API Calls

1405 Instructor: Ruiqing (Sam) Cao

Required Python Libraries for Today

Main libraries: json, requests, csv, Beautiful Soup (bs4), pyjsonviewer

```
import requests
from bs4 import BeautifulSoup
import pyjsonviewer
import json
import csv
```

Recurring libraries (we'll see a lot more of later): numpy, pandas, matplotlib

```
import numpy as np
import pandas as pd
from matplotlib import pyplot as plt
```

If a `module` is not yet installed, you can type `%pip install module` inline in your Jupyter Notebook to install it

Application Programming Interface (API)

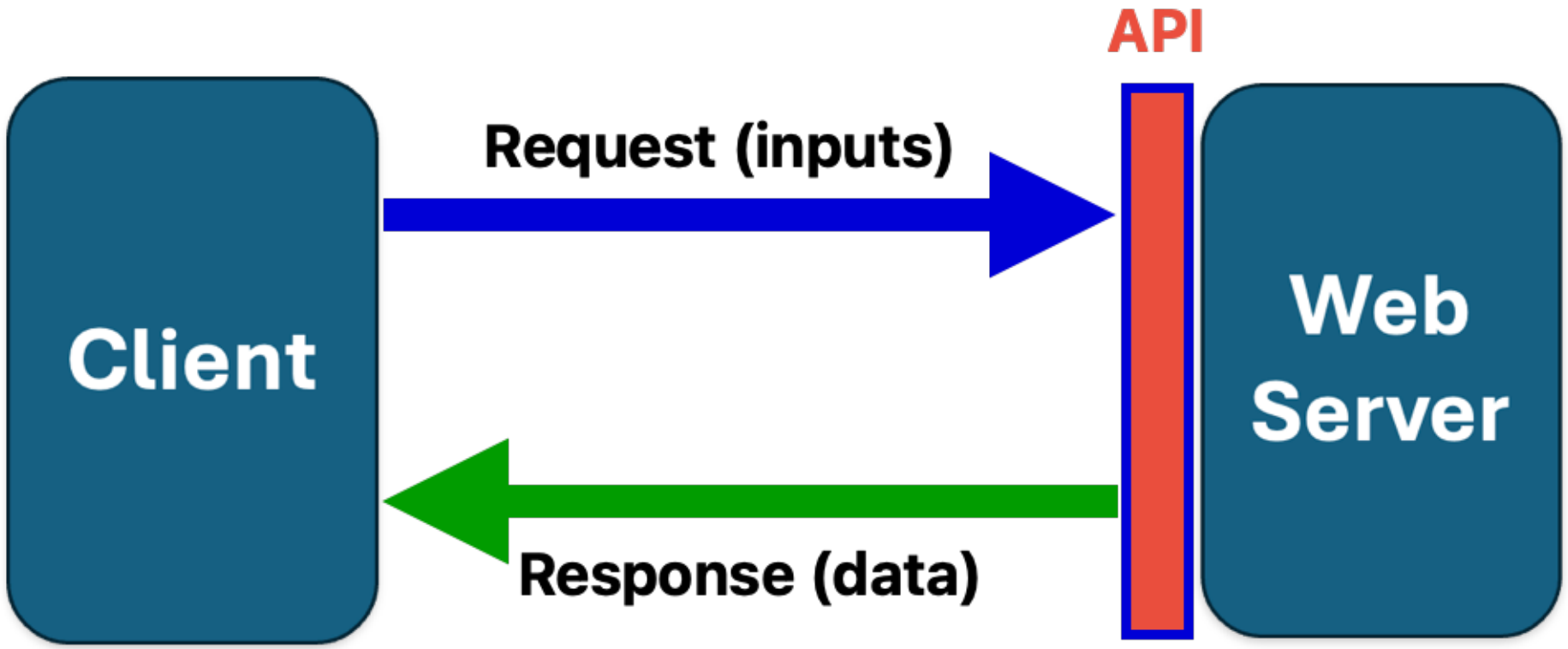
- Application Programming Interface (API): an ***interface*** that is used to connect two pieces of software programs

Application Programming Interface (API)

- Application Programming Interface (API): an ***interface*** that is used to connect two pieces of software programs

- An API is designed to *open up a software system*, allowing outside agents to interact with it, by *exchanging data according to a set of defined rules* (written in the API)

API calls



API requests: GET() and POST()

- APIs are like glues between two different software applications (e.g., you the **client** and an Internet-based **service**), so that they can communicate and exchange data

- The client sends an API call (*request*) to the web service through the Internet, and receives a *response* from the web service

- The client can also *send* data to the web service, and not only *receive* data from the web service

- Let's learn more about this using exercises from a real API…

APIs

- Query string: URL ? (start of the query) parameter=value&param2=value2

- REST API calls typically return JSON objects. This simpler than HTML/XML files to work with. Both are semi-structured data.

