kayak_explore_scraper

September 24, 2019

The Kayak explore feature uses google maps to display the cheapest flights to international airports across the world at any point within a specified time interval. You can leave the interval blank to find the cheapest flights possible, but in this case we are looking for a good deal within the next summer break (specifically, the beginning of June to the end of August). Our program first uses the python request library to scrape all of the flight data sent to google maps from kayak in JSON format. We then parse the JSON string to get the specific details we are interested in.

```
In [2]: import requests, smtplib, os, datetime
        import pandas as pd
        from bs4 import *
        import urllib.request as ur
        from email.mime.multipart import MIMEMultipart
        from email.mime.text import MIMEText
        from matplotlib import pyplot as plt

        # Specify the beginning and end of the time frame of possible dates as YYYYMMDD
        timeframe_begin = 20200601
        timeframe_end = 20200830

        def scrape_kayak(start='', end='', airport = 'BER'):
            """
            This function scrapes flight information from the kayak explore page.

            Parameters:
            start, end, airport - integer representing earliest possible departure date
            in YYYYMMDD format, integer representing latest return date, string with
            three letter code for starting airport. When both are start and end are
            left blank, results are returned from present date to one year in the
            future.

            Returns:
            df - a data frame containing all destination cities and corresponding
            flight information returned by the scrape
            """

            # Format the beginning and end dates to insert them into the URL
            start = '&depart=' + str(start)
```

```
            end = '&return=' + str(end)

            url = "https://www.kayak.com/s/horizon/exploreapi/elasticbox?airport=" + airport +
            "&stopsFilterActive=false&duration=&budget=&topRightLat=68.58212830775821&topRightL
            response = requests.post(url).json()

            df = pd.DataFrame(columns=['City', 'Country', 'Price', 'Airline', 'Airport', 'Date

            for i in range(len(response['destinations'])):
                destination = response['destinations'][i]
                row = list([destination['city']['name'], destination['country']['name'],
                            destination['flightInfo']['price'], destination['airline'],
                            destination['airport']['shortName'], pd.to_datetime(destination['d
                            str('http://kayak.com'+destination['clickoutUrl'])])
                df.loc[i] = row

            city_mins = df.groupby(['City']).idxmin().astype(int)
            df = df.loc[city_mins['Price'].to_list()]
            # There is a glitch where some flights are returned with unrealistically
            # high prices, so we'll remove those entries.
            df = df.where(df['Price']!=999999).dropna()

            return df

        all_flights = scrape_kayak(timeframe_begin, timeframe_end)
        all_flights.head()
```

Out[2]:

	City	Country	Price	Airline	Airport	\
204	Abakan	Russia	418.0	Aeroflot	ABA	
20	Aberdeen	United Kingdom	188.0	KLM	ABZ	
569	Abu Dhabi	United Arab Emirates	510.0	Multiple Airlines	AUH	
53	Abuja	Nigeria	790.0	Turkish Airlines	ABV	
106	Acapulco	Mexico	3593.0	Multiple Airlines	ACA	

	Date	Link
204	2020-07-08	http://kayak.com/flights/SXF-ABA/2020-07-08/20...
20	2020-07-02	http://kayak.com/flights/TXL-ABZ/2020-07-02/20...
569	2020-07-02	http://kayak.com/flights/TXL-AUH/2020-07-02/20...
53	2020-07-02	http://kayak.com/flights/TXL-ABV/2020-07-02/20...
106	2020-07-02	http://kayak.com/flights/TXL-ACA/2020-07-02/20...

