

Privacy in Targeted advertising and Facebook ad targeting

Nataliia Bielova

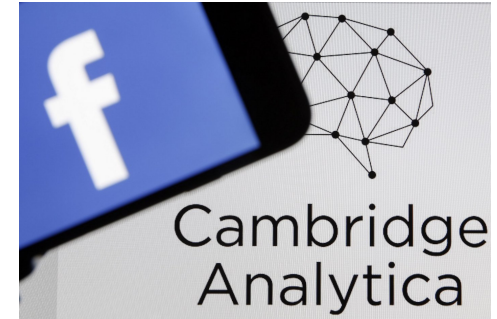
[@nataliabelova](https://twitter.com/nataliabelova)

Security, privacy and ethical aspects of data

Université Côte d'Azur

Cambridge Analytica scandal

- A lot of user's data collected
- Political ads that target users
- Reactions
 - How did they collect all that data?
 - Why collect this data? What did it allow them to do?



Why collect this data? What did it allow them to do?

*“Cambridge Analytica generally utilizes **custom audiences**, some of which were created from contact lists and other identifiers... and in some instances, refined those audiences with **additional targeting attributes**.”*

- Facebook (in response to U.S. Senate questions)

How many of you understand what this means?

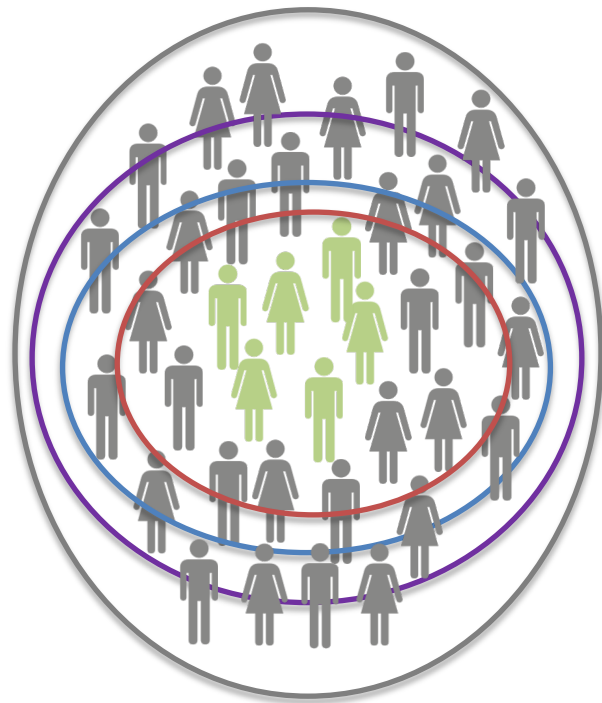
Targeted advertising

- Users who see ad called the *audience*
 - How can advertiser select their audience?

Ad on a broadcast medium (TV)

Ad targeting *search keywords*


Ad targeting *user attributes*



Ads on Facebook

Coralie Masson
Sponsored · €

Parce qu'il vous faut des Coralie Masson sous le sapin, n'attendez plus et passez vos commandes avant le 20 décembre!



Boots Josy cognac et glitter

Shop Now


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Suggested Post

Fluent Forever - Learn Any Language
Sponsored · €

The Secret to Learning a New Language is Sticking To It. Fluent Forever offers exercises and programs to keep you engaged at any level. The BEST part: what you learn, you KEEP for life. Pre-Order for E



Unlock The Secret of Language Learning.
The Most Successful App in Kickstarter History. Now Live on

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Suggested Post

Swatch
Sponsored · €

Soyez au top de la tendance minimaliste avec les nouveaux modèles SKIN.



#YOURMOVE, votre style
Imposez votre style

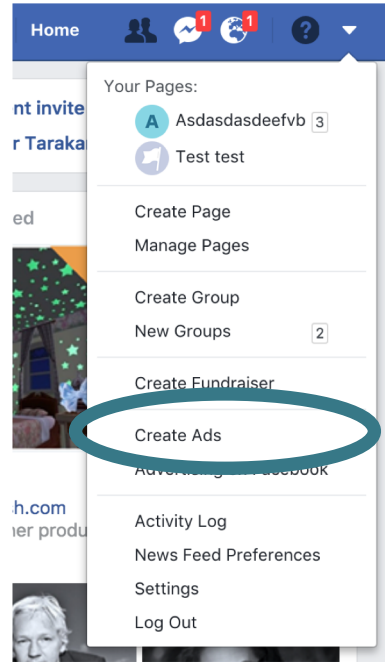
SWATCH.COM

Shop Now

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Like Comment Share

Anyone can be an advertiser in just a few clicks!



