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# TARGETED ONLINE ADVERTISING IN ACTION



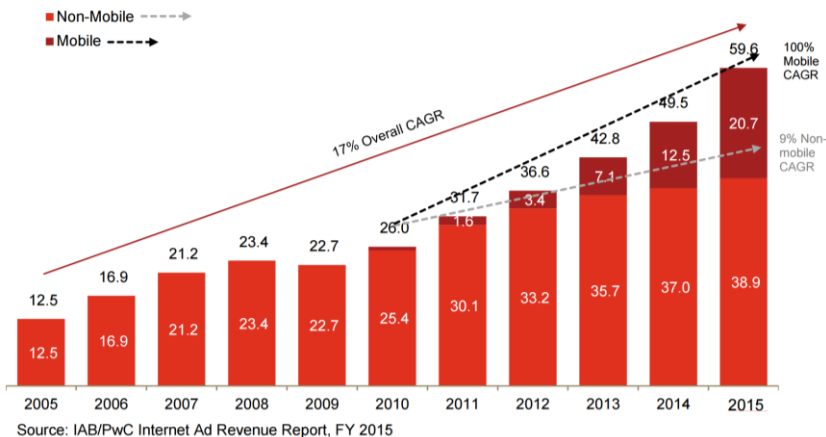
# CONTENT

- Introduction to online advertisement
- Targeted advertising
- Lesson learned from Cốc Cốc
- Conclusion



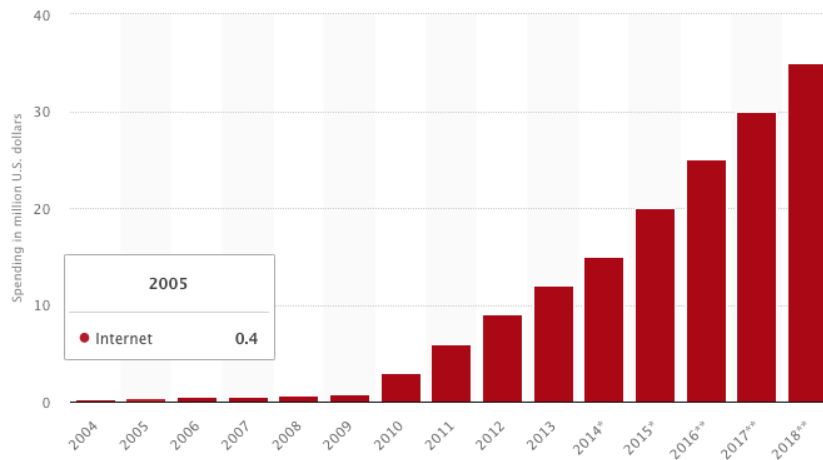
# INTRODUCTION

- Online Advertising plays a critically important role in the Internet world.
- Advertising is the main way of profiting from the Internet, the history of Internet advertising developed alongside the growth of the medium itself



## Global

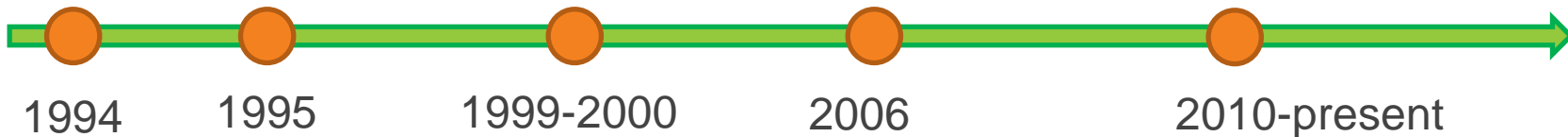
Source: <https://www.statista.com/statistics/257580/advertising-spending-in-vietnam-by-medium/>



## Vietnam



## A Brief History of Online Advertising



1994 : First internet banner, AT&T.

1995: Display ads become increasingly targeted

1999 - 2002: Advertisers turn to paid search and pay-per-click

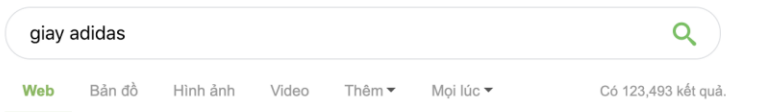
2006: Digital ads become hyper-targeted

2010 - present: Marketers find value native ads ( personalized ads, contextual ads)



## PARTIES

- Advertiser
  - Got money, wants publicity
  - e.g., Coca-Cola, Vinfast, KIA
- Publisher
  - Got content, wants money
  - Dantri.com, Kenh14.vn
- Ad-network
  - Got advertising infrastructure, wants money
  - e.g., Google AdSense, Admarket,
- Consumer
  - Wants free content, free application



**Mua Ngay Giày Adidas Phong Cách - Ưu Đãi Tới 50% Tại Shopee!**

[Ad] <https://shopee.vn/>

Lướt Shopee - Gì Cũng Có - Vận Chuyển Miễn Phí - Mua Trong Nháy Mắt!

**Giày Sneaker Adidas Thời Trang 2018**

[Ad] <https://www.sendo.vn/giay-dep/giay-nam/giay-sneaker-nam/>

Freeship Đơn Hàng 150K trên toàn Siêu Chợ-Mua Online Vô tư Không Lo Phí Ship!

