

QSS20: Modern Statistical Computing

Unit 09: APIs

Outline

- ▶ **API: terminology and basics**
- ▶ Example 1: API with no credentials and no wrapper (NAEP data API)
- ▶ Example 2: API with credentials and no wrapper (Yelp API)
- ▶ Example 3: API with credentials and wrapper (wrapper for Twitter API)

Terminology

- ▶ **API:** application programming interface; way to ask an app or website for something and get something in return
- ▶ **Call the API:** sending a request for something to the API
- ▶ **Response:** can think of this as a message back telling us *whether* we got something back or whether the call returned an error
- ▶ **JSON:** if we get something back, oftentimes it'll be stored in `json` format, which is basically a text string with a particular structure that is similar to the *data structure* of a dictionary; can pretty easily convert to a `pandas` dataframe
- ▶ **Wrapper:** a language-specific module or package that helps simplify the process of calling an API with code written in a particular language (e.g., later we'll review `tweepy`, a Python wrapper for the Twitter API; there are also R wrappers for the Twitter API)

Main use in our context: data acquisition

Three general routes to acquiring data:

Exists already:

csv or excel data we've been working with for problem sets

API:

Use to create data or flat files for use; most relevant for "high-velocity" data that changes frequently (e.g., tweets; job postings) and also for using code rather than point/click to get data

Scraping:

APIs are a sort of "front door" to a website, where the developers provide an easy way to get content but also set limits (e.g., what content you can get; how much content you can pull in a given period); scraping is a back door for when there's no API or when we need content beyond the structured fields the API returns

Why go through the effort to use data that doesn't exist already?

I got the data for my thesis from web scraping, **which I mostly learned from Google**. I highly recommend learning how to scrape website information. It is often a guarantee that you are working with original data, which means you are uncovering an original thesis topic (Source: https://qss.dartmouth.edu/sites/program_quantitative_social_science/files/zach-schnell-thesis-advice.pdf)

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High-level overview of steps: APIs that don't need credentials

1. Construct a query that tells the API what we want to pull
2. Use `requests.get(querystring)` to call the API
3. Examine the response: message from the API telling us whether it returned something
4. If the response returned something, extract the content of the response and make it usable

Step 1: construct a query

- ▶ Generic example:
“<https://baseurl.com/one thing=something&another thing=something else>”
- ▶ Specific NAEP example (use the (syntax to split across lines)

```
1 example_naep_query = (  
2 'https://www.nationsreportcard.gov/'  
3 'Dataservice/GetAdhocData.aspx?'  
4 'type=data&subject=writing&grade=8&  
5 'subscale=WRIRP&variable=GENDER&',  
6 'jurisdiction=NP&stattype=MN:MN&',  
7 'Year=2011')
```

- ▶ Breaking things down:
 - ▶ nationsreportcard: this is the “base url” we’re using for the API call and what we add parameters to
 - ▶ subject: type of parameter
 - ▶ subject=writing: specific value for that parameter (error if we feed it a subject that doesn’t exist)
 - ▶ And so on...

Steps 2-4: call the API, examine the response, and if response indicates something usable, extract content

```
1 ## use requests.get to call the API
2 naep_resp = requests.get(example_naep_query)
3
4 ## we got usable response, so get json of status and
   result
5 naep_resp_j = naep_resp.json()
6
7 ## extract contents in `result` key
8 ## and convert to dataframe
9 naep_resp_d = pd.DataFrame(naep_resp_j['result'])
```

What do I mean by “no wrapper”?

- ▶ We write a query to request something from the API
- ▶ While the request syntax differs across languages, the query is the same— eg could use same query and run below R code to get content

```
1 ## packages
2 library(httr)
3 library(jsonlite)
4
5 ## ping API
6 return_q = GET(example_naep_query)
7
8 ## get data from that ping
9 data = fromJSON(rawToChar(return_q$content))$result
```

Activity 1: practice pulling data using the NAEP API

Notebook: https://github.com/rebeccajohnson88/qss20_slides_activities/blob/main/activities/w22_activities/07_apispart1_examplecode_blank.ipynb

- ▶ Example of executing a query that doesn't have errors
- ▶ Example of executing a query that returns nothing
- ▶ Working together to write a function to do multiple calls to the API

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What changes about the general steps?

