

Homework 6: Server-side Scripting using Python Flask, JSON and Finnhub Stock API

1. Objectives

- Get experience with Python programming language and Flask framework.
- Get experience creating web pages using HTML, CSS, JavaScript, DOM, JSON format and XMLHttpRequest object.
- Get experience with Finnhub Stock API.
- Getting hands-on experience in GCP, AWS or Azure.

1.1 Directions

- The backend of this homework must be implemented in the cloud on Google Cloud App Engine, AWS or Azure, using Python.
- See homework assignment 5 for deployment of your project on GCP, AWS or Azure.
- See the hints in section 3; a lot of reference material is provided to you.
- For Python and Flask kick-start, please refer to the Lecture slides on the class website.
- YouTube Link: <https://youtu.be/ljx0aBLxuHk>
- You must refer to the grading guidelines, the video, the specs and Piazza. Styling will be graded and the point's breakup is mentioned in the grading guidelines.

2. Description

In this exercise, you are asked to create a webpage that allows you to search for stock information using the Finnhub Stock API, and the results will be displayed in both tabular format and charts format using HighCharts. You will also provide news articles for the selected stock using the Finnhub API.

2.1. Description of the Search Form

The user first opens a web page as shown below in Figure 1, the initial search page, where he/she can enter a stock ticker symbol. Providing a value for the "Stock Ticker Symbol" field is mandatory.

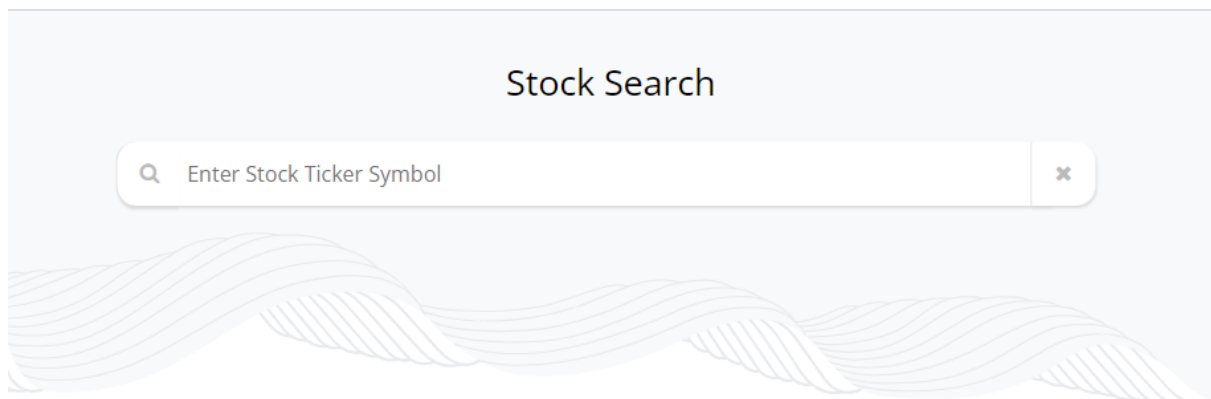


Figure 1: Initial search page

The search form has two buttons:

1. Search button (Magnifying glass symbol):

Once the user has provided **valid data** (a stock ticker is required), and **clicked** on the **Search** button or when the enter/return key is hit, **your front-end JavaScript script will make a request to your web server providing it with the form data that was entered (the ticker symbol)**. You **must use GET to transfer the form data to your web server** (do not use POST, as you would be unable to provide a sample link to your cloud services). A Python script using **Flask** will **retrieve the data** and **send** it to the **Finnhub Stock API**. You need to **use the Flask Python** framework to **make all the API calls**.

Using **XMLHttpRequest** or any other JavaScript calls for anything other than calling your own “cloud” backend will lead to a 4-point penalty. **Do not call the Finnhub Stock API directly from JavaScript.**

Define **routing endpoints** and make your API call from the Python backend. The recommended tutorial for **Flask** and more importantly, routing, can be found at the following link: <https://flask.palletsprojects.com/en/1.1.x/>

If the user clicks on the **Search** button without providing a value in the field, an alert should pop up **“Please fill out this field”** (an example is shown in **Figure 2**).

