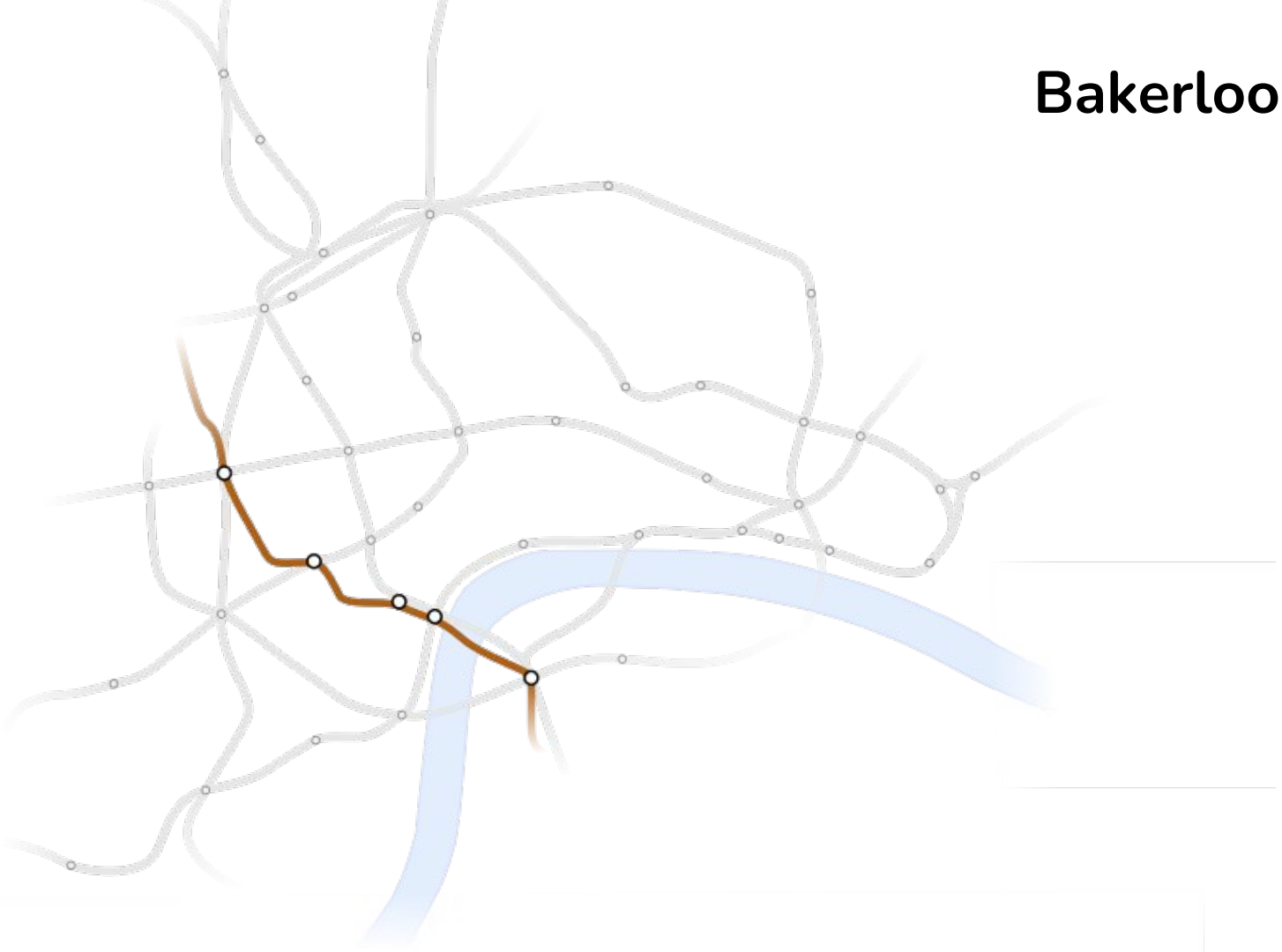
# All Lines, All Ways

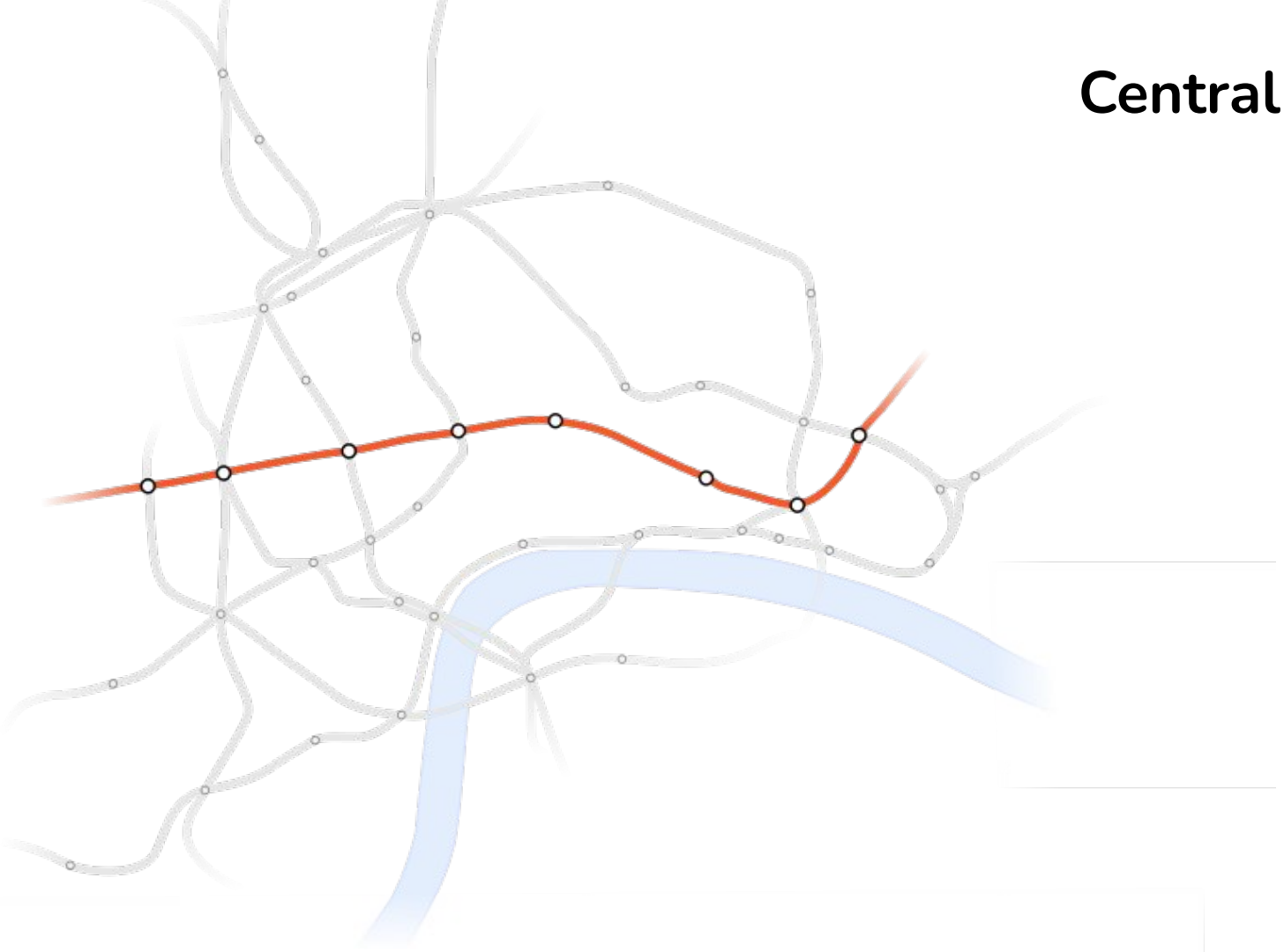
Ally Stanley

# London Underground

# Bakerloo Line

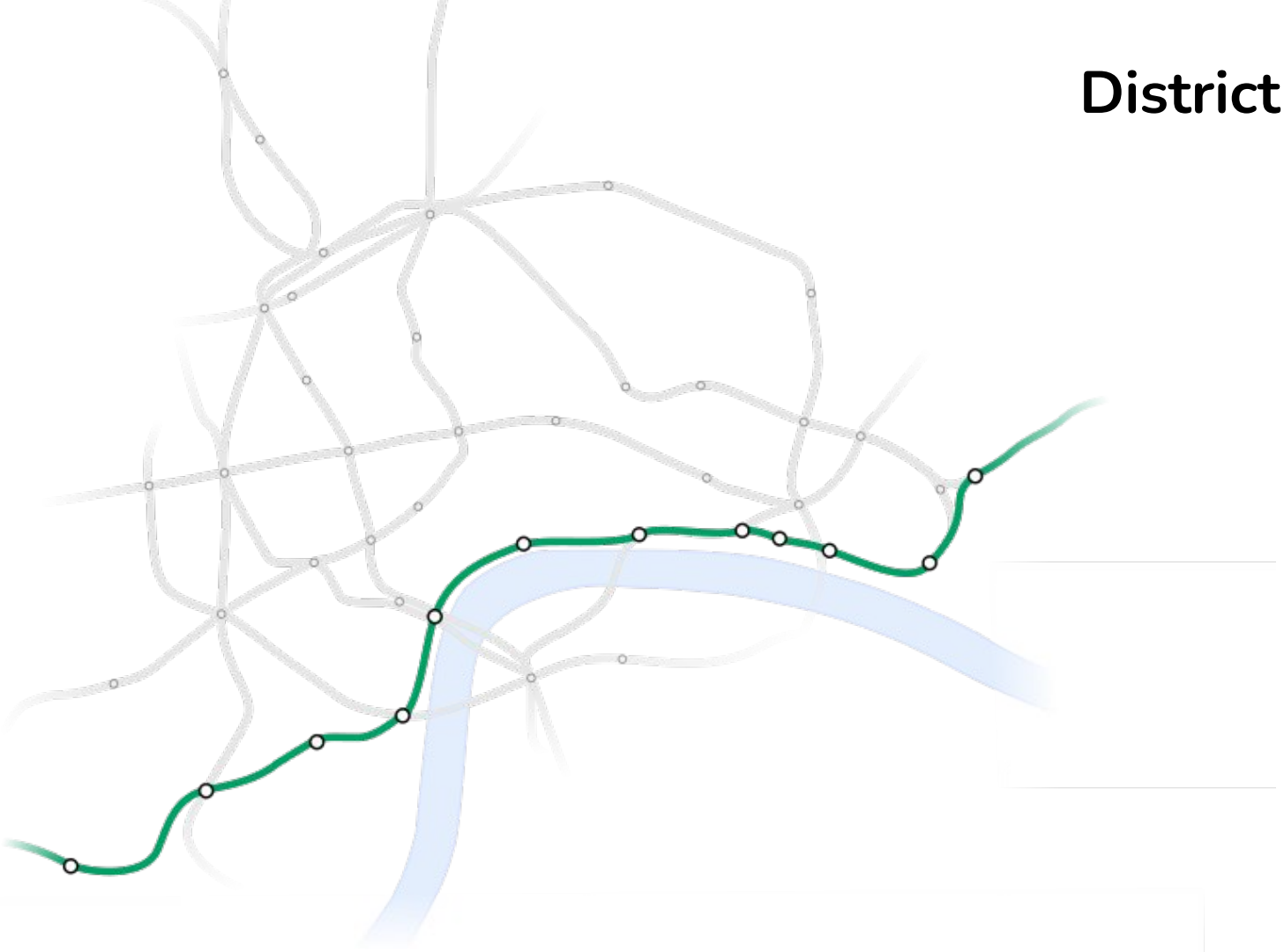


# Central Line

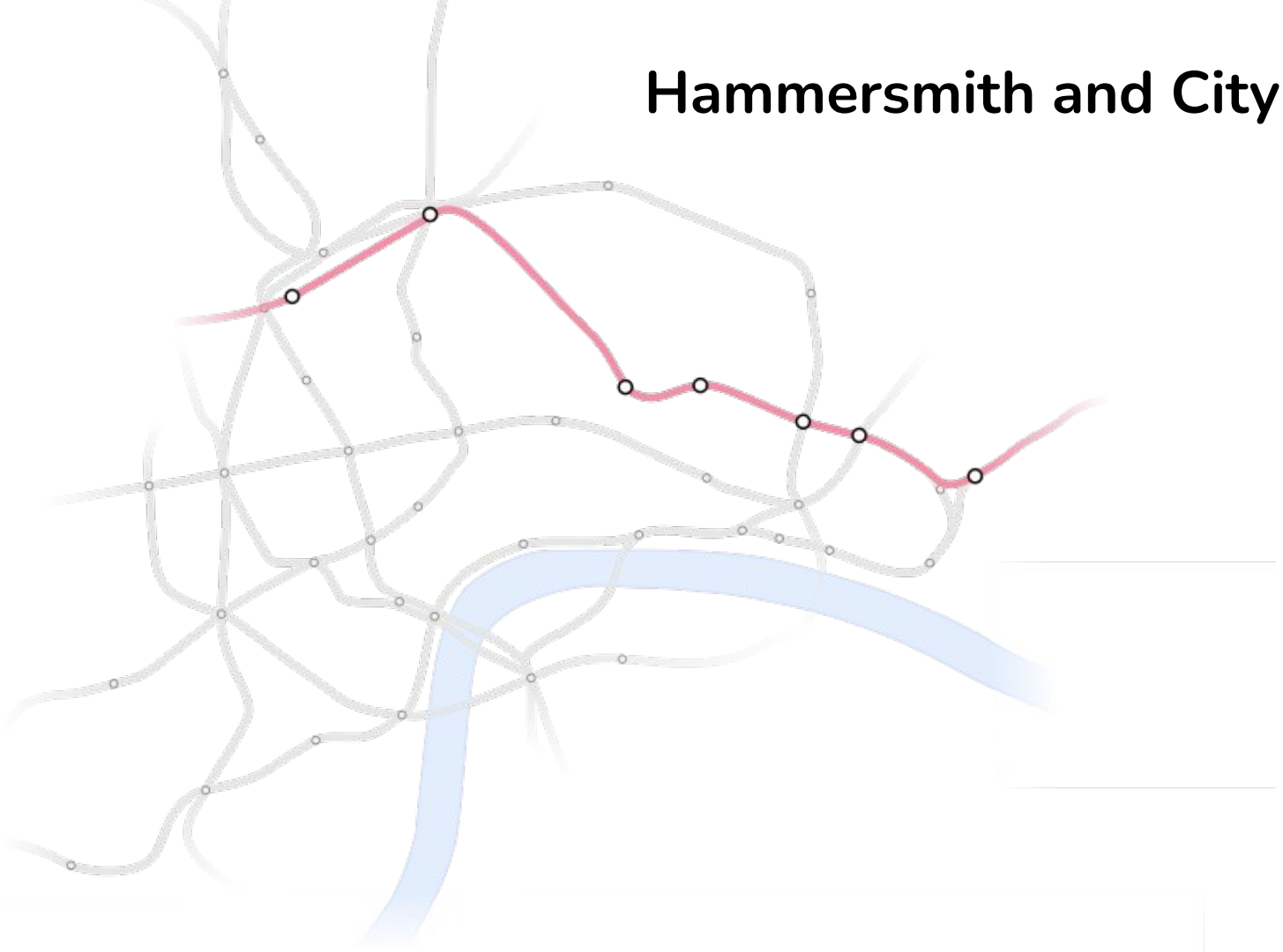


