

JOBMATCH: SUPPORTING RECRUITERS THROUGH ALGORITHMIC HIRING

JOBMATCH CLOSING EVENT

FEBRUARY 28, 2024

- ▶ Jobmatch
 - Three-year Grand Solutions project with two post-docs (Mesut Kaya and Qiuchi Li)
 - Collaboration between University of Copenhagen, Aalborg University and Jobindex
- ▶ Goal is to support Jobindex' recruiters in their work

Jobindex

OUR TEAM

3



Mesut Kaya

Postdoc
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Toine Bogers

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Qiuichi Li

Postdoc
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Sofie Vedtofte

Business Analyst
Jobindex



Carina Emma Sørensen

Team Leader
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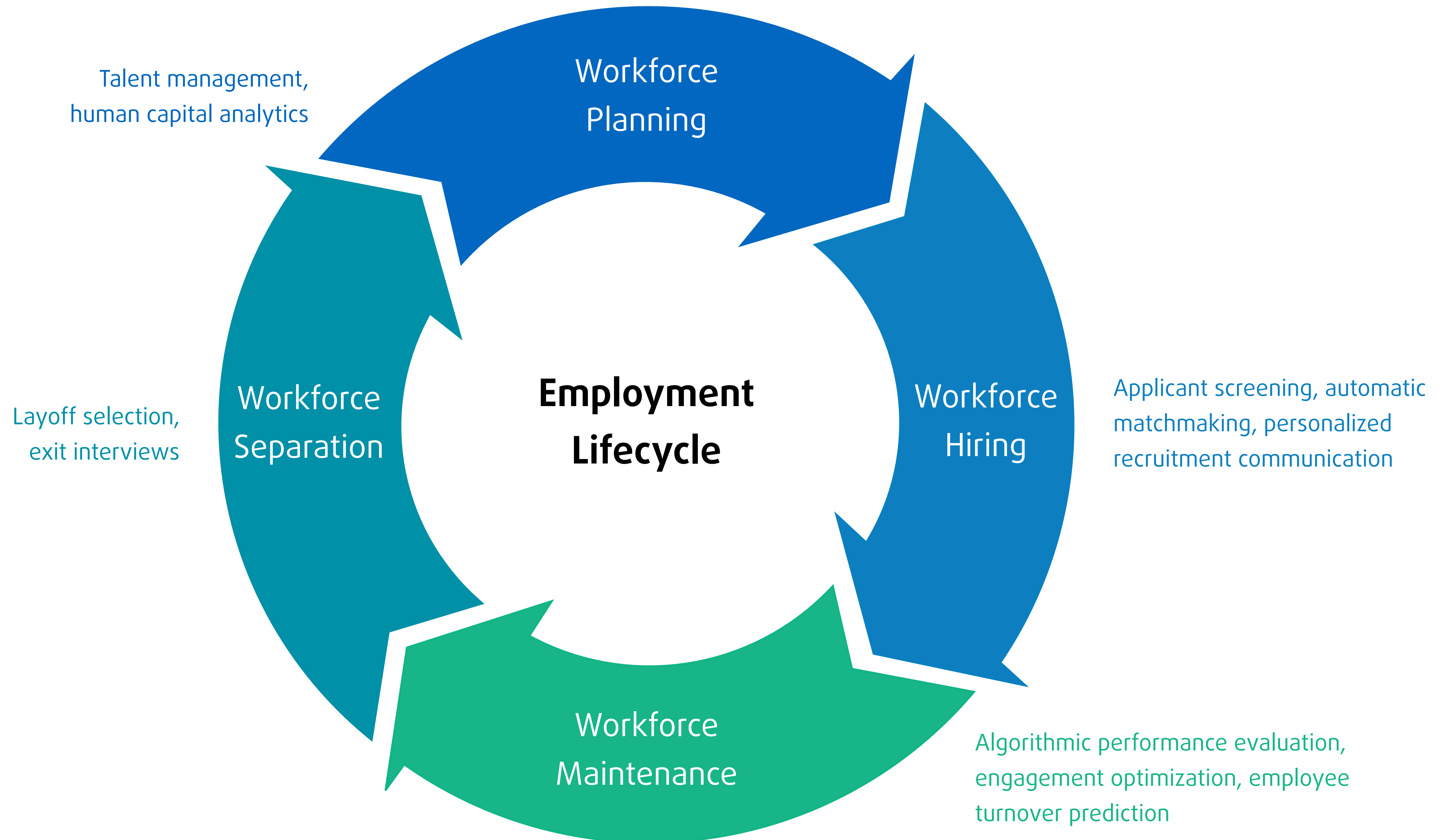
Klaus Madsen

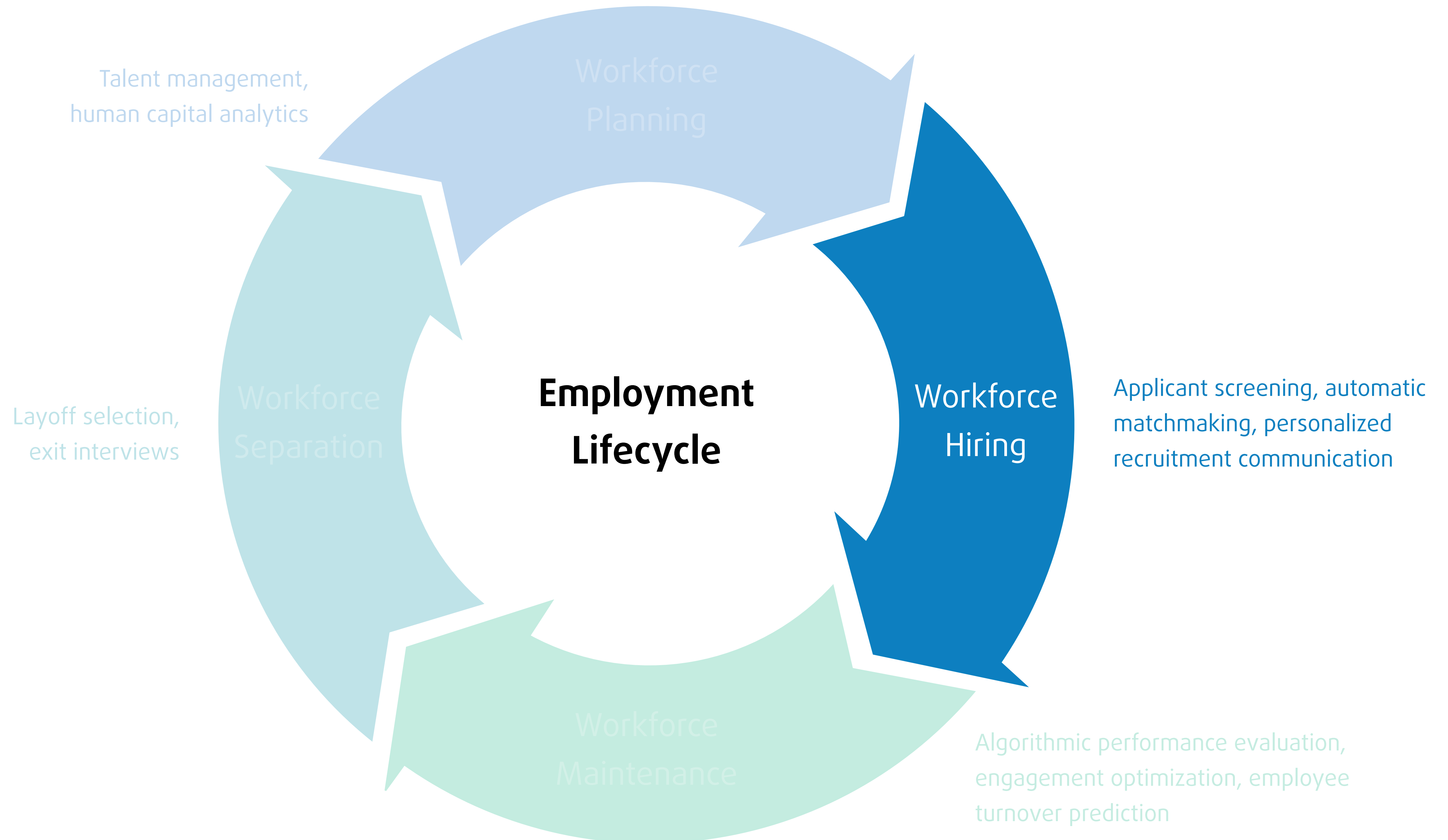
CTO
Jobindex



Christina Lioma

Professor
KU





HOW DO JOBINDEX RECRUITERS WORK?

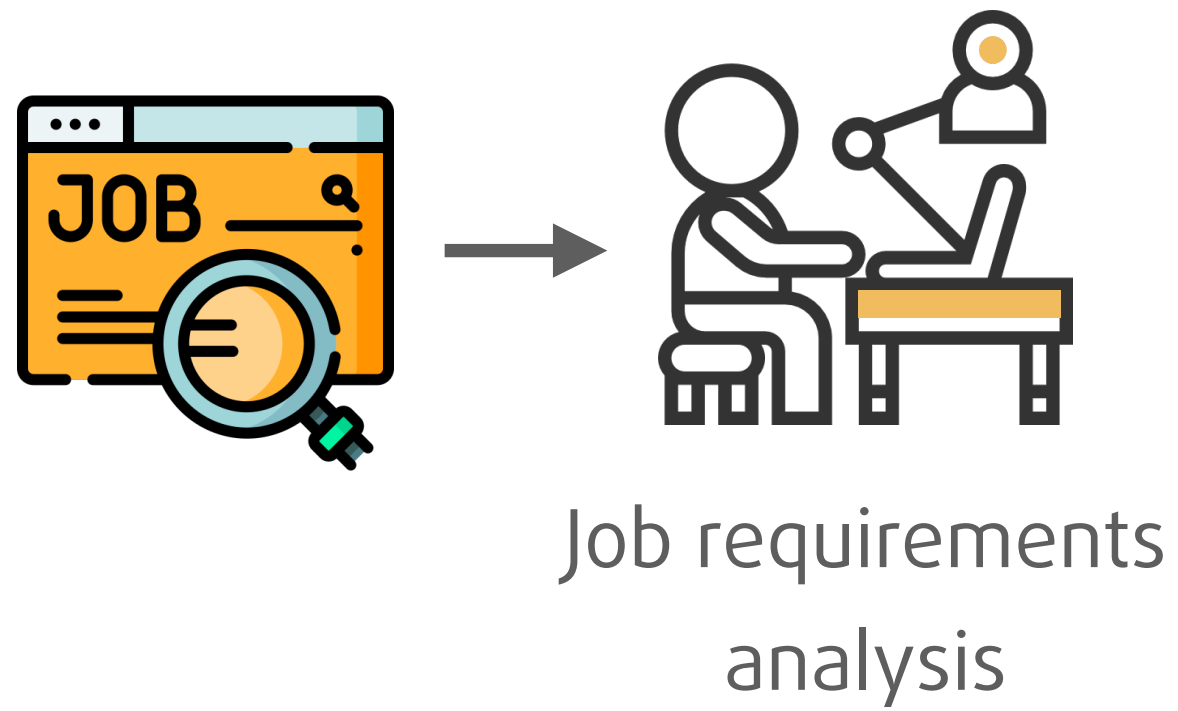
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35,900
job ads

