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# Booking.com

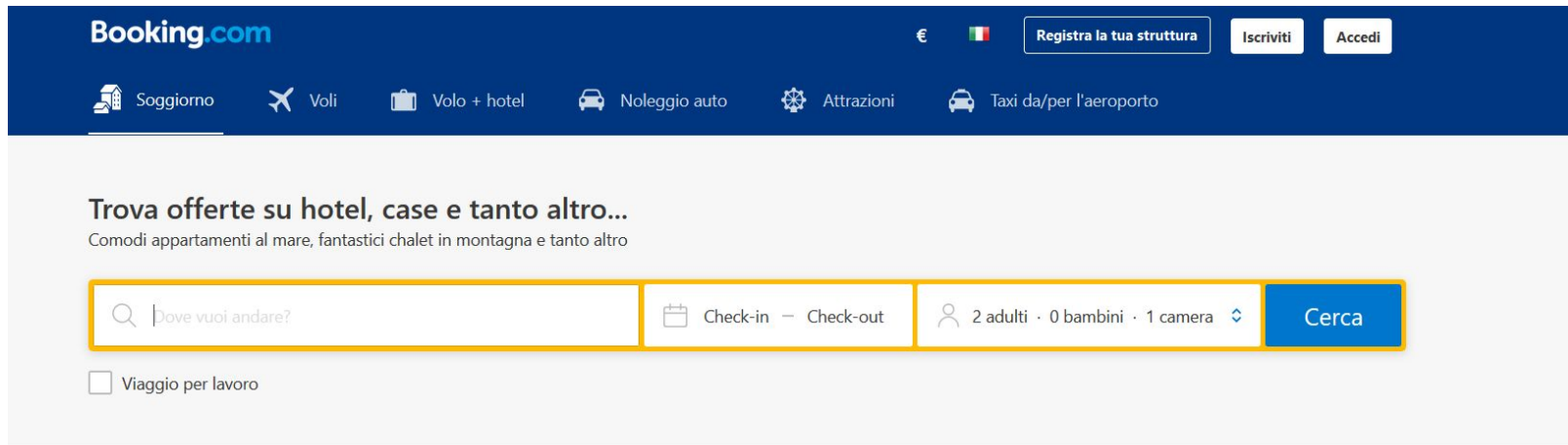
Recommendation system

Fabrizio Mazzone - Philipp Schlieker

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# The context







Booking.com allows the user to book hotels from everywhere in the world.






The image shows the Booking.com homepage. At the top is a dark blue navigation bar with the Booking.com logo on the left. To the right of the logo are the currency symbol (€), the Italian flag, and three buttons: "Registra la tua struttura", "Iscriviti", and "Accedi". Below the navigation bar is a horizontal menu with icons and labels for "Soggiorno", "Voli", "Volo + hotel", "Noleggio auto", "Attrazioni", and "Taxi da/per l'aeroporto". The main content area has a light gray background. It starts with the heading "Trova offerte su hotel, case e tanto altro..." followed by the subtext "Comodi appartamenti al mare, fantastici chalet in montagna e tanto altro". Below this is a search bar with a yellow border. The search bar is divided into four sections: a text input field with a magnifying glass icon and the placeholder "Dove vuoi andare?", a date selection field with a calendar icon, "Check-in", a minus sign, "Check-out", a guest selection field with a person icon, "2 adulti · 0 bambini · 1 camera", and a dropdown arrow, and a blue "Cerca" button. Below the search bar is a checkbox labeled "Viaggio per lavoro".

Booking.com

€  [Registra la tua struttura](#) [Iscriviti](#) [Accedi](#)

 Soggiorno  Voli  Volo + hotel  Noleggio auto  Attrazioni  Taxi da/per l'aeroporto

**Trova offerte su hotel, case e tanto altro...**  
Comodi appartamenti al mare, fantastici chalet in montagna e tanto altro

 Check-in — Check-out  2 adulti · 0 bambini · 1 camera  [Cerca](#)

☐ Viaggio per lavoro

# The ranking

Typing a city, you can see the results basing on several ranking filters.

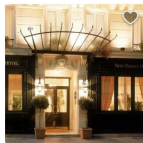
|               |                  |                      |         |                       |                           |     |
|---------------|------------------|----------------------|---------|-----------------------|---------------------------|-----|
| Our top picks | Show homes first | Price (lowest first) | Stars ▼ | Star rating and price | Distance from city centre | ... |
|---------------|------------------|----------------------|---------|-----------------------|---------------------------|-----|


# Top picks


Our top picks

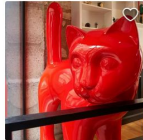
We will focus on what Booking defines *our top picks*.  
This ranking is a recommendation system based on many factors:


- Room availability
- Preferred Partners
- Reviews
- Booking earning margin





**New Orient Hotel** ★★ ★★   
8<sup>e</sup> arrondissement, Parigi - Mostra sulla mappa - 3,5 km dal centro  
- Vicino alla metro  
Ospitato in un edificio in stile Haussmann dell'VIII arrondissement, l'elegante New Orient Hotel si trova a soli 2 km dall'Opéra Garnier e dall'Arco di Trionfo, e offre una reception aperta 24 ore al...  
2 prenotazioni nelle ultime 24 ore sul nostro sito


