19 September 2017

The Best Privacy Defense is a Good Privacy Offense

Obfuscating a Search Engine User's Profile

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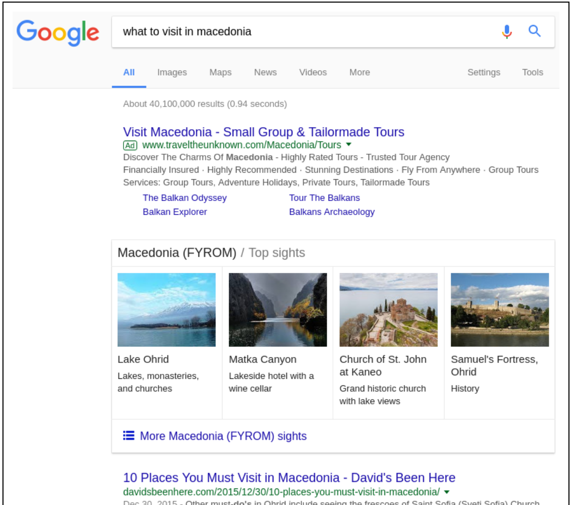
Privacy Defence

- Privacy on the internet is an important and unsolved issue
- Privacy preserving data mining addresses this from a service provider perspective
- From a user’s perspective, what can the user do to ensure the protection of his or her data?

Search Engines



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Lake Ohrid	Matka Canyon	Church of St. John at Kaneo	Samuel's Fortress, Ohrid
Lakes, monasteries, and churches	Lakeside hotel with a wine cellar	Grand historic church with lake views	History

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Dec 30, 2015 - Other must-**do's** in Ohrid include seeing the frescoes of Saint Sofia (Sveti Sofia) Church

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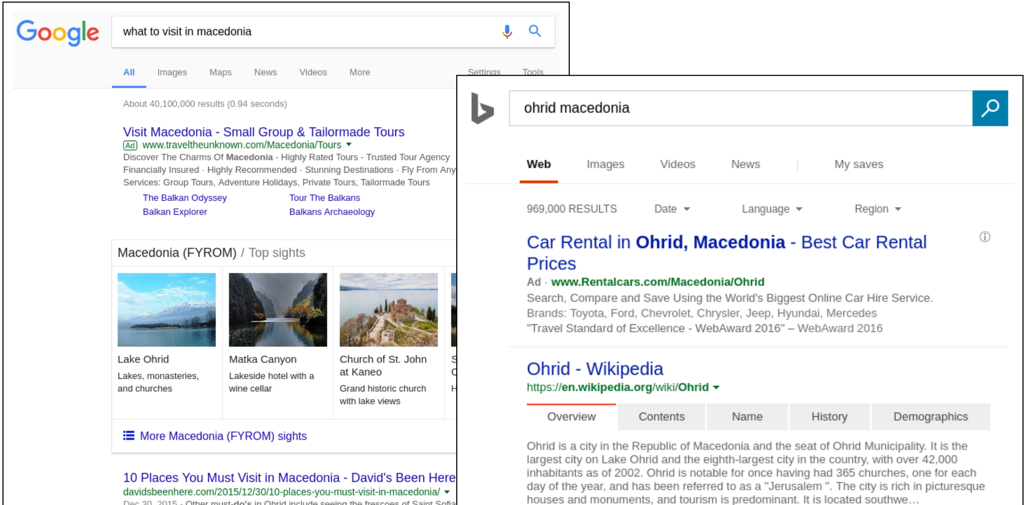

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Ohrid - Wikipedia
https://**en.wikipedia.org**/wiki/**Ohrid**

Ohrid is a city in the Republic of Macedonia and the seat of Ohrid Municipality. It is the largest city on Lake Ohrid and the eighth-largest city in the country, with over 42,000 inhabitants as of 2002. Ohrid is notable for once having had 365 churches, one for each day of the year, and has been referred to as a "Jerusalem ". The city is rich in picturesque houses and monuments, and tourism is predominant. It is located southwe…