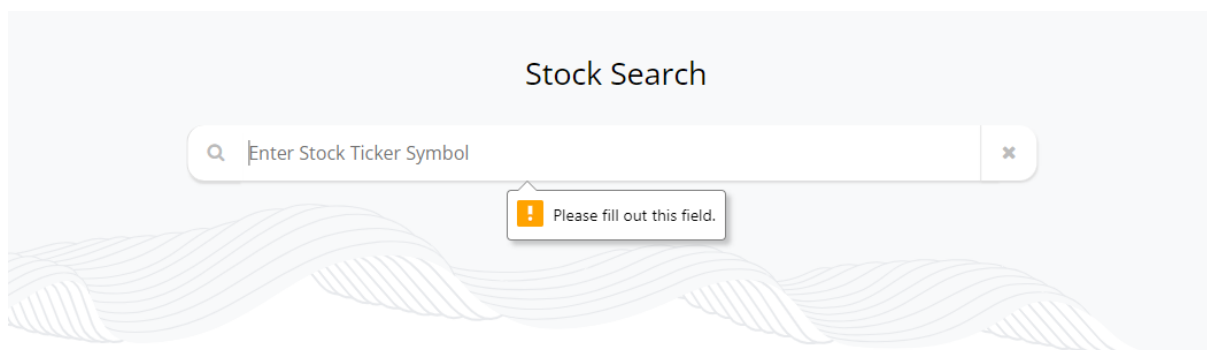


Figure 2: An Example of Empty Input alert

2. Clear button (Cross symbol):

This button must clear the result area (below the search area) and the text field (stock ticker symbol).

2.2 Displaying Results

In this section, we outline how to use the form data to construct the calls to the RESTful web services of the *Finnhub APIs* and display the results in the web page.

If the **ticker symbol** is **invalid** (if your API call returns no data) then your webpage should display an error message which says **"No record has been found"**.

A sample result is shown in **Figure 3**.

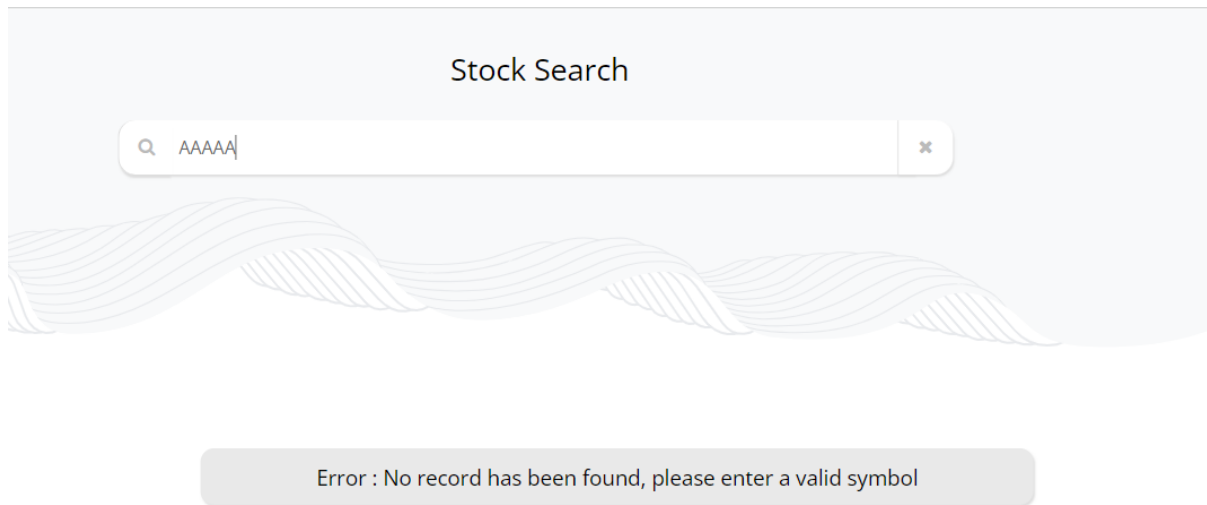


Figure 3: A Sample Search Result for Invalid ticker symbol

There are **four** components to display in a "tabs" from on the web page: **Company**, **Stock Summary**, **Charts** and **Latest News**.

A sample result is shown in **Figure 4**.