Favoloso  8,7  
558 recensioni  
[Visualizza tariffe](#)




**Hotel Excelsior Latin** ★★ ★★   
5<sup>e</sup> arrondissement, Parigi - Mostra sulla mappa - 1,2 km dal centro  
- Vicino alla metro  
Situato a 200 metri dai Giardini del Lussemburgo, il 2<sup>o</sup> parco pubblico più grande di Parigi, l'Hotel Excelsior Latin dista 400 metri dal famoso Pantheon, e offre una reception aperta 24 ore su 24 ed...  
6 prenotazioni nelle ultime 24 ore sul nostro sito

Ottimo  8,2  
1.210 recensioni  
Posizione 9,3  
[Visualizza tariffe](#)



**Hôtel Garance** ★★ ★★   
18<sup>e</sup> arrondissement, Parigi - Mostra sulla mappa - 9,8 km dal centro

Buono  7,8  
1.332 recensioni

# Room availability

Booking merges data from internal booking and manual updates to know about rooms availability in every hotel.

Of course, hotels that are full should not be recommended.



**ibis Paris Italie Tolbiac** ★★

[13th arr., Paris](#) • [Show on map](#) • 3.5 km from centre • Metro access

Good  
1,154 reviews

7.6

We have no availability at this property for your dates: Thu 5 Mar 2020 - Sat 28 Mar 2020 (23 nights)

# Reviews

The reviews in Booking.com are in the range from 0 to 10, with a decimal digit.

They are usually sided by a very short description.

Superb  
1,657 reviews

9.3

Very good  
451 reviews

8.4

Good  
9,576 reviews

7.9

# Preferred partners

The preferred partner program is proposed to the user to provide guests a positive experience thanks to its commendable service and good value.

The hotel could pay Booking.com a bit more to be in that program.



# Booking earning margin

Booking.com should make money.

Well, Booking .com actually makes money through charging hotels for selling their inventories. It takes a little commission depending on the city, the hotel, the room.

Of course, it tries to push up the results where it can earn more.





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**Users** are important  
for booking.com

# User preferences

Users decide which hotel to book focusing on:

- Price Sensitivity
- Business vs. Leisure
- Accompaniment
- Rating of the hotel
- Location of the hotel



# What we did

We want to simulate Booking.com recommendation system based on what we set in the previous slides.

Our aim is obtaining the lowest regret and thereby maximizing *booking.com* margin.



## What we need

→ **Environment**

All the elements that simulates our website (Booking.com)

→ **Some agents**

An agent states the strategy used to suggest a hotel.

→ **Statistics**

We did some comparison in order to know the best agent to choose for our specific environment

# Our environment

## 1. Room Availability

Every hotel has a different room availability.

## 2. Partner Hotels

Some hotels are featured and they should appear more than the others.

## 3. Earning Margins

If the user likes the hotel, the margin is different for every hotel.

# Some agents

## 1. Random

It performs a completely **random** choice, respecting the constraints, though.

## 2. Adaptive Greedy

At first it randomly chooses, then it takes the hotel that had the **average** greatest reward.

## 3. Epsilon Greedy

With a **eps** probability, it picks randomly, than exploits the learned **feature** to choose the best hotel.

# Some agents

## 4. Thompson Sampling

It calculates and updates the estimated reward based on **probability** distribution.

## 5. Upper Confidence Bound

It samples very quickly to reduce the **uncertainty** of the unknowns before **locking** onto the most profitable hotel..

# Some agents

## 6. Embedding Agent Offline

It trains embeddings based on **historical data** and learns expected payouts.

## 7. Embedding Agent Offline / Online

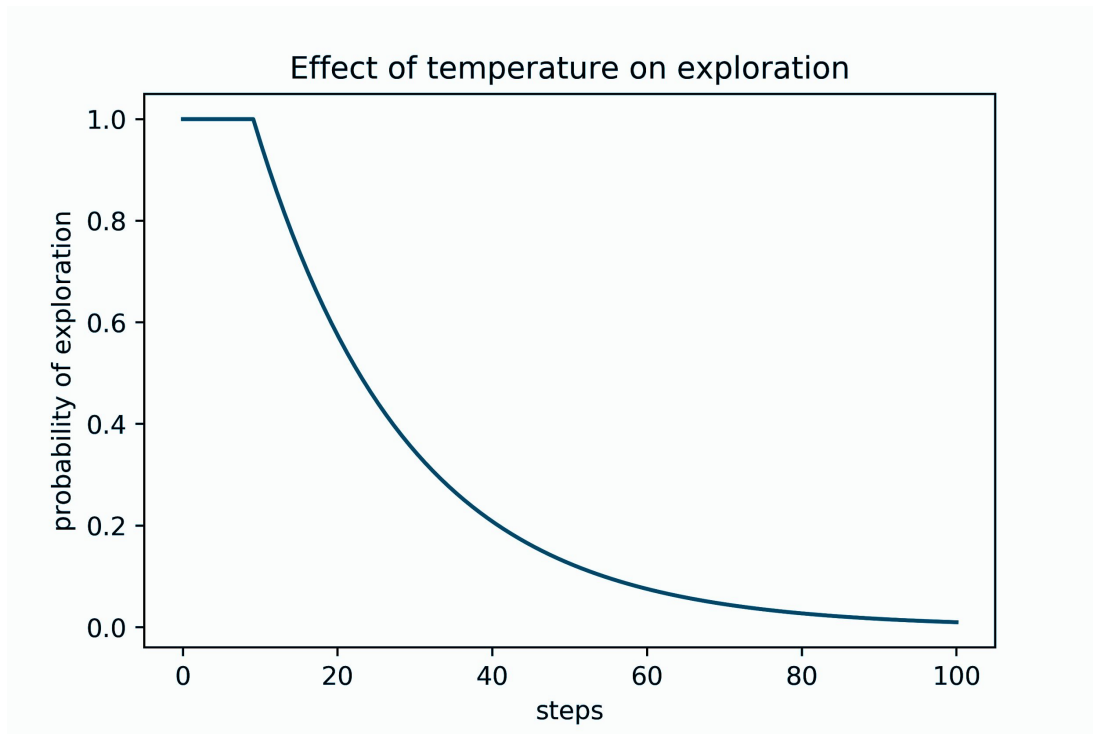
Embedding model that retraines when 30% new data is available.

