A Customisable Pipeline for Continuously Harvesting Socially-Minded Twitter Users

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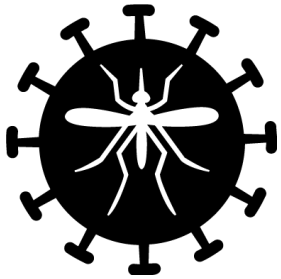
Motivation



Problem: Zika, Dengue, Chikungunya

are dangerous endemic diseases in Brazil

Solution?

- Government has low resources
- Crowdsourcing has “needle in a haystack” problem

Goal: identify target users for recruitment

Activist: a person who demonstrates an inclination to become engaged in social issues, regardless of the specific topic

- “socially-minded”

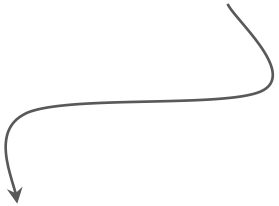
Can it be…

- Defined with computable metrics?
- Discovered independently from its social focus?

Customisable **pipeline** for **continuous discovery** of users of interest in **multiple topics** in **social media**

Approach

Goal: find users actively engaged in events



Defined by → **user metrics**

Measurements of relationships and social activities over Twitter

Defined by → **contexts**

Queries that retrieve event-related content

Contexts

$$\underset{\text{context}}{C} = (\underset{\text{hashtags}}{K}, \underset{\text{date interval}}{\Delta t}, \underset{\text{location}}{s})$$

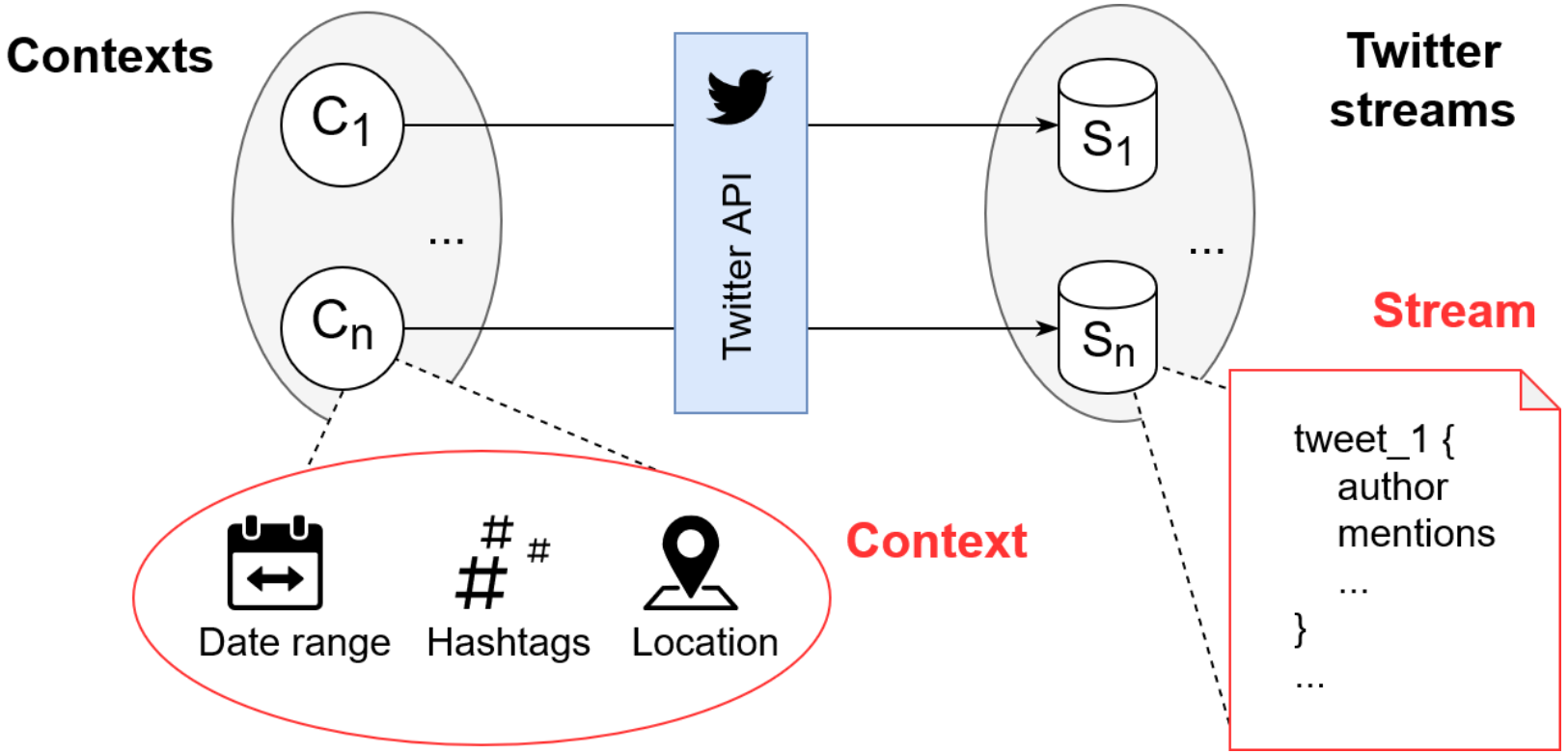
$$\underset{\text{set of posts}}{P(C)} \longrightarrow \underset{\text{post}}{p} \in P(C) \qquad \underset{\text{author of post}}{u(p)} \in P(C)$$

