The Lane's Gifts v. Google Report

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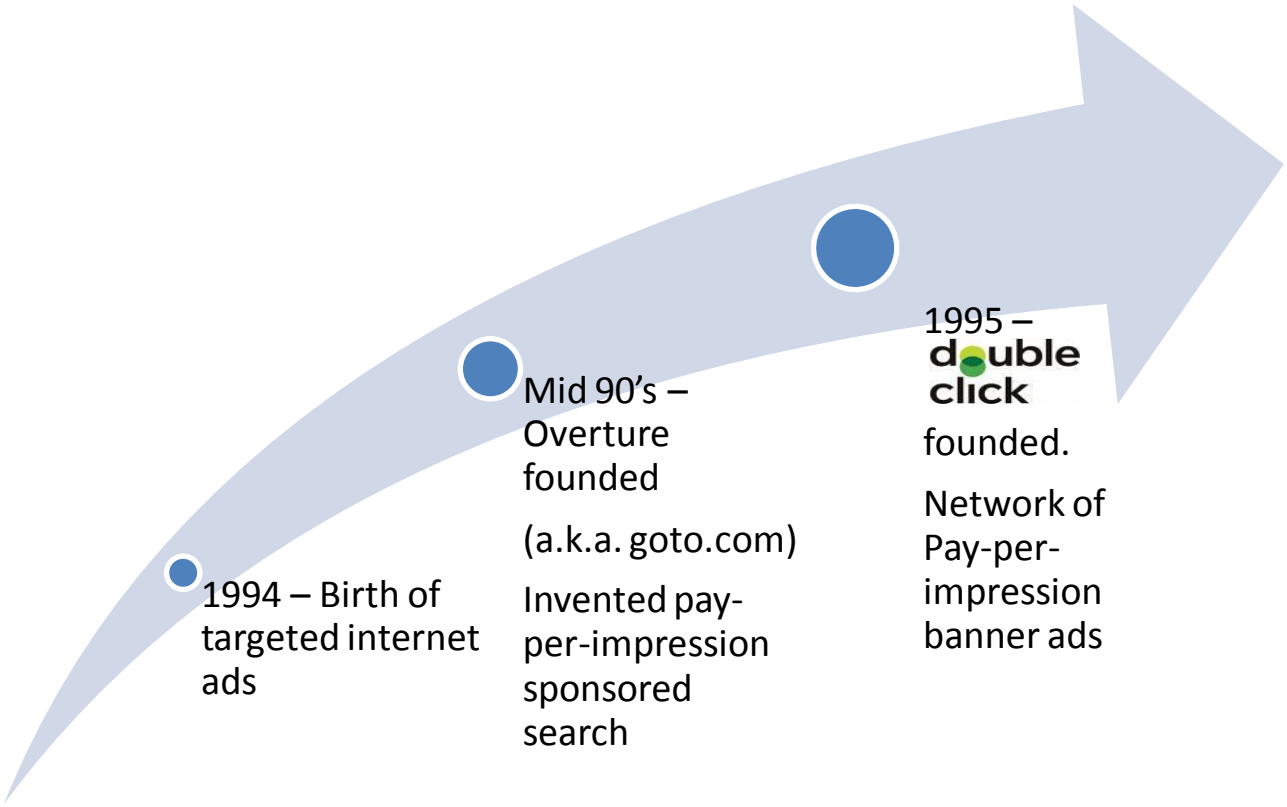
The Lane's Gifts case

- 2005 – "Lane's Gift and Collectibles" filled a law suit against Google on behalf of all Google advertisers.
  - tired of paying for invalid clicks.
- Mid. 2006:
  - Case settled: Google agrees to refund $90 million
  - Opened for advertisers to apply for reimbursement for clicks they believe are invalid
- Mid. 2006 - Alexander Tuzhilin was asked to evaluate Google invalid click detection efforts

