# Personalized Search

## Building a prototype to infer the user's interest

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Technology Product Owner Search

Wolters Kluwer

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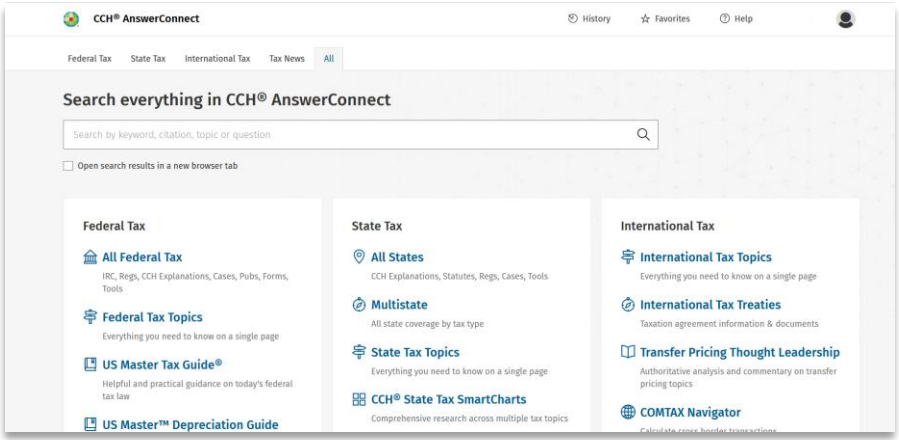
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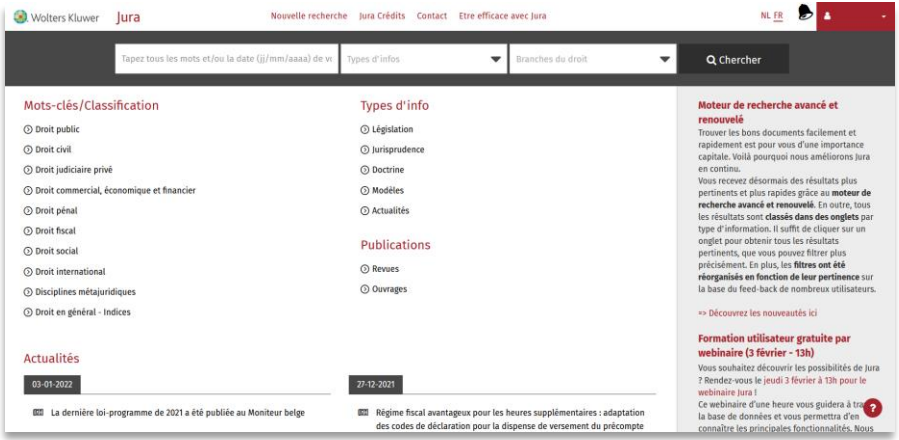
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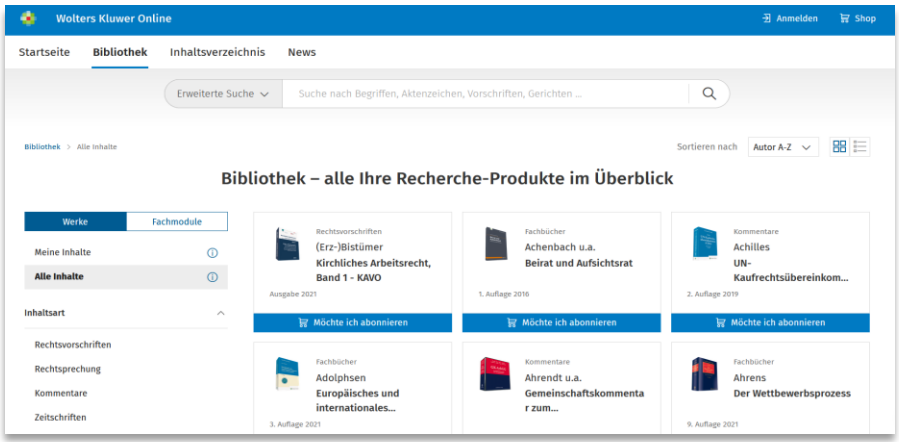
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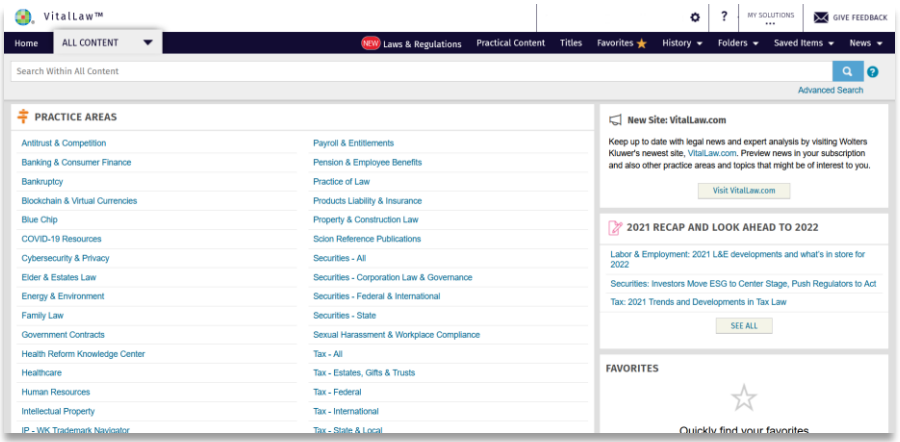
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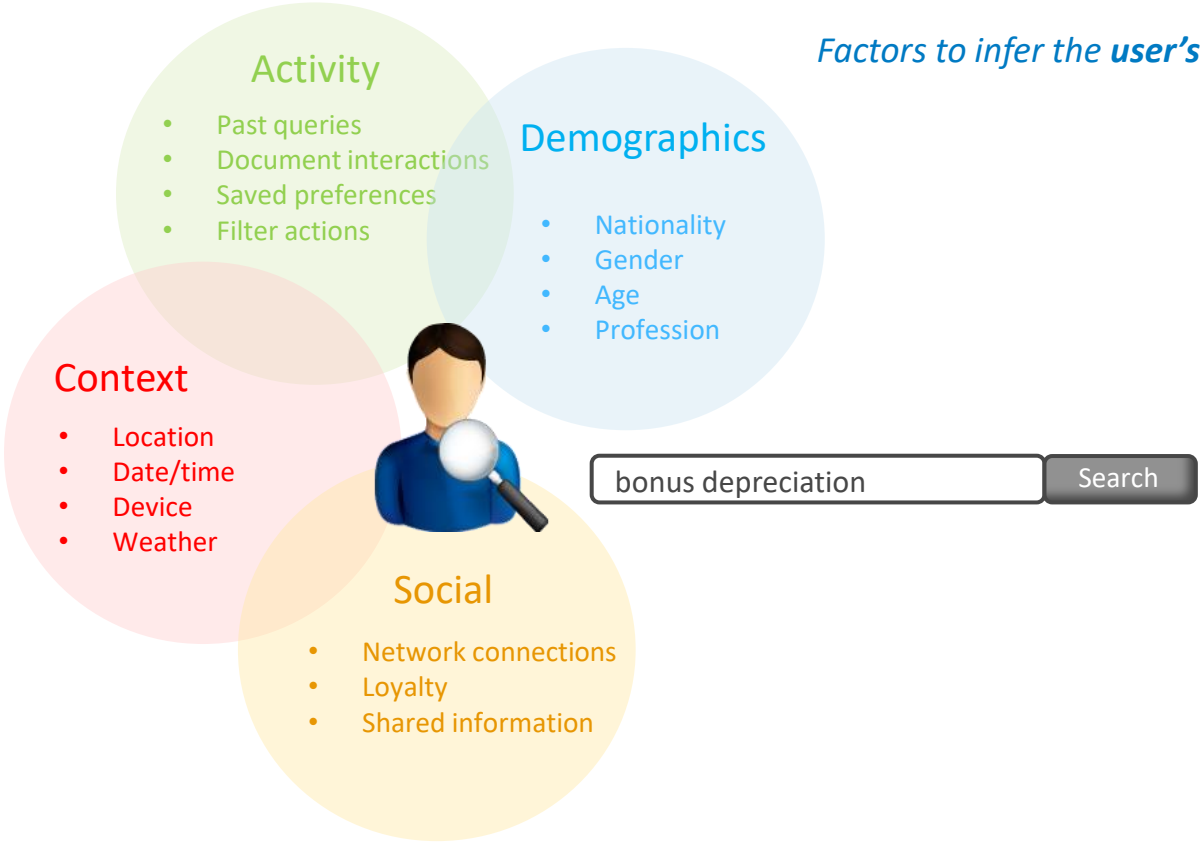
# Make search better through **Personalization**….a controversial topic