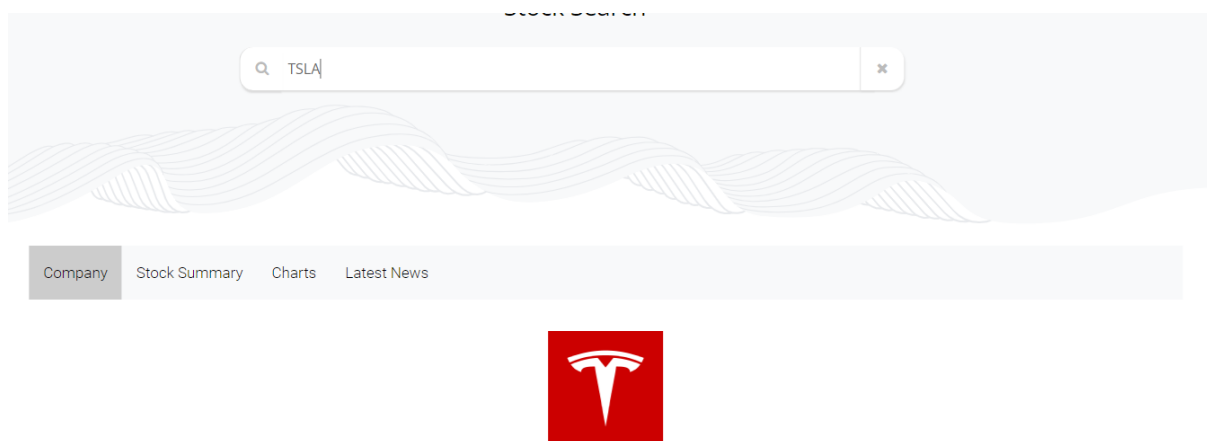


Figure 4: A Sample Search Result for Tesla Inc (TSLA)

2.2.1 Displaying Company Tab

We use the **Finnhub "Company Profile 2" Services** to get general information of a company. Please refer to

<https://finnhub.io/docs/api/company-profile2>

for more details on the API.

API Sample: https://finnhub.io/api/v1/stock/profile2?symbol=TSLA&token=API_KEY

The process to create your API key is explained in section 3. When constructing the Python request required to obtain the Company Details, you need to provide two values in the URL:

1. The first value, the **symbol**, is the **stock ticker** the user entered in the form.
2. The second value, the **token** is your **API_KEY** that you create as described in section 3.

The **response** of this Python request is a **JSON-formatted object**. **Figure 5** shows a sample response from the request for the TSLA symbol. You need to parse this JSON object and extract some fields as required. The mapping of the JSON response to the tabular data to be displayed on the screen is shown in **Table 1**.

```
{
  "country": "US",
  "currency": "USD",
  "exchange": "NASDAQ NMS - GLOBAL MARKET",
  "finnhubIndustry": "Automobiles",
  "ipo": "2010-06-09",
  "logo": "https://finnhub.io/api/logo?symbol=TSLA",
  "marketCapitalization": 1000519,
  "name": "Tesla Inc",
  "phone": "16506815000.0",
  "shareOutstanding": 1004.26,
  "ticker": "TSLA",
  "weburl": "https://www.tesla.com/"
}
```


Figure 5: **Sample JSON response** from Finnhub API's Company Profile 2 endpoint

Tabular Data	Data from Finnhub company profile 2 service
Company Logo (At the top)	The value of key "logo"
Company Name	The value of key "name"
Stock Ticker Symbol	The value of key "ticker"
Stock Exchange Code	The value of key "exchange"
Company Start Date	The value of key "ipo"
Category	The value of key "finnhubIndustry"

Table 1: Mapping JSON data and company tab display

After extracting the data, the data should be displayed in a tabular format with the logo at the top of the table. A sample output is shown in **Figure 6**.

Company	Stock Summary	Charts	Latest News
---------	---------------	--------	-------------



Company Name	Tesla Inc
Stock Ticker Symbol	TSLA
Stock Exchange Code	NASDAQ NMS - GLOBAL MARKET
Company IPO Date	2010-06-09
Category	Automobiles

Figure 6: Example of Company Tab

2.2.2 Displaying Stock Summary Tab

We use the **Finnhub “Quote” Services** to fetch the stock information for the ticker. Please refer to <https://finnhub.io/docs/api/quote> for more details on the Service.

API Sample: https://finnhub.io/api/v1/quote?symbol=TSLA&token=API_KEY

When constructing the Python request required to obtain the Company Details, you need to provide two values in the URL:

1. The first value, the **symbol**, is the **stock ticker** the user entered in the form.
2. The second value, the **token** is your **API_KEY** that you create as described in section 3.