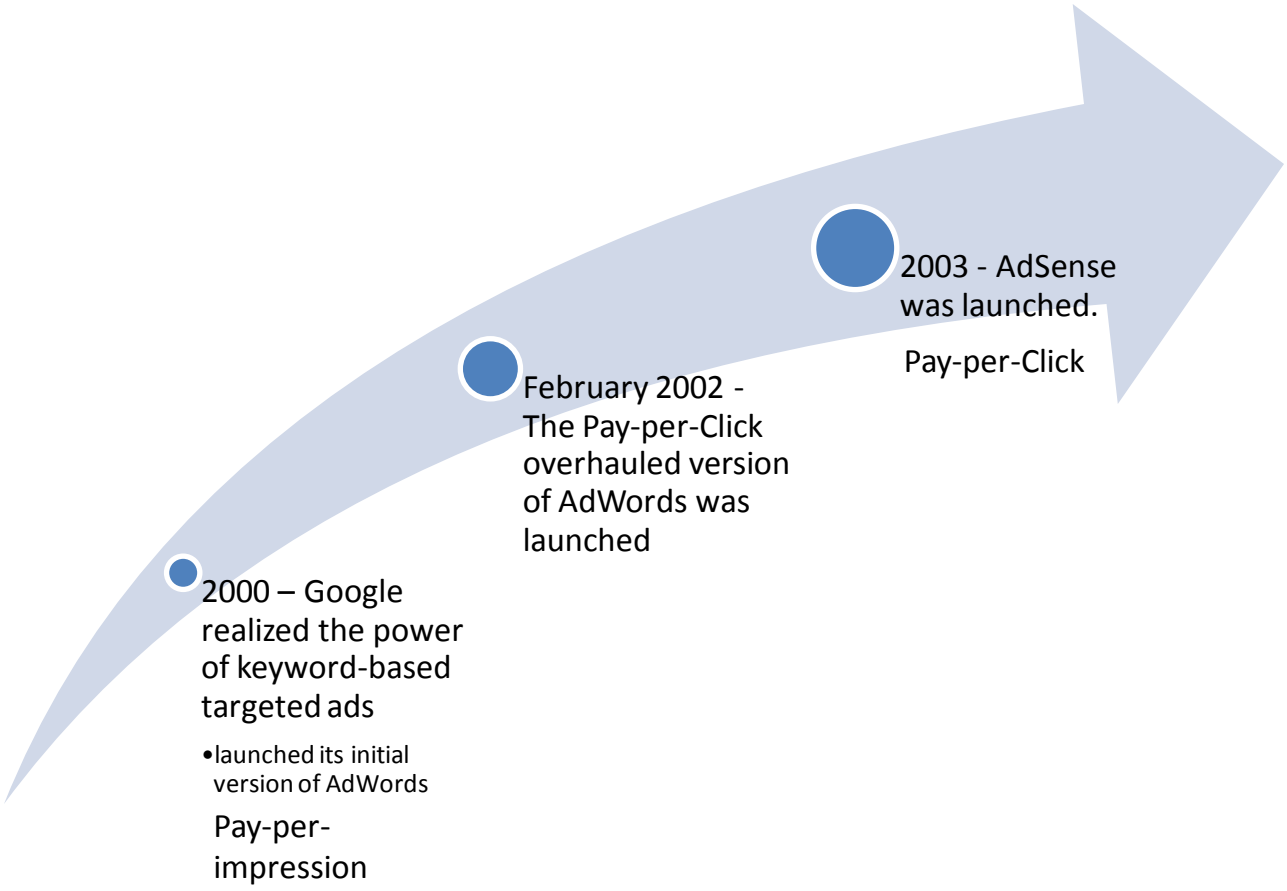
Outline

- **Background information**
- Invalid Click – Hard to define
- Google's Approach
- Conclusion

Background


1994 – Birth of targeted internet ads
Mid 90's – Overture founded
(a.k.a. goto.com)
Invented pay-per-impression sponsored search
1995 – double click founded.
Network of Pay-per-impression banner ads

