledge of tax, the different types of tax and their relative strengths and
weaknesses

Extremely organised and detail conscious, highly communicative and process oriented.

PubChem

Statistical Quality Control processes

Jenkins

IT support: 5 years (Preferred)

Security Policy generation

JQuery

Atlassian products

experience in Bioinformatics

Bachelors Degree

Computer Science

Problem-Solving skills

Arista

completed education in a technical financial accounting discipline

knowledge of revision control systems

Epic implementation experience

Active Directory

GEE

SureChEMBL

HTML

Windows

neural nets

802.1.x

working on user-experiences

Knowledge of modern engineering best practice

4+ years of software development experience

Experienced gamer, able to adapt to any game genre with ease

SCRUM

Work to tight deadlines

Team Player.

IoT technologies

multi-tasking skills

DBA

NoSQL

A proven track record in a top tier consultancy

Kubernetes

Browser Stack

Excellent written and verbal communications skills

Windows Server 2012 – 2019

Strong analytical skills

deep learning

Customer Service: 2 years (Preferred)

Android

cytotoxicity
Routing
Discrete optimisation
virtualization
mercurial
work independently under pressure of deadlines
Driving (Required)
RDS
spark
Configure firewall policiesCisco ASA
Strong communication skills
finding the most important issues
genetic algorithms
Disclosure and Barring Service Check
Lean
Knowledge of Biological or the Life Sciences.
root causesexperience in Statistical Genomics
Bachelor"s Degree in Econometrics, Economics, Engineering, Mathematics, Applied
Sciences, Statistics or job-related discipline or equivalent experience
scalable platforms
Negotiation skills
Palo Alto Networks
scikit-learn
Jira Jenkins
knowledge of at least one web or mobile platform
SOAP
random Forrest
DevOps mindset can work with code reviews
BDD
Active Learning bagging
GPT2
decision trees
extensive experience in leading and delivering large scale, complex IT
bashunderstanding of Google cloud technologies
Experience of database design
ActionScript
Android TV
Marvel
Ability to setup data pipelines to handle data
Experience building prototypes from wireframes and designs
Palo Alto Networks (PAN) NGFWs
Strong Customer Service skills
Reliable, with high work standards and the willingness to meet and exceed
expectations.

Angular

Testing

Excellent understanding of computer science fundamentals, data structures and algorithms

any equivalent combination of education

Strong background in linear algebra

Masters

High Availability

Time-management skills

B.S.

Palo Alto Firewalls

Ansible

Strong proficiency in C and C++, and object oriented design.

TDD

Be passionate about resolving user pain points through great design

CellProfiler

test automation frameworks

VPN technologies

submit a relatively simple program to demonstrate your skills

UIAutomation

Juniper Mist

Communicating and influencing

Experience maintaining, optimizing, and performing in-place upgrades

experienced Vice President

good server knowledge

Strong attention to detail

time series forecasting

automation with Ansible/bash

Advanced Python skills

Self-motivated.

Experience working with awarding bodies

You will have excellent verbal and written communication skills.

T cell functional assays

Bachelor's Degree

DBCC commands

Buildkite

Aruba

Experience with time series analysis

Illustrator

VLANs

A10

Redshift

Current Epic certification

ImageJ

Postgress
valid practising certificate
Git
DHCP
Web
specialized training
Fire TV
scala
automation
Knowledge of machine learning algorithms
High school or equivalent (Preferred)
HTML5
SDK
Advanced knowledge of network layer security including
Machine Learning
Automated Testing
bootstrapping
Experience working in a dynamic fast-paced environment.
Frequently sit, grasp lightly, use fine manipulation and perform desk-based computer tasks, lift, carry, push and pull objects weighing up to ten pounds
Docker
Cisco switching and routing product line
Bracknell
Automation
PyTorch
Strong understanding of qPCR and amplification curve data
Experience in high speed serial
Data science models
Fivetran ETL
Previous experience with using different software, applications and websites.
attainment of Epic certification
Bachelor's (Required)
possessing strogn organizational abilities
Strong knowledge of backups
High calibre professional
Designing and evaluating experiments monitoring key product metrics
Ruckus
Bachelors degree in Computer Science plus 8+ years of experience or MS in Computer Science plus 6+ years of hands-on experience in building large-scale distributed systems.
Appium
Experience with the mobile app infrastructure
Database mirroring
Lightroom

iOS or Android device

ADB

Fortigate

Experience building customer-facing websites

Ability to run flesh-surface, hair, rigid sim, crowd, cloth simulations

Expert understanding of database technologies

Have practical knowledge of the latest transformer language modelsBert

Chromecast

Ability to troubleshoot technical applications

Knowledge of the Agile Development Methodology.

