

# Android Market Discovery: helping users discover apps!

July 18<sup>th</sup>, 2011, Social Web Mining, IJCAI

Bhaskar Mehta

Staff Software Engineer, Google Zurich

*Joint work with Ihar Mahaniok, Fabio De Bona, Istvan Hernadvolgyi, Christian Sonntag, Fernando Delgado, and Android Market Team*



- **Android and its growth**
- **Main challenges for users and developers**
- **Enabling discovery**
- **Discovery across the shopping funnel**
- **Features and algorithms**
- **Whats next?**

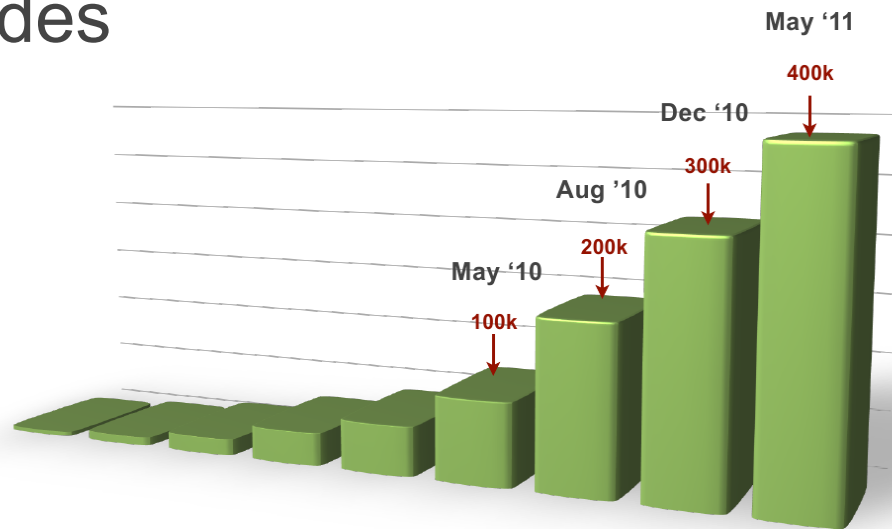


# Android - a growth story

## Huge growth on the platform!

### Main reasons:

1. Platform openness
2. High quality, Quick upgrades
3. Manufacturer adoption
3. Developer adoption



~550k activations a day<sup>4</sup>

~300 devices (models) running Android 1.5 - 2.3

~6 billion installs of apps to date!



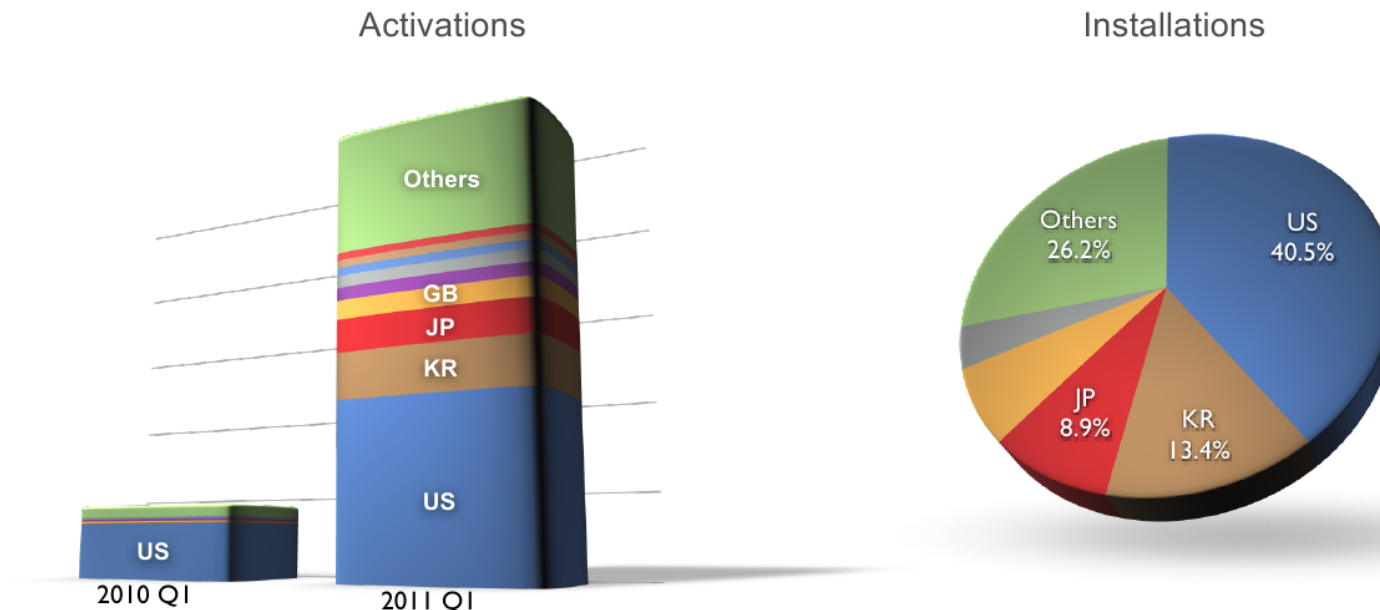
# Android's global growth

## Global growth in 2011, as opposed to US only!

### Users from all over the world

1. Applications developed are both global and local
  2. Very diverse user base, needs are very different
- Users from 131 countries can download paid apps!