Background – Google's initiative



AdWord vs. AdSense

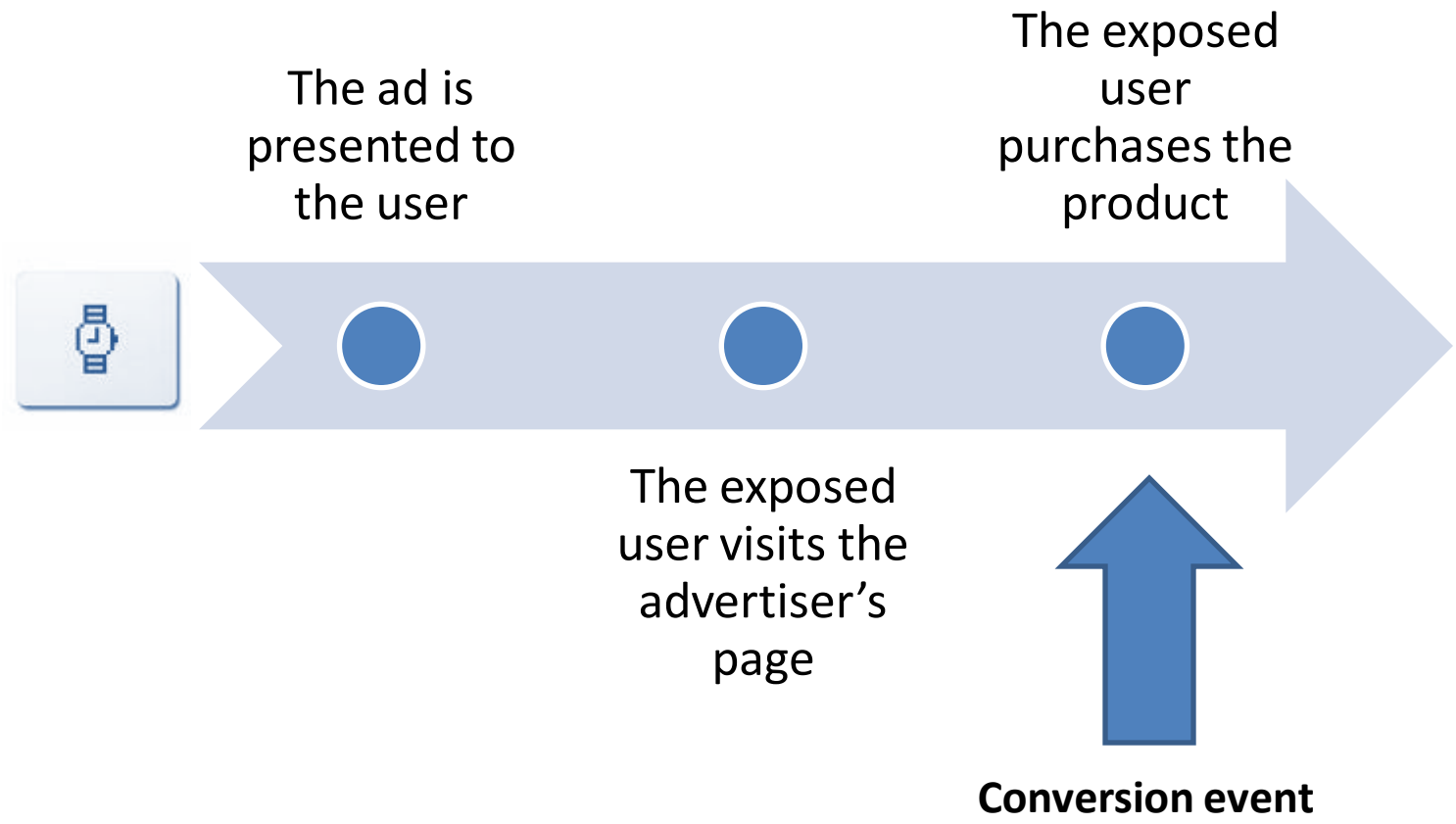
	AdWord	AdSense
Where	www.google.com	www.publishersSite.com
What	Query based	Content based
Who makes money	Google	Google + publisher
Who gains due to click fraud (short-term)	Google + targeted advertiser's competitors	Google + publisher + advertiser's competitors
Who loses due to click fraud (short-term)	Targeted Advertiser	Targeted Advertiser
Who loses due to click fraud (long -term)	Targeted Advertiser + Google	Targeted Advertiser + Google

Time

When charge the advertiser?

- When the ad is being shown to the user
  - *CPM – Cost per Mille*
- When the ad is being clicked by the user
  - *CPC – Cost per Click*
- When the ad has “influenced” the user (conversion event)
  - *CPA – Cost per Action*