## Wikipedia says

**Personalized search** is web based search results that are tailored specifically to an individual's interests by incorporating information about the individual beyond the specific query provided.

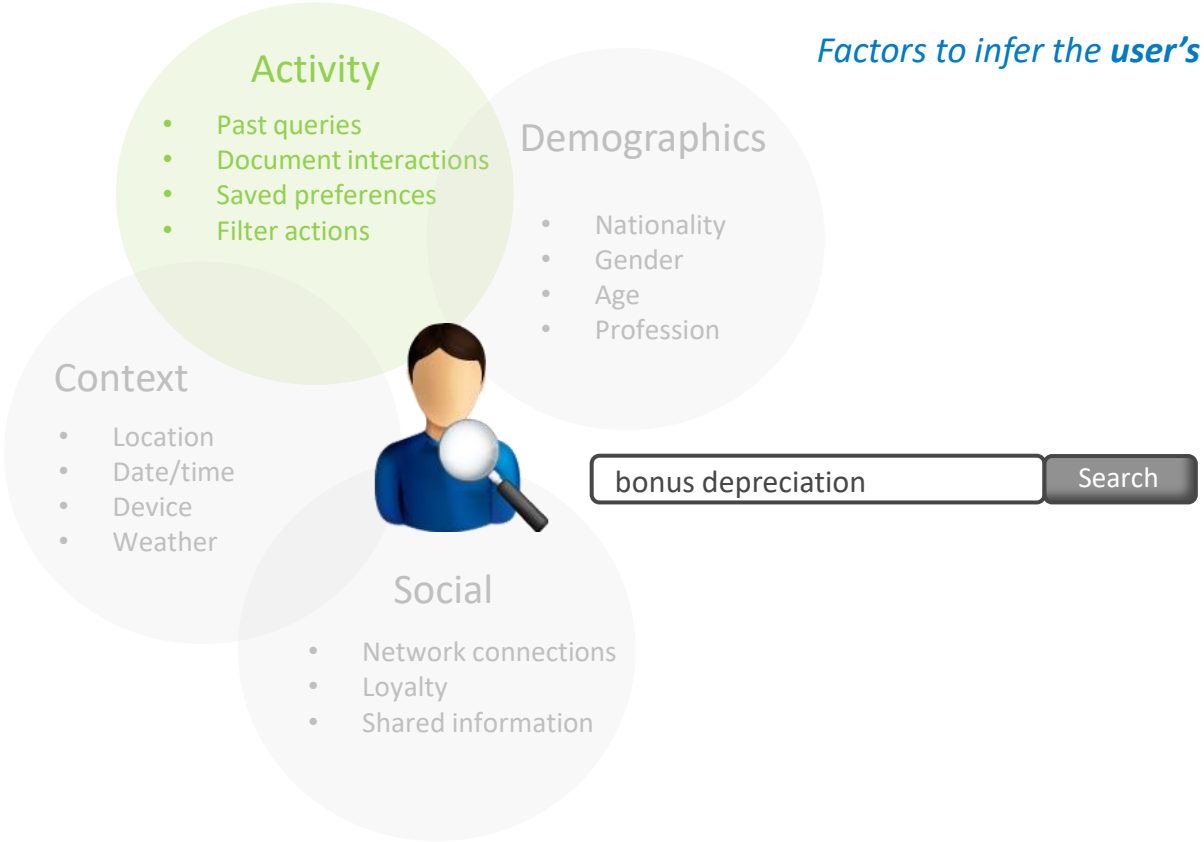
# What could make search “personal”