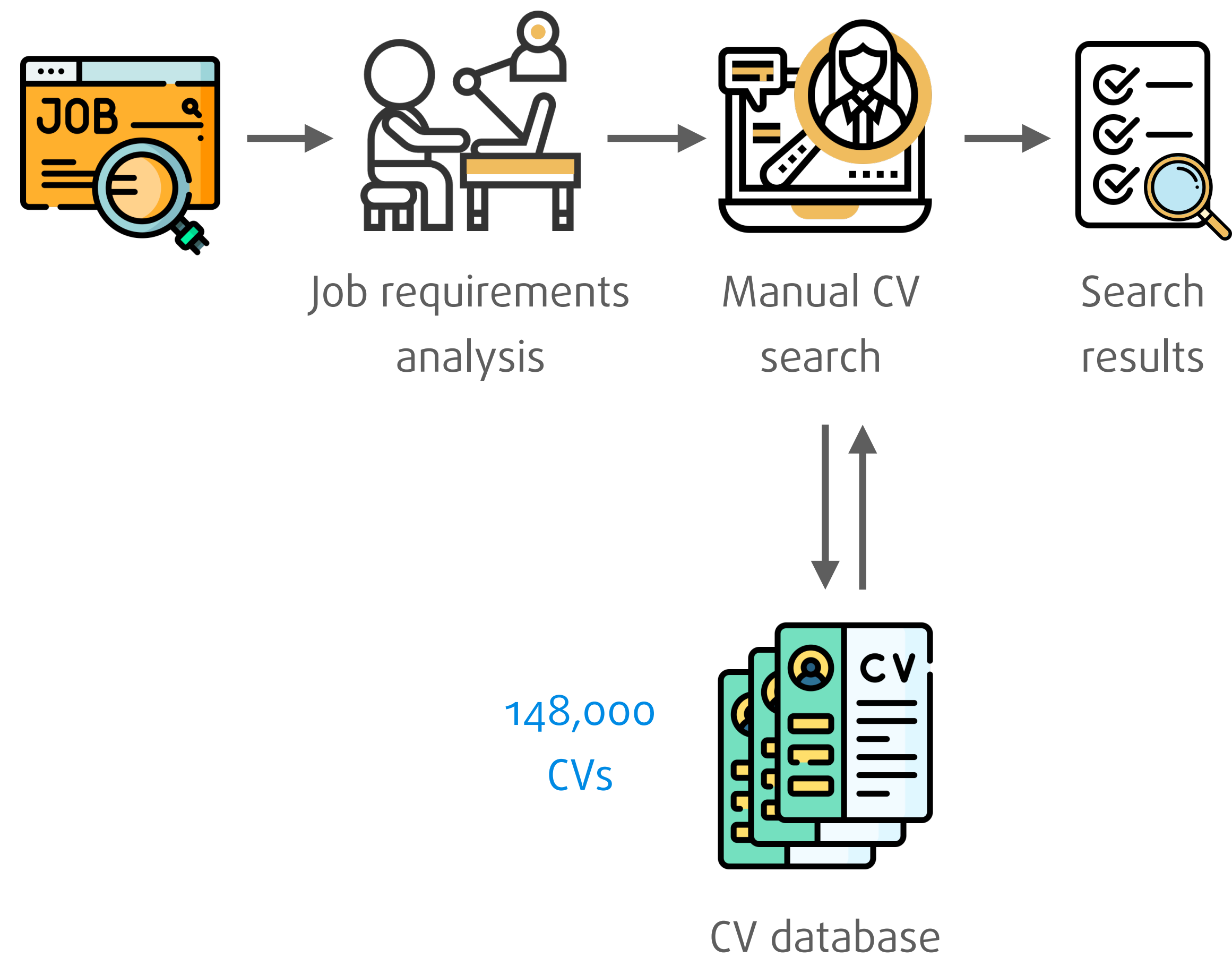


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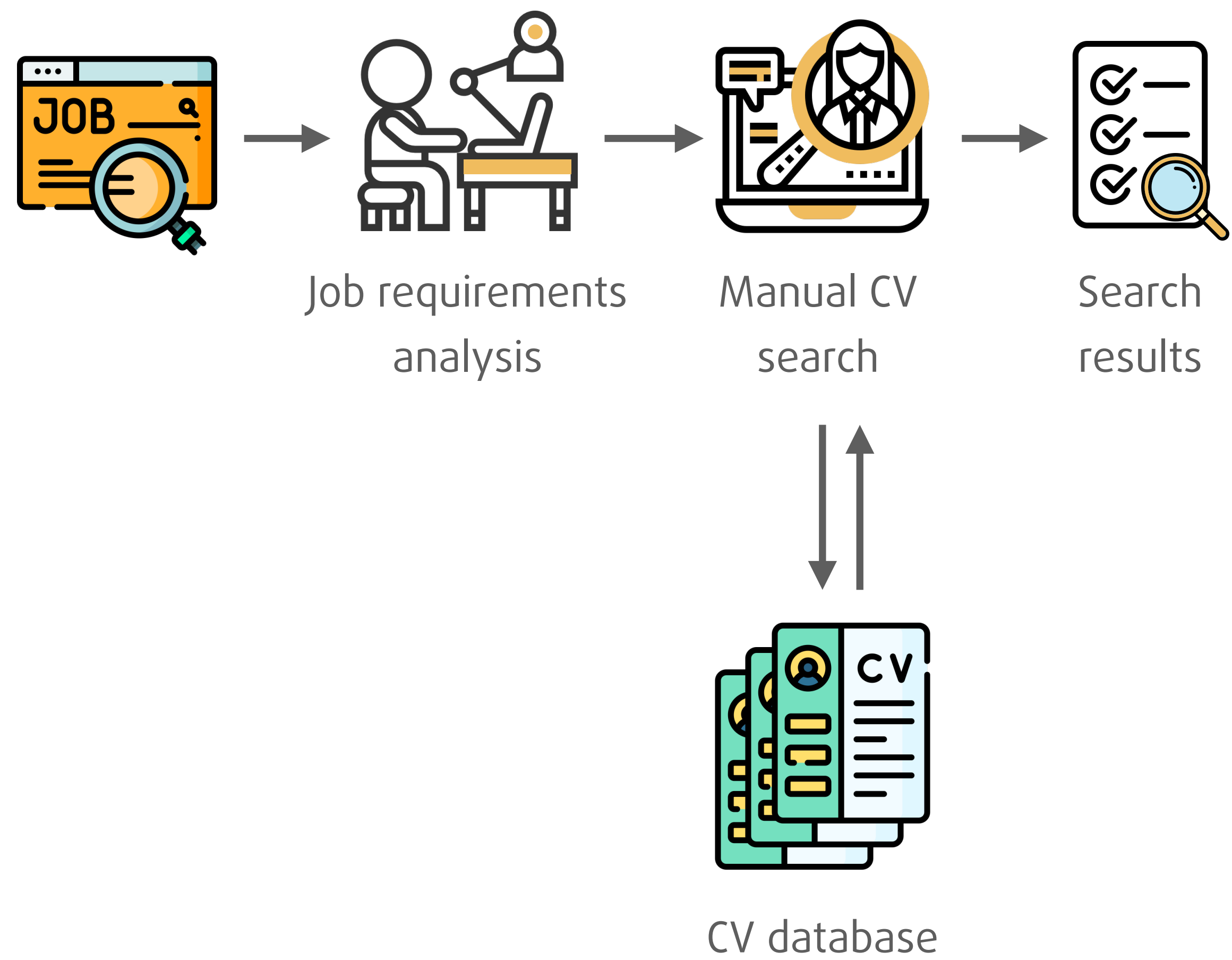
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HOW DO JOBINDEX RECRUITERS WORK?



HOW DO JOBINDEX RECRUITERS WORK?



Search in CVs

Search

Reset

Filter your search

Following company

☐ Testfirma

Education level

At least

Maximum

Work experience (years)

10

Maximum

Management experience (years)

5

Maximum

Salary expectations

40,000 kr.

60,000 kr.

Tags

Advanced

Language skills

English

Minimum language proficiency

Found 1,845 users.

Contact CVs

Clear CVs

Sent me

Experienced Supply Chain Management Professional

Job wishes: Supply Chain Director, Category Manager, COO, Director and 6 others

Latest job: Owner and founder

Geography:

Education: Graduate Diploma in Business Administration) – HD 2. Supply Chain Management

Salary expectations: DKK 40-50,000

Work experience: 24 years

Conditions of employment: Full-time and temp

Management experience: 20 years

Experienced Supply Chain Management Professional – with extensive international leadership experience from Strategic Sourcing, Procurement, Supply Chain Management, Product Portfolio Management, Business & Product Development and leading global international teams.

... one of the best managers within Supply Chain and Procurement in Denmark ...

