

Twitter Bot Detection in Ukraine War Context

Florian, Julius, Matteo, Oliver & Triyan

An introduction to social bots on Twitter

Politics and definition issues

Automated Diffusion? Bots and Their Influence During the 2016 U.S. Presidential Election

[Olga Boichak](#), [Sam Jackson](#), [Jeff Hemsley](#) ✉ & [Sikana Tanupabrungsun](#)

Conference paper | [First Online: 15 March 2018](#)

4613 Accesses | **9** Citations | **11** Altmetric

Computational Propaganda in Brazil: Social Bots during Elections

Dan Arnaudo, University of Washington

[Submitted on 1 Jul 2017]

Disinformation and Social Bot Operations in the Run Up to the 2017 French Presidential Election

Emilio Ferrara

Rec *[Submitted on 25 May 2018]*
exp

Effects of Social Bots in the Iran–Debate on Twitter

Andree Thieltges, Orestis Papakyriakopoulos, Juan Carlos Medina Serrano, Simon Hegelich

2018 started with massive protests in Iran, bringing back the impressions of the so called "Arab Spring" and its revolutionary impact for Maghreb states, Syria and Egypt. Many reports and scientific examinations considered online social networks (OSN's) such as Twitter or

Social bots who distort political discussions on Twitter have been a popularly discussed theme over the last years, most notably since the 2016 US election.

Revealed: Putin's army of pro-Kremlin bloggers

Hundreds of workers are paid around £500 a month and required to write at least 135 comments per day - or face immediate dismissal

Paul Gallagher • Friday 27 March 2022

Twitter bans over 100 accounts that pushed #IStandWithPutin

Laptop generals and bot armies: The digital front of Russia's Ukraine war

Analysis Digital technology plays a key role in the armed conflict in Ukraine – as a tool for cyberattacks and digital protest, and as an accelerator for information and disinformation.

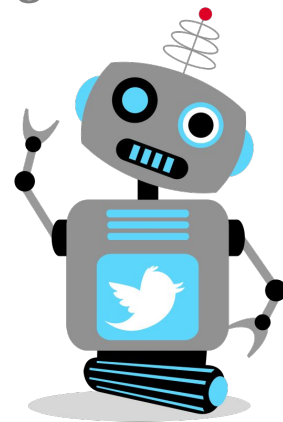
1 March 2022 by [Sabine Muscat](#) and [Zora Siebert](#)

... Russia-linked manipulation, but little of the Kremlin's

State controlled disinformation campaigns have often been associated with the Kremlin. In the Ukraine war, traditional military warfare is accompanied by an information and cyber war.

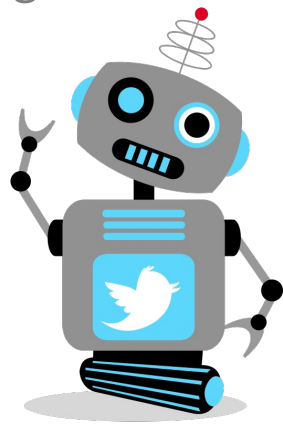
Bot or not?

- Automated accounts controlled by software, often aiming to mimic human users



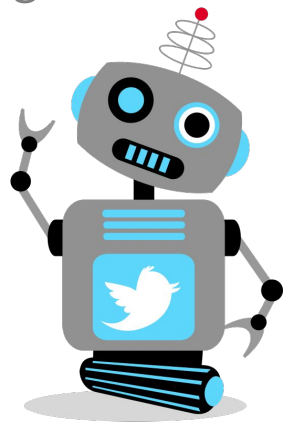
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- Bots are employed for a broad set of tasks:
 - Transparent automation (e.g. for a news outlet)
 - Commercial advertising or scamming
 - Trolling/political disinformation



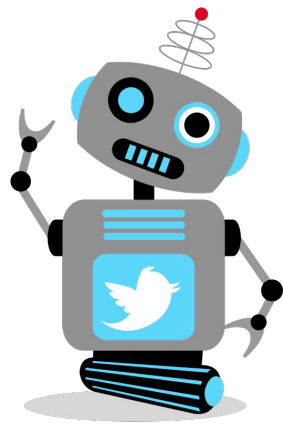
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 - Hybrid forms (Human-in-the-loop)
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 - Bot tag almost impossible to verify from the outside
- Automated social media accounts as a phenomenon of data-driven societies



Our research questions

Where do automated bot accounts appear in the discourse on the Ukraine war on Twitter?

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- What *topics and positions* do they try to propel? What *reach* do they gain?

Our research questions

Where do automated bot accounts appear in the discourse on the Ukraine war on Twitter?

- What *topics and positions* do they try to propel? What *reach* do they gain?
- Do bot accounts *interact*? Can we identify *bot networks*?

Bot Detection

Dataset | Preprocessing | Predictions

Dataset



Ukraine dataset
(26 Mar - 31 Mar)

Dataset



Ukraine dataset (26 Mar - 31 Mar)

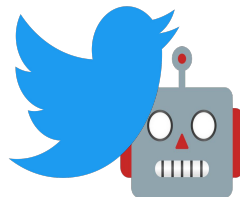
- User id, name
- Nb of followers/friends
- Nb of tweets
- Tweets (text, posting time, nb of retweets & favorites...)

Datasets



Ukraine dataset (26 Mar - 31 Mar)

- User id, name
- Nb of followers/friends
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Twibot dataset

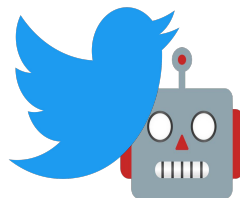
- User id, name
- Nb of followers/friends
- Nb of tweets
- Tweets (text, posting time, nb of retweets & favorites...)
- Is user verified?
- Has user a profile image?
- Which domains are usually tackled?
- Is profile protected?
- ...
- **Is user a bot?**

Datasets



Ukraine dataset (26 Mar - 31 Mar)

- User id, name
- Nb of followers/friends
- Nb of tweets
- Tweets (text, posting time, nb of retweets & favorites...)



Twibot dataset

- User id, name
- Nb of followers/friends
- Nb of tweets
- Tweets (text, posting time, nb of retweets & favorites...)
- **Is user a bot?**

Preprocessing (1/2)



Preprocessing (1/2)



Nb of favorites

Preprocessing (1/2)

Is it a retweet?



Twitter
@twitter



Following

RT: @ZelenskyUA A team in @ethz conducted a project on #BotDetection on Twitter, against backdrop of current war 🇺🇦. You can find their project on this repo: <https://github.com/aegonwolf/ukraine-conflict-social-news>. More ...

Nb of retweets

RETWEETS
539

FAVORITES
503



Posting time

6:42 PM - 5 Nov 2014

Nb of favorites

Preprocessing (1/2)

Is it a retweet?

Is it a reply?

Following

RT: @ZelenskyyUA A team in @ethz conducted a project on #BotDetection on Twitter, against backdrop of current war 🇺🇦. You can find their project on this repo: <https://github.com/aegonwolf/ukraine-conflict-social-news>. More ...