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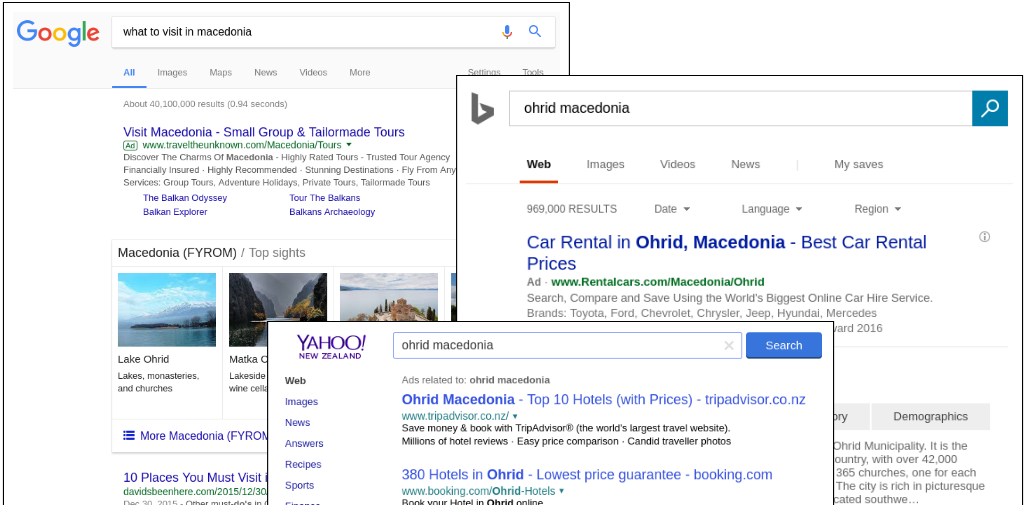

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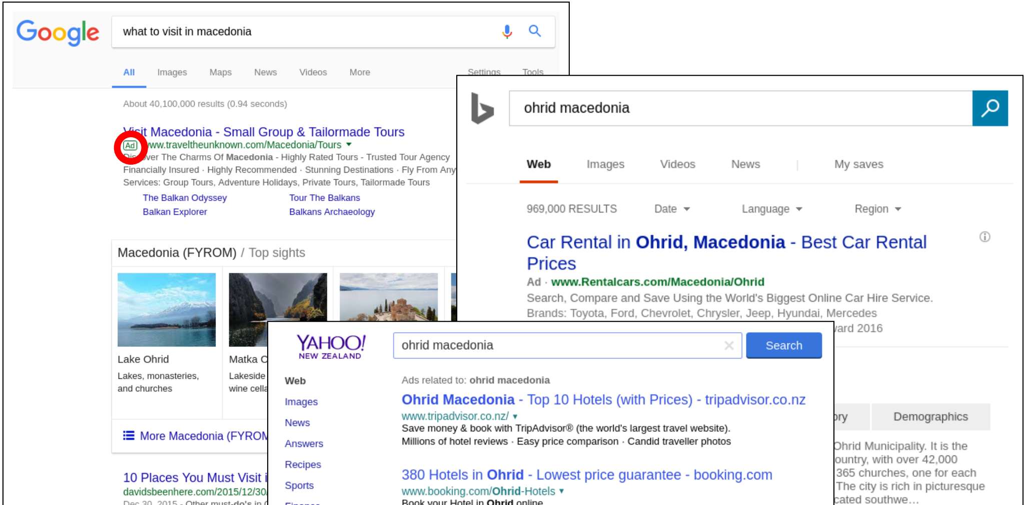