**Platform's success ultimately depends on apps usage!**





# Android Apps: Opportunities and Challenges

## Open App publishing platform leads to low entry barrier

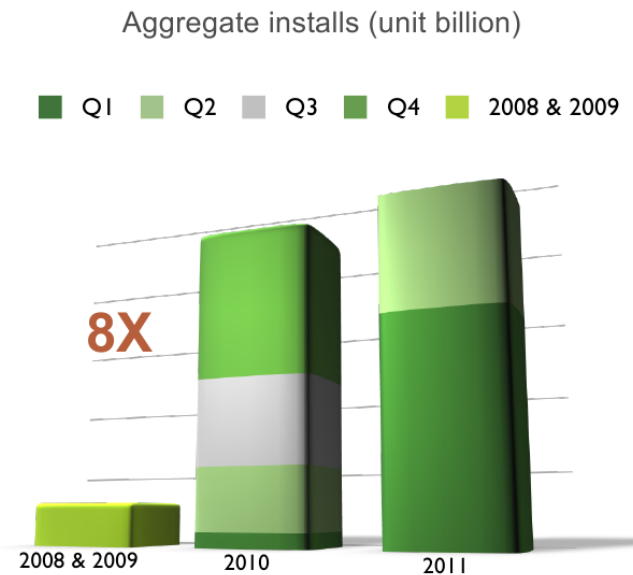
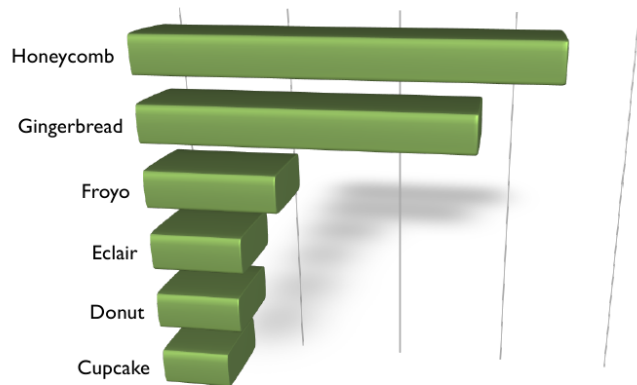
## Developers from all over the world can create apps

### Whats working well

- Fast growth of app base: > 200k growing XY%
- Newer OS versions more conducive to app usage
- User adoption of popular apps

### Main challenges

- Users: find interesting apps easily
- Developers: merchandise new apps



# A New Android Market for Phones





# Enabling App Discovery

## Users want to find out what they are missing!

### Fast growing corpora more conducive to discovery

- Search is harder to do: smaller/untrusted text descriptions
- Users' intent unclear: 'new hottest games'

### Pivoting of early adopters and the crowd:

- What are other users doing?
- What hot apps am I missing?
- What is the best keyboard?
- What is popular amongst people in my city/country?
- What do people like me/my friends do?

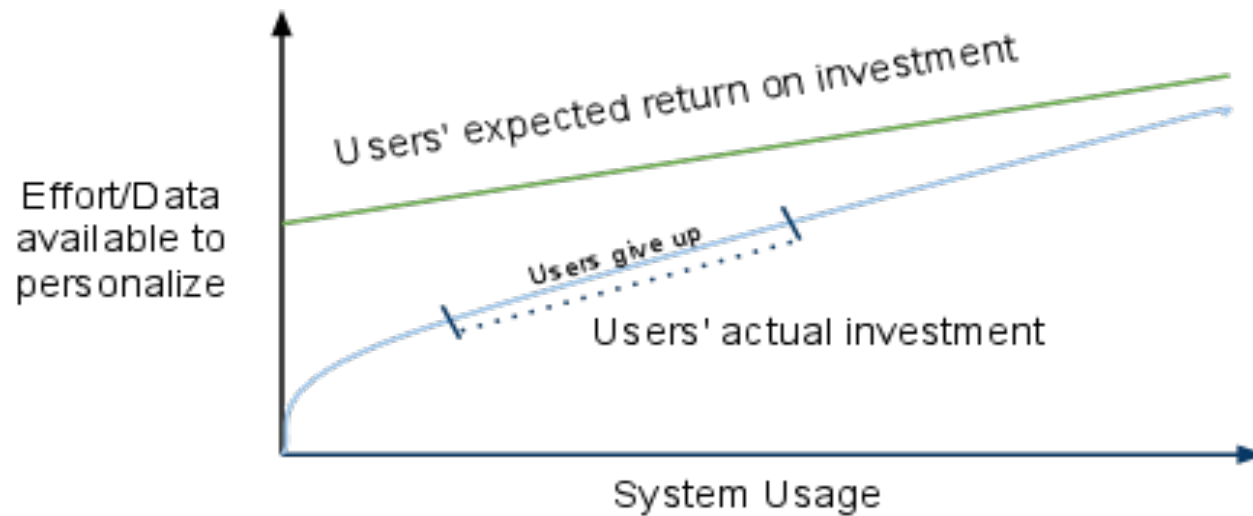
### Device constraints

- Scrolling is easier than typing!
- Browsing more comfortable/easier than searching