Nb of retweets

RETWEETS 539

FAVORITES 503

Posting time

6:42 PM - 5 Nov 2014

Nb of favorites



The image shows a screenshot of a Twitter post from the user @ZelenskyyUA. The post is a retweet (RT) of a tweet from @ethz. The text of the tweet mentions a project on #BotDetection on Twitter, against the backdrop of the current war in Ukraine (indicated by the Ukrainian flag emoji). It also provides a link to a GitHub repository: <https://github.com/aegonwolf/ukraine-conflict-social-news>. The tweet has 539 retweets and 503 favorites. The posting time is 6:42 PM on November 5, 2014. Red circles and lines are used to highlight specific features for preprocessing: the 'RT' prefix, the user handle '@ZelenskyyUA', the link, the number of retweets (539), the number of favorites (503), and the posting time (6:42 PM - 5 Nov 2014). Labels with arrows point to these features: 'Is it a retweet?' points to the 'RT' prefix; 'Is it a reply?' points to the user handle '@ZelenskyyUA'; 'Nb of retweets' points to the '539' value; 'Nb of favorites' points to the '503' value; and 'Posting time' points to the timestamp '6:42 PM - 5 Nov 2014'.

Preprocessing (1/2)

Is it a retweet?

Is it a reply?

Nb of mentions

Nb of retweets

Posting time

Nb of favorites



The image shows a Twitter post from the official Twitter account (@twitter). The tweet text is: "RT: @ZelenskyyUA A team in @ethz conducted a project on #BotDetection on Twitter, against backdrop of current war 🇺🇦. You can find their project on this repo: <https://github.com/aegonwolf/ukraine-conflict-social-news>. More ...". The tweet has 539 retweets and 503 favorites. It was posted at 6:42 PM on 5 Nov 2014. Red circles and lines highlight specific features: "RT:" for "Is it a retweet?", "@ZelenskyyUA" and "@ethz" for "Nb of mentions", the retweet and favorite counts for "Nb of retweets", the timestamp for "Posting time", and the favorite count for "Nb of favorites".

Feature	Value
Is it a retweet?	RT:
Nb of mentions	@ZelenskyyUA, @ethz
Nb of retweets	539
Nb of favorites	503
Posting time	6:42 PM - 5 Nov 2014

Preprocessing (1/2)

The image shows a screenshot of a Twitter post from the official Twitter account (@twitter). The post is a retweet of a tweet by @ZelenskyyUA. The text of the tweet mentions a project by @ethz on bot detection and includes a link to a GitHub repository. The tweet has 539 retweets and 503 favorites. The post was made on November 5, 2014, at 6:42 PM. Red circles and lines highlight specific features for preprocessing: the retweet status, the number of hashtags, the number of mentions, the number of retweets, the number of favorites, and the posting time.

Is it a retweet?

Is it a reply?

Nb of mentions

Nb of hashtags

Nb of retweets

Posting time

Nb of favorites

RT: @ZelenskyyUA A team in @ethz conducted a project on #BotDetection on Twitter, against backdrop of current war 🇺🇦. You can find their project on this repo: <https://github.com/aegonwolf/ukraine-conflict-social-news>. More ...

RETWEETS 539 FAVORITES 503

6:42 PM - 5 Nov 2014

Preprocessing (1/2)

Is it a retweet?

Nb of hashtags

Nb of retweets

Posting time

Is it a reply?

Nb of mentions

Nb of emojis

Nb of favorites

The image shows a screenshot of a Twitter post from the user @twitter. The tweet text is: "RT: @ZelenskyyUA A team in @ethz conducted a project on #BotDetection on Twitter, against backdrop of current war 🇺🇦. You can find their project on this repo: <https://github.com/aegonwolf/ukraine-conflict-social-news>. More ...". The tweet has 539 retweets and 503 favorites. It was posted at 6:42 PM on 5 Nov 2014. Red circles and lines highlight specific features for preprocessing: "RT:" (retweet indicator), "@ZelenskyyUA" and "@ethz" (mentions), "#BotDetection" (hashtag), "🇺🇦" (emoji), the retweet count "539", the favorite count "503", and the posting time "6:42 PM - 5 Nov 2014".

Feature	Value
Is it a retweet?	Yes (RT)
Nb of hashtags	1 (#BotDetection)
Nb of retweets	539
Posting time	6:42 PM - 5 Nov 2014
Is it a reply?	No
Nb of mentions	2 (@ZelenskyyUA, @ethz)
Nb of emojis	1 (🇺🇦)
Nb of favorites	503

Preprocessing (1/2)

Is it a retweet?

Nb of hashtags

Nb of links

Nb of retweets

Posting time

Is it a reply?

Nb of mentions

Nb of emojis

Nb of favorites

The image shows a screenshot of a Twitter post from the account @twitter. The tweet text is: "RT: @ZelenskyyUA A team in @ethz conducted a project on #BotDetection on Twitter, against backdrop of current war 🇺🇦. You can find their project on this repo: <https://github.com/aegonwolf/ukraine-conflict-social-news>. More ...". The tweet has 539 retweets and 503 favorites. It was posted at 6:42 PM on 5 Nov 2014. Red circles and lines highlight specific features for preprocessing: "RT:" (retweet indicator), "@ZelenskyyUA" and "@ethz" (mentions), "#BotDetection" (hashtag), the URL (link), the Ukrainian flag emoji (🇺🇦), the retweet count (539), the favorite count (503), and the posting time (6:42 PM - 5 Nov 2014). Annotations also point to the tweet's origin (Twitter) and the user's profile picture.

Preprocessing (1/2)

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Is it a retweet?

Nb of hashtags

Nb of links

Nb of retweets

Posting time

Is it a reply?

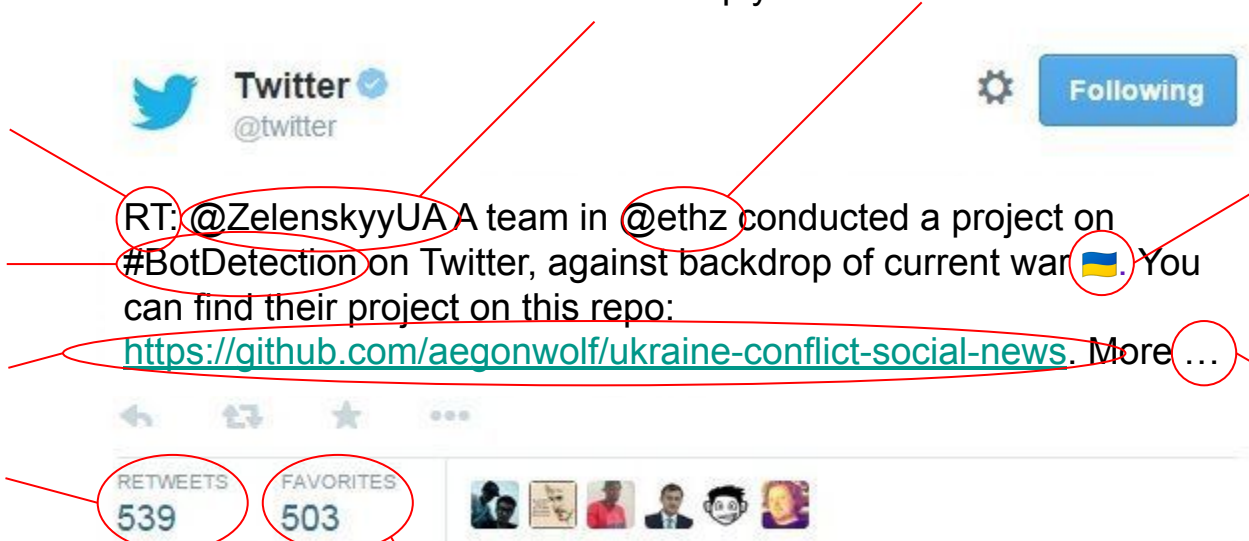
Nb of mentions

Nb of emojis

Is it part of a series of tweets?

