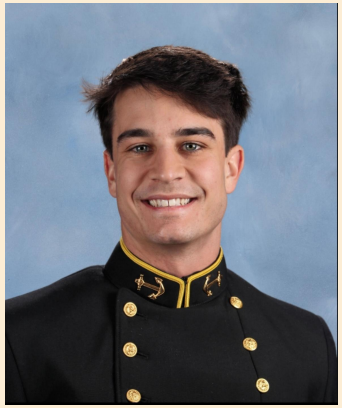
Info Challenge
DC Metro

MIDN 3/C Mallory, Nelson, Shuchman

MindPetal

About us

Johnny Mallory-
College: USNA
Hometown: Buffalo, NY
Sport/ECA: Intramural Basketball (Current Brigade 4th Place Associate Captain)



Dylan Nelson-
College: USNA
Hometown: Virginia Beach
Sport/ECA: Club Baseball

Isaiah Shuchman -
College: USNA
Hometown: Philadelphia, PA
Sport/ECA: Heavyweight Rowing

Our Data Science Pipeline

01 Data Acquisition

02 Data Processing

03 Data Analysis

04 Data Visualization

Our Problem

We set out to determine patterns of ridership during specific events/times. Our focus remained on Friday and Saturday nights when DC bar areas are packed.]

We set out to create a metro pathway home for these individuals to get home with safer and cheaper options than uber or deciding to recklessly drive.

Popular Stations

Dupont, Foggy Bottom, Gallery Place, Navy Yard, Rosslyn, Tentley Town, Woodley Park (mostly used by college students or locals at these hours on weekends)

Entries (Evenings and Late Nights)

Comparing Entries at particular times to find the most potentially used paths.

Exits (Evenings and Late Nights)

Comparing Exits to reveal how stations could be used more at late nights.

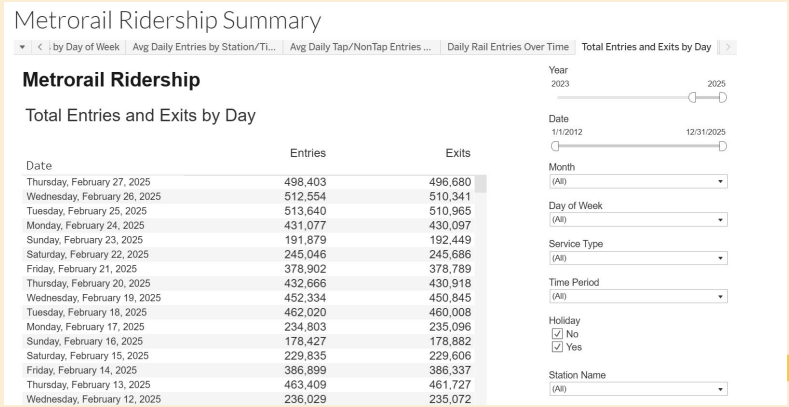
How we did it

Collect more data

We specified day of week (W, F, Sa), changed time periods, and checked each desired station to use as comparison.

Scraping

Downloaded and cleaned data on csv files.


Metrorail Ridership Summary

by Day of Week | Avg Daily Entries by Station/Ti... | Avg Daily Tap/NonTap Entries ... | Daily Rail Entries Over Time | Total Entries and Exits by Day

Metrorail Ridership

Total Entries and Exits by Day

Date	Entries	Exits
Thursday, February 27, 2025	498,403	496,680
Wednesday, February 26, 2025	512,554	510,341
Tuesday, February 25, 2025	513,640	510,965
Monday, February 24, 2025	431,077	430,097
Sunday, February 23, 2025	191,879	192,449
Saturday, February 22, 2025	245,046	245,686
Friday, February 21, 2025	378,902	378,789
Thursday, February 20, 2025	432,666	430,918
Wednesday, February 19, 2025	452,334	450,845
Tuesday, February 18, 2025	462,020	460,008
Monday, February 17, 2025	234,803	235,096
Sunday, February 16, 2025	178,427	178,882
Saturday, February 15, 2025	229,835	229,606
Friday, February 14, 2025	386,899	386,337
Thursday, February 13, 2025	463,409	461,727
Wednesday, February 12, 2025	236,029	235,072