# Challenges with Personalized Discovery

**Motivation:** Serving our users better requires understanding them better, and in totality.



## Challenges with Personalized discovery

- User investments are higher
- Benefits take longer
- User expectations are higher

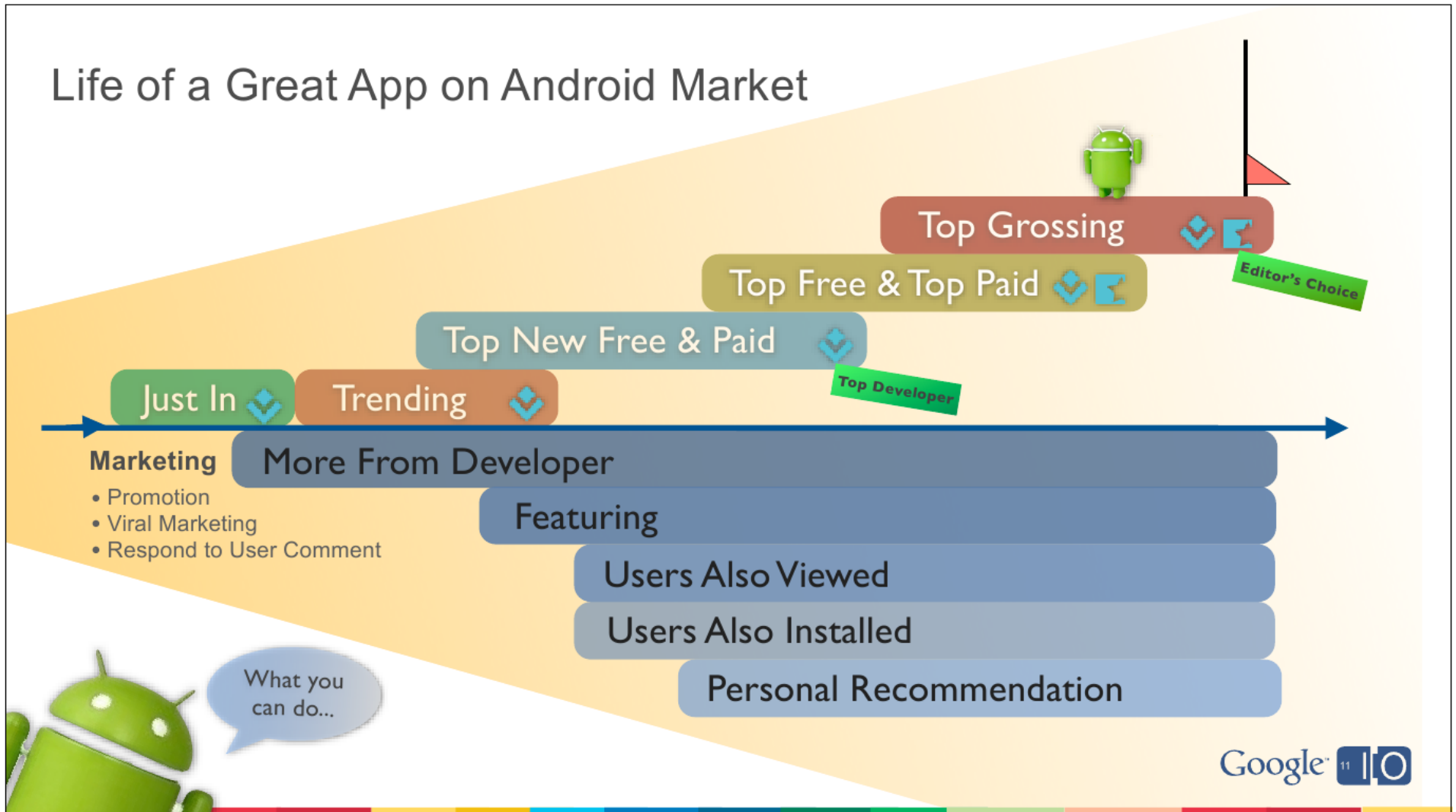
*Solution: Use "Wisdom of the crowds" extensively*





