

# Analysis of Population Loss in Chicago / Illinois

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MSCA 32018 Final Project   **Ruoxin Shi**

# Executive Summary

## Problem Statement:

In our contemporary society, with the rapid development of economy and the huge societal progress, many social problems are aroused, which caused frequent population migration. Among all the states with notable population change, **Illinois** is one of the very few states with **negative population growth**.

We are interested in the underlying reasons for this population decrease and thus we search for a collection of news articles related to either Chicago or Illinois.

## Goal of Analysis:

Based on the collected articles, we want to:

- ☐ Extract insights from the text to define the top reasons for the declining population.
- ☐ Provide possible actionable recommendations on making Chicago / suburbs more attractive and reversing the decreasing trend.

# Methodology Overview



## Data Preprocessing

Perform clustering to remove outliers



## Topic Detection

Use LDA / BERTopic to detect topics and extract keywords



## Sentiment Analysis

Use Yelp-data pre-trained model to perform sentiment analysis and get useful insights



## Entity Identification

Use SpaCy model to identify organizations and people



## Targeted Sentiment Analysis

Apply both Yelp-data based model and ABSA model on identified targets



## Insight Conclusions

Conclude the topic and insights

# 02 Data Overview & Preprocessing

200120 news articles in total (about 500 MB)

date	The date the article posted.
language	The language of the article
title	The title of the article
text	The text of the article (including some extra words from the website that are not related to the article content)

date	language	title	text
0	2022-01-06	english	No deal, no school: Chicago cancels classes fo... CHICAGO (AP) — Chicago school leaders canceled...
1	2022-01-06	english	No deal, no school: Chicago cancels classes fo... CHICAGO (AP) — Chicago school leaders canceled...
2	2022-01-06	english	Watch 'Chicago P.D.' Preview Wednesday Chicago PD 9×11 'Lies' Season 9 Episode 11 Pro...
3	2022-01-06	english	Trump's Solution for Chicago Public Schools? K... Wise of Foolish?inThe Chicago Tribune article ...
4	2022-01-06	english	Family, friends, colleagues gathering today at... The neighbors near Mashawn Plummer's Portage P...
...	...	...	...
200114	2022-03-05	english	Chicago girl shot after celebrating 12th birth... Authorities say a girl who was shot in the hea...
200115	2022-03-05	english	Loyola Chicago vs. Northern Iowa — MVC Tourna... The No. 4 seed Loyola Chicago Ramblers (23-7, ...
200116	2022-03-05	english	DraftKings Illinois Promo Code: \$1,050 Bonus a... Remember to check out the DraftKings Illinois ...
200117	2022-03-05	english	Sidney, Illinois had a median home valuation o... [BlockShopper.com] \n[Buyer][Address][Valuat...
200118	2022-03-06	english	Ukrainian woman weds Chicago fiancé ahead of r... CHICAGO (AP) — When Russia invaded her home co...

200119 rows x 4 columns

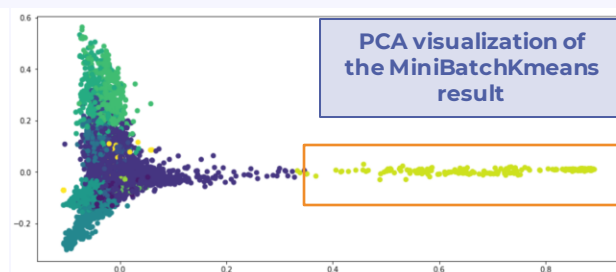
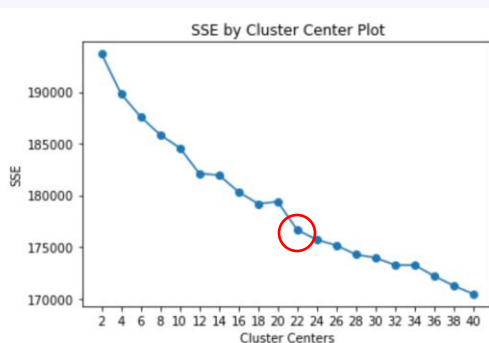
## Data cleaning (for clustering)

- Delete newline character '\n'
- Delete **urls** (unrelated to the article content)
- Keep only the alphabetic characters (delete numbers, punctuations)
- Delete **Stopwords**
- Make all words to **lowercase**

## Clean up the noise

We want to eliminate articles irrelevant to the analysis.

1. Apply the **tf-idf** vectorizer (**Term Frequency Inverse Document Frequency**) on the cleaned text to get a numerical vector for each article.
2. Fit the data with **DBSCAN** model. Find clusters of text with unrelated content.
3. Fit the data with **MiniBatchKMeans** and calculate the SSE to find the optimal k. (Based on the plot, here I choose **k=22**).
4. Based on clustering results from both models, select unrelated clusters and remove the corresponding articles.