**adidas Official Website | adidas**

<https://www.adidas.com.vn/>

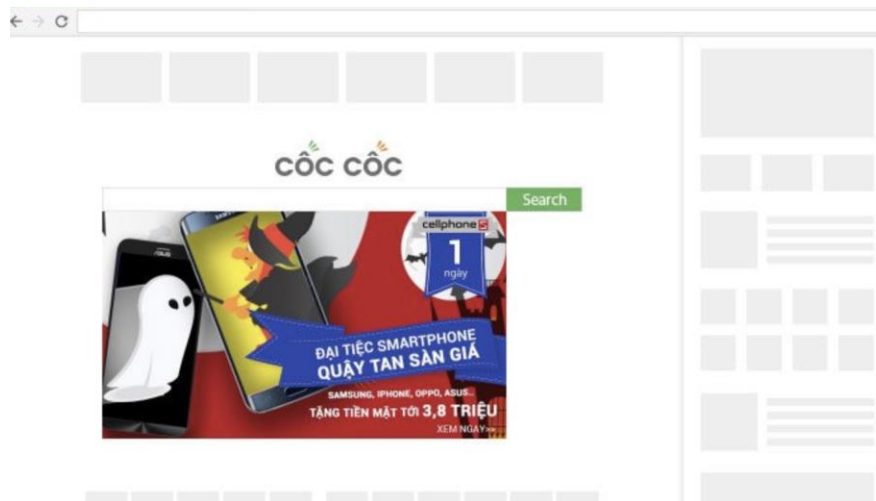
Browse for **adidas** shoes, clothing and collections, **adidas** Originals, Running, Football, Training and more on the official **adidas** website.

**Giày Adidas Chính Hãng | Myshoes.vn**

<https://myshoes.vn/giay-adidas>



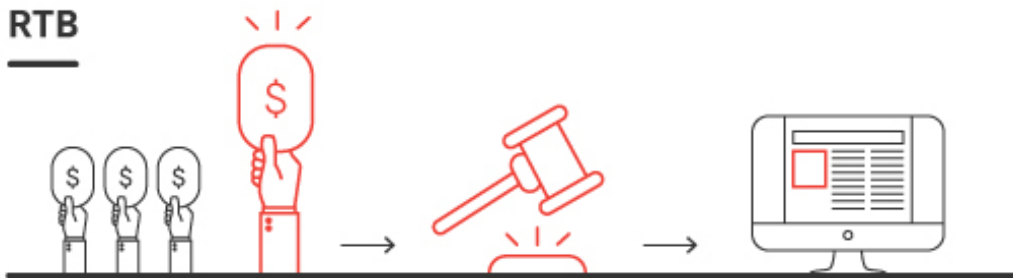
**Giày Adidas Chính Hãng** tại Myshoes.vn luôn có giá tốt nhất, mẫu mã đa dạng, đẹp mắt. **Giày Adidas** là sự lựa chọn tuyệt vời dành cho người yêu thể thao. Sản phẩm được Myshoes.vn nhập khẩu chính hãng từ **adidas** ...





# How to display Ads

**RTB**



Advertiser Bid

+



Ad Quality &  
Relevance

+







Estimated  
Action

=





## How to display Ads

ADVERTISER	MAX BID	QUALITY SCORE	FORMAT IMPACT	AD RANK
 BOB	\$4	Low	Low	<div>NOT SHOWN</div> 5
 JANE	\$3	High	Low	<div>2<sup>ND</sup></div> 15
 SUE	\$2	High	High	<div>1<sup>ST</sup></div> 20
 TOM	\$1	Medium	Medium	<div>3<sup>RD</sup></div> 8



## Business Value – Quality Score

- CPM = Cost Per thousand impressions
  - Impression: user just sees the ad.
  - Rates vary from \$0.25 to \$100
- CPC = Cost Per Click
  - This is the cost charged to an advertiser
  - every time their ad is "clicked" on
  - Rates around 0.3\$ per click
- CPA = Cost Per Action
  - a sale, click, or form submit (e.g., contact request, newsletter sign up, registration etc.



# Types of online advertising

## Contents [\[hide\]](#)

### 1 Types

- 1.1 [Search engine marketing](#)
- 1.2 [Social media targeting](#)
- 1.3 [Television](#)
- 1.4 [Mobile devices](#)
- 1.5 [Content and contextual targeting](#)
- 1.6 [Technical targeting](#)
- 1.7 [Time targeting](#)
- 1.8 [Sociodemographic targeting](#)
- 1.9 [Geographical and location-based targeting](#)
- 1.10 [Behavioural targeting](#)
  - 1.10.1 [Onsite](#)
  - 1.10.2 [Network](#)
  - 1.10.3 [Theoretical research](#)
- 1.11 [Privacy and security concerns](#)
- 1.12 [Retargeting](#)

- **Retargeting** – Using cookies, track if a user left a webpage without making a purchase and retarget the user with ads from that site
- **Behavioral targeting** – Data related to user's online activity is collected from multiple websites, thus creating a detailed picture of the user's interests to deliver more targeted advertising
- **Contextual advertising** – Display ads related to the content of the webpage
- **Geo targeting** – Ads are presented based on the user's suspected geography

Taken from wiki ( a lot)...



