Create a Web Application for an ETF Analyzer

In this Challenge assignment, you'll build a financial database and web application by using SQL, Python, and the Voilà library to analyze the performance of a hypothetical fintech ETF.

Instructions:

Use this notebook to complete your analysis of a fintech ETF that consists of four stocks: GOST, GS, PYPL, and SQ. Each stock has its own table in the `etf.db` database, which the `Starter_Code` folder also contains.

Analyze the daily returns of the ETF stocks both individually and as a whole. Then deploy the visualizations to a web application by using the Voilà library.

The detailed instructions are divided into the following parts:

- Analyze a single asset in the ETF
- Optimize data access with Advanced SQL queries
- Analyze the ETF portfolio
- Deploy the notebook as a web application

Analyze a Single Asset in the ETF

For this part of the assignment, you'll use SQL queries with Python, Pandas, and hvPlot to analyze the performance of a single asset from the ETF.

Complete the following steps:

1. Write a SQL `SELECT` statement by using an f-string that reads all the PYPL data from the database. Using the SQL `SELECT` statement, execute a query that reads the PYPL data from the database into a Pandas DataFrame.
2. Use the `head` and `tail` functions to review the first five and the last five rows of the DataFrame. Make a note of the beginning and end dates that are available from this dataset. You'll use this information to complete your analysis.
3. Using hvPlot, create an interactive visualization for the PYPL daily returns. Reflect the "time" column of the DataFrame on the x-axis. Make sure that you professionally style and format your visualization to enhance its readability.
4. Using hvPlot, create an interactive visualization for the PYPL cumulative returns. Reflect the "time" column of the DataFrame on the x-axis. Make sure that you professionally style and format your visualization to enhance its readability.

Optimize Data Access with Advanced SQL Queries

For this part of the assignment, you'll continue to analyze a single asset (PYPL) from the ETF. You'll use advanced SQL queries to optimize the efficiency of accessing data from the database.

Complete the following steps:

1. Access the closing prices for PYPL that are greater than 200 by completing the following steps:
    - Write a SQL `SELECT` statement to select the dates where the PYPL closing price was higher than 200.0.
    - Using the SQL statement, read the data from the database into a Pandas DataFrame, and then review the resulting DataFrame.
    - Select the "time" and "close" columns for those dates where the closing price was higher than 200.0.
2. Find the top 10 daily returns for PYPL by completing the following steps:
    - Write a SQL statement to find the top 10 PYPL daily returns. Make sure to do the following:
        - Use `SELECT` to select only the "time" and "daily_returns" columns.
        - Use `ORDER` to sort the results in descending order by the "daily_returns" column.
        - Use `LIMIT` to limit the results to the top 10 daily return values.
    - Using the SQL statement, read the data from the database into a Pandas DataFrame, and then review the resulting DataFrame.

Analyze the ETF Portfolio

For this part of the assignment, you'll build the entire ETF portfolio and then evaluate its performance. To do so, you'll build the ETF portfolio by using SQL joins to combine all the data for each asset.

Complete the following steps:

1. Write a SQL query to join each table in the portfolio into a single DataFrame. To do so, complete the following steps:
    - Use a SQL inner join to join each table on the "time" column. Access the "time" column in the `GDOT` table via the `GDOT.time` syntax. Access the "time" columns from the other tables via similar syntax.
    - Using the SQL query, read the data from the database into a Pandas DataFrame. Review the resulting DataFrame.
2. Create a DataFrame that averages the "daily_returns" columns for all four assets. Review the resulting DataFrame.

    > **Hint** Assuming that this ETF contains equally weighted returns, you can average the returns for each asset to get the average returns of the portfolio. You can then use the average returns of the portfolio to calculate the annualized returns and the cumulative returns. For the calculation to get the average daily returns for the portfolio, use the following code:
    >
    > ```
    > etf_portfolio_returns = etf_portfolio['daily_returns'].mean(axis=1)
    > ```

> You can use the average daily returns of the portfolio the same way that you used the daily returns of a single asset.