Year: 2023 – 2025

Date: 1/1/2012 – 12/31/2025

Month: (All)

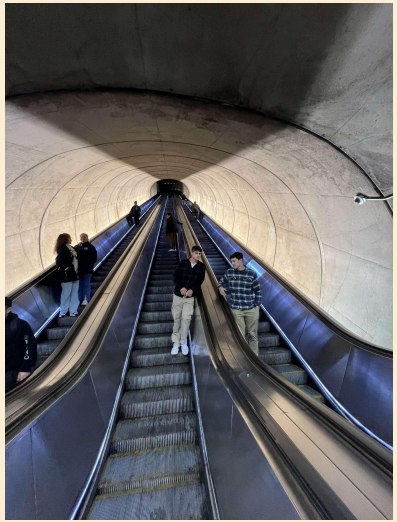
Day of Week: (All)

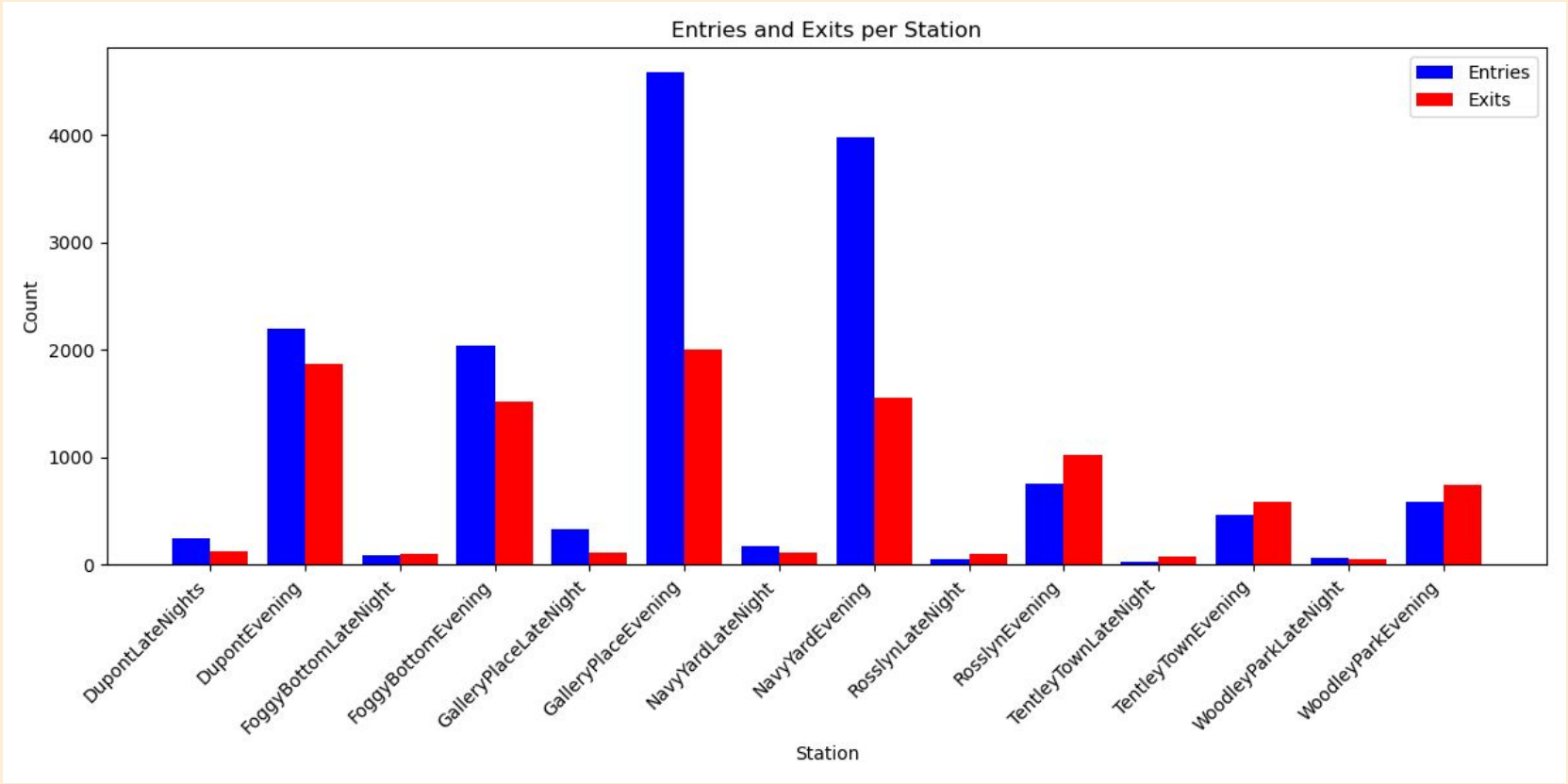
Service Type: (All)

