Rebecca Yedid, Elliot Heldman, Thomas Joppich

SI 206

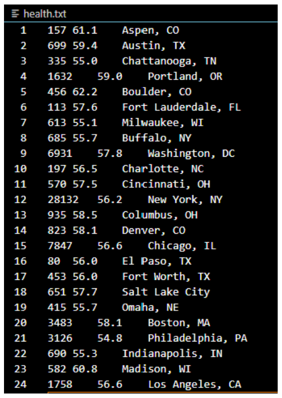
12/12/2023

Final Project Part 5 - Report

1. Our goals for this project began with our project proposal. Our group originally planned to work with four sources: a weather API containing data about the future weekly forecast, a weather API containing data about past weather, an API about city bikes and their use and quantity, and a website containing city data about the cities in which the bikes are held. The goals for these APIs and websites were to create data tables pertaining to the weather and data within cities in which there are city bikes, in order to find out why some cities may have more or less active bikes.
2. By the end of the project, we ended up using three of the four originally intended web sources. We achieved the goal of using the weather API containing data about future weekly forecasts, the city bike API about use and quantity, and the website containing city data in which bikes are held. We were able to successfully join the tables and relate the data for each city with the weather and bike quantity in order to attempt to analyze different aspects of the cities.
3. We faced some initial problems when accessing the data from both APIs due to unforeseen differences between them. One of these included having to access first an API within the API, which would then direct us to the data we were looking to gather into our tables. Another problem we faced was almost using Selenium to scrape our website with Beautiful Soup. We almost wasted bountiful time learning and using Selenium to scrape,

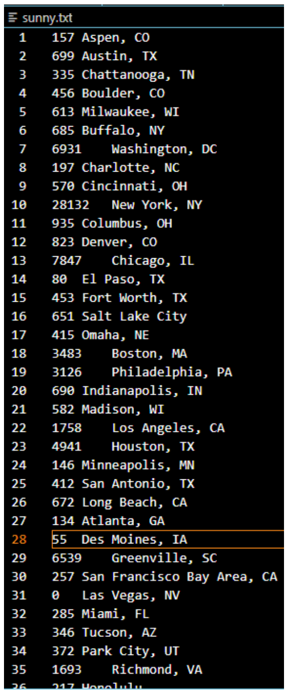
when we were then able to figure it out without having to do so. A final problem we faced was having to use integer keys to join our tables instead of the original string keys we had. We initially programmed all of our state listings in the table to format together to join over, but instead we had to update the tables to include integer keys to join over.

4.



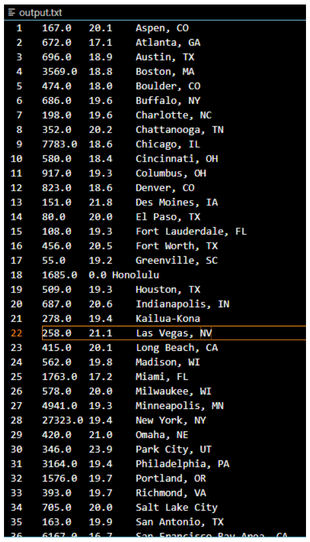
health.txt

```
157 61.1    Aspen, CO
699 59.4    Austin, TX
335 55.0    Chattanooga, TN
1632    59.0    Portland, OR
456 62.2    Boulder, CO
113 57.6    Fort Lauderdale, FL
613 55.1    Milwaukee, WI
685 55.7    Buffalo, NY
6931    57.8    Washington, DC
197 56.5    Charlotte, NC
570 57.5    Cincinnati, OH
28132   56.2    New York, NY
935 58.5    Columbus, OH
823 58.1    Denver, CO
7847    56.6    Chicago, IL
80  56.0    El Paso, TX
453 56.0    Fort Worth, TX
651 57.7    Salt Lake City
415 55.7    Omaha, NE
3483    58.1    Boston, MA
3126    54.8    Philadelphia, PA
690 55.3    Indianapolis, IN
582 60.8    Madison, WI
1758    56.6    Los Angeles, CA
```