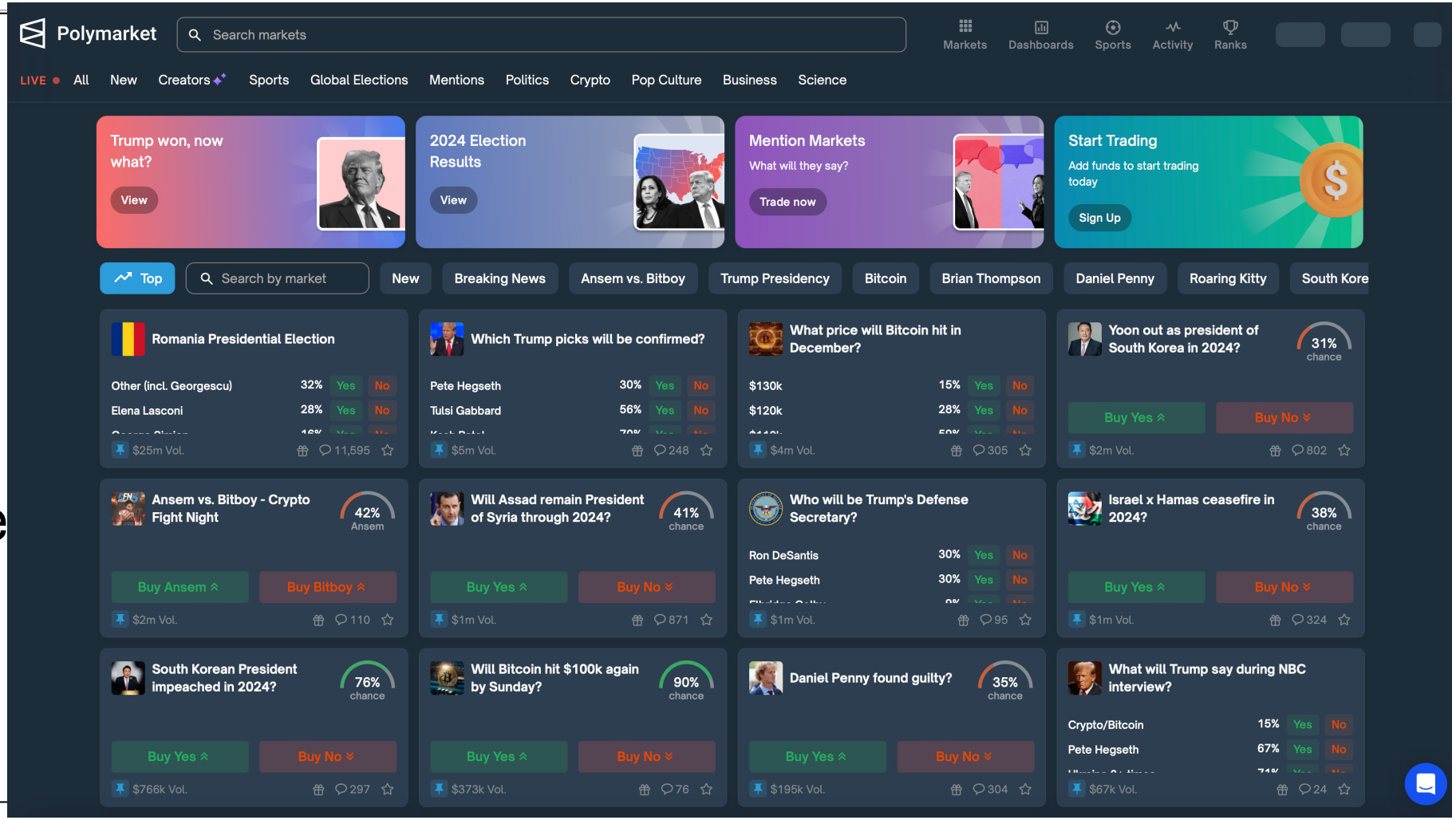
Polymarket: World's largest prediction market

2020

- Launched

2024

- Raised US$70 million in two funding rounds
- ~200,000 active traders, over $500 million trading volume



Prediction Markets

- Prediction market: a speculative market designed so ***prices can be interpreted as probabilities*** of a future event and used to make predictions

- Traders with superior information about a certain future event can profit from their knowledge by betting correctly on the outcome (binary) of that event

How Polymarket Works

- Traders can buy and sell shares representing a future event's outcome (e.g., "Who will win the 2024-25 UEFA Champions League?")

- The price $p is always a number between 0 and 1, and you can buy "YES" for $p or "NO" for $(1-p) per share

- Shares representing the correct final outcome are paid out $1 USD each share after the event's outcome is realized

How Polymarket Works

- Markets are created out of all kinds of events: most popular in sports and politics, but also in pop culture and business (e.g., “Will OpenAI become for-profit before April 2025?”)

- Market internalizes the superior knowledge or information that some traders may have about an event that others don’t have, which in aggregate are reflected in the ***prices***

- Prediction markets provides an alternative to polls and expert opinions for predicting outcomes of major events, by aggregating information into a single price that represents the market's view

Polymarket API

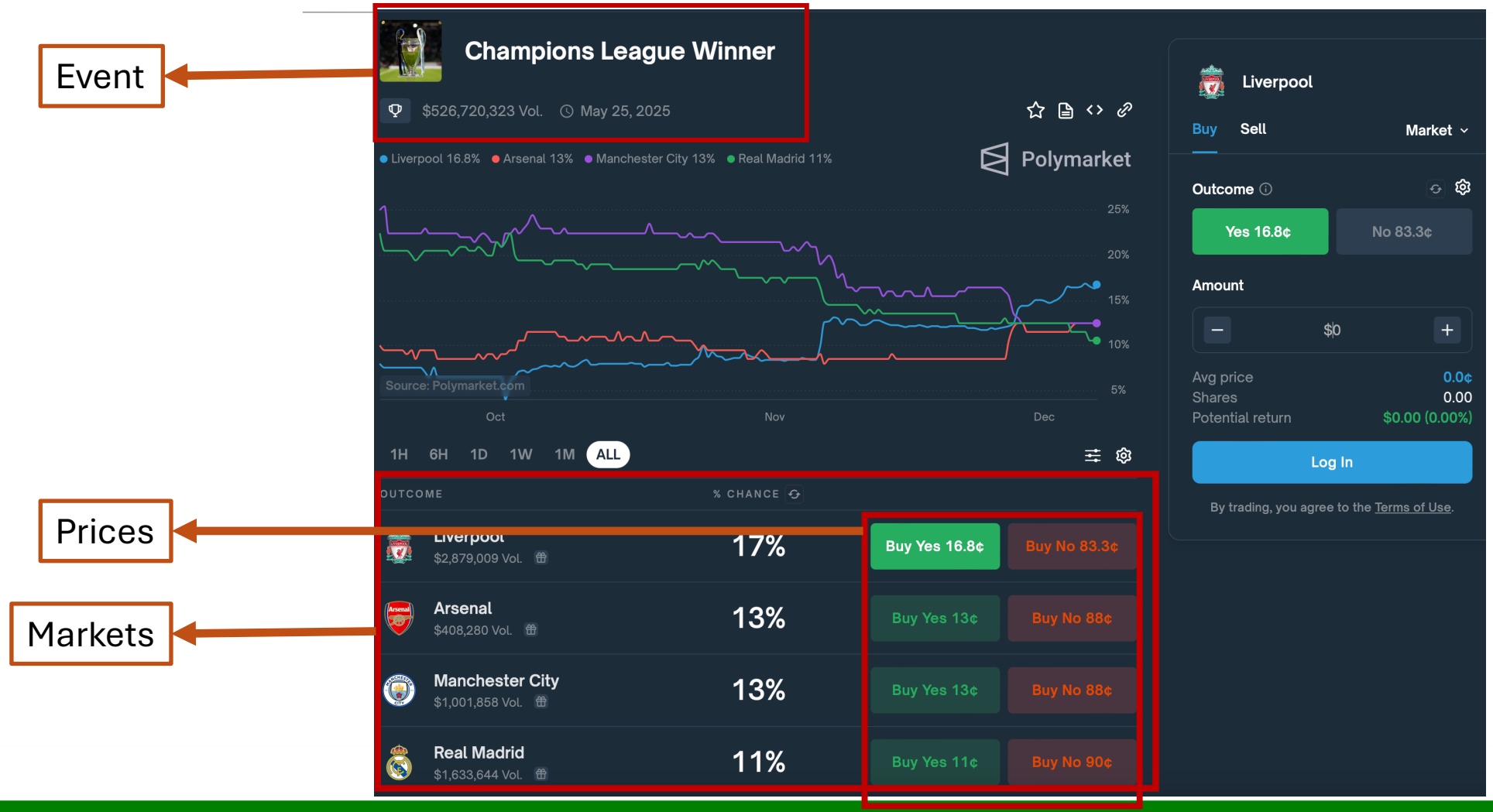
- Polymarket offers an API that allows public access to its events, markets, and historical prices. We will use its API as an example to show how to collect data by calling an API