Result: **16799** outliers removed

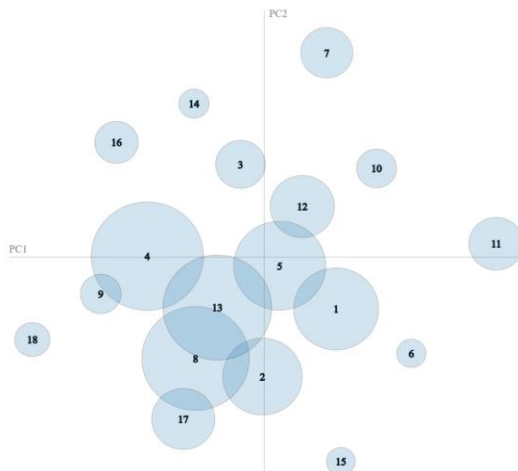
## LDA

- **Tokenize, lemmatize** the words of text, remove **stopwords** and make **trigrams of words**.
- Apply LDA model on the trigrams list and perform model tuning to find the proper number of topics (*10-21 topics*) with less overlapping and highest coherence score (**18**)
- Extract the top 20 **keywords** for each topic to summarize topic content (*table attached in appendix*)
- Corresponding each text to 2 **top-weighted topics**. (*table attached in appendix*)

	Topics	Alpha	Beta	Coherence
2	18	asymmetric	auto	0.515411
3	13	asymmetric	auto	0.511738
4	14	asymmetric	auto	0.504834
1	11	asymmetric	auto	0.502225
2	12	asymmetric	auto	0.501802
5	15	asymmetric	auto	0.501142
3	19	asymmetric	auto	0.500278
0	10	asymmetric	auto	0.491126
1	17	asymmetric	auto	0.463183
1	21	asymmetric	auto	0.450092
0	16	asymmetric	auto	0.448947
0	20	asymmetric	auto	0.436051

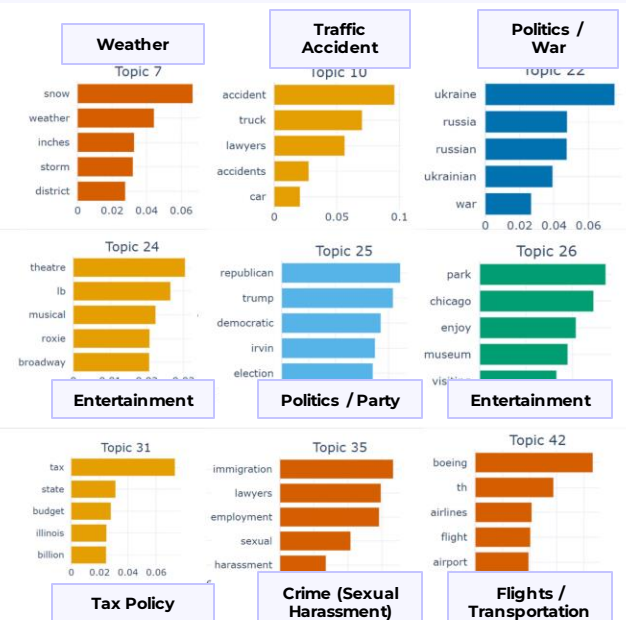
No.	Topic Content	No.	Topic Content
0	Business	9	Food
1	Politics	10	Business
2	Alcohol & Drug	11	Maintenance / Living
3	NBA / Sports	12	<b>NOT SURE</b>
4	Law / Social	13	Product / Market
5	Maintenance / Living	14	<b>NOT SURE</b>
6	Game / Sports	15	Law (Divorce Law)
7	Crime	16	Covid / Education
8	Covid / Public health	17	Game / Sports / NBA

Intertopic Distance Map (via multidimensional scaling)



## BERTopic

- Use cleaned text to fit the model
- Find the top 50 topics
- Most results are same as that of LDA
- Some **new topics** found



## Methodology

- Use the **Yelp** dataset to create the pipeline (**CountVectorizer + SDGClassifier**). Fit the model on splitted training data.
- Use the pipeline to make sentiment analysis and label the articles.
- Divide the text based on *topic number* and *sentiment result*. Then select the text with *topic weight* ( $\geq 0.98$ ) in each topic with each sentiment.
- Use **NLTK** to calculate the *word frequencies* to get insights from the top-related articles.
- Visualize topic keywords use **word cloud**.
- Also, use the text summarization approach using **ktrain TransformerSummarizer** to help get insights more properly.

## Result:

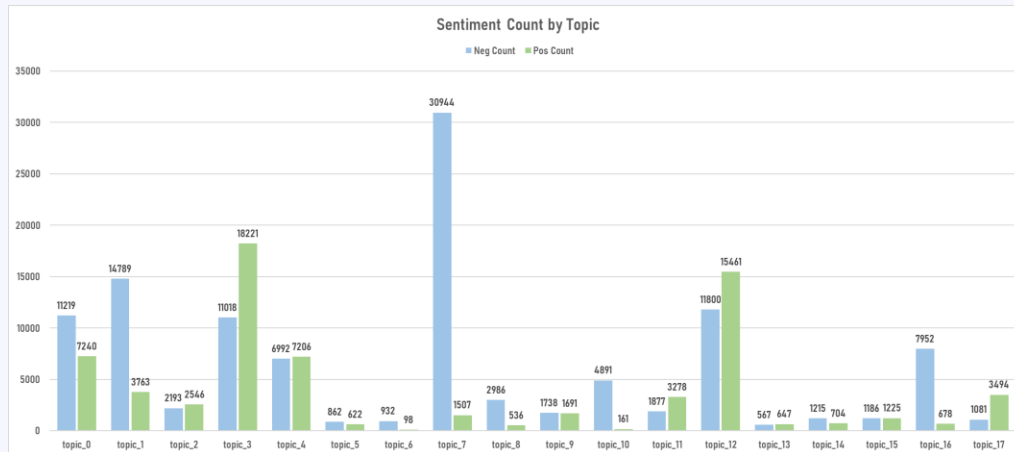
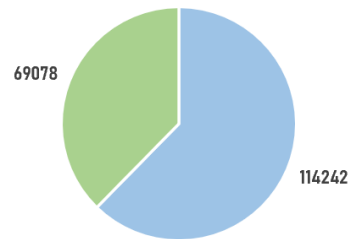
We could see that over half of the articles are classified as negative sentiment.