# Discovery across the funnel: Android Market

**Objective:** Help users discover apps, drive engagement!





# 1. Trending Apps Recommendations

**Objective:** Show apps which are gaining popularity

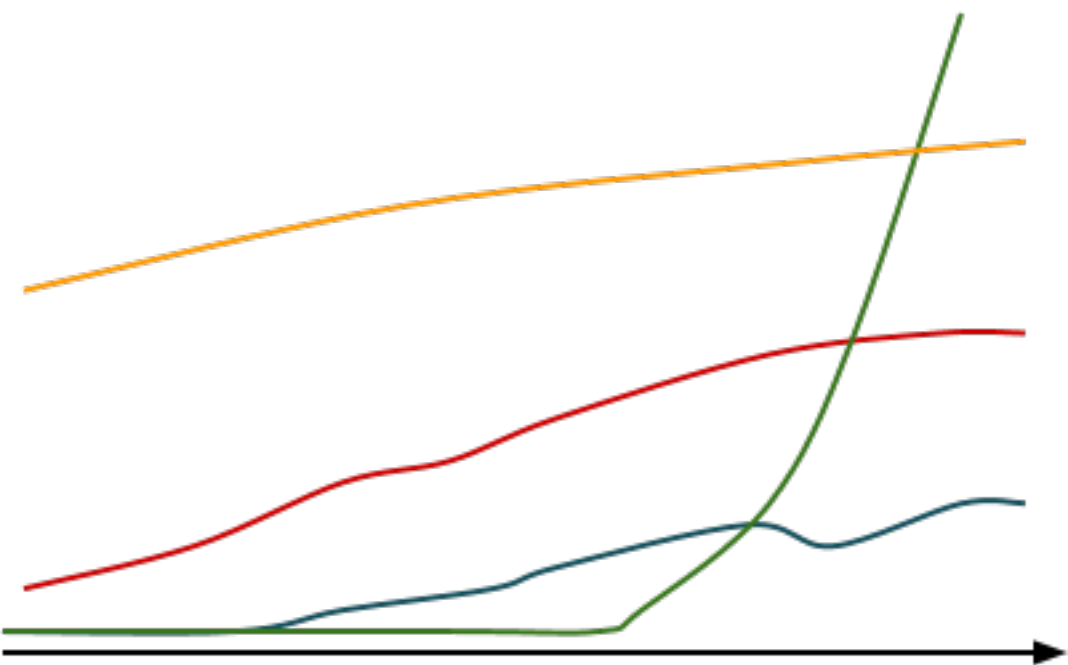
**What we use:**

**Step 1:** Collect recent installation logs from Android Market

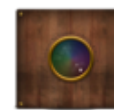
**Step 2:** Calculate normalized "force" per app

**Step 3:** Rank & filter

Status: Launched on Web + Phone



## Trending Apps



**PicFX Camera Upgrad**  
DROID GENIUS  
★★★★★ (429)  
INSTALL



**CONTRACT KILLER**  
GLU MOBILE  
★★★★★ (177)  
INSTALL



**Fly Boy**  
FEELINGTOUCH INC.  
★★★★★ (58)  
INSTALL



**Kids Doodle**  
BEJOY MOBILE  
★★★★★ (2,687)  
INSTALL



**Crime Inc.**  
UKEN GAMES  
★★★★★ (34)  
INSTALL



**FARKLE**  
VIRAL  
★★★★★ (34)  
INSTALL



**Cocomong 2 Hidden..**  
MFLARE.CO.LTD  
★★★★★ (35)  
INSTALL



**Grave Digger Free**  
FIGHTINGFISH GAMES  
★★★★★ (284)  
INSTALL



**Space Jump**  
CANDY MOBILE  
★★★★★ (222)  
INSTALL



**Plan B**  
LOOKOUT LABS  
★★★★★ (285)  
INSTALL



**Bang Bang Racing TH**  
PLAYBOX  
★★★★★ (46)  
7.05 CHF BUY



**Cleopatra's Pyramid**  
GAMEDUELL  
★★★★★ (811)  
INSTALL

# 2. Top Lists

Give users a new way to discover apps that are local!

- New lists: Top New Free/ Top New Paid
- Revamped lists: Top Paid/ Top Free
- Top Grossing Apps

Encourages local developers, helps user find niche apps easily!

Also, top grossing list encourages in-app purchase integration and higher average price.

**Android Market**

**Top Free in Apps**

Rank	App Name	Developer	Editor's Choice	Rating	Install
1	Google Maps	GOOGLE INC.	Yes	★★★★★	INSTALL
2	WhatsApp Messenger	WHATSAPP INC.	No	★★★★★	INSTALL
3	YouTube	GOOGLE INC.	No	★★★★★	INSTALL
4	SBB Mobile	SCHWEIZERISCHE BUNDESBAHN	No	★★★★★	INSTALL
5	Paradise Island	COOPER MEDIA CORP.	No	★★★★★	INSTALL
6	Facebook for Android	FACEBOOK	Yes	★★★★★	INSTALL
7	Shazam	SHAZAM ENTERTAINMENT	Yes	★★★★★	INSTALL
8	Angry Birds Rio	ROVIO MOBILE LTD.	Yes	★★★★★	INSTALL
9	Angry Birds	ROVIO MOBILE LTD.	No	★★★★★	INSTALL
10	Skype	SKYPE	No	★★★★★	INSTALL
11	Google Earth	GOOGLE INC.	Yes	★★★★★	INSTALL
12	Drag Racing	CREATIVE MOBILE	No	★★★★★	INSTALL
13	20 Minuten Online	20 MINUTEN ONLINE	No	★★★★★	INSTALL
14	Swiss Weather Radar	TJUNOD	No	★★★★★	INSTALL
15	Swiss Phone Book	LOCAL.CH AG	No	★★★★★	INSTALL