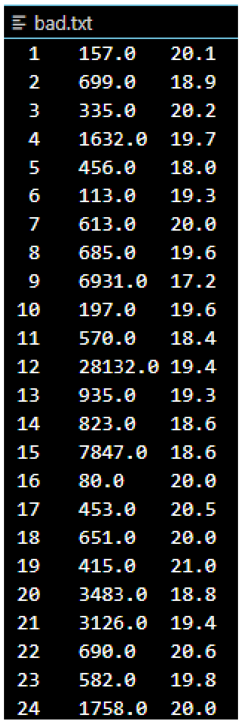
sunny.txt

```
157 Aspen, CO
699 Austin, TX
335 Chattanooga, TN
456 Boulder, CO
613 Milwaukee, WI
685 Buffalo, NY
6931    Washington, DC
197 Charlotte, NC
570 Cincinnati, OH
28132   New York, NY
935 Columbus, OH
823 Denver, CO
7847    Chicago, IL
80  El Paso, TX
453 Fort Worth, TX
651 Salt Lake City
415 Omaha, NE
3483    Boston, MA
3126    Philadelphia, PA
690 Indianapolis, IN
582 Madison, WI
1758    Los Angeles, CA
4941    Houston, TX
146 Minneapolis, MN
412 San Antonio, TX
672 Long Beach, CA
134 Atlanta, GA
55  Des Moines, IA
6539    Greenville, SC
257 San Francisco Bay Area, CA
0   Las Vegas, NV
285 Miami, FL
346 Tucson, AZ
372 Park City, UT
1693    Richmond, VA
```



output.txt

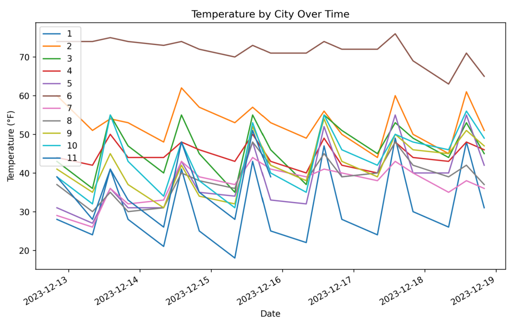
```
167.0   20.1    Aspen, CO
672.0   17.1    Atlanta, GA
696.0   18.9    Austin, TX
3569.0  18.8    Boston, MA
474.0   18.0    Boulder, CO
686.0   19.6    Buffalo, NY
198.0   19.6    Charlotte, NC
352.0   20.2    Chattanooga, TN
7783.0  18.6    Chicago, IL
580.0   18.4    Cincinnati, OH
917.0   19.3    Columbus, OH
823.0   18.6    Denver, CO
151.0   21.8    Des Moines, IA
80.0    20.0    El Paso, TX
108.0   19.3    Fort Lauderdale, FL
456.0   20.5    Fort Worth, TX
55.0    19.2    Greenville, SC
1685.0  0.0 Honolulu
509.0   19.3    Houston, TX
687.0   20.6    Indianapolis, IN
278.0   19.4    Kailua-Kona
258.0   21.1    Las Vegas, NV
415.0   20.1    Long Beach, CA
562.0   19.8    Madison, WI
1763.0  17.2    Miami, FL
578.0   20.0    Milwaukee, WI
4941.0  19.3    Minneapolis, MN
27323.0 19.4    New York, NY
420.0   21.0    Omaha, NE
346.0   23.9    Park City, UT
3164.0  19.4    Philadelphia, PA
1576.0  19.7    Portland, OR
393.0   19.7    Richmond, VA
705.0   20.0    Salt Lake City
163.0   19.9    San Antonio, TX
```

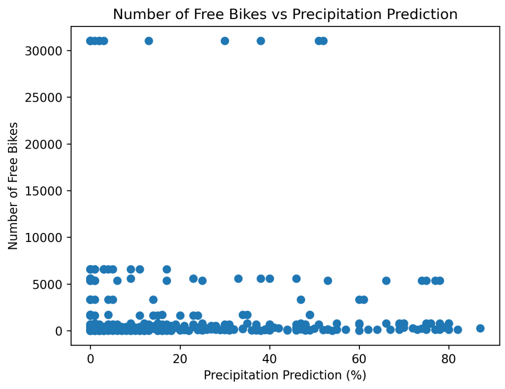


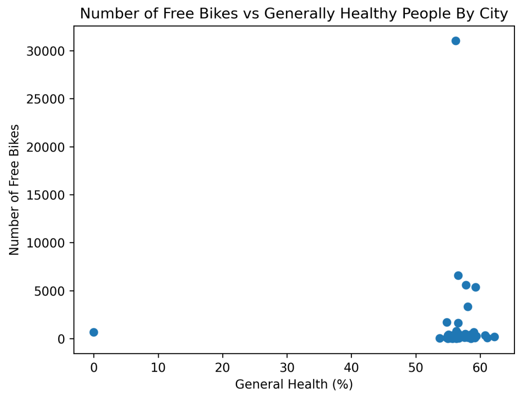
bad.txt

```
157.0   20.1
699.0   18.9
335.0   20.2
1632.0  19.7
456.0   18.0
113.0   19.3
613.0   20.0
685.0   19.6
6931.0  17.2
197.0   19.6
570.0   18.4
28132.0 19.4
935.0   19.3
823.0   18.6
7847.0  18.6
80.0    20.0
453.0   20.5
651.0   20.0
415.0   21.0
3483.0  18.8
3126.0  19.4
690.0   20.6
582.0   19.8
1758.0  20.0
```

5.