## For the specific topics:

- **Topic 3, 11, 12 and 17** are more **positive**.
- **Topic 2, 4, 5, 9, 13, 15** have similar level for **positive** and **negative**.
- **Topic 0, 1, 6, 7, 8, 10, 16 (especially 7)** are more **negative** - which make sense since topic 7 is about crime.

## Sentiment Count

■ Neg Count ■ Pos Count

SVM  
Accuracy &  
Classification  
Report

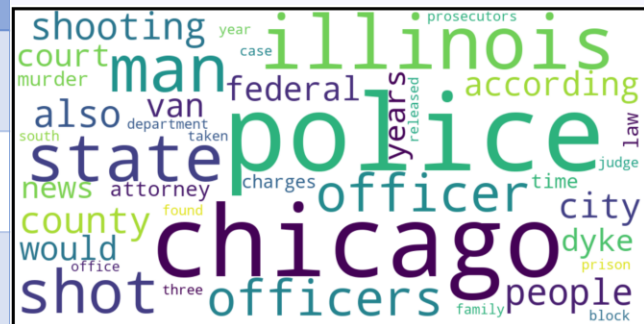
0.9734709838886282					
	precision	recall	f1-score	support	
0	0.97	0.97	0.97	32016	
1	0.97	0.97	0.97	31914	
accuracy			0.97	63930	
macro avg	0.97	0.97	0.97	63930	
weighted avg	0.97	0.97	0.97	63930	

# Sentiment Analysis

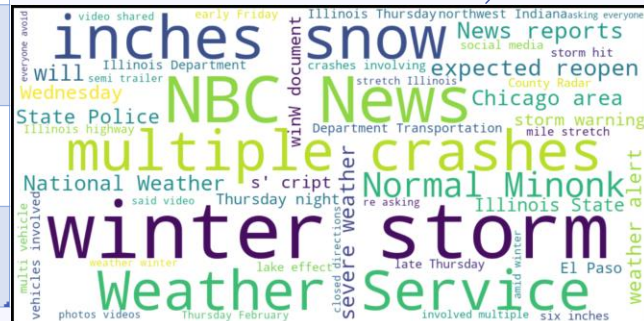
03

## Top reasons for population decline

Topic NO.	Topic	Keywords	Details	Suggestions on Corrective Actions
[topic 1]	Climate	frequent snow, storms	Bad and extreme weather decrease living quality.	Provide real-time weather report and improve early warning and response systems. Provide services / shelters to protect people from extreme weather. Formulate related policies and plans.
[topic 1]	Politics	Russia Ukraine War / Government Corruption	People feel unsafe about the political environment and lose confidence in the government.	<ul style="list-style-type: none"> <li>Make new elections of government officers to deal with the corruption problem and listen to people's voices.</li> <li>Formulate policies to provide protection for people who were negatively impacted by the political conflict.</li> </ul>
[topic 7,8,14]	Crime	gunshots, murder, sexual harassment, robbery, violence	Frequent criminal events, police's illegitimate behaviors (especially to minority group) and irrational judgement by the court make people feel unsafe.	Strengthen regional management on community security and gun-holding-related policy. Make proper laws about corresponding <i>punishment</i> for criminal behaviors and <i>protection solutions</i> for victims.
[topic 16]	COVID-19	increasing cases	Negative impact on economy (crash / inflation) created problems on many businesses. Unsatisfactory COVID cases control make people feel uncomfortable.	Support local business to overcome the difficulties brought by COVID-19. (Fundings, beneficial policies.)
[topic 16]	Education	school cancellation, remote learning, mask mandate	Conflicts between schools and the teacher union influence education quality / COVID-19-related issue of remote learning and class cancellation.	<ul style="list-style-type: none"> <li>Listen to opinions from schools, teachers, students and parents to get agreement about school policy.</li> <li>Focus on improving the teaching quality even with remote classes.</li> </ul>
[topic 0, 13]	Marijuana	Cannabis products	Legalization of recreational Marijuana / Many Marijuana related advertisements, companies and products.	Strengthen the control of cannabis selling and usage as well as anti-addiction education.
[topic 2]	Alcohol & Drug	treatment, therapy	Great amount of rehab information indicates the severe addiction situations, which made the part of the citizens who do not enjoy this feel uncomfortable.	Strengthen drug-and-alcohol-related management policy to prevent negative impact on people who do not support its usage.



Sample Visualization  
for Climate & Crime related topics



negative sentiment

Sample Text Summarization Result in next page

# Sample Text Summarization Results

## Climate – bad weather

ktrain TransformerSummarizer applied

CPU times: user 1.64 s, sys: 22.4 ms, total: 1.66 s

Wall time: 1.79 s

'A cold front approaching the Chicago area generated showers and thunderstorms, with a severe thunderstorm warning and power outages occurring as a result of those storms. At least 3,500 customers were left without power as of 6 p.m. Wednesday due to high winds and severe storms that swept through the area. A cold front propelling the storms is expected to bring cooler-than-average temperatures along with it late Wednesday.'

## Law / Crime: illegitimate police behavior

CPU times: user 1.47 s, sys: 1.82 ms, total: 1.47 s

Wall time: 1.47 s

'NEW: Adam Toledo's family files a wrongful-death lawsuit against the city and the officer. NEW: Attorney for Toledo family says they will contact the U.S. Department of Justice. The officer who fatally shot 13-year-old Adam Toledo will not be charged, state's attorney says. Officer who killed Anthony Alvarez, 22, will also not face charges, she says.'

