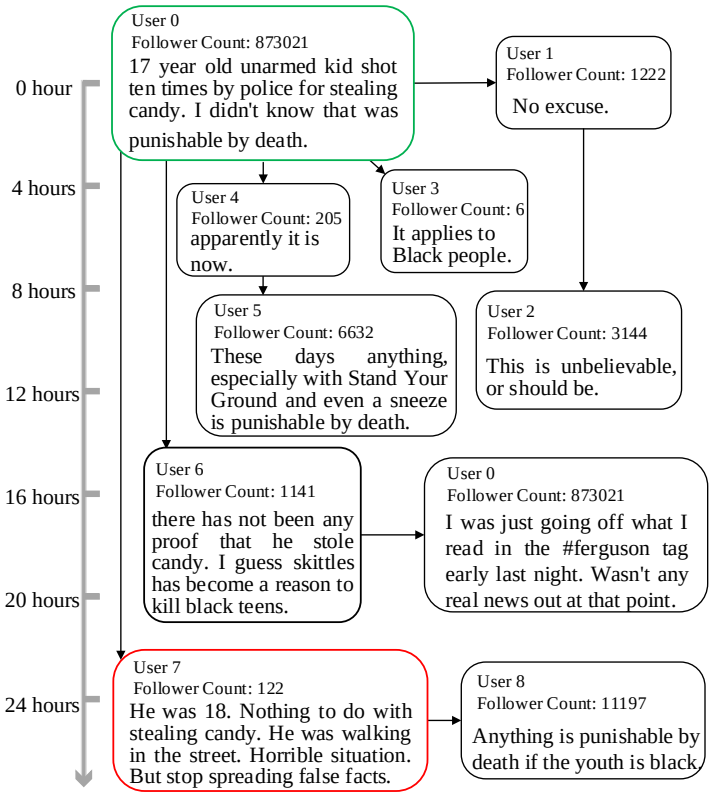
COMP90042 Project 2022:
Rumour Detection and Analysis on Twitter

Project type: Group
Report and code submission due date: 9pm Fri, 13th May 2022
Codalab submission due date: 1pm Fri, 13th May 2022 **(no extensions possible for this component)**

The concept of rumour has a long history, and it is typically defined as an unverified statement or news circulating from person to person. Rumours have the potential to spread quickly through social media, and bring about significant economical and social impact. The figure below illustrates an example of a rumour propagating on Twitter. The source message (green box) started a claim about the cause of Michael Brown's shooting, and it was published shortly after the shooting happened. It claimed that he was shot ten times by the police for stealing candy. The message was retweeted by multiple users on Twitter, and within 24 hours there were about 900K users involved, either by reposting, commenting, or questioning the original source message. From the replies we can see some users (e.g. User 7; red box) questioned the truthfulness of the original message.



The challenge of the project is to develop a rumour detection system and analyse the nature of rumours that are being spread on Twitter. We will frame this using two tasks: rumour detection and rumour analysis.

Task 1: Rumour Detection

In this task, you will be provided with a set of *tweet IDs* for the source tweets (i.e. the first tweet that started the story) and their replies (i.e. the comments we saw in the figure above), and each source tweet is labelled as either a rumour or non-rumour. The task here is to use the Twitter API to crawl the tweet IDs to get the *tweet objects*, and then build a binary classifier to classify whether a source tweet is a rumour or not. A tweet object provides a variety of information, including the text of the tweet, information of the user who made the tweet, when the post was created, etc (see "Datasets" section below for more information).

You're free to explore any methods or machine learning models for building the binary classifier. To give some ideas, we could model the source tweet and replies as a sequence of tweets using recurrent networks.

Alternatively we could also model them based on their propagation structure (like the tree structure of comments we saw earlier) using recursive networks or graph networks. We might want to consider incorporating some user information, as it could provide hints to the trustworthiness of a user. While you are permitted to use pretrained models or embeddings, you should only use the provided labelled tweets for training the model, i.e. **you should not find more labelled data beyond what we have provided**. Whatever methods or features you use, **you must at least incorporate the tweet text in your model** (we are doing an NLP project, after all).

Task 2: Rumour Analysis

In this task, you will use your trained rumour classifier from the first task and apply it to *unlabelled* COVID-19 tweets to detect rumours. Given the predicted rumours and non-rumours, the aim here is to perform some analyses to understand the nature COVID-19 rumours and how they differ to their non-rumour counterparts. We have provided a preliminary set of tweet IDs (of source tweets and their replies) related to COVID-19 that you can use, but **you're free to search for more COVID-19 tweets to support your analyses in this task**. Examples of datasets that you can potentially use are: https://github.com/thepanacealab/covid19_twitter and https://www.kaggle.com/datasets/gpreda/covid19-tweets.