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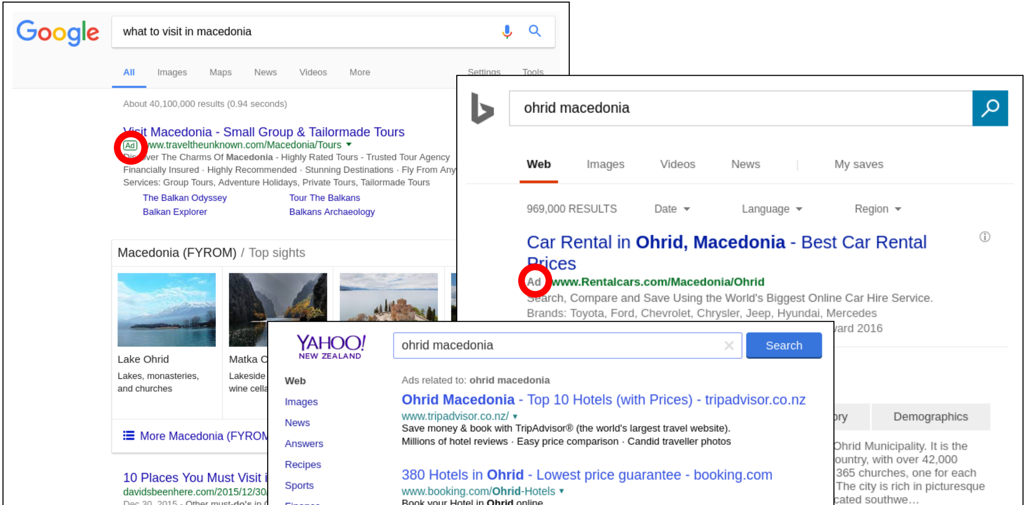

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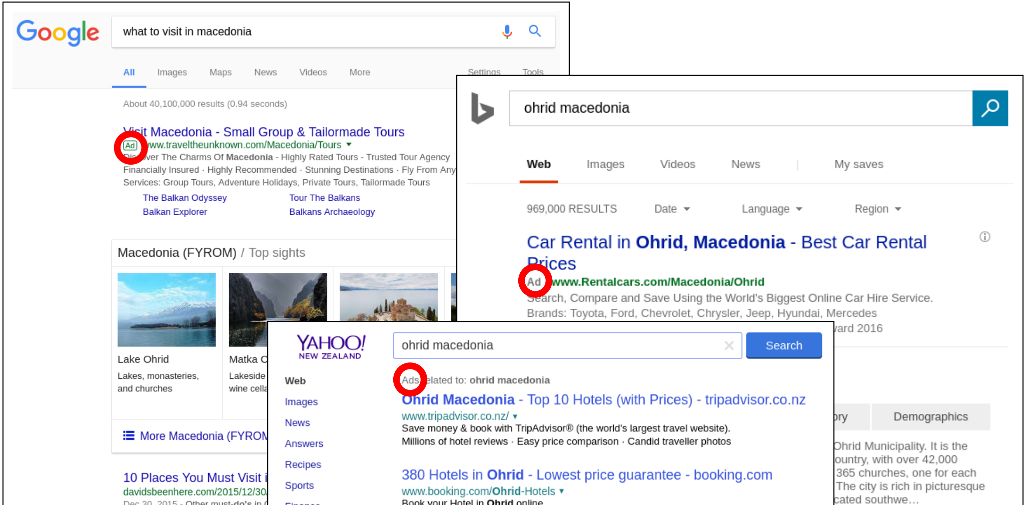

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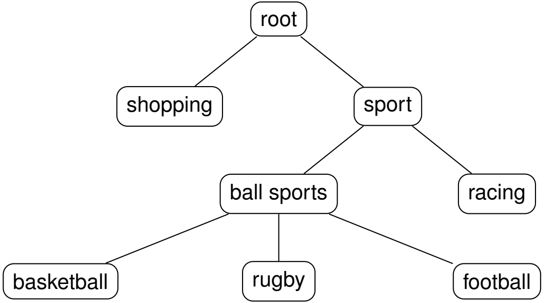
Personalised Advertisement