The **response** of this Python request is a **JSON-formatted object**. **Figure 7** shows a sample response from the request. You need to parse this JSON object and extract some fields as required. The mapping of the JSON response to the tabular data to be displayed on the screen is shown in **Table 2**.

```
{
  "c": 162.41,
  "d": -2.1,
  "dp": -1.2765,
  "h": 166.32,
  "l": 162.3,
  "o": 164.415,
  "pc": 164.51,
  "t": 1642798803
}
```

Figure 7: Sample JSON response from Finnhub API's Quote endpoint

Tabular Data	Data from Finnhub Quote service JSON response
Stock Ticker Symbol	The value of key "ticker" from company profile 2 service
Trading Day	The value of key "t". The time stamp is given in the Unix epoch time. Convert it to human readable date as given in the screenshot below.
Previous Closing Price	The value of key "pc"
Opening Price	The value of key "o"
High Price	The value of key "h"
Low Price	The value of key "l"
Change	The value of key "d". Also display the upward arrow or downward arrow depending on whether the difference value is positive or negative.
Change Percent	The value of key "dp". Also display the upward arrow or downward arrow depending on whether the difference value is positive or negative.

Table 2: Mapping JSON data and stock summary display

After extracting the data, the data should be displayed in a tabular format. A sample output is shown in Figure 8.

Company	Stock Summary	Charts	Latest News
<div> <div>Stock Ticker Symbol</div> <div>TSLA</div> </div> <div> <div>Trading Day</div> <div>21 January, 2022</div> </div> <div> <div>Previous Closing Price</div> <div>996.27</div> </div> <div> <div>Opening Price</div> <div>996.34</div> </div> <div> <div>High Price</div> <div>1004.55</div> </div> <div> <div>Low Price</div> <div>940.5</div> </div> <div> <div>Change</div> <div>-52.37 ▼</div> </div> <div> <div>Change Percent</div> <div>-5.2566 ▼</div> </div> <div> <div>Strong Sell</div> <div>4</div> <div>6</div> <div>15</div> <div>9</div> <div>13</div> <div>Strong Buy</div> </div> <div> <div>Recommendation Trends</div> </div>			

Figure 8: Example of Stock Summary Tab

As per the figure 8. The last buy/sell indicator is made using **"Recommendation Trends" Services of Finnhub API**. Please refer to <https://finnhub.io/docs/api/recommendation-trends> for more details on the Service.

API Sample: https://finnhub.io/api/v1/stock/recommendation?symbol=TSLA&token=API_KEY

When constructing the python request required obtaining the Recommendation Trends, you need to provide two values in the URL:

1. The first value, the **symbol**, is the **stock ticker** the user entered in the form.
2. The second value, the **token** is your **API_KEY** that you create as described in section 3.

The **response** of this Python request is a **JSON-formatted object**. **Figure 9** shows a sample response from the request. You need to parse this JSON object and extract some fields as required.

```
[{
  "buy": 9,
  "hold": 15,
  "period": "2022-01-01",
  "sell": 6,
  "strongBuy": 13,
  "strongSell": 4,
  "symbol": "TSLA"
}, {
  "buy": 9,
  "hold": 14,
  "period": "2021-12-01",
  "sell": 6,
  "strongBuy": 12,
  "strongSell": 4,
  "symbol": "TSLA"
}, {
  "buy": 10,
  "hold": 13,
  "period": "2021-11-01",
  "sell": 6,
  "strongBuy": 13,
  "strongSell": 4,
```

Figure 9: Sample JSON response from Finnhub API's Recommendation Trends endpoint

Use the recommendation values for the latest date for building the indicator as given in **figure 10**. You will need 5 values from the latest response and display them in this respective order: **strongSell, sell, hold, buy, strongBuy**.

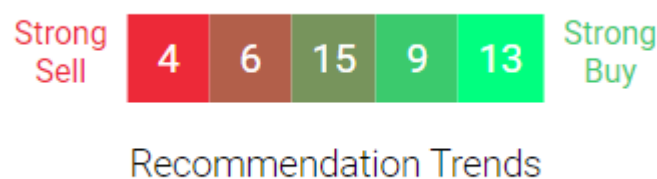


Figure 10: Example of Recommendation Trends

2.2.3 Displaying Charts Tab

You should extract the content of **Time Series Data** from the returned JSON object to construct a chart which is **responsible** for **displaying (close) price** and **volume**. The chart is provided by **HighCharts**. Find more information about HighCharts at:

<https://www.highcharts.com/demo>

<https://www.highcharts.com/demo/stock/area>

<https://www.highcharts.com/demo/stock/candlestick-and-volume>

The historical data for the ticker can be obtained from **Finnhub's "Stock Candles" Service**.

Please refer to <https://finnhub.io/docs/api/stock-candles> for more details on the Service.