Some questions that you may want to consider in your analyses:

- What are the topics of COVID-19 rumours, and how do they differ from the non-rumours?
- How do COVID-19 rumour topics or trends evolve over time?
- What are the popular hashtags of COVID-19 rumours and non-rumours? How much overlap or difference do they share?
- Do rumour source tweets convey a different sentiment/emotion to the non-rumour source tweets? What about their replies?
- What are the characteristics of rumour-creating users, and are they different to normal users?

Note that these are just some suggestions, and you are free to explore any questions to understand COVID-19 rumours on Twitter. As before, while you are free to do any analyses that may not be text-related (e.g. propagation analysis), most of your analyses should involve the text of the tweets.

You will complete both tasks, and write a report that details: (1) your detection system (first task), e.g. the reason behind the choices you have made and its performance; and (2) findings from your analyses (second task). Both tasks are equally important, so you should put similar efforts to them when you're working on the project.

We hope that you will enjoy the project. To make it more engaging **we will run the first task as a Codalab competition**. You will be competing with other teams in the class. The following sections give more details on data format, the grading scheme and the use of Codalab. Your assessment will be based on your report, your performance in the competition, your code, and your contribution to the team.

Submission materials: Please submit the following:

- Report (.pdf): https://canvas.lms.unimelb.edu.au/courses/124586/assignments/300356
- A zip file (.zip) containing your python code (.py or .ipynb) and scripting code (.sh or similar) if using Unix tools: https://canvas.lms.unimelb.edu.au/courses/124586/assignments/300357

Note that there are two different submission links/shells for the project report and code. The reason for separating these two submissions is that we will be running peer reviewing for the report shortly after the project has completed. Please note that you should be uploading a single pdf document for your report and a single zip file for your code; **all other formats are not allowed**, e.g. docx, 7z, rar, etc. Your submission will not be marked and will be given a score of 0 if you use these other formats. You do not need to upload your data files in the zip (e.g. the tweet objects). You'll find more information in the submission shells on how to submit the report and code as a team.

If multiple code files are included, please make it clear in the header of each file what it does. Note that we may review your code if needed, however note that code is secondary — the primary focus of marking will be your report, and your system performance on Codalab.

You must submit at least one entry to the Codalab competition.

Late submissions: -10% per day

Marks: 35% of subject

Materials: See Using Jupyter Notebook and Python page on Canvas (under Modules>Resources) for information on the basic setup required for COMP90042, including an iPython notebook viewer and the Python packages NLTK, Numpy, Scipy, Matplotlib, Scikit-Learn, and Gensim. For this project, you are encouraged to use the NLP tools accessible from NLTK, such as the Stanford parser, NER tagger etc, or you may elect to use the Spacy or AllenNLP toolkit, which bundle a lot of excellent NLP tools. You may also use Python based deep learning libraries: TensorFlow/Keras or PyTorch. **You should use Python 3.**

You are being provided with various files including a training, a development and a test set. See the instructions below (section "Datasets") for information on their format and usage. If there's something you want to use and you are not sure if it's allowed, please ask in the discussion forum (without giving away too much about your ideas to the class).

Grading: You will be graded based on several criteria: clarity of expressions of your report, soundness and novelty of your methods, substance of your work, interpretation of your results, performance of your system and your contribution to the team (section "Grading" below will provide more details).

Updates: Any major changes to the project will be announced via Canvas. Minor changes and clarifications will be announced in the discussion forum on Canvas; we recommend you check it regularly.

Academic Misconduct: While you're free to discuss the project with other teams/students, reuse of code between teams, copying large chunks of code from online sources, or other instances of clear influence will be considered cheating. Do remember to cite your sources properly, both for research ideas and algorithmic solutions and code snippets. We will be checking submissions for originality and will invoke the University's Academic Misconduct policy where inappropriate levels of collusion or plagiarism are deemed to have taken place.

Datasets

You are provided with several files for the project:

`[train,dev,test].data.txt`**:** tweet IDs of source tweets and replies for the first task (rumour detection);
`[train,dev].label.txt`**:** rumour labels for the first task (rumour detection);
`tweet-objects.zip`**:** zip file containing JSON tweet objects for the test set
`covid.data.txt`**:** tweet IDs of source tweets and replies for the second task (rumour analysis).