# Circle Line

# District Line

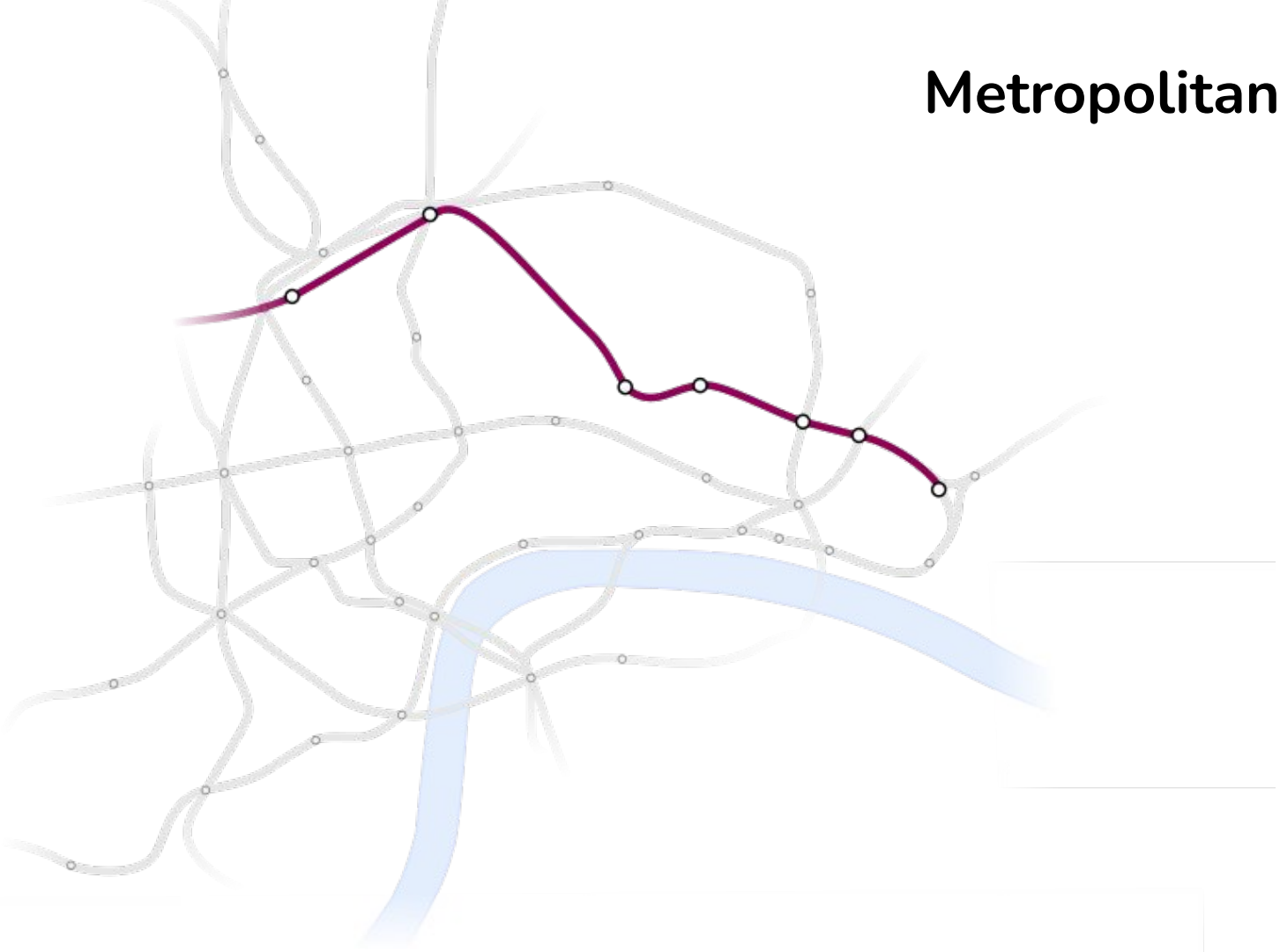


# Hammersmith and City Line



# Jubilee Line

# Metropolitan Line

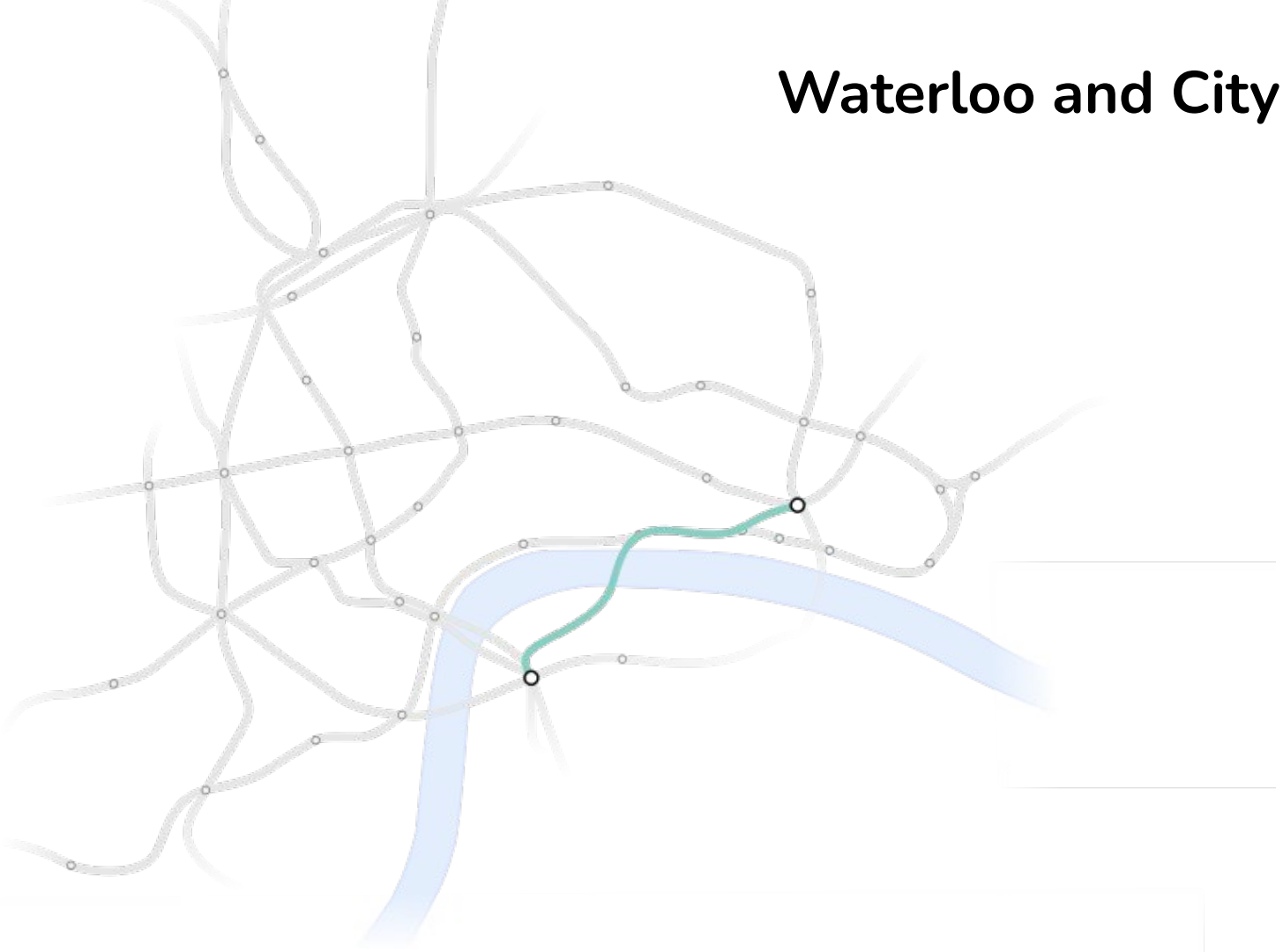


# Northern Line

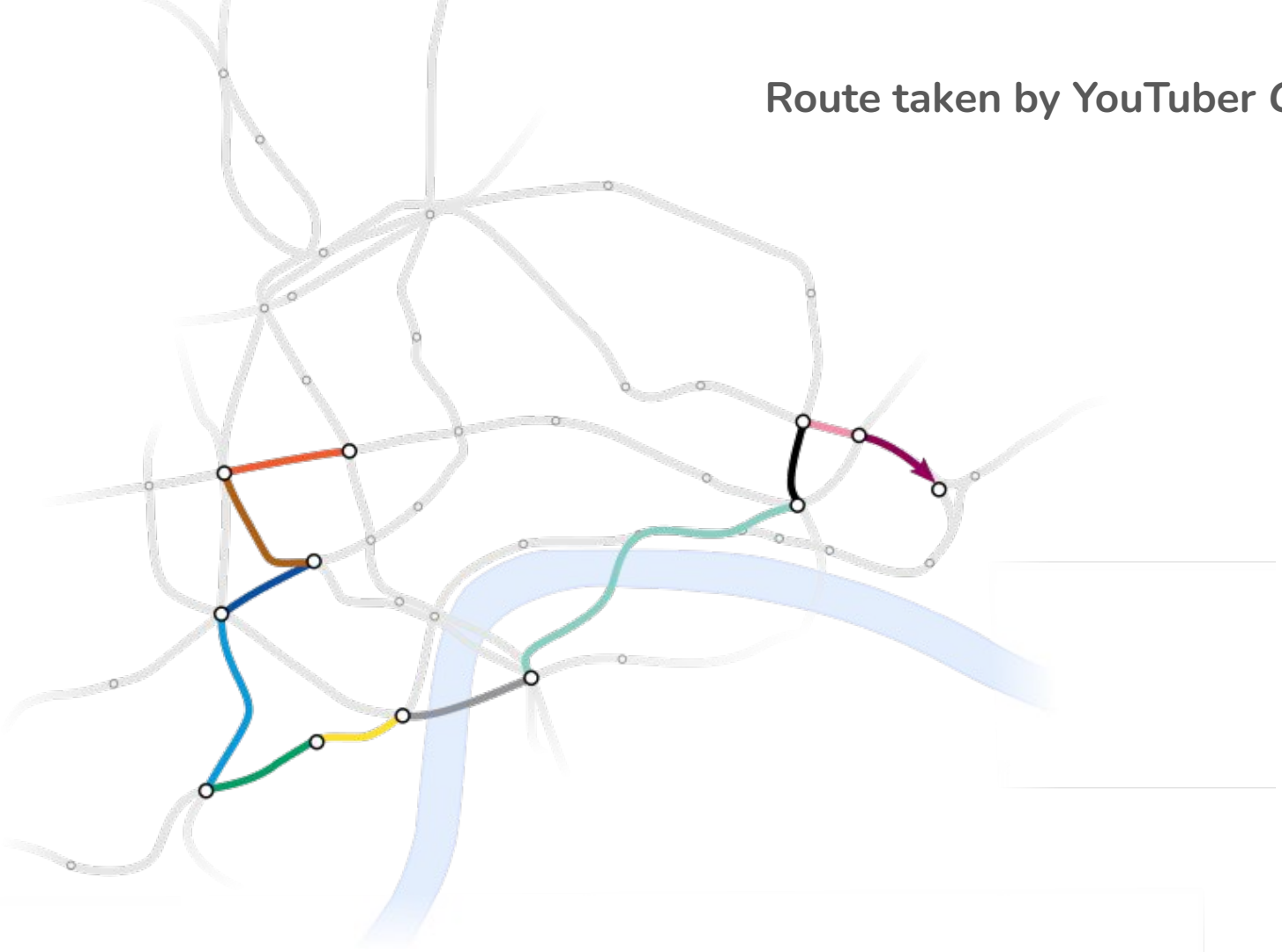