Cost-per-Action



Two effectiveness measures

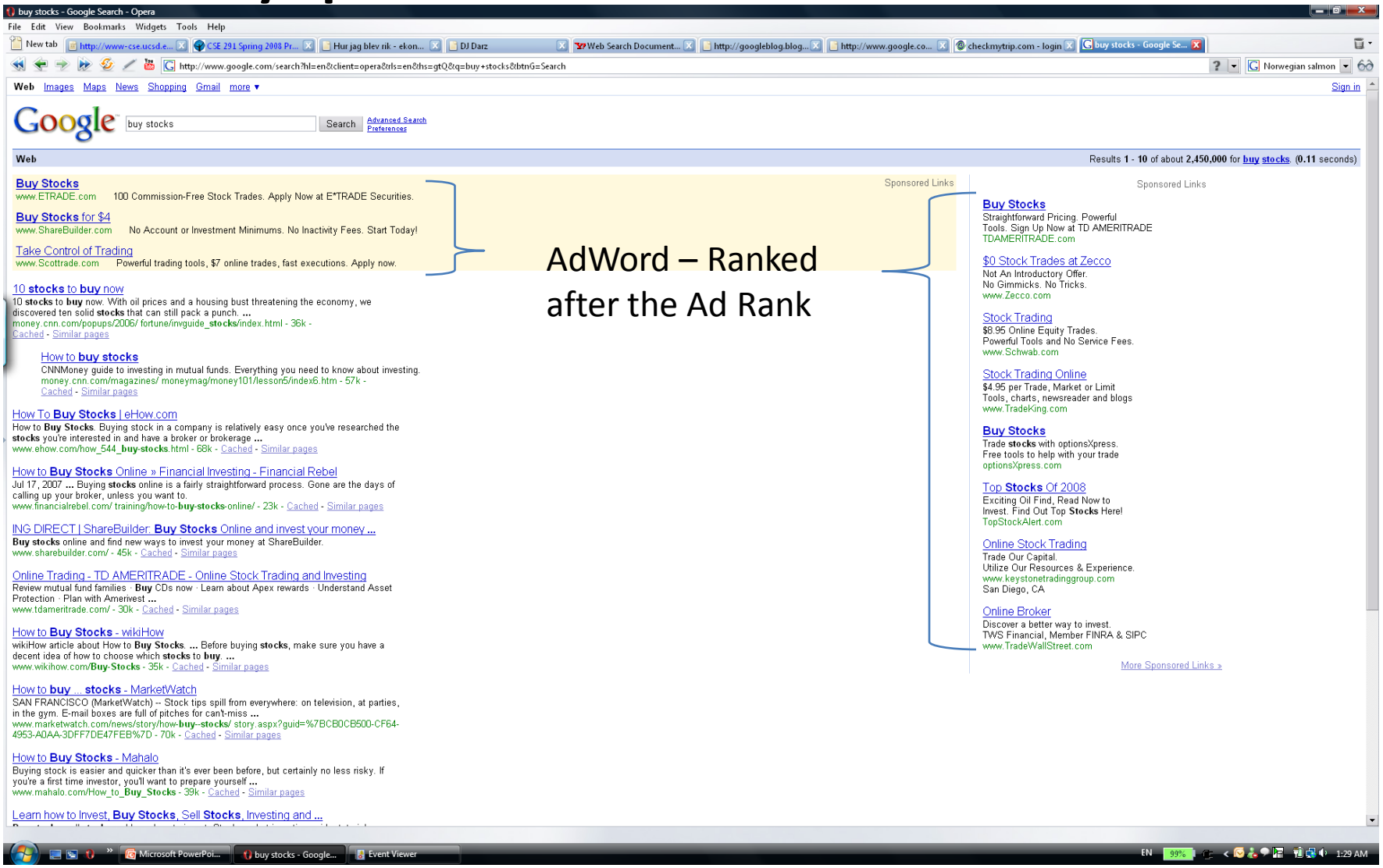
- Click-Through Rate (CTR)
  - $$CTR = \frac{\#ads\_clicked}{\#ads\_presented}$$
- Conversion Rate
  - The % of visitors who took the conversion action

Cost-per-click Advertising Model

- Ad Rank – How high the ad is placed on www.google.com (example on next slide)
- Cost-per-Click (CPC)
- Quality Score – quality of the keyword/ad pair
  - Depends on the Click-through-rate (CTR)

Ad Rank = f (CPC , QualityScore)

Pay-per-Click AdWord model



Problems with CPC

- Good click-through rates (CTRs) are not indicative of good conversion rates
- No “built-in” fundamental protection (endogenous) mechanisms against click fraud

Invalid click

From Wikipedia:

"Click fraud occurs in pay per click online advertising when a person, automated script or computer program imitates a legitimate user of a web browser clicking on an ad, for the purpose of generating an improper charge per click."

Example of Click Frauds

- Firm A has an ad budget of 100$/day
- Firm B depletes this budget with fake clicking.
  - > No more ads for Firm A that day

- Firm A publishes an ad at www.firmB.biz
- Firm B clicks on the ad several time without any plans of buying anything
  - Firm A has to pay for fruitless clicks and Firm B gets paid for invalid clicks.

Different kind of problems with the Cost-per-Click Model

- Unethical advertisers of AdWords will try to use up budgets of other advertisers
- Unethical publishers of AdSense will try to enrich themselves
- Google launched a beta CPA model March 2007 to handle these problems.

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Invalid click – Hard to define

- Consider the case of a double-click, i.e., two clicks on the same ad impression by the same browser, where the second click follows the first one within time period *p*
  - *What is the threshold p which splits the clicks into valid and invalid? 10 sec ? 1 sec?*

- Consider clicks on different ads by same viewer leading to the same page.