Targeting method 1: *Attributes*

- Advertiser can **include/exclude attributes** to create audience
- Attributes attached to users based on
 - Facebook activity
 - Third-party Web browsing
 - “Partner” companies
- >1,200 well-defined attributes
- >250,000 free-form attributes

The screenshot displays the Facebook Audience Builder interface. At the top, there are two tabs: "Create New" (selected) and "Use a Saved Audience". Below the tabs, the "Custom Audiences" section has a text input field with the placeholder "Add Custom Audiences or Lookalike Audiences". Underneath this, there are links for "Exclude" and "Create New". The "Locations" section features a dropdown menu set to "Everyone in this location", a search bar containing "United States", a location pin icon, and a button labeled "United States". Below the search bar, there is a link to "Add Bulk Locations..." and a section for "Age" with a range from "18" to "65+". The "Gender" section has three buttons: "All", "Men", and "Women". The "Languages" section has a text input field with the placeholder "Enter a language...". The "Detailed Targeting" section is expanded, showing a header "INCLUDE people who match at least ONE of the following" and a search bar with the placeholder "Add demographics, interests or behaviors". Below the search bar, there are four expandable categories: "Demographics", "Interests", "Behaviors", and "More Categories". At the bottom of the interface, there is a button labeled "Save This Audience".

How can advertisers target users?

Traditional targeted advertising: boolean formula

Audience = married + new mover + lives in Grenoble

Many attributes available for targeting

Detailed Targeting ⓘ INCLUDE people who match at least ONE of the following ⓘ

Add demographics, interests or behaviors | Suggestions | Browse

Connections ⓘ

Demographics

How your ads to the right people

- ▶ Multicultural Affinity
- ▶ Purchase behavior
- ▼ Residential profiles
 - Likely to move
 - New mover
 - Recent homebuyer
 - Recent mortgage borrower
- ▶ Travel
- ▶ More Categories

- ▶ Financial
- ▶ Football
- ▼ Job role
 - Corporate executives ☐
 - Financial professionals ☐
- ▶ Media
- ▶ Mobile Device User
- ▶ Mobile Device User/Device Use Time

Attributes can be invasive

The image displays three overlapping screenshots of a search interface, illustrating how different attributes can be used to filter results. Each screenshot shows a search bar with a filter applied, a list of suggestions, and a 'Browse' button.

Top Left Screenshot: The search bar contains 'Fascism'. The suggestions list includes 'Fascism' and 'Anti-fascism'.

Top Right Screenshot: The search bar contains 'Homosexuality'. The suggestions list includes 'Homosexuality' and 'Interests'.

Bottom Screenshot: The search bar contains 'Income >'. The suggestions list includes 'Income > 2. \$50,000 - \$74,999', 'Income > 3. \$75,000 - \$99,999', 'Income > 6. \$150,000 - \$249,999', 'Income > 4. \$100,000 - \$124,999', 'Income > 5. \$125,000 - \$149,999', and 'Income > 1. \$40,000 - \$49,999'. The 'Browse' button is visible next to each suggestion.

Data on everyone

- Out of 230M users (US):
 - Politics (US): 179M
 - Financial/Net worth/Liquid Assets: 74M
 - Family & Relationships: 138M

Where these attributes come from?

Collected all targeting attributes form 8 countries

Country	Facebook	Acxiom	Epsilon	Experian	DLX	Data broker (unspecified)	Total
US	614	128	14	5	350	10	1121
UK	614	103	0	17	19	0	753
France	614	21	0	0	0	0	635
Germany	614	60	0	0	0	0	674
Australia	614	24	0	34	0	0	672
Brazil	614	0	0	20	0	0	634
Japan	614	17	0	0	0	0	631
India	614	0	0	0	0	0	614