## Government Corruption

CPU times: user 941 ms, sys: 8.28 ms, total: 949 ms

Wall time: 948 ms

'Former Illinois House Speaker Michael Madigan Indicted. Madigan has been indicted on federal corruption charges. He was speaker of the Illinois House of Representatives from 1997 to 2011. He is accused of misusing his position as speaker to advance his political career. He has denied the allegations.'

## COVID-19

CPU times: user 1.11 s, sys: 834  $\mu$ s, total: 1.12 s

Wall time: 1.11 s

'Illinois health officials reported 24,646 new COVID-19 cases over the past week. That's an increase in cases, but a decrease in deaths from this time last week. In all, 3,138,682 cases of coronavirus have been reported in the state since the pandemic began.'

## Education: School and teacher union's conflict

CPU times: user 24.2 s, sys: 203 ms, total: 24.4 s

Wall time: 24.9 s

'Chicago school leaders cancel classes for a second straight day after failing to reach an agreement with the teachers union. The issues include metrics that would trigger school closures and more COVID-19 testing. Chicago Public Schools has rejected retuning to remote learning, saying it worsened racial inequities. District officials insist schools can safely remain open with protocols in place.'

## Marijuana Advertisement

CPU times: user 1.24 s, sys: 0 ns, total: 1.24 s

Wall time: 1.23 s

'Moon rocks are actually a THC megazord: They are cannabis buddies dipped in hash oil, then turned in kief. Depending on where you acquire, you can obtain moon rocks from \$19 as much as \$3,000. Moon stones are encouraged for experiences as individuals as they load a strong strike.'

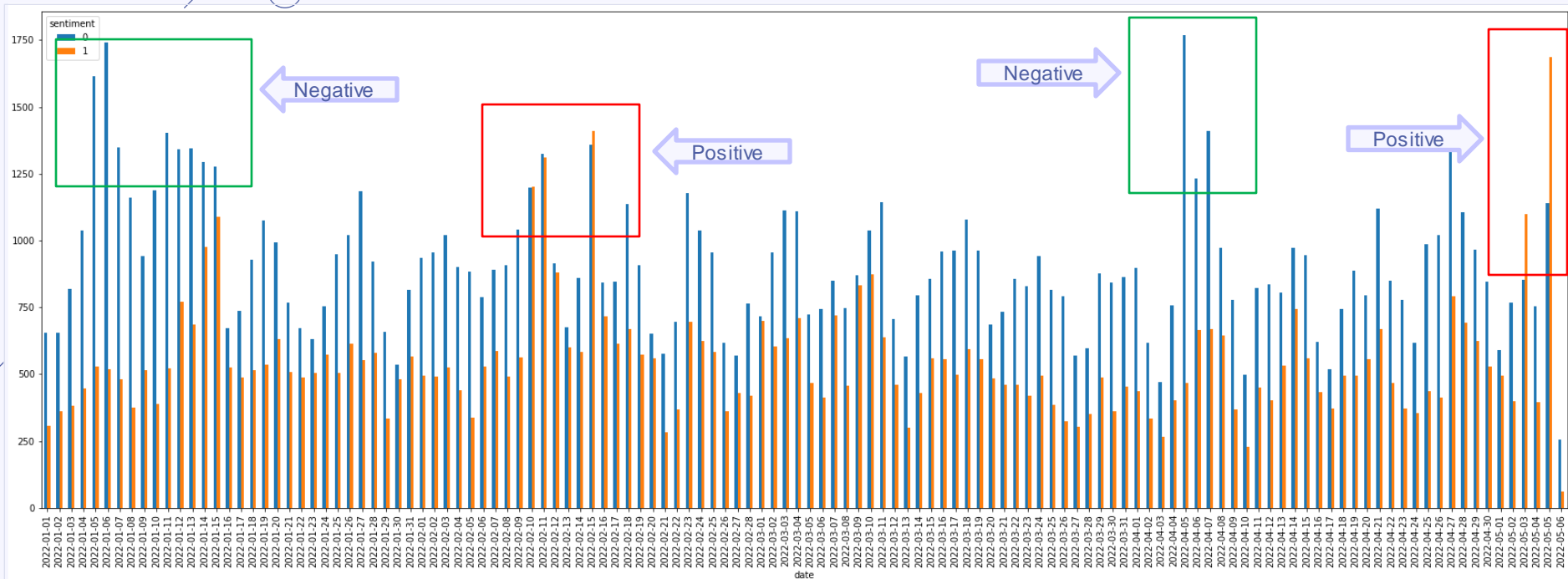


## 03



Topic NO.	Topic	Keywords	Details
[topic 0]	Business	market research, financial statement	Many companies create great value to the economy. The overall economic level would increase, thus help other businesses to develop.
[topic 3, 5, 6, 9, 12, 17]	Entertainment	Sports teams, Theaters, Museums, TV Shows, Artists/Musicians Performance.	The number of sports teams and entertainment events implies the great potential of future development in these industries. / Localized TV show series (Chicago Fire, PD, Med) are popular, which might lead the direction of new media.
[topic 9, 12]	Food	restaurants of various types.	Citizens living in Chicago enjoy diverse kinds of food from all over the world, meaning that restaurants would have possible development. Also, some local icon food like Chicago deep dish and thin crust are of great popularity, indicating that local food has development opportunities.
[topic 1]	Policy	casino, tax	New Chicago casino supported by the government. Solve fund problems by the great tax revenue created by the casino.
[topic 4]	Loan	Payday Loan	Help people with less-than-perfect credit, and is easy and fast to apply, which enables those people to develop businesses.
[topic 9]	Business Service	consulting, strategy	There are credit counseling service help with credit problems as well as advisory strategic consulting service.