All data files (`[train,dev,test,covid].data.txt`) are text files, where each line is a list of tweet IDs. For these files, each line is an *event*: a list of tweets where the first tweet is the source tweet and the rest are reply tweets. When classifying whether a source tweet is spreading a rumour, we recommend that you use both source and reply tweets from the event.[1] Note that the reply tweets are sorted arbitrarily — they are not ordered chronologically by their timestamp, so you need to be careful if you are modelling them as a sequence of tweets.

You will need to crawl these tweet IDs using the Twitter API to recover their *tweet objects* so as to get more information such as the tweet text, user, etc. When you crawl these tweets, you'll inevitably find that some tweets cannot be retrieved because they have been deleted by their users. There's not much you can do about these deleted tweets — this is the nature of working with Twitter data and you just have to ignore/remove these tweets from your data. That said, you should be able to recover the objects for most tweets. For the test tweets, we have provided the tweet objects (in `tweet-objects.zip`) and as such you will not need to crawl them (this is to ensure that everyone has the same test set and the evaluation is fair).

A tweet object is a JSON object, and looks like the following:

[1] While you can technically build a classifier that use only the source tweets to detect rumours, its performance is likely to be poor, as the reply tweets will provide helpful information whether the source tweet is spreading a rumour, as we saw in the example figure earlier.

```
{
  "created_at": "Wed Jan 07 12:01:03 +0000 2015",
  "id_str": "552797058990870528",
  "in_reply_to_user_id_str": null,
  "text": "Spread this cover in solidarity with the victims at Charlie Hebdo. Don't let the
    sword conquer the pen. http:\/\/t.co\/XVkPPbkLhn",
  "user": {
    "id": 11345012,
    "id_str": "11345012",
    "name": "Ivo Vegter",
    ...
  },
  ...
}
```


For more information about the fields in the object, please consult the Twitter API documentation.

The label files (`[train,dev].label.txt`) are formatted in a similar way, where each line denotes the label (*rumour* or *nonrumour*) of an event that **shares the same line number**. For example, the label of the event in the first line of `train.data.txt` is in the first line of `train.label.txt`.

Training, Development and Test

For the first task (rumour detection), there are 3 data partitions: training, development and test. Each of this partitions has a different purpose. The training set (`train.data.txt` and `train.label.txt`) should be used for building your models, e.g. for use in development of features, rules and heuristics, and for supervised/unsupervised learning. You are encouraged to inspect this data closely to fully understand the task.

The development set (`dev.data.txt` and `dev.label.txt`) is formatted like the training set. This will help you make major implementation decisions (e.g. choosing optimal hyper-parameter configurations), and should also be used for detailed analysis of your system — both for measuring performance and for error analysis — in the report.

You will use the test set (`test.data.txt`) to participate in the Codalab competition. For this reason no labels are provided for this partition. You should not **at any time** manually inspect the test dataset; any sign that you have done so will result in loss of marks. For the first task, you should not use any other data (e.g. by searching for more tweets with rumour labels) beyond what we have supplied.

For the second task (rumour analysis), there is only 1 file: `covid.data.txt`. You will use your trained rumour detection system from the first task to classify these COVID-19 tweets and do some analyses to understand the nature of COVID-19 rumours. As mentioned earlier, the provided data is a preliminary dataset to get you started for the second task; you're free to search for more COVID-19 tweets should you choose to.

Evaluation Script

For the first task, we provide a script (`eval.py`) for evaluating your rumour detection results. This script takes two input files: the ground truth and your predictions, and computes precision, recall and F1 score on the rumour class. Shown below is the output from running against random predictions on the development set:

```
$ python eval.py --predictions dev.baseline.txt --groundtruth dev.label.txt
Performance on the rumour class:
Precision = 0.21337579617834396
Recall    = 0.48201438848920863
F1        = 0.2958057395143488
```

Your rumour detection system will hopefully be a good deal higher! We will be focussing on F1 scores on the

rumour class, and the precision and recall performance are there for your information, and may prove useful in developing your system.

The example prediction file, `dev-baseline.txt`, is the output of a baseline system where the labels are randomly populated. This file will help you understand the required file format for creating your development output (for tuning your system using `eval.py`) and your test output (for submission to the Codalab competition).