# Piccadilly Line

# Victoria Line

# Waterloo and City Line

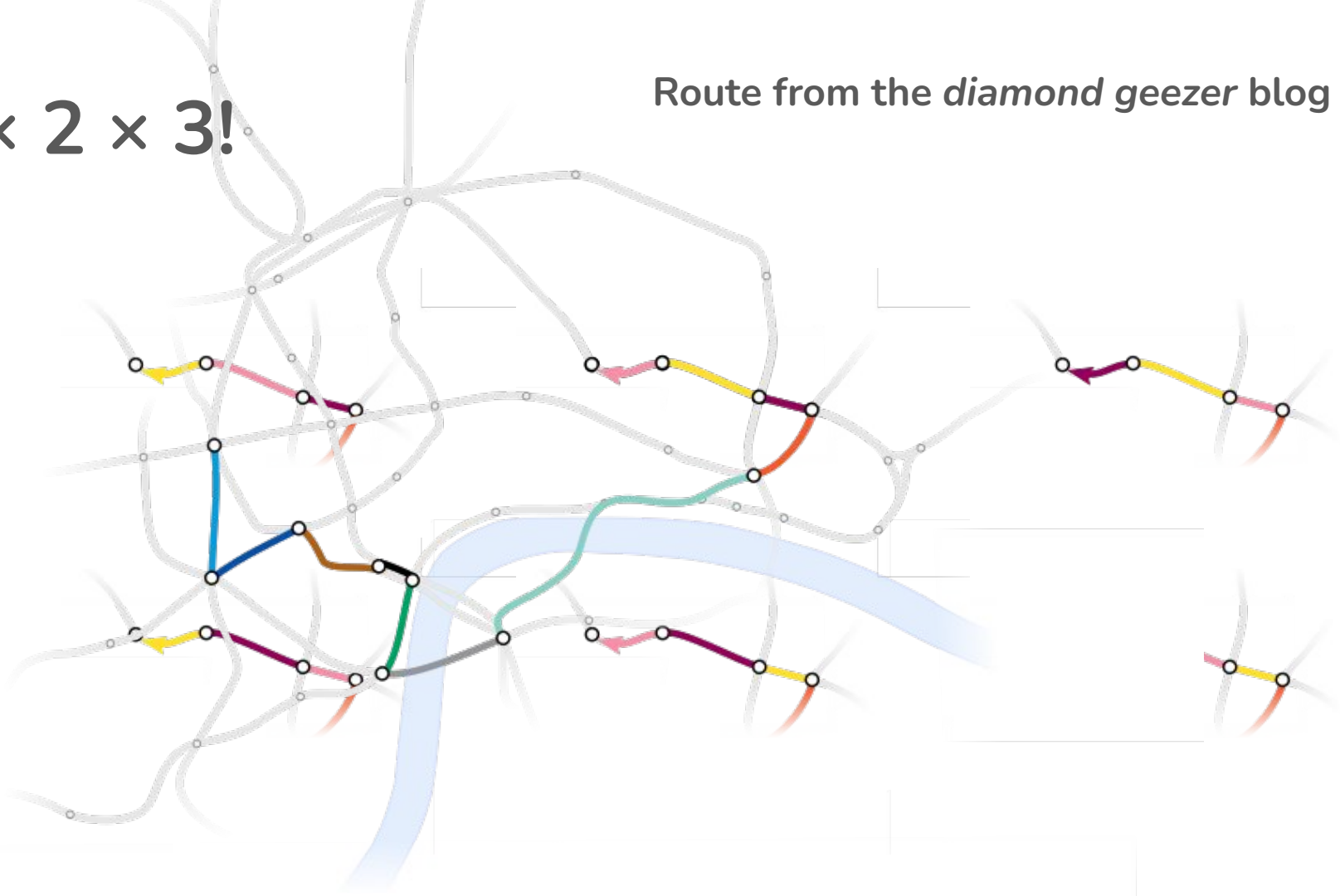


# Route taken by YouTuber *Cheeky*



$n \times 2 \times 3!$

Route from the *diamond geezer* blog



EXPLORER

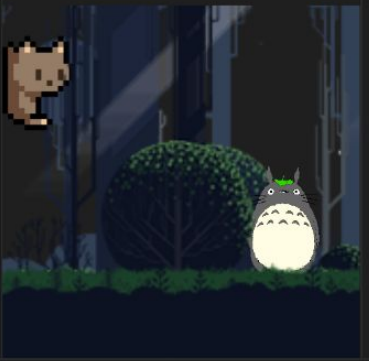
CODE

- constants
- timetables
- abbreviations.txt
- best_routes.txt
- helpers.py
- load_timetables.py
- notes.txt
- results_sorted.txt
- results.txt
- route_abbreviations.txt

OUTLINE

TIMELINE

VS CODE P...



route_finder.py

route_finder.py > ...