Nb of favorites

Preprocessing (1/2)



The image shows a screenshot of a Twitter post from the official Twitter account (@twitter). The tweet is a retweet of a post by @ZelenskyyUA, mentioning a team in @ethz and a project on #BotDetection. The tweet includes a link to a GitHub repository and a Ukrainian flag emoji. Red circles and lines highlight various features for preprocessing:

- Is it a retweet?**: Points to the "RT:" prefix.
- Nb of mentions**: Points to the "@ethz" mention.
- Nb of emojis**: Points to the Ukrainian flag emoji (🇺🇦).
- Nb of hashtags**: Points to the "#BotDetection" hashtag.
- Nb of links**: Points to the GitHub URL.
- Is it part of a series of tweets?**: Points to the "More ..." link.
- Is it a reply?**: Points to the "@ZelenskyyUA" mention.
- Nb of retweets**: Points to the "539" retweet count.
- Nb of favorites**: Points to the "503" favorite count.
- Posting time**: Points to the timestamp "6:42 PM - 5 Nov 2014".

Additional features listed on the right side of the slide:

- Nb of characters/tokens
- Average length of tokens
- Nb of punctuation signs, verbs, etc.
- ...

Preprocessing (2/2)

User-level metadata

- Nb of followers
- Nb of friends

Tweet-level metadata

- Is modified?
- Is a reply?
- Has an ellipsis?
- Saturation (nb of characters / 240)
- Ratio of unknown characters
- Nb of cashtags
- Nb of hashtags
- Nb of links
- Nb of mentions
- Nb of emojis

Preprocessing (2/2)

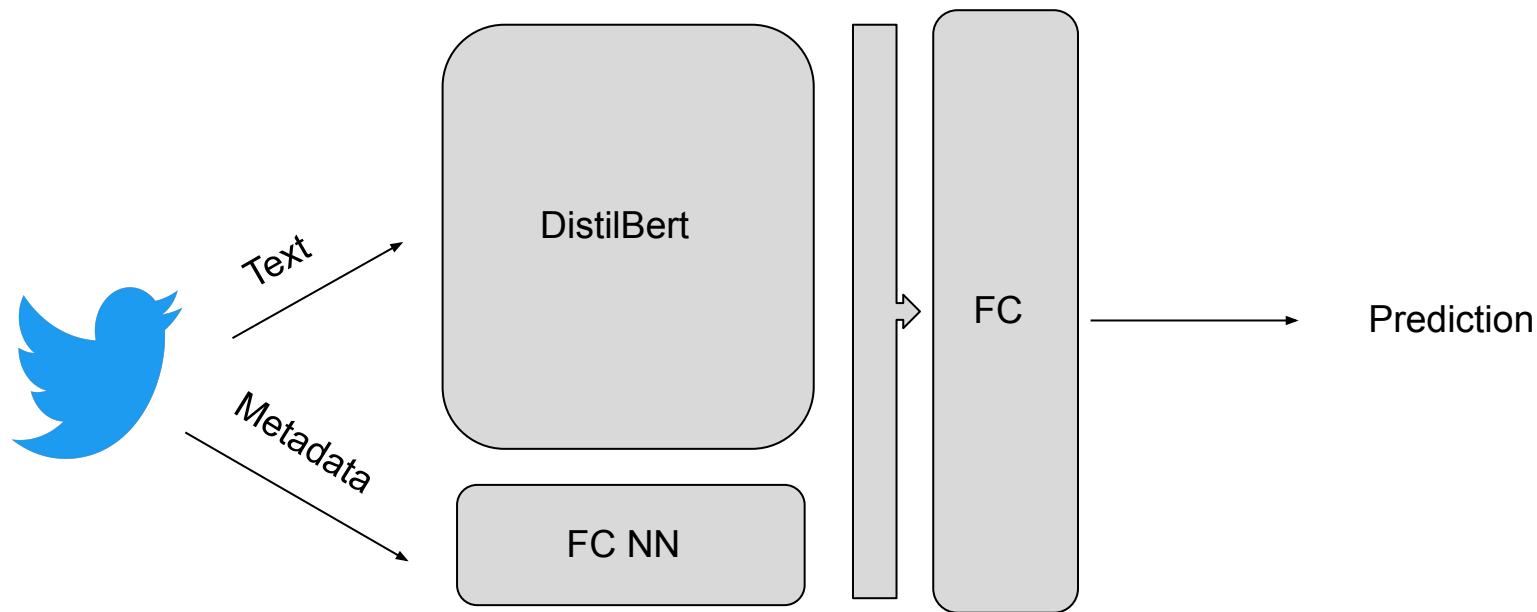
User-level metadata

- Nb of followers
- Nb of friends

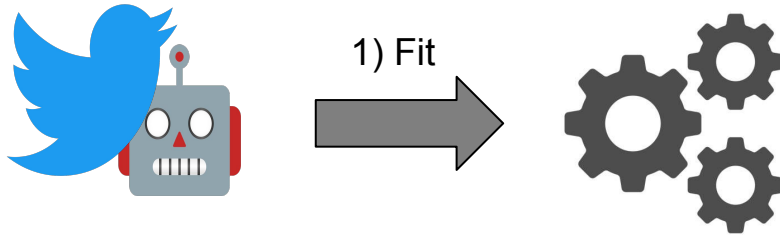
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- Ratio of unknown characters
- Nb of cashtags
- Nb of hashtags
- Nb of links
- Nb of mentions
- Nb of emojis

