Homelessness in California

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Introduction

- An estimated **161,000** people experience homelessness in California, accounting for nearly **half** of the total homeless population in the US.
- By adopting **network science** and **natural language processing** tools we aim to gather insights on this complex problem:
    - What are the **causes** of this phenomenon?
    - What is being done to solve the crisis?
    - What is the public perception of this subject?
- Comparison with New York: it seems natural and the data gathered also suggests it.

- ≈ 90000 and ≈ 27000 tweets gathered using the **Twitter API** during a period of 30 days starting January 5.
- Query-based search with a combination of **keywords** and **locations**.
- Preprocessing steps to extract words performed with `nltk`:
  - remove duplicates and non-English tweets
  - **text cleaning**: remove mentions, emoji, links, etc. . .
  - **tokenization** and **lemmatization**
- Words and, separately, hashtags are connected if they appear in the same tweet: if a pair appears multiple times the corresponding **edge weight** is increased.
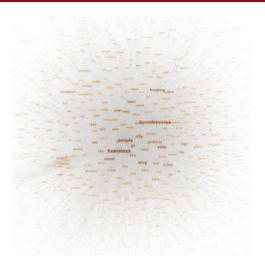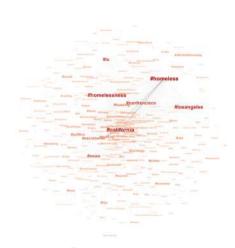
Figure: Words network

Figure: Hashtag network

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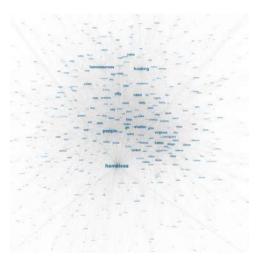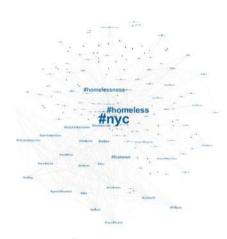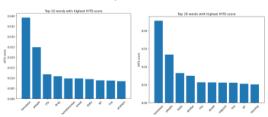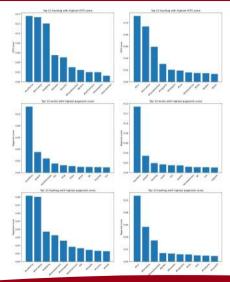
	Words		Hashtag	
	CA	NY	CA	NY
Nodes	2330	1299	463	175
Edges	42377	12221	2433	645
Avg. degree	36.38	18.82	10.51	7.37
Avg. squared degree	11388	3083	508	179
Avg. weighted degree	543.39	175.17	25.05	13.38
Avg. weighted squared degree	9954517	825898	9825	934
Density	0.0156	0.0145	0.0227	0.0424
Diameter	4	5	∞ (6)	∞ (5)
Avg. path length	2.03	2.13	∞ (2.49)	∞ (2.33)
Weighted diameter	56	43	∞ (9)	∞ (9)
Weighted avg. path length	16.21	13.19	∞ (3.30)	∞ (3.44)

Table: Major network metrics

Closeness	Betweenness	Harmonic
homeless	homeless	homeless
people	people	people
homelessness	homelessness	homelessness
city	city	city
drug	state	drug
state	housing	state
go	drug	go
street	blah	street
housing	live	housing
live	go	live

Closeness	Betweenness	Harmonic
homeless	homeless	homeless
people	people	people
housing	housing	housing
city	city	city
shelter	homelessness	shelter
hotel	shelter	hotel
homelessness	hotel	homelessness
go	live	go
need	go	need
live	crisis	live

Table: Centrality measures for California (top) and New York (bottom) word networks

Closeness	Betweenness	Harmonic
#california	#homelessness	#california
#homeless	#homeless	#homeless
#homelessness	#california	#homelessness
#losangeles	#losangeles	#losangeles
#sanfrancisco	#la	#la
#la	#sanfrancisco	#sanfrancisco
#news	#news	#news
#sacramento	#twitterblue	#sacramento
#crime	#sandiego	#housing
#housing	#nyc	#crime