# User Segmentation targeting



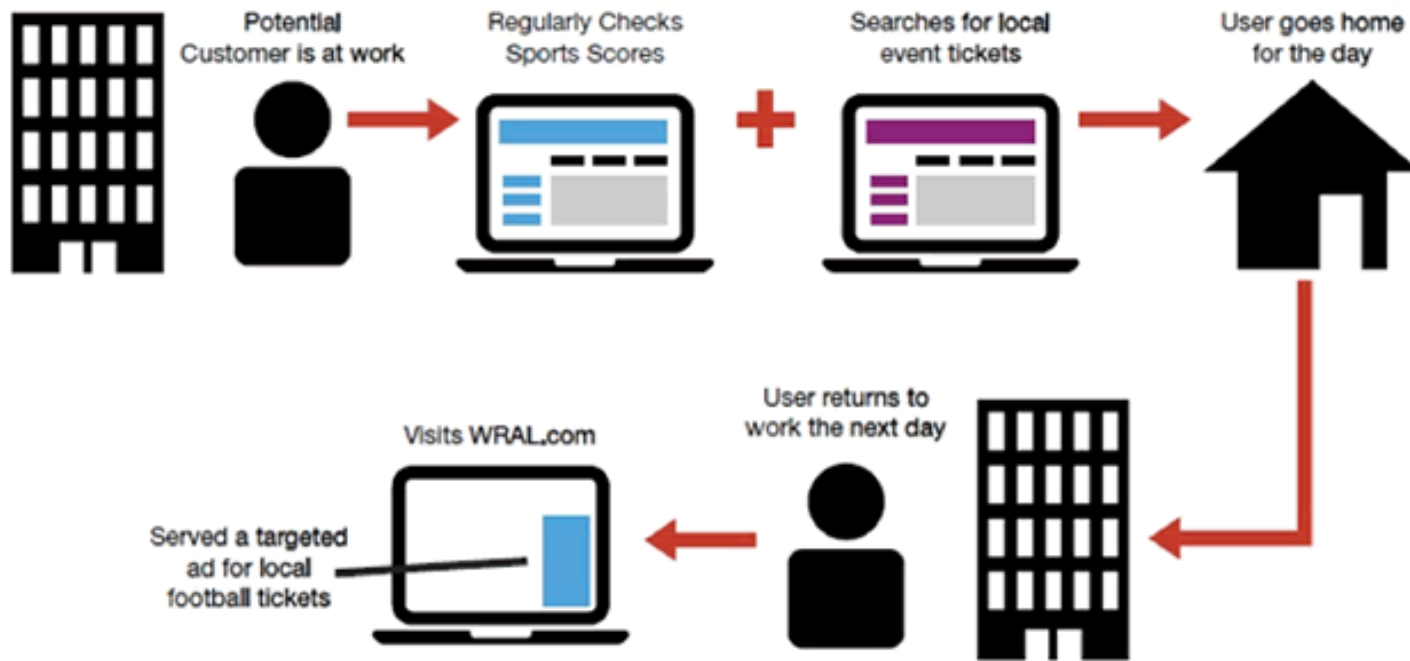
## Pros

- Allows to know customers very well
- Anticipate the needs and wants of current clients
- Increase productivity
- Marketing research and new innovations

## Cons

- Expensive
- Doesn't work for all products
- Privacy concerns
- Problems with location-based marketing
- Limited reach

# Behavioral Online Targeting



## Behavioral Online Targeting

“Through studying ads CTR before and after user segmentation for ads delivery, we observe that ads CTR can be improved by as much as **670%** over all the ads we collected. The t-test results, which are very close to zero, confirm the statistical significance of CTR improvements”  
1



## Challenges in CocCoc...

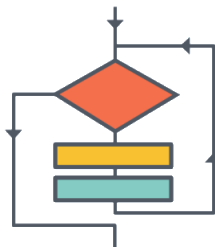
GOAL improves **user experience and user engagement**, and helps advertiser create more **personalized and effective campaigns**



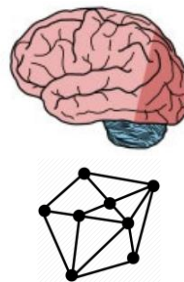
Massive data



Computing cluster



Algorithms



Deep learning



Decision making

## ...and Solution ( Ads Engine)

### 1. Business value prediction ( CTR prediction)

- How to estimate CTR ( Click Through Rate) and performance of ads

### 2. Ads Recommendation Engine ( User-Ad Relevance Score)

- How to select personalized ads ( Search, New tabs)





# Ads Engine

IPHONE XS



iPhone Xs 64GB - Giá sốc online GIẢM NGAY 1 triệu



<https://www.thegioioidong.com/dtdd/iphone-xs>

★★★★★ 4.8 – 6 bình luận

Thông tin sản phẩm Điện thoại iPhone Xs 64GB, cấu hình, thông số kĩ thuật, so sánh giá cả, review đánh giá, tư vấn mua hàng & giao hàng tận nơi

Mua iPhone XS chính hãng, trả góp 0%, giá rẻ | CellphoneS.com ...