Check the **API documentation** first: Human-readable instructions

- Available endpoints, methods, authentication protocols, parameters, etc.
- Sometimes examples of common requests and responses

- Extremely useful for getting started with a new API and for building the correct queries to retrieve the needed data

Who will win the UEFA Champions League?



Who will win the UEFA Champions League?

There are multiple possible outcomes of ***event*** "winner of 2024-25 UEFA Champions League", each associated with a distinct ***market***

There are *36 markets* under the title event, for example, one of them is "Will ***Liverpool*** win the UEFA Champions League in 2024-25?"

Each market is associated with a different team that can be a potential winner: for example, ***Liverpool***, ***Aresenal***, ***Manchester City***, and ***Real Madrid*** are currently the top teams projected as possible winners, so they each has a distinct market where traders can buy or sell shares

Polymarket API

For the assignment you may need to install the Python client for the Polymarket CLOB, by typing the following

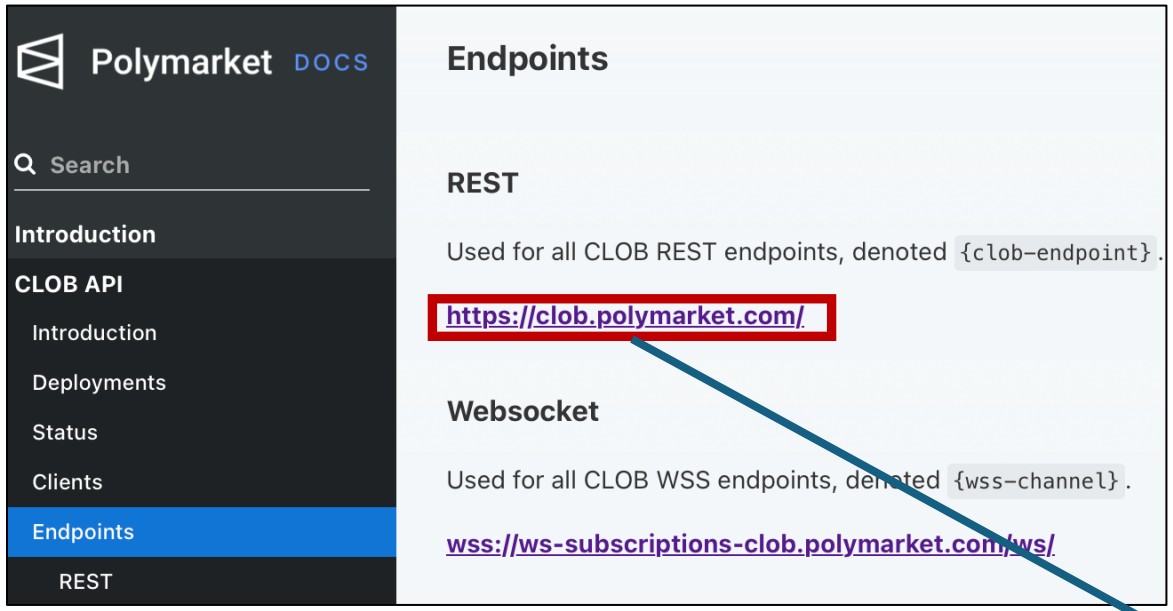
```
>> %pip install py-clob-client
```

Look for the following in the API documentation:

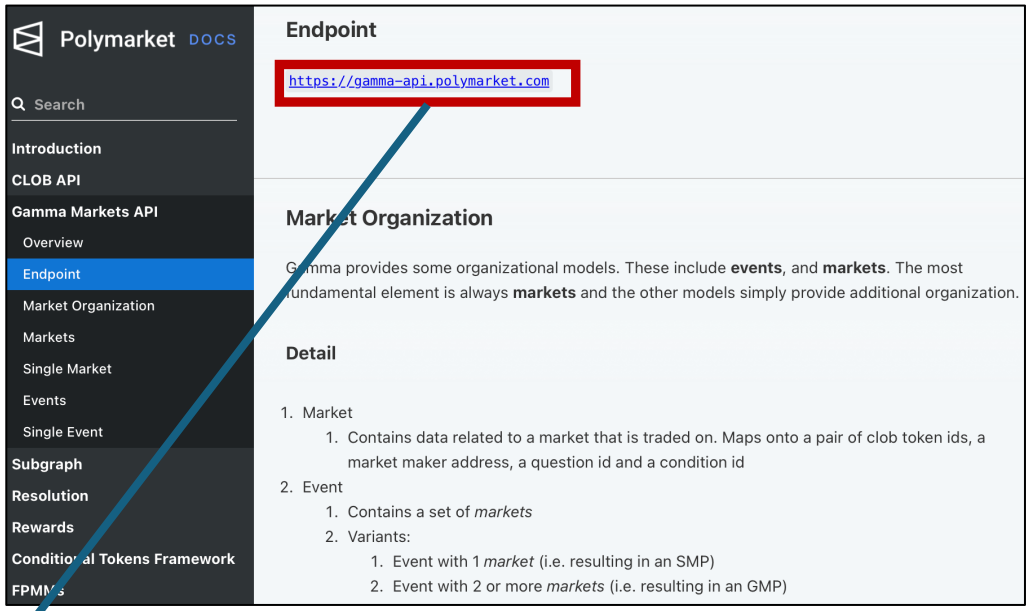
- Endpoints
- Request method (e.g., GET or POST)
- Query parameters
- Example queries