# 3. Related Apps Recommendations - shallow dive



## Related Items Recommendations

- Formally: hard to describe: *graph problem?*
- For each items
  - Most likely items to be clicked next (YT Related Video)
  - Most likely Replacement (Product search, Android)
  - Most similar thematically (books, similar pages)
- Objective: Find a list to match criteria

## Common Methods:

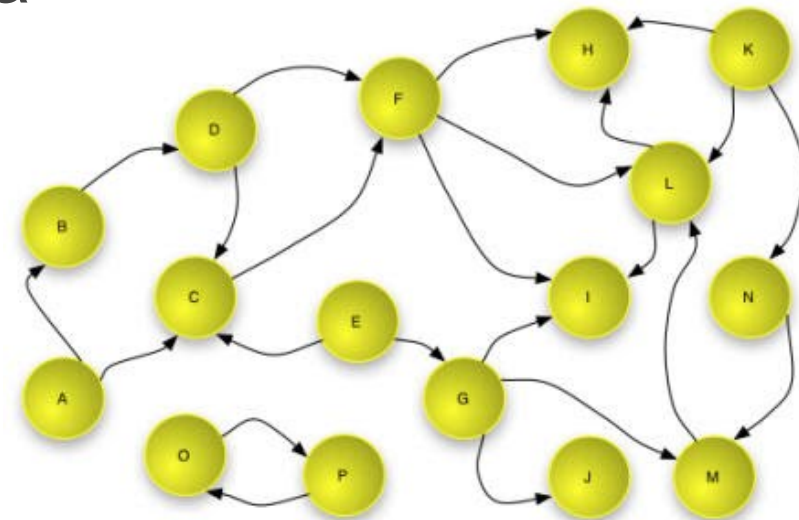
Association rule mining

Graph methods

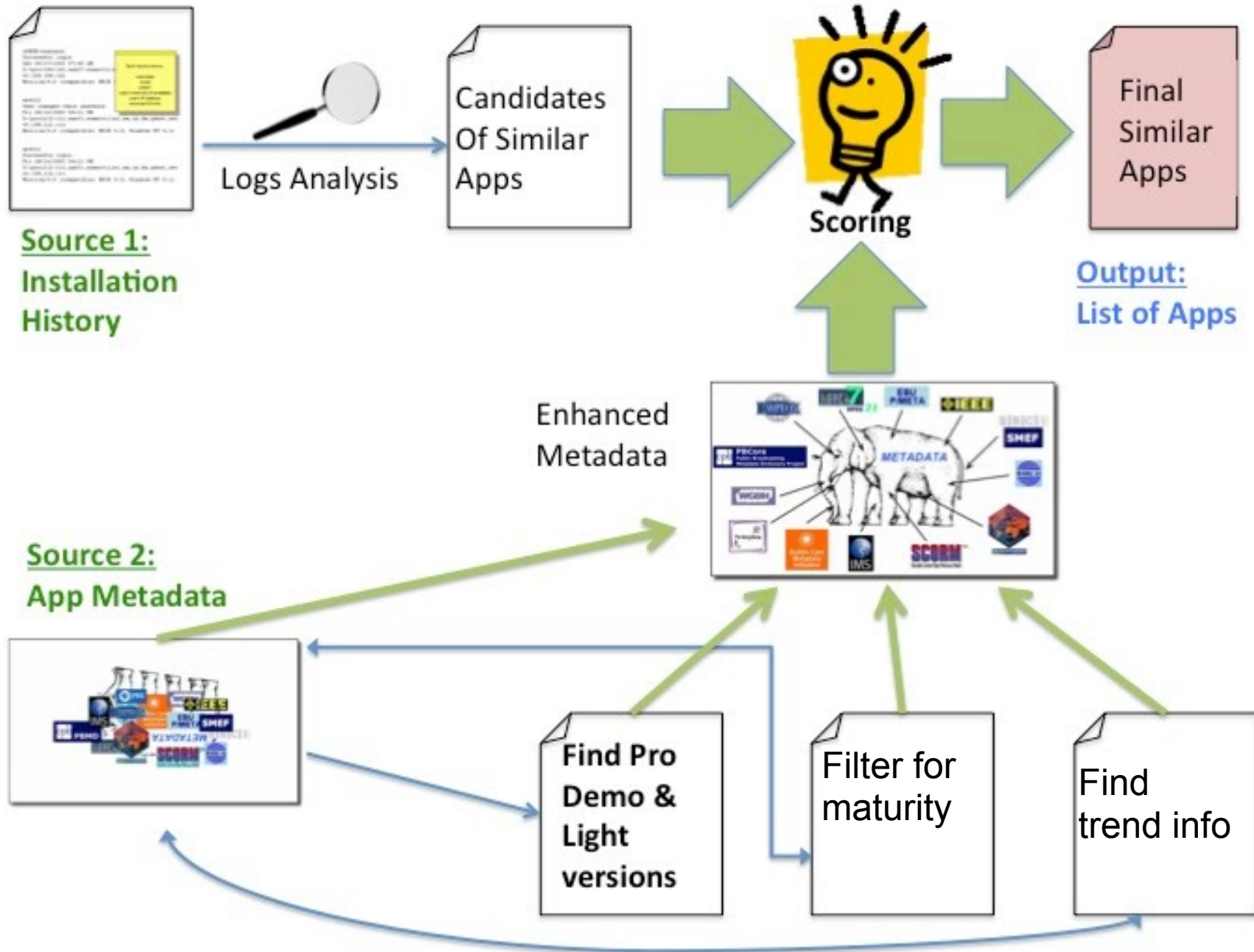
Bayesian models

Simple view counts

**What we use:** Association rule mining++ (Using content, metadata, category, ratings, social signals, filtering, recency)