3. Use the average daily returns in the `etf_portfolio_returns` DataFrame to calculate the annualized returns for the portfolio. Display the annualized return value of the ETF portfolio.

> **Hint** To calculate the annualized returns, multiply the mean of the `etf_portfolio_returns` values by 252.
>
> To convert the decimal values to percentages, multiply the results by 100.

1. Use the average daily returns in the `etf_portfolio_returns` DataFrame to calculate the cumulative returns of the ETF portfolio.

2. Using hvPlot, create an interactive line plot that visualizes the cumulative return values of the ETF portfolio. Reflect the "time" column of the DataFrame on the x-axis. Make sure that you professionally style and format your visualization to enhance its readability.

Deploy the Notebook as a Web Application

For this part of the assignment, complete the following steps:

1. Use the Voilà library to deploy your notebook as a web application. You can deploy the web application locally on your computer.

2. Take a screen recording or screenshots to show how the web application appears when using Voilà. Include the recording or screenshots in the `README.md` file for your GitHub repository.

Review the following code which imports the required libraries, initiates your SQLite database, popluates the database with records from the `etf.db` seed file that was included in your Starter_Code folder, creates the database engine, and confirms that data tables that it now contains.

```
['GDOT', 'GS', 'PYPL', 'SQ']
```

Analyze a single asset in the FinTech ETF

For this part of the assignment, you'll use SQL queries with Python, Pandas, and hvPlot to analyze the performance of a single asset from the ETF.

Complete the following steps:

1. Write a SQL `SELECT` statement by using an f-string that reads all the PYPL data from the database. Using the SQL `SELECT` statement, execute a query that reads the PYPL data from the database into a Pandas DataFrame.

2. Use the `head` and `tail` functions to review the first five and the last five rows of the DataFrame. Make a note of the beginning and end dates that are available from this dataset. You'll use this information to complete your analysis.

3. Using hvPlot, create an interactive visualization for the PYPL daily returns. Reflect the "time" column of the DataFrame on the x-axis. Make sure that you professionally style and format your visualization to enhance its readability.

4. Using hvPlot, create an interactive visualization for the PYPL cumulative returns. Reflect the "time" column of the DataFrame on the x-axis. Make sure that you professionally style and format your visualization to enhance its readability.