$$\underset{\text{complement of P(C)}}{\tilde{P}(C)} = P(C') \setminus P(C)$$

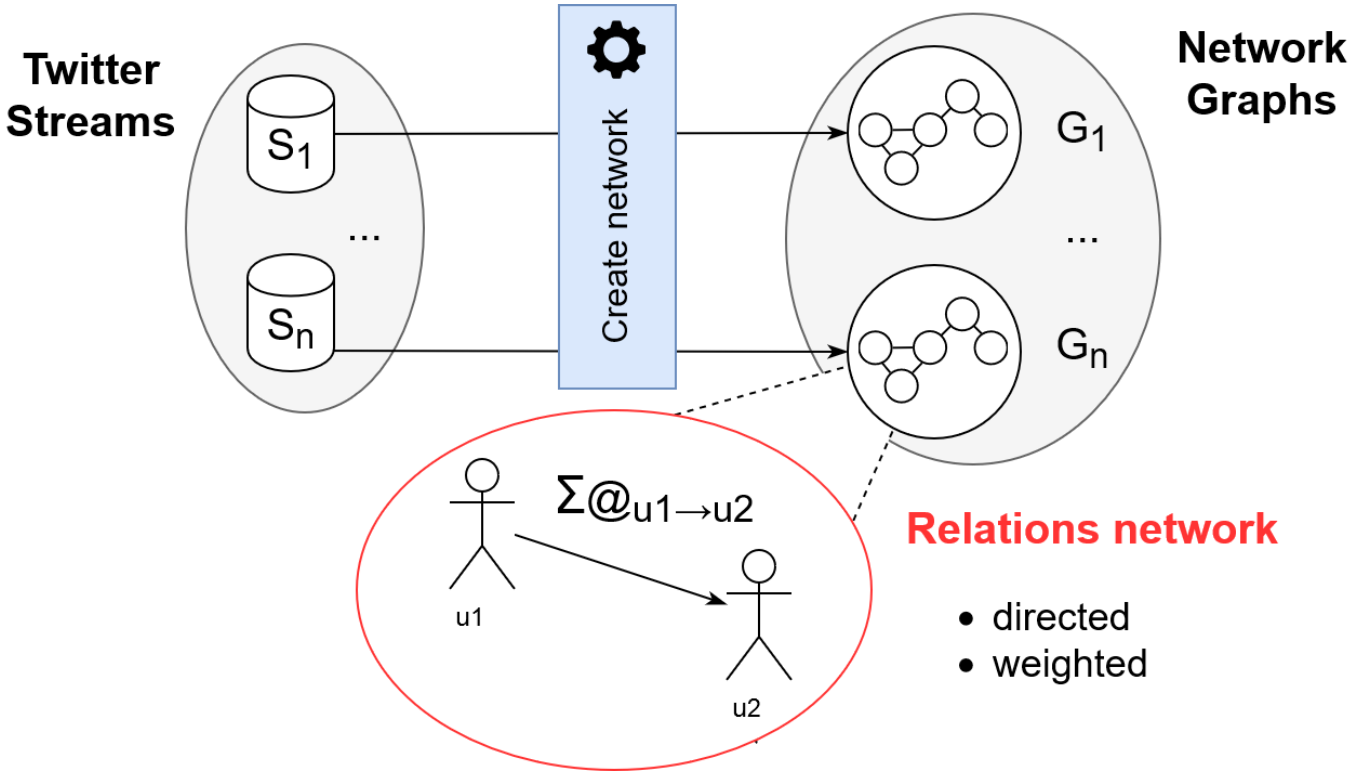
$$\underset{\text{graph for C}}{G_C} = (V, E) \longrightarrow \underset{\text{set of nodes}}{V} = \{u(p) | p \in P(C)\}$$

$$\underset{\text{edge}}{e} = \langle \underset{\text{post author}}{u_1}, \underset{\text{mentioned/ retweeted author}}{u_2}, \underset{\text{weight}}{w} \rangle$$