Basic Model Structure



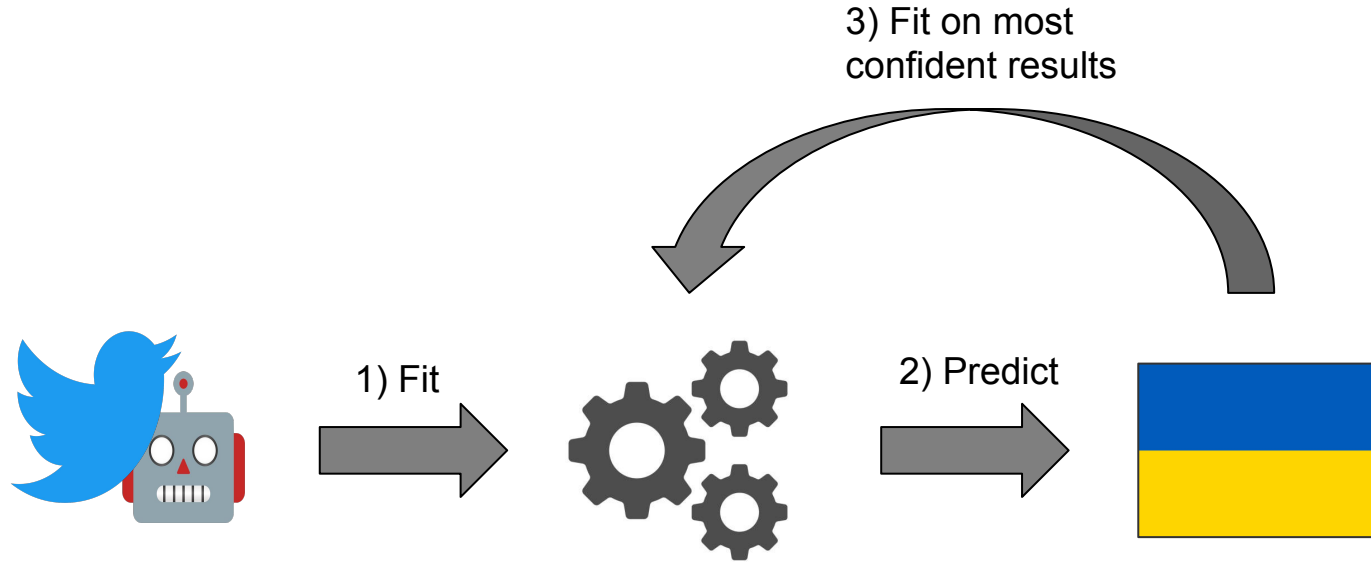
Predictions



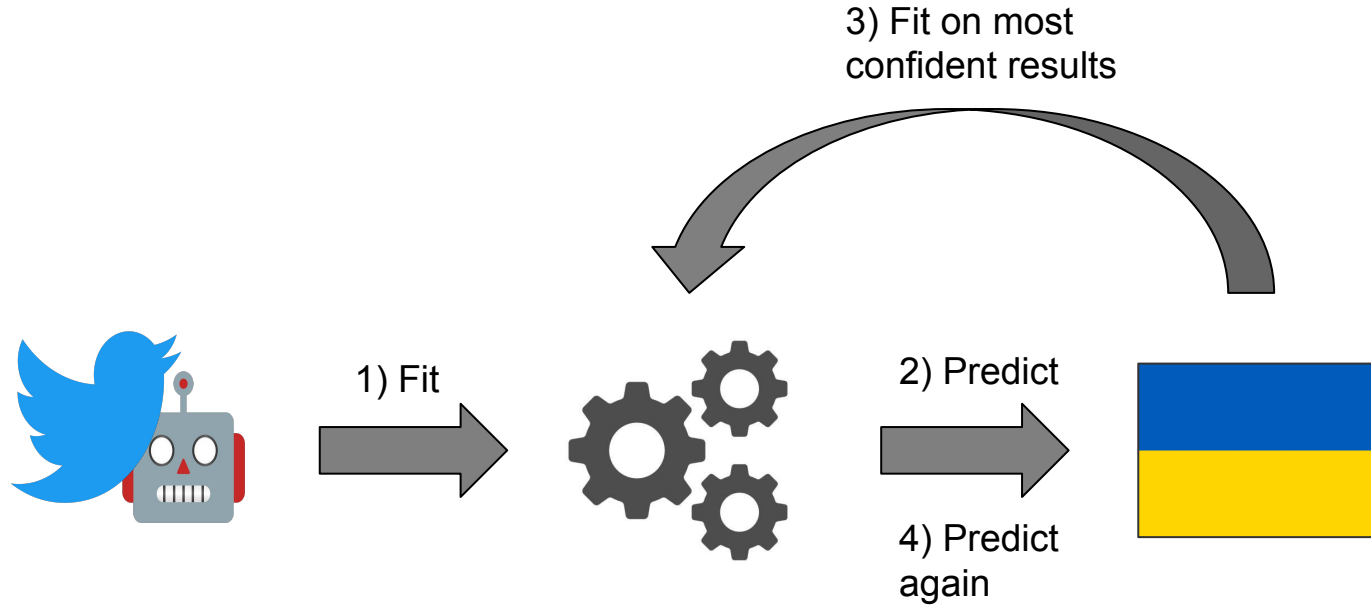
Predictions



Predictions



Predictions



Results

Let's look at some bots!

Crypto bots everywhere!



- Bot confidence: 97.8%
- Part of a bot network posing as charities
- Possibly created in response to Ukraine's official call for crypto donations
- Always exact same tweet (except first line), posted multiple times a day by multiple accounts
- The addresses seem to have no transactions
- False negatives: not all members of the network could be identified
- We decided to filter out crypto bots

Your typical spam bots



...

@SianMorg @TUIUK #UkraineUnderAttack
#boycottTUI #Billionaire #Alexey_Mordashov, ardent
supporter of war criminal #Putin, has simply handed
over his shares in #TUI, largest tourism company in the
world, to his wife. TUI bookings supports murder of
innocent people in the #UkraineWar

- Bot confidence: 92.0% and 97.5%
- On the order of 100 tweets over the course of a few days in burst fashion (precisely every 6-7s)



...

#Ukraine #UkraineRussiaWar #russia #Russians
#RussianWarCrimes #RussiaInvadesUkraine Breaking
News: Just Now Ukraine vs Russia War: Watch Video
👉👉👉👉👉👉👉👉👉👉👉👉👉👉
<https://t.co/LcYfdqcKim>

Pro Russian stance



...

#Mariupol or Stalingrad of our Modern Times where Our Brave #Russian Comrades are Fighting the New #Nazis And Raising the Flag of Freedom and Victory And the End of The Western Nazis Domination . Allah Akbar ❤️

🇷🇺🇺🇦❤️ #UkraineWar #Russia #Ukraina

#WeStandWithRussia #Chechen

<https://t.co/YEDyW8WAVI>

- Bot confidence: 98.1% and 94.1%
- Many bots resort to the “denazification” narrative of the Russian government
- Account suspended



...

To The #Ukrainian Radicals ; The Definition of Psychological Insecurities , Psychosis & Fake Heroism is Torturing Prisoners of War & Thinking You Can Win ! You #Nazi Terrorists Are only Proving That #Russia Has Every Right Fighting Criminals like You ! #Ukraine
[#RussiaUkraineWar](#)

False positive



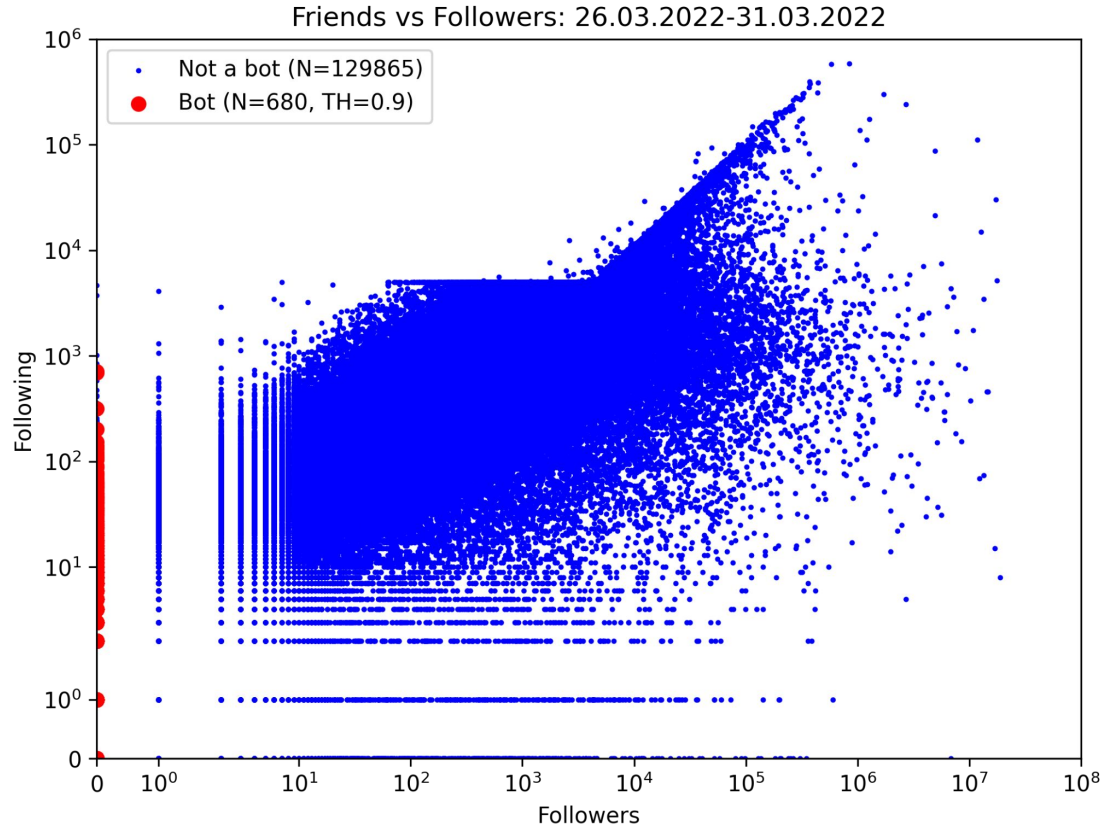
...