Time Period: (All)

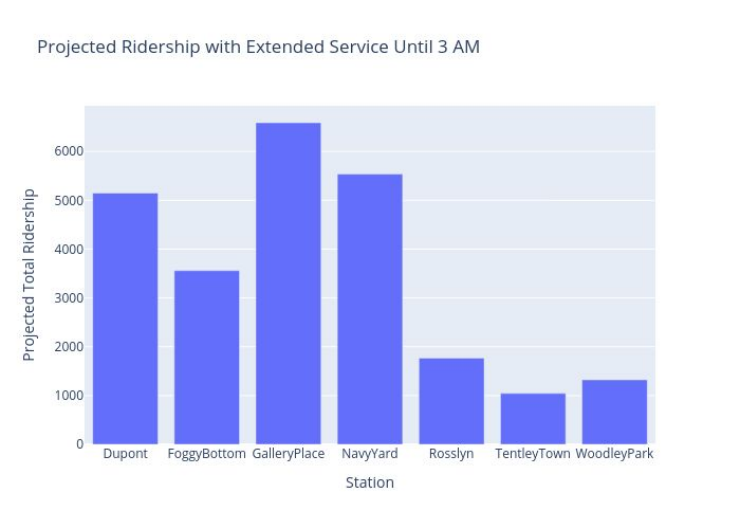
Holiday: ☑ No ☑ Yes

Station Name: (All)




Entries and Exits per Station
Entries
Exits
Count
0
1000
2000
3000
4000
DupontLateNights
DupontEvening
FoggyBottomLateNight
FoggyBottomEvening
GalleryPlaceLateNight
GalleryPlaceEvening
NavyYardLateNight
NavyYardEvening
RosslynLateNight
RosslynEvening
TentleyTownLateNight
TentleyTownEvening
WoodleyParkLateNight
WoodleyParkEvening
Station