**positive sentiment**



## Sentiment Changes over Time

Negative  
Positive

- The sentiment is very **negative** in **January** (especially in the first 2 weeks), and in the first week of **April**.
- The **positive** ratios are relatively higher in **mid-February**. And it becomes very **positive** starting from the beginning of **May**.
- Overall, the sentiment is more **negative**.

# Entity Identification - NER

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- Select related topics with high weights ( $\geq 0.9$ ) **selected topics: [topic 0, 1, 7, 10, 16]. Work on related 21654 articles.**
- Use **SpaCy** model ("en\_core\_web\_lg") to perform **NER** and identify business entities ('**ORG**') and people ('**PERSON**') from the text.
- Clean the repeated values.  
(E.g. SEC, the Securities and Exchange Commission, the Securities & Exchange Commission are the same).
- Get the **top 20 entities** and visualize the result.
- Also, find each text's corresponding organization list and person list.

(Note: Also tried **NLTK**, but did not perform as well as SpaCy.)

Text Content	Organization List	Person List
text	Orgs	Person
CHICAGO (AP) — Students are poised to return t...	[AP, the teachers union, Chicago Teachers Unio...	[Lori Lightfoot, Jesse Sharkey, Jesse Sharkey,...
Block Club spoke to parents across the city. S...	[Block Club]	[]
Chicago (AP) —Private negotiations on Saturday...	[AP, the Chicago Teachers Union, COVID,   Top,...	[Lori Lightfoot, Lightfoot, Jesse Sharkey, Lig...
Chicagoans should definitely come eat here. De...	[Lincoln Park]	[BYOB]
By Theresa Waldrop and Omar Jimenez, CNN\nThe ...	[Chicago Teachers Union, Omicron, CNN, Omicron...	[Theresa Waldrop, Omar Jimenez, Stacy Davis Ga...
[News]\n[Pandemic &nbsp;]\nChicago Cancels Scho...	[News][Pandemic &nbsp;]Chicago, Cancels School,...	[Pedro Martinez, Lori Lightfoot, Chris Geovani...
Photo: Getty Images\nA dispute over COVID safe...	[Getty, COVID, the Chicago Teachers Union, Omi...	[Jesse Sharkey, Lori Lightfoot, Barrera Tobón]
Virtual 'walkout': Chicago teachers vote for r...	[students][Grace Hauck]CHICAGO, Chicago Teacher...	[Lori Lightfoot, Pedro Martinez, Lightfoot, Ma...
Chicago — Students from several Chicago Public...	[Solorio Academy High School, the Youth Allian...	[]
A majority of Chicago teachers voted to refuse...	[COVID, COVID, COVID, Curie Metropolitan High ...	[Pedro Martinez, Lori Lightfoot, Lightfoot, Je...
Chicago teachers union votes to return to remo...	[OMICRON, omicron, Twitter, The New York Times...	[Pedro Martinez, Lori Lightfoot, Lightfoot, "She]
Omicron Surge Forces Chicago Teachers Out of D...	[Omicron Surge Forces, the Chicago Teachers Un...	[Lori Lightfoot, Jesse Sharkey, Martinez, Brin...

Entities	Count	Entities	Count
Illinois Tool Works	42099	Lori Lightfoot	6836
NYSE	9695	Jason Van Dyke	2898
SEC	8930	J.B. Pritzker	2543
the industrial products company's	4994	Jesse Sharkey	2156
Morgan Stanley	3369	Pedro Martinez	1865
AP	2559	Madigan	1773
Automotive OEM	2474	David Brown	1708
MarketBeat	2160	Kim Foxx	1595
Specialty Products	1809	Maria	1547
the Chicago Teachers Union	1802	Alvarez	1309
COVID	1703	Smollett	1288
CBS	1636	Ernest Scott Santi	1164
Chicago News Videos	1592	Sullivan	712
Deutsche Bank Aktiengesellschaft	1567	Sophia Tareen	605
Twitter	1523	Lei Zhang Schlitz	599
Illinois Municipal Retirement Fund	1495	Clinton	596
Chicago Chicago News & Search 1	1480	Adrian	594
Illinois Municipal Retirement Fund's	1455	Laquan McDonald	559
Company	1377	Harris	525
House	1318	Biden	499