Authentic Azov recruitment video,

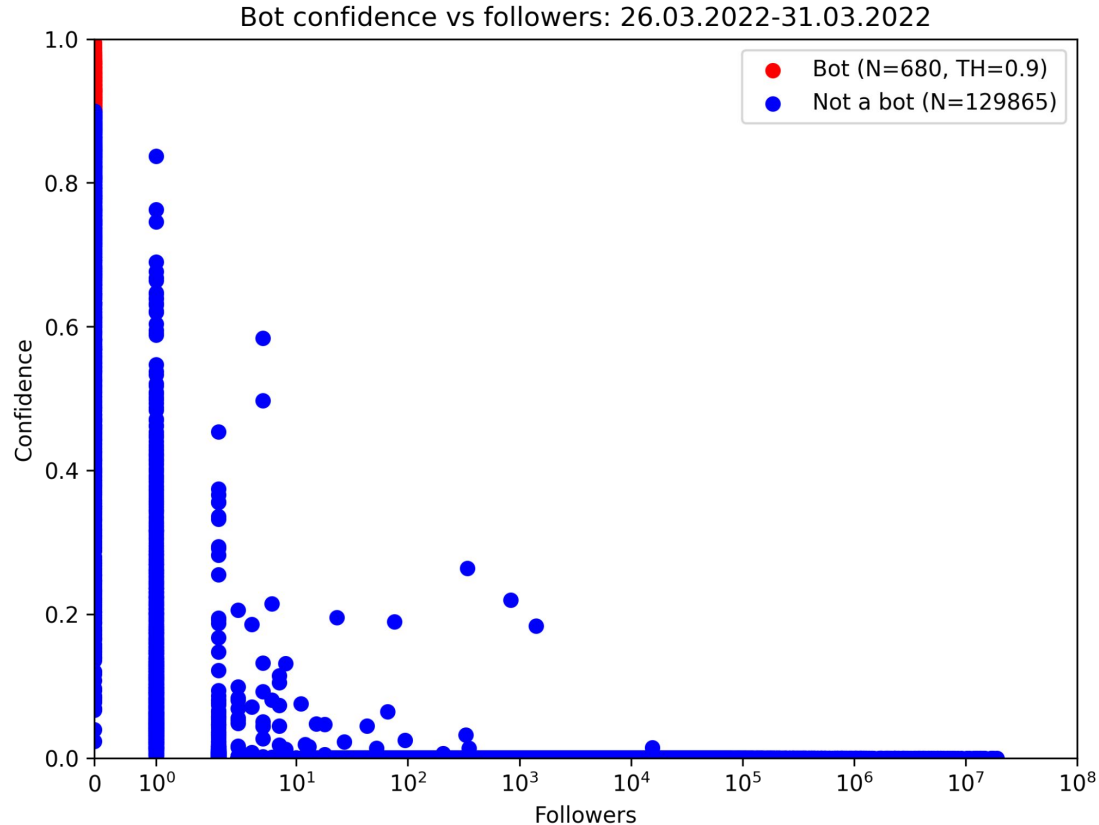
<https://t.co/Rvm5TTzYbB> #ukraine #russia #chechen
#chechyna #mariupol #war #combat #footage #Azov
#AzovBattalion

- Bot confidence: 97.8%
- It has the hashtags, and a URL
- User has no followers/friends
- Account belongs to an American YouTuber independently reporting on/analysing the Russia-Ukraine events

Analysing Bot Activity - Friends/Followers

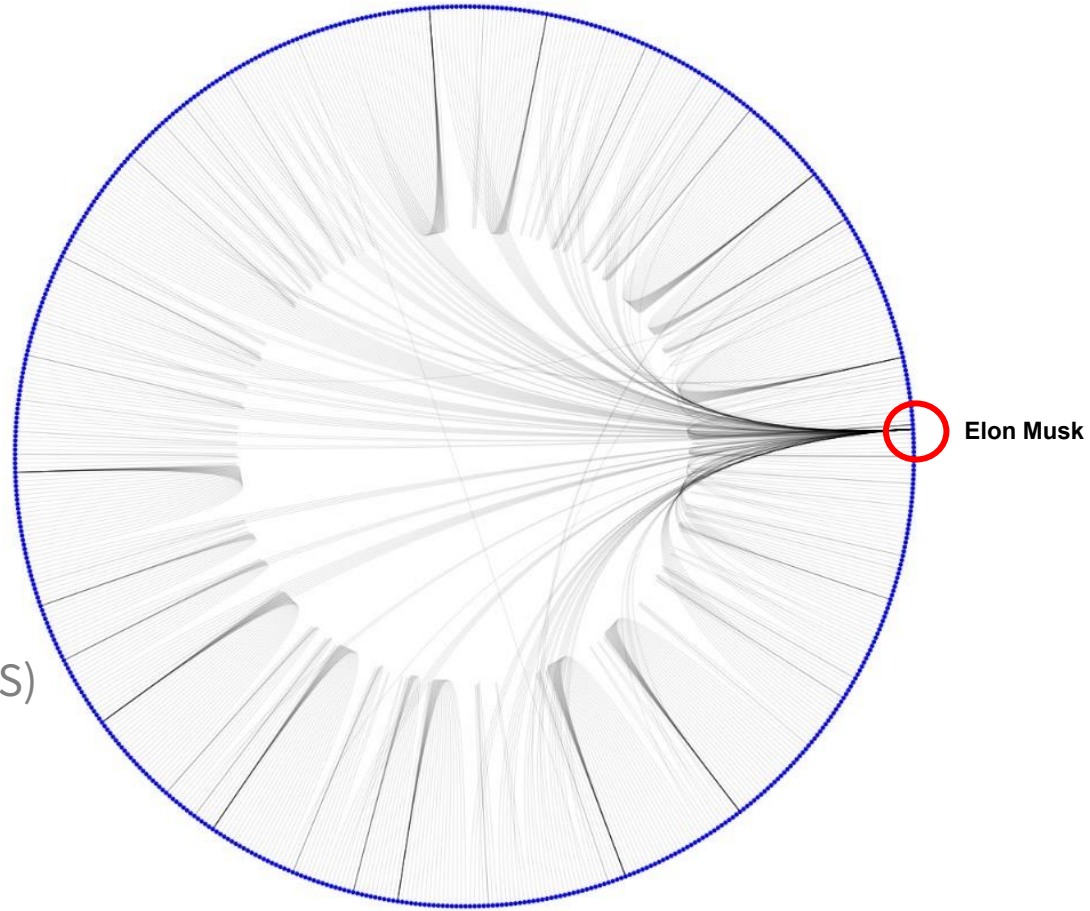


Analysing Bot Activity - Confidence/Followers



Who do bots follow?