- Which ad is displayed depends on
  1. The submitted query
  2. **The user profile**
- Ads are assigned to categories
- Users are assigned to categories



Privacy Offense

- To implement a method to defend privacy, we need

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- To implement a method to defend privacy, we need
  - A way to measure the privacy, i.e. objective function

Privacy Offense – Goal

- Objective function:

$$\sigma(\kappa_i, P) = \sum_{p_j \in P, \kappa_j \in T} p_j d_T(\kappa_i, \kappa_j)$$

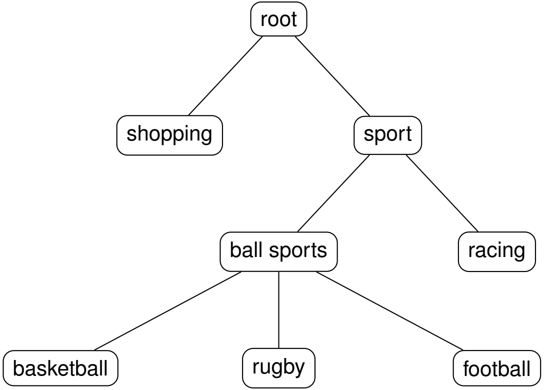
- User interest category κ, distribution of probabilities P, category tree T, tree distance d_T
- Score σ is the weighted distance between user interest category and current category the user is assigned to

Privacy Offense

- To implement a method to defend privacy, we need
  - A way to measure the privacy, i.e. objective function
  - Method to use the feedback (ads)

Category Prediction of an Ad

- Search engines provide example queries for each category
- Use sample queries of category tree as input and train independent classifiers – one for each category
- Classifiers can be applied to queries, as well as any other text
- Predictions on ads work very well due to similar structure of the text



Privacy Offense

- To implement a method to defend privacy, we need
  - A way to measure the privacy, i.e. objective function
  - Method to use the feedback (ads)
  - A set of actions

Actions

Definition of actions to choose one category κ in the set of categories K using category tree T based on reference category κ_{ref}

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- Jaccard Distance
- Normalized Mutual Information

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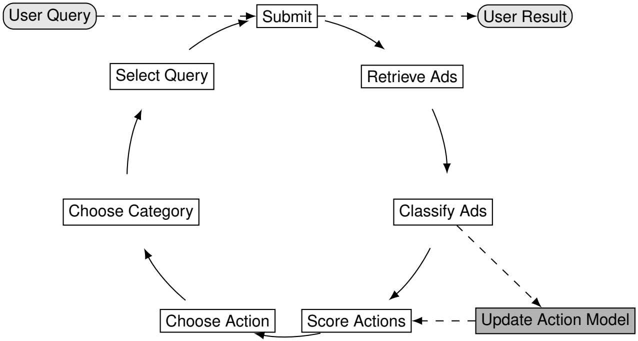

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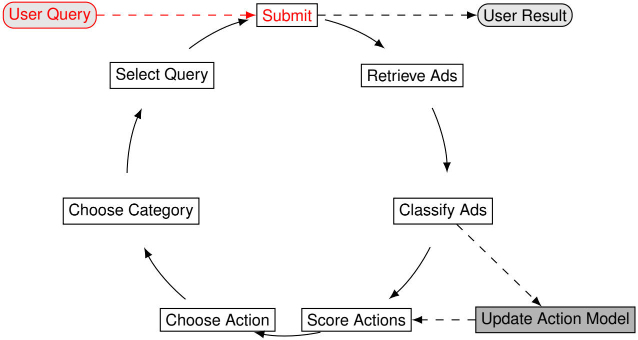