<https://cellphones.com.vn/mobile/apple/iphone-xs.html>

Mua điện thoại iPhone XS chính hãng, ưu đãi hấp dẫn, bảo hành 12 tháng tại Hệ thống cửa hàng CellphoneS.com.vn ✓ Trả góp 0% ✓ Giá rẻ hơn ✓ Giao hàng miễn phí



iPhone Xs | Shopee  
Việt Nam

25,000,000<sup>d</sup>

Shopee.Vn



iPhone XS 64GB

24,740,000<sup>d</sup>

Priceme.Com.Vn



iPhone Xs Max

28,390,000<sup>d</sup>

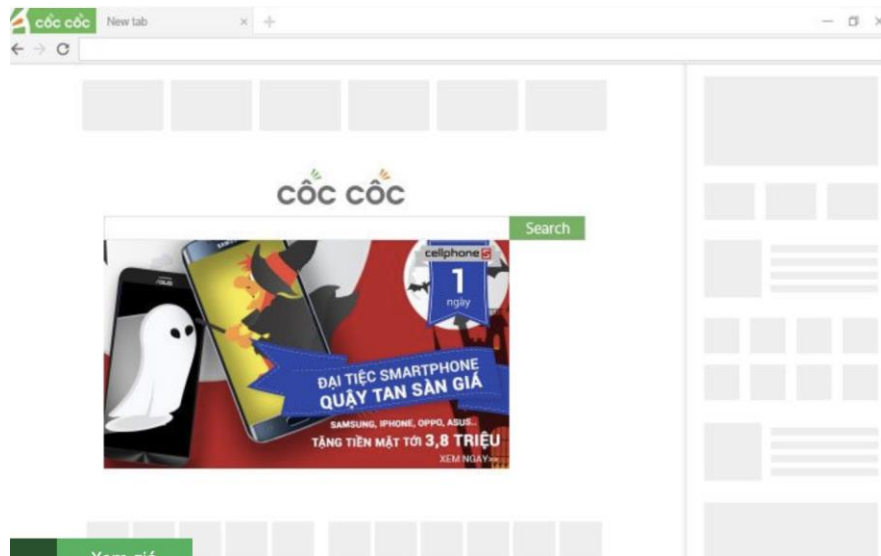
Iboxvietnam.Vn



iPhone XS 256GB |  
Shopee Việt N...

29,990,000<sup>d</sup>

Shopee.Vn

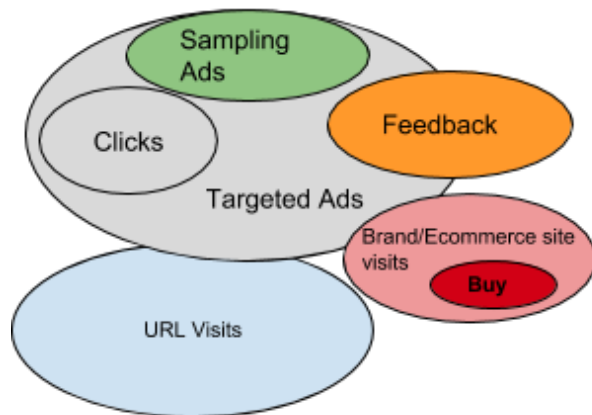




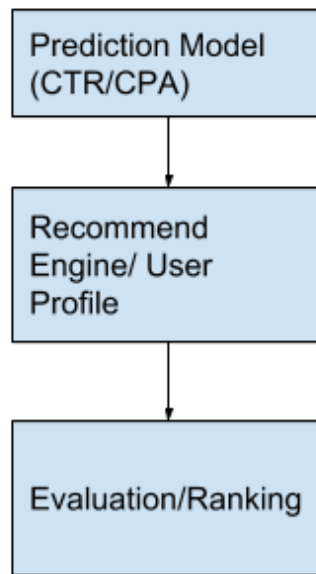


# Overall System

## User Events



## Processing



# CTR Prediction

How likely is the user to click on the ads

**CTR:** Click-Through Rate

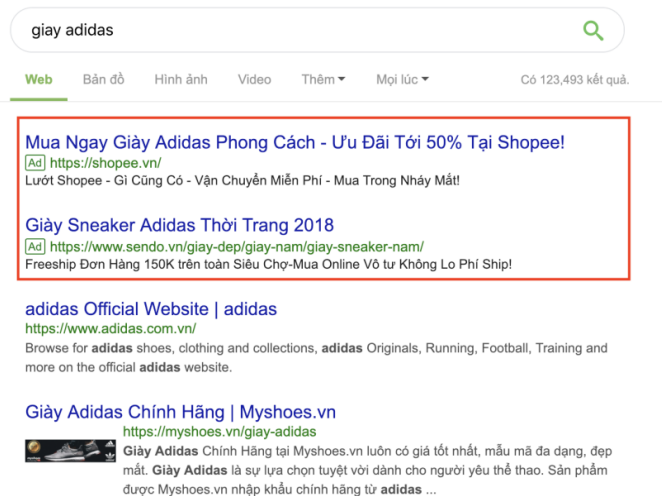
$CTR = \text{Clicks} / \text{Impress} * 100.$

**pCTR :** prediction CTR

1.4%

2.4%

5.4%




giay adidas

Web Bản đồ Hình ảnh Video Thêm Mọi lúc Có 123,493 kết quả.

**Mua Ngay Giày Adidas Phong Cách - Ưu Đãi Tới 50% Tại Shopee!**  
<https://shopee.vn/>  
Lướt Shopee - Gi Cũng Có - Vận Chuyển Miễn Phí - Mua Trong Nháy Mắt!