- Bots are not followed by many other users
- Bots tend to follow large-scale accounts
(e.g. Elon Musk, Zelenskyy, POTUS)

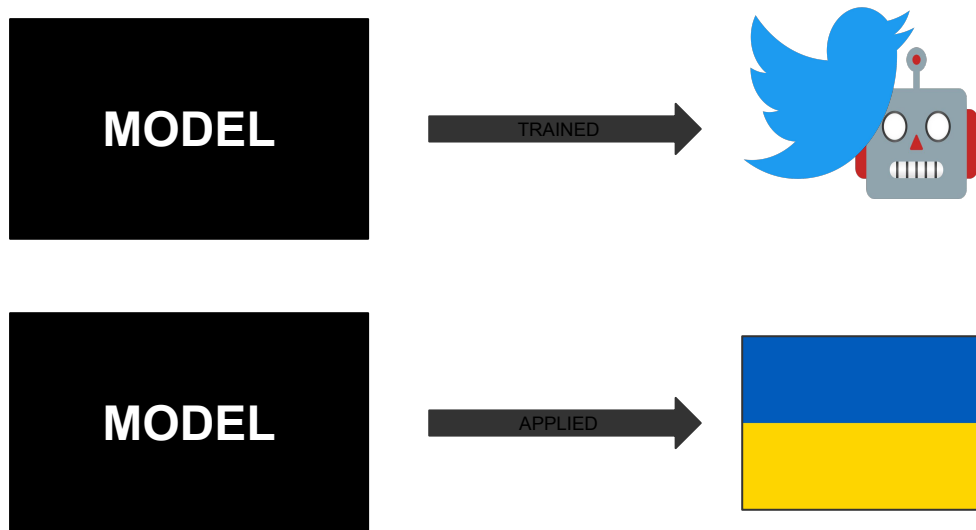


Graph visualization of accounts followed by bots

Trustworthiness of our results

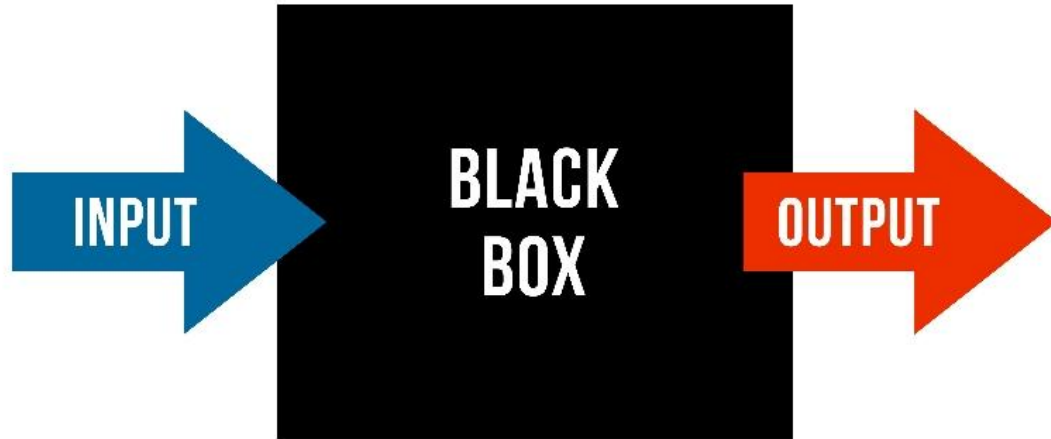
Is the dataset reliable? (1/3)

Two datasets: Twibot (labelled), Ukraine dataset (unlabelled)

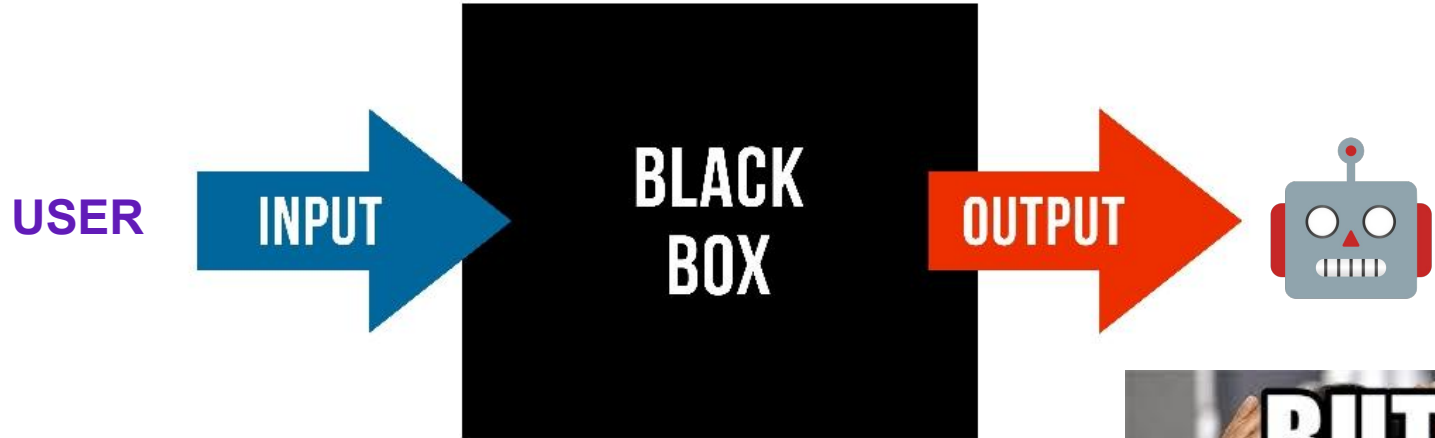


Interpretability in Machine Learning

High performance ML models are often complex and hard to interpret



Why do we need interpretability?



Is the dataset reliable? (1/2)

- Five annotators are then assigned to each user in TwiBot-20 to determine whether it is operated by bot or not.
- In order to identify potentially ambiguous cases, annotators are permitted to report 'undecided' regarding a specific user.
- Test questions were also mixed with real annotations tasks to assess annotators performance.
- Annotators who are more than 80% correct on standard questions are considered to be trustworthy and their annotation is adopted.

Is the dataset reliable? (2/2)

- User labelled accordingly if $\frac{4}{5}$ annotators agree upon
- Twitter's direct message feature was used to send out simple questions in natural language, the annotation was then performed manually
- Remaining undecided users were manually examined within the research team. Disputed cases were discarded and only users where a consensus was reached were annotated.

Conclusion (1/2)

- Within our dataset from 26 - 31 Mar, we labelled bots with various purposes and across the political spectrum in the Ukraine conflict – alongside some false positives.
- Because of the nature our topic, the reliability of our labels is hard to evaluate.
- None of the bots gained significant attention. Interaction was only observable on a very limited scale.
- Many of these accounts have been blocked by Twitter in the meantime.

Conclusion (2/2)

This is not the end of the line. For further research, it would be worthwhile...

- ... to increase our timescale. Other research has already identified bot networks that operated for some time.
- ... to compare disinformation attempts by humans and automated accounts.

SCIENCE

Twitter bot network amplifying Russian disinformation about Ukraine war, researcher says

ABC Science / By technology reporter [James Purtill](#)

Posted Tue 29 Mar 2022 at 8:30pm, updated Tue 29 Mar 2022 at 10:26pm

Thanks for your attention!



Elon Musk 

@elonmusk



If our twitter bid succeeds, we will defeat the spam bots or die trying!