API Sample:

https://finnhub.io/api/v1/stock/candle?symbol=TSLA&resolution=D&from=6_MONTHS_1_DAY&to=TODAY&token=API_KEY

When constructing the Python request required to obtain the Company Stock Chart, you need to provide 5 values:

1. The first value, the **symbol**, is the **stock ticker** the user entered in the form.
2. The second value, the **resolution** is time intervals for which you want your data, use day (D) as input to resolution.
3. The third value is the **from**, a prior date which should be 6 months and 1 day prior to the **current date**. You can use Python DateUtils's "relativedelta" to calculate the date. Please refer to <https://dateutil.readthedocs.io/en/stable/relativedelta.html> for more details.
4. The fourth value, **to**, is the current date (Today's date).
5. The fifth value, the **token** is your **API_KEY** that you create as described in section 3.

Note: The Service only accepts dates in UNIX timestamps so you will need to convert dates to UNIX epoch time.

The **response** of this Python request is a **JSON-formatted object**. **Figure 11** shows a sample response from the request. You need to parse this JSON object and extract some fields as required.


```

{
  "c": [149.9, 144.908, 140.696, 121.6, 129.066, 126.846, 112.10999999999999, 109.324,
  "h": [153.304, 149.15, 141.4, 132.5996, 133.6, 130.716, 118.9, 121.51400000000001, 9
  "l": [144.9469, 143.614, 136.85399999999998, 121, 121.6, 122.6, 109.25, 100.4, 88.43
  "o": [152.79206, 144.754, 138.0007, 121.078, 131.886, 128.04000000000002, 116.178, 1
  "s": "ok",
  "t": [1583280000, 1583366400, 1583452800, 1583712000, 1583798400, 1583884800, 158397
  "v": [75244885, 54263285, 63314590, 85368700, 77972215, 67067935, 94545260, 11320127
}

```

Figure 11: Sample JSON response from Finnhub API's Stock Candles Endpoint

The data obtained from the API can then be mapped to the **HighCharts** dataset using the mapping below.

Chart Data	Data from Finnhub stock-candles service JSON response
Date	The value of key "t". The time stamp is given in the Unix epoch time. Convert it in UTC format as input to the chart.
Stock Price	The value of key "c"
Volume	The value of key "v"

Table 3: Mapping JSON data and HighCharts data

Note: Map each returned array element for each attribute, by its index. For example, for date (timestamp) `t[0]`, close price is `c[0]` and volume is `v[0]`.

For mapping the Stock price data to data for HighCharts, create an array of data points `(x1, y1)` where `x1` will be the date (in UTC format) and `y1` will be the corresponding close stock price for that day. This array will then act as an input dataset for your HighCharts. Please refer to links in **Section 3** for more details.

Similarly create another array of points `(x2, y2)` where `x2` will be the date (also in UTC format) and `y1` will be the volume for that day. This array will be the second input for your HighCharts. Since you will be plotting Stock Price vs Date and Volume vs Date you will have two different datasets and two y-axis and a single x-axis.

Initially, the chart shows the historical stock price (in blue line with filling the area below, two digits after decimal) and volume (in grey bar) for the past six months by an interval of one day. **Figure 12** shows an example of the Stock Price/Volume chart.