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## How dataset look like ?

```
id: ad identifier
click: 0/1 for non-click/click
hour: format is YYMMDDHH
C1: anonymized categorical variable
banner_pos
site_id
site_domain
site_category
app_id
app_domain
app_category
device_id
device_ip
device_model
device_type
device_conn_type
C14-C28 anonymized categorical variables
```

Label	hour	banner_pos	site_id	site_domain	...	C20
+1	14102100	0	1fbe01fe	f3845767	...	-1
-1	14102100	1	fe8cc448	9166c161	...	100084
			⋮			
-1	14103023	1	f61eaaae	25d4cfcd	...	100077
?	14103100	0	8fda644b	7e091613	...	100084
?	14103100	1	e151e245	f3845767	...	100019
			⋮			
?	14103123	0	1fbe01fe	bb1ef334	...	-1



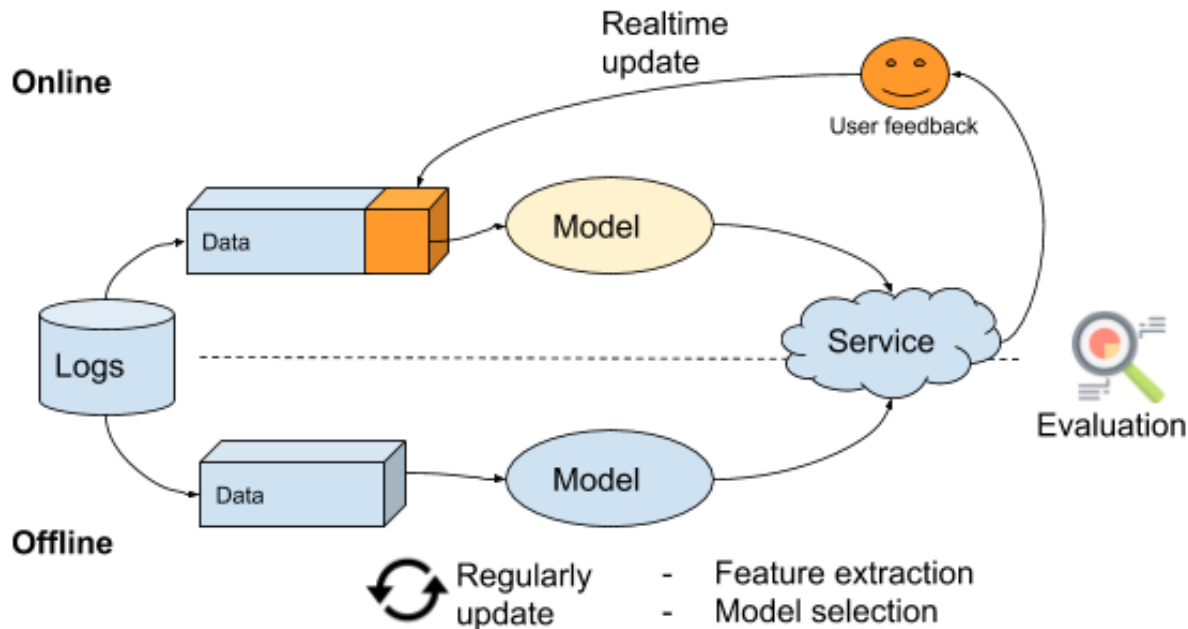
## Evaluation

$$\text{logloss} = -\frac{1}{L} \sum_{i=1}^L y_i \log p_i + (1 - y_i) \log (1 - p_i),$$

where  $L$  is the number of instances,  $y_i \in \{0, 1\}$  is the label of the  $i^{\text{th}}$  instance, and  $p_i$  is the probability of that the  $i^{\text{th}}$  instance is clicked

# ML Pipeline

- Online
  - Vowpal Wabbit
  - Q-network
- Offline
  - XgBoots
  - FFM
- Evaluation
  - A/B Testing
  - Model Selection





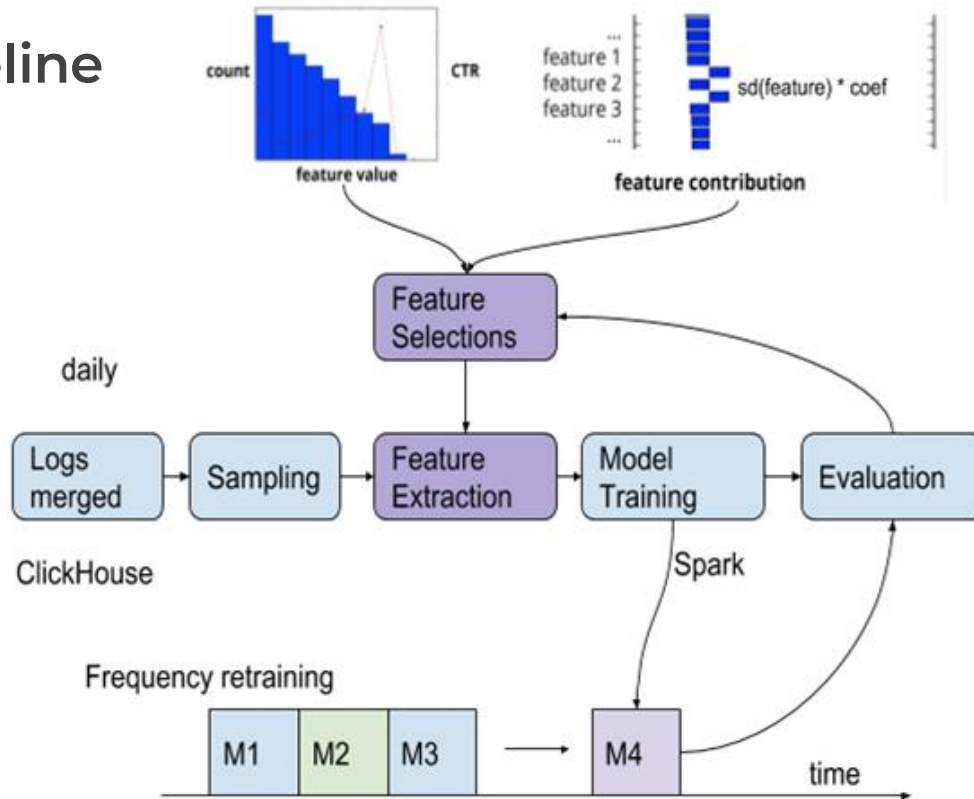
# MP Pipeline

## Infrastructure

- Log at source of online prediction
- Verify predictions (visualization tool)
- Incremental training