8:53 PM · Apr 21, 2022 · Twitter for iPhone

78.9K Retweets **12.8K** Quote Tweets **901.2K** Likes

Supplementary Material

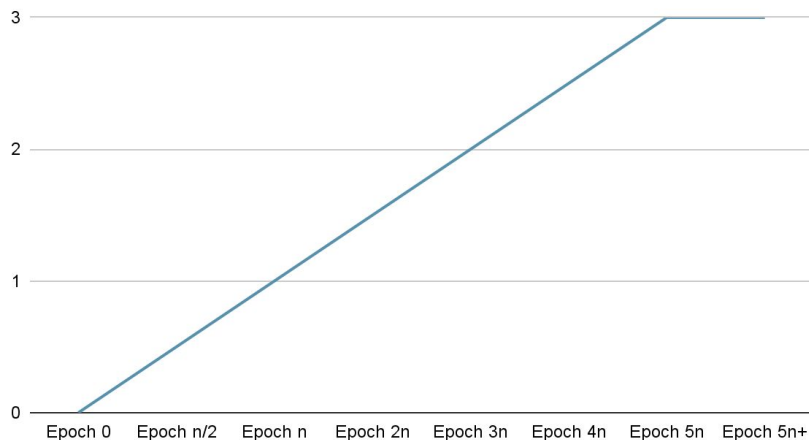
Pseudo-Labeling with Neural Networks

Semi-Supervised Learning => Bootstrapping

Basic Idea:

$\text{Loss} = \text{Labeled Loss} + \text{weight} * \text{Unlabeled Loss}$

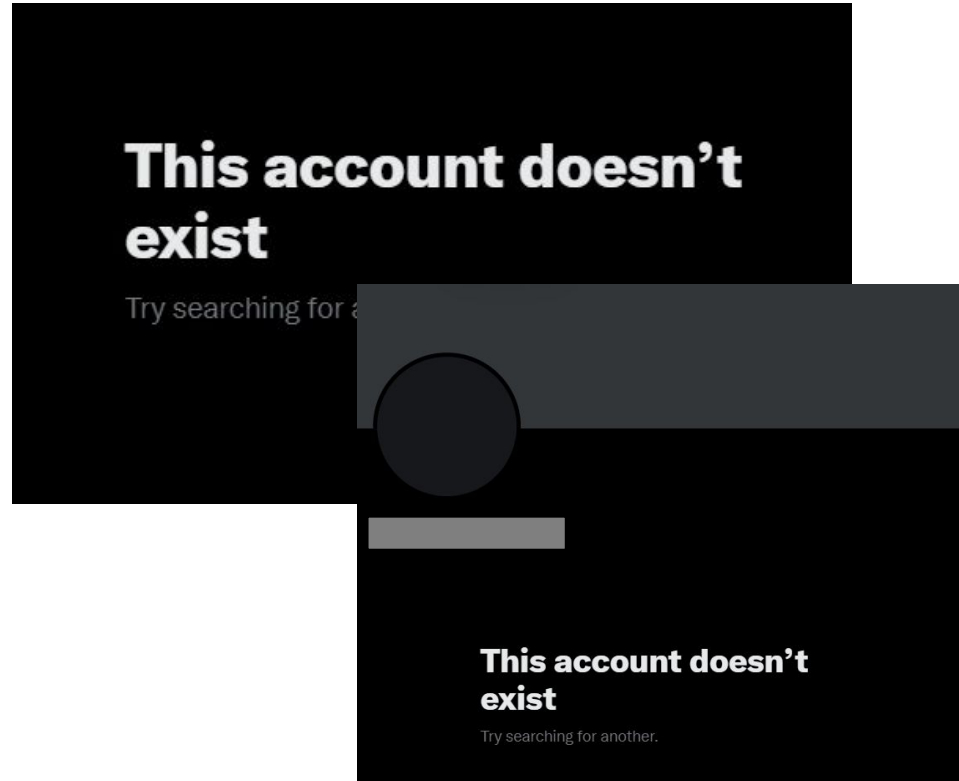
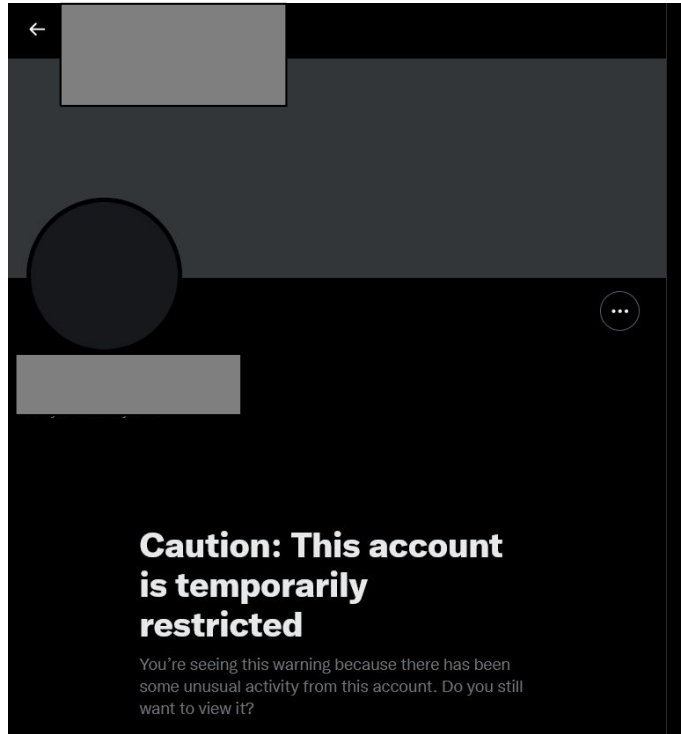
Pseudo Label Weight



- Also possible per batch
- Different Learning Rates
- Empirically proven
- Dangers of overfitting