... PROFILE I am an Experienced Supply Chain Management Professional with a solid ...

supply shipment

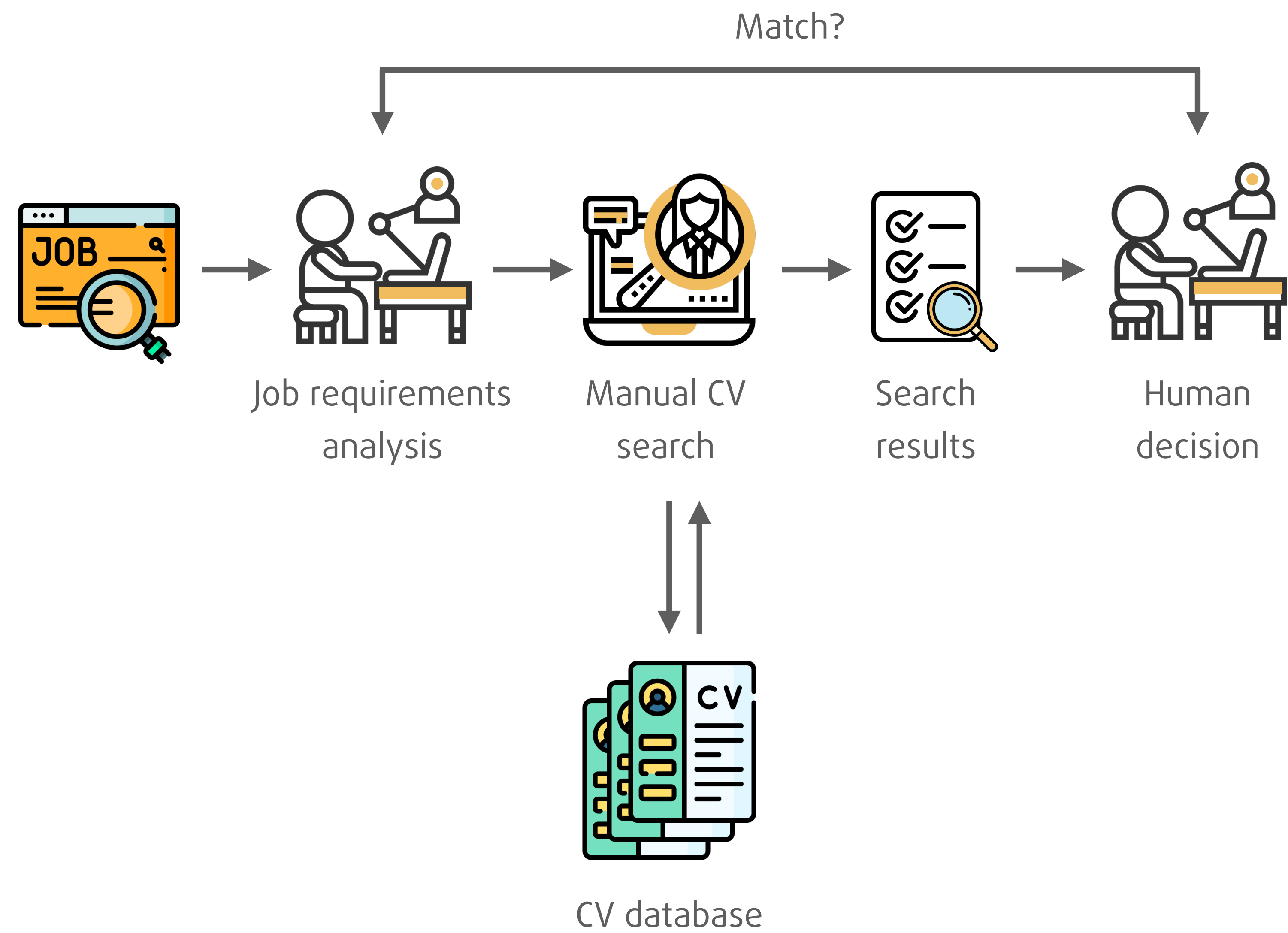
Experienced Supply Chain Management Professional

Global Supply Chain Jobs

ABC

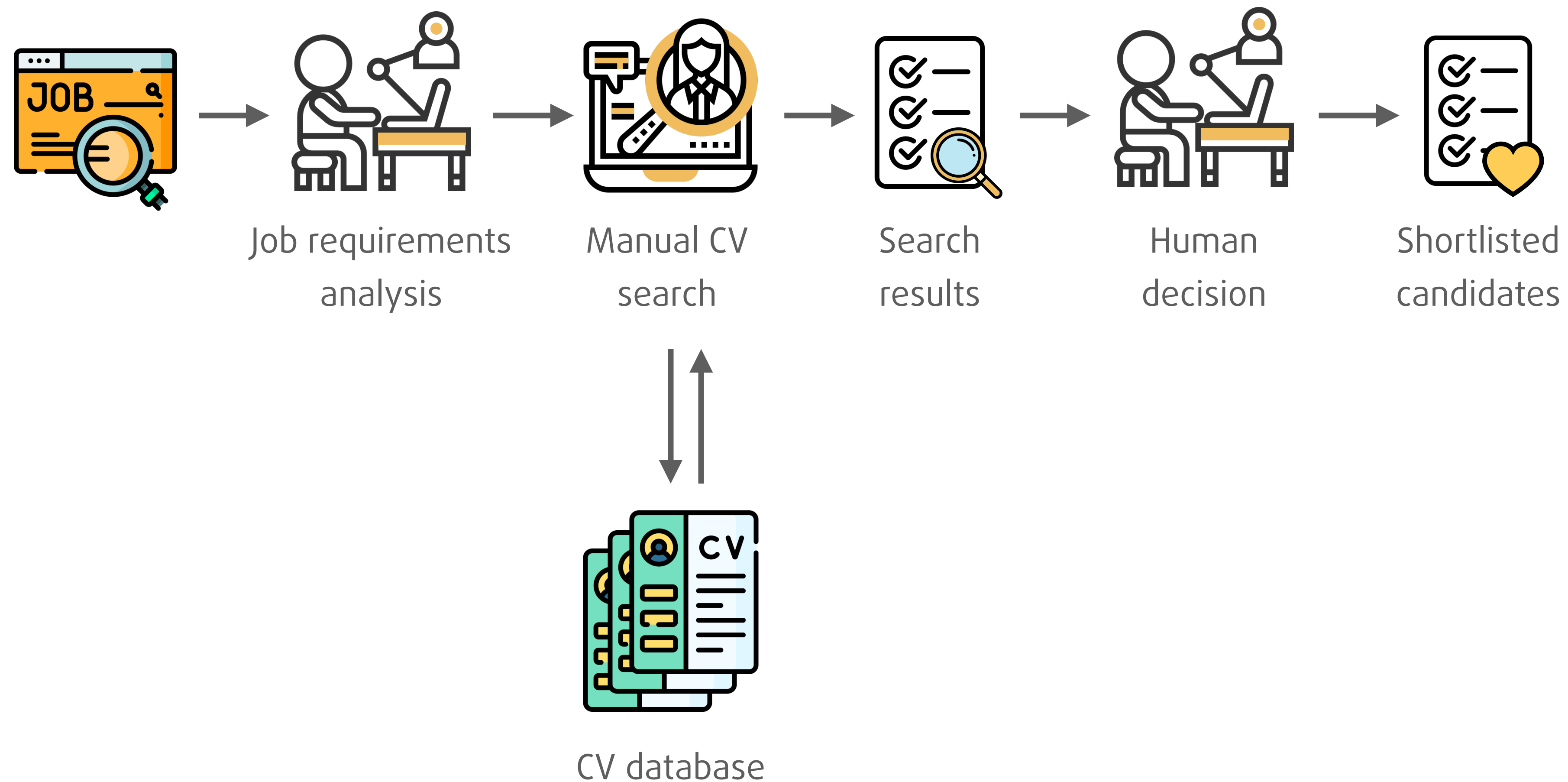
+ 134 others

HOW DO JOBINDEX RECRUITERS WORK?



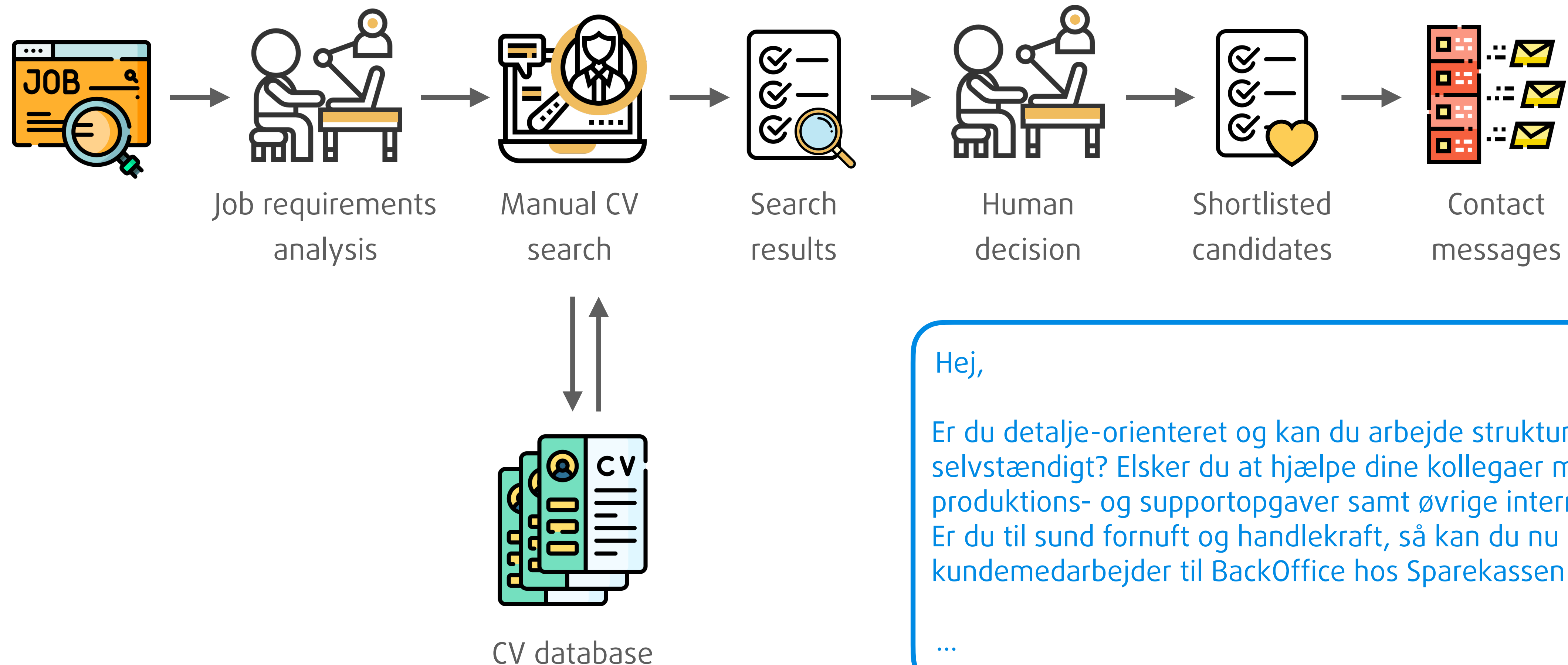
HOW DO JOBINDEX RECRUITERS WORK?

11



HOW DO JOBINDEX RECRUITERS WORK?