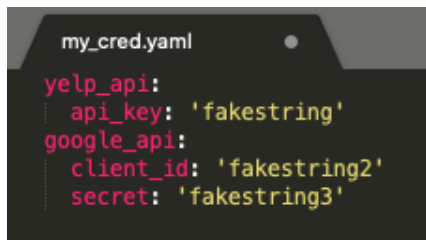
1. Acquire credentials for the API: these may be an API key (single string) or a client ID and secret (strings; can store in a `yaml` creds file that I'll outline)
2. Construct a query that tells the API what we want to pull
3. Two paths:
 - 3.1 **Use credentials to authenticate and then call the API:** we'll later see example of this with Twitter API/wrapper
 - 3.2 **Feed API your credentials when you call the API:** we'll see example of this with Yelp
4. Examine the response: message from the API telling us whether it returned something
5. If the response returned something, extract the content of the response and make it usable

Step 1: acquire credentials

- ▶ Varies across APIs, but general involves going to the “developer’s portal,” creating an account, and obtaining credentials
- ▶ Examples:
 - ▶ Google developer’s console (things like google geocoding API; maps API): <https://console.cloud.google.com>
 - ▶ Facebook: <https://developers.facebook.com/docs/development>
 - ▶ Twitter (via Tweepy wrapper):
https://docs.tweepy.org/en/latest/auth_tutorial.html
 - ▶ Yelp: <https://www.yelp.com/developers/documentation/v3/authentication>
- ▶ Note weird-ish terminology for social science applications since you often set up “an application” in order to get credentials (but we’re often doing a one-way pull of data and not developing an app. that repeatedly calls it)

Step 1: store those credentials somewhere

- ▶ Your key or client ID/secret are meant to be unique to you like a password, so you shouldn't generally print in code
- ▶ Can use any text editor to make a yaml file (structured similar to a dictionary); screenshot below from Sublime text with fake credentials



```
my_cred.yaml
yelp_api:
  api_key: 'fakestring'
google_api:
  client_id: 'fakestring2'
  secret: 'fakestring3'
```

Step 1: load the file with credentials

```
1 ## imports
2 import yaml
3
4 ## load creds
5 with open("../.. / private_data / my_cred .yaml", 'r') as
    stream:
6     try:
7         creds = yaml.safe_load(stream)
8     except yaml.YAMLError as exc:
9         print(exc)
10
11 ## can then get the relevant key
12 creds['yelp_api']['api_key']
```


Step 2: construct a query

Same exact process as before; here focusing on **Yelp Fusion API**; API has different endpoints shown in the screenshot; we'll initially focus on Business Search, since that returns a Yelp-specific ID (https://www.yelp.com/developers/documentation/v3/get_started)

Name	Path	Description
Business Search	/businesses/search	Search for businesses by keyword, category, location, price level, etc.
Phone Search	/businesses/search/phone	Search for businesses by phone number.
Transaction Search	/transactions/{transaction_type}/search	Search for businesses which support food delivery transactions.
Business Details	/businesses/{id}	Get rich business data, such as name, address, phone number, photos, Yelp rating, price levels and hours of operation.
Business Match	/businesses/matches	Find the Yelp business that matches an exact input location. Use this to match business data from other sources with Yelp businesses.
Reviews	/businesses/{id}/reviews	Get up to three review excerpts for a business.
Autocomplete	/autocomplete	Provide autocomplete suggestions for businesses, search keywords and categories.

Step 2: construct a query

```
1 ## defining inputs
2 base_url = "https://api.yelp.com/v3/businesses/search?"
3 my_name = "restaurants"
4 my_location = "Hanover,NH,03755"
5
6 ## combining them into a query
7 yelp_genquery = (
8     '{base_url}'
9     'term={name}'
10    '&location={loc}').format(
11        base_url = base_url,
12        name = my_name,
13        loc = my_location)
```

Step 3: authenticate and call the API

For Yelp, we feed a dictionary with our key directly into the get call via the optional `header` parameter; for other APIs, we sometimes authenticate in a separate step

```
1 ## construct my http header dict
2 header = {'Authorization': f'Bearer {API_KEY}'}
3
4 ## call the API
5 yelp_genresp = requests.get(yelp_genquery, headers =
    header)
```

Step 3: output of successful and unsuccessful call

- Successful call:

`<Response [200]>`

- Unsuccessful call (put Hanover,WY,09999 as the location, which doesn't exist)

`<Response [400]>`

```
{'error': {'code': 'LOCATION_NOT_FOUND',  
  'description': 'Could not execute search, try specifying a more exact location.'}}
```

Step 4: if output successful, make results usable

See that 'businesses' key of json file has a dictionary for each business, but some nesting to deal with variable lengths (e.g., within 'location', 'address1', 'address2', etc.) that might produce odd things when we concat. to a df:

```
{'id': '8ybF6YyRldtZmU9jil4xlg',  
  'alias': 'mollys-restaurant-and-bar-hanover',  
  'name': "Molly's Restaurant & Bar",  
  'image_url': 'https://s3-media2.fl.yelpcdn.com/bphoto/1YkJFic4Czt9b2FsZyOrwQ/o.jpg',  
  'is_closed': False,  
  'url': 'https://www.yelp.com/biz/mollys-restaurant-and-bar-hanover?adjust_creative=Agny=yelp_api_v3&utm_medium=api_v3_business_search&utm_source=ABQTB3e9fTiSiyqs0c-3Bg',  
  'review_count': 403,  
  'categories': [{ 'alias': 'tradamerican', 'title': 'American (Traditional)' },  
                 { 'alias': 'burgers', 'title': 'Burgers' },  
                 { 'alias': 'pizza', 'title': 'Pizza' }],  
  'rating': 4.0,  
  'coordinates': { 'latitude': 43.701144, 'longitude': -72.2894249 },  
  'transactions': [ 'delivery' ],  
  'price': '$$',  
  'location': { 'address1': '43 South Main St',  
                'address2': '',  
                'address3': '',  
                'city': 'Hanover',  
                'zip_code': '03755',  
                'country': 'US',  
                'state': 'NH',  
                'display_address': [ '43 South Main St', 'Hanover, NH 03755' ] },  
  'phone': '+16036432570',  
  'display_phone': '(603) 643-2570',  
  'distance': 250.8301601841674 }
```

Approach 1 to step 4: more automatic pd.concat that leaves those as lists

```
1 yelp_gendf = pd.DataFrame(yelp_genjson[ 'businesses '])
```

Approach 2 to step 4: only retaining columns that are already strings

```
1 def clean_yelp_json(one_biz):
2
3     ## restrict to str cols
4     d_str = {key:value for key, value in one_biz.items()
5               if type(value) == str}
6
7     df_str = pd.DataFrame(d_str, index = [d_str['id']])
8     return(df_str)
9
10 yelp_stronly = [clean_yelp_json(one_b)
11                 for one_b in yelp_genjson['businesses']]
12 yelp_stronly_df = pd.concat(yelp_stronly)
```

Activity 2: practice with the Yelp API

Same url: https://github.com/rebeccajohnson88/qss20_slides_activities/blob/main/activities/w22_activities/07_apispart1_examplecode_blank.ipynb

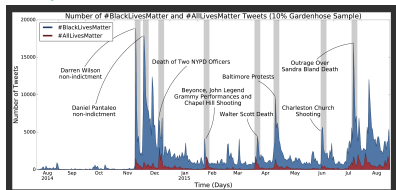
- ▶ Try running a business search query for your hometown or another place by constructing a query similar to 'yelp_genquery' but changing the location parameter
- ▶ Other endpoints require feeding what's called the business' fusion id into the API. Take an id from 'yelp_stronly.id' and use the documentation here to pull the reviews for that business:
https://www.yelp.com/developers/documentation/v3/business_reviews
- ▶ **Challenge:** generalize the previous step by writing a function that (1) takes a list of ids as an input, (2) calls the reviews API for each id, (3) returns the results, and (4) rowbinds all results

Outline

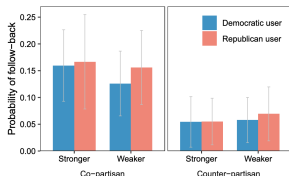
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Academic research using Twitter data

- Gallagher et al. 2018. “Divergent discourse between protests and counter-protests: BlackLivesMatter and AllLivesMatter”



- Mosleh et al. 2021. “Shared partisanship dramatically increases social tie formation in a Twitter field experiment”



- And many more!