PII-based targeting

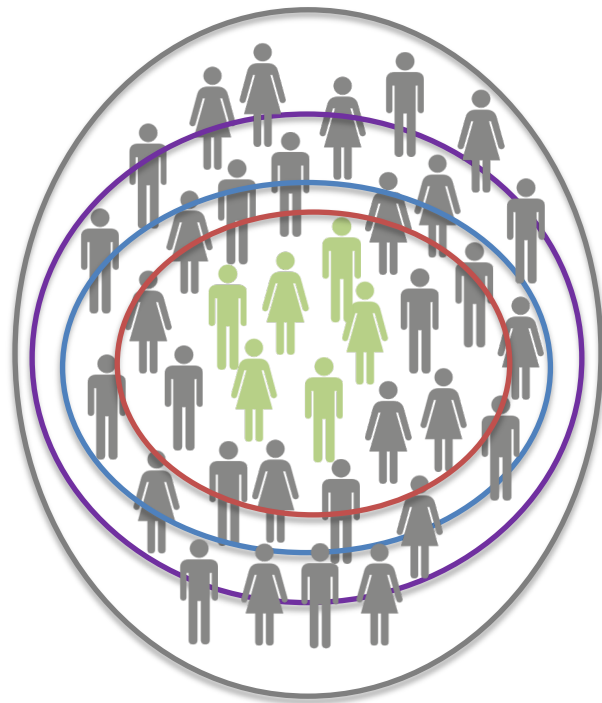
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Targeted advertising

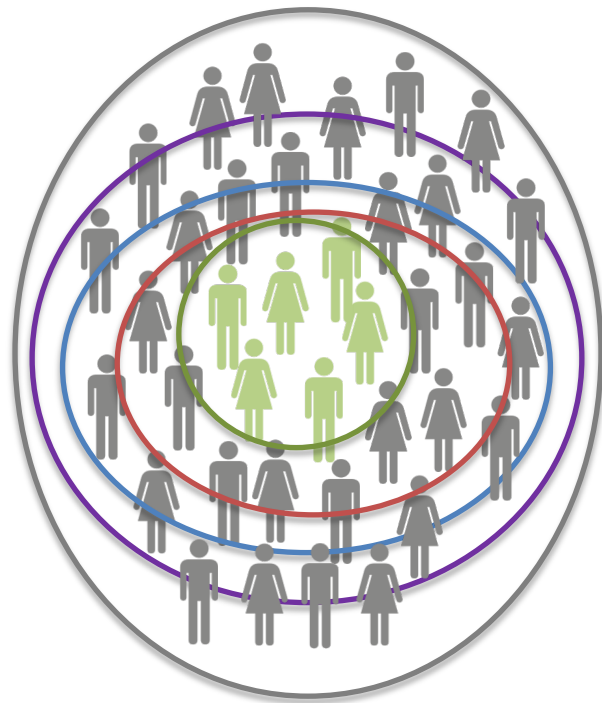
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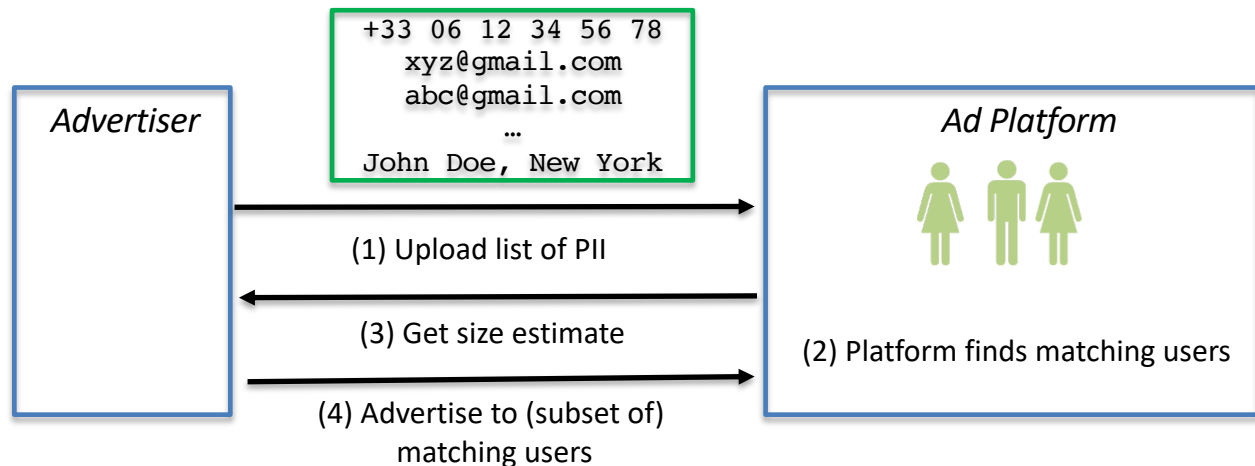
Ad targeting *search keywords*