12



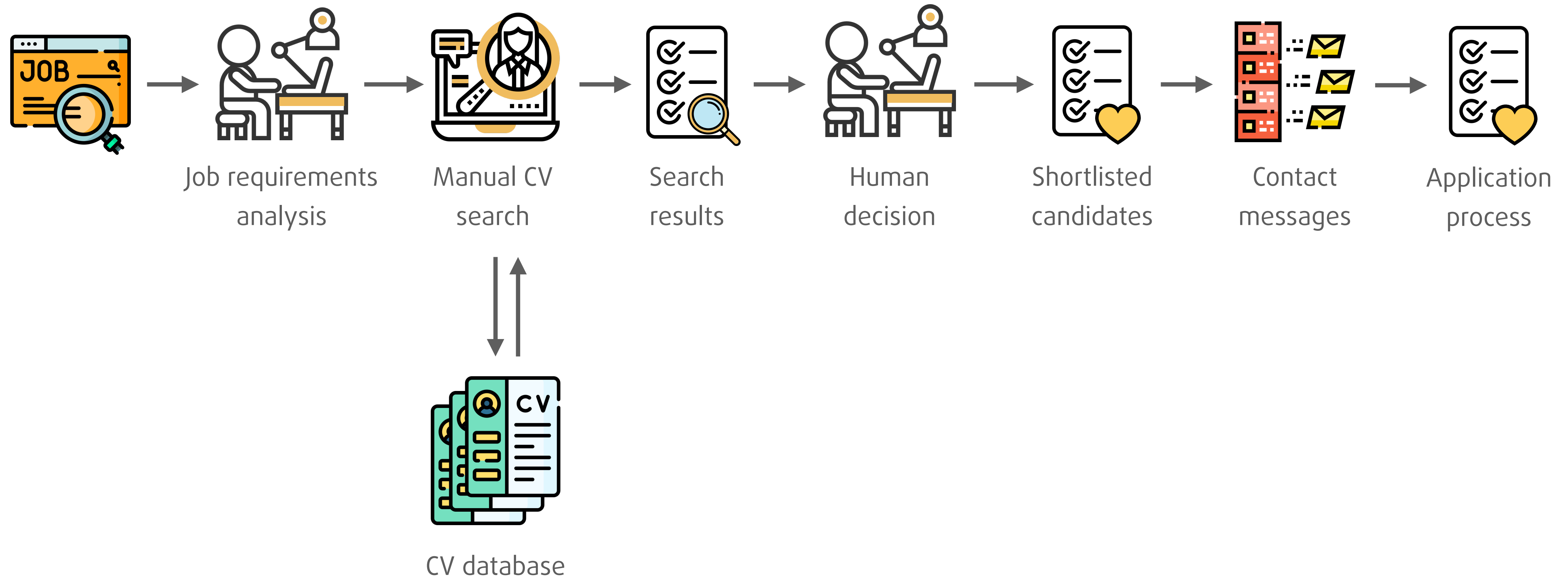
Hej,

Er du detalje-orienteret og kan du arbejde struktureret og selvstændigt? Elsker du at hjælpe dine kollegaer med produktions- og supportopgaver samt øvrige interne opgaver? Er du til sund fornuft og handlekraft, så kan du nu blive kundemedarbejder til BackOffice hos Sparekassen Danmark A/S.

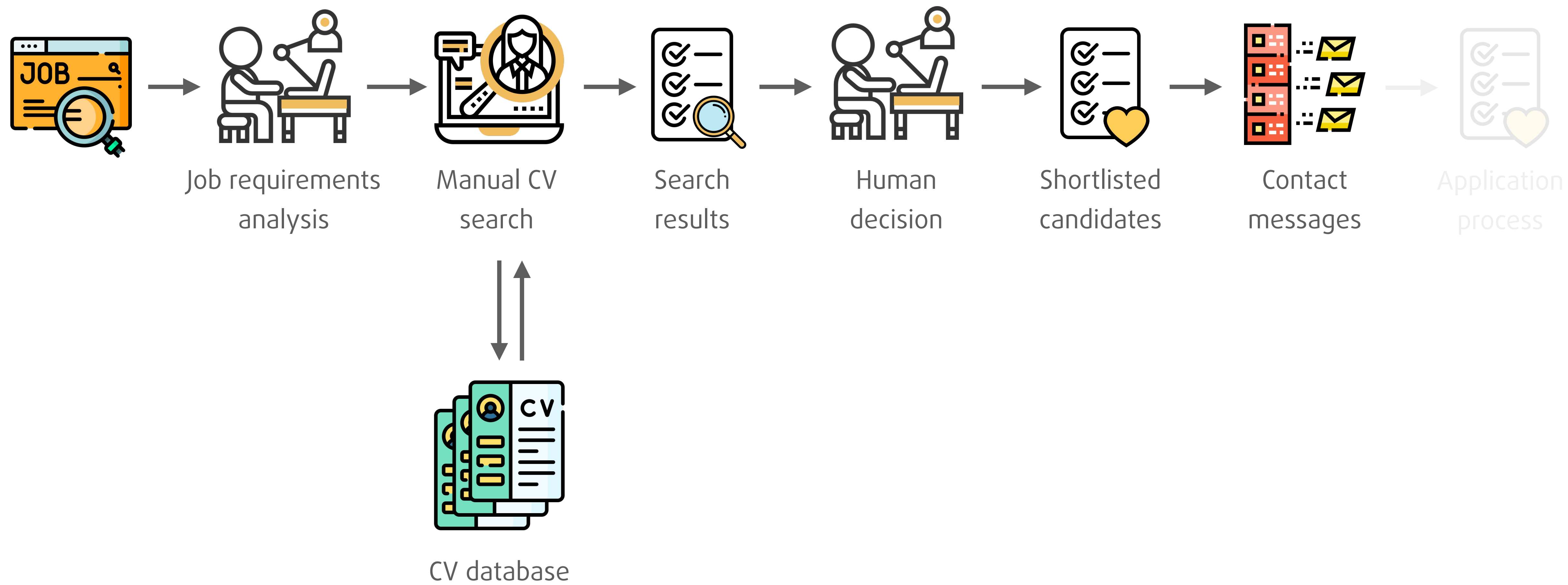
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HOW DO JOBINDEX RECRUITERS WORK?

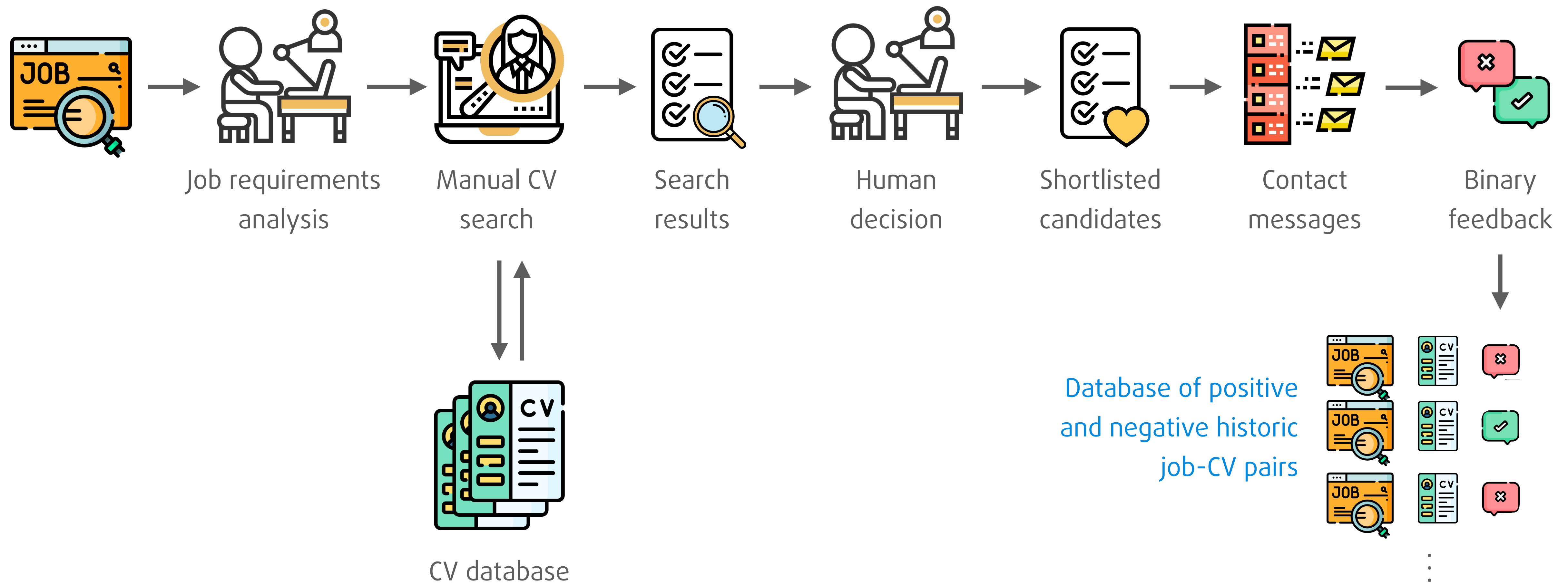
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HOW DO JOBINDEX RECRUITERS WORK?



HOW DO JOBINDEX RECRUITERS WORK?