Polymarket API: Endpoint

CLOB API endpoints

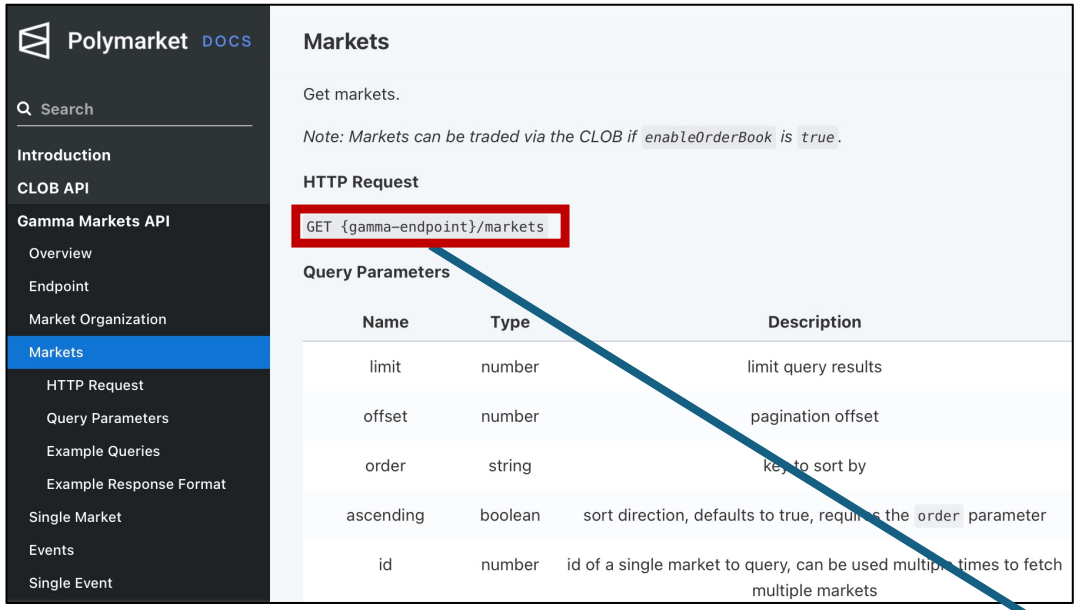


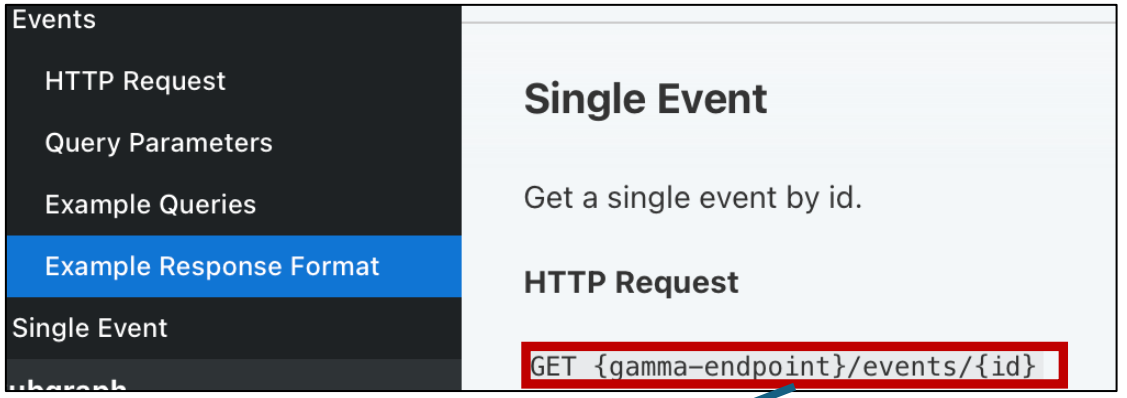
Gamma Markets API endpoints



Endpoint: URL (web address) that provides the location of the resource to which the API requests should be sent