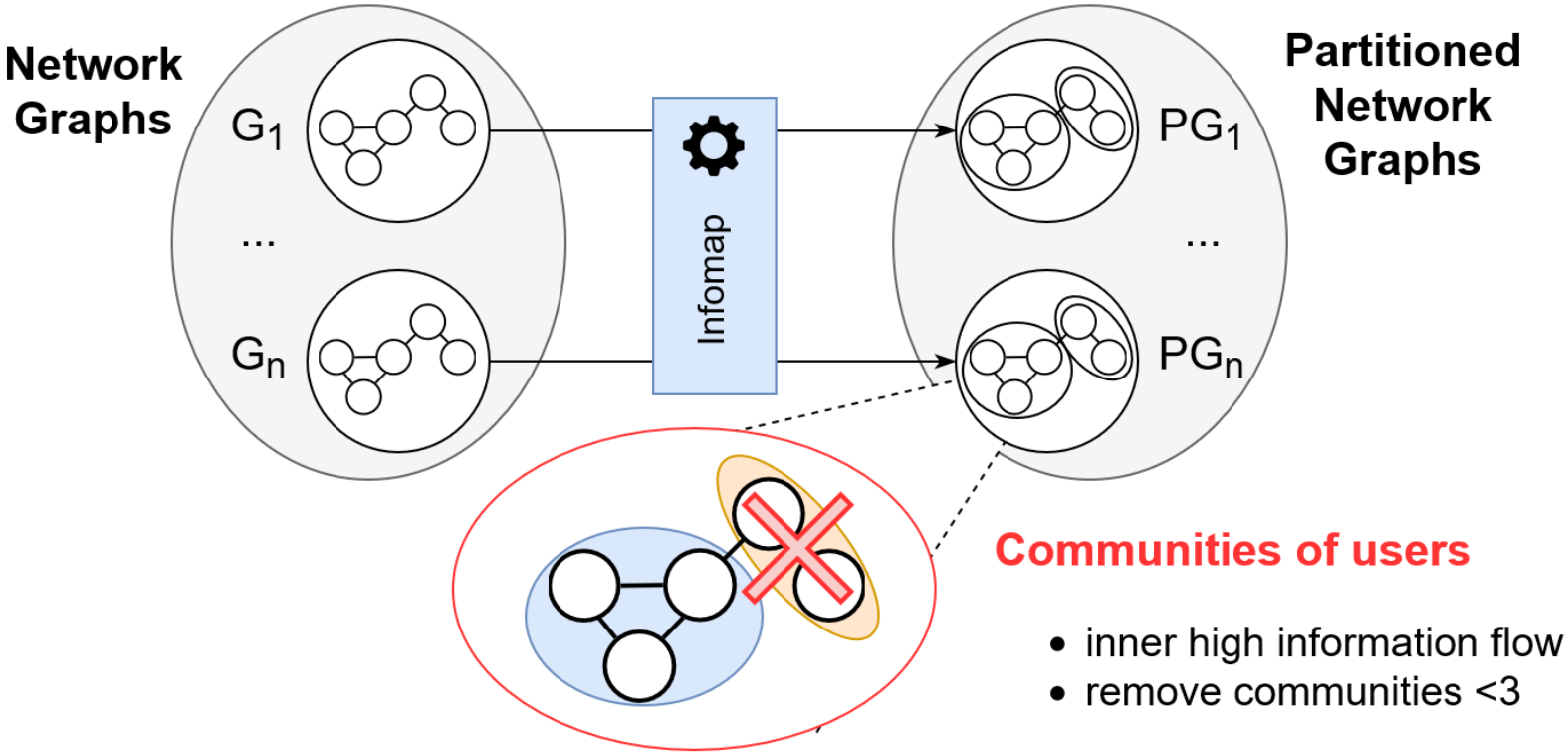
1. Harvesting content from context



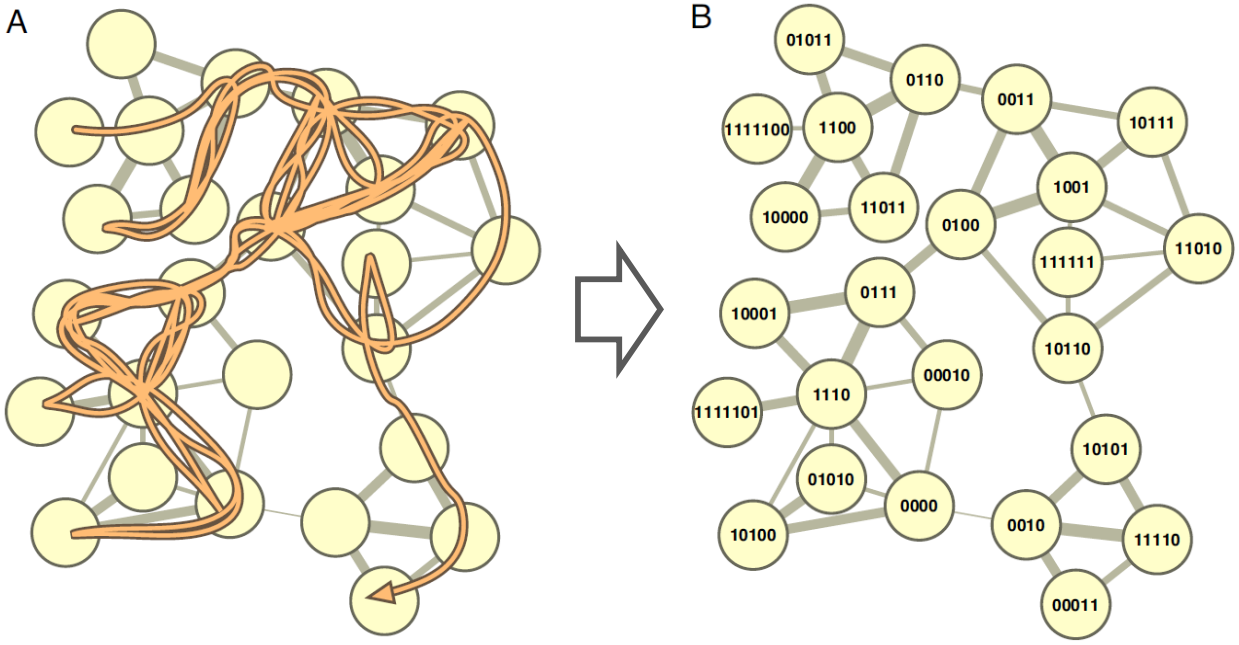
2. Network creation



3. Community detection



3. Community detection: Infomap



Random Walker path

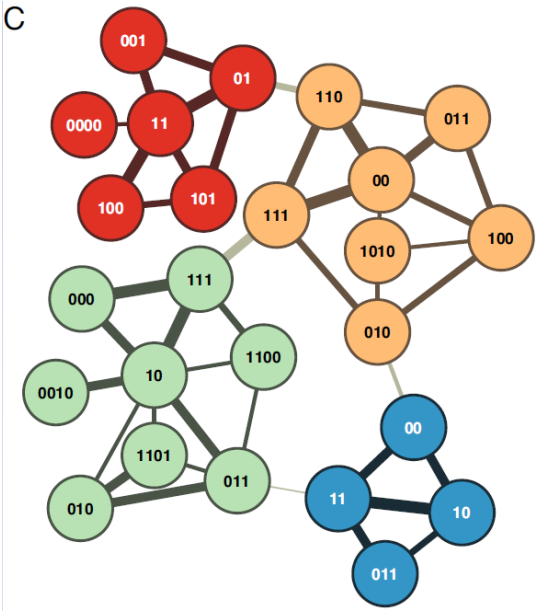
Huffman Coding of the nodes

Random Walker path:

1111100 1100 0110 11011 10000 11011 0110 0011 10111 1001 00 11 1001 0100 0111 10001 1110 0 111 10001 0111 1110 0000 1110 10001 0111 1110 0111 1110 111 1101 1110 0000 10100 0000 111 0 10001 0111 0100 10110 11010 10111 1001 0100 1001 10111 10 01 0100 1001 0100 0011 0100 00 11 0110 11011 0110 0011 0100 1 001 10111 0011 0100 0111 1000 1 1110 10001 0111 0100 10110 1 11111 10110 10101 11110 00011

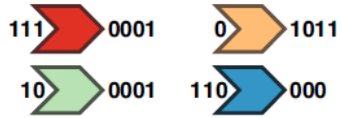
~~Code length: 314 bits~~

3. Community detection: Infomap



Random Walker path using prefixes

Random Walker path:



111 0000 11 01 101 100 101 01 **0**
001 **0** 110 011 00 110 00 111 **101**
1 **10** 111 000 10 111 000 111 10
011 10 000 111 10 111 10 0010 1
0 011 010 011 10 000 111 **0001** **0**
111 010 100 011 00 111 00 011 0
0 111 00 111 110 111 110 **1011** **1**
11 01 101 01 **0001** **0** 110 111 00
011 110 111 **1011** **10** 111 000 10