6. Instructions for Running Final Project Code:
    a. First, run the file called “city_bikes_part.py”. It will populate the CityBikes table from the CityBikes API. If you notice there are duplicate indices starting at around index 25 in the database, delete the database and run this file again.
    b. Second, run the file called “weather_part.py”. We created a commented out loop that will help with runtime as this function needs to be run 32 times (25 data points each). Feel free to comment it out to run one long loop instead. It will populate the WeatherCities table from the Weather API. If you see a few blank indices, this may result from time zone differences as the Weather API does get refreshed data every hour. This will not result in any future errors. You might also see some 500 or 503 errors, these will also not affect the code and are also caused by time differences.

c. Thirdly, run the file called “city_data.py”. It will populate the CityData table from the CityData website.

d. Next, run the file called “calculations.py”. It will create new tables called CityIndex, sqlite_sequence, and DescriptionIndex.

e. Finally, run the file called “visualizations.py”. It will pop up our three visualizations. The second shows up after the first is closed out, and the third after the fourth is closed out.

7. Function Descriptions

    a. Bikes_part.py

        i. get_city_bike_data(): this function navigates the created json file and gets the data from it for the base API data. It outputs the data in the base API to be then used later. It also actively error checks that the link it gets is not faulty.

        ii. load_json(): this function takes in the return of the get_new_data() function and outputs the actual data to be parsed by the make_SQL() function. It uses json.dump to do so.

        iii. set_up_database(): this function solely sets up the path to the database and returns the cur and conn values to be used in later work.

        iv. get_list_of_ids(): this function navigates the originally created API access to find the network ids. It uses the network ids to then go into those APIs and gather the secondary ids which get stored in a list. It then outputs that list to be used in a later function to gather more data for our table.

v. get_new_data(): this function takes in a url. It then checks the url validity before finding its data in the json file. After finding the data it returns the data to be used in a later function.

vi. make_SQL(): this function takes in the cur and conn for database usage . It then creates our BikeCities table and navigates through the listing of links given. Utilizing the get_new_data() and load_json() files, it gets all of our data needed for BikeCities and inserts it with a limit of 25 items to be inserted each time the file is run. After 25 unique items, it commits the changes to the database and ends.

vii. main(): we technically have our lines of code outside of a main function, but we use this space to run the above listed functions and create our database.

b. Weather_part.py

   i. get_coordinates_from_database(): this function takes in the path to the database as well as the cur and conn to sqlite. This functions gets us connected with the database, creates a cursor, and then retrieves all of the coordinates from the database we made in bikes_part.py. It then puts that data into a list and returns that list of coordinates.

   ii. get_links(): this function takes in the list made in get_coordinates_from_database(). It then creates a list for links and loops through all of the coordinates forming them into URLs to be placed in the list. It also does active error checking with a try and except statement to see if the link actually works. It then returns the list of links.

- iii. get_new_data(): this function takes in a url. It then checks the url validity before finding its data in the json file. After finding the data it returns the data to be used in a later function.
- iv. load_json(): this function takes in the return of the get_new_data() function and outputs the actual data to be parsed by the make_SQL() function. It uses json.dump to do so.
- v. make_SQL(): this function takes in the cur and conn for database usage as well as the list of links we created in get_links(). It then creates our WeatherCities table and navigates through the listing of links given. Utilizing the get_new_data() and load_json() files, it gets all of our data needed for WeatherCities and inserts it with a limit of 25 items to be inserted each time the file is run. After 25 unique items, it commits the changes to the database and ends.
- vi. main(): we technically have our lines of code outside of a main function, but we use this space to run the above listed functions and create our database.

c. City_data.py

- i. scrape_city(city): This function takes in the name of a U.S. city and returns a tuple with three health statistics: (city id, general health percentage, overweight population percentage, percentage of people who ‘feel badly about themselves’). The function appends the city name to the base url and accesses the city’s unique profile page on city-data.com.