Problem Solving skills

technical tools used for virtual events

probabilistic models

Physics

experience of handling multiple tickets and calls

micro-services

TeamCity

Matplotlib

Engineering

Experience with forecasting

High proficiency with Microsoft Office.

sense of urgency

JavaScript

Disaster Recovery

Lean Six Sigma Green belt

have a history of delivering customer friendly, pixel perfect and brand consistent experiences

NLP

Scipy

Very strong attention to detail

Artifactory

Figma

recovery models

possessing strong interpersonal abilities

DevOps

CSS

Berkshire

Fortinet

Bi-Lingual (Preferred)

Know the basics of cryptocurrencies

Only full-time employees eligible

Data Scientist

restores

familiarity with pandas

linear regression
XMLExpert understanding of web technologies
Snowflake database modeling
chemokine
Ability to perform under pressure
Roberta
Rest API's
eMobile
clustering algorithms
Support Disaster Recovery
EHR
Six Sigma
Network Authentication Systems
ChEMBL
Bachelor's (Preferred)
PostgreSQL
Big Data
College
MS/PhD preferred
Premier Pro
IP Networks
experience which provides the requisite knowledge, skills, and abilities
branch & bound
success in web development
Master's (Preferred)
Palo Alto Networks NGFW
Ability to work with others, share ideas and participate in decision making.
understanding what patterns lie beneath the structure of the blockchain.
Experience of EDC systems
degree in Accounting/Finance
Experienced with packet capture analysis and troubleshooting
ISTQB Certified Agile Tester qualification
Experience in parallel mixed signal PHY/IO designs
Selenium
Engineering and L4 troubleshooting
DynamoDB
include a cover letter
Keras
InVision
Firewalls
implement customised algorithms
LSTM
IaaS
Palo Alto Firewall Design

Linux
NLP Open Source Libraries
CI/CD
Slack
experience working with AWS
On call work and weekend work may be required.
possessing strong oral abilities
Terraform
Photoshop
Excellent communication, presentation, interpersonal and analytical skills.
constraint programming
Flash
Excellent problem-solving skills
Learning and development tailored to your role
Good communication skills
Numpy
minimize and contain amplicon contamination
related work experience
Apple TV
Comfortable discussing web & digital product processes & terminologies to inexperienced end users
Knowledge In Supply Chain, Trade Marketing, or Merchandising
ML
automated regression
enjoy working with users to identify their pain points
Must have dexterity of hands and fingers
Planning/organizational skills
Software Test
iOS
Redis
QA
Cypress.io
numbers testing for calculations

Responsibilities list:

Implements, supports and maintains Epic clinical and/or financial applications
Adhering to change control policies and procedures
first point of contact for web issues, the ECA will manage the web issues email addresses on Salesforce and ticketing systems, to ensure projects are triaged, initiated and managed to successful completion in line with existing Service Level Agreements
multi-factor authentication
Define the blueprints and evolutionary road maps for WPP data centres, infrastructure, distributed cloud, networks, applications, data and digital workplace technologies

Consistency of terminology and imagery.

account & item set up and management, order processin

Design, implement our proprietary cutting edge Hadoop/Spark based systems

building systems to collect and use explicit and implicit signals from customer behavior

Work to improve the features and ease of use of these cross-cutting tools

Act as a liaison for sales support

Grow new leads by converting website traffic through calls-to-action, landing pages and lead generation content

perform technical administration

Provides hands-on execution and implementation of data science models

Assesses business implications associated with modeling assumptions, inputs, methodologies, technical implementation, analytic procedures and processes, and advanced data analysis.

Read and analyse packet captures using Wireshark

walk; use hands to finger, handle, or feel; reach with hands and arms; stoop, kneel, crouch, or crawl

Agile

Customer Service – Responds promptly to Sales' needs; Solicits feedback to improve service; Responds to requests for service and assistance; Meets commitments.

Develop and build a network

Performing data backup and restore requests

Collaborate with customers and partner with technical teams to make changes to network connectivity.