Polymarket API: GET Method & Base URL

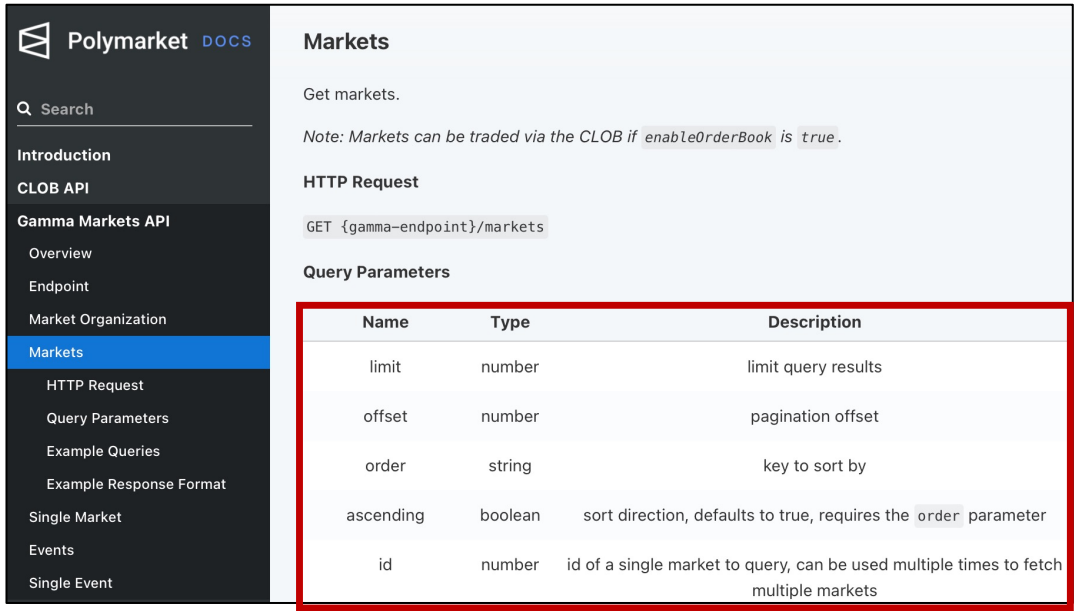


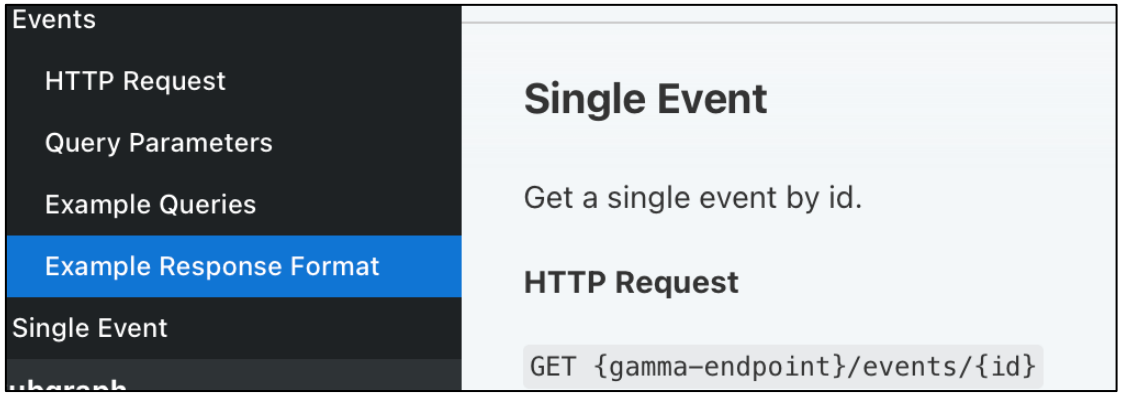


Recall that {gamma-endpoint} is https://gamma-api.polymarket.com from the last slide

GET: Send API calls using the GET method and format the base URL using the specified format under HTTP Request

Polymarket API: Query Parameters





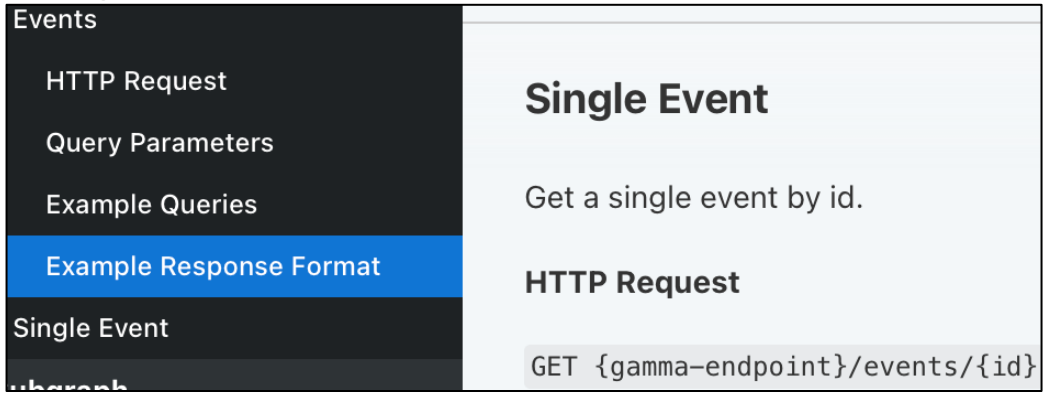
Query parameters: Some of them are optional, or take default value if unspecified (e.g., limit=20), format is "?param1=value1&param2=value2" after the base URL

Polymarket API: Putting It All Together

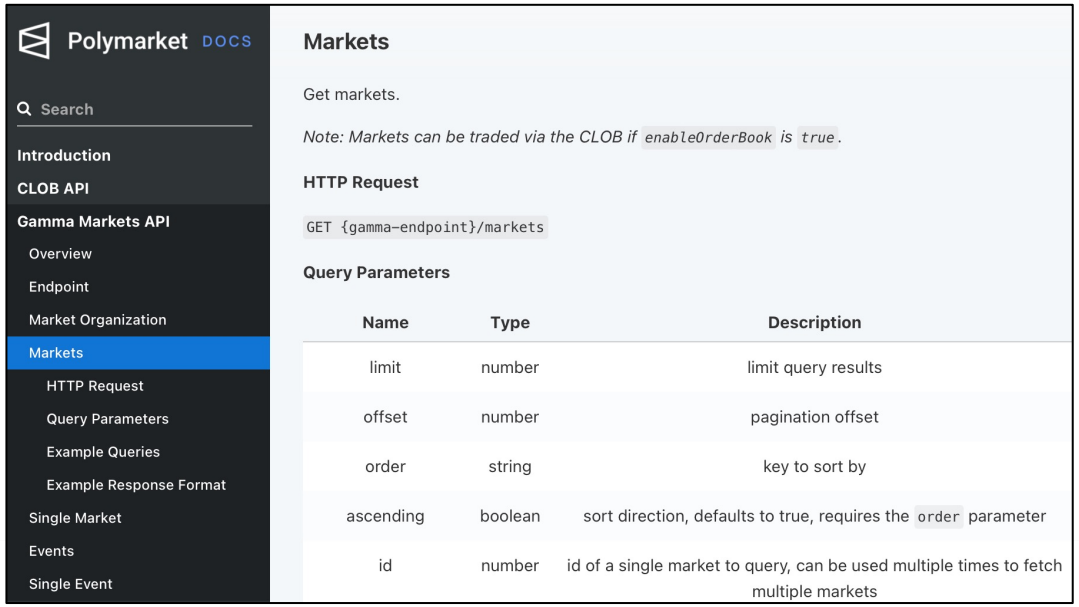
Two approaches –

Any problems?

Get data for a single event (send event ID)



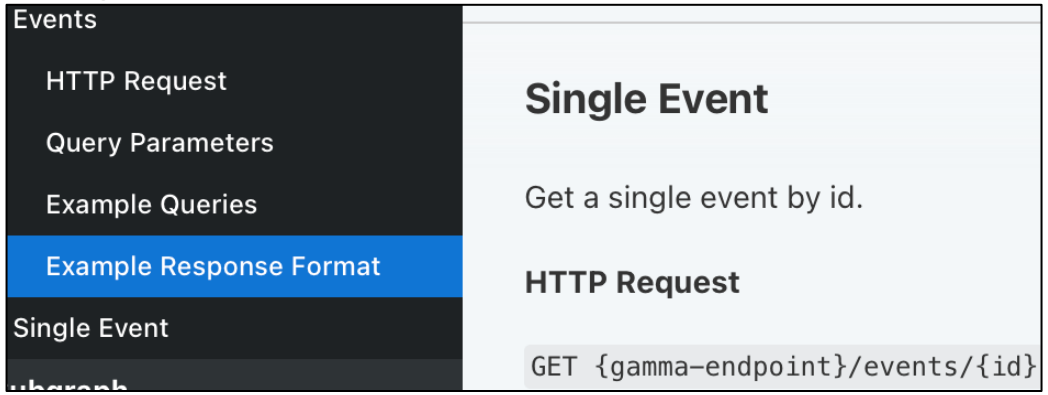
Get data for all the markets (by sending market IDs)