Ad targeting *user attributes*

Ad targeting *identified users*



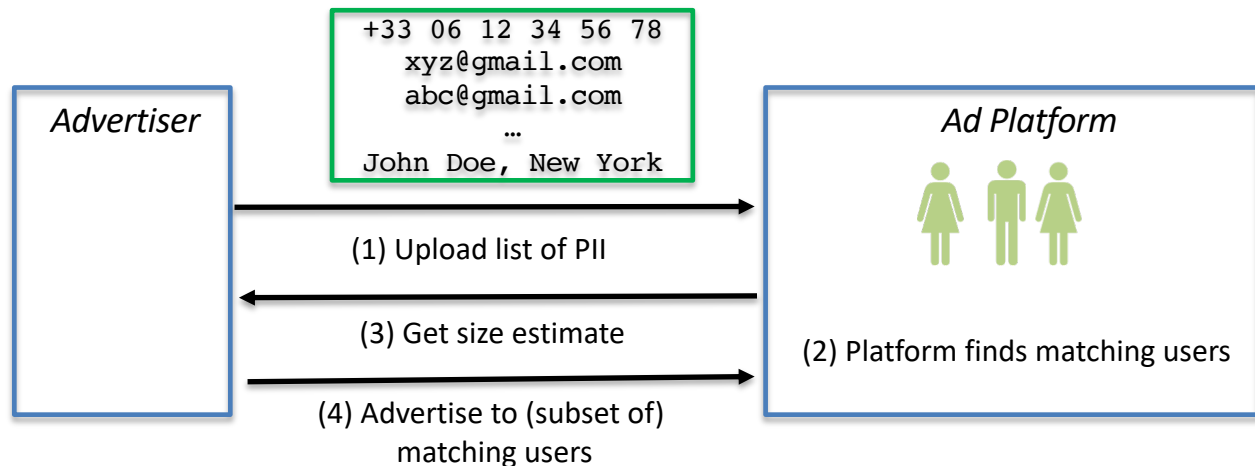
Targeting method 2: *PII*



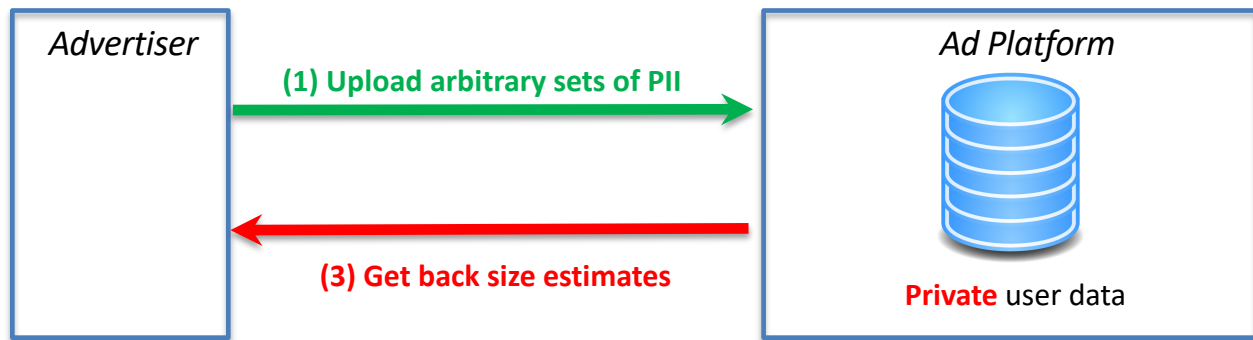
Advantages for advertiser:

1. Pay only **for users** you want to reach
2. Exploit different **external data** sources

PII-based targeting is common



PII-based targeting is common



This is a **query** to the user database!

Could these statistics **intentionally** leak user information?

Anybody can be an advertiser...

Features of Facebook's size estimates

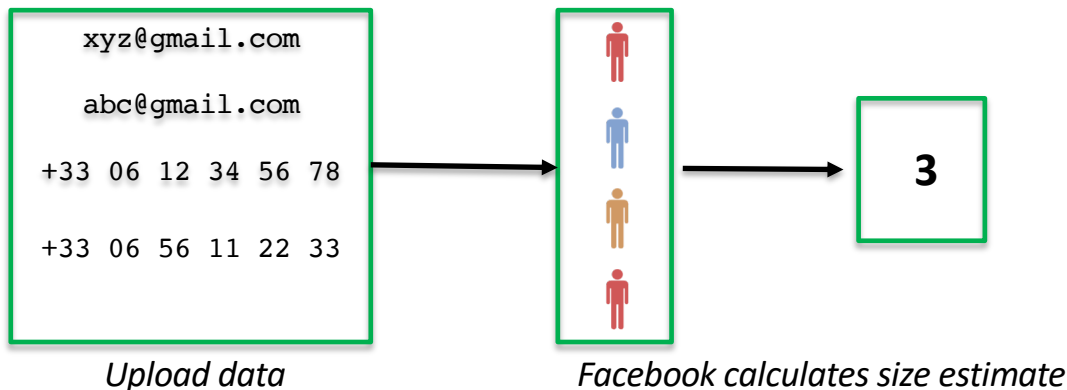
1. Size estimates obfuscated by **sample rounding**

(20, 30, 40, ..., 1000, 1100, 1200, ..., 10000, 11000, ...)