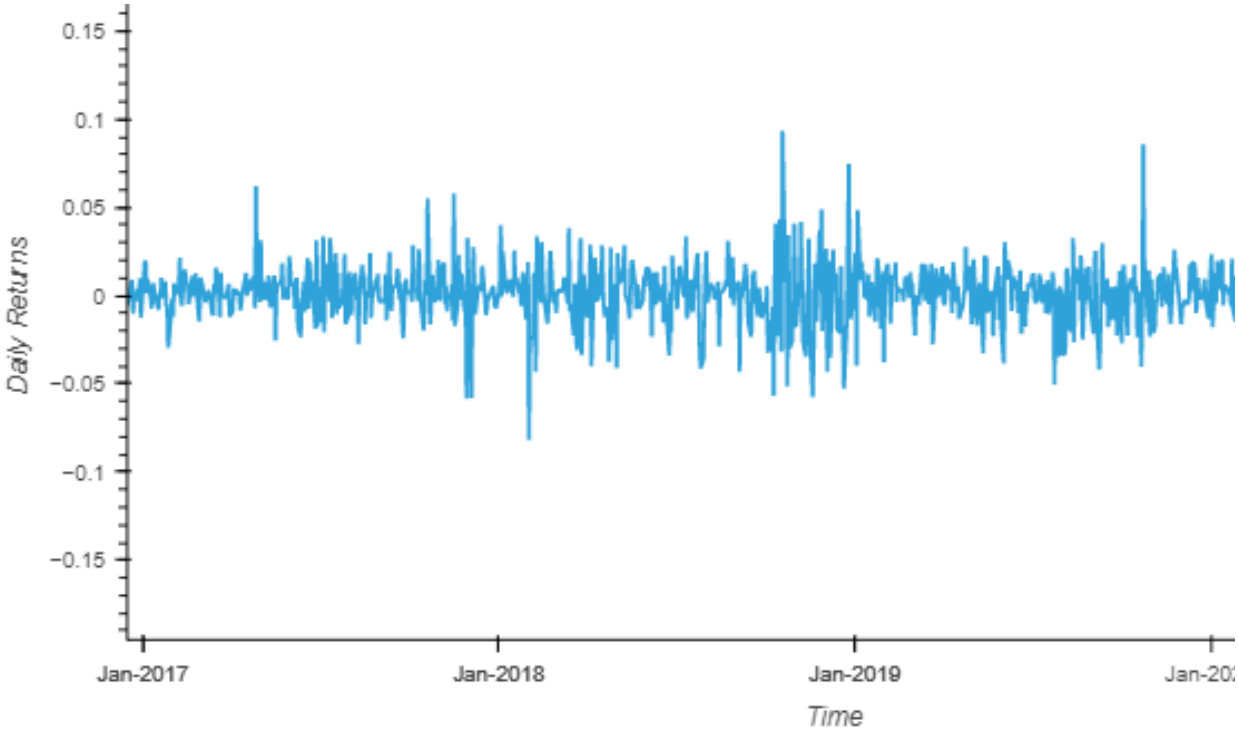
Step 1: Write a SQL `SELECT` statement by using an f-string that reads all the PYPL data from the database. Using the SQL `SELECT` statement, execute a query that reads the PYPL data from the database into a Pandas DataFrame.

Step 2: Use the `head` and `tail` functions to review the first five and the last five rows of the DataFrame. Make a note of the beginning and end dates that are available from this dataset. You'll use this information to complete your analysis.

	time	open	high	low	close	volume	daily_returns
0	2016-12-16 00:00:00.000000	39.90	39.90	39.12	39.32	7298861	-0.005564
1	2016-12-19 00:00:00.000000	39.40	39.80	39.11	39.45	3436478	0.003306
2	2016-12-20 00:00:00.000000	39.61	39.74	39.26	39.74	2940991	0.007351
3	2016-12-21 00:00:00.000000	39.84	40.74	39.82	40.09	5826704	0.008807
4	2016-12-22 00:00:00.000000	40.04	40.09	39.54	39.68	4338385	-0.010227

	time	open	high	low	close	volume	daily_returns
994	2020-11-30 00:00:00.000000	212.51	215.83	207.0900	214.200	8992681	0.013629
995	2020-12-01 00:00:00.000000	217.15	220.57	214.3401	216.520	9148174	0.010831
996	2020-12-02 00:00:00.000000	215.60	215.75	210.5000	212.660	6414746	-0.017827
997	2020-12-03 00:00:00.000000	213.33	216.93	213.1100	214.680	6463339	0.009499
998	2020-12-04 00:00:00.000000	214.88	217.28	213.0100	217.235	2118319	0.011901

Step 3: Using hvPlot, create an interactive visualization for the PYPL daily returns. Reflect the "time" column of the DataFrame on the x-axis. Make sure that you professionally style and format your visualization to enhance its readability.



Step 4: Using hvPlot, create an interactive visualization for the PYPL cumulative returns. Reflect the "time" column of the DataFrame on the x-axis. Make sure that you professionally style and format your visualization to enhance its readability.

Optimize the SQL Queries

For this part of the assignment, you'll continue to analyze a single asset (PYPL) from the ETF. You'll use advanced SQL queries to optimize the efficiency of accessing data from the database.