000 111 **0001** **0** 111 010 1010 01
0 **1011** **110** 00 10 **011**

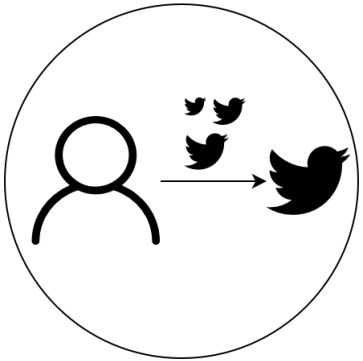
Code length: 243 bits

Dual problem:

detect communities by compressing the description of information flows on networks

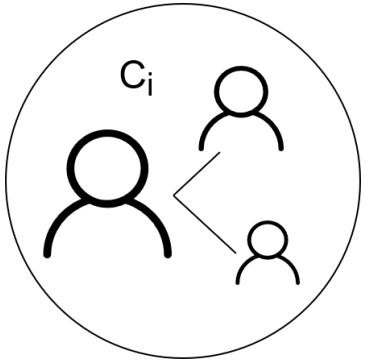
4. Profiling

Characterize users with metrics



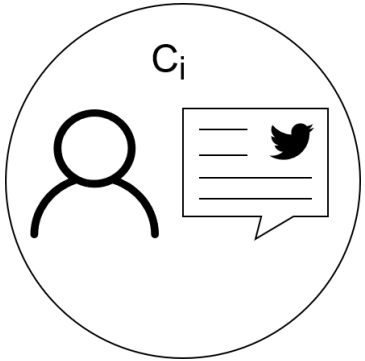
Context independent

- Follower rank



Context specific

- Indegree centrality



Content based

- Topical Focus
- Topical Strength
- Topical Attachment

4. Profiling

Context independent:

$$\underset{FollowerRank}{FR(u)} = \frac{\mid \text{followers}(u) \mid}{\mid \text{followers}(u) \mid + \mid \text{following}(u) \mid}$$

Context specific:

$$\underset{IndegreeCentrality}{IC(u)} = \frac{indegree(u)}{N-1}$$

4. Profiling

Content based:

$$TF(u)_{TopicalFocus} = \frac{P1_{on}(u)}{P1_{off}(u) + 1}$$

$$TA(u)_{TopicalAttachment} = \frac{P1_{on}(u) + P2_{on}(u)}{P1_{off}(u) + P2_{off}(u) + 1}$$

$$TS(u)_{TopicalStrength} = \frac{P2_{on}(u) \cdot \log(P2_{on}(u) + R3_{on} + 1)}{P2_{off}(u) \cdot \log(P2_{off}(u) + R3_{off} + 1) + 1}$$

Where:

- P1: # of original posts by u in C
- P2: # urls found in original posts by u in C
- R3: # of retweets of u's tweets