We have about 500 rows of flight information, so we really need a good way to summarize the data. Let's return a dataframe showing the cheapest flights from our destination to each continent. Unfortunately, the JSON string returned by Kayak doesn't specify the continent of each destination country, so let's scrape wikipedia to map countries to their respective continents.

```
In [3]: def scrape_wikipedia():
            """
```

```
    This function scrapes and parses several wikipedia pages to map flight
    destination cities to their respective continents. It then cleans the
    resulting data frame.

    Returns:
    df - a data frame containing all cities from the wiki data and the
    continents where they are located
    """

    urls = ['https://en.wikipedia.org/wiki/List_of_African_countries_by_area',
            'https://en.wikipedia.org/wiki/List_of_North_American_countries_by_GDP_(nom
            'https://en.wikipedia.org/wiki/List_of_South_American_countries_by_populati
            'https://en.wikipedia.org/wiki/List_of_European_countries_by_area',
            'https://en.wikipedia.org/wiki/List_of_Oceanian_countries_by_population',
            'https://en.wikipedia.org/wiki/List_of_countries_in_Asia-Pacific_by_GDP_(no
            'https://en.wikipedia.org/wiki/List_of_Middle_Eastern_countries_by_populati

    #  We'll count the Middle East as Asia
    continents = ['Africa', 'North America', 'South America', 'Europe',
                  'Oceania', 'Asia', 'Asia']
    all_continents, countries = [], []
    df = pd.DataFrame(columns=['Country', 'Continent'])

    for i in range(len(urls)):
        html = ur.urlopen(urls[i]).read()
        soup = BeautifulSoup(html, 'html.parser')
        table = soup.find_all('table')[0]
        rows = table.find_all('tr')

        for row in rows:
            columns = row.find_all('td')
            if len(columns) > 0:
                country = columns[1].get_text().strip()
                if country not in countries:
                    countries.append(country)
                    all_continents.append(continents[i])

    # Remove all parentheses
    countries = pd.Series(countries).replace(regex=True,
                          to_replace=[r'\d', r'\([^)]*\)', ''], value=r'')
    # Remove brackets and asterisks
    countries = countries.replace(regex=True,
                                  to_replace=[r'\[[^()]*\]', r'[\*]'],
                                  value=r'')
    df['Country'] = countries
    df['Continent'] = pd.Series(all_continents)

    return df
```

```
        # If we've already run the scraper, there's no need to scrape wikipedia a
        # second time.
        if not os.path.isfile('data\continents.csv'):
            all_continents = scrape_wikipedia()
        else:
            all_continents = pd.read_csv('data\continents.csv', index_col=0)

        print(all_continents.head())
```

```
                           Country Continent
0                          Algeria    Africa
1  Democratic Republic of the Congo    Africa
2                            Sudan    Africa
3                            Libya    Africa
4                             Chad    Africa
```

Now that we have the continent for each country, let's find the best deal for each continent, and include two other regional destinations we are interested in to group alongside the continents (Japan and Hawaii).

```
In [5]: def summarize_results(cities):
            """
            This function finds the lowest priced flight to each continent, as well as
            to specific regions we're interested in, in this case Japan and Hawaii.

            Parameters:
            cities - a data frame with scraped kayak flight information with a
            continent mapped to each city.

            Returns:
            deals - a data frame containing flight information for the cheapest flight
            to each destination of interest.
            """

            hi_airports = ['HNL', 'MKK', 'OGG', 'KOA', 'ITO']
            hawaii = cities[cities['Airport'].str.match('LIH')]

            # Create a dataframe with all of the Hawaii flights
            for airport in hi_airports:
                hawaii = hawaii.append(cities[cities['Airport'].str.match(airport)])

            # Doing the same for Japan is a bit easier since we can just grep the
            # country ccolumn
            japan = cities[cities['Country'].str.match('Japan')]
            jp_lowest = japan.loc[japan['Price'].idxmin()].copy()
            jp_lowest['Continent'] = 'Japan*' # Differentiate the Japan flights from Asia flig
```

```
            hi_lowest = hawaii.loc[hawaii['Price'].idxmin()].copy()
            hi_lowest['Continent'] = 'Hawaii*'
            lowest = cities.groupby(['Continent'])['Price'].idxmin()
            deals = cities.iloc[lowest,:]
            deals = deals.append(jp_lowest)
            deals = deals.append(hi_lowest)
            deals = deals.set_index('Continent')
            deals['Price']= deals['Price'].astype(int)
            deals['Price']= '$' + deals['Price'].astype(str)

            return deals

        flights_list = all_flights.merge(all_continents, how='left', on='Country')
        results = summarize_results(flights_list)
        print(results.head())
```

```
                    City        Country Price            Airline Airport  \
Continent
Africa          Marrakesh        Morocco  $135            easyJet     RAK
Asia             Tel Aviv         Israel  $196            Ryanair     TLV
Europe         Luxembourg     Luxembourg   $53            Ryanair     LUX
North America      Newark  United States  $364  Multiple Airlines     EWR
Oceania            Sydney      Australia  $726              Scoot     SYD

                    Date                                               Link
Continent
Africa        2020-06-18  http://kayak.com/flights/SXF-RAK/2020-06-18/20...
Asia          2020-07-27  http://kayak.com/flights/SXF-TLV/2020-07-27/20...
Europe        2020-06-03  http://kayak.com/flights/TXL-LUX/2020-06-03/20...
North America 2020-06-08  http://kayak.com/flights/TXL-EWR/2020-06-08/20...
Oceania       2020-08-03  http://kayak.com/flights/TXL-SYD/2020-08-03/20...
```