Recognizing Invalid Clicks (1)

Anomaly-based

- *i.e.* a normal average clicking frequency on an ad is <1 clicks/week per user. If someone clicks on it 100 times/week => abnormally large clicking activity

Challenges:

- Identify groups of clicks from “same user”, “same ad”, etc.
- identify what the “normal” clicking activities
- Define what “deviation from the norm” is

Recognizing Invalid Clicks (2)

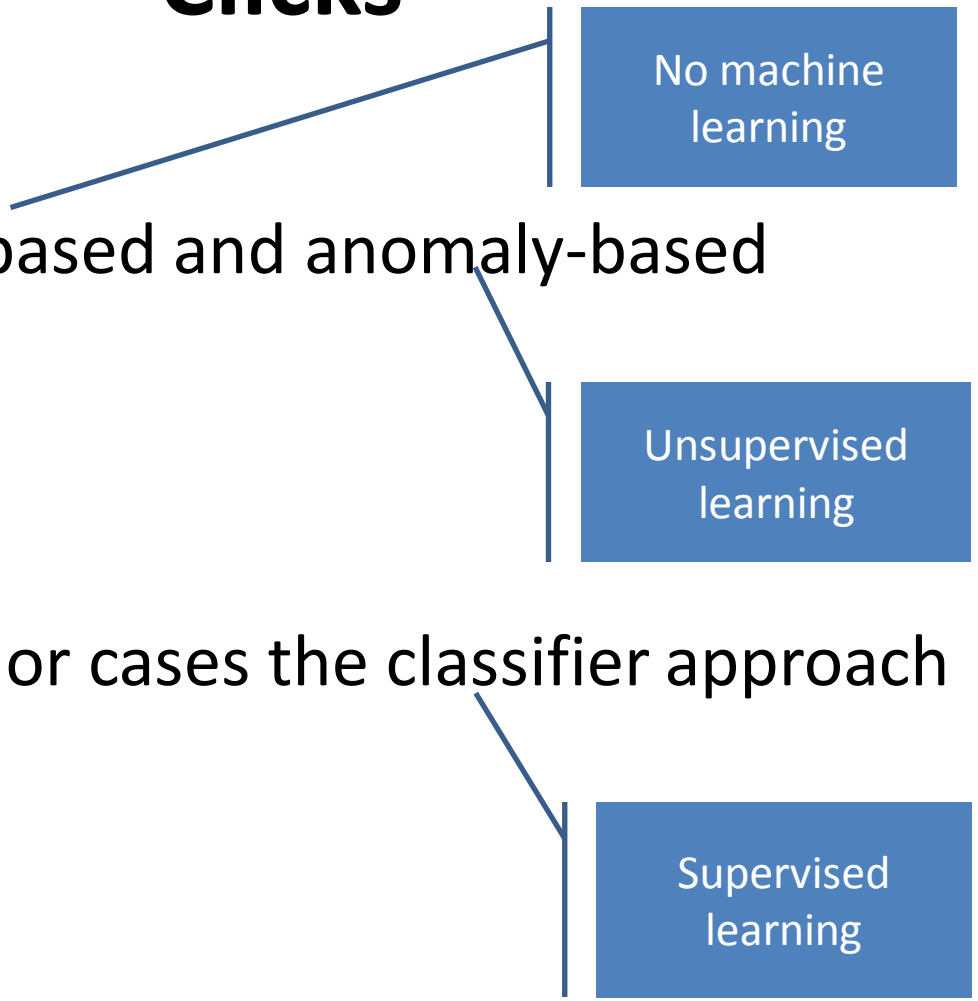
- *Rule-based*
  - set of rules identifying invalid or invalid clicking activities
  - *i.e.* "IF Double-click occurred THEN the second click is Invalid"
- *Challenges:*
  - *Are the conditions reasonable?*
    - *i.e. duplicate click was in the start treated by Google as a valid click => the customers had to pay for it.*
  - *Are the conditions consistent (to the definition of invalid click)?*

Recognizing Invalid Clicks (3)

- *Classifier-based*
  - Build a statistical model based on the past data that can classify new clicks into valid or invalid
  - Assign probability to the classification
- Challenges:
  - Need to manually label a large training set, which might be an issue in itself.
  - Does the classifier manage to capture the conceptual description of an invalid click?
  - Concept drift and adversarial classification

Operational Definitions of Invalid Clicks

- Google uses:
  - Mainly rule-based and anomaly-based approaches.
  - For some minor cases the classifier approach



Fundamental problem of the Cost-per-click Model

Publish the rules?