## 8. Epsilon Embedding Agent

It performs a **weighted pick** between random exploration and exploitation of learned embeddings.



# Effect of Temperature on Exploration

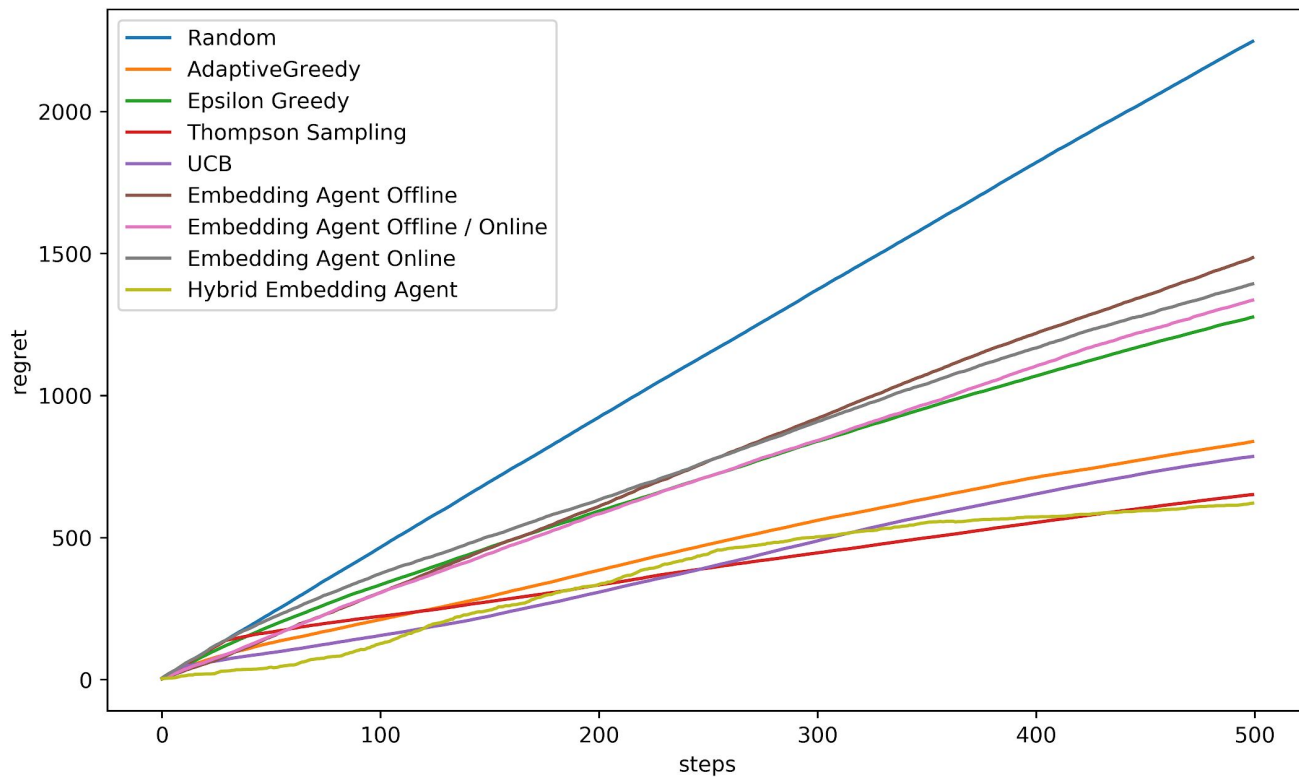


# Some agents

## 9. Hybrid Agent

Uses Embeddings but also takes Meta-Data into account

# Our results



# Further improvements

- Implement Linear Stochastic bandits (LinUCB, LinTS)
- Perform Grid Search on Parameter Space
- Experiment with different ways to reduce temperature