5. Ranking

$$R1(u) = \frac{1}{\sum_{u \in C} IC(u)+1} \cdot \sum_{u \in C} TF(u)$$

↑ on topic ↓ community leader

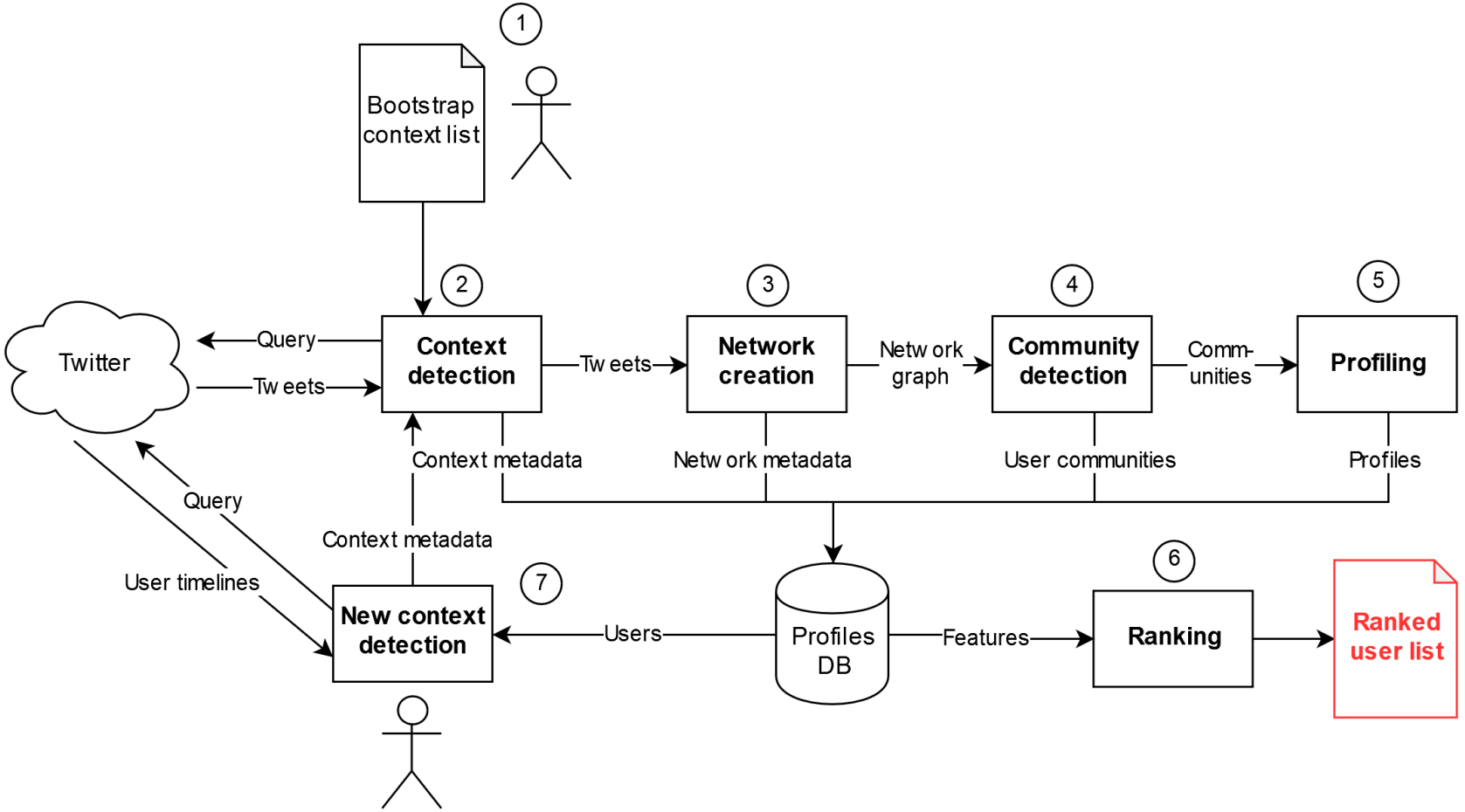
$$R2(u) = \mid FR(u) - 1 \mid \cdot \left(\sum_{u \in C} TA(U) + \sum_{u \in C} IC(U) \right)$$

↑ on topic ↑ community leader ↓ popularity

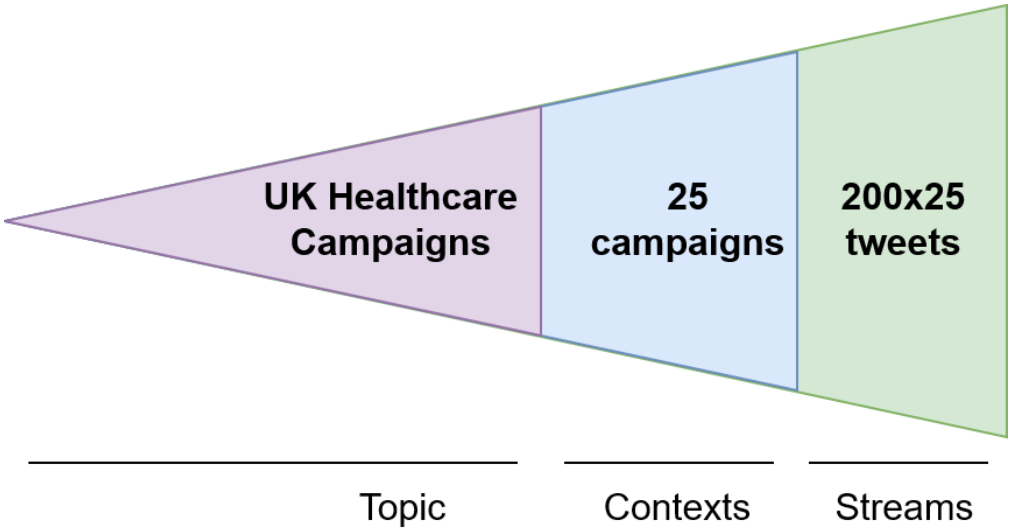
$$R3(u) = |FR(u) - 1| \cdot \left(\sum_{u \in C} TA(U) + \frac{1}{\sum_{u \in C} IC(U)+1} \right)$$