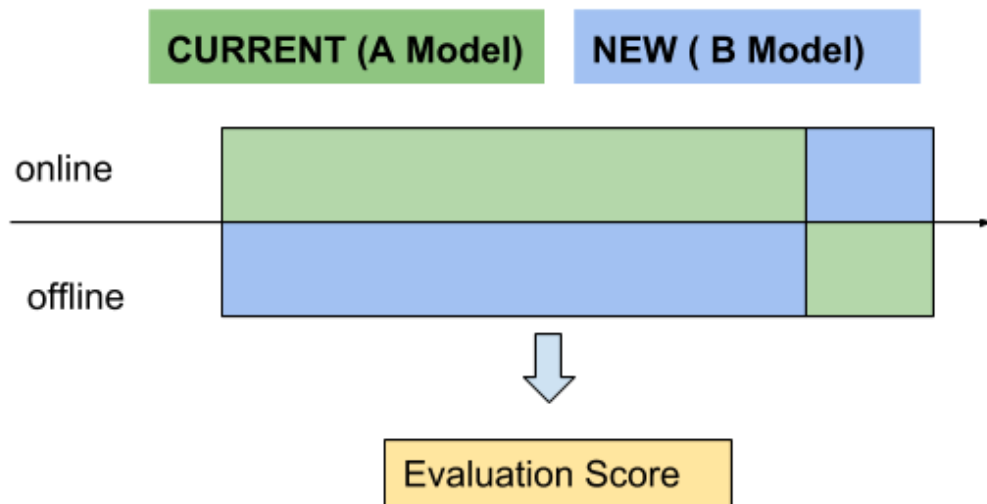
## Model

- Evaluate, evaluate, evaluate
- Be aware of threshold effects
- A/B Testing



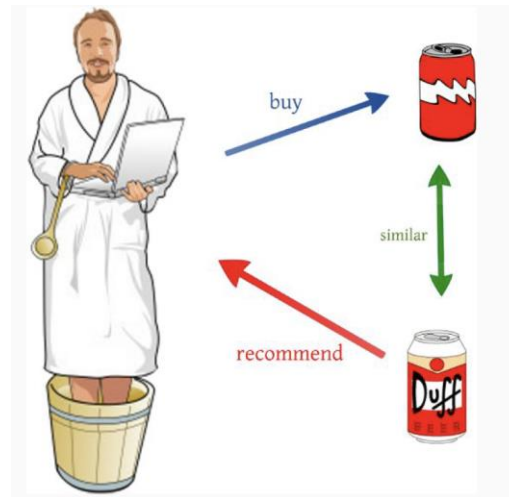


## A/B Testing ( Evaluation)....



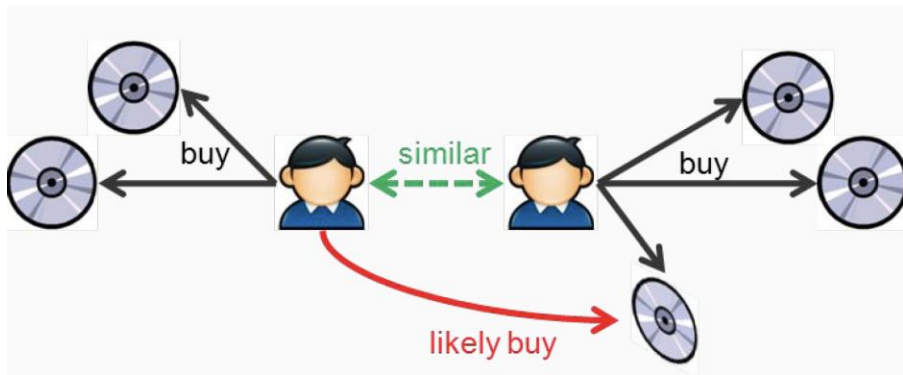
# User-Ad Relevance Score

- User-Based Filtering
- Content-based Filtering
- Hybrid Recommendation Systems
- Collaborative Topic Modeling (CTM )
- Collaborative Poisson Factorization (CPF)