*Factors to infer the **user’s interest***



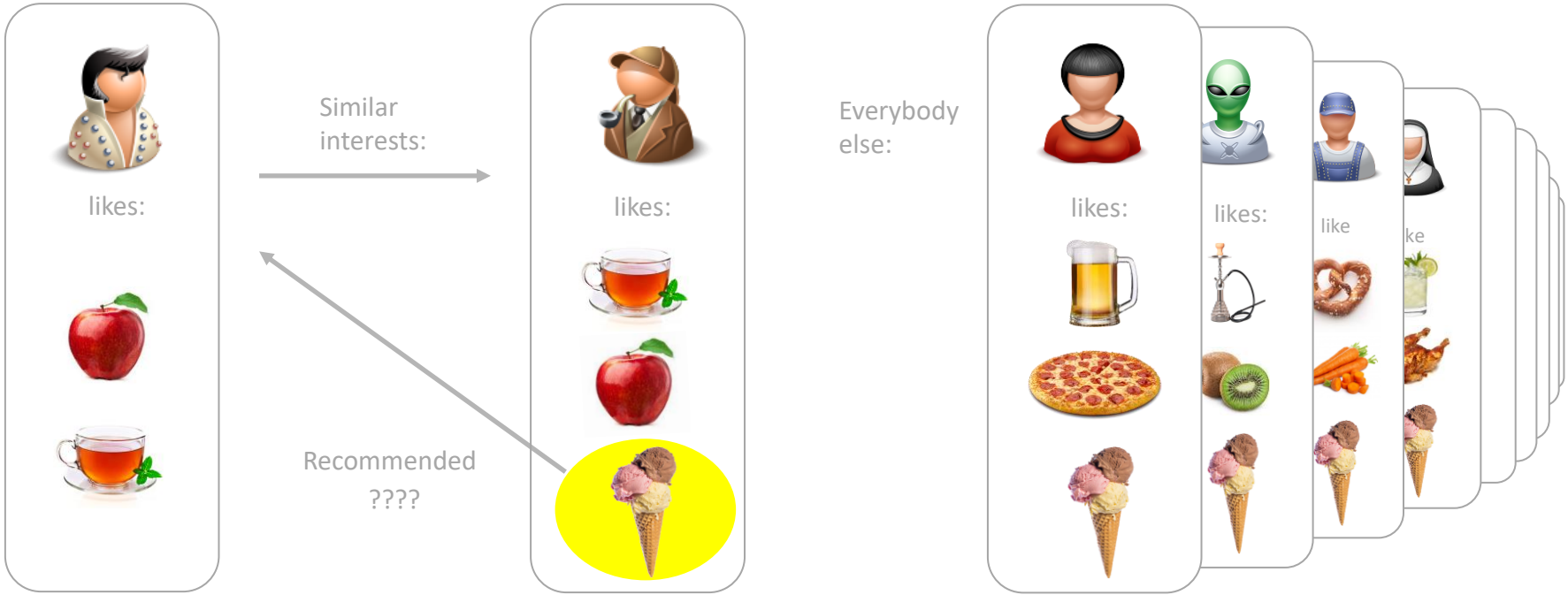
# What could make search “personal” (this PoC)

*Factors to infer the **user’s interest***



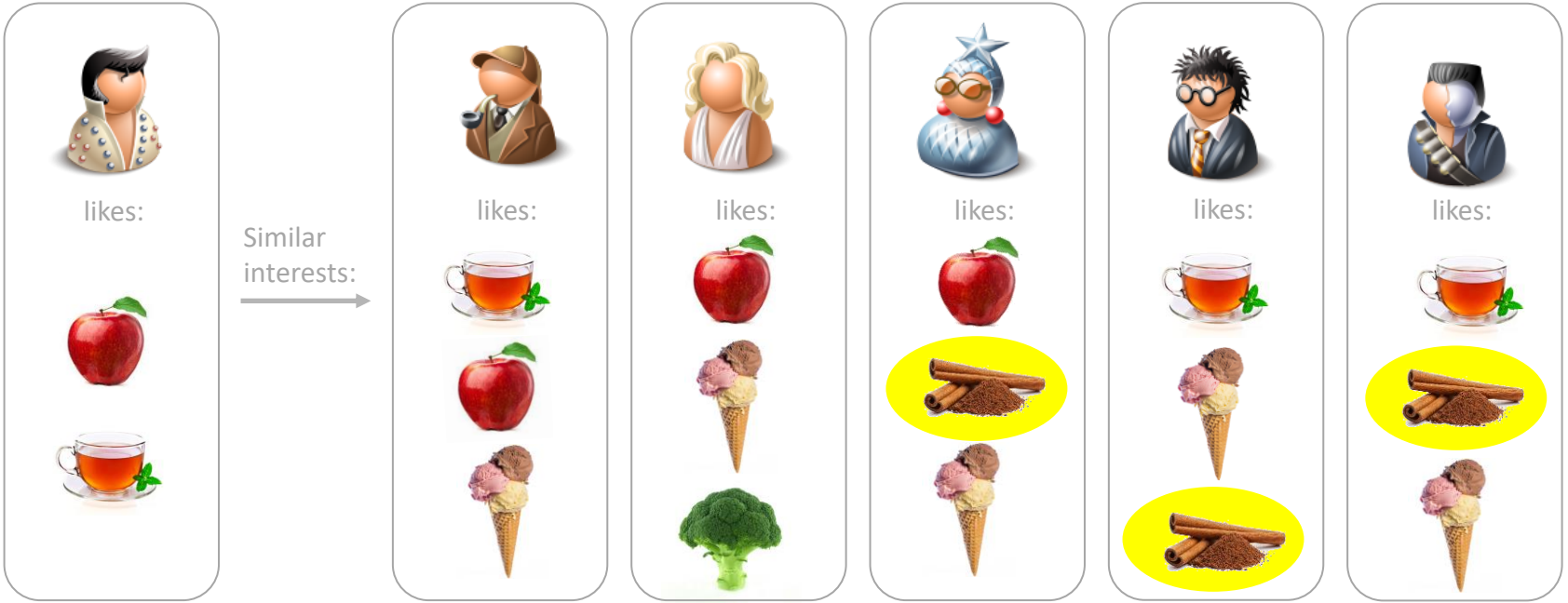
# Hypothesis

*The basis for **Personalized Search** is a **Recommendation Engine** which is based on an index of **user activity** that allows to infer the **user's interest** via **collaborative filtering**.*



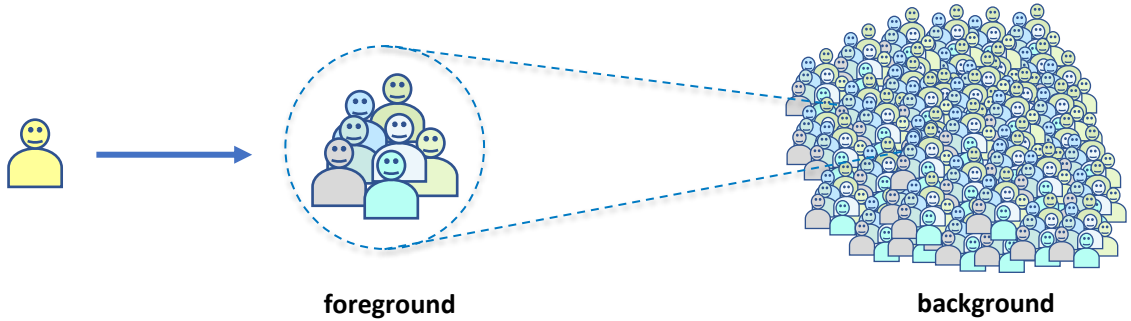
# Collaborative filtering & anomaly detection