# 3(b) Architecture: Related Apps Generation



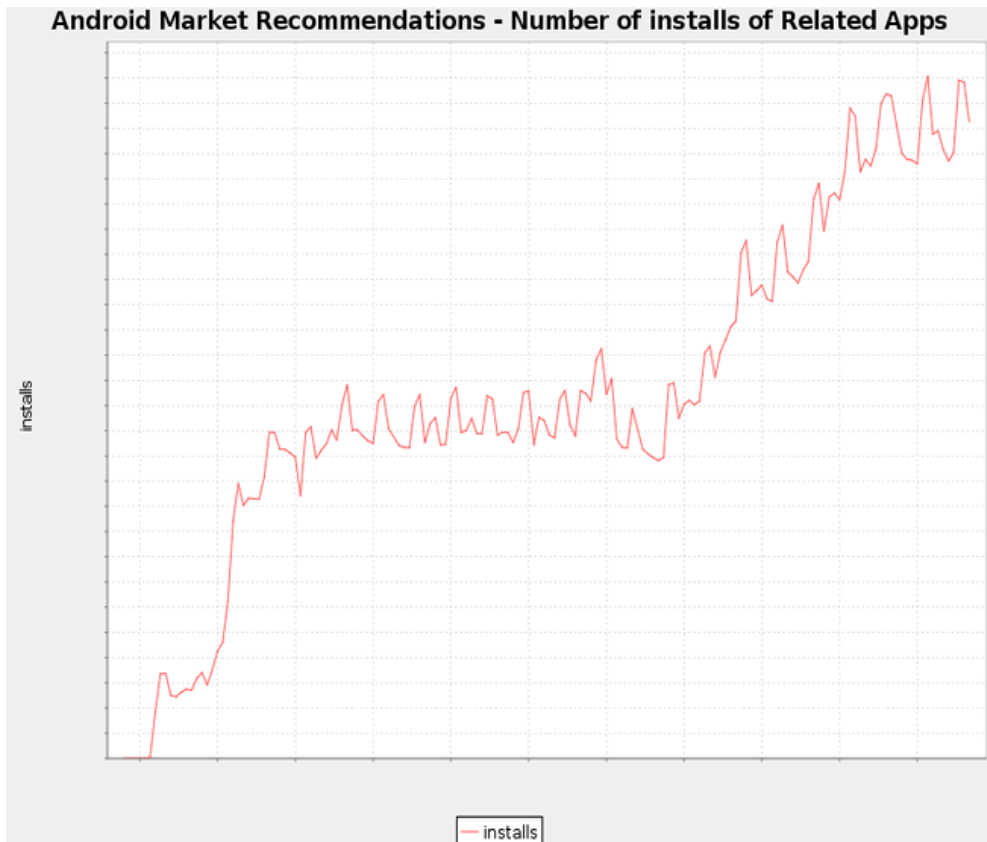


# 3(c) Related App Usage

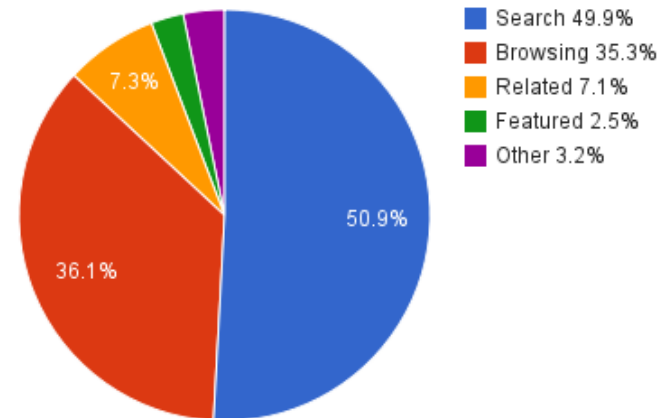
**Objective:** For each app, find *Most likely Replacement*

Stats:

7-8% of daily installs from Related >1k QPS



Referrers to Android Market downloads







## 4. Cross Sell recommendations - shallow dive

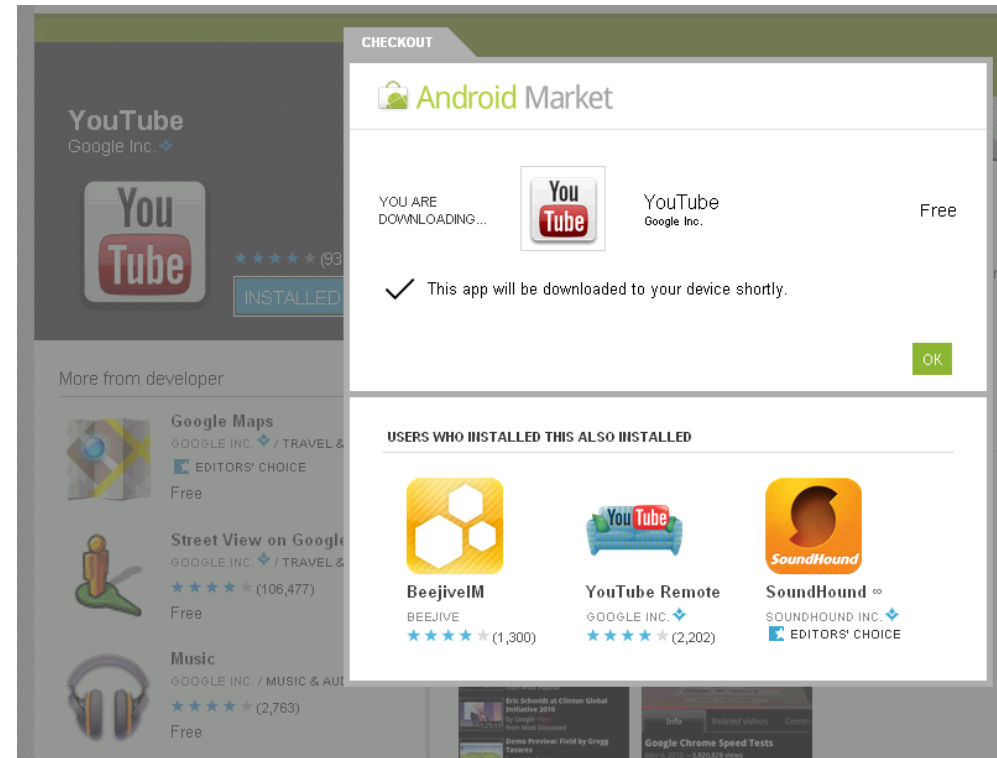
**Objective:** When a user installs an app, show the other apps they might be interested in.

### What we use:

**Step 1:** Analyze install patterns, merge versions

**Step 2:** Probabilistic model for ranking/scoring

**Step 3:** Removal of low-quality apps



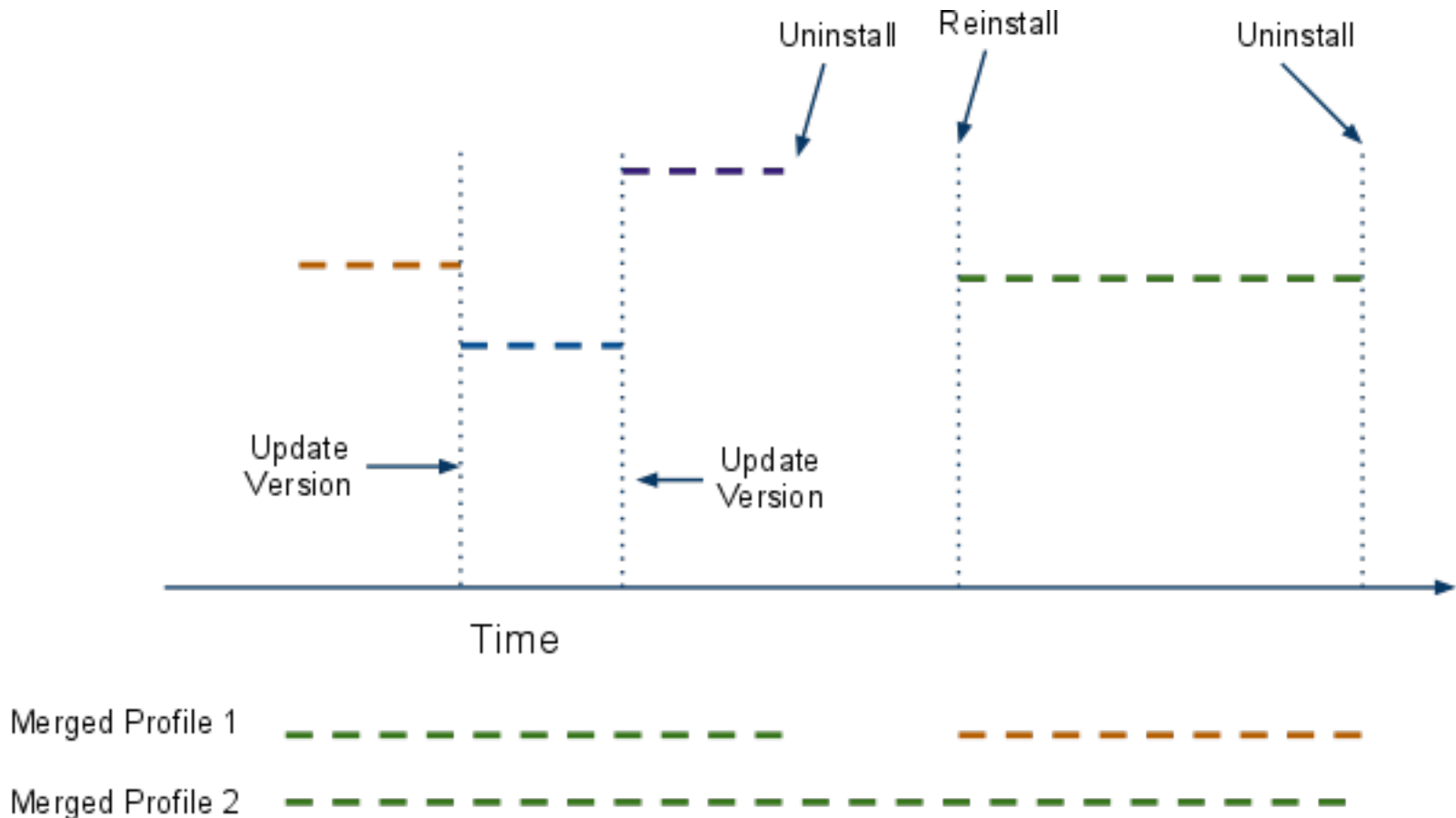
**~5 billion un/installs, analyzed daily:** (increasing x% per month)