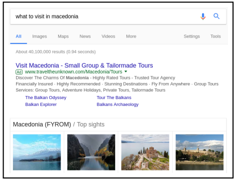
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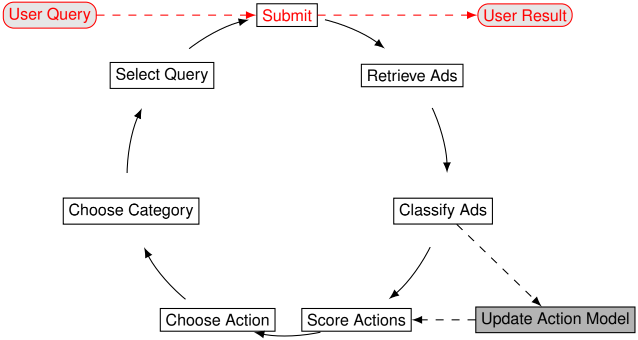

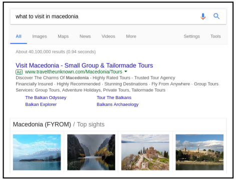

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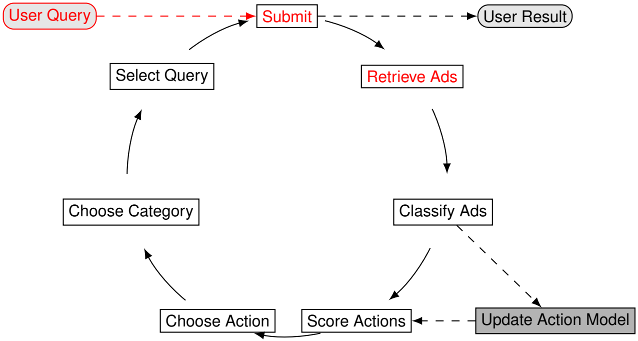

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User Result

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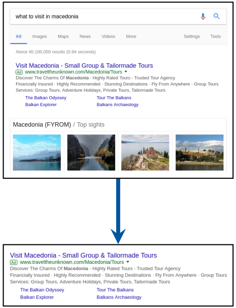
Choose Category

Classify Ads

Choose Action

Score Actions

Update Action Model



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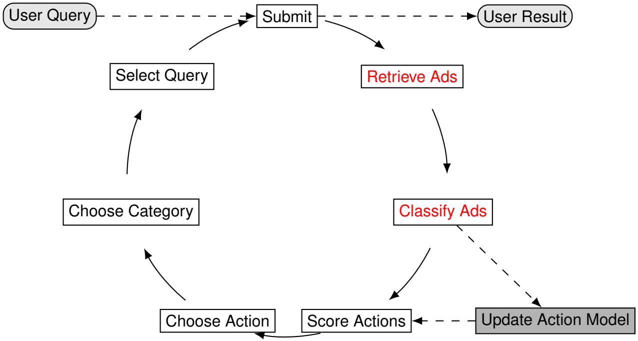

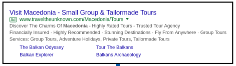
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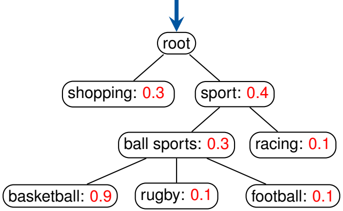

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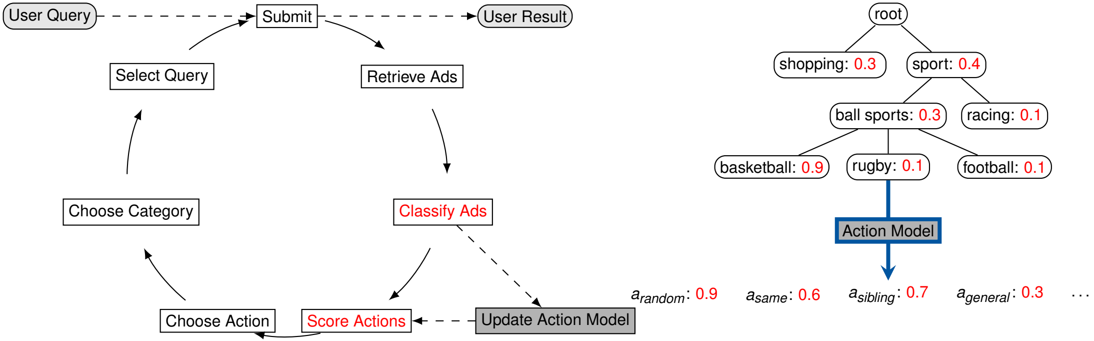