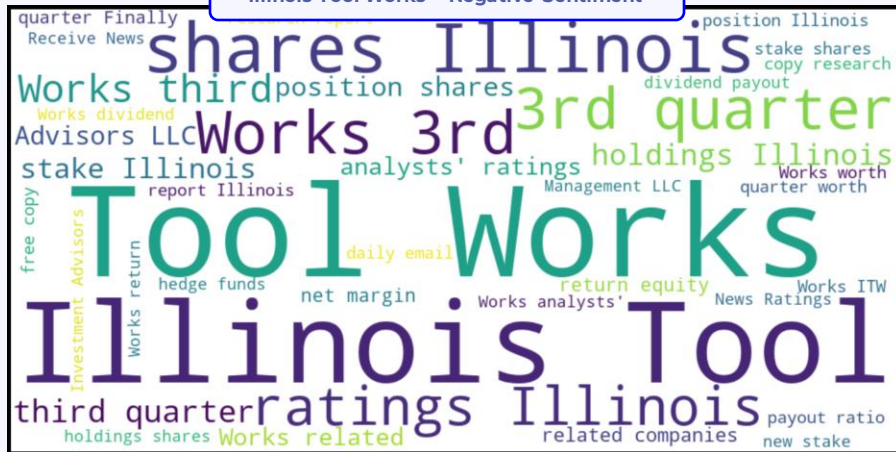
TOP 20 Organization Name

TOP 20 Person Name

## 03

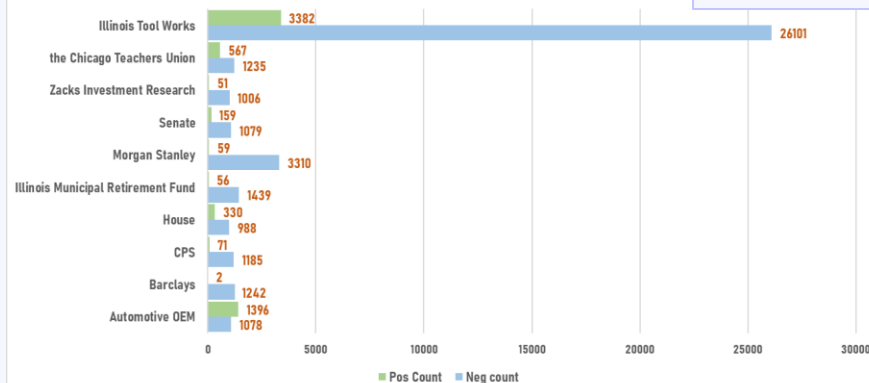
1. Utilize pre-trained pipeline (based on Yelp dataset) with **Logistic Regression Classifier** to get the sentiment for each sentence along with the probabilities.
2. Use the **aspect-based-sentiment-analysis** package in python. Perform **absa** on top 10 organizations and people in the previous list.
3. Visualize the sentiment count result using bar charts.

### Illinois Tool Works – Negative Sentiment



Here we could see that most words are related to **financial report and market research**. This again shows the relatively **neutral** tone for organization related articles.

### Sentiment Result for top 10 ORG



### Result From Yelp-based model

	Entities	Labels		Sentence	Sentiment	Neg	Prob	Pos	Prob
0	UChicago Medicine	ORG	Join one of the nation's most comprehensive ac...		1	0.428091	0.571909		
1	the University of Chicago Medicine	ORG	Our staff are encouraged to achieve their care...		0	0.543881	0.456119		
2	the Respiratory Therapist	ORG	this role, the Respiratory Therapist administe...		0	0.773318	0.226682		
3	The Respiratory Therapist	ORG	The Respiratory Therapist initiates and mainta...		0	0.996861	0.103139		
4	Small Volume Nebulizer	ORG	Administers supplemental oxygen/medical gas th...		0	0.662929	0.337071		

### Sample Result from absa model

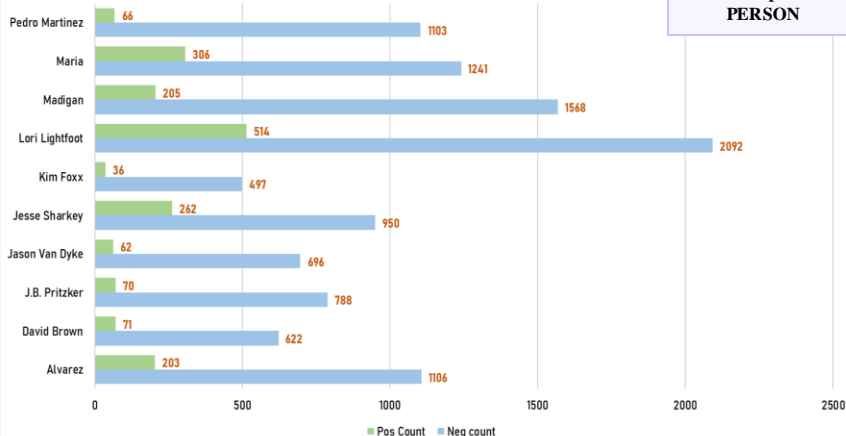
	sentence	score	sentiment
0	Henkel, Sika, Bostik, RPM International, KCC, ...	[0.003842097, 0.0012475062, 0.9949104]	1
1	] Illinois Tool Works: Q4 Earnings Snapshot -	[0.11129689, 0.003494288, 0.88520885]	1
2	Five analysts have provided estimates for Illi...	[0.41533464, 0.0043354826, 0.5803299]	1
3	Illinois Tool Works reported sales of \$3.48 bil...	[0.008301846, 0.001709402, 0.98989874]	1
4	The business is scheduled to announce its next...	[0.794829, 0.02242639, 0.18274465]	0

# Targeted Sentiment Analysis - PERSON 03

## Result From Yelp-based model

	Entities	Labels	Sentence	Sentiment	Neg Prob	Pos Prob
123178	Lightfoot	PERSON	"A day earlier, Lightfoot said she and Chicago...	0	0.769892	0.230108
123179	Pedro Martinez	PERSON	"A day earlier, Lightfoot said she and Chicago...	0	0.769892	0.230108
123180	Lightfoot	PERSON	"We haven't sat idly by and let COVID race thr...	0	0.879724	0.120276
123181	Raylene Grischow	PERSON	Sangamon County Circuit Judge Raylene Grischow...	0	0.909034	0.090966
123182	James Courti	PERSON	[\$42,720](Chambana SunHelp [ ] ,Buyer)[Address][Valuation]Jennifer A. B...	0	0.808233	0.191767

## Sentiment Count for PERSON



Sentiment Result  
for top 10  
PERSON

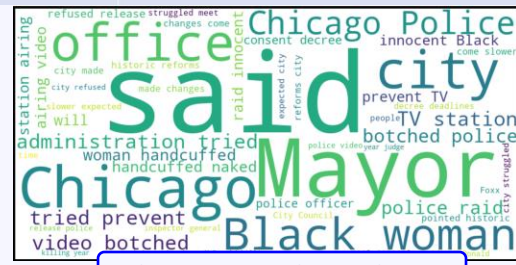
## Sample Result from absa model

	sentence	score	sentiment
0	CHICAGO (CBS 58) -- Chicago is one step closer...	[0.050318062, 0.8267901, 0.12289188]	1
1	"A city casino signals to the world that our e...	[0.4882559, 0.44871983, 0.063024335]	0
2	's been close to three years since state legis...	[0.29124725, 0.6985253, 0.10227481]	0
3	Lightfoot administration estimates that a new ...	[0.758051, 0.068628, 0.17332098]	0
4	The two proposals that were rejected were from...	[0.48773965, 0.23079708, 0.28146333]	0

For people, the overall sentiment is more negative since generally, the public cares and criticizes more on the things that the governors did wrong.