Here is a function that determines whether or not to send an email based on the present results.

```
In [ ]: def check_df(results, start, end):
            """
            This function compares the results of the current scrape with previous
            results to determine if an email update should be sent.

            Parameters:
            results, start, end - dataframe with summarized scrape results, integer
            representing earliest possible departure date in YYYYMMDD format, integer
            representing latest return date

            Returns:
            msgs, email - list of strings indicating continents for which good deals are
            available, boolean indicating whether an email should be sent
```

```
        """

        filename = 'data/' + str(start) + '_to_' + str(end) + '_kayak_scrape.csv'
        if os.path.isfile(filename):
            df = pd.read_csv(filename)
        else:
            df = pd.DataFrame(columns=['Date'])

        current_scrape = results['Price']

        # Append the current scrape as a row if it isn't a duplicate
        if df.append(current_scrape).drop([
                'Date'], axis=1).duplicated().any() == False:
            df = df.append(current_scrape)
            now = datetime.datetime.now()
            df.iloc[-1,0] = now
            df.index = range(len(df))

        df.to_csv(filename, index=False)
        msgs = ''
        # Bool indicating if an email will be sent. Will be set to true if good
        # deals are detected
        email = False
        # Percent of average flight price to a given destination; if a current price is
        # under this threshold, an email alert will be generated
        email_threshold = 0.85

        for column in range(1,len(df.columns)):
            col_mean = df.iloc[:,column].mean()
            if col_mean * email_threshold > df.iloc[-1,column]:
                name = df.columns[column]
                msg = 'Flights to ' + name + ' right now are abnormally cheap.<br>'
                msgs += msg
                email = True

        print(df)

        return msgs, email

    msgs, email = check_df(results, timeframe_begin, timeframe_end)
    print(msgs)
```

This function sends an email if the current scrape has any outstanding deals to at least one of our destinations.

```
In [14]: def send_email(flights):
             """
             This function sends an email with the summarized flight data as a data
```

```
            frame in html to the specified address.

            Parameters:
            flights - a dataframe of the best deals on flights and the corresponding
            details returned by our scrape.
            """

            password = input('Type your password:')
            message = MIMEMultipart('alternative')
            message.add_header('Content-Type','html')
            sender = 'youremail@domain.com'
            receiver = 'theiremail@domain.com'
            message['Subject'] = "Here is your latest Kayak scrape!"
            message['From'] = sender
            message['To'] = receiver
            html = "<html><head></head><body><p>" + msgs + \
            flights.to_html() + ". </p></body></html>"

            part1 = MIMEText(html, 'html')
            message.attach(part1)
            mail = smtplib.SMTP('smtp.gmail.com', 587)
            mail.ehlo()
            mail.starttls()
            mail.login('your_username', password)
            mail.sendmail(sender, receiver.split(','), message.as_string())
            mail.quit()

        if email:
            #send_email(results)
            pass #  No email in this jupyter version
```