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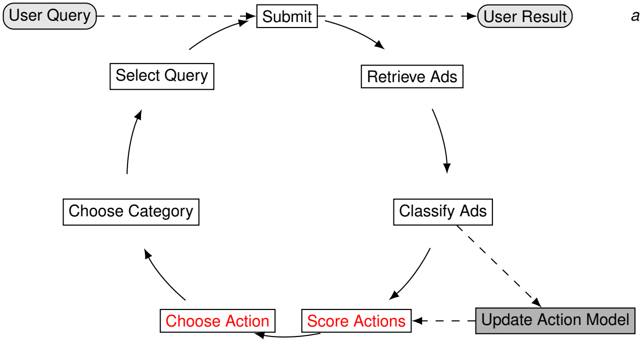

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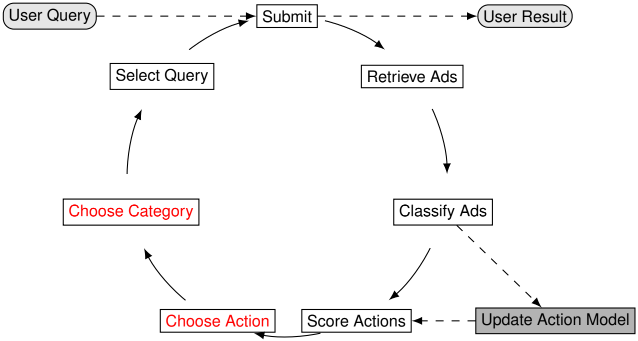

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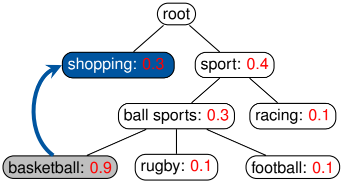

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shopping: 0.3
sport: 0.4
ball sports: 0.3
racing: 0.1
basketball: 0.9
rugby: 0.1
football: 0.1

$$a_{random}(T, \kappa_{ref}) = random\_select(\kappa_r \in K)$$

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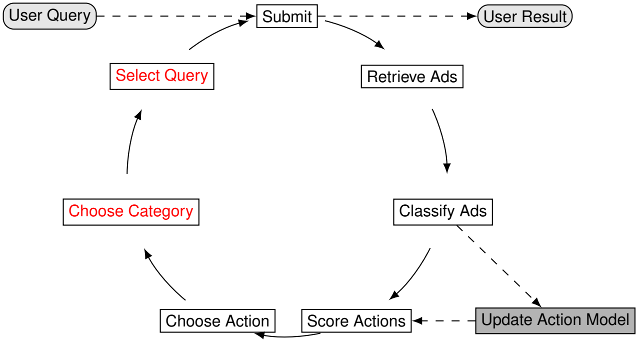