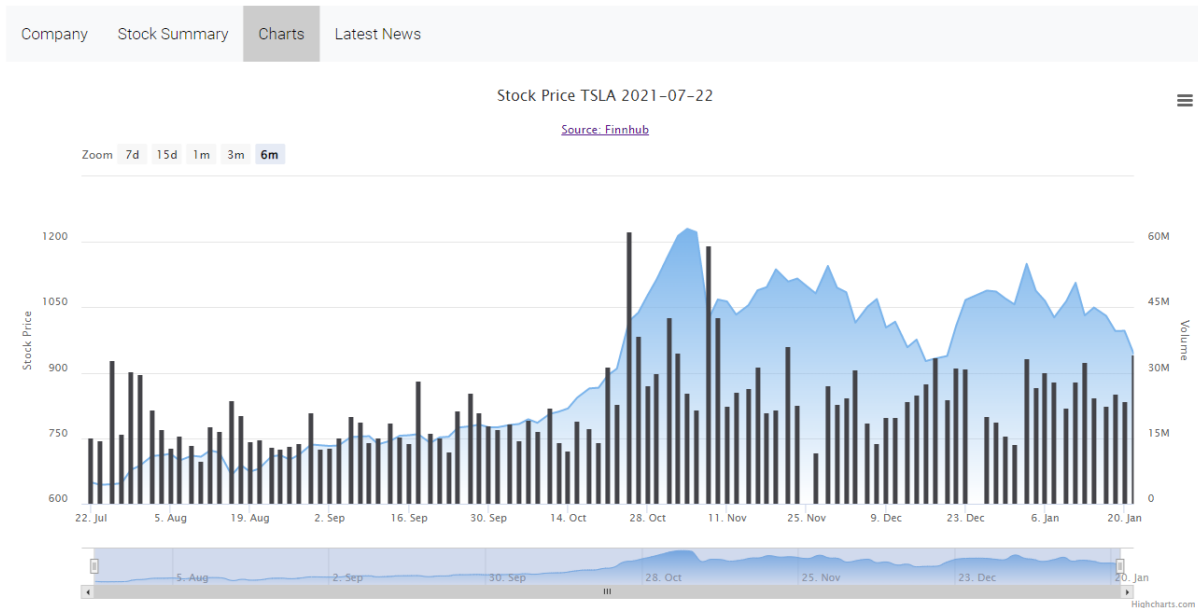


Figure 12: An Example of Chart showing Stock Price/Volume for 6 months

The title of the chart for showing price/volume is “**Stock Price <Ticker> (YYYY-MM-DD)**”, where “**YYYY-MM-DD**” is today’s date. The subtitle of the chart should be “Source: Finnhub” and should hyperlink to the Finnhub website: <https://finnhub.io/>. The title of the Y-axis is “**Stock Price**” when showing the stock price and the other Y-axis is “**Volume**”.

The **X-axis** changes on the basis of the **zoom** level **6 months**, **3 months**, 1 month, 15 days, and 7 days. Please refer to **Section 3** for references on how to change the chart data on the basis of the zoom level. **Figure 13** shows an example of the Stock Price/Volume chart for 15 days zoom level.

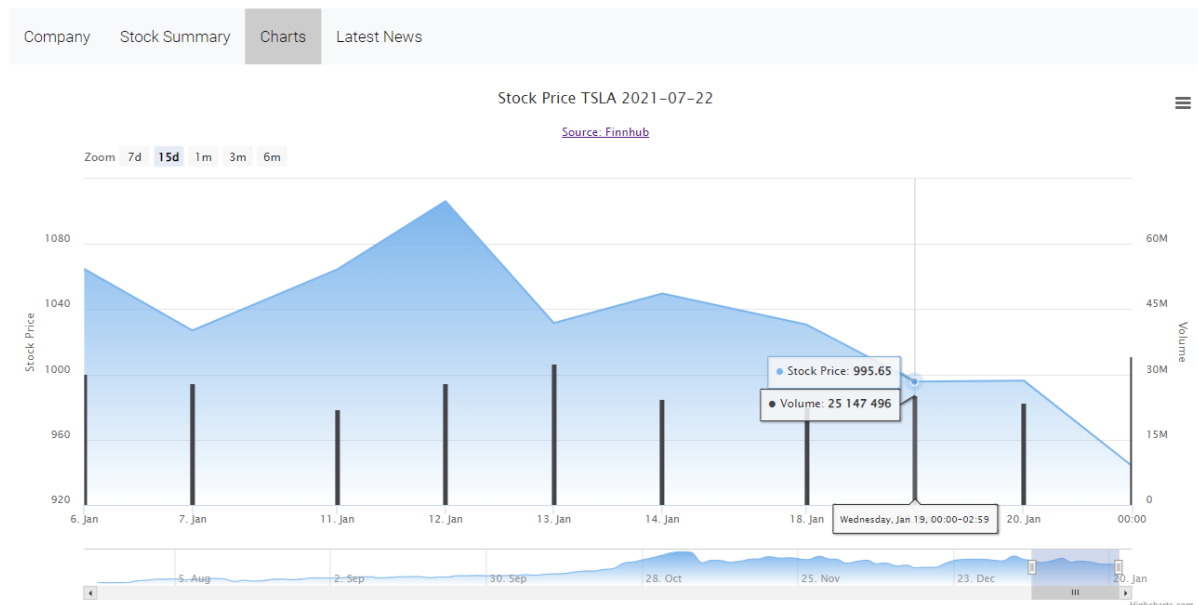


Figure 13: An Example of Chart showing Stock Price/Volume for 15 days

2.2.4 Displaying Latest News Tab

We use the **Finnhub “Company News” Services** to fetch the stock information for the ticker. Please refer to <https://finnhub.io/docs/api/company-news> for more details on the Service.