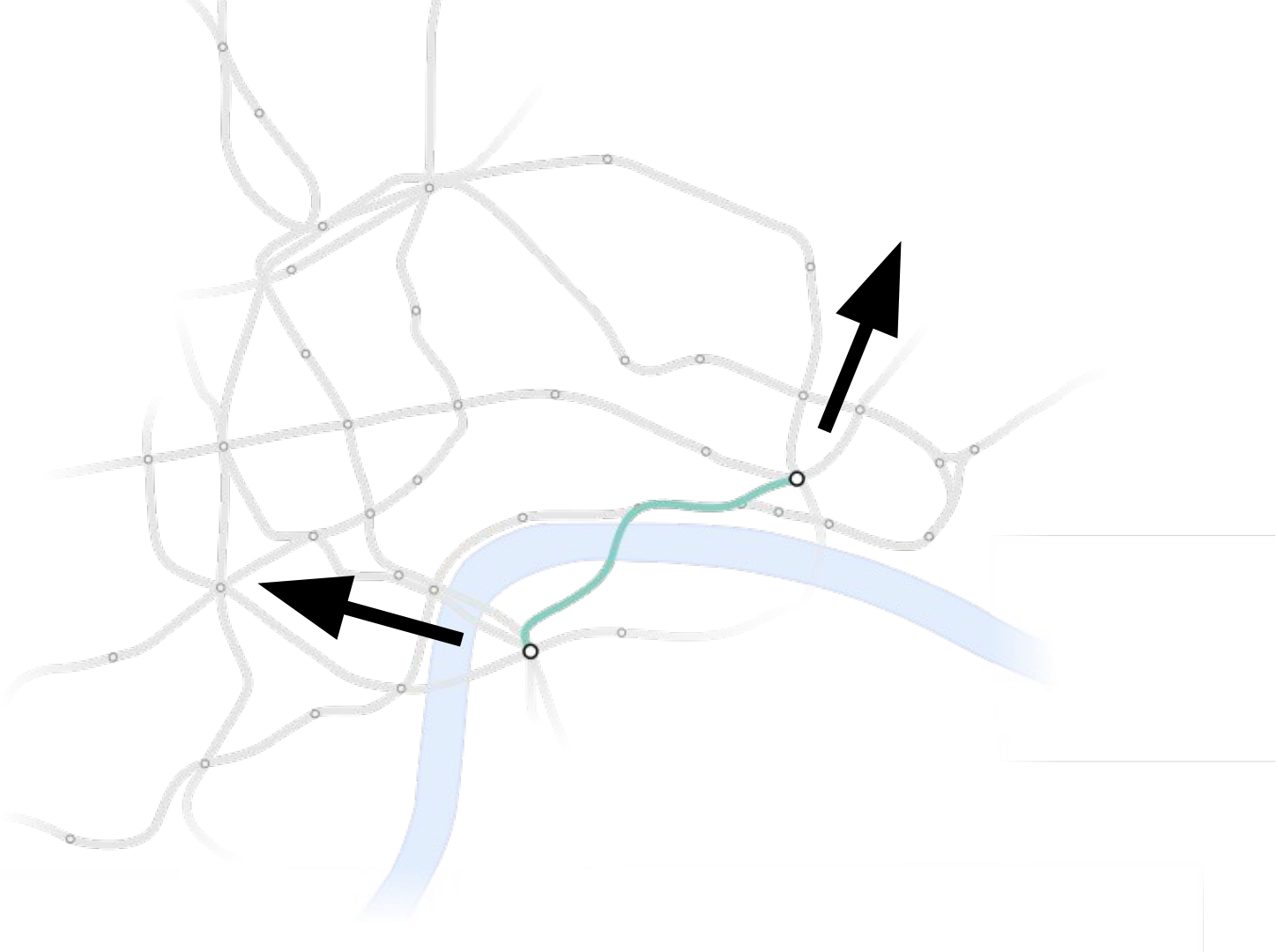
```python

def find_routes():
    # depth-first search of routes
    routes = set()

    def _extend_route(start, end, edges, lines):
        # are we done?
        if len(lines) == 11:
            routes.add(edges)

        else:
            # first try to extend backwards from the start
            for edge in connections_to[start]:
                if edge.line not in lines:
                    _extend_route(
                        edge.start,
                        end,
                        (edge, *edges),
                        set([*lines, edge.line])
                    )

            # then try to extend forwards from the end
            for edge in connections_from[end]:
                if edge.line not in lines:
```