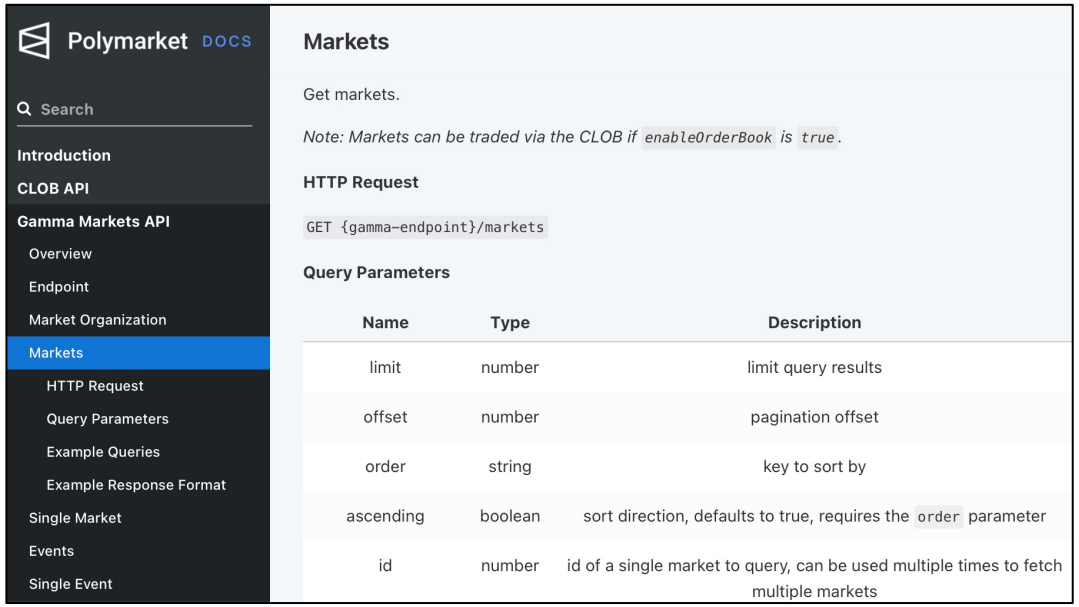
Polymarket API: Putting It All Together

Problem: we don't know either the event ID or the market IDs

Get data for a single event (send event ID)



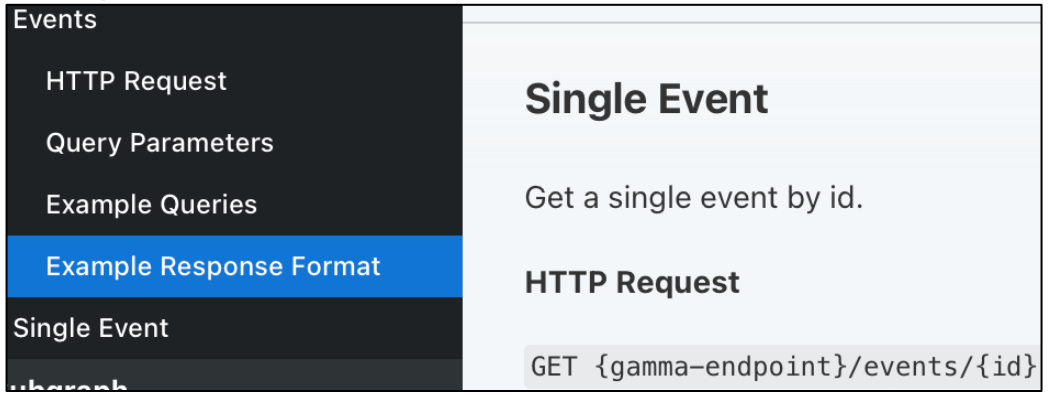
Get data for all the markets (by sending market IDs)



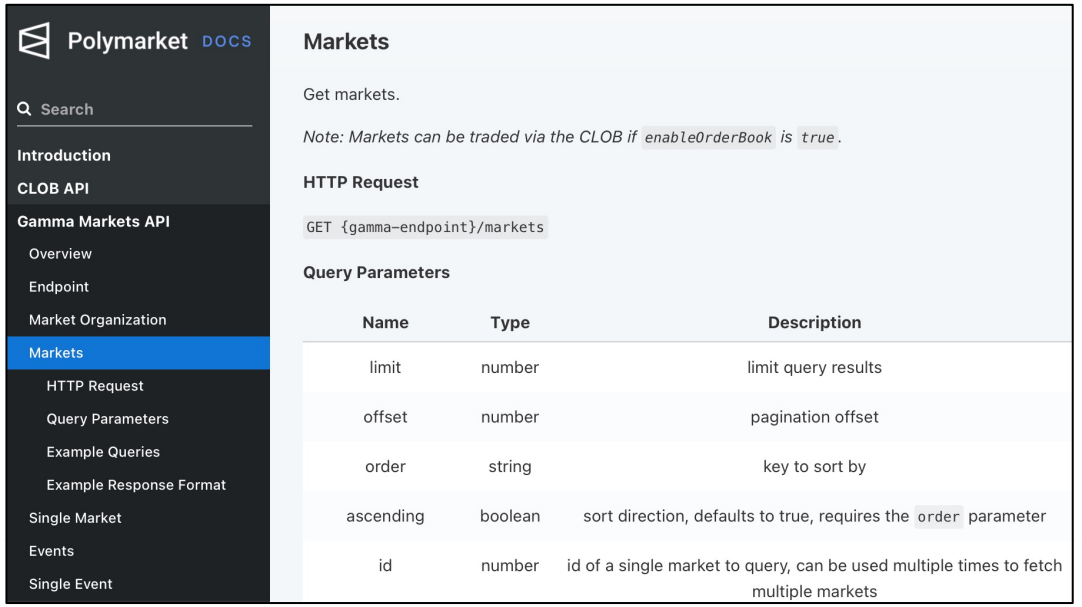
Polymarket API: Putting It All Together

Solution: look for hints of IDs from the HTML page source

Get data for a single event (send event ID)