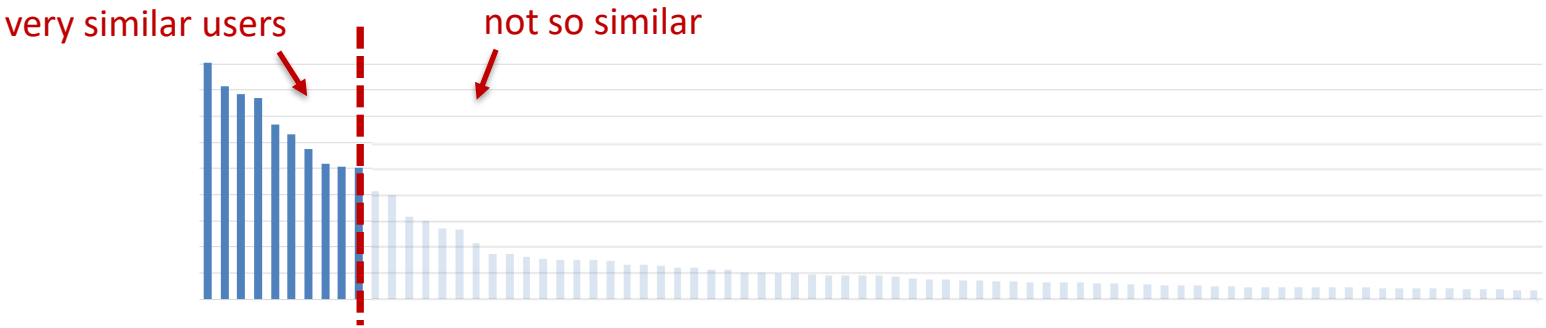
- *Find users with **similar interests***
- *Recommend items with an **unusually high presence** in this group compared to the rest*



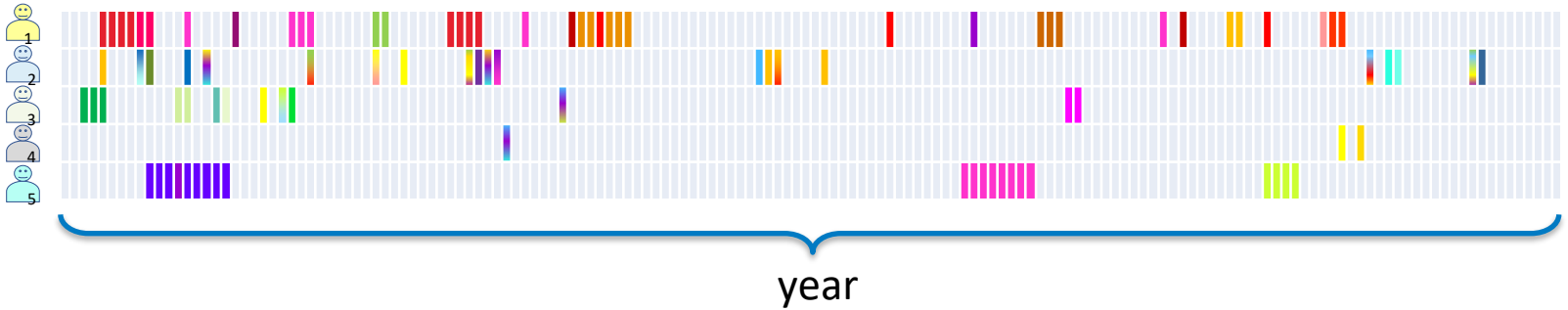
# Collaborative filtering & selecting the foreground

- *Find only users with **very similar interests***
- *Balance between similarity and volume*



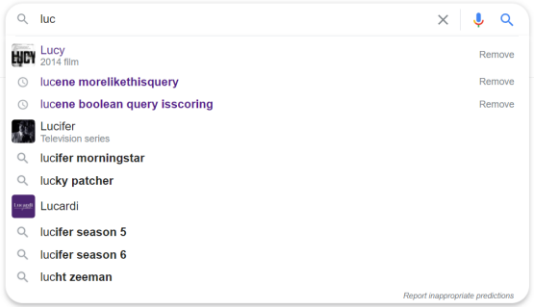
# What is the ideal time window to infer the user's interest?





# Example extremely temporary personalization

1

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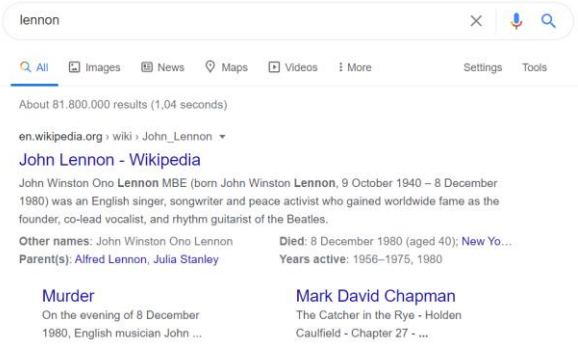


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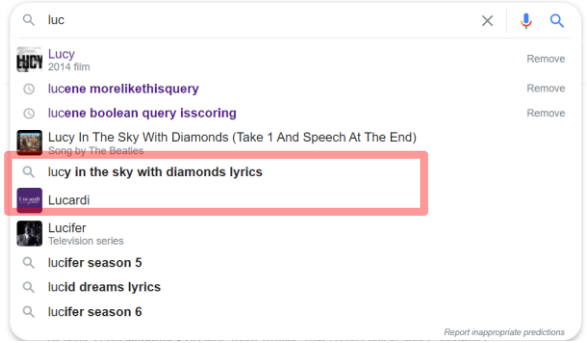


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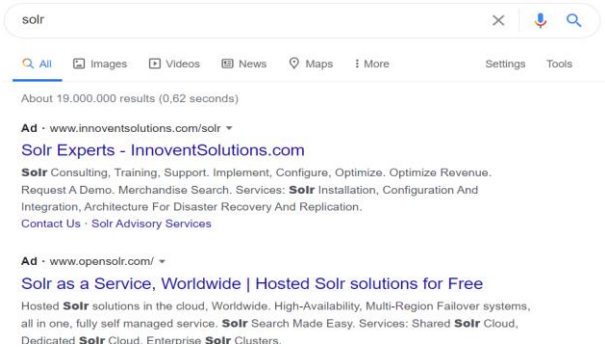