Two routes

1. **API as the “front door” route:** controlled access to Twitter content; see discussion of access tiers here:
<https://developer.twitter.com/en/docs/twitter-api/getting-started/about-twitter-api#v2-access-level>; we're using the most basic tier (essential); if want to do more, apply for extended or academic tier
2. **Scraping as the “back door” route:** messier and need to deal with pagination, site blocking API calls from your IP address, etc.

Tweepy: wrapper for Twitter API

- ▶ In previous examples with NAEP and Yelp we:
 1. Set up credentials (where relevant)
 2. Constructed a query based on the API documentation
 3. Used `requests.get(query)` to call the API
 4. Got a response
 5. Extracted the content of the response and turned it into usable data
- ▶ Wrappers can simplify those steps by simplifying the process of **calling the API**
- ▶ Instead of a long string with a complex query, can feed methods within the wrappers arguments that specify what we want to pull
- ▶ **Downside:** need to understand how to structure functions within that wrapper (but can be easier than constructing queries yourself)
- ▶ Documentation for **tweepy** (one python-based wrapper):
<https://docs.tweepy.org/en/latest/index.html>

High-level overview of steps

1. Acquire credentials for the API: see Canvas message; for our purposes, we'll just be using the `bearer_token`

2. Use those credentials to establish a connection to the Twitter API:

```
client = tweepy.Client(bearer_token=
                       creds['twitter_api']['bearer_token'])
```

3. Read the documentation here to learn about different methods for pulling information about tweets, engagement, and users:

[https:](https://dev.to/twitterdev/a-comprehensive-guide-for-using-the-twitter-api-v2-using-tweepy-in-python-15d9)

[//dev.to/twitterdev/a-comprehensive-guide-for-using-the-twitter-api-v2-using-tweepy-in-python-15d9](https://dev.to/twitterdev/a-comprehensive-guide-for-using-the-twitter-api-v2-using-tweepy-in-python-15d9)

4. Use a method to call the API and return a response- generic setup:

```
tweet_resp = client.some_method(some_args...)
```

5. Previous step just returns a tweepy client response (message back); similar to other examples, need to extract **content** of response; instead of via `.json()`, use `.data` attribute, which returns a list:

```
tweet_data = tweet_resp.data
```

6. Extract relevant information from that list (e.g., tweet content; tweet's unique id; creation date), and transform into a dataframe

Examples of three things we can do (even on the most limited “essential” tier)

1. **Pull tweets associated with a hashtag and attributes of people tweeting**
2. Examine connections between different accounts via follower/following relationships
3. Pull tweets from a specific user and examine others' engagement with those tweets

Follow along:

https://github.com/rebeccajohnson88/qss20_slides_activities/blob/main/activities/w22_activities/solutions/08_apis_twitter_essentialendpoint_examplecode.ipynb

Step 1: call the API and pull recent tweets

```

1 ## construct a query (see notebook for guide)
2 query = "#metoo -is:retweet is:verified"
3 ## use the search_recent_tweets method
4 tweets_mt = client.search_recent_tweets(query = query,
5                                         max_results = 100,
6                                         tweet_fields = ['created_at', 'author_id', 'geo',
7                                                         'lang', 'public_metrics'],
8                                         user_fields = ['description', 'location',
9                                                         'verified', 'public_metrics'],
10                                         expansions = 'author_id',
11                                         end_time = "2022-02-15T01:00:00-00:00")

```

Breaking things down:

- ▶ query: what we'd type into the twitter search bar if using site
- ▶ search_recent_tweets(): method in tweepy client class to pull tweets from the last 7 days
- ▶ tweet_fields: argument that takes a list of metadata we want to pull about the tweet (full list here: <https://developer.twitter.com/en/docs/twitter-api/data-dictionary/object-model/tweet>)
- ▶ user_fields: argument that takes a list of metadata we want to pull about user tweeting (full list here: <https://developer.twitter.com/en/docs/twitter-api/data-dictionary/object-model/user>)
- ▶ expansions: helps us connect tweet authors to that user metadata

Step 2: extract info. about tweets (printing info)

First example: print the first 5 results

```

1 tweet_res = [print("""On {}, {} tweeted {} in {} language,
2               which was liked by {}""".format(tweet.created_at,
3               tweet.author_id, tweet.text, tweet.lang,
4               tweet.public_metrics['like_count']))
5               for tweet in tweets_mt.data[0:5]]

```

- ▶ `for tweet in tweets_mt.data:`
 - ▶ `tweets_mt` is the response from the previous step
 - ▶ `.data` gets a list containing its content
 - ▶ We then iterate over list items, where each item is a single tweet that matches the query (tweets about metoo from verified users)
- ▶ `tweet.author_id`, `tweet.text`, and so on: attributes of each tweet; single values
- ▶ `tweet.public_metrics`: rather than a single value, an attribute that's a dictionary of different tweet metrics, where the key is the type of metric (e.g., likes; retweets) and value is count for focal tweet

Previous example just printed things; what if we want to store them in a dataframe?