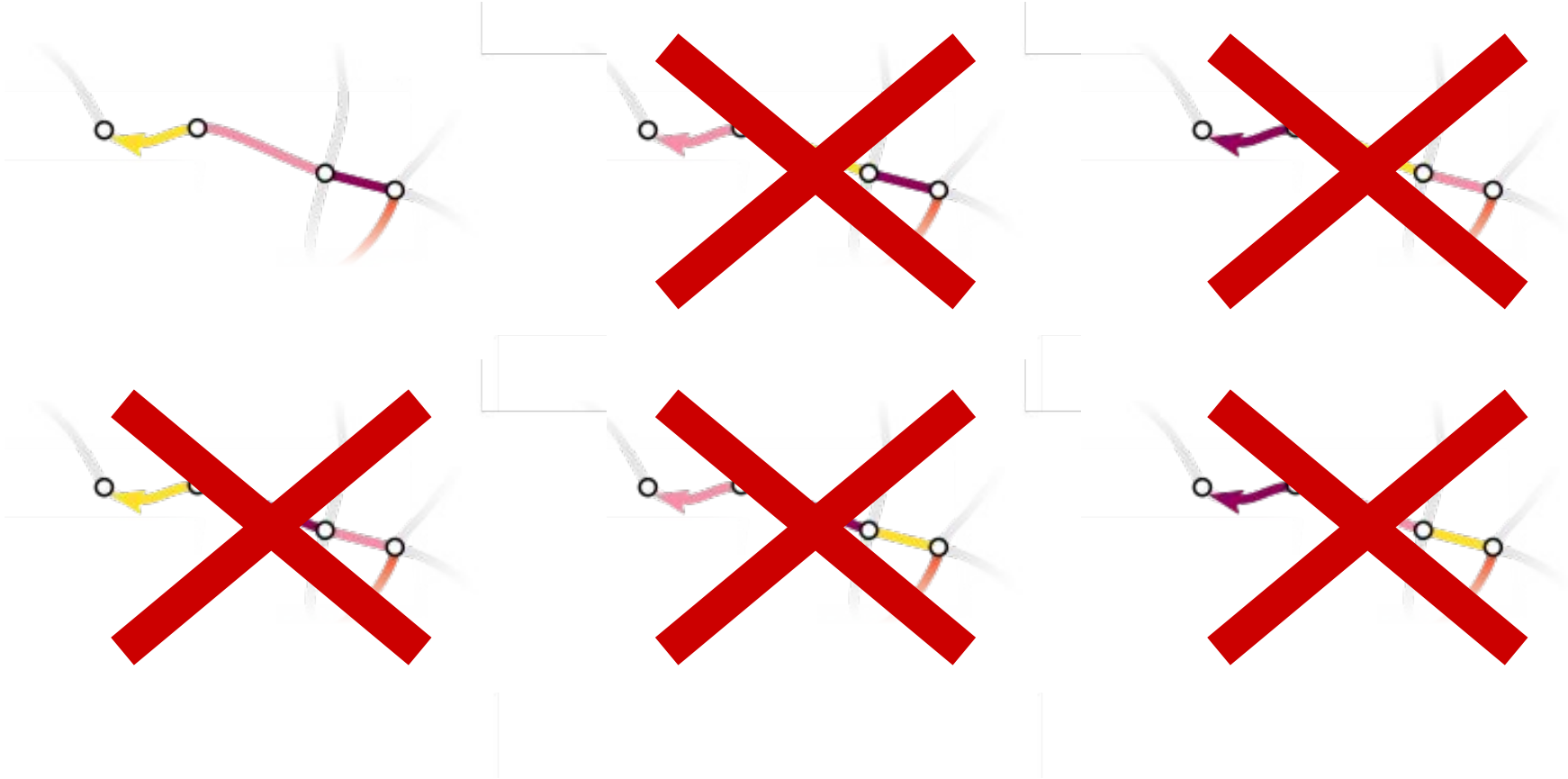


576

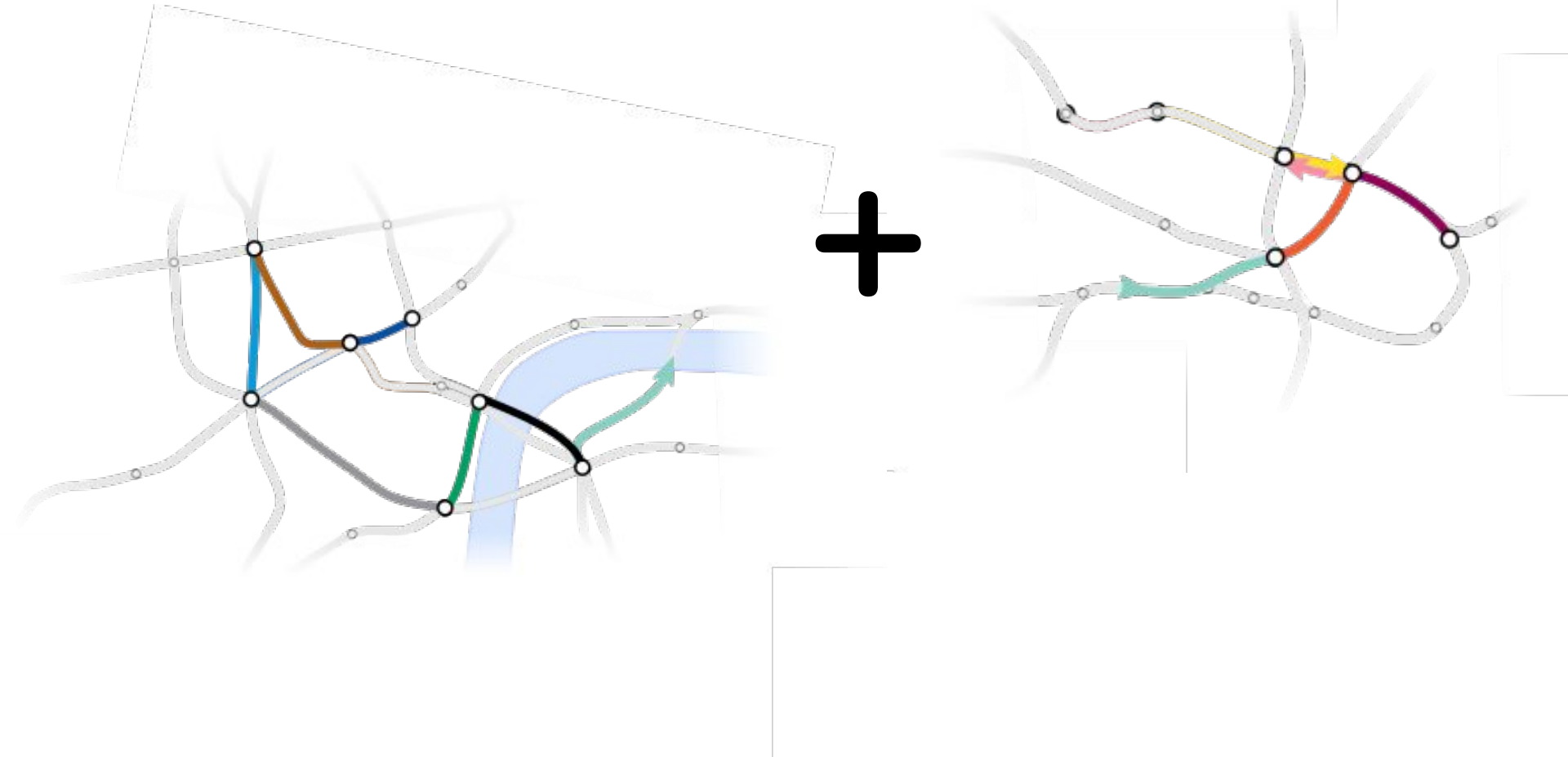
“That’d be too much work for a 5 minute talk”