# 4(a) Life of an Installed App

- Users install, uninstall, re-install, update apps frequently.
- Results in noisy data for co-install analysis

## Merging installs is important!



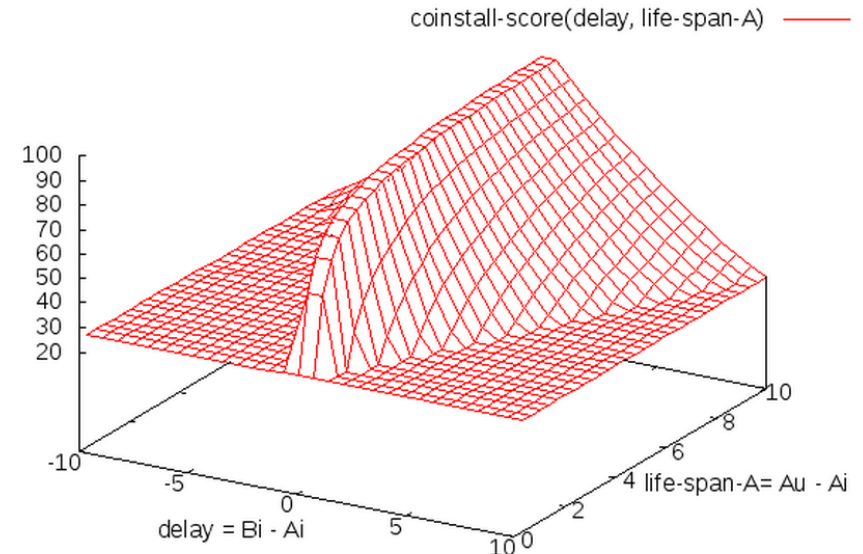




# 4(b) Scoring Co-installs

## 1. Weight co-installs

- For each user, consider
  - Consider all pairs (A, B) of installed apps
  - MR: Output(A&B, co-install-weight(A,B)); (non-symmetric)
  - MR: Output(A, 1.0); Output(B, 1.0);
- Co-install weight takes into account
  - A & B installed closely after each other
  - B installed after A is uninstalled/long after A is installed





## 4(c) Scoring Candidates

### 2. Normalize co-installs, and compute probability scores

- For each pair of App, consider  $w(A,B)$ ,  $w(A)$ ,  $w(B)$ 
  - Independence:  $I = 1 - P(!A | B)$
  - Lift  $L = P(A|B)$
  - Score =  $k * I^a * L^b$
  - Normalization is key!

### 3. Remove Noise

- For each App, consider all candidate
  - Remove low rated, low quality apps (< 10 install)
  - Remove apps in incompatible category\*
  - Remove apps rated mature.
  - Multiply score by quality score
  - Rerank!



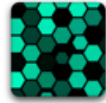
# 5. Personalized Recommendations

**Objective:** Given users a ranked list personalized for them

Apps for You



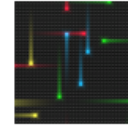
Beautiful Live We...  
LEVELUP STUDIO  
★★★★★ (8,632)  
INSTALL



Light Grid Pro Li...  
JOKO INTERACTIVE  
★★★★★ (2,169)  
€ 0,70 BUY



Custom Launcher I...  
JONFHANCOCK  
★★★★★ (1,980)  
€ 2,80 BUY



Nexus Revamped Pr...  
STEALTHCOPTER.COM  
★★★★★ (684)  
€ 1,13 BUY

**What we use:**

**Step 1:** Candidate generation item2itemCF, recent, local, popular

**Step 2:** Perceptron learning over chosen features (is this a top 100 app? in same language as user locale?)

**80+ million profiles, 5 billion un/installs:** (increasing x% per month) *One of the largest recommender system in the world!*



# Whats next for Android Market Discovery?

**Measure and iterate**

**Extend to other media e.g. Books**

From **Wired**:

*“The biggest problem we have in the Market is discovery,” said Michael Novak, Android engineer for Groupme.com, in an interview. “Google has definitely heard the complaints from people like me, and these new features being rolled out are proof.”*



# Q&A