Closeness	Betweenness	Harmonic
#nyc	#nyc	#nyc
#homeless	#homelessness	#homeless
#homelessness	#homeless	#homelessness
#foxnews	#ny	#foxnews
#democrats	#foxnews	#democrats
#illegalimmigrants	#democrats	#biden
#biden	#illegals	#democrat
#hope	#democrat	#blacklivesmatter
#migrants	#affordablehousing	#covid19
#bidenbordercrisis	#ericadams	#illegals

Table: Centrality measures for California (top) and New York (bottom) hashtag networks

Scale-free analysis

- Data plotted in log-log scale and **log-binning** used to compute pmf
- Automatic computation of k_{min} based on the K-S distance (D), performed by the `powerlaw` package
- Comparison with crossover distributions through **log-likelihood ratio**

Figure: Degree distribution in a log-log plot and power law fit: $p_k = C\, k^{-\gamma}$

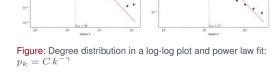|	Words		Hashtag	
	CA	NY	CA	NY
γ	2.09 ± 0.08	2.51 ± 0.21	2.27 ± 0.12	2.12 ± 0.16
D	0.21	0.35	0.16	0.23
p-value	0.808	0.343	0.972	0.898
exponential	+	+	++	+
stretched exponential	+	+	+	+
truncated power law	-	+	+	-
lognormal positive	-	+	+	+

Table: Fit estimates of gamma exponent

Degree (dis-)assortativity

- Plot data in log-log scale and take the average k_{nn} for each degree k
- Extract the **assortativity coefficient** μ with a linear fit
- Compare with **degree preserving randomization with simple links (R-S)**

Figure: Average neighbor degree k_{nn} vs degree k in a log-log plot

	Words		Hashtag	
	CA	NY	CA	NY
μ	-0.212 ± 0.004	-0.239 ± 0.007	0.05 ± 0.02	-0.01 ± 0.04
r	-0.1237	-0.1430	-0.1641	-0.2006
R-S μ	-0.068 ± 0.005	-0.03 ± 0.02	-0.25 ± 0.04	-0.19 ± 0.06
R-S r	-0.0507	-0.0788	-0.1728	-0.2223

Table: Assortativity coefficient μ and Pearson's correlation coefficient r

Robustness

- Two main types of nodes failure:
  - **Random failures**: a fraction of the nodes of the network is randomly selected and removed.
  - **Attacks**: nodes with the highest degree, i.e. hubs, are targeted first.
- For the random failure, the test is repeated 100 times and the results are averaged

	Words		Hashtag	
	CA	NY	CA	NY
κ	18319	4714.84	392.21	69.82
f_c	0.9999	0.9998	0.9974	0.9855

Table: Inhomogeneity ratio (κ) and breaking point (f_c)
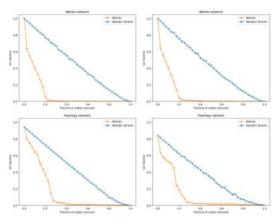
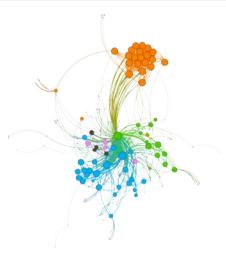Figure: Gian component (GC) fraction as a function of the percentage of removed nodes.

This part aims to determine if the **network** is divided into communities and how strong these communities are.

We exploit some **metrics** and perform some **algorithms**, namely:

- Fast greedy modularity optimization
- Spectral clustering
- Betweenness clustering
- Louvian clustering

Modularity measures the **quality** of a cluster as fraction of the edges that fall within the given groups minus the expected fraction if edges were distributed at random

Figure: New York - hashtags
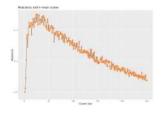
Figure: California - hashtags
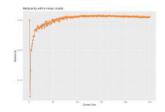
Figure: California - words
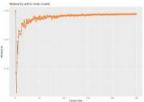
Figure: New York - words

Conductance is another quality metric, computed as the ratio of the number of edges that cross the boundary between two sets of nodes, to the total number of edges that are incident to those two sets.