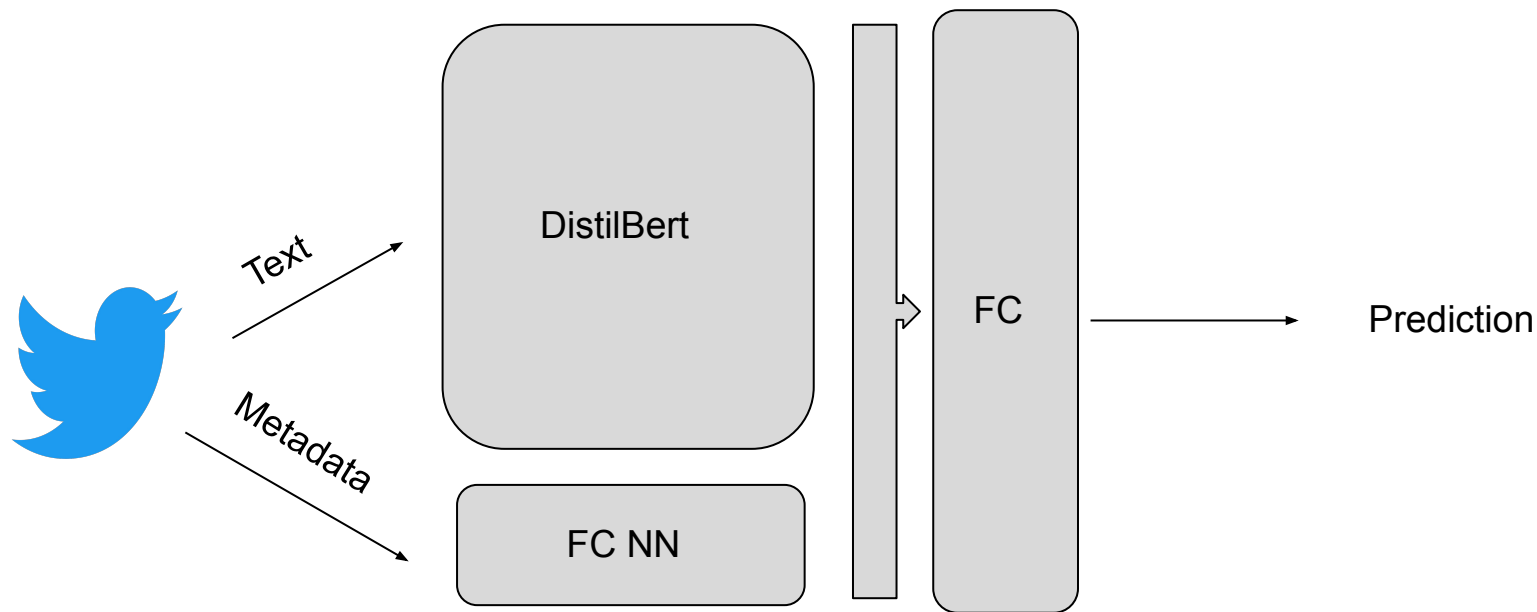


Deleted, suspended or restricted - a common theme

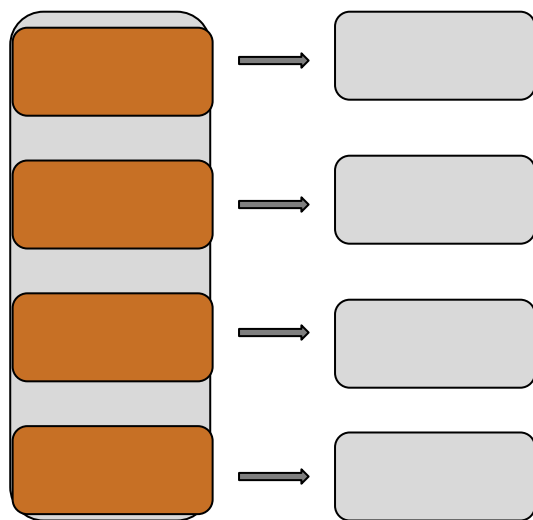




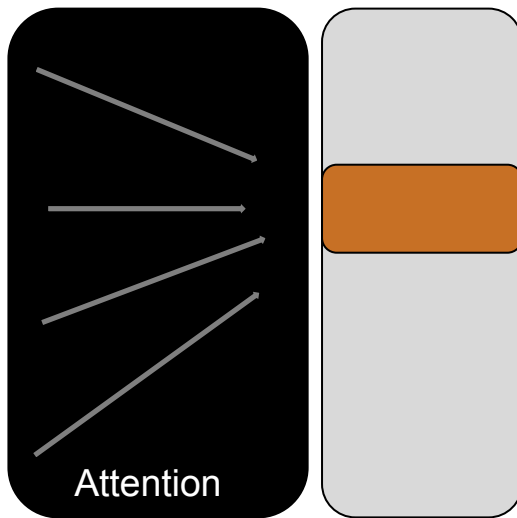
Basic Model Structure



The Transformer



Encoder



Attention + Decoder

Hidden State for each input from the encoder

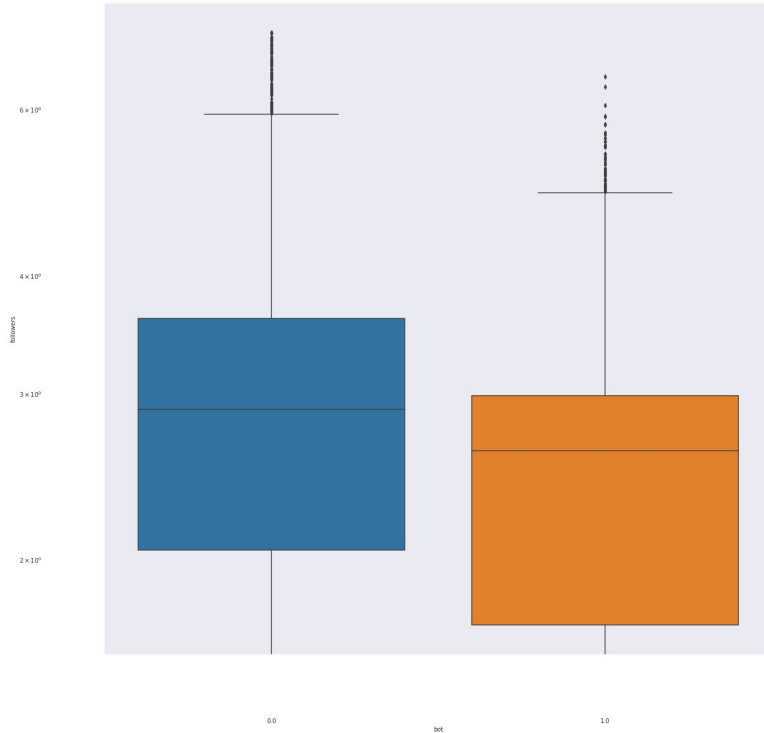
Each output assigns weight (attention) to generate output state in the decoder
Extension self-attention
Basically the same also for the encoder

Bot or No Bot by text only Training Twibot

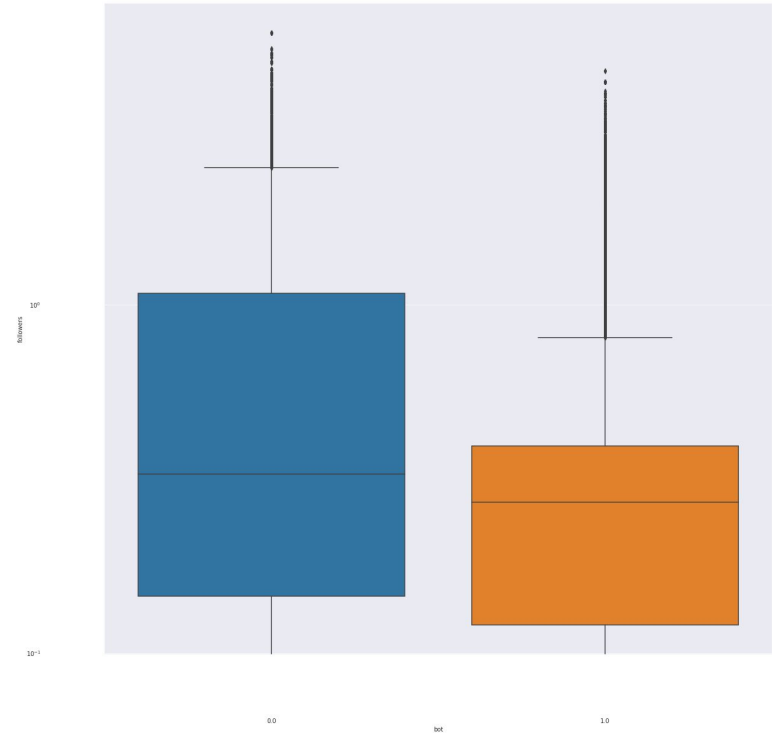
- 200 tweets per user in Twibot
- Train/validation/test split via userid, i.e. no leak via same user/different tweets
- In the Ukraine dataset: With validation and pseudolabelling this is not done, but learning rate has been lowered massively to reign in overfitting

Followers and Following Distributions

Followers Human/Bot



Ratio Human/Bot



Bots favor Propaganda But so do Humans