Obfuscation

2. Records matching same user are **de-duplicated**

De-duplication



Exploiting these features

Is

Victim's email

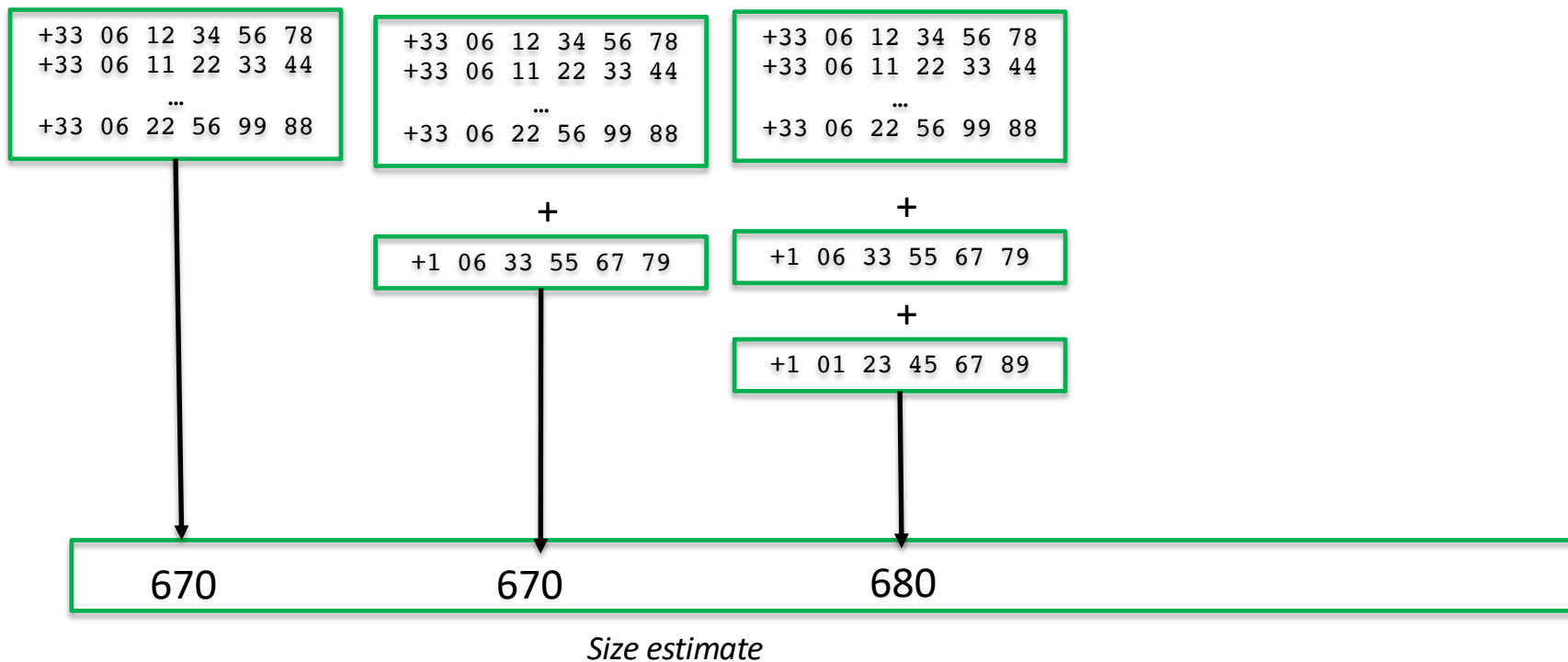
in

+33	06	12	34	56	78
+33	06	11	22	33	44
...					
+33	06	22	56	99	88

?