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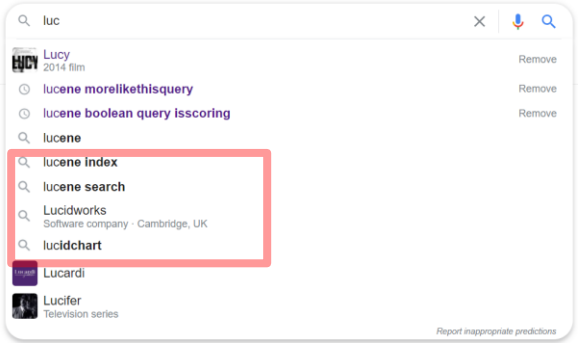
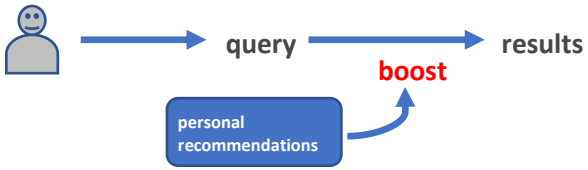
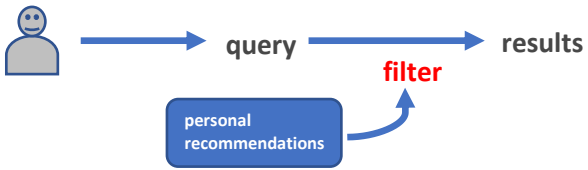


# How to apply the inferred user's interest?

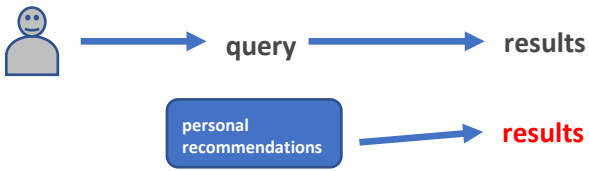
as a boost:




as a filter:

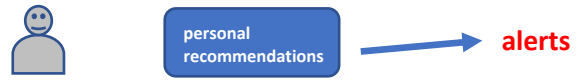



as a separate result set:




as interesting items:


as alerts:




as query suggestions:

# Goals of this PoC

## How to build it?

What can we do on our existing technology stack?

## In what cases to apply it?

Where is the need for personalization? What form is needed?

## What data do we need?

Define ‘additional’ data sources; cleaning of noise

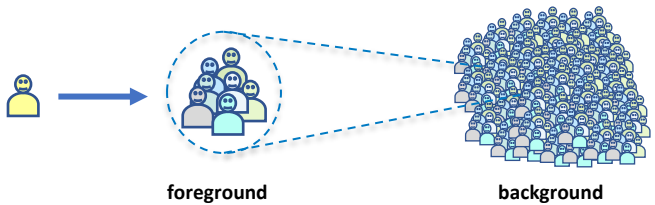
## How to measure success?

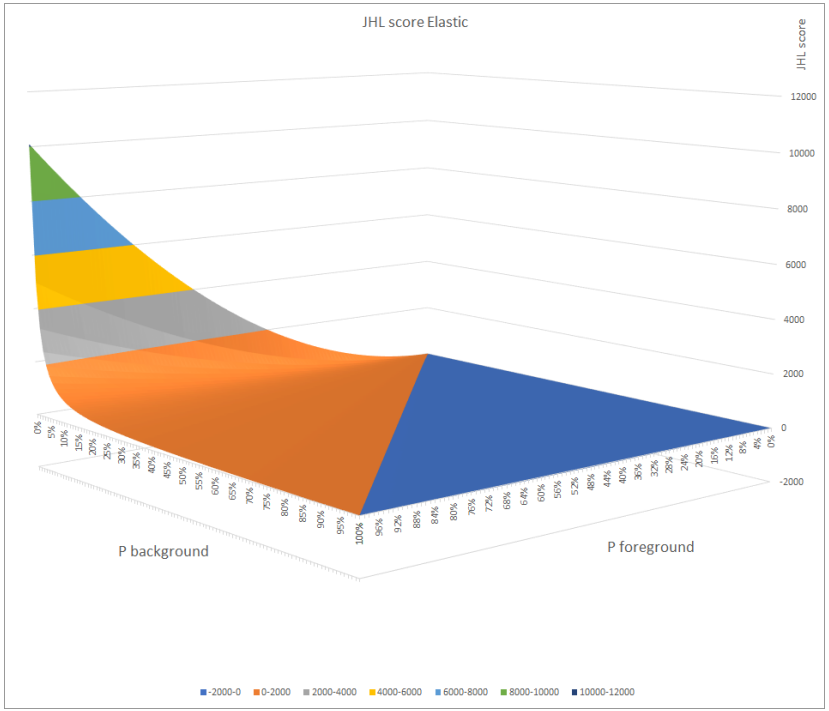
Can we test/tune it offline? How to A/B test online?

- Technology
- Need
- Data
- Verification

# Finding a technology for anomaly detection

elasticsearch Significant Terms



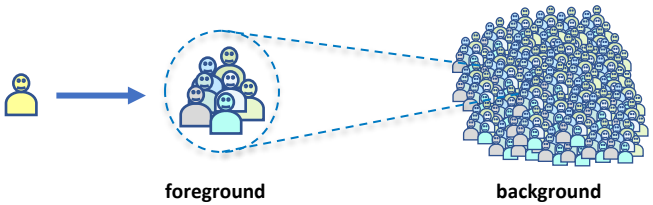

JLH score in Elastic = `(fg_percentage - bg_percentage) * (fg_percentage / bg_percentage)`

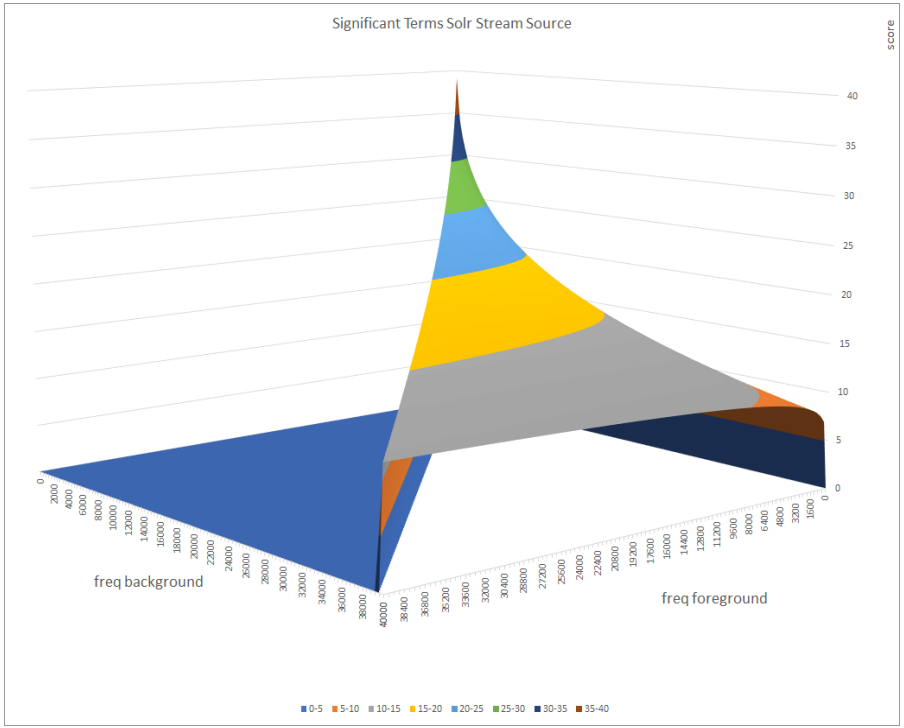
# Finding a technology for anomaly detection