Step 2: extract info. about tweets (storing info)

```
1 ##### define the attributes (need to be pulled
2 ##### in the tweet_fields arg of search_recent_tweets call above)
3 tweet_attr = ['id',
4               'created_at', 'author_id',
5               'text', 'lang', 'geo', 'public_metrics']
6
7 ##### function to iterate over attributes
8 def pull_attr(one_tweet, which_attr):
9     all_attr = [one_tweet[attr] if attr != 'public_metrics'
10                 else one_tweet[attr]['like_count']
11                 for attr in which_attr]
12     return(all_attr)
13
14 ##### iterate over tweets and pull tweet info
15 tweets_info_list = [pull_attr(one_tweet, tweet_attr)
16                     for one_tweet in tweets_mt.data]
17
18 ##### transform into a dataframe
19 tweets_info_df = pd.DataFrame(tweets_info_list,
20                               columns = tweet_attr)
```

Output of previous step (with most likes)

created_at	author_id	text	lang	geo	public_metrics
2022-02-13 4:28:24+00:00	2835451658	South Korea: The wife of a top presidential candidate has caused controversy after saying she'd jail journalists & suggested #MeToo women are doing it for the money. Despite the comments in a fiery interview, her husband's polling has actually increased. https://t.co/Ex6hRD1peL	en	None	900
2022-02-13 3:10:45+00:00	453704729	I'm sending love to @sistadbarnes today and wondering: \n\nWhy are we still platforming unrepentant abusers? Does #MeToo matter? \n\nAnd if #BlackLivesMatter why did artists in the #SuperBowl HalfTimeShow take a knee with @Kaepernick7 only to rock the mic for an unrepentant NFL? https://t.co/oNvF5iJSk6	en	None	256

See that it's missing key info on the users who are tweeting these statements!

Step three: extract info. about users who tweeted those tweets

```

1 ##### list with user ids for relevant tweets
2 users = {user["id"]: user for user in tweets_mt.includes['users']}
3
4 ##### define the user attributes
5 user_attr = ['username', 'description',
6              'location', 'verified', 'public_metrics']
7
8 ##### function to iterate over user attributes
9 def pull_user_attr(one_tweet, which_attr):
10     one_user = users[one_tweet.author_id]
11     all_attr = [one_tweet.author_id] + [one_user[attr]
12     if attr != "public_metrics"
13         else one_user[attr]['followers_count']
14         for attr in which_attr]
15     return(all_attr)
16
17 ##### iterate over tweets and execute to pull user info
18 users_info_list = [pull_user_attr(one_tweet, user_attr)
19                     for one_tweet in tweets_mt.data]
20 user_info_df = pd.DataFrame(users_info_list,
21                             columns = ['author_id'] + user_attr)

```

Can then merge on author_id to get annotated tweets and users

text	public_metrics_tweet	username	description	public
South Korea: The wife of a top presidential candidate has caused controversy after saying she'd jail journalists & suggested #MeToo women are doing it for the money. Despite the comments in a fiery interview, her husband's polling has actually increased. https://t.co/Ex6hRD1peL	900	MrAndyNgo	Independent journalist & author of NYT bestseller, 'Unmasked.' Editor-at-large: @TPostMillennial. Contact, support, follow: https://t.co/6ZvZk6Gwgx	
I'm sending love to @sistadbarnes today and wondering: \n\nWhy are we still platforming unrepentant abusers? Does #MeToo matter? \n\nAnd if #BlackLivesMatter why did artists in the #SuperBowl HalfTimeShow take a knee with @Kaepernick7 only to rock the mic for an unrepentant NFL? https://t.co/oNvF5i.lSk6	256	deardrewdixon	Silence Breaker. Producer. Writer. Mom. She/Her/Hers. As seen in @OnTheRecordDoc Press Requests: ryanmaziepr@gmail.com	