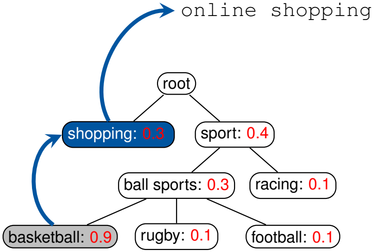

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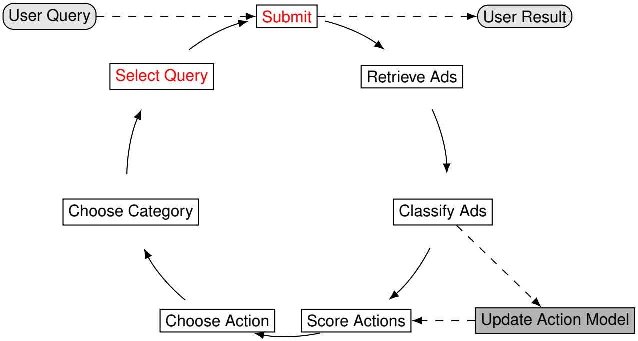
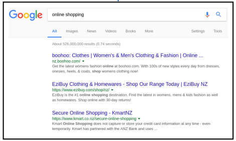


online shopping



online shopping

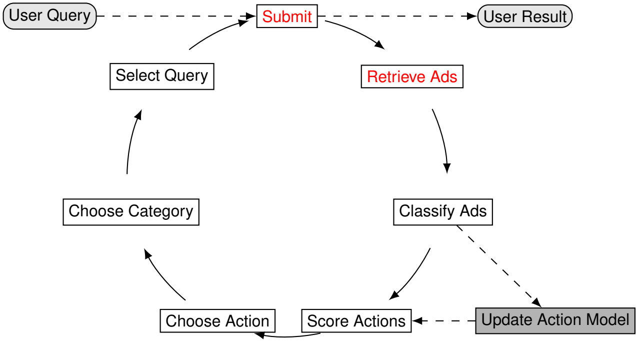
About 526,000,000 results (0.74 seconds)

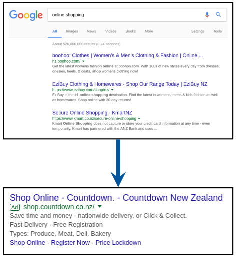
boohoo: Clothes | Women's & Men's Clothing & Fashion | Online ...
nz.boohoo.com/ ▾
Get the latest womens fashion **online** at boohoo.com. With 100s of new styles every day from dresses, onesies, heels, & coats, **shop** womens clothing now!

EziBuy Clothing & Homewares - Shop Our Range Today | EziBuy NZ
https://www.ezibuy.com/shop/nz/ ▾
EziBuy is the #1 **online shopping** destination. Find the latest in womens, mens & kids fashion as well as homewares. Shop online with 30-day returns!

Secure Online Shopping - KmartNZ
https://www.kmart.co.nz/secure-online-shopping ▾
Kmart **Online Shopping** does not capture or store your credit card information at any time - even temporarily. Kmart has partnered with the ANZ Bank and uses ...

Privacy Offense – Method





Google

online shopping

About 526,000,000 results (0.74 seconds)

boohoo: Clothes | Women's & Men's Clothing & Fashion | Online ...
nz.boohoo.com/ ▾
Get the latest womens fashion **online** at boohoo.com. With 100s of new styles every day from dresses, onesies, heels, & coats, **shop** womens clothing now!

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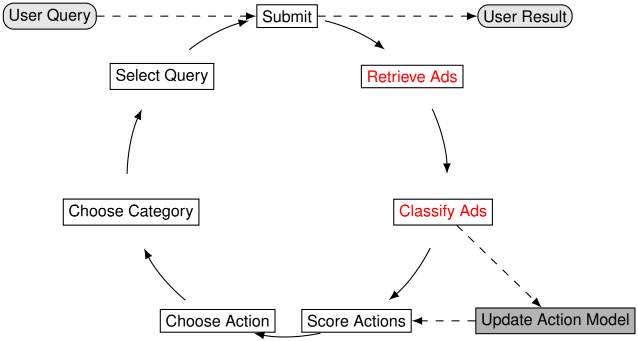
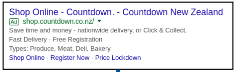
Shop Online - Countdown. - Countdown New Zealand
Ad shop.countdown.co.nz/ ▾
Save time and money - nationwide delivery, or Click & Collect.
Fast Delivery · Free Registration
Types: Produce, Meat, Deli, Bakery
Shop Online · Register Now · Price Lockdown