API Sample: https://finnhub.io/api/v1/company-news?symbol=TSLA&from=BEFORE_30&to=TODAY&token=API_KEY

When constructing the Python request required to obtain the Company News, you need to provide four values in the URL:

1. The first value, the **symbol**, is the **stock ticker** the user entered in the form.
2. The second value is the **from**, a prior date which should be **30 days prior to the current date**. You can use Python DateUtils’s “relativedelta” to calculate the date. Please refer to <https://dateutil.readthedocs.io/en/stable/relativedelta.html> for more details.
3. The third value, **to**, is the current date (**Today’s date**).
4. The fourth value, the **token** is your **API_KEY** that you create as described in section 3.

Note: The Service only accepts dates in YYYY-MM-DD format so you will need to convert dates to this format.

The **response** of this Python request is a **JSON-formatted object**. **Figure 14** shows a sample response from the request. You need to parse this JSON object and extract some fields as required. The mapping of the JSON response to the tabular data to be displayed on the screen is shown in **Table 4**. Only the articles that have *image*, *url*, *headline* and *datetime* keys present with a non-empty value should be displayed. If any attribute is missing, empty or blank, do not display it in the results. Display the **first five** articles from the response which have all the keys and values present as mentioned.

```
[{
  "category": "company",
  "datetime": 1642867200,
  "headline": "Bitcoin drops below $35,000 Saturday as global market selloff spreads",
  "id": 95112175,
  "image": "https://s.yimg.com/ny/api/res/1.2/QSz447Gxee8mVgnWMtQX3Q--/YXBwaWQ9aGlna",
  "related": "TSLA",
  "source": "Yahoo",
  "summary": "Cryptocurrency prices tumbled Friday night, with bitcoin hitting its 1",
  "url": "https://finnhub.io/api/news?id=a889402cc5e86397f7ec1173fbef770fb5abb6b4621",
}, {
  "category": "company",
  "datetime": 1642859520,
  "headline": "Why Does Bitcoin's Price Rise and Fall?",
  "id": 95112199,
  "image": "https://s.yimg.com/uu/api/res/1.2/AnkmgjYs51STS6wIv_P5ig--~B/aD0yNzU7dz0",
  "related": "TSLA",
  "source": "Yahoo",
  "summary": "Bitcoin's price has gone from $32,983 on Jan. 22, 2021 to $35,811 on t",
  "url": "https://finnhub.io/api/news?id=2809b72a2a1ea11972dbe1424dd85a0340beaa73f2e",
}, {
  "category": "company",
  "datetime": 1642852800,
```

Figure 14: Sample JSON response from Finnhub API's Company News Endpoint

The mapping between the information populated in the results and the JSON object is shown in **Table 4**.

Card Data	Data from Finnhub company-news service JSON response
Image	The value of key "image"
Title	The value of key "headline"
Date	The value of key "datetime". The time stamp is given in the Unix epoch time. Convert it to human readable date as given in the screenshot below.
Link to Original Post	The value of key "url"

Table 4: Mapping between result card and JSON object

After extracting the data, it should be displayed as shown in **Figure 15**. The **"See Original Post"** hyperlink opens the original post in a new tab in the browser.