Solr

## Significant Terms

Stream source




Solr's SignificantTerms score = `(log(freq_foreground)+1) * (log( (numDocs + 1)/(freq_background + 1) ) + 1)`

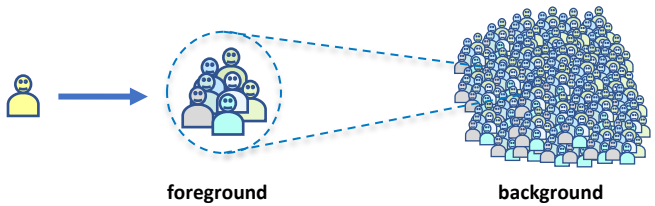
(SignificantTermsStream.java)

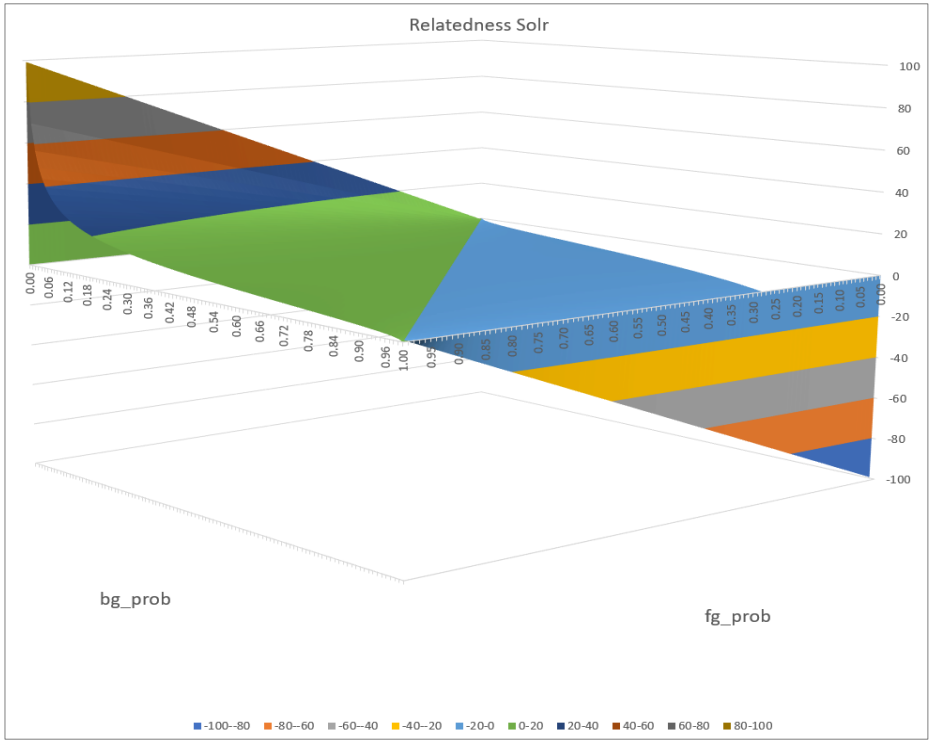
# Finding a technology for anomaly detection

Solr

## Reletedness() JSON Facet function

a.k.a. Semantic Knowledge Graph




$$\text{Z-score} = \frac{\texttt{fq\_count - fg\_size * bg\_prob}}{\texttt{sqrt(fg\_size * bg\_prob * (1 - bg\_prob))}}$$

(RelatednessAgg.java)

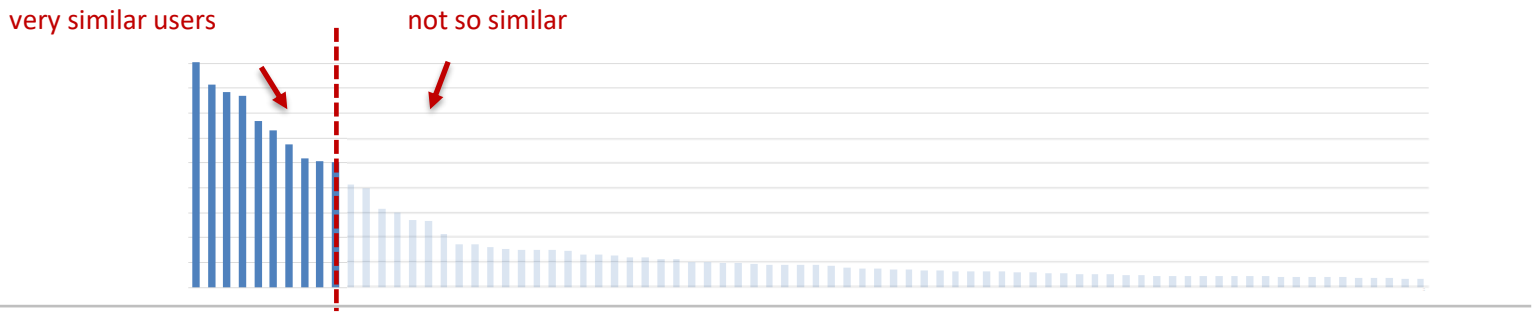
```
bg_prob = bg_count / bg_size
fg_prob = fg_count / fg_size
```

# Selecting similar users

- MLT standard Solr query parser to find all similar documents
- MLTPLUS home made query parser to only keep documents that are *very* similar.