It's minimum for each cluster size define the **network community profile**.
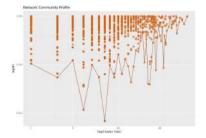
Figure: California - NCP
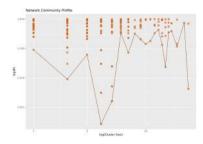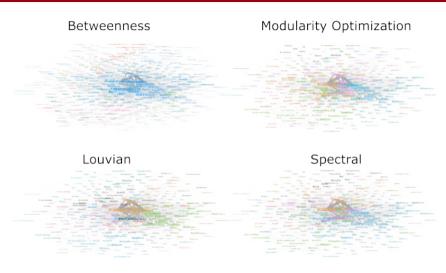
Figure: New York - NCP

Betweenness

Modularity Optimization

Louvian

Spectral

Betweenness

Modularity Optimization

Louvian

Spectral

Topic modeling - BERTopic

Step of the **BERTopic** pipeline with parameter tuning:
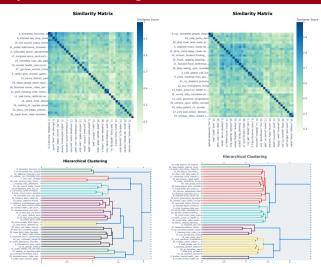
- Document embeddings: which sentence transformer model to use

- Dimensionality reduction: **UMAP** has two main parameters `n_neighbors` and `n_components`

- Clustering: **HDBSCAN** has two main parameters `min_cluster_size` and `min_samples`

- Topic selection and representation: `diversity coefficient` of **MMR** and the `n_gram_range` to allow for n-tuples of keywords. Stop words are also removed from the representation in this step

Automatic or manual **topic reduction** and **outliers reduction** with different strategies can be applied.