Person	Title	Details
Pedro Martinez	CEO of Chicago Public Schools	appointed by Mayor Lightfoot in September, 2021
Lori Lightfoot	current Mayor of Chicago	Support new casino and want to expand gambling outline gun violence related policy in accordance to Chicago mass shootings
Kim Foxx	state attorney of Cook County	support for the proposed legalization of recreational marijuana use in Illinois
Jesse Sharkey	current president of the Chicago Teacher Union	Have conflict with the Chicago Public Schools, disagreement on COVID-related policy
Jason Van Dyke	Former Chicago police officer	shoot a 17-year-old black boy, was free only after 3 years
J. B. Pritzker	43rd governor of Illinois	Abortion legislation, Fund for Colleges/Universities.
David Brown	63rd Superintendent of the Chicago Police Department	associated with crime related articles
Alvarez	Anthony Alvarez	a 22-year-old Latino man, was shot and killed by a Chicago Police Department officer

Here we could see some words like "killing", "police", "black", "struggle", "refuse", and "handcuffed", which indicates some criminal events and thus with a negative tone.



Lightfoot - Negative Sentiment



Topic	Keyword
Business / Finance	Corporations Financial Report, Market Research, Loan, Credit service
Politics	Russain Ukraine War, Government corruption
Food	Chicago Deep Dish, Chicago Style thin crust, Restaurants (from different countries)
Crime	Mass shootings, robbery, sexual harrassment, murder, violence, police illegitimate behaviors
Covid / Public health	Mask mandate, vaccination requirement
Education	Remote Learning, class cancellation, class quality, disagreement between schools and the teacher union.
Law / Policies	Marijuana, Abortion, Casino, Tax-related policy, Alcohol and drug usage, Lawyers
Entertainment / Sports	Musicians/Artists events, Sports team, Theaters, Museums, TV Shows

## Topic Insights Review

### Why residents should stay in IL or move into IL?

#### Entertainment:

Sports teams, Theaters, Museums, TV Shows, Artists/Musicians Performance.

- The variety of entertainment events provide people with multiple choices of relaxation.
- Different sports teams (NBA, Baseball, Football) would be attractive to team fans.

#### Food: restaurants of various types.

- The diversity in types of restaurants from all over the world enable people to enjoy a wide range of food without feeling boring.
- The localized icon food: Chicago Deep dish is of great popularity, which would be a reason for people to stay.

#### Law:

- There are many expert lawyers for family relations, accidents and injuries, immigration, and insurance, which provide people with professional help.
- State support women's abortion right and protect reproductive freedom.

**Job:** Many job descriptions indicate that there are many working opportunities in Chicago.

### Why businesses should stay in IL or move into IL?

**Business:** Many companies, organizations create great value to economy from the market research reports. The development of those above-mentioned company would promote the development of overall economic level and help create promising developing environment.

#### Policies:

New Chicago casino supported by the government would drive regional economic development by providing great tax revenue.

#### Beneficial services:

- There are many Payday Loan available in Chicago to help people with less-than-perfect credit to develop their own businesses since the Loan is easier and faster to apply compared to normal loan provided by banks and lenders.
- Also, there are credit counseling service and strategic consulting companies for businesses.

# Sample Text Summarization Results

## Sports related news

ktrain TransformerSummarizer applied

CPU times: user 1.36 s, sys: 0 ns, total: 1.36 s

Wall time: 1.35 s

'Bears GM Ryan Poles has completed his first draft class. Poles engineered four trades Saturday to increase his Day 3 picks from three to eight. The Bears ended the weekend with 11 newly drafted players, including four offensive linemen, an edge rusher, a running back, a safety and a punter.'

## Entertainment

CPU times: user 1.42 s, sys: 0 ns, total: 1.42 s

Wall time: 1.41 s

'13 Hidden Chicago Speakeasies with Secret Doors + Fun Cocktails. Whether you are heading to the big brilliant city of Chicago for business or pleasure you will definitely want to experience Chicago nightlife. Use the Rome2rio website or app to help you navigate and plan your routes to any of the listed secret entrance speakeasie in Chicago.'

## Chicago Pizza - Local food

CPU times: user 1.54 s, sys: 0 ns, total: 1.54 s

Wall time: 1.54 s

'The dough is pushed up onto the sides of the frying pan, forming a bowl for an extremely thick layer of toppings. Detroit-style pizza functions a thick and also crunchy crust with a bright red tomato sauce and also melty Wisconsin block cheese in a rectangle-shaped shape. Pizza makers often poke a little hole in the top of the "lid" to enable air and also steam to leave while cooking.'

## Abortion related opinion

CPU times: user 1.32 s, sys: 1e+03 µs, total: 1.32 s

Wall time: 1.32 s

'Chief Justice John Roberts confirmed Tuesday the authenticity of the leaked draft opinion. Illinois Governor JB Pritzker condemned the report that could allow states to enact even more restrictive anti-choice laws. The document is not a final decision, but a "first draft" of the opinion in a case challenging Mississippi's abortion ban.'