Complete the following steps:

1. Access the closing prices for PYPL that are greater than 200 by completing the following steps:

2. Access the closing prices for PYPL that are greater than 200 by completing the following steps:

    - Write a SQL `SELECT` statement to select the dates where the PYPL closing price was higher than 200.0.
    - Select the "time" and "close" columns for those dates where the closing price was higher than 200.0.
    - Using the SQL statement, read the data from the database into a Pandas DataFrame, and then review the resulting DataFrame.

3. Find the top 10 daily returns for PYPL by completing the following steps:

    - Write a SQL statement to find the top 10 PYPL daily returns. Make sure to do the following:
        - Use `SELECT` to select only the "time" and "daily_returns" columns.
        - Use `ORDER` to sort the results in descending order by the "daily_returns" column.
        - Use `LIMIT` to limit the results to the top 10 daily return values.
    - Using the SQL statement, read the data from the database into a Pandas DataFrame, and then review the resulting DataFrame.

Step 1: Access the closing prices for PYPL that are greater than 200 by completing the following steps:

- Write a SQL `SELECT` statement to select the dates where the PYPL closing price was higher than 200.0.
- Select the "time" and "close" columns for those dates where the closing price was higher than 200.0.
- Using the SQL statement, read the data from the database into a Pandas DataFrame, and then review the resulting DataFrame.

time	close
2020-08-05	202.92
2020-08-06	204.09
2020-08-25	201.71
2020-08-26	203.53
2020-08-27	204.34

Step 2: Find the top 10 daily returns for PYPL by completing the following steps:

- Write a SQL statement to find the top 10 PYPL daily returns. Make sure to do the following:
  - Use `SELECT` to select only the "time" and "daily_returns" columns.
  - Use `ORDER` to sort the results in descending order by the "daily_returns" column.
  - Use `LIMIT` to limit the results to the top 10 daily return values.
- Using the SQL statement, read the data from the database into a Pandas DataFrame, and then review the resulting DataFrame.

time	daily_returns
2020-03-16	-0.164673
2020-11-09	-0.088792
2020-03-09	-0.084491
2018-02-01	-0.081806
2020-03-20	-0.074228
2020-03-27	-0.070960
2020-03-12	-0.067013
2020-03-18	-0.065495
2020-09-04	-0.063881
2017-11-29	-0.058361

Analyze the Fintech ETF Portfolio

For this part of the assignment, you'll build the entire ETF portfolio and then evaluate its performance. To do so, you'll build the ETF portfolio by using SQL joins to combine all the data for each asset.

Complete the following steps:

1. Write a SQL query to join each table in the portfolio into a single DataFrame. To do so, complete the following steps:

   - Use a SQL inner join to join each table on the "time" column. Access the "time" column in the `GDOT` table via the `GDOT.time` syntax. Access the "time" columns from the other tables via similar syntax.

   - Using the SQL query, read the data from the database into a Pandas DataFrame. Review the resulting DataFrame.

2. Create a DataFrame that averages the "daily_returns" columns for all four assets. Review the resulting DataFrame.

   > **Hint** Assuming that this ETF contains equally weighted returns, you can average the returns for each asset to get the average returns of the portfolio. You can then use the average returns of the portfolio to calculate the annualized returns and the cumulative returns. For the calculation to get the average daily returns for the portfolio, use the following code:

```
etf_portfolio_returns = etf_portfolio['daily_returns'].mean(axis=1)
```

You can use the average daily returns of the portfolio the same way that you used the daily returns of a single asset.

3. Use the average daily returns in the `etf_portfolio_returns` DataFrame to calculate the annualized returns for the portfolio. Display the annualized return value of the ETF portfolio.

> **Hint** To calculate the annualized returns, multiply the mean of the `etf_portfolio_returns` values by 252.
>
> To convert the decimal values to percentages, multiply the results by 100.

1. Use the average daily returns in the `etf_portfolio_returns` DataFrame to calculate the cumulative returns of the ETF portfolio.