~Ben Ashforth

288

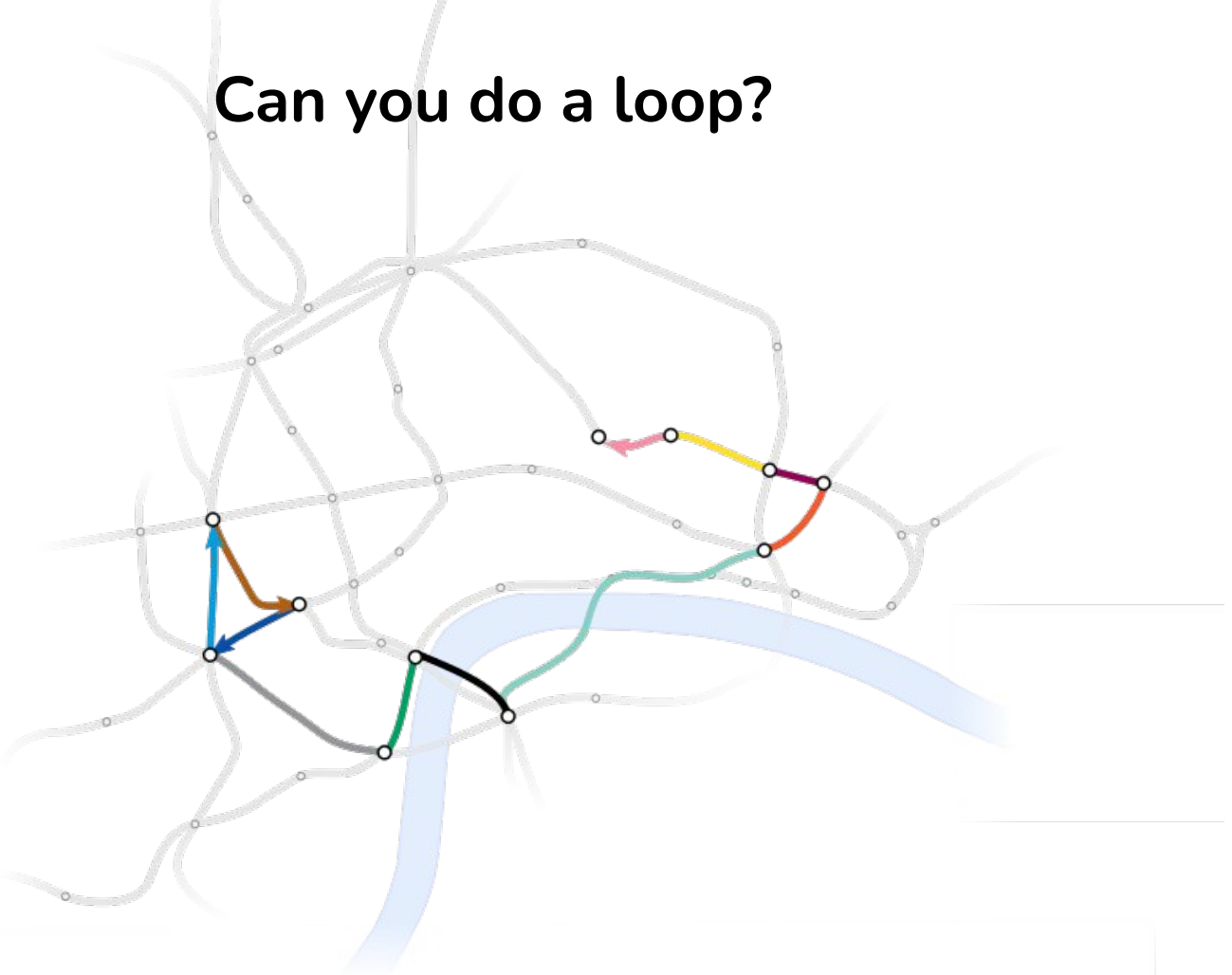


68



22 ✔

# Can you do a loop?



## Can the whole route be a loop?

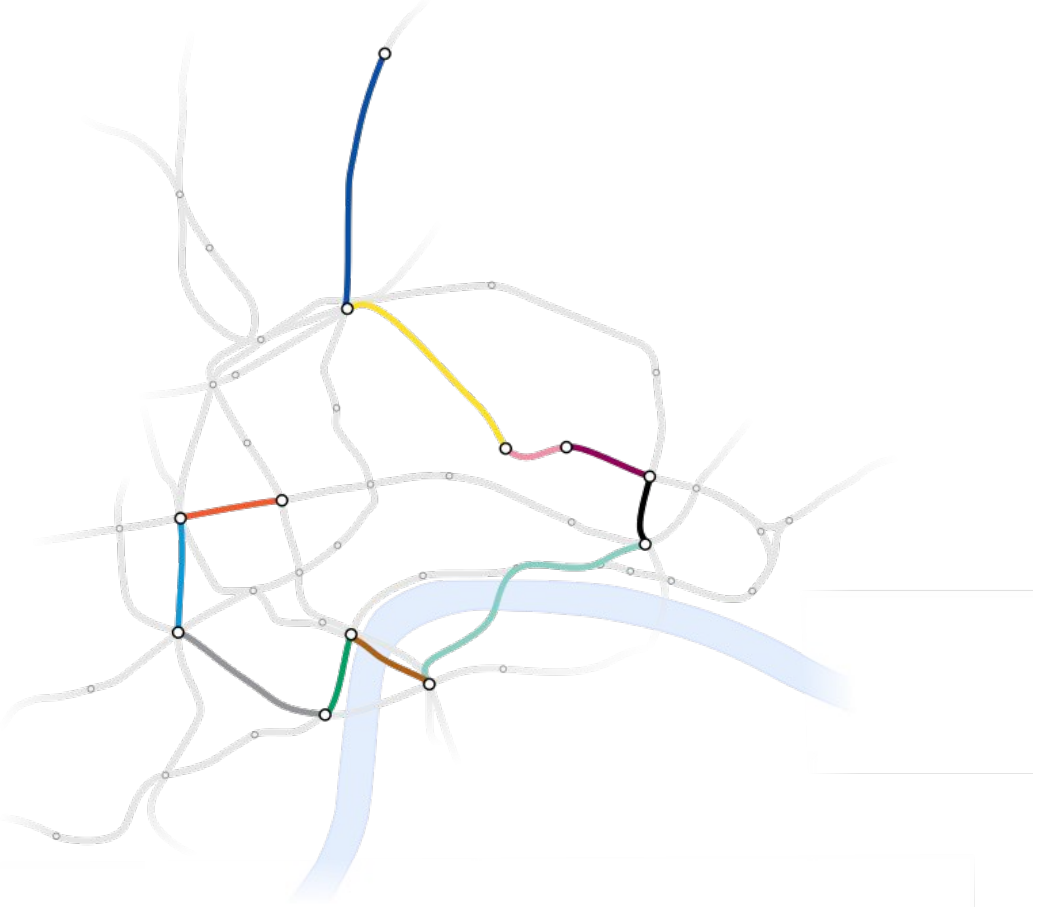
# No

## Which stations *MUST* be visited?

# There are 4

**(Left as an exercise)**

# Can you escape Zone 1?



# Which route is the fastest?

# Top Times: All Lines Challenge

This has since been beaten

**Last updated: 17th November 2023**

**Current 11 lines challenge (excluding ELL)**

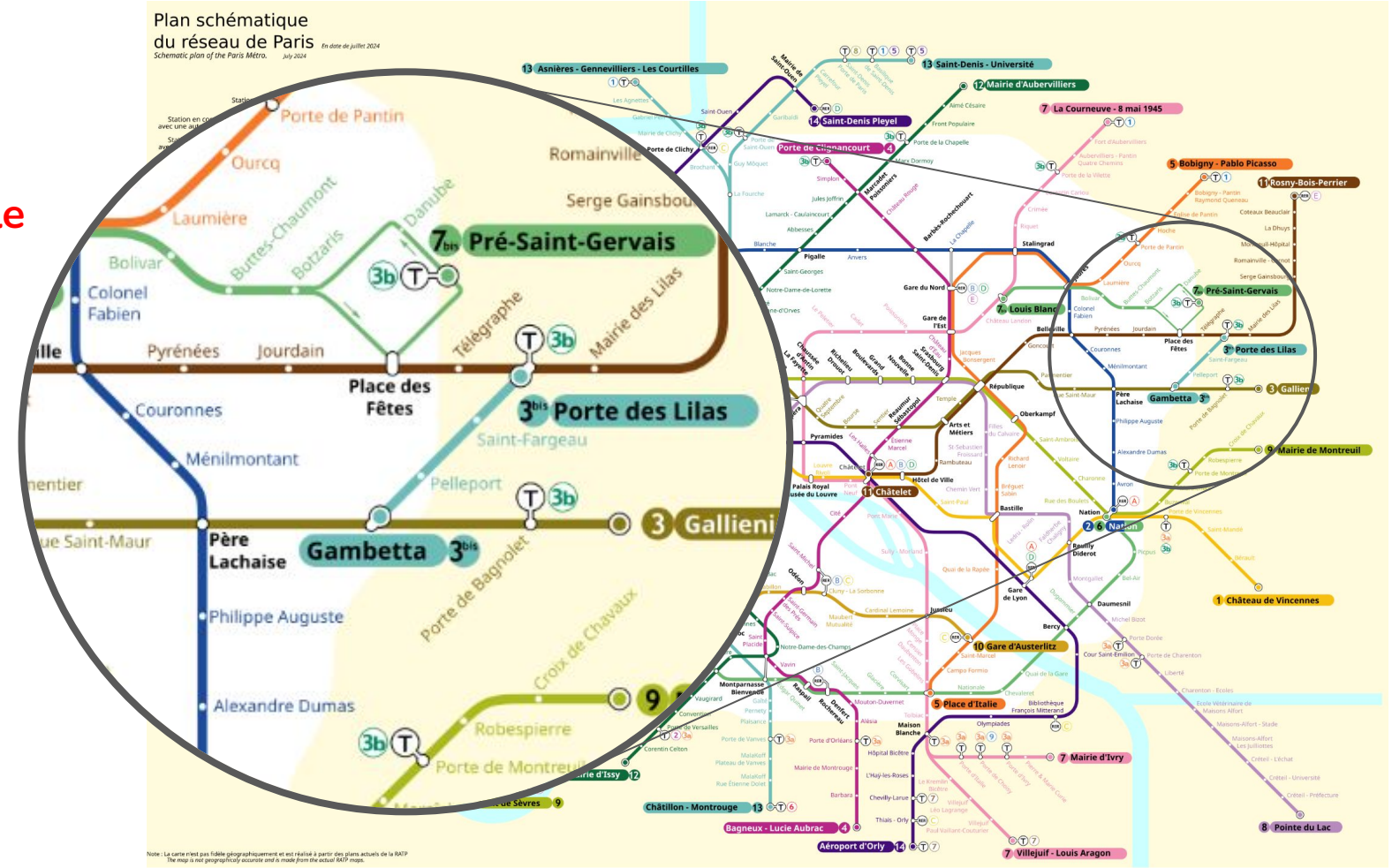
| Position | Time | Date | Challengers |
|---|---|---|---|
| 01 | 00:33:37 | 08/05/2008 | Matthew Scrivin and Steven Karahan |
| 02 | 00:36:38 | 10/11/2023 | Alastair Stanley |
| 03 | 00:37:14 | 16/06/2015 | Callum Liston and Ben Curtis |
| 04 | 00:37:30 | 05/07/2016 | Clive Burgess |
| 05 | 00:38:23 | 13/07/2016 | Andrew Chilcraft |
| 06 | 00:38:41 | 13/07/2012 | Andi James |
| 07 | 00:38:56 | 10/11/2023 | Alastair Stanley |
| 08 | 00:39:46 | 07/02/2008 | Matt Nunn |
| 09 | 00:40:08 | 08/12/2018 | Leon Gunasekara and Aidan Gill |
| 10 | 00:40:25 | 07/01/2015 | Hugo Marrow |
| 11 | 00:40:45 | 25/07/2022 | Sacha Hunter, Joe Kouyoumjian and Ben Levene |
| 12 | 00:41:02 | 30/07/2016 | Sam Smith |
| 13 | 00:41:20 | 29/08/2013 | Hugo Marrow |
| 14 | 00:41:42 | 07/01/2015 | Hugo Marrow |
| 15 | 00:41:48 | 13/07/2012 | Andi James |