STLC

Site Reliability Engineering

Manage sales tool activation and licenses

Scaled Agile Development

RADIUS

Performs collaborative work on data science problems and mentor junior data scientists.

IOS

responsive design

Collect and report customer feedback

Java

provide support for ad hoc projects

Provide ad hoc operational support

rigging and enveloping hero to background creature

Effectively communicate with third parties regarding technical issues

technical evaluation

Generate data to assist reporting requirements including collating of data from different sources including; IFS, Business Objects, Google Analytics and data sourced from agency partners, to deliver reports against key KPI's for the web shop, including traffic and revenues

Take product ideas from ideation to implementation

Support the ongoing delivery of an up to date website user manual as a key training guide which helps deliver a high level working knowledge of website functionality across the business

Supporting Android

VPN technologies

Fortinet Firewalls

be responsible for configuring / optimising the network

Berkshire

raise the bar for design

Developing an understanding of KPMG's broader offerings to enable identification of business opportunities

understanding root causes of changes in metrics

AD

load balancers

work either immediately, or at short notice.

DSC

understand our users motivations, pain points and behaviors

Manage the companies web sites and other social media accounts.

Juniper Mist

Coordinate and monitor results for sales contests

ad hoc financial analyses

Leads development of high complexity models and training sets.

Develop a deep understanding of our users' goals, workflows and pain points

Writing reports on errors/bugs found.

Attendance at daily stand-up sessions – inputting updates on work streams and highlighting blockers as they occur

Pixel perfect front-end development

Ensuring that quality is built into testing strategies by providing testing leadership, and quality assuring the test process

Mobile Testing

review qualitative and quantitative data and build businesses cases

Generate and provide regular and ad hoc statistical reports from the Directory and other IT services to colleagues and external stakeholders

otv

Remain current on information security best practices.

Maintaining PCs, printers, telephones and credit card terminals, coordinating quarterly preventative maintenance

Matrix or direct manage team performing sales admin functions

perform complete install and programming

automation with Ansible/bash

Recognizes and prioritizes the most important work related to data science models to achieve highest operational impact for analytics in the business

push the envelope

Rest API's

Investigate and report maintenance and safety conditions which might endanger personnel, including fires, evacuations, hazardous situations, or other facility related events

DNS

Troubleshoot and support current platform in production

Continuously improve software engineering practices

Input and Management of data internal reporting systems to ensure accuracy of Quickbooks, CRM and Internal tracking tools

Engage with customers in a friendly and professional manner

Provide expertise on the functional use of SAP Hybris Commerce and it's various administrative cockpit

Atlassian products

managing staff such as postdoctoral Research Associates

Identifying spelling, grammar, punctuation and other language errors.

systematic root cause analysis

Coordinating hardware maintenance and repairs with vendors

Real-time query engine – design, implement our state-of-the-art in-memory query engine to bring quick insights to customers

ad hoc sales support

ensure ultra low latency is achieved for intraday trading and direct market access systems

Acting as the gate keeper for payment gateway system

Support Disaster Recovery

latency

Working towards fixed weekly/monthly targets

Defect Management

resiliency

rheology

develop initial draft of core program budget and strategic plan

pushing boundaries beyond typical, existing play types

provide back up to client personnel as needed

Problem Solving

Active Directory

vxlan

fast paced environment

perform technical administration, technical implementation of infrastructure projects, low level design, maintenance functions and documentation creation

Assign new prospects and manage account moves for the sales teams

DevSec Ops

Troubleshoot and resolve infrastructure inefficiencies and other problems

Ubiquiti Wireless Access Points

IP Networks

deliver products ranging from topics like supply chain optimisation to loyalty schemes

roll up their sleeves and take on anything that comes their way

exposure to Linux projects mainly with Red Hat

Windows

Refine our approach to infrastructure-as-code, evolving our architecture to meet future needs

VLANs

Communication with internal and external customers to ensure compliance with IT Helpdesk requirements and update on progress of existing web support projects

Supporting Windows Mobile

Oversees resolution of complex projects and programs.

expanded our product portfolio

Lead and manage a small team of test assurance analysts

Predictive analytics – design, implement our analytics platform for our customers to discover potential new consumers

Video-Conferencing and Audio Visual Support

Large-scale data ingestion and integration – design, implement scalable ETL processes to collect and store large amount of data from multiple data centers and diverse external partners

Support users by trouble shooting hardware and software issues

Updating our CRM platform with the results of your investigations

pixel perfect design to web migration

Automation Tester

Palo Alto Networks hardware

DHCP

App Annie models/products/systems

Web

Work with product owners to understand desired application capabilities and testing scenarios

determine material properties (structure, chemical, electronic, thermal, and/or mechanical).

ensuring the operation and ability to release products

low level design

Build BigData systems – work on improving and adding new functionality to Amobee's Data Systems backbone.