Examples of three things we can do

1. Pull tweets associated with a hashtag and attributes of people tweeting
2. **Examine connections between different accounts via follower/following relationships**
3. Pull tweets from a specific user and examine others' engagement with those tweets

Network structure of twitter

- ▶ For each focal “user”—e.g., Oprah; Dartmouth College—there are followers of that user
- ▶ Similarly, each follower of a user has followers
- ▶ We’re going to explore connections to a focal account and their 2nd-degree connections (though building a network would require access beyond essential endpoint; since we’re limited to most recent 100 followers)

Step one: get id for a username and pull their followers

```

1 ##### pull numeric id for a user name
2 focal_acc_id = client.get_user(username =
3     "MrAndyNgo").data['id']
4
5 ##### use the get_users_followers method
6 ##### to pull followers (pulling same user
7 ##### metadata as on previous slide)
8 follow_focal = client.get_users_followers(id =
9     focal_acc_id ,
10     user_fields = user_attr)

```

Breaking this down:

- ▶ `get_user()`: method to pull metadata about one username; we're then extracting the contents (`.data`) and pulling the `id`
- ▶ `get_users_followers()`: feed this method the numeric `id` and user fields we want to pull (using list from previous step with description, verified status, etc.); similar to other step, it returns an API response we need to extract contents of

Step two: extract content of response and put in a dataframe

```

1 user_data = pd.DataFrame(
2     {'uname': [user['username']]
3     for user in follow_focal.data],
4     'description': [user['description']]
5     for user in follow_focal.data],
6     'user_id': [user['id']]
7     for user in follow_focal.data],
8     'followers': [user['public_metrics']['followers_count']]
9     for user in follow_focal.data})

```

Breaking this down:

- ▶ Iterate over the content of the response (`follow_focal.data`) and pull different fields
- ▶ See `pull_attr` on earlier slide for a less manual way that iterates over metadata fields
- ▶ Can then repeat to get followers of follower (see notebook)

Examples of three things we can do

1. Pull tweets associated with a hashtag and attributes of people tweeting
2. Examine connections between different accounts via follower/following relationships
3. **Pull tweets from a specific user and examine others' engagement with those tweets**

Pull tweets from a specific user

```

1 ## step 1: choose a focal account and get their numeric id
2 focal_account = "SenatorHassan"
3 get_id = client.get_user(username= focal_account , user_fields =
4                             user_attr)
5 hassan_id = get_id.data['id']
6 ## step 2: use the get_users_tweets method to
7 ## pull recent tweets — here, i'm pulling most recent 100
8 hassan_tweets_resp = client.get_users_tweets(id = hassan_id ,
9                                               max_results = 100, tweet_fields = tweet_attr)
10 ## step 3: that returns a response with data as an attribute
11 ## to turn into a dataframe, use function above
12 hassan_tweets_list = [pull_attr(one_tweet , tweet_attr)
13                       for one_tweet in hassan_tweets_resp.data]
14 ## step 4: transform into a dataframe
15 senator_tweets_df = pd.DataFrame(hassan_tweets_list ,
16                                  columns = tweet_attr)

```

- ▶ Same process for numeric id as previous section (get_user)
- ▶ Use get_user_tweets to get tweets from that user and pull_attr function defined previous to pull attributes

Activity 3: practice with the Twitter API

Notebook: https://github.com/rebeccajohnson88/qss20_slides_activities/blob/main/activities/w22_activities/08_apis_twitter_activity_blank.ipynb

1. Choose a public user (e.g., a politician; celebrity) and pull 100 tweets from their timeline and metadata about those tweets. When pulling metadata, make sure to get the `conversation_id` and count of replies (latter is in `public_metrics`)
2. Choose one of their tweets to focus on that got a lot of replies and get the `conversation_id` of that tweet
3. Paste the conversation id of that tweet into a query using this documentation for query building: <https://developer.twitter.com/en/docs/twitter-api/tweets/search/integrate/build-a-query#examples>
4. Similar to example 1.1 in the example code, use the `search_recent_tweets()` method to pull tweets that are in response to the focal tweet from step 2
5. Place the replies in a dataframe and do some text analysis of the results (eg sentiment; tokenizing and top words)