Ridership Projection

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Projected Ridership by Station:
Time         Station  Projected
0             Dupont   5147.062
1        FoggyBottom   3559.000
2      GalleryPlace   6588.723
3           NavyYard   5535.249
4             Rosslyn   1768.580
5         TentleyTown   1043.481
6        WoodleyPark   1322.518
```

- Determine projected ridership for each station type
- **Non-Nightlife:**

  Evening + Late Night = Projected
- **Nightlife:**

  Evening + 3(Late Night) = Projected

Edsger Dijkstra's algorithm

Edsger W. Dijkstra

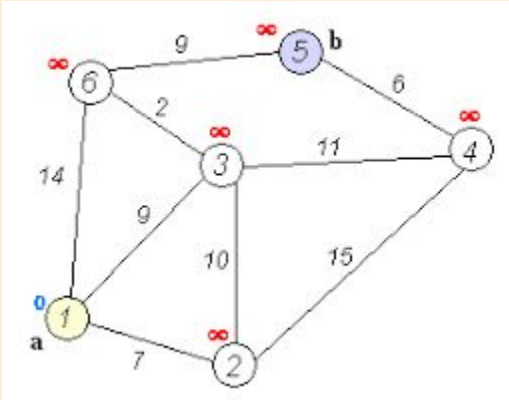
Edsger W. Dijkstra was a pioneering computer scientist whose work on algorithms and contributions to structured programming profoundly shaped the field of computer science.

What it does?

Find the shortest paths between nodes in a weighted graph, which may represent, for example, a road network

How it applies

Allows us to look at different metro stops and create a new path that is more efficient



Our Algorithm

Graph Setup & Initialization:

- Model transit stations as nodes and travel times as weighted edges; initialize the source node with a distance of zero and all other nodes with infinity.

Selection of the Nearest Node:

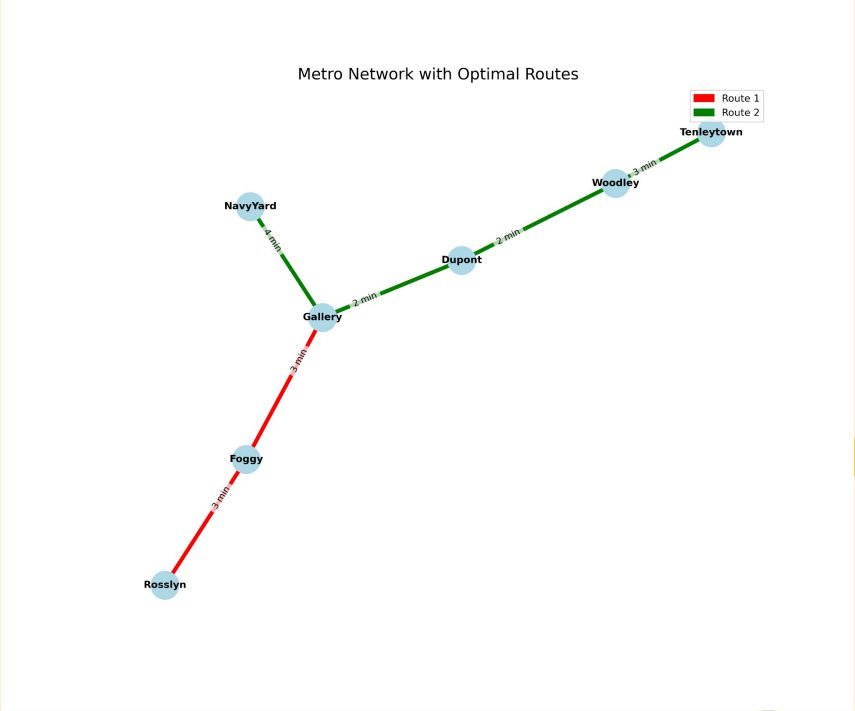
- Iteratively choose the unvisited node with the smallest current distance from the source.

Edge Relaxation:

- For the chosen node, update the distances of its neighbors if a shorter path is found through it, recording predecessors for path reconstruction.

Completion & Path Reconstruction:

- Repeat until the target is reached (or all nodes are visited), then backtrack using the recorded predecessors to assemble the optimal route.



Case studies

Case 1	The study also ranked D.C. in the top 5 worst drivers in the U.S. for 2024, with 54.6 driving incidents per 1,000 drivers.
Case 2	A study ranked Washington, D.C. as having a DUI rate of 3.6 DUIs per 1,000 drivers.
Case 3	In 2024, there were approximately 1 million DUI arrests in the United States, with alcohol-related crashes causing more than 13,000 deaths.

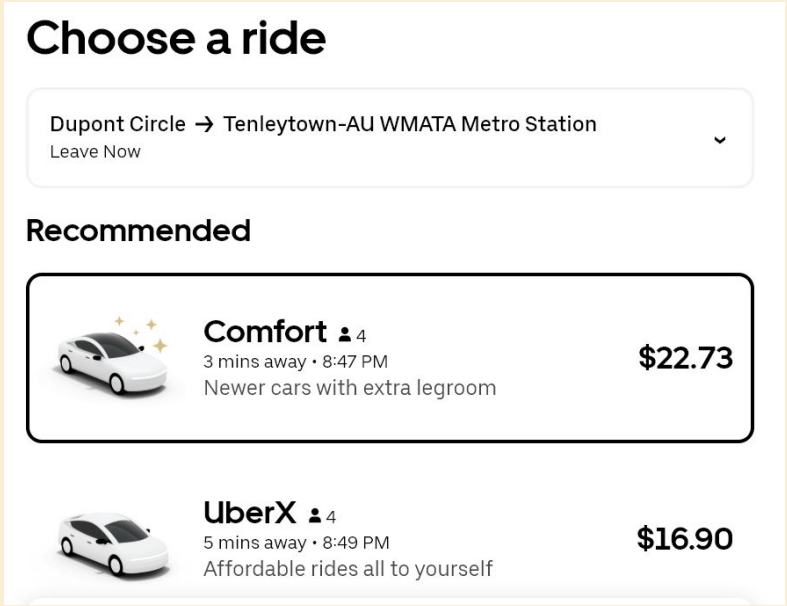
Price & Environmental Comparison

90.1% Reduced Cost

Metrorail		
	Regular Fare	Reduced Fare*
Weekday (5:00 a.m. - 9:30 p.m.)	$2.25 - $6.75	$1.10 - $3.35
Weekday (After 9:30 p.m.) Weekends	$2.25 - $2.50	$1.10 - $1.25

Metrobus		
	Regular Fare	Reduced Fare*
Regular Routes	$2.25	$1.10
Express Routes	$4.80	$2.40