- ▶ Supporting the recruiters means **understanding how they work**
 - **Qualitative** study of recruiters' work processes
 - 12 contextual inquiry sessions ($\approx$ mix of observation and interview)
 - 1 focus group
 - **Quantitative** study of recruiters' search logs
 - Analysis of 157,046 search sessions (queries, contacted candidates, responses)



UNDERSTANDING RECRUITERS: CONTEXTUAL INQUIRY

17

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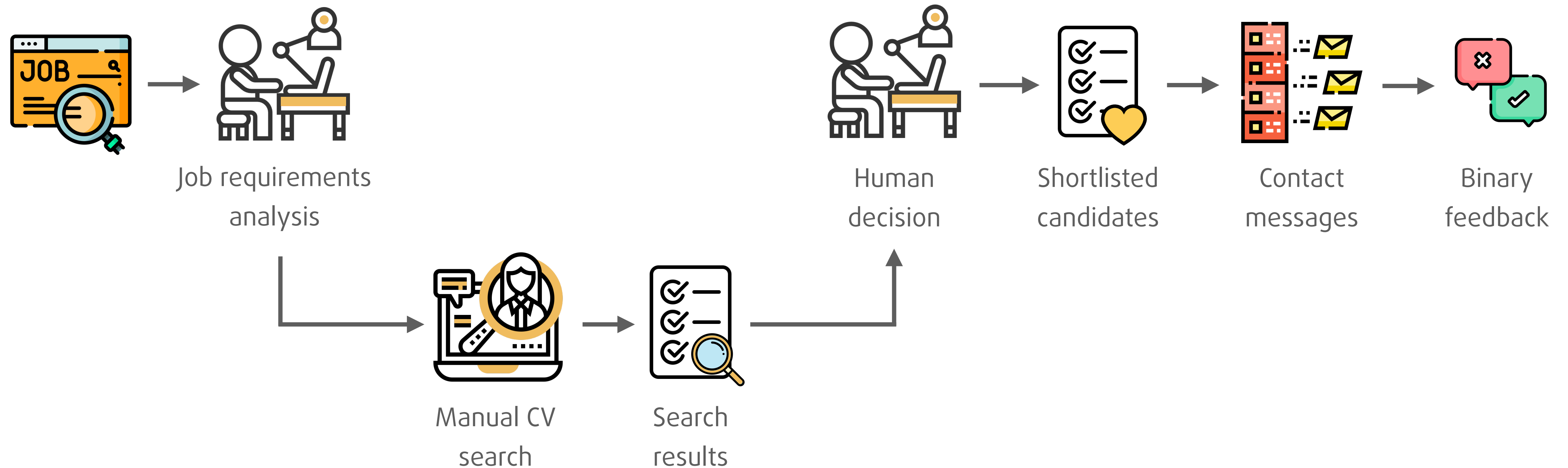
► Findings

- Recruiters focus on **primary qualifications** (= skills & competences) and past/current **job titles**
- Search results can serve as source of new search terms
- Commonly used **filters** include **salary** and **years of work/management experience**
- Relevance assessed using **1-3 most recent work experiences** and matches on **qualifications**
- Strong reliance on **highlighting in the results list**
- First 10 candidates are low-hanging fruit, **next 10 candidates require more time and effort**
- **Time per query, use of filters and query complexity** all increase throughout the sessions
- Caveat: no clickstream data → we are collecting a richer search log for future work