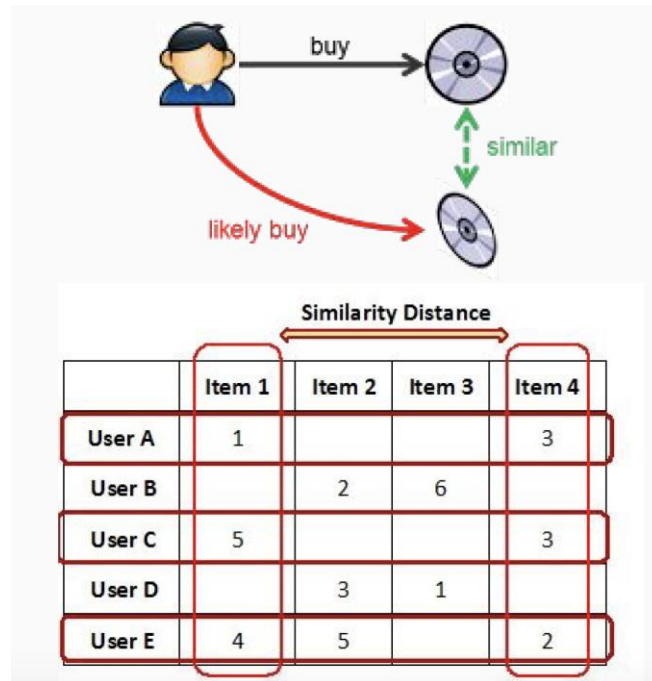


# User-Based and Item-Based Recommendation



$$\text{similarity} = \cos(\theta) = \frac{\mathbf{A} \cdot \mathbf{B}}{\|\mathbf{A}\| \|\mathbf{B}\|} = \frac{\sum_{i=1}^n A_i B_i}{\sqrt{\sum_{i=1}^n A_i^2} \sqrt{\sum_{i=1}^n B_i^2}}$$