This function saves a dataframe with the data from all flights (not just the best deals), which is useful for producing some charts.

```
In [17]: def save_scrape(flights, start, end):
            """
            This function appends a column containing all of the current scraped prices
            to a dataframe of saved flight price data.

            Parameters:
            flights, start, end - dataframe with all scraped flight results, integer
            representing earliest possible departure date in YYYYMMDD format, integer
            representing latest return date

            Returns:
            dataframe containing all previously scraped flight data plus the current scrape
            """
            filename = 'data/' + str(start) + '_to_' + str(end) + '_all_flights.csv'
```

```
            now = datetime.datetime.now()
            current_prices = flights.set_index('City')['Price']
            current_prices.name = now

            if os.path.isfile(filename):
                df = pd.read_csv(filename, index_col=0)
                df = df.merge(current_prices, how='outer', left_index=True,
                              right_index=True)
            else:
                df = pd.DataFrame(current_prices)
                df['Continent'] = flights_list.set_index('City')['Continent']

            df.to_csv(filename)

            return df.drop('Continent', axis=1).dropna()

        historical = save_scrape(flights_list, timeframe_begin, timeframe_end)
        print(historical.head())
```

```
          2019-09-11 22:05:24.869258  2019-09-12 09:01:14.631851  \
City
Aberdeen                       563.0                       188.0
Abu Dhabi                      510.0                       510.0
Abuja                         1877.0                      1878.0
Acapulco                      2486.0                      2486.0
Accra                          711.0                       711.0

          2019-09-12 11:36:55.827211  2019-09-12 12:22:00.953972  \
City
Aberdeen                       188.0                       188.0
Abu Dhabi                      510.0                       510.0
Abuja                         1878.0                      1878.0
Acapulco                      2486.0                      2486.0
Accra                          709.0                       709.0

          2019-09-12 12:23:51.262758  2019-09-12 12:47:19.909551  \
City
Aberdeen                       188.0                       188.0
Abu Dhabi                      510.0                       510.0
Abuja                         1878.0                      1878.0
Acapulco                      2486.0                      2486.0
Accra                          709.0                       709.0

          2019-09-12 14:41:09.103147  2019-09-12 14:43:29.661475  \
City
Aberdeen                       679.0                       679.0
Abu Dhabi                      510.0                       510.0
Abuja                         1878.0                      1878.0
```

```
Acapulco                      3591.0                      3591.0
Accra                          669.0                       669.0

           2019-09-13 18:31:06.671201  2019-09-13 18:33:38.926318  ...  \
City                                                                ...
Aberdeen                       185.0                       185.0  ...
Abu Dhabi                      499.0                       499.0  ...
Abuja                         1874.0                      1874.0  ...
Acapulco                      3584.0                      3584.0  ...
Accra                          710.0                       710.0  ...

           2019-09-15 22:29:49.689412  2019-09-16 09:47:06.249882  \
City
Aberdeen                       186.0                       186.0
Abu Dhabi                      502.0                       502.0
Abuja                         1876.0                       790.0
Acapulco                      3587.0                      3587.0
Accra                          643.0                       643.0

           2019-09-16 12:14:03.140103  2019-09-16 20:11:48.235263  \
City
Aberdeen                       186.0                       186.0
Abu Dhabi                      502.0                       510.0
Abuja                          790.0                       790.0
Acapulco                      3587.0                      3587.0
Accra                          465.0                       465.0

           2019-09-16 20:27:21.839269  2019-09-17 09:44:16.044334  \
City
Aberdeen                       186.0                       186.0
Abu Dhabi                      510.0                       510.0
Abuja                          790.0                       790.0
Acapulco                      3587.0                      3587.0
Accra                          465.0                       465.0

           2019-09-17 09:47:57.780076  2019-09-17 14:01:20.505055  \
City
Aberdeen                       186.0                       186.0
Abu Dhabi                      510.0                       510.0
Abuja                          790.0                       790.0
Acapulco                      3587.0                      3603.0
Accra                          465.0                       717.0

           2019-09-17 14:01:25.940395  2019-09-17 14:01:55.559245
City
Aberdeen                       186.0                       186.0
Abu Dhabi                      510.0                       510.0
Abuja                          790.0                       790.0
```

```
Acapulco                        3603.0                        3603.0
Accra                            717.0                         717.0

[5 rows x 29 columns]
```

This chart summarizes the distribution of prices to each continent from the current scrape.