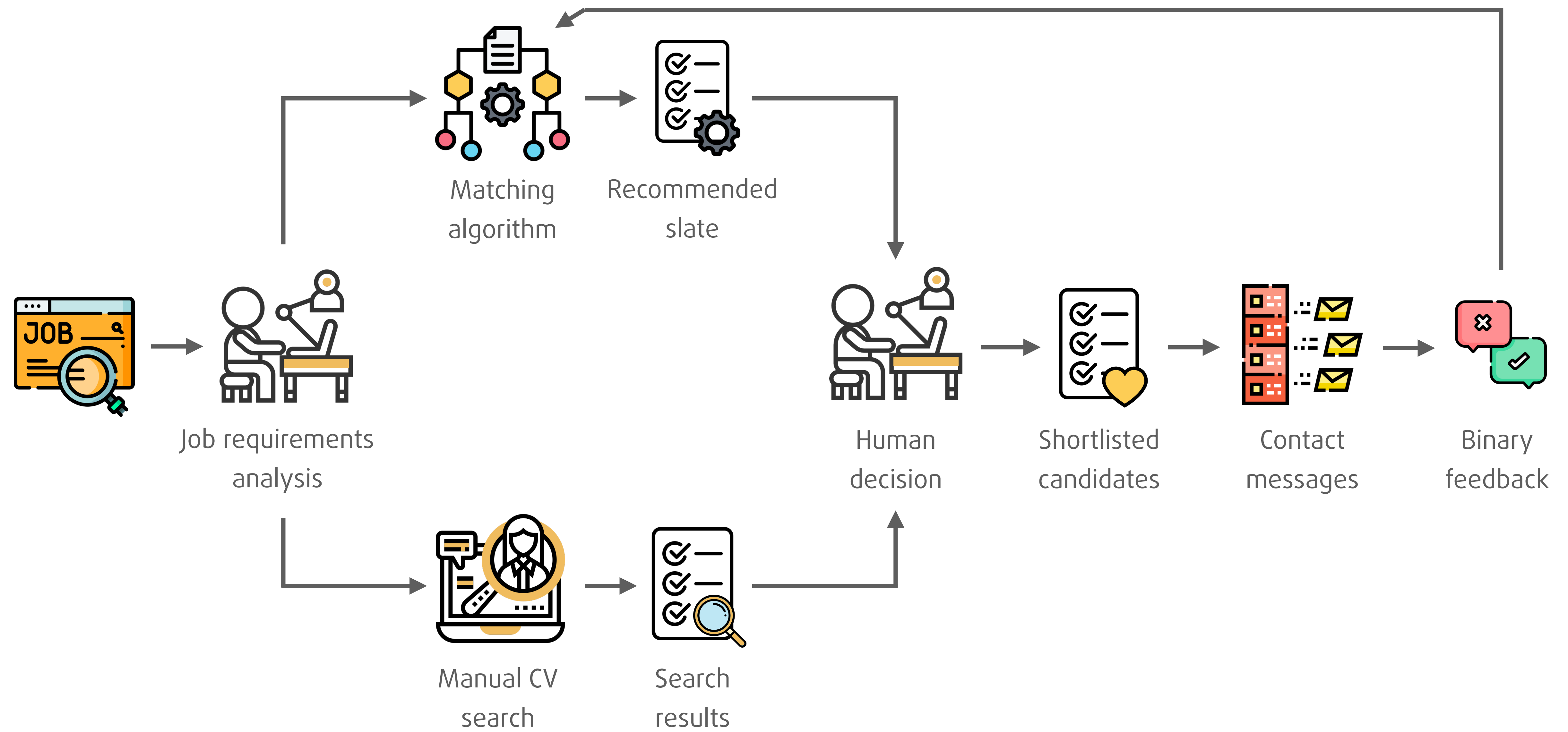
Part 2

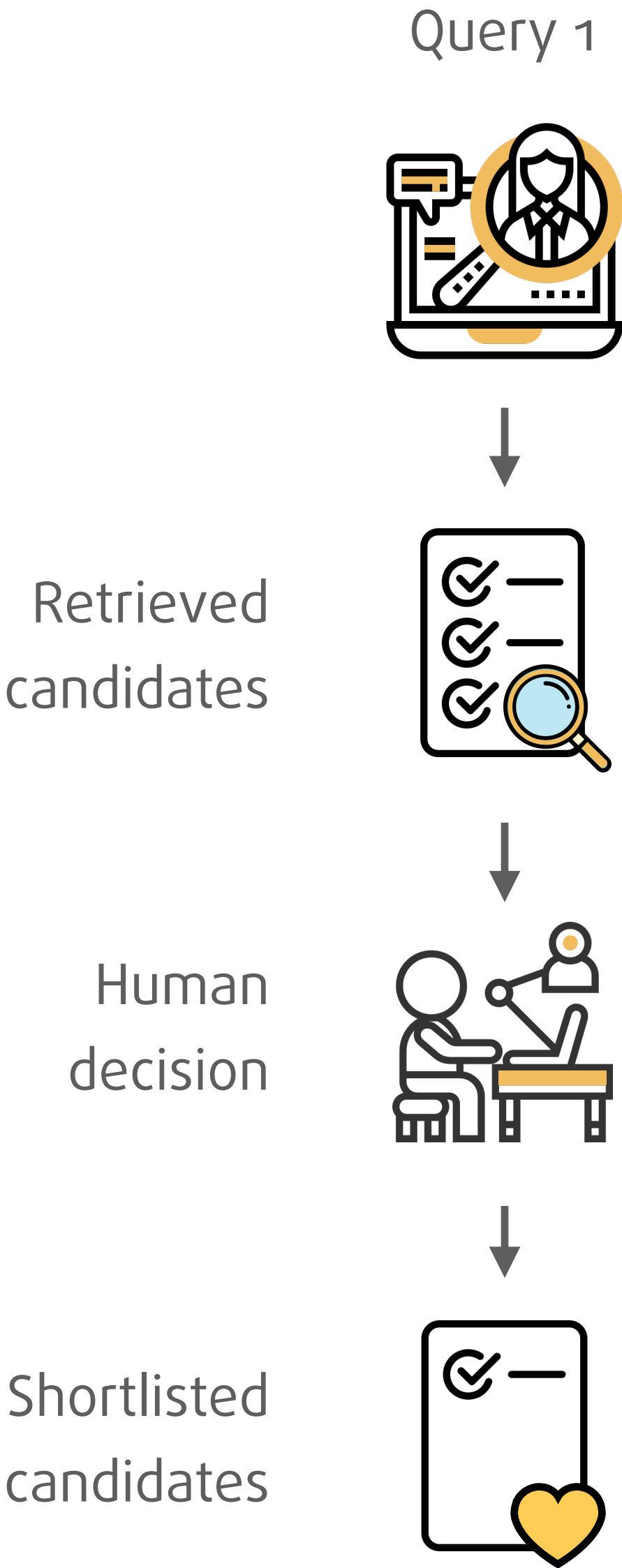
CANDIDATE RECOMMENDATION

20

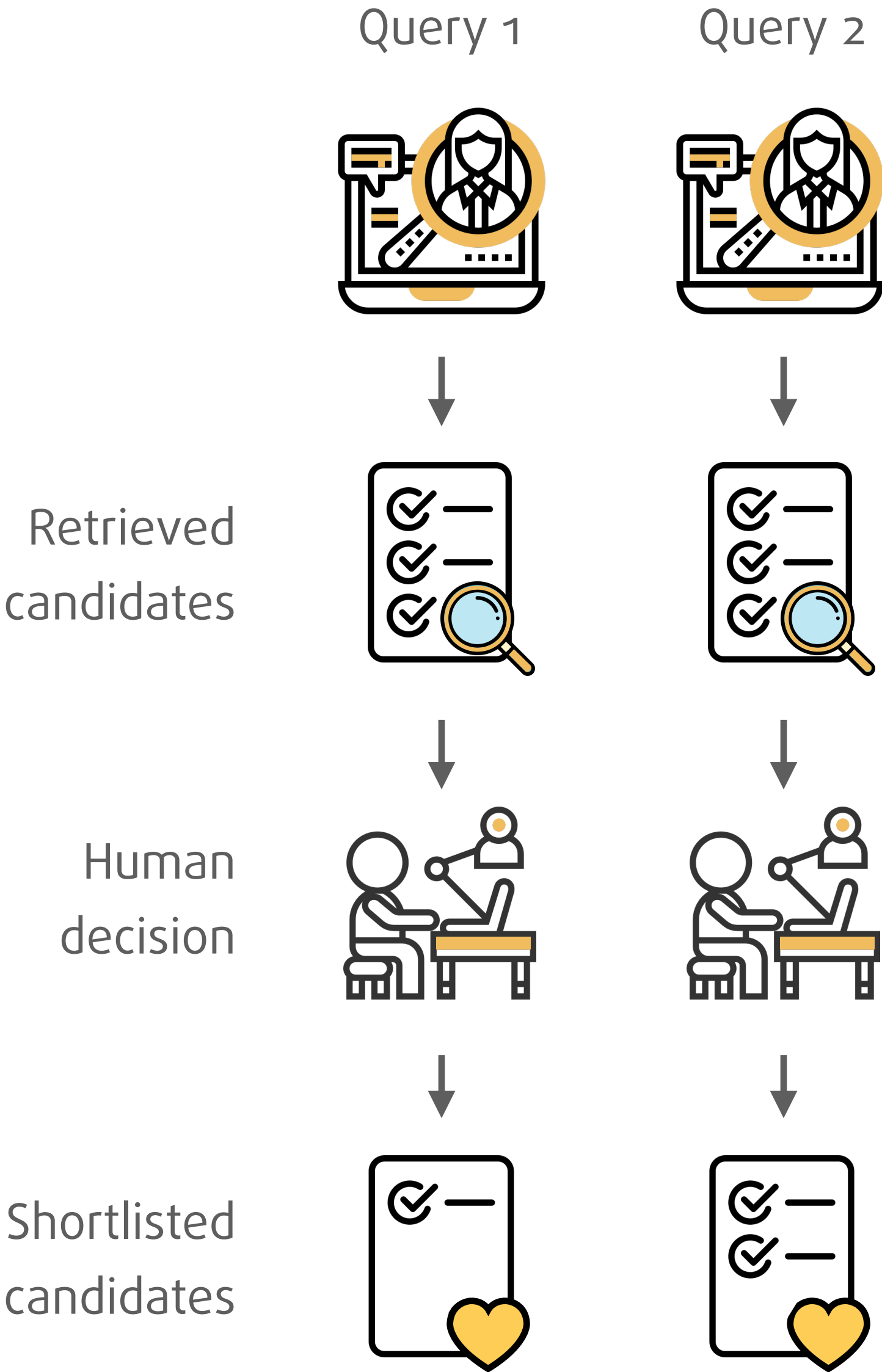


CANDIDATE RECOMMENDATION

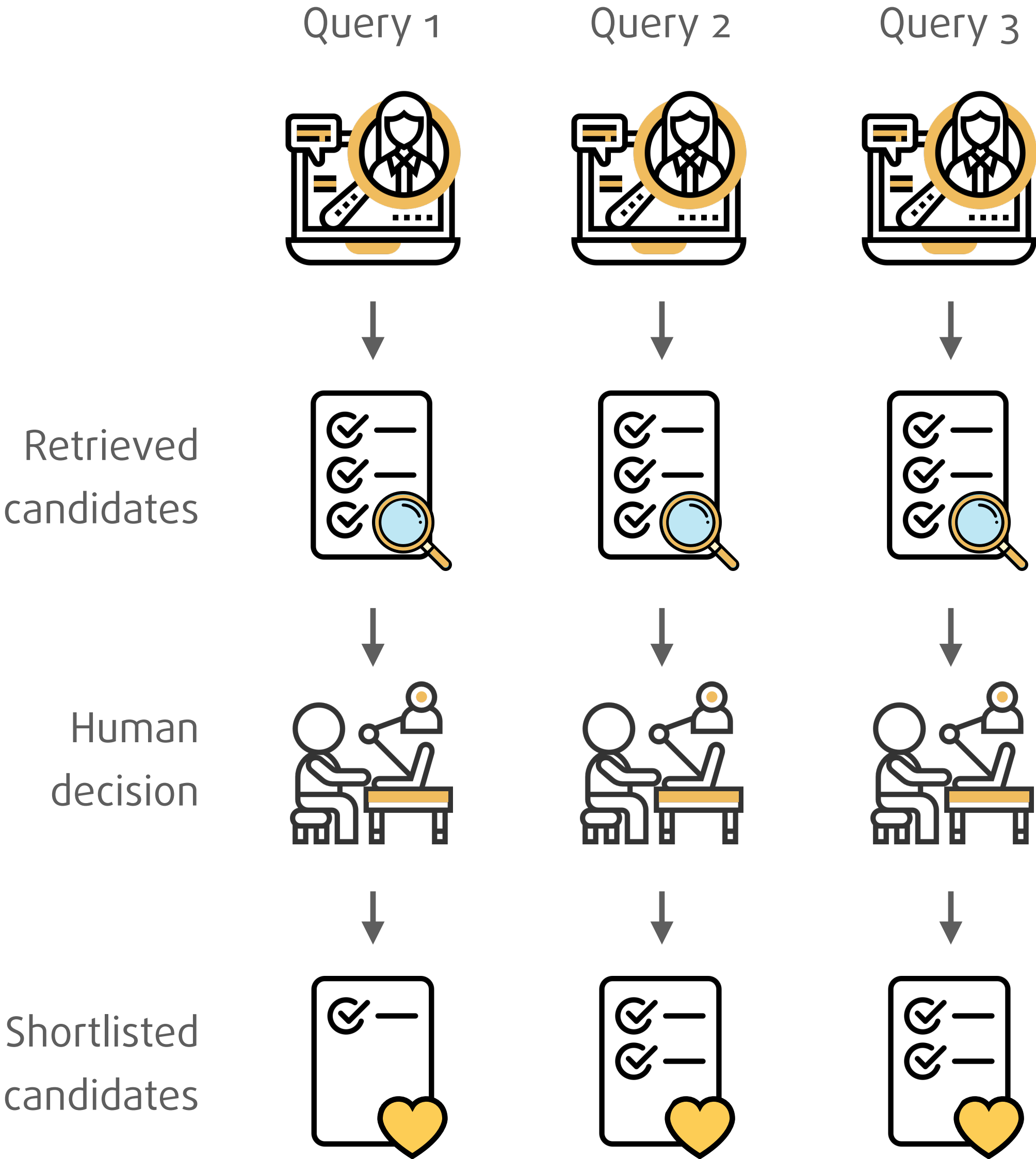




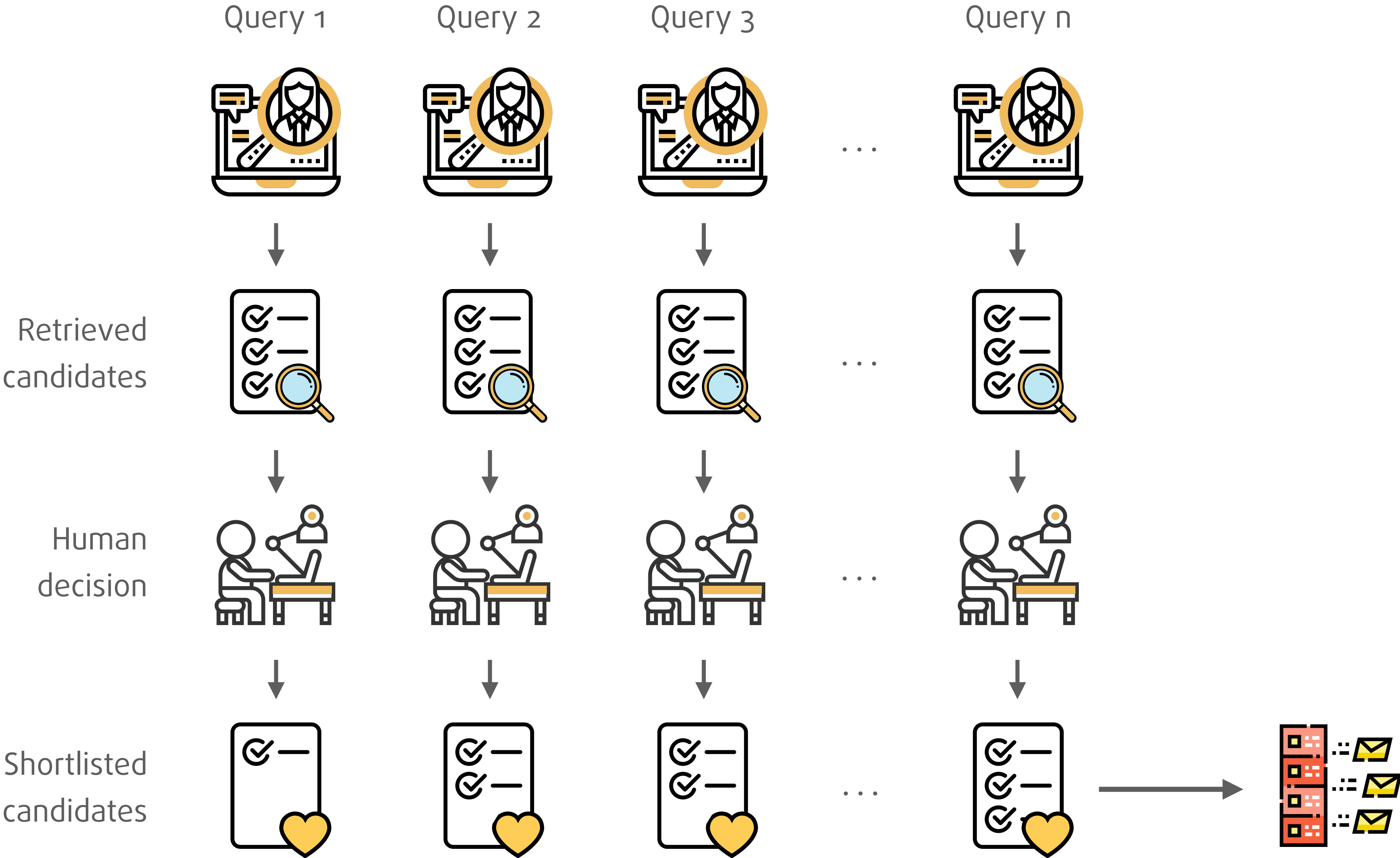
CANDIDATE RECOMMENDATION



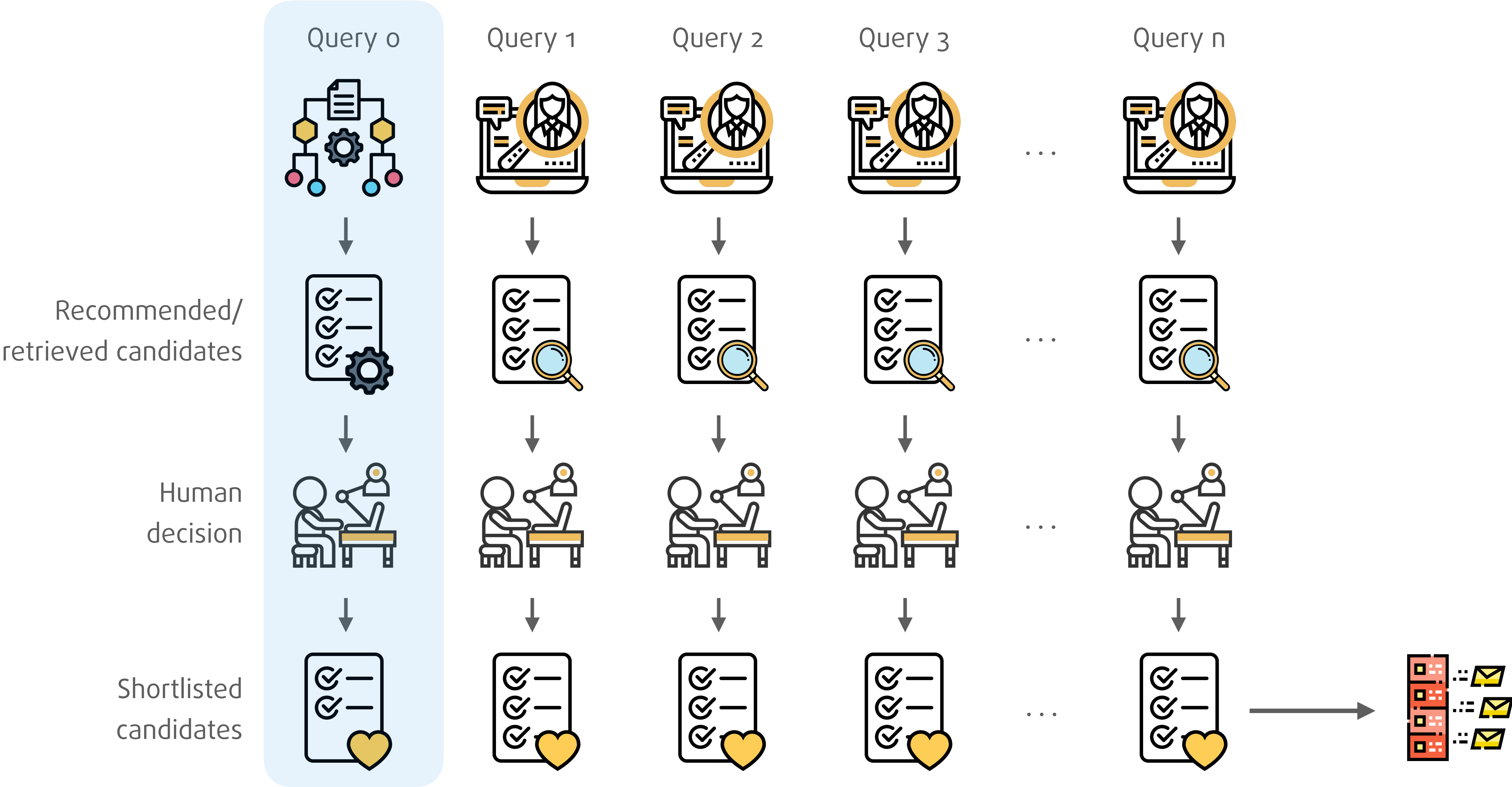
CANDIDATE RECOMMENDATION



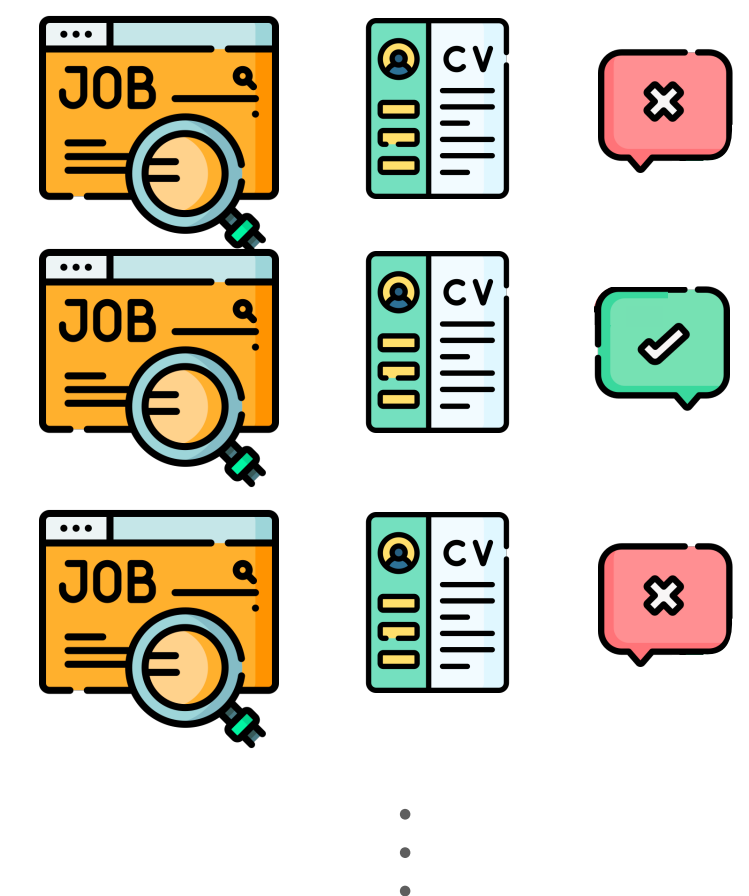
CANDIDATE RECOMMENDATION



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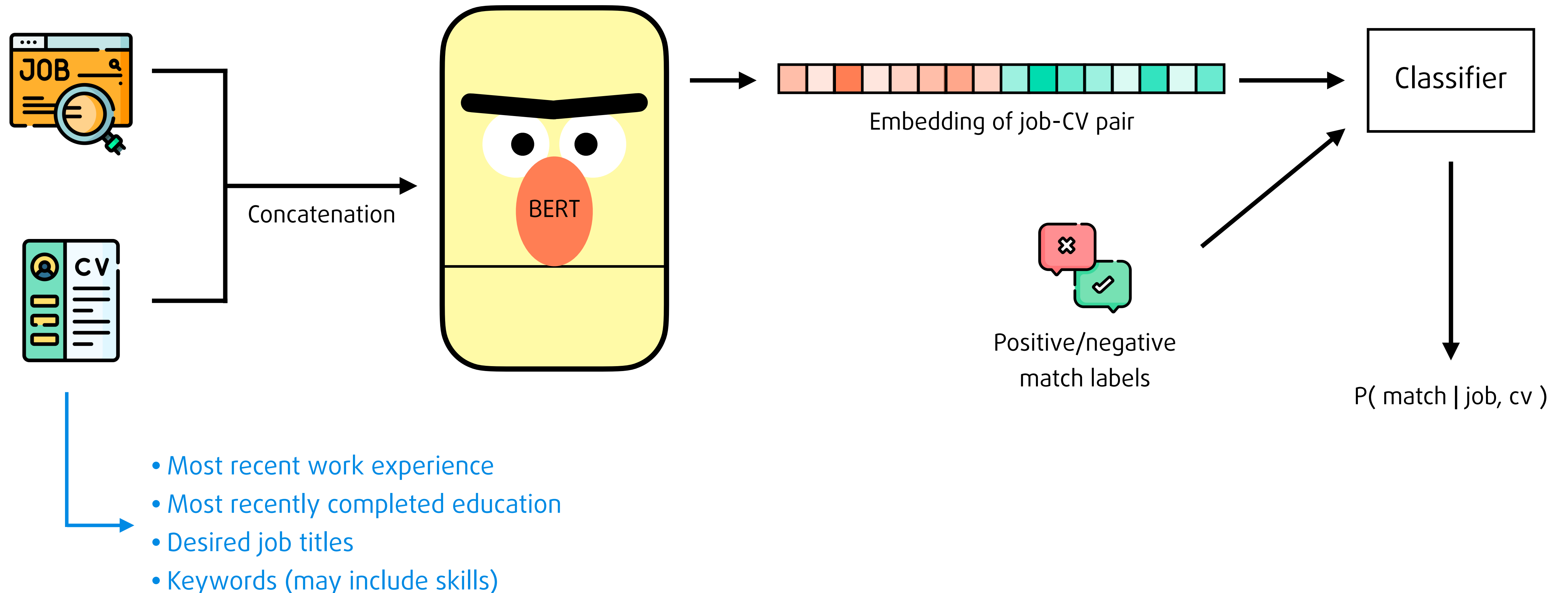


- ▶ Goal is to **support recruiters with recommendations** instead of replacing them
 - Relevant recommendations should result in **shorter sessions** and more efficient recruiters
- ▶ Algorithm development
 - **Collaborative filtering** baselines → using past interactions between job seekers and job ads (“People who applied for job X also applied for this job”)
 - Item-based k-Nearest Neighbor
 - Bayesian Personalized Ranking
 - Problems: **cold start** (each job is new!) and **data sparsity** (few interactions!)