Defining the testing activities, ensuring that standards and procedures are adhered to.

Develop deep understanding of business drivers and financial levers to provide strategic decision support.

Document and communicate clearly architecture and implementation solutions

support clients located in Brazil and Chile.

throughput

Participate in design and code reviews

Creates shared process models, business objects, activity diagrams and process documentation to effectively articulate multiple views of the business solutions that support technical architecture.

Browser Stack

Test suite creation using gherkin syntax
Integrate with technical staff to maximise their support to the sales process.
gherkin syntax
Provide reporting to measure activity
firewalls
Supporting particularly iOS operating systems
deliver the more natural, simple profiles
Reviewing test standards and procedures to optimise test delivery
small and medium sized businesses with varied IT requirements
Juniper
owning the completion of a wide range of project work
Run cloth, hair, rigid body, crowd, or muscle simulations
brought synergistic technical expertise to enhance our capabilities
Android
Move up to 49lbs as well as stand and walk during shifts lasting up to 12 hours
Selenium
Routing
Audit and provide reporting on client data and orders
New Product and Supplier Sourcing
produce clear, concise and accurate documentation and job notes
Identifying, mitigating and resolving root causes
virtualization
maintenance functions
conducting user research and running workshops
Coaching and mentoring the testing community to support their professional development
regularly required to stand
x-ray diffraction
Track and manage sales admin workload and ensure timely responses
installing network printers, either on a wired or wireless network
Firewalls
OSPF routing protocols
Bracknell
assess the design and operational effectiveness
JavaScript libraries
Automation
Collaborate with Product and Design to iterate on our product
Web-based research to collate business information
Develop backend services that expand the capabilities of our analytics product
fabricpath
Create and maintain documentation for network environments and user documentation for utilizing network services.
Ensure the security of the trading and corporate networks.
Translates business analysis needs into well-defined data science problems, and

selecting appropriate models and algorithms and communicates model evaluation and implications of results back to stakeholders

complaint responses are completed in a timely manner

BET

IaaS

Marketing Support where required such as photography, updating social media, case studies briefings and new product descriptions directly onto websites

Install, configure, administer, and maintain

Lead the craftsmanship, availability, resilience, and scalability of your solutions

Keep the Head of Digital Services informed of service bugs and defects and problems experienced by users of the Directory and other online products and services

VPN Tunnels

Collaborate with internal and external, technical and non-technical teams to build and support development platforms

WLAN

Handling of new & existing customer enquiries via phone, email, video call and online web chat

Hunting for missing / wrong content.

This role will report to the Head of Infrastructure & Operations and is located at Rubrik HQ in Palo Alto, CA.

Lights out management, maintenance, and administration of HPE servers

Linux

Overlay protocols

Security Systems

Participate in various phases of QA and testing activities for software releases

support product commercialisation and reimbursement

Develops new or revises complex models to predict business demand trends, and volume and expenditures forecasts capacity analysis, and various other metrics to identify potential opportunities.

Lead engineering discussions and mentor others on engineering best practices

Designing and evaluating experiments monitoring key product metrics

fast paced help desk

Palo Alto

Balances tradeoffs among analytics value, model development methods and design and technologies used to implement data science models with a bias toward action

supervising research and PhD students

lisp

raise our bar for quality

BGP routing protocol

SEM

Managing a quality service

Understand performance and scalability principles and apply when developing software

Enable and setup CI/CD pipelines, monitoring and alerting, secret management

systems, and more.

Optimize the performance of our data ingestion and processing pipelines

Appium

database backup and restore

Analyze materials and associated data using a variety of methods

Collaborates with leaders, other LOBs, and business partners to work on issues, projects or activities.

Keep it running – Help troubleshoot application operational issues

High Availability and Disaster Recovery

Supporting test engineers and software developers to identify test scenarios

Aruba switches

Educating and supporting the rest of the delivery teams with testing, educating internal (and external) stakeholders, and working with delivery teams to define 'quality', best practice and guidelines

micro-service architectures

Designing and managing large-scale networks in a global environment

TCP/IP

technical implementation of infrastructure projects

deliver insights to evolve our product and empower our customers to hire better

work successfully with multi-functional teams across organizational boundaries

Ensuring the proper date/calendar/character display / format.