Grading

Your submissions will be graded as follows:

Component	Criteria	Description	Marks
Writing	Clarity	Is the report well-written and well-structured?	5
	Tables/Figures	Are tables and figures interpretable and used effectively?	3
Content	Soundness	Are the experiments sound? Are methods justified and used correctly?	7
	Substance	How much work is done? Is there enough substance?	5
	Novelty	How novel or ambitious are the techniques or methods?	5
	Results	Are the results and findings convincing? Are they well articulated?	5
Performance	Rumour class F1	Graded based on Codalab leaderboard ranking	5

A report should be submitted with the description, analysis, and comparative assessment of methods used. You should describe your methods in enough detail that we could replicate them without looking at your code. For the first task, you should mention any choices you made in implementing your system along with empirical justification for those choices using the development set. You should also detail both your development performance and the "Final Evaluation" performance on the Codalab leaderboard (details in the section below). For the second task, you should articulate the intention of your analyses (i.e. the questions they are addressing), and explain your findings. For both tasks, you should use tables and the appropriate charts to report your results/findings.

The description of your method should be clear and concise. You should write it at a level that a Masters student could read and understand without difficulty. If you use any existing algorithms, you do not have to rewrite the complete description, but must provide a summary that shows your understanding and you should provide a citation to reference(s) in the relevant literature. In the report, we will be very interested in seeing evidence of your thought processes and reasoning for choosing one approach over another (as indicated by the heavier weighting of the "soundness" criteria).

The report should also have a section that clearly outlines the contribution of each team member. Be as concrete as possible when describing your contribution so as to help us judge if a member under-performed. In situations where we see a team member not contributing much, penalties will be applied.[2]

The report should be submitted as a PDF, and be no more than: (1) four A4 pages of content for teams of 2; or (2) five pages for teams of 3. This page limit excludes references and the team contribution section (as outlined above). In terms of expectation, we expect more content (in terms of experiments and analyses) from 3-person teams in the report (hence the additional page limit). You should use the ACL template when writing your report. We prefer you to use LaTeX, but you are permitted to use Word. **You must include the student numbers of all members in your team under the title** (using the `\author` field in LaTeXand enabling the `\aclfinalcopy` option), **but not your names** so as to facilitate anonymous peer reviewing. We will not accept reports that are longer than the stated limits above, or otherwise violate the style requirements.

For the performance component, you will be graded based on the relative ranking of your system, computed as: $\frac{N-r+1}{N} \times 5$, where N is the total number of systems/teams on the leaderboard and r is your system rank. E.g. if $N = 100$ and you're the top-ranked system (#1), you will score 5.0; but if you're ranked #50, you will score 2.55.

[2] In the extreme case where a team member did not do anything, they will receive no marks.

Codalab

You will need to join the competition on Codalab to submit your rumour detection system for the first task. The Codalab competition link will be announced on Canvas at a later date.

You should elect one member in your team to participate in the competition (i.e. we do not want everyone in the team to sign up for the competition). The elected member will be responsible for uploading your team's system results and they should sign up for a Codalab account **using their student.unimelb.edu.au address** and request to join the competition via the "Participate" tab. Only students enrolled in the subject will be permitted to join, and the request may take a few hours for us to process so please do not leave this to the last minute.

Once the request is approved, please edit your account details by clicking on your login in the top right corner and selecting "Settings". **Set your team name using the student numbers of all members** (e.g. 229501,483759). **Submissions which have no team name will not be marked.**

You can use this system to submit your test output, by selecting the "Participate" tab and then clicking the "Ongoing evaluation" button, and then "Submit". This will allow you to select a file, which is uploaded to the Codalab server, which will evaluate your results and add an entry to the leaderboard. Your file should be a **zip archive** containing a single file named `test.predictions.txt`, which has a label prediction for all source tweets in `test.data.txt`. The format of the output file should follow the format of the provided baseline system in the "Evaluation Script" section above (i.e. `dev.baseline.txt`). **The system will produce an error message if the filename is different, as it cannot process your file**.

The results are shown on the leaderboard under the "Results" tab, under "Ongoing Evaluation". To start you off, I have submitted a system that gives random predictions, to give you a baseline. The competition ends at 1pm on 13th May, after which submissions will no longer be accepted (extensions can not be granted to this deadline). At this point the "Final Evaluation" results will be revealed. These two sets of results reflect evaluation on different subsets of the test data. The best score on the ongoing evaluation may not be the best on the final evaluation, and we will be using the final evaluation scores in assessment. **The final result of your best submission(s) can now be discussed in the report**, which is due at 9pm on the same day (13th May).

Note that Codalab allows only 3 submissions per user per day, so please only upload your results when you have made a meaningful change to your system. Note that the system is a little slow to respond at times, so you will need to give it a minute or so to process your file and update the result table.