Yes – unethical users will take advantage of the information (adversarial problem).

No – no overview over what the advertisers exactly is charged for.

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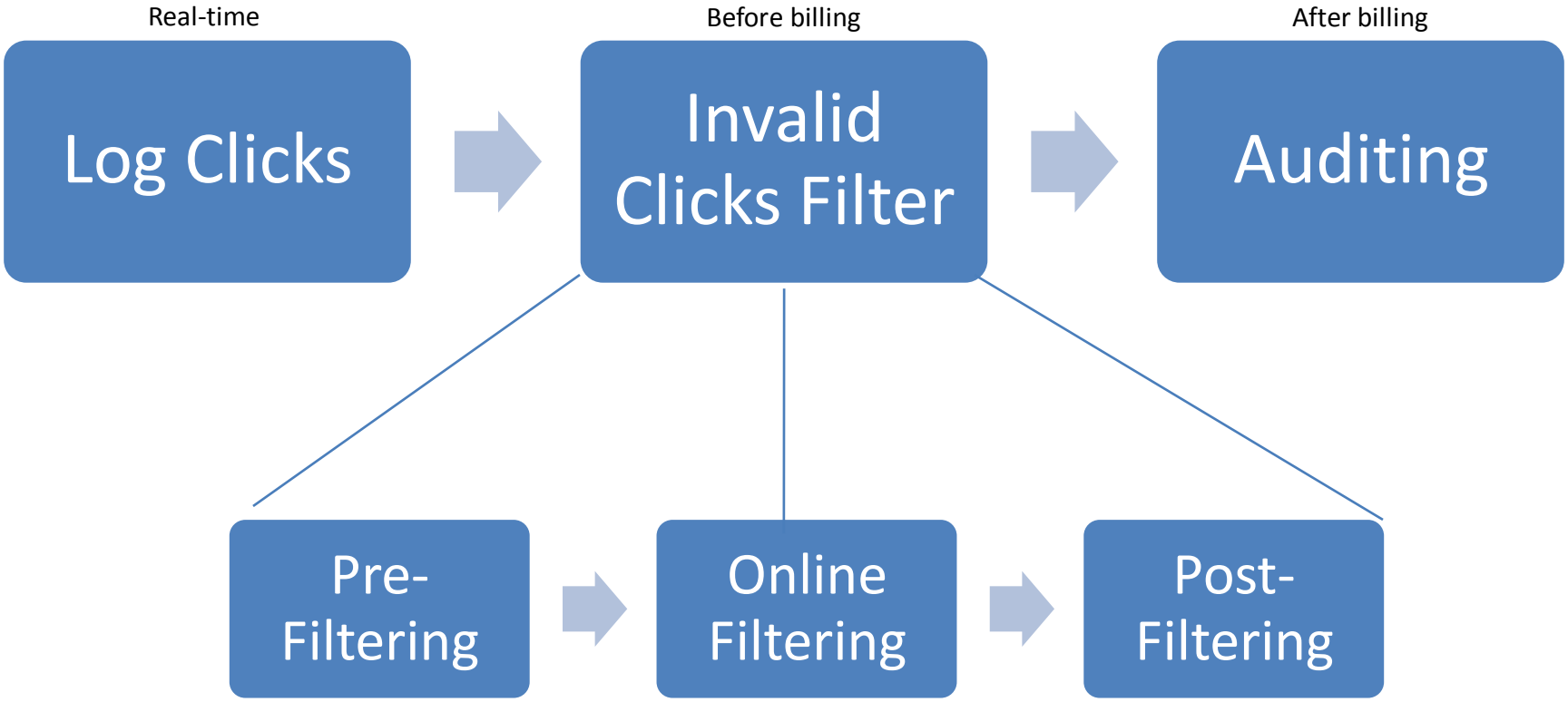
Google’s Approach

The Click Quality team's mission statement:

- Protect Google’s advertising network (long-term profit) and provide excellent customer service to advertisers. We do that by:
  - monitoring invalid clicks/impressions and removing its source
  - Reviewing all client requests and responding in a timely manner
  - Developing and improving systems that remove invalid clicks/impressions and properly credit clients for invalid traffic
  - Educating advertisers and employees on invalid clicks/impressions.