↑ on topic ↓ community leader ↓ popularity

The complete user extraction pipeline



Evaluation: tweets harvesting



Unsupervised validation method

A posteriori validation of the generated user ranking

no prior ground truth

Evaluation: test contexts

Context name	Period (2018)	Nodes	Edges	Density	Avg degree	Assor-tativity
16 days of action	11-25 / 12-10	396	349	0.002	1.8	-0.1
Elf day	12-03 / 12-12	365	436	0.003	2.4	-0.2
Dry january	01-01 / 01-31	235	234	0.004	2.0	-0.3
Cervical cancer prevention week	01-21 / 01-27	209	192	0.004	1.8	-0.1
Time to talk day	02-06 / 02-07	268	231	0.003	1.7	-0.2
Eating disorder awareness week	02-25 / 03-03	256	241	0.004	1.9	-0.2
Rare disease day	02-28 / 03-01	294	206	0.002	1.4	-0.2
Ovarian cancer awareness month	03-01 / 03-31	215	202	0.004	1.9	-0.4
Nutrition and hydration week	03-11 / 03-17	273	326	0.004	2.4	-0.3
Brain awareness week	03-11 / 03-17	307	281	0.003	1.8	-0.1
No smoking day	03-13 / 03-14	254	219	0.003	1.7	-0.3
Epilepsy awareness purple day	03-26 / 03-27	306	252	0.003	1.6	-0.2
Experience of care week	04-23 / 04-27	176	196	0.006	2.2	-0.1
Brain injury week	05-01 / 05-31	238	306	0.005	2.6	-0.1
Mental health awareness week	05-14 / 05-20	268	245	0.003	1.8	-0.5
Dementia action week	05-21 / 05-31	300	300	0.003	2.0	-0.0
Mnd awareness month	06-01 / 06-30	141	234	0.012	3.3	-0.3
Wear purple for jia	06-01 / 06-30	165	245	0.009	3.0	-0.5
Carers week	06-11 / 06-17	270	277	0.004	2.1	0.0
National dementia carers	09-09 / 09-10	184	177	0.005	1.9	-0.2
Mens health week	06-11 / 06-17	264	214	0.003	1.6	-0.2
Stress awareness day	11-07 / 11-08	293	209	0.002	1.4	-0.2
National dyslexia week	10-01 / 10-07	229	235	0.004	2.1	-0.2
Ocd awareness week	10-07 / 10-13	202	193	0.005	1.9	-0.6
Jeans for genes day	09-21 / 09-22	246	325	0.005	2.6	-0.2

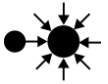
25 contexts

1 day → 1 month

254 nodes

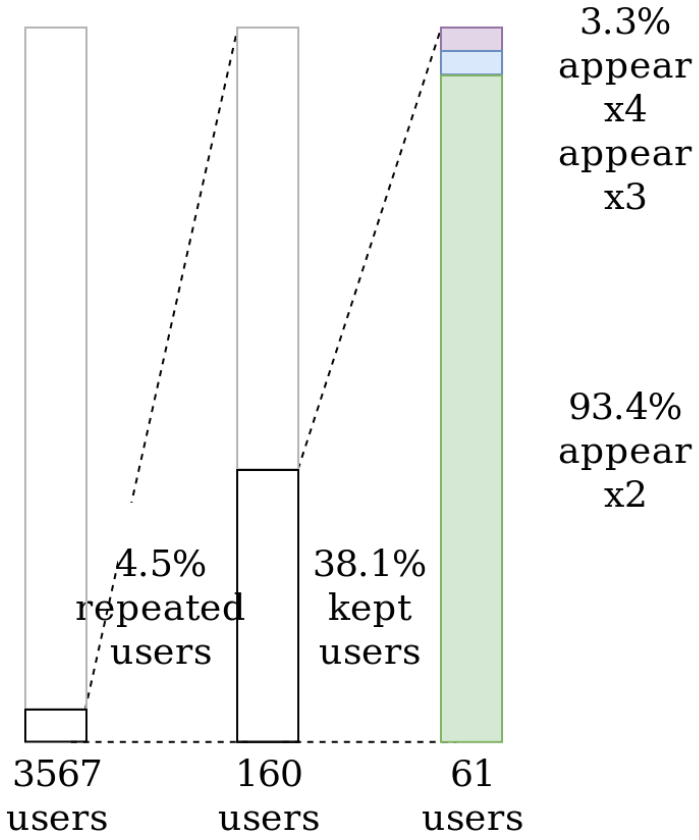
253 edges

2 density



-0.2 assortativity

Evaluation: repeated users



Repeated users are ranked higher (multiple participations to contexts).

example:

$$\sum_{u \in C} TF(u)$$

Remove inactive users:

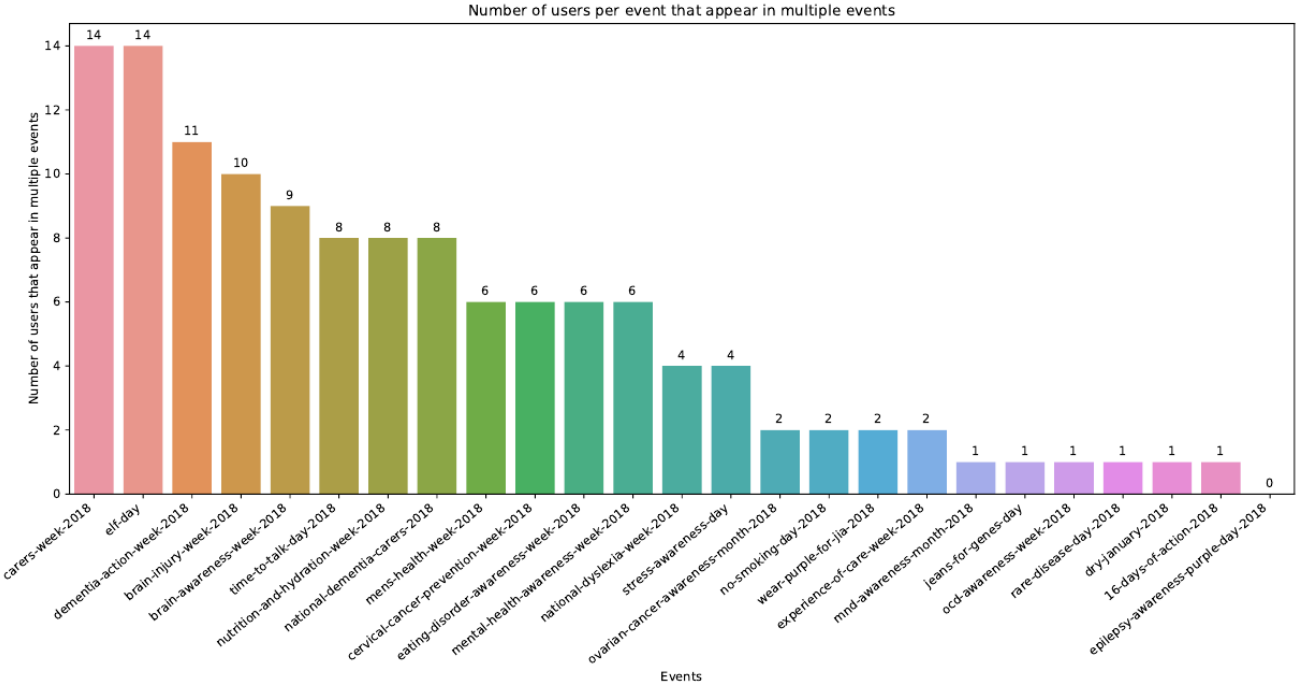
- FR(u) = 0
- min_max(|Tweets(u)|) < 0.005

Evaluation

Username	Name	Follower rank	Participations
alzheimerssoc	Alzheimer's Society	0.99	4
dementiauk	Dementia UK	0.98	4
mentalhealth	Mental Health Fdn	0.97	3
colesmillerllp	Coles Miller LLP	0.65	3
jeremy_hunt	Jeremy Hunt	1.0	2
nhsengland	NHS England	0.99	2
carersuk	Carers UK	0.95	2
rdash_nhs	RDaSH NHS FT	0.88	2
alzsocseengland	Alzheimer's Society - South ...	0.64	2
mndassoc	MND Association	0.64	2