Get data for all the markets (by sending market IDs)



Polymarket API: View Response JSON

```
response = requests.get('https://gamma-api.polymarket.com/events/12585')
event = response.json()
```

Visualize the tree structure of **event**:

Polymarket API: Load Response in Pandas

```
response = requests.get('https://gamma-api.polymarket.com/events/12585')
event = response.json()
```

```
event['markets']
```

Transform the markets into a Pandas DataFrame (we'll cover this in the course until later)

	id	question	conditionId	slug	resolutionSource	endDate	liquidity	startDate
0	507300	Will Inter Milan win the UEFA Champions League?	0x7beceb04f7b1d4f0dde80b58c6f43c23b8ad54b21c69...	will-inter-milan-win-the-uefa-champions-league		2025-05-31T12:00:00Z	116104.3188	2024-09-17T18:19:37.243795Z
1	507301	Will Juventus win the UEFA Champions League?	0x1459fcca779f3b97a765d02ac9a881892244aad83660...	will-juventus-win-the-uefa-champions-league		2025-05-31T12:00:00Z	206258.41635	2024-09-17T18:20:16.423567Z
2	507305	Will Paris Saint-Germain win the UEFA Champion...	0x6cf8b2ebe77711ab5c32fac330b8d493640cf25d278f...	will-paris-saint-germain-win-the-uefa-champion...		2025-05-31T12:00:00Z	101815.93411	2024-09-17T18:26:26.570998Z
3	507302	Will Lille win the UEFA Champions League?	0xcf6ee989453b44e532516119deeb5b581119bd0f09e0...	will-lille-win-the-uefa-champions-league		2025-05-31T12:00:00Z	286425.9397	2024-09-17T18:20:46.445231Z
4	507303	Will Liverpool win the UEFA Champions League?	0x4549ef05bb9b63f2934e36a4ea57942d8be4d45aeae3...	will-liverpool-win-the-uefa-champions-league		NaN	86464.1934	2024-09-17T18:25:11.466771Z
5	507304	Will Monaco win the UEFA Champions League?	0xeda024367dd24ff6425696d2020d4938a6143d8c5882...	will-monaco-win-the-uefa-champions-league		2025-05-31T12:00:00Z	177960.22497	2024-09-17T18:25:38.334925Z
6	507317	Will Sturm Graz win the UEFA Champions League?	0x9504d1af8c51f94a1d8a2028fc28b59f11a479594407...	will-sturm-graz-win-the-uefa-champions-league		2025-05-31T12:00:00Z	296088.61379	2024-09-17T18:43:14.282003Z
7	507306	Will PSV Eindhoven win the UEFA Champions League?	0x70755cd933b53e8181425a2664f2a46acfd66f2544a2...	will-psv-eindhoven-win-the-uefa-champions-league		2025-05-31T12:00:00Z	185112.31745	2024-09-17T18:27:07.663669Z

Polymarket API: Load Response in Pandas

```
response = requests.get('https://gamma-api.polymarket.com/events/12585')
event = response.json()
```

```
event['markets']
```

Transform the markets into a Pandas DataFrame (we'll cover this in the course until later)

List of questions associated with each team (market)

	id	question	conditionId	slug	resolutionSource	endDate	liquidity	startDate
0	507300	Will Inter Milan win the UEFA Champions League?	0x7beceb04f7b1d4f0dde80b58c6f43c23b8ad54b21c69...	will-inter-milan-win-the-uefa-champions-league		2025-05-31T12:00:00Z	116104.3188	2024-09-17T18:19:37.243795Z
1	507301	Will Juventus win the UEFA Champions League?	0x1459fcca779f3b97a765d02ac9a881892244aad83660...	will-juventus-win-the-uefa-champions-league		2025-05-31T12:00:00Z	206258.41635	2024-09-17T18:20:16.423567Z
2	507305	Will Paris Saint-Germain win the UEFA Champion...	0x6cf8b2ebe77711ab5c32fac330b8d493640cf25d278f...	will-paris-saint-germain-win-the-uefa-champion...		2025-05-31T12:00:00Z	101815.93411	2024-09-17T18:26:26.570998Z
3	507302	Will Lille win the UEFA Champions League?	0xcf6ee989453b44e532516119deeb5b581119bd0f09e0...	will-lille-win-the-uefa-champions-league		2025-05-31T12:00:00Z	286425.9397	2024-09-17T18:20:46.445231Z
4	507303	Will Liverpool win the UEFA Champions League?	0x4549ef05bb9b63f2934e36a4ea57942d8be4d45aeae3...	will-liverpool-win-the-uefa-champions-league		NaN	86464.1934	2024-09-17T18:25:11.466771Z
5	507304	Will Monaco win the UEFA Champions League?	0xeda024367dd24ff6425696d2020d4938a6143d8c5882...	will-monaco-win-the-uefa-champions-league		2025-05-31T12:00:00Z	177960.22497	2024-09-17T18:25:38.334925Z
6	507317	Will Sturm Graz win the UEFA Champions League?	0x9504d1af8c51f94a1d8a2028fc28b59f11a479594407...	will-sturm-graz-win-the-uefa-champions-league		2025-05-31T12:00:00Z	296088.61379	2024-09-17T18:43:14.282003Z
7	507306	Will PSV Eindhoven win the UEFA Champions League?	0x70755cd933b53e8181425a2664f2a46acfd66f2544a2...	will-psv-eindhoven-win-the-uefa-champions-league		2025-05-31T12:00:00Z	185112.31745	2024-09-17T18:27:07.663669Z