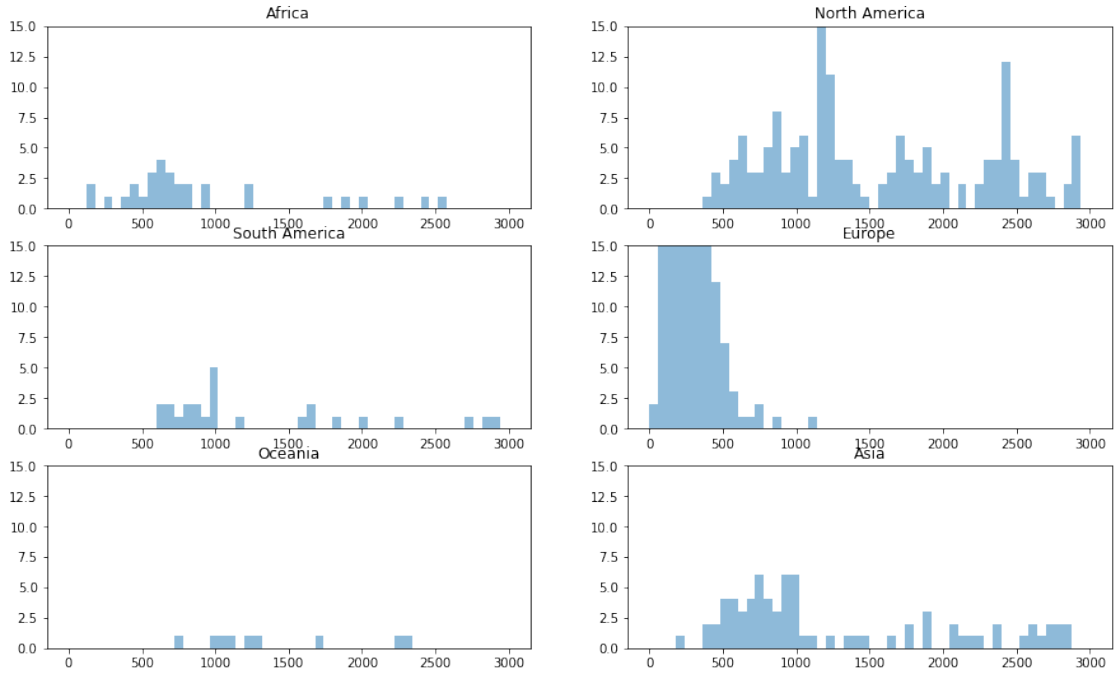
```
In [6]: %matplotlib inline
        %pylab inline
        pylab.rcParams['figure.figsize'] = (15, 9)

        continents = ['Africa', 'North America', 'South America',
                      'Europe', 'Oceania', 'Asia']
        plot_num = 1

        for continent in continents:
            plt.subplot(3,2,plot_num)
            axes = plt.gca()
            axes.set_ylim([0,15])
            df = flights_list.where(flights_list['Continent']==continent).dropna()
            plt.hist(df['Price'], bins=50, alpha=0.5, range=(0,3000))
            title = plt.gca().set_title(continent)
            plot_num += 1

        plt.show()
```

```
Populating the interactive namespace from numpy and matplotlib
```



The next chart is possibly more useful, because it tells us which cities in our regional destinations have a wide variability in flight prices. Cities for which the boxes are long or have many outliers may be worth paying additional attention to.

```
In [21]: dest_prices, labels = [], []

         # This lists cities from Hawaii and Japan to which flights are present in our
         # data frame.
         bp_cities = ['Honolulu', 'Kailua-Kona', 'Kahului', 'Lihue', 'Osaka', 'Nagoya',
                      'Tokyo', 'Sapporo', 'Okinawa']

         for city in bp_cities:
                 df = historical[historical.index.str.match(city)].T
                 if df.shape[1] > 0:
                     df = pd.Series(df[city]).tolist()
                     dest_prices.append(df)
                     labels.append(city)

         fig, ax = plt.subplots()
         ax.boxplot(dest_prices, labels=labels, whis=2)
         plt.ylabel('Price in USD')
         plt.show()
```