Google's Process



- Automated monitoring
- Manual Reviews
  - Proactively
  - Reactively

Overview: Google's Approach

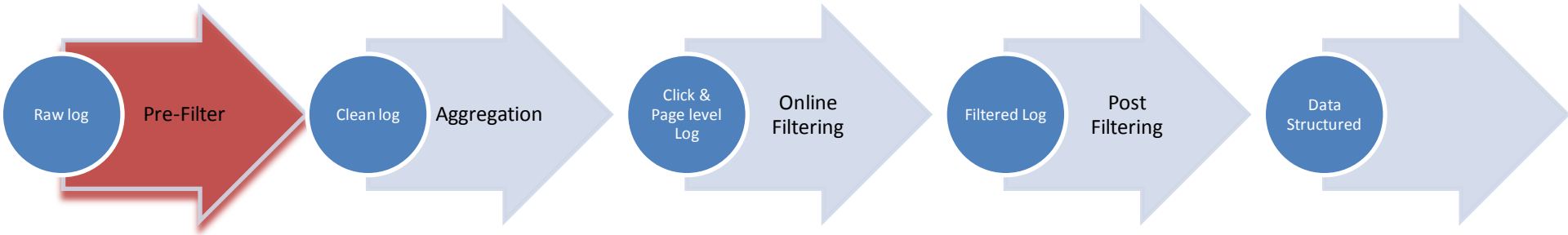
- Prevention
  - Discouraging invalid clicking
    - Hard to make duplicate accounts
    - Hard to make fake accounts
    - Don't pay for fraudulent activities
- Detection
  - Detecting and removing invalid click

-Building walls

-Very limited punishment

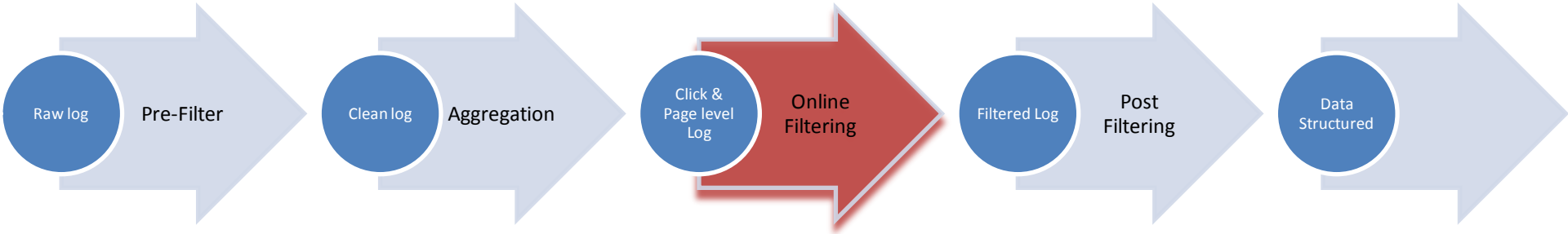
Pre-Filtering

- Clicks removed from log in order to keep the performance statistics clean
  - Google test clicks removed
    - From Google's IPs
  - Meaningless clicks removed
    - Improperly recorded clicks



Online Filtering

- Rule-based filters and anomaly-based filters
- Detection within a short time window
- Clicks are identified and marked as invalid and advertisers are not charged for them
- The invalid clicks are removed at the end of the filtering process => the filter sees all the clicks; can compare multiple related clicks



Performance of the Online Filters

- The typical way of presenting performance of a classifier is with a Confusion Matrix
- Unfortunately, Google does not know which clicks are actually valid
  - > Have to measure performance through indirect evidence

Performance of the Online Filters contd.

- The indirect evidence:
  - If newly added filters only suggest a few additional invalid clicks
  - The offline filters suggest only a few additional invalid clicks

Performance of the Online Filters

- From indirect evidence, Online Filters seem to be effective.
- This surprised the author; are the filters too simple?
- Answer:
  - Reasonable performance due to:
    - Combination of filters
    - Simplicity of most attacks
    - Some complex filters (although most of them are simple)

The long tail of invalid clicks

- Massive amount of invalid clicks from only a few types of inappropriate activities
- Long tail: many infrequent idiosyncratic activities
- Google's filters easily catches the left part
- Question 1: Why do criminals continue?
- Question 2: Which activities are shrinking/expanding?