Privacy Offense – Method





Shop Online - Countdown. - Countdown New Zealand

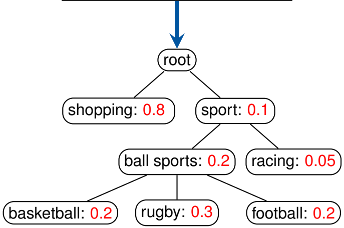
Ad shop.countdown.co.nz/ ▾

Save time and money - nationwide delivery, or Click & Collect.

Fast Delivery · Free Registration

Types: Produce, Meat, Deli, Bakery

Shop Online · Register Now · Price Lockdown



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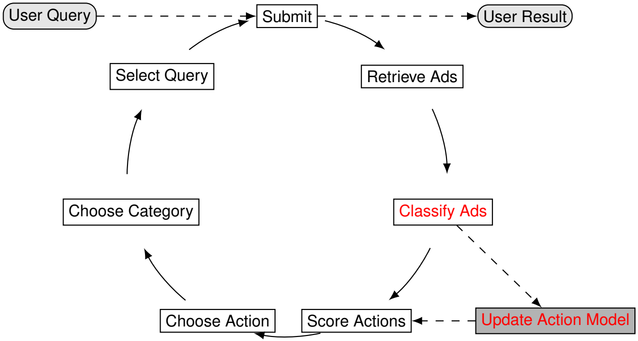
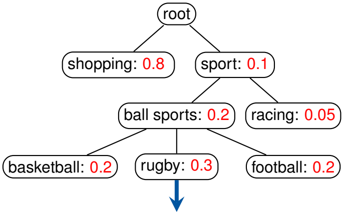




update online model $g_{a_{random}}$ using

$\sigma(\kappa_i, P) = \sum_{p_j \in P, \kappa_j \in T} p_j d_T(\kappa_i, \kappa_j)$ as target,

various features of the previous 5 queries

Experiments

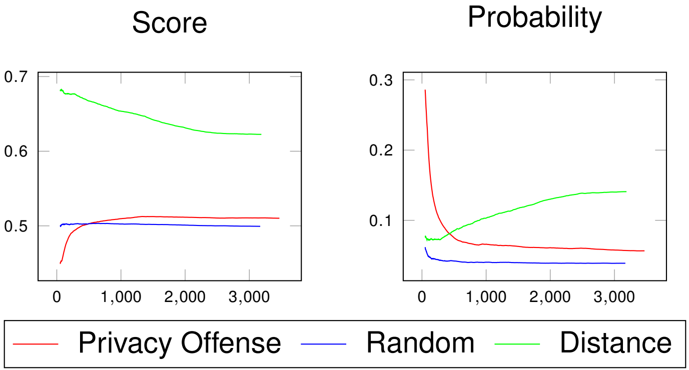
- Users are given one interest category and either
  - Use the proposed method, or
  - Submit queries from random categories, or
  - Submit queries from the category that is the furthest away from their interest category
- All users submit in 10% of the cases random queries from their interest category

- 20 categories where used:

antiques and collectibles
car video
cosmetic procedures
desktop computers
erectile dysfunction
game systems and consoles
make up and cosmetics
real estate listings
timeshares and vacation properties
vitamins and supplements

bicycles and accessories
computer components
dating and personals
drugs and medications
family
laptops and notebooks
motorcycles
sexual enhancement
toys
weight loss

Results



All users, queries **not** in interest category

Conclusion

- Does it work?

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  - Maybe

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- Future work
  - More sophisticated model
  - Use more feedback than just the ads
  - Extend the use beyond search engines

Thank you for your attention! Any questions?

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