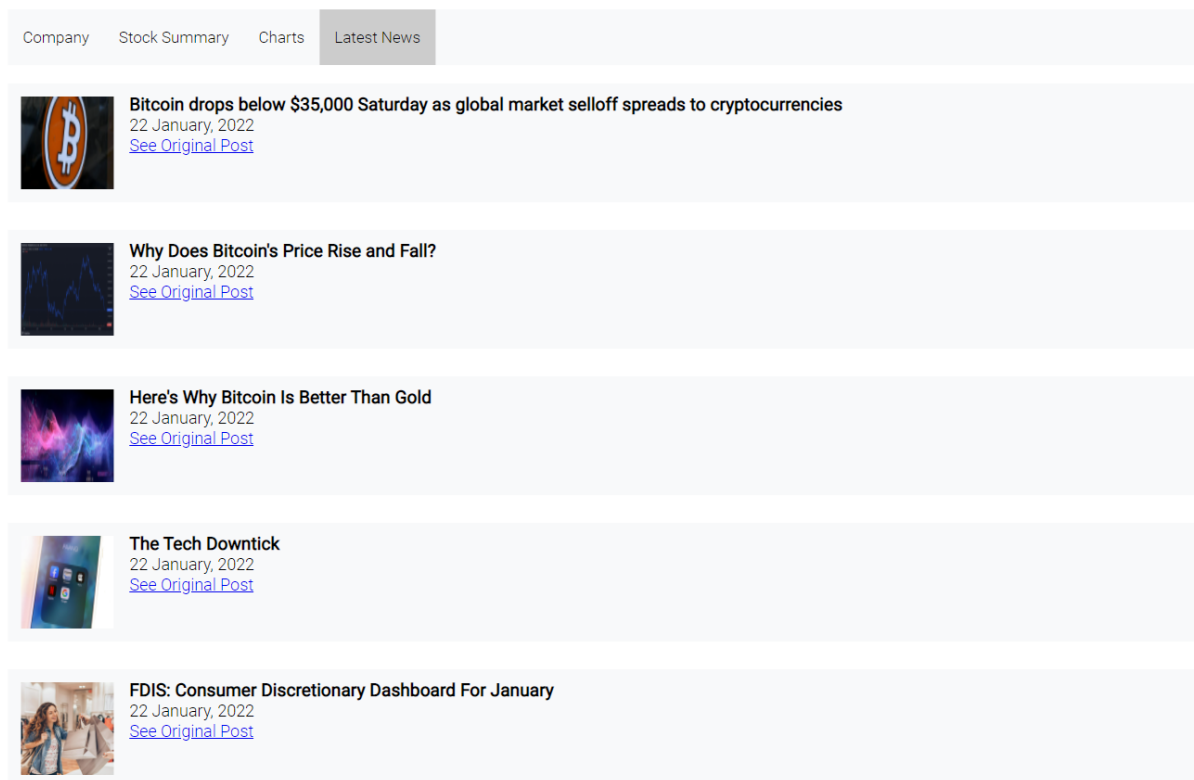


Figure 15: Example of Latest News

2.3 Saving Previous Inputs

In addition to displaying the results, the page should maintain the entered value while displaying the current result. For example, if a user searches for "AAPL", the user should see what was provided in the search form when displaying the results. Specifically, when clicking on the **Search** button, the page should display the result retrieved from the *Finnhub API* service and keep the value provided in the search form.

3. Hints

3.1 Finnhub API Documentation

To apply for an API key on Finnhub and read the API documentation, please go to:

<https://finnhub.io/>

Click on the “**Get free API key**” button. Enter your **Name**, your @usc.edu **E-mail** address and **Password**, and click on **Sign-up** and go to get your API_KEY.

<https://finnhub.io/dashboard>

3.2 Deploy Python file to the cloud (GCP/AWS/Azure)

You should use the domain name of the GCP/AWS/Azure service you created in HW #5 to make the request. For example, if your GCP/AWS/Azure server domain is called **example.appspot.com** or **example.elasticbeanstalk.com** or **example.azurewebsites.net** the following links will be generated:

GAE - <http://example.appspot.com/index.html>

AWS - <http://example.elasticbeanstalk.com/index.html>

Azure - <http://example.azurewebsites.net/index.html>

The *example* subdomain in the above URLs will be replaced by your choice of subdomain from the cloud service. You may also use a different page than index.html.

3.3 References for HighCharts

1. <https://api.highcharts.com/highstock/>
2. <https://www.highcharts.com/demo/stock/intraday-area>
3. <https://www.highcharts.com/demo/stock/compare>

4. Files to Submit

In your course homework page, you should **update the Homework 6 link** to refer to your new initial web search page for this exercise (for example, **index.html**). Your files must be hosted on GCP, AWS or Azure cloud services. Graders will verify that this link is indeed pointing to one of the cloud services.

Also, submit your source code file to DEN D2L. Submit a **ZIP file** of both **front-end and back-end** code, plus any additional files needed to build your app (e.g., yaml file). **The timestamp of the ZIP file will be used to verify if you used any “grace days.”**

****IMPORTANT**:**

- All discussions and explanations in Piazza related to this homework are part of the homework description and grading guidelines. So please review all Piazza threads, before finishing the assignment. If there is a conflict between Piazza and this description and/or the grading guidelines, **Piazza always rules**.
- You can use **jQuery** for Homework 6 but it is not required.

-
- You should not use **Bootstrap** for Homework 6.
- You should **not call any of the APIs directly from JavaScript**, bypassing the Python proxy. Implementing any one of them in JavaScript instead of Python will result in a **4-point penalty**.
- **APPEARANCE OF ALL VIEWS, TABLES AND CHARTS** should be similar to the reference video as much as possible.