The long tail of invalid clicks

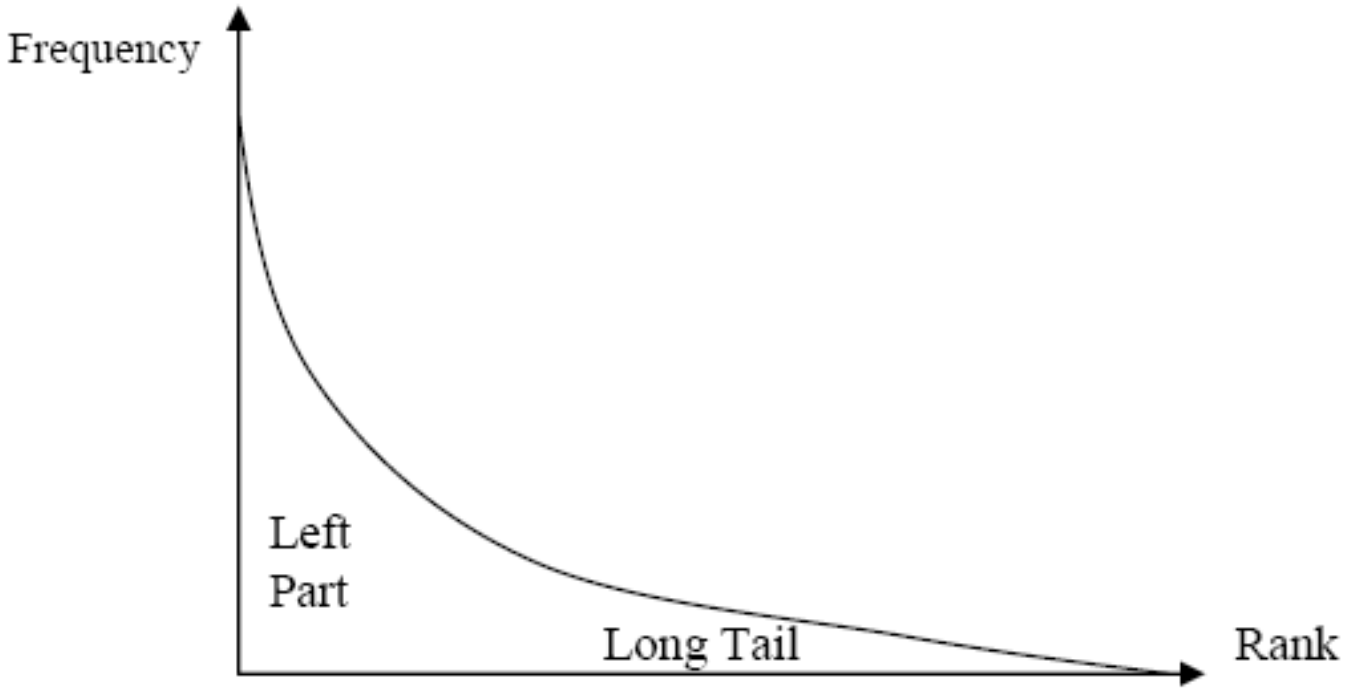


Figure 1: The Zipf's Distribution and the Long Tail of Invalid Clicks.

Online Filters: The future threats

- Today: Filters perform well and seem to be accurate
- Future: New attacks might pretend to shift towards the long tail
  - E.g. botnets

Are the filters biased?

- Is it profitable for Google to filter laxly
  - > let through some invalid clicks
- I.e. consider filter:
  - *"If signal **X** associated with a click is above the threshold level **α** then mark the click as invalid"*
- Low ***α*** => lost short-term profit for Google
- High ***α*** => gain in short-term profit for Google

Are the Online filters biased? Contd.

- Is it worth gaining some revenue but losing the advertisers trust?

- Author's investigation:
  - Click classification is purely a engineering decision, with no input from the finance department
  - Except the case regarding duplicate click
    - This case was a big concern for the management
    - Still, despite the short-term, they decided to change the policy.

What is missing in Google Filters?

- More supervised learning approaches
- Using the conversion data in filters
  - Hard to collect conversion data
  - Very sparse data
  - Conversion can take some time after the actual click => hard to use in online filters.

Post/offline detection methods

- No real-time constraint, no computational constraint.
- Automated
  - Alert systems
  - Automated termination system for AdSense publishers
- Manual
  - Handle complaints
  - Handle alerts

Performance of detection methods

- Indirect evidence:
  - Newly added and revised filters detects few additional invalid clicks
  - Same for the offline methods
  - Increase in # of clicks marked invalid, but not in complaints from AdSense publishers.
- No hard evidence :/
  - > but can conclude that the filters works reasonably well

Conclusion

- The conceptual definition of invalid click assume human intent:
  - No method satisfying this definition for algorithmically detecting invalid clicks
  - > Need operational definitions:
    - Anomaly based
    - Rules based
    - Classifier based
- No complete data on actual valid/invalid clicks but
  - Complaints from advertiser indicate invalid
  - Complaints from publishers indicate valid