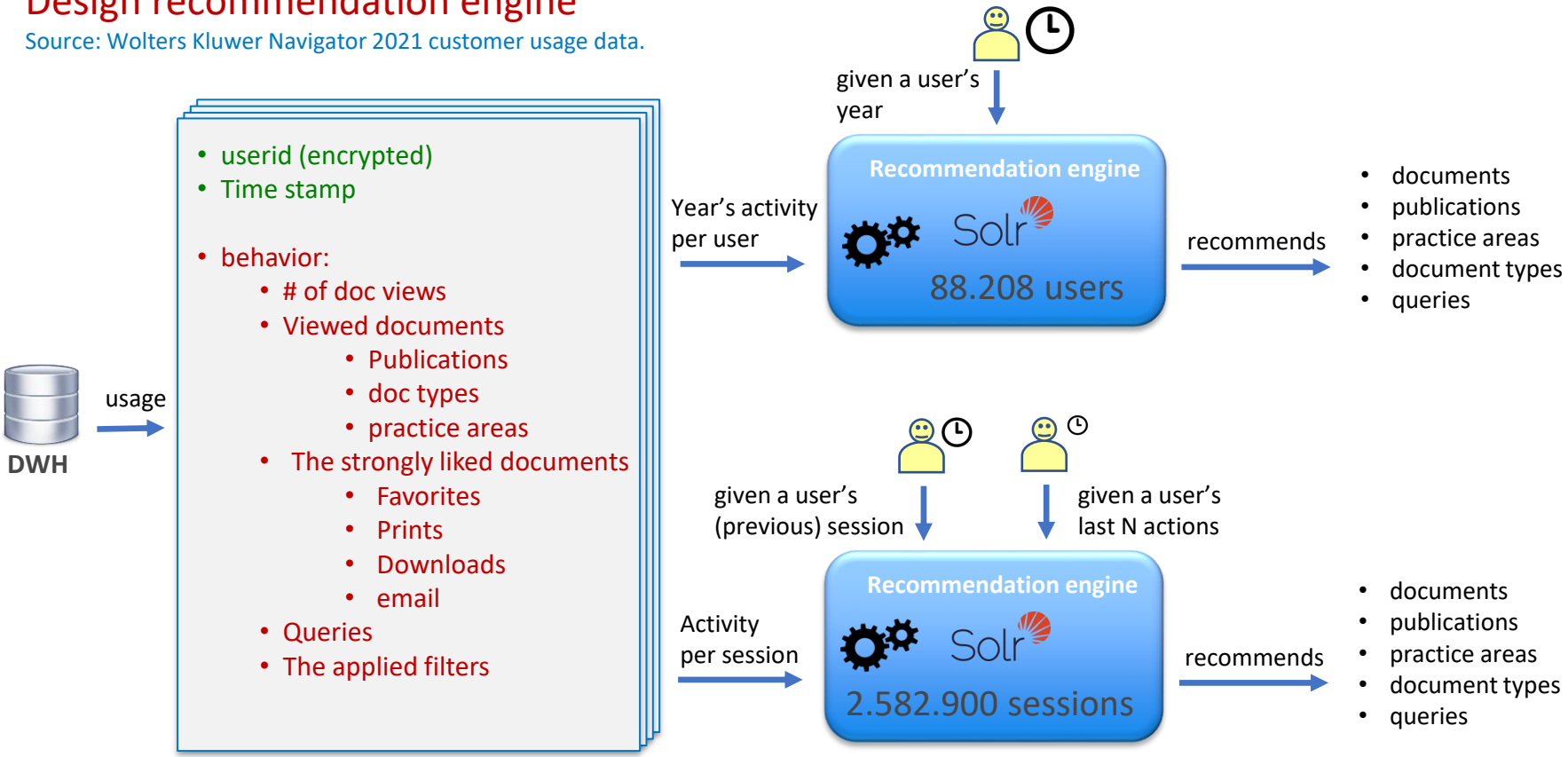
## Wrapping **mlt** into **mltplus**

```
(
  ({!wkmltplus minqt=3  mm=3  mmp=20 score=false}{!mlt v=$user maxqt=200 mintf=1 mindf=1 qf='suas'}) OR
  ({!wkmltplus minqt=10 mm=5  mmp=10 score=false}{!mlt v=$user maxqt=200 mintf=1 mindf=1 qf='docdocviews'}) OR
  ({!wkmltplus minqt=10 mm=10 mmp=70 score=false}{!mlt v=$user maxqt=200 mintf=1 mindf=1 qf='publicationdocviews'}) OR
  ({!wkmltplus minqt=10 mm=20 mmp=85 score=false}{!mlt v=$user maxqt=200 mintf=1 mindf=1 qf='palevel3'})
)
AND
({!filters param=$scope})
```

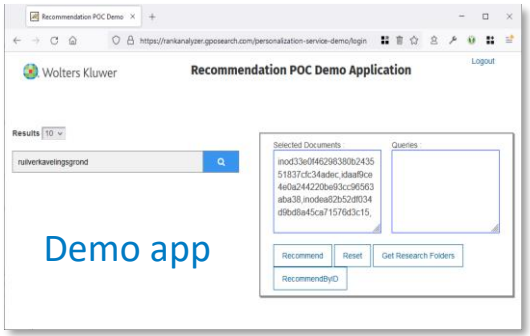


# Design recommendation engine

Source: Wolters Kluwer Navigator 2021 customer usage data.



# Personalization prototype




user's (last) year ID
*long-term personalization*

user's (last) session ID
*short-term personalization*

user's current actions
*Very short-term personalization*

content of personal folder

Recommended
- documents
- publications
- practice areas
- document types
- queries