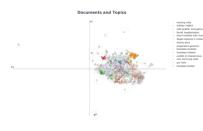| Keywords	Title	Representative tweet	Explanation
homeless, francisco, la, state, city, gallery owner, crime, count, live, help	california's homeless	San Francisco has one of the biggest and highest homeless and poverty rates in the USA today.	Macro-topic on homelessness in California's major cities.
housing crisis, affordable housing, building, people, homelessness crisis, city, solve, sf, income, need	housing crisis	Affordable housing should be equally addressed, outrageous rent prices in Los Angeles and (SF) is a major part of the problem. With so many coming to LA to be homeless in a warmer climate, those born/worked and paid taxes in LA should be served first	High rents and lack of affordable housing are among the leading cause of the homelessness crisis.
addiction, francisco, san, california, amp, don, city, sf homeless, free, homeless addicts	drug addiction	if you BAN public drug usage in SF...less "homeless" drug addicts from other states and cities will not be interested in going to SF. Your homeless situation would be manageable and for people who are legitimately going through hard times, not mentally ill and drug addicts	Drug addiction and abuse are common among homeless people.
sf, homeless man, people, white, homeless violence, city, even, video, arrest, likely	homelessness and crime	The data fom San Diego is clear. Homeless people are MUCH more likely to be involved in crime than the rest of the population. Homeless people are 130 TIMES MORE LIKELY to commit assault than the general population	Relation between homelessness and crime rates: both committed and suffered by homeless people.
new, york, chicago, eric adams, homeless nyc, mayor, asylum, nypd, cities, la	comparison with nyc	In a few years New York City will become just like LA and San Francisco in terms of homelessness. Great liberal policies are catching up.	Comparison between the homelessness crisis happening in California's major cities and New York: reference to the forced hospitalization implemented by NY's major.
unhoused, storm, sacramento, climate, beds, shelter program, inclement weather, homeless people, weather shelter, flooded	inclement weather	As California is hit hard by storms, few are facing as stark a challenge as the state's more than 170,000 homeless residents.	The unusual cold and the floods are additional challenges that the homeless have to face.
california, homelessness, gov, taxes, california governor, gov gavin, newsom wants, governor newsom, budget, will	gov gavin newsom	Gavin Newsom has destroyed California. What once was a beautiful place now is taxed to death and ravaged with homelessness. Stupidity is growing and we have to stop clowns like this from ruining our country.	Criticism directed at the governor of California Gavin Newsom for his policies addressing the homeless problem.
hillcrest san, amp, covid, experiencing homelessness, seniors, diego hospital, hi, hotel rooms, care, nurse speaks	a victim story	RIP Mr B discharged from a hospital in Hillcrest San Diego to the streets with no where to go as an older adult Black male experiencing homelessness.	A local story about a homeless black man who died after being discharged from a hospital.
bass, mayor karen, angeles, mayor bass, angeles mayor, venice, homeless, new mayor, 000 people, plan	mayor karen bass	Mayor Karen Bass of LA talks homelessness while two hours south our fed govt lets in over 8,000 illegals per day. Wise policy, Dems.	Criticism directed at the mayor of Los Angeles Karen Bass for her policies addressing the homeless problem.
mental health, care court, people, treatment, california, civil rights, health homelessness, senate, new health, chair prioritize	mental health	In California, a large proportion of chronically homeless individuals suffer from mental health conditions. The upcoming event on February 1 will discuss the relationship between homelessness and the health care system.	A large portion of homeless people suffer from mental health conditions: the healthcare system is asked to address this situation.
collier gwin, woman, gallery owner, art, francisco, hose, hosing, gwin gallery, spraying homeless, warrant	gallery owner arrested	Collier Gwin, the gallery owner who was filmed spraying a homeless woman with a hose in San Francisco, has been arrested for battery.	A local news story: Collier Gwin, an art gallery owner, has been arrested after spraying a homeless woman with a hose.
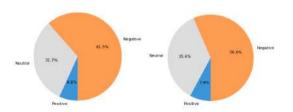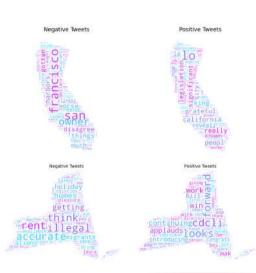
Keywords	Title	Representative tweet	Explanation
nyc, homeless people, mayor, shelter, streets, hotels, adams, will, many, help	homeless in nyc	New York City has 67,150 homeless people, including 21,089 homeless children, sleeping each night in New York City's main municipal shelter system. Yet somehow, they were able to house migrants at luxury hotels for months. Dems support illegals OVER America	Macro-topic on homelessness in New York City.
housing crisis, crisis, nyc, affordable housing, apartments, homeless, compact, nyc housing, rise, solve	housing crisis	The Mayor also reaffirmed the City's commitment to addressing NYC's housing shortage and solve its affordable housing crisis.	The accommodation shortage and the lack of affordable housing are one of the root causes of the homeless crisis in NYC.
homeless shelters, hotels, open 24, unhoused, public, need, toilet, ny, building, shelter cont	homeless shelter	NYC provides comfy cots, 3 meals a day, sanitary facilities, warm or AC facilities for allowed by , yet many homeless waste away after serving this under bridges and side streets.	The city provides shelter for the homeless, but most of them end up living on the streets anyway.
nyc, immigrants, living, rent, homeless, us, free, taxes, benefit workers, wealthiest	rent and living costs	Man I know about of folks in nyc like myself living from paycheck to paycheck! The housing prices/rent is ridiculously high. And has been more people that became homeless in the last two years than the previous decade. That's a fact	Even employed people risk becoming homeless due to the prohibitively high rents and living costs.
subways, system, stations, see, homeless people, manhattan, nyc train, public, clean, public transit	subway neglect	The NYC Subway is polluted, the air quality in many stations is really bad. The smell of trash, the homeless, on top of these pollutants. You have to wear something when riding the subway.	The subway system in NYC is used as a shelter by many homeless: there are many concerns about the hygiene and degradation of this phenomenon.
york, governor, progressive, today, states, blah blah, washington, amp, california new, crime	progressive governor	Yup, progressive governing has worked GREAT in NYC. Thriving economy, low crime (so low), growing population,…	Criticism against the progressive policies of the mayor of NY and the governor of New York State, both belonging to the Democratic party.
cold, please, call 311, code blue, nyc, one, night, will denied, intake homeless, temperatures expected	cold weather emergency	Due to frigid temperatures expected tonight, NYC is activating , beginning at 4pm. No one will be denied intake at a homeless shelter. Please do not be indifferent to any vulnerable person you see in the street. Call 311 immediately.	Due to the extreme cold weather typical of NYC, an emergency number 311 is activated to provide assistance to all homeless.
ny, shelters, pomona, mobile units, will, worked, health services, income, homeless families, day	homeless children	Guess who lives in family shelters? Kids! Children, who go to "schools, day care centers, dance, tutoring and child care centers and parks"... Shouldn't they have the same opportunities as their peers? What about *their* safety?	There are families with children that are homeless and have to live in shelters while getting their education.
mental, mental health, health expert, questions forced, forced hospitalization, judge, york homeless, proceed, people, let deaf	forced hospitalization	A judge ruled that New York City's controversial plan to allow first responders to involuntarily hospitalize homeless people with mental illnesses can proceed.	A controversial law in NYC allows the forced hospitalization of homeless people that suffers from mental illness.
migrants, joe, nyc, vets homeless, hotels, president, homeless biden, help, shelters, 500 night	illegal migrants in hotels	President Biden didn't bother visit the border crisis in Midtown. It is outrageous that illegal migrants refuse to move to a different shelter; demand hotel accommodations. Not only can NY not afford it, but we have homeless NYers on our streets.	Protests against President Biden for the fact that illegal migrants are hosted in luxury hotels while American citizens are on the streets.
lives, amp, go back, homeless, charity providing, prison now, cynthia, vanessa santiago, queens runs, vee	charity story	Vanessa Santiago served 17.5 years in prison. Now she lives in Queens, runs a small charity providing free furniture and more to people in need	Local story of an ex-convict woman that now helps people in need with free furniture.