- ▶ **Content-based filtering** → using semantic representations of jobs and CVs to match them
 - Generated **embeddings** of job ads and CVs using **word2vec**, **doc2vec**, and (Danish) **BERT**
 - Pre-trained as well as **fine-tuned** on ~260,000 CVs and ~426,000 job ads
 - Standard matching between job ad and CV embeddings using **FAISS** library
 - Development iterations
 - **Iteration 1:** Full-text embeddings vs. embedding **only job titles**
 - **Iteration 2:** Hybrid algorithm that **incorporates the interaction history** embedding of job titles only
 - ★ A CV is represented by the average of all job (embeddings) they interacted with
 - ★ A job is represented by the average of all CV (embeddings) that interacted with it (**cold start issue**)

- **Iteration 3:** Matching CVs and jobs using **sentence-pair classification**

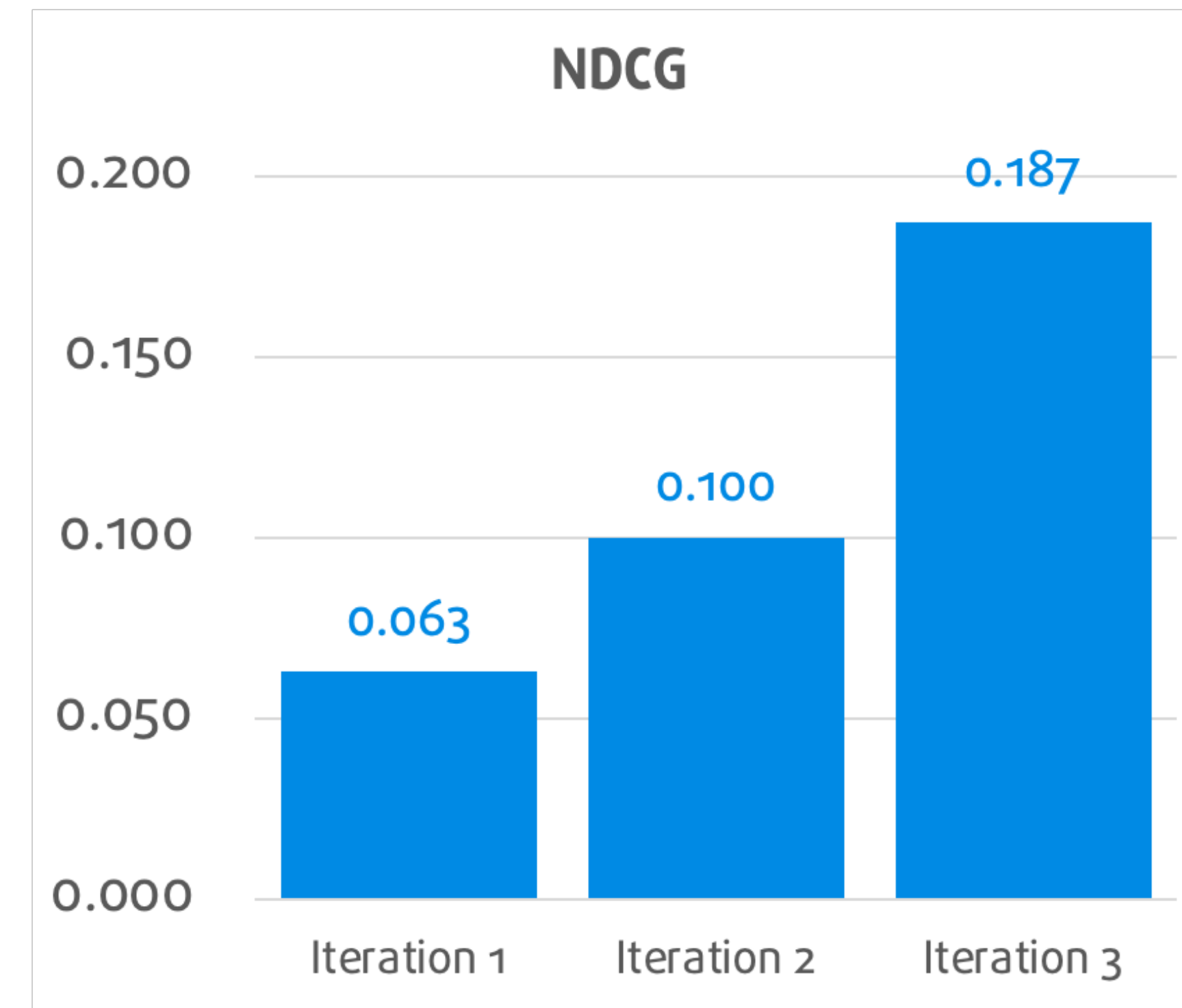


► **Offline** evaluation

- Iteration 3 outperforms the existing prototypes by a wide margin

► **Online** evaluation (of iteration 3, April-Nov 2023)

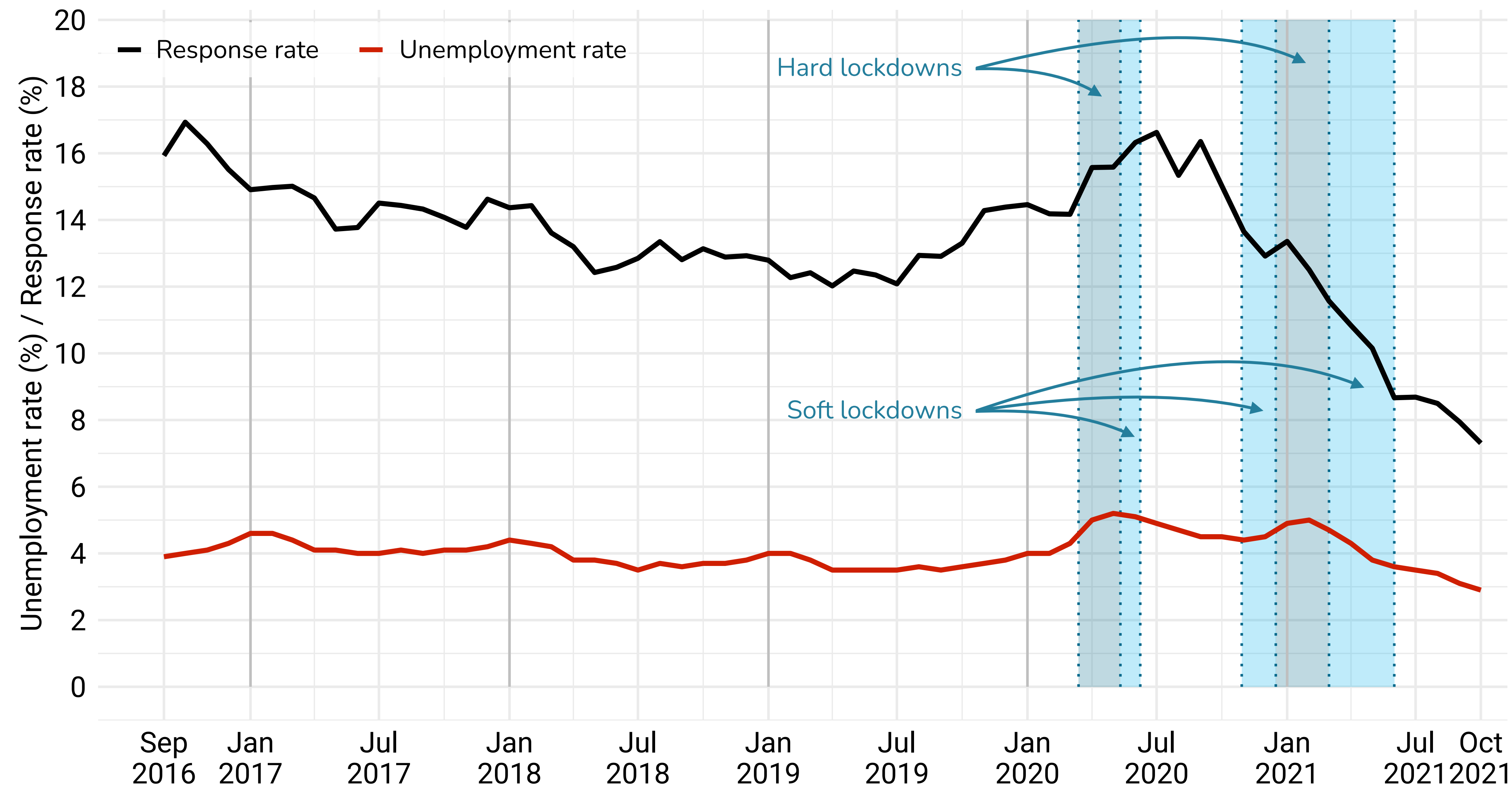
- **11.5% higher response rate** when viewing the list of recommendations
- **12.8% fewer queries** submitted
- Around **8 out of 23** candidates to be contacted are in the list of recommendations
- **Lots of effort** went into implementing A/B testing infrastructure at Jobindex



► Lessons learned

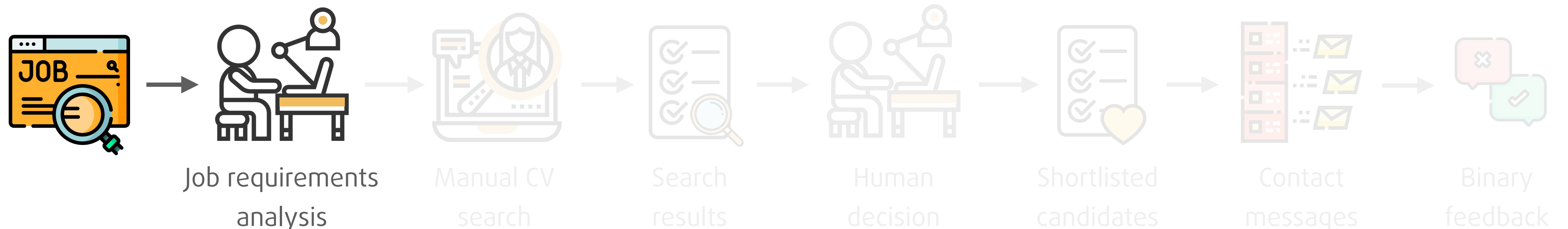
- Habits can be **hard to break** (~40% ignore the recommendations)
- **Communication** and **involvement** is key! (fear of being replaced vs. lack of trust)
- ~~Check Double-check~~ **Triple-check for bugs!**
- **Pre-filtering the candidate set** can be used to **offset** costly sentence-pair classification
- Important to **coordinate A/B tests with other departments**
- Success **partially** depends on **external factors**

CANDIDATE RECOMMENDATION :: FINDINGS



Part 3

- ▶ Work by Qiuchi Li on skill extraction from job ads and CVs
 - Li, Q., & Lioma, C. (2023). **Joint Extraction and Classification of Danish Competences for Job Matching**. In European Conference on Information Retrieval (pp. 475-483). Springer.
- ▶ Future work
 - Distinguishing between primary and secondary skills
 - Renewed effort on integrating this in the recommendation algorithm



- ▶ Recruiters need to send contact emails to matched candidates asking them to apply for the job
→ currently, all candidates receive the same message
 - Goal is to **automatically** generate **personalized** contact emails!
 - Recruiters typically follow **template-filling practices** when writing contact emails, so the challenge is to **automatically generate candidate-specific text fields**
 - Core challenge is the generation of a **motivational sentence**, which should convince the candidate to apply



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- ▶ Incorporating other features
 - Full-time vs. part-time, renewed look at integration of extracted skills
- ▶ Further integration between recommendation and message generation
- ▶ Multi-sided fairness for algorithmic hiring
 - Multi-stakeholder approach to fairness in algorithmic hiring
 - Development of fairness dashboard for Jobindex
 - Fairness-aware candidate and job recommendation algorithms
- ▶ Career path prediction
- ▶ Generative AI support for job seekers



THANKS FOR YOUR ATTENTION!