2. Using hvPlot, create an interactive line plot that visualizes the cumulative return values of the ETF portfolio. Reflect the "time" column of the DataFrame on the x-axis. Make sure that you professionally style and format your visualization to enhance its readability.

Step 1: Write a SQL query to join each table in the portfolio into a single DataFrame. To do so, complete the following steps:

- Use a SQL inner join to join each table on the "time" column. Access the "time" column in the `GDOT` table via the `GDOT.time` syntax. Access the "time" columns from the other tables via similar syntax.
- Using the SQL query, read the data from the database into a Pandas DataFrame. Review the resulting DataFrame.

	time	open	high	low	close	volume	daily_returns	time	open	high	...	
0	2016-12-16 00:00:00.000000	24.41	24.7300	23.9400	23.980	483544	-0.023218	2016-12-16 00:00:00.000000	242.80	243.1900	...	3
1	2016-12-19 00:00:00.000000	24.00	24.0100	23.5500	23.790	288149	-0.007923	2016-12-19 00:00:00.000000	238.34	239.7400	...	3
2	2016-12-20 00:00:00.000000	23.75	23.9400	23.5800	23.820	220341	0.001261	2016-12-20 00:00:00.000000	240.52	243.6500	...	3
3	2016-12-21 00:00:00.000000	23.90	23.9700	23.6900	23.860	249189	0.001679	2016-12-21 00:00:00.000000	242.24	242.4000	...	4
4	2016-12-22 00:00:00.000000	23.90	24.0100	23.7000	24.005	383139	0.006077	2016-12-22 00:00:00.000000	241.23	242.8600	...	3
...	...	...	...	...	...	...	...	...	...	...	...	
994	2020-11-30 00:00:00.000000	55.87	56.0899	53.1100	53.550	361004	-0.043750	2020-11-30 00:00:00.000000	232.05	235.0000	...	21
995	2020-12-01 00:00:00.000000	54.00	54.2500	52.0007	53.790	546792	0.004482	2020-12-01 00:00:00.000000	231.96	234.8704	...	21
996	2020-12-02 00:00:00.000000	53.20	53.7900	50.9400	52.320	479868	-0.027328	2020-12-02 00:00:00.000000	232.08	238.1300	...	21

	time	open	high	low	close	volume	daily_returns	time	open	high	...	
997	2020-12-03 00:00:00.000000	52.48	54.1600	52.0200	53.760	474175	0.027523	2020-12-03 00:00:00.000000	237.29	238.8500	...	21
998	2020-12-04 00:00:00.000000	53.87	54.1900	53.0850	53.860	83596	0.001860	2020-12-04 00:00:00.000000	237.70	239.6400	...	21

999 rows × 28 columns

Step 2: Create a DataFrame that averages the “daily_returns” columns for all four assets. Review the resulting DataFrame.

	average_daily_returns
0	-0.007038
1	-0.001216
2	0.008567
3	-0.001004
4	-0.008243
...	...
994	-0.014635
995	-0.003990
996	-0.006288
997	0.011246
998	0.009108

999 rows × 1 columns

Step 3: Use the average daily returns in the etf_portfolio_returns DataFrame to calculate the annualized returns for the portfolio. Display the annualized return value of the ETF portfolio.

	average_daily_returns
0	-1.773496
1	-0.306518
2	2.158814
3	-0.252987
4	-2.077206
...	...
994	-3.688025

	average_daily_returns
995	-1.005606
996	-1.584645
997	2.834002
998	2.295281

999 rows × 1 columns

Step 4: Use the average daily returns in the `etf_portfolio_returns` DataFrame to calculate the cumulative returns of the ETF portfolio.

```
average_daily_returns    437.834451
Name: 998, dtype: float64
```

Step 5: Using hvPlot, create an interactive line plot that visualizes the cumulative return values of the ETF portfolio. Reflect the "time" column of the DataFrame on the x-axis. Make sure that you professionally style and format your visualization to enhance its readability.