Metro Prices Compared to Typical Uber Prices at Similar Distances



Produces 76% fewer greenhouse gas emissions per passenger mile than single-occupancy vehicles (SOVs)

Marketing

- Extending late-night Metrorail service would incur additional operational expenditures.
- The potential economic benefits include increased tax revenue, job creation, and enhanced property values.
- Expansion would stimulate significant growth in tourism by improving accessibility and enhancing the visitor experience.
- Safe and reliable late-night transit options would likely boost participation in the city's nightlife economy, amplifying its overall economic impact.

For example, Gallery Place increases potential ridership from 4500 to 6500 for entries increases profit by about 44% . This ensures a comparison of the DC metro station bringing in an estimated $11,250 in the evening in contrast to a potential $16,250 by using our pathway we created using the Dijkstra algorithm.

8,000

Additional Riders per average weekend night

$20,000

Additional gross revenue per average weekend night

$2.08M

Additional gross revenue from one year of weekend service

Cost Assessment/Analysis

- Running one subway car for an hour costs ~$250
  - 3 cars per line and two lines brings overhead to $1500/hr
  - Per night costs are $4500
- As the cars typically stop running at 1 AM, there would be no necessity in extra investment in more cars.
- The extension of the DC metro running at late night would not increase taxes for VMATA.
- However, there would be indirect tax revenue benefits since the economy would be stimulated due to easier access for individuals to participate in nightlife.
- In addition to this, the increase in nightlife activity would attract more individuals from 20–30 to the DC area since it would improve DC's reputation for low DUI rates and bring attention to more events in the region.

Citations

- https://www.wmata.com/initiatives/ridership-portal/Metrorail-Ridership-Summary.cfm
- https://plotly.com/python-api-reference/
- https://networkx.org/documentation/stable/reference/index.html
- https://pandas.pydata.org/docs/
- https://matplotlib.org/stable/index.html
- https://docs.python.org/3/library/os.path.html
- https://www.marketplace.org/2019/04/11/subways-us-expensive-cost-comparison/
- Chat GPT (Open AI) – was used for troubleshooting code syntax and understanding theory

Thank you!

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