Polymarket API: Plot Current Prices

Plot the current projected winning probabilities (prices) of all teams

1. Examine all variables in the markets data, and find the right variables to use

Polymarket API: Plot Current Prices

Plot the current projected winning probabilities (prices) of all teams

1. Examine all variables in the markets data, and find the right variables to use

```
event['markets'][0].keys()
```

```
dict_keys(['id', 'question', 'conditionId', 'slug', 'resolutionSource', 'endDate', 'liquidity', 'startDate', 'image
', 'icon', 'description', 'outcomes', 'outcomePrices', 'volume', 'active', 'closed', 'marketMakerAddress', 'created
At', 'updatedAt', 'new', 'featured', 'submitted_by', 'archived', 'resolvedBy', 'restricted', 'groupItemTitle', 'gro
upItemThreshold', 'questionID', 'enableOrderBook', 'orderPriceMinTickSize', 'orderMinSize', 'volumeNum', 'liquidity
Num', 'endDateIso', 'startDateIso', 'hasReviewedDates', 'volume24hr', 'clobTokenIds', 'umaBond', 'umaReward', 'volu
me24hrClob', 'volumeClob', 'liquidityClob', 'acceptingOrders', 'negRisk', 'negRiskMarketID', 'negRiskRequestID', '_
sync', 'ready', 'funded', 'acceptingOrdersTimestamp', 'cyom', 'competitive', 'pagerDutyNotificationEnabled', 'appro
ved', 'clobRewards', 'rewardsMinSize', 'rewardsMaxSpread', 'spread', 'oneDayPriceChange', 'lastTradePrice', 'bestBi
d', 'bestAsk', 'automaticallyActive', 'clearBookOnStart', 'manualActivation', 'negRiskOther'])
```

team title

current price

Polymarket API: Plot Current Prices

Plot the current projected winning probabilities (prices) of all teams

2. Produce an array with 36 rows and 2 columns, where the first column contains the names of each team, and the 2nd column contains the current prices.

Polymarket API: Plot Current Prices

Plot the current projected winning probabilities (prices) of all teams

2. Produce an array with 36 rows and 2 columns, where the first column contains the names of each team, and the 2nd column contains the current prices.

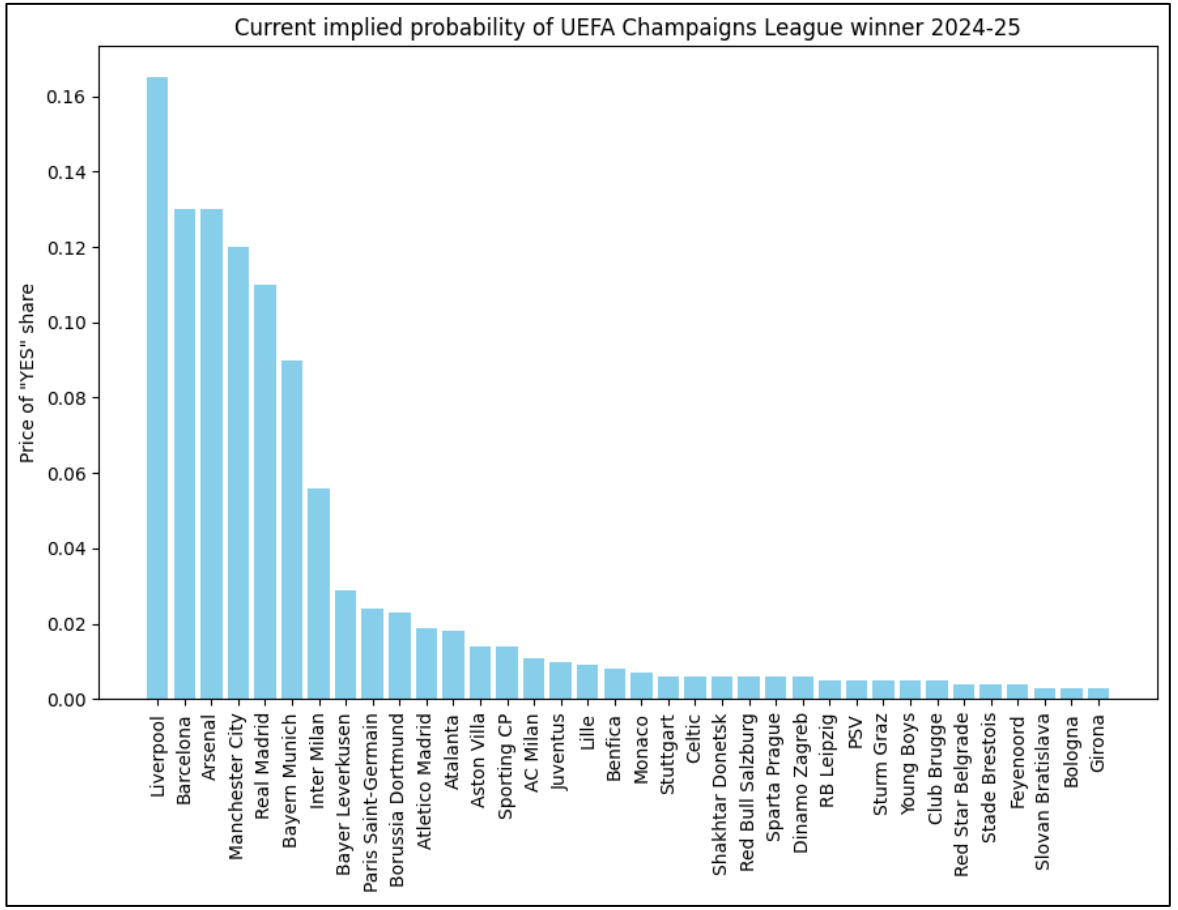
```
data = np.array([[x['groupItemTitle'],x['lastTradePrice']] for x in event['markets']])
```

```
array([['Inter Milan', '0.056'],
       ['Juventus', '0.01'],
       ['Paris Saint-Germain', '0.024'],
       ['Lille', '0.009'],
       ['Liverpool', '0.165'],
       ['Monaco', '0.007'],
       ['Sturm Graz', '0.005'],
       ['PSV', '0.005'],
       ['RB Leipzig', '0.005'],
       ['Real Madrid', '0.11'],
       ['Red Bull Salzburg', '0.006'],
       ['Red Star Belgrade', '0.004'],
       ['Shakhtar Donetsk', '0.006'],
       ['Atletico Madrid', '0.019'],
```

Polymarket API: Plot Current Prices

Plot the current projected winning probabilities (prices) of all teams

3. Plot the data.



Exercise: Polymarket API Queries

Your task is to collect specific data using Polymarket's APIs. For each scenario, identify the appropriate API endpoints and the necessary query parameters.

1. Retrieve market information for the top five FIFA World Cup teams in 2026 (with the highest current predicted winning probabilities). Hint: Determine which API endpoint provides market details and how to filter results for specific teams.
2. Retrieve up to 5 events tagged with "Grammys". Hint: Use the endpoint that allows event searches by tag. Key Parameter: Use tag_id=924 for Grammys-related events. Configure the API call to return no more than 5 results.
3. Collect the historical price data for the event: Spain winning the 2026 FIFA World Cup. Hint: Identify the endpoint that provides historical price data.