Performing software and hardware upgrades

Quoting and follow up of sales enquires

Management of workflow including artwork approvals, production planning and logistics

Assist on adhoc projects, as needed

Develops and maintains up-to-date detailed project schedules and work plans.

TEM

Fire Alarm

reate sitemaps, customer journey maps, wire frames, and prototypes

Answer incoming customer inquiriesStay up-to-date on new products, services, and policies

TGA

developing algorithms to optimise supply chains

effectively communicate and 'translate' quantitative findings

Software Test

iOS

Raman spectroscopy

Configure multicast networks, including Multicast PIM Sparse/Dense and IGMP.

lecturing undergraduate and postgraduate courses

QA

Identify and resolve network failures on both switches and servers and network performance within both the trading environment and corporate network.

documentation creation

effective root cause analysis
Testing
Recommend and implement security tools, policies and procedures.

Working conditions list:

freedom to define your own role
data teams each meet weekly; work talk forbidden
Flexible Working
weekly yoga classes
temporarily due to COVID-19
State/Region: London
civil union
Frequent visits to our facilities
Friendly, creative and relaxed working atmosphere
Sensibly managed projects
importance of work-life balance
an equal opportunity employer.
Life Insurance
pool table
May require unscheduled after-hours work
Competitive Salary
Childcare vouchers
Flexible spending account
Job Types: Contract
arrest and conviction records
UK Visas and Immigration service
Wellness Programmes
Employer contributory pension plan
7% Company Pension
mini golf
Sick pay
Maternity and Paternity leave
40 hours per week
Pay: Up to per year
coffee
equal opportunity employer
value diversity at our company.
presence of fumes or airborne particles, toxic or caustic chemicals
Job Type: Part-time
Full-time, Permanent*
Overtime
Hours/Shift: Full Time
Hours per week

* 8 hour shift
Work remotely:
able to hire remotely
Weekends
Working from Home
season ticket loan
Working Locations:
LOCATION
One location
will consider qualified applicants with arrest and conviction record
Reasonable accommodations to enable individuals with disabilities
Sick pay
employee discounts.
Social activities - book club, dungeons and dragons, mindfulness and many more
shifts lasting up to
401(k) matching
Tuition Reimbursement
Retirement plans
Pension
no suitably qualified EEA or EU worker can fill the post
Employee Assistance Program
in-year bonus scheme
Work Authorization
core values is 'Authentic'
Health Insurance
subsidised gym membership
Salary up to
we do not accept unsolicited resumes
outer fringe allowance
buzzword bingo
encourage people of colour, lesbian, gay, bisexual, transgender, queer and non-binary
people, veterans, parents, and individuals with disabilities to apply.
fuse ball table
Your work will predominately be based at our Sagentia offices
opportunities to travel to client sites in Europe or USA.
massage therapy
Flexibility in scheduling
4/10 Schedule
OUR OPPORTUNITY
Open to UK, Commonwealth and European Economic Area (EEA) and certain non
EEA nationals
third party service providers
Summer BBQ
Studio community activities

Vision insurance
Salary: per year
career development programs, tuition reimbursement, or audit a course
Christmas Party
Private medical insurance
Monday – Friday
affirmative action employer
On-site Parking
Disability insurance
Parental Leave
sharing our employee engagement dashboard
Cash-back on treatment costs
Dental insurance
diverse workforce
Bonus Pay
do not discriminate on the basis of race, religion, color, national origin, gender, sexual orientation, age, marital status, veteran status, or disability status.
Casual dress
Paid time off
Pay: per hour
401 K
Benefit Conditions:
Cycle 2 Work Scheme
Childcare Voucher
25 days' holiday;
New renovated branded office
Company Events
Free breakfast every day
Fresh fruit and snacks
fresh fruit
noise level is usually loud
Casual Dress
Summer and Christmas parties
reasonable accommodations
fixed term contract

APPENDIX 3: THREE-WAY MATRIX CALCULATIONS AND CLUSTERING CODE

Code for three-way matrix calculations and clustering experiments can be viewed in Github repository [18] by URL: https://github.com/THNTS/three-way_clustering

All relevant files are marked as _appendix_3