**Personalization Service**

**Recommendation engine**

88.208 users

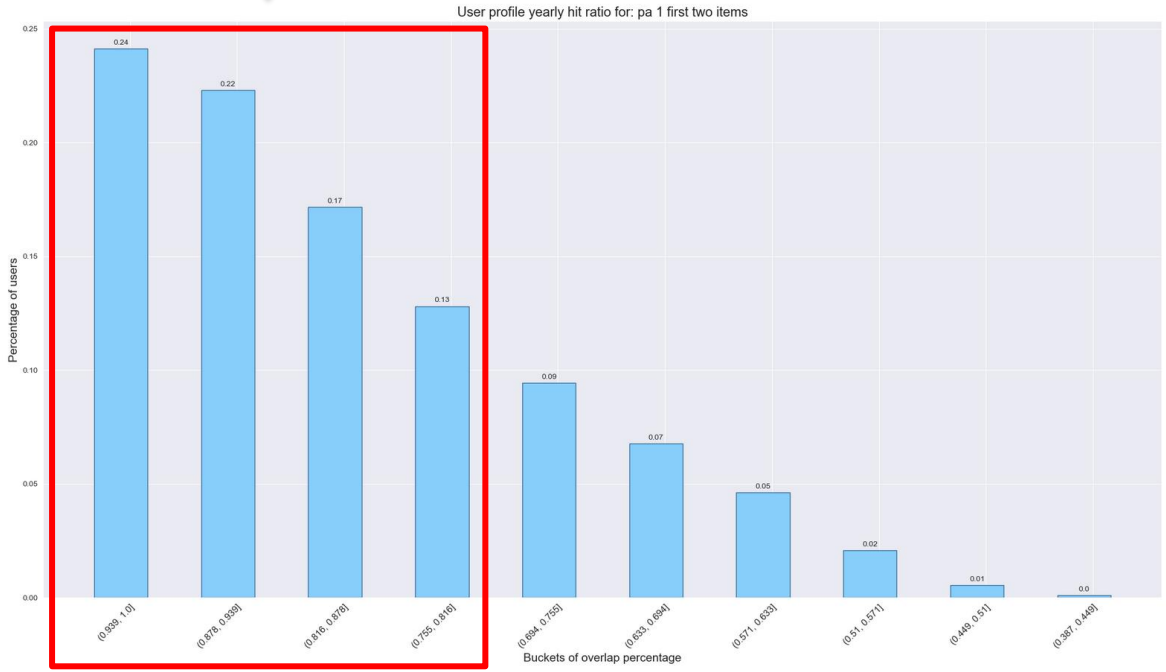
2.582.900 sessions

Solr

# What is the need for personalization based on a year history ?

## How consistent is the user's interest through the year?

32% users > 20 actions / year | 68% users < 20 actions / year

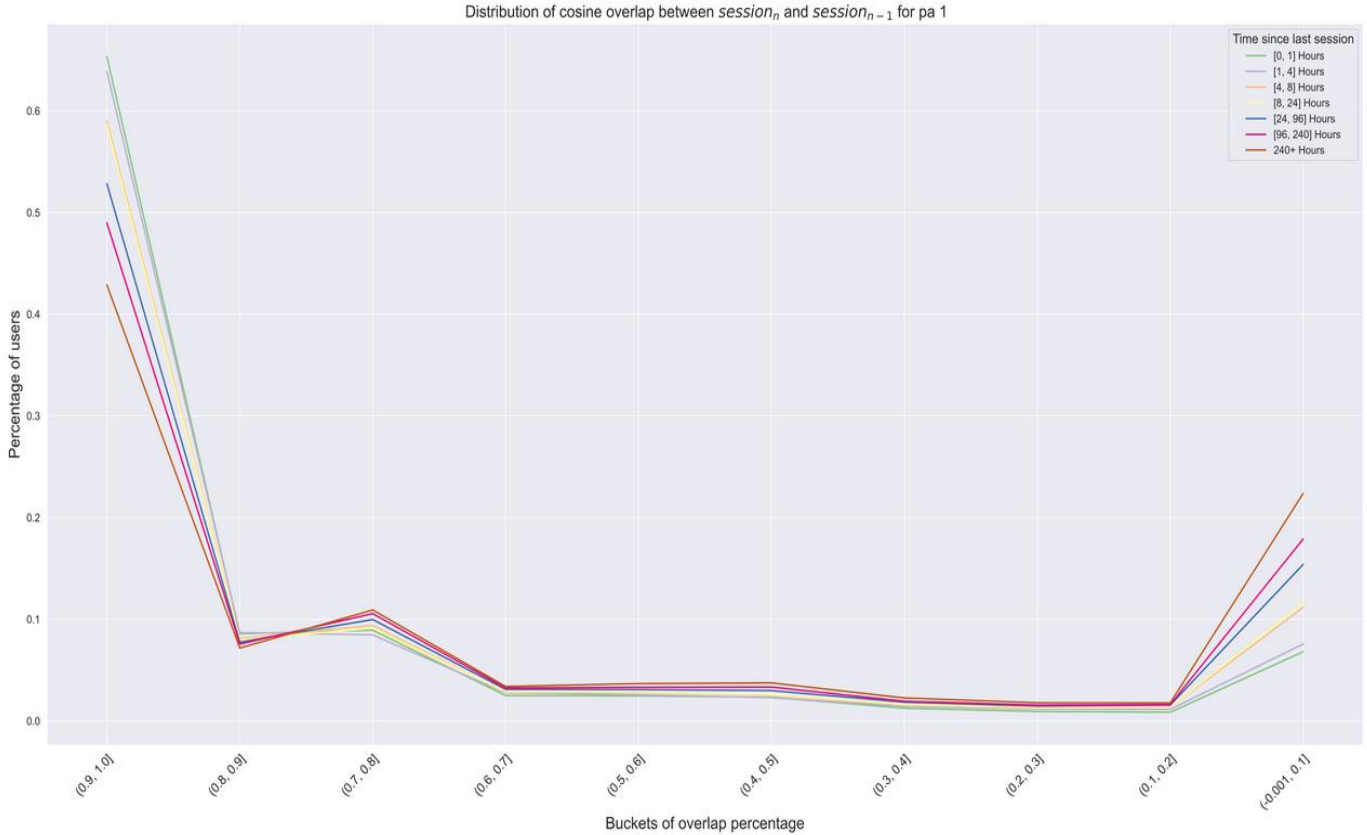



From the 32% most active users: 66% have viewed (relatively) consistently documents of the same 2 practice areas.

So for 21% of all users recommending PAs based on the activity of past year *might* make sense.

# What is the need for personalization based on the last session ?

## How much does the last session predict the interest of the next one?




For 42% of the users the previous session has a 0.9-1.0 consine overlap with the current one w.r.t. PA interest.

This rises to 66% when the time between sessions get shorter.

## How to measure success?

- Offline:
  - Manual tests by a domain expert
  - Build a model that predicts the likelihood that the previous session predicts the interest of the current one.
  - Replay user sessions and guestimate how much shorter they could have been in case personalization would have been applied.

- Online:
  - Measure clicks on explicit recommendations
  - A/B test (in case recommendations applied as boosts/filters)

# Lessons learned

## Yes we can

We can indeed infer the **user's interest via collaborative filtering** of user actions, using Solr and using usage data from a large Wolters Kluwer product

## What works best

Short-term personalization is applicable to **more users** than long-term personalization (may differ per business case)

## Quality logs needed

The accuracy of the recommendations depends on the **purity/completeness** of the **usage logs**. Preferred: front-end usage logging

## Challenge: testing

Offline testing of personalization is **hard**, but slightly easier for the short-term variant. Online testing **takes time**.

## We're not done yet

Improvement opportunities:

- Use **frond-end logs**
- Better data **cleaning**
- Query **normalization**
- Add **more signals** like filters & autocomplete clicks
- Testing strategies