Then, a beautiful soup object is created to parse the city's profile page for the health statistics.

ii. make_tup_list(city_list): This function takes in a list of US cities and returns a list of tuples generated by the scrape_city() function. The function iterates through the list of cities using a for loop, calling scrape_city() each time. Each tuple is appended to the return list (return_lst).

iii. make_SQL(data_list, cur, conn): This function takes in a list of data as well as cursor and connection items from sqlite3. A table is created called "Cityhealth" with four columns corresponding to the tuple values generated from scrape_city(). The list of tuples is iterated through using a for loop that inserts a row to the Cityhealth table for each city. The function limits the number of insertions to 25 on each call. After 25 rows are inserted, or when the end of the data_list is reached, the function commits and ends.

iv. main(): we technically have our lines of code outside of a main function, but we use this space to run the above listed functions and create our database.

d. Calculations.py

i. create_city_index(cur, conn): This function creates a table named CityIndex in the database, populates it with unique city names, and cleans up any empty entries.

ii. create_description_index(cur, conn): This function creates a table named DescriptionIndex in the database, populates it with unique weather descriptions, and cleans up any empty entries.

iii. update_weather(cur, conn): This function adds a new column called short_id to the WeatherCities table. It performs an update operation using information from the DescriptionIndex table to populate this new column.

iv. Calculations Functions:

   1. calculate_bikes_bad(cur, conn): Calculates the average number of empty bike slots and the average percentage of people feeling bad about themselves for each city and returns the result.
   2. calculate_sunny(cur, conn): Calculates the number of empty bike slots for cities with the weather described as "Sunny" and returns the result.
   3. calculate_bikes_genhealth(cur, conn): Calculates the number of empty bike slots and the general health percentage for each city and returns the result.

v. write_results_to_file(results, output_file_path) and write_results_to_file_health(results, output_file_path): These functions write the calculation results to text files.

vi. The script then connects to the database, creates indexes, updates weather data, performs calculations related to bike slots, weather conditions, and health percentages for cities, and writes these results to separate output files (sunny.txt, health.txt, bad.txt).

e. Visualization.py

   i. fetch_weather_data_from_db(database_path): This function connects to the specified SQLite database, retrieves weather data (city, date, hour, temperature) from the WeatherCities table, limits the data to 200 entries, stores it in a Pandas DataFrame, and returns it.

   ii. plot_temperature_by_city(df): This function takes the weather data DataFrame, converts the date and hour columns to a datetime format, groups the data by city, and plots the temperature over time for each city.

   iii. fetch_weather_bike_data(database_path): This function retrieves data from both the WeatherCities and BikeCities tables by performing a join on the 'city' column and returns a DataFrame containing city, precipitation, and the number of free bikes.

   iv. plot_bikes_precip_scatter(df): This function takes the weather-bike data DataFrame and creates a scatter plot showing the relationship between precipitation prediction and the number of free bikes across cities.

   v. fetch_health_bike_data(database_path): This function retrieves data from the CityHealth and BikeCities tables by performing a join on the 'city' column and returns a DataFrame containing city, general health percentage, and the number of free bikes.

   vi. plot_bikes_health_scatter(df): This function takes the health-bike data DataFrame and creates a scatter plot showing the relationship between the general health percentage and the number of free bikes across cities.

vii. main(): fetches weather data, creates temperature plots by city, fetches weather-bike and health-bike data, and creates scatter plots to visualize relationships between weather factors, health percentages, and the availability of free bikes in different cities.

8. Documentation of All Resources Used

Date	Issue Description	Location of Resource	Result
12/05	Having trouble error checking as to why our sites were getting faulty links and giving errors.	ChatGPT	Found that we could use an error checking try and except function which we then implemented.
12/11	Help with errors in normalization in our integer key between our tables.	Office Hours	Unable to receive help because office hours ended up being closed.
12/05	Needed help creating SQL	Class Notes/Slides	Found lab slides and homework

	database, table, and inserting items		projects with the necessary information.
12/03-12/12	Needed information from the API in order to create data tables every time we ran our code daily.	Weather API	Gathered data on the 40 US Cities hourly weather which updated every hour as well, to be used in calculations and visualizations.
12/03-12/12	Needed health data for US cities	City Data Website	Gathered health data on 40 US cities that can be used in calculations and visualizations.
12/03-12/12	Needed information about city bike availability in US cities	City Bike API	Gathered data on 40 US cities pertaining to bike rental availability