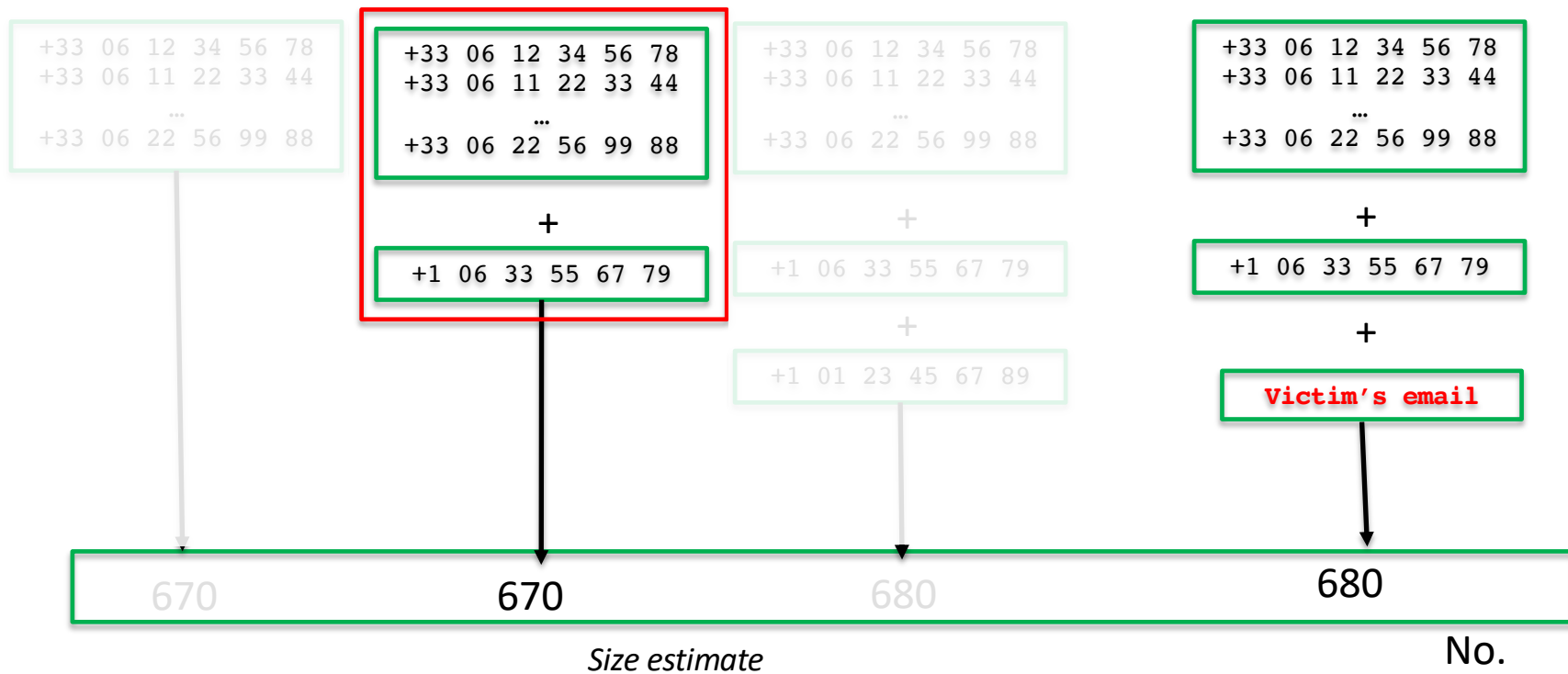
Exploiting these features

Goal: given victim's email address, find if victim is in a given **list of phone numbers**



Exploiting these features

Goal: given victim's email address, find if victim is in a given **list of phone numbers**



Attack: Inferring user's phone numbers

Can ask: Is **Victim** in Target list

Is **victim** in

100-000-0000
100-000-0001
100-000-0002
...
199-999-9999

If **No**: First digit is not 1
If **Yes**: First digit is 1

Is **victim** in

200-000-0000
200-000-0001
200-000-0002
...
299-999-9999

If **No**: First digit is not 2
If **Yes**: First digit is 2

Is **victim** in

010-000-0000
010-000-0001
010-000-0002
...
919-999-9999

If **No**: Second digit is not 1
If **Yes**: Second digit is 1

Attacks discovered

- Other attacks:
 - De-anonymise individual visitors to attacker's website
 - Infer PII for visitors to attacker's website in masse
- All attacks are easy to launch and have a large-scale impact:
 - Anyone can conduct an attack
 - Any Facebook user can be a potential victim
 - No interaction with the victim
- Responsibly disclosed with Facebook:
 - Temporarily removed size estimates for audiences with multi PII