User-Based



ItemBased



## Matrix factorization machine

Item

W X Y Z

User

A		4.5	2.0	
B	4.0		3.5	
C		5.0		2.0
D		3.5	4.0	1.0

Rating Matrix

=

A	1.2	0.8
B	1.4	0.9
C	1.5	1.0
D	1.2	0.8

User Matrix

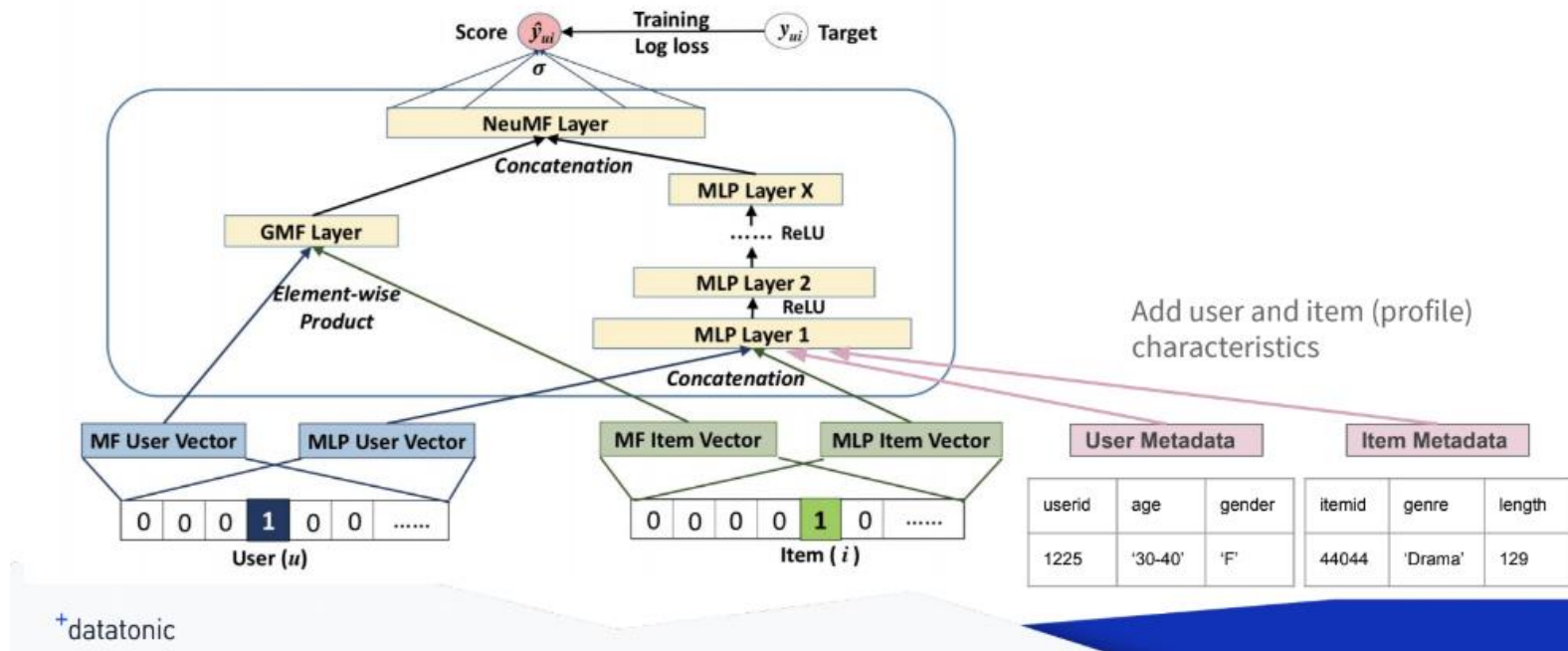
X

W	X	Y	Z
1.5	1.2	1.0	0.8
1.7	0.6	1.1	0.4

Item Matrix



# Neural matrix factorization model (MF)



# MF Training Processing



Keras



CUDA



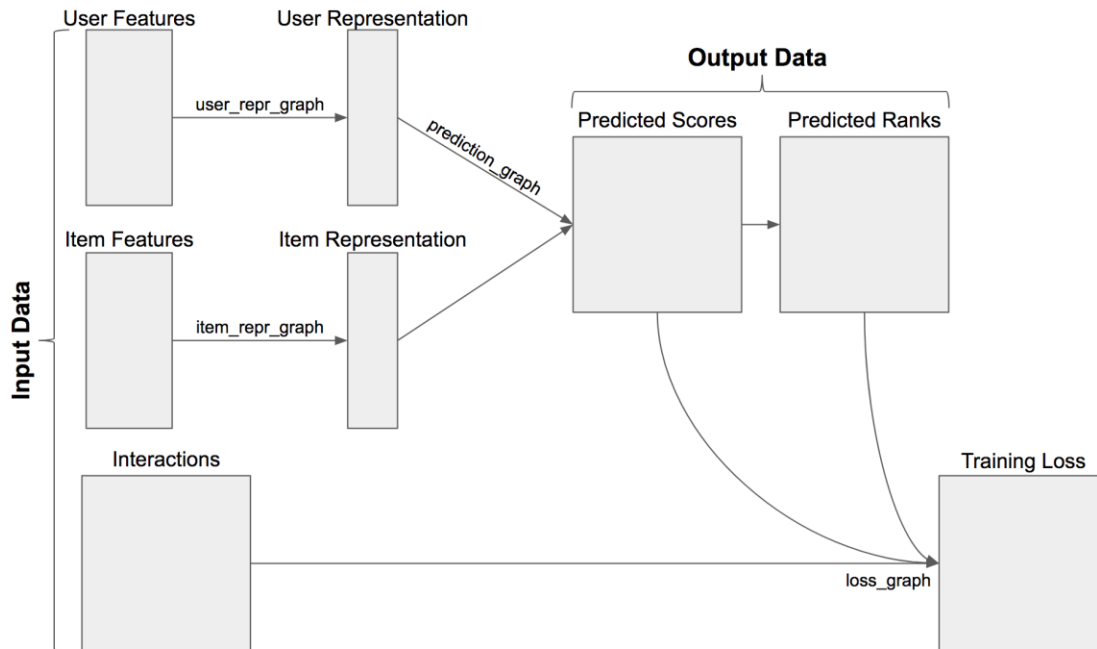
Theano



scikit-learn



OpenCV





# AD Ranks



User-Ad  
Relevance  
Score

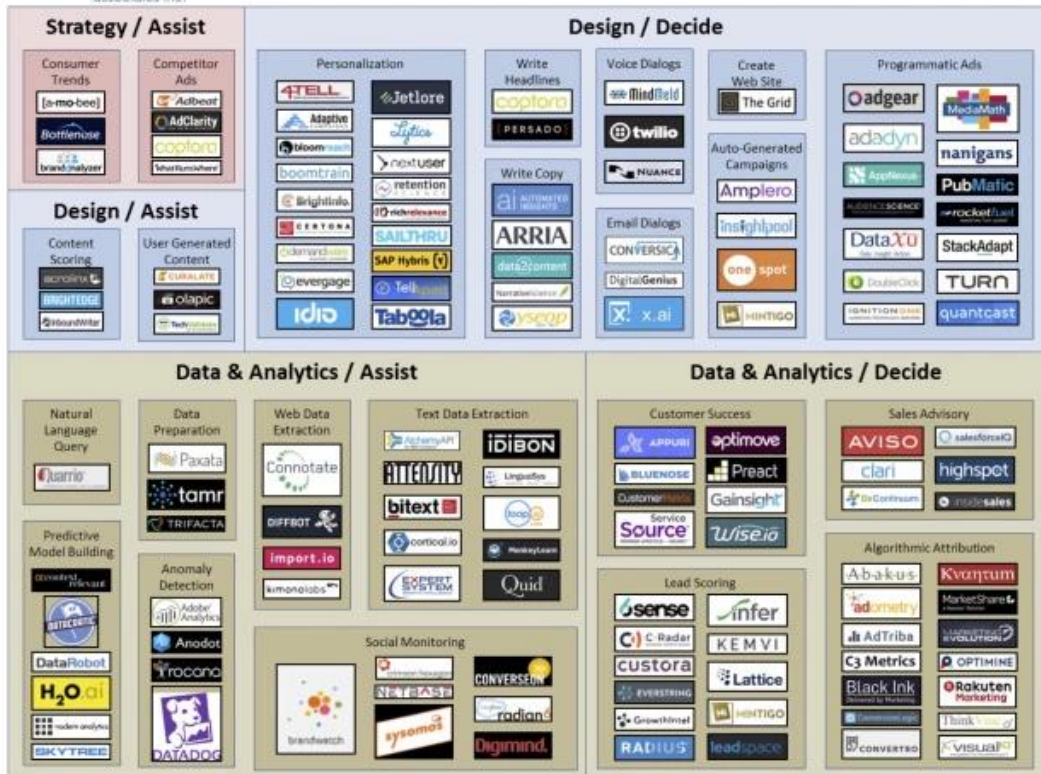
CTR  
prediction



ADVERTISER	MAX BID	QUALITY SCORE	FORMAT IMPACT	AD RANK
BOB	\$4	Low	Low	NOT SHOWN 5
JANE	\$3	High	Low	2 <sup>ND</sup> 15
SUE	\$2	High	High	1 <sup>ST</sup> 20
TOM	\$1	Medium	Medium	3 <sup>RD</sup> 8

## Conclusions

- Targeted advertising
- Lesson Learned from CocCoc





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# Thanks