## Business - Casino

CPU times: user 1.25 s, sys: 0 ns, total: 1.25 s

Wall time: 1.25 s

'Mayor Lori Lightfoot plans to select the operator and location of a Chicago casino in "early 2022," officials said. The city, which is banking on a casino to generate \$200 million in annual tax revenue to plug its public pension funding holes, plans to submit its choice to the Illinois Gaming Board.'

## Business - Advisory Service

CPU times: user 1.31 s, sys: 1.63 ms, total: 1.31 s

Wall time: 1.31 s

'Hakluyt, the strategic advisory firm for businesses and investors, announced today that it has opened a new office in Chicago. This office, which will be Hakluyt's base in the Midwest, will be jointly led by Gretchen Crosby Sims and Tom Wyler. Gretchen has spent 20 years in politics, policy, philanthropy and impact investing.'

# Appendix

## 20 Keywords For 18 topics From LDA

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
0	company	say	also	game	get	roof	sweepstake	say	state	pizza	share	also	go	also	ad	mom	school	point
1	work	city	well	team	use	repair	sponsor	state	covid	stock	well	say	well	say	—	dad	student	shoot
2	program	accord	alcohol	season	need	cookie	prize	accord	accord	also	additional_share	need	get	go	card_carousel	court	say	game
3	include	year	individual	go	time	set	winner	get	say	top	company	get	see	actually	change	also	district	season
4	provide	news	use	get	also	door	entrant	take	case	dough	owns_share	work	show	rock	true_trackactiv e_card_carous el_bind	well	teacher	last_game
5	business	report	time	play	find	roofing	award	people	people	side	illinois_tool_w ork	make	make	sale	watch	parent	return	field_opponent
6	service	area	treatment	bear	lawyer	use	right	charge	hospital	use	value	certainly	know	moon_rock	trackactive	child	union	bull
7	support	state	person	make	go	contractor	participate	city	virus	make	holding	time	time	make	use	kid	covid	go
8	team	expect	content	say	company	website	responsible	year	report	crust	position	go	want	know	quote	state	parent	lead
9	new	also	need	win	work	estimate	time	police	adstyzgoogle window_adstyz google_push	chicago_styl e	stake	home	come	even	previous_week	youngster	child	per_game
10	year	document_doc umentelement	get	bull	case	crew	event	go	make	get	industrial_pro ducts_company _stock	require	also	certainly	case	order	mask	at
11	state	see	type	come	make	house	agree	case	vaccine	fact	purchase	dumpster	work	get	penalty_minu te	need	remote_learn e	datum
12	community	high	center	point	good	store	use	time	center	cheese	buy	use	take	market	save	time	week	story_using_te chnology_provi de
13	need	plan	addiction	player	individual	home	rule	call	number	sauc	worth	kind	people	end	facebook_wha tsapp_sms_pri rit	get	work	data_skrive
14	use	ukraine	make	time	well	day	subject	make	interview	know	company_sto ck	roof	think	create	cases_per_re sident	family_law_att orneys_near	go	spread
15	experience	day	people	year	fact	post	claim	officer	bear	right	report	lot	good	high	resident	divorce	city	averaged_poi nts_per_gam e
16	information	move	alcohol_drug	start	know	company	released_parti e	shoot	region	area	acquire	fact	find	moon	penalty	announce_min utes_ago_fate	class	bet
17	well	make	problem	lead	help	shingle	enter	also	county	time	accord	roof_cove	way	roll	feature	divorce_lawy er	state	state
18	help	new	best_drug_re hab_center	take	service	roofer	win	report	Increase	https_www_co m_new	rating	know	day	stone	view	attorney	pandemic	look
19	market	number	therapy	see	provide	make	arbitration	block	day	cover	transaction	set	year	moon_stone	owl	various	continue	illinois_state

page 3 attached tables

## Corresponding topic and weights with text

	date	language	title	text	cleaned_text	topic_1	topic_2	w1	w2
0	2022-01-06	english	No deal, no school: Chicago cancels classes fo...	CHICAGO (AP) — Chicago school leaders canceled...	chicago ap chicago school leaders canceled...	16	-1	0.995696	0.000000
1	2022-01-06	english	No deal, no school: Chicago cancels classes fo...	CHICAGO (AP) — Chicago school leaders canceled...	chicago ap chicago school leaders canceled...	16	-1	0.995942	0.000000
2	2022-01-06	english	Watch 'Chicago P.D.' Preview Wednesday	Chicago PD 9×11 "Lies" Season 9 Episode 11 Pro...	chicago pd lies season episode pro...	12	9	0.548833	0.194461
3	2022-01-06	english	Trump's Solution for Chicago Public Schools? K...	Wise of Foolish?nThe Chicago Tribune article ...	wise of foolish the chicago tribune article t...	7	16	0.506048	0.253361
4	2022-01-06	english	Family, friends, colleagues gathering today at...	The neighbors near Mashawn Plummer's Portage P...	the neighbors near mashawn plummer s portage p...	12	7	0.628751	0.277253



The background features abstract geometric patterns in the corners, consisting of thin blue lines, dots, and circles. In the top-left, there are several parallel lines and a small cluster of dots. In the top-right, a circle with a dot inside is connected by a line to another dot. In the bottom-left, there are more parallel lines and a circle with a dot. In the bottom-right, there is a complex arrangement of lines, dots, and a circle with a dot, including a series of parallel diagonal lines.

**Thank you.**