Top 10 repeat users

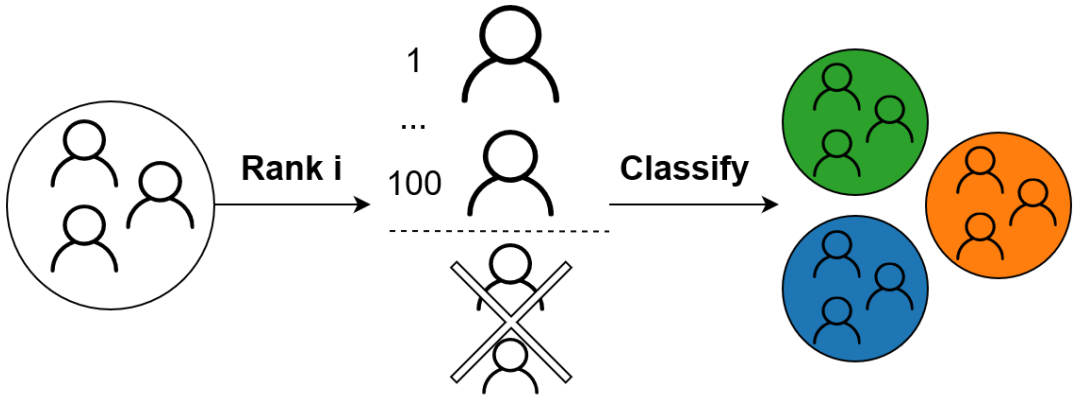
Evaluation



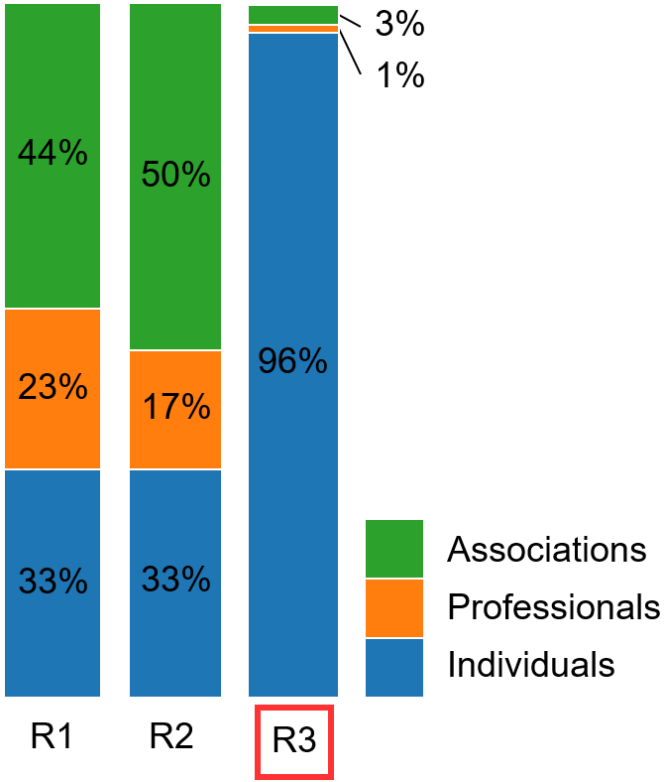
Number of repeat users for each context

Evaluation: choice of ranking function

Number of ranked users: 3567



R3 effectively finds individuals



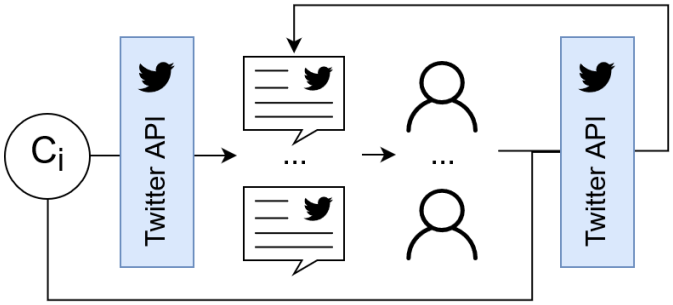
Evaluation

	Ranking 1			Ranking 2			Ranking 3		
#	User	On-topic	Individual	User	On-topic	Individual	User	On-topic	Individual
1	homesnutrition	X		johnneustadt	X		johnneustadt	X	
2	ficajones	X	X	jo_millar27	X	X	solutions777	X	X
3	helenvweaver	X	X	hatchbrenner			kingste29344921	X	X
4	spriggsnutri	X		nchawkes	X	X	daisylu1964		X
5	critcarelthtr	X		moz0373runner	X	X	zakariamarsli	X	X
6	danielleroisin_	X	X	aimsonhealth	X	X	meowaaaaaa		X
7	mynameisandyj	X	X	wordsharkv5		X	vecta67		X
8	fionaliu92	X	X	fullcircle_play	X		cosfordfamily1	X	X
9	ldpartnership	X		qsprivatehealth	X		hayleycorriganx		X
10	milaestevam1		X	socialissp			jhbrasfie		X

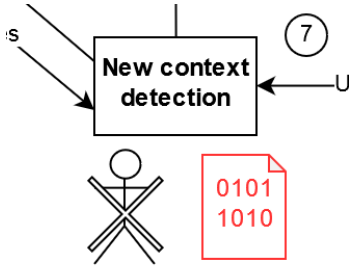
Top 10 ranked users for the ranking functions R1, R2 and R3

What are we doing now

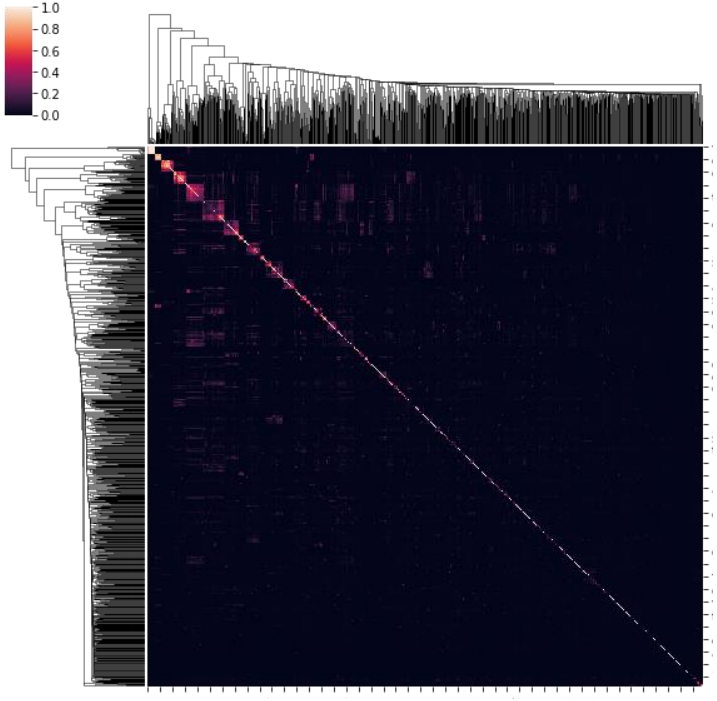
Recursive Twitter contexts expansion



Context detection automation



Users-hashtags clustering



Thank you!

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Slides, code and full-text paper available @ https://flavioprimo.xyz/blog/a-customisable-pipeline-for-continuously-harvesting-socially-minded-twitter-user/

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