- **RoBERTa-base** (Robustly optimized BERT approach) model trained on ≈ 124M tweets
- Each tweet is assigned to one of the following **3 classes**: 'Negative', 'Positive', 'Neutral'.

Classification	Representative tweets
Negative	Fuck your issuing an arrest warrant for this man for doing your job? Fuck that entire shit city. Fix your streets you shitty city with a great football team. Not only that, California is in the worst state it has been in my lifetime. The homeless problem is out of control, its infrastructure is crumbling and the schools are failing.
Positive	I am excited to share that we received a $10,000 donation last night to the New Beginnings Scholarship Fund for Unhoused Youth in San Diego! Thanks and gratitude to our federal partners for providing $75M to help unsheltered Californians!
Neutral	Kymberli and B first lived in their car. They then lived in a vacant lot. Kymberli and B now live in a tent community in Oakland, California. San Jose officials plan to send workers to communicate evacuation orders to unhoused residents along the Guadalupe River

Classification	Representative tweets
Negative	"Senator, why you send all my $ to Ukraine when people are dying in Harlem? People are homeless in the Bronx! 50 yrs in Harlem & still F'ed up! You are useless!" F$#& these migrants bitches help the homeless we have in NYC. What is wrong with the government.
Positive	Also I recommend on Queens Square, a wonderful cafe that do wonderful things for the community and homelessness and they do wonderful red velvet cake so get down there So proud of the work we do at the Y! Bridgeport homeless shelters prepare for frigid weekend.
Neutral	Today at 4 p.m. NYC's Department of Homeless Services Code Blue goes into effect. It will last until 8 a.m. tomorrow morning. New York City to Open Migrant Shelter at Brooklyn Cruise Terminal

- We were able to identify some of the causes of the complex problem of homelessness: such as **unsustainable living costs** and **lack of affordable housing**.
- **Drug abuse** and **mental illness** are also closely related to the homeless crisis.
- Comparison with New York helped distinguish between common and state-specific topics: such as **crime** and **immigration**.
- We showed the predominance of **negative** sentiment towards the homeless and the related phenomena.
- Possible improvements for future works are to **increase the amount of data** and perform a **finer** sentiment analysis.