# Other Networks

## Are minimal routes possible?

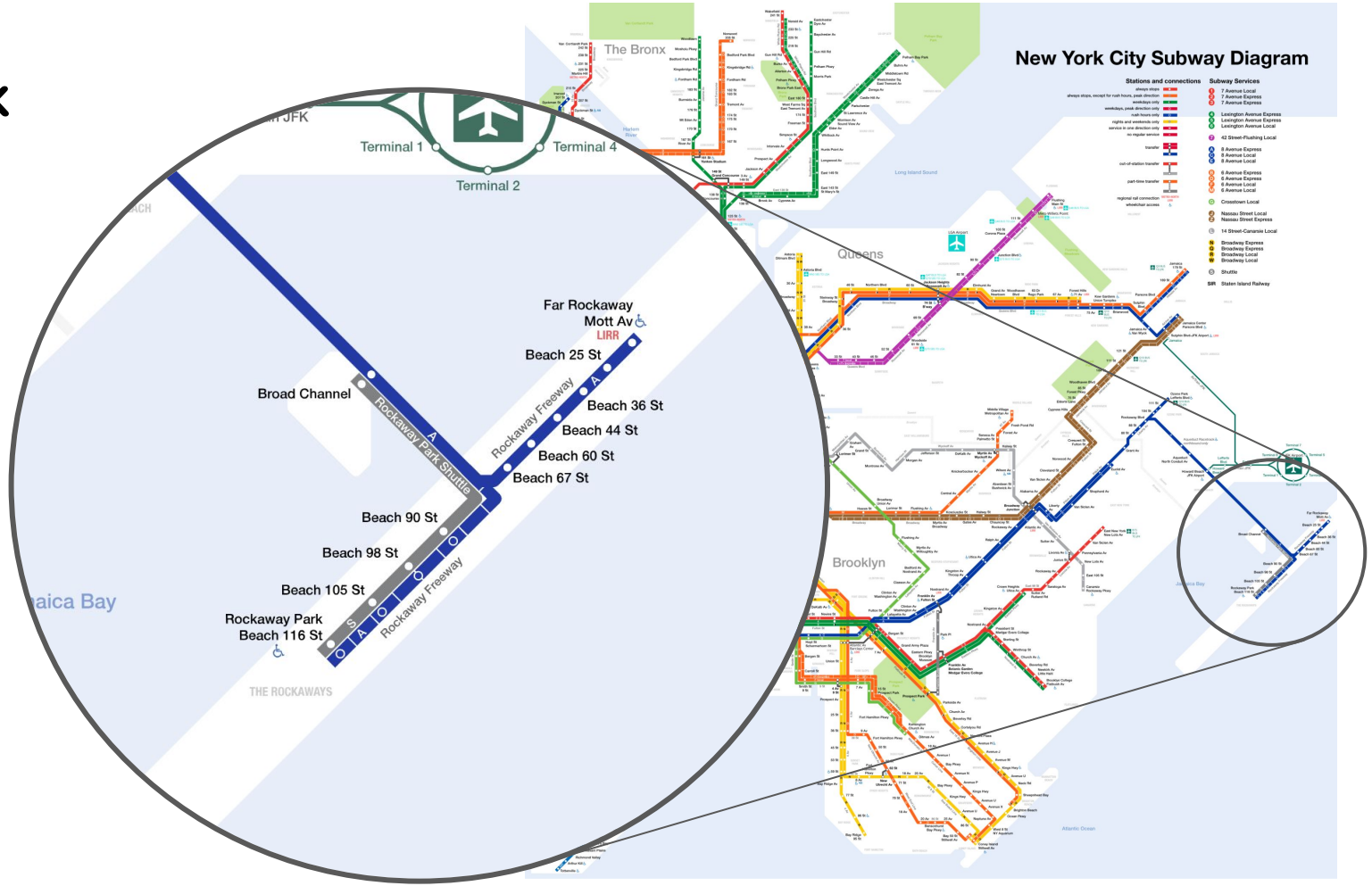
# Paris

**Impossible**



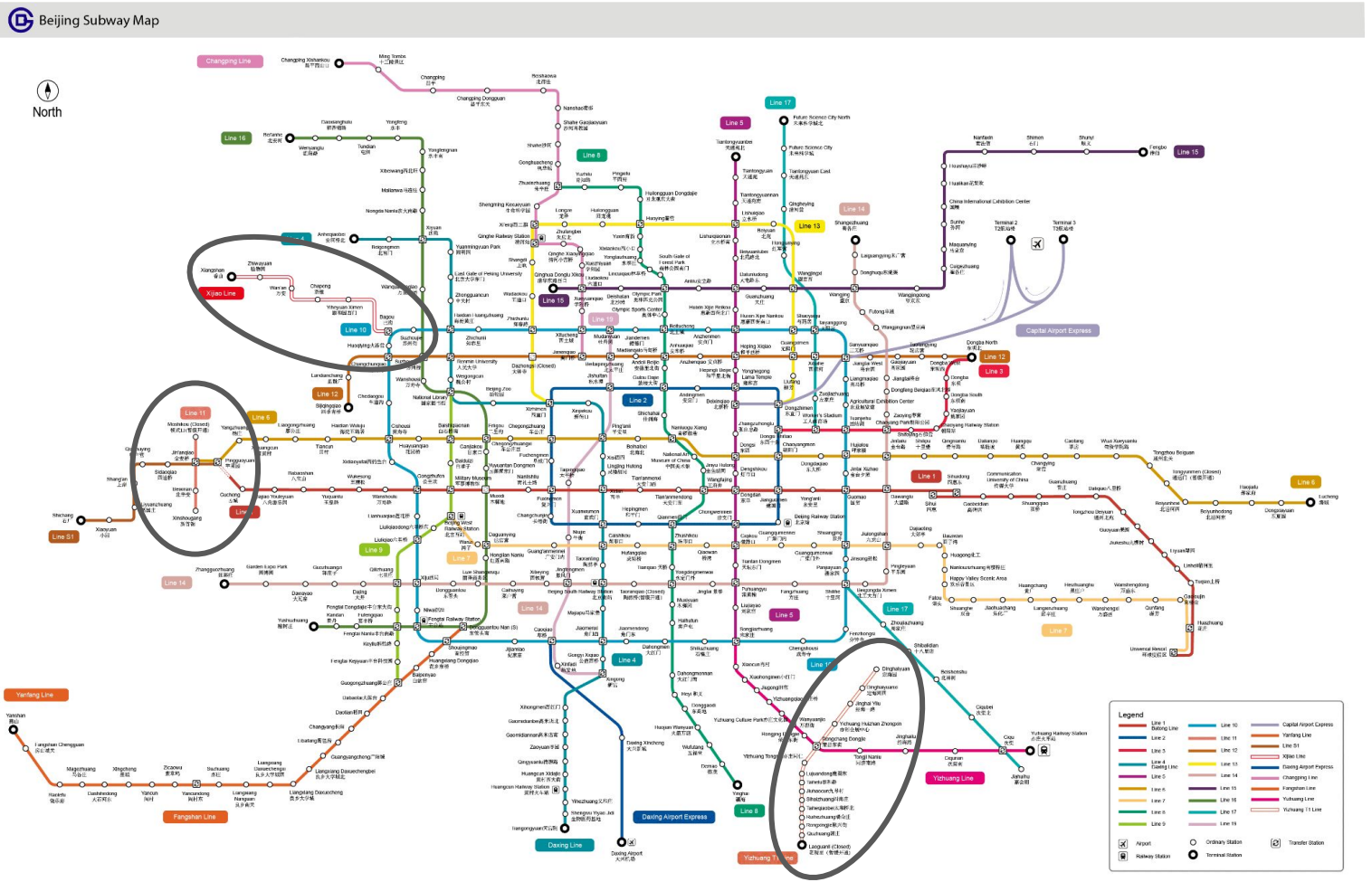
# New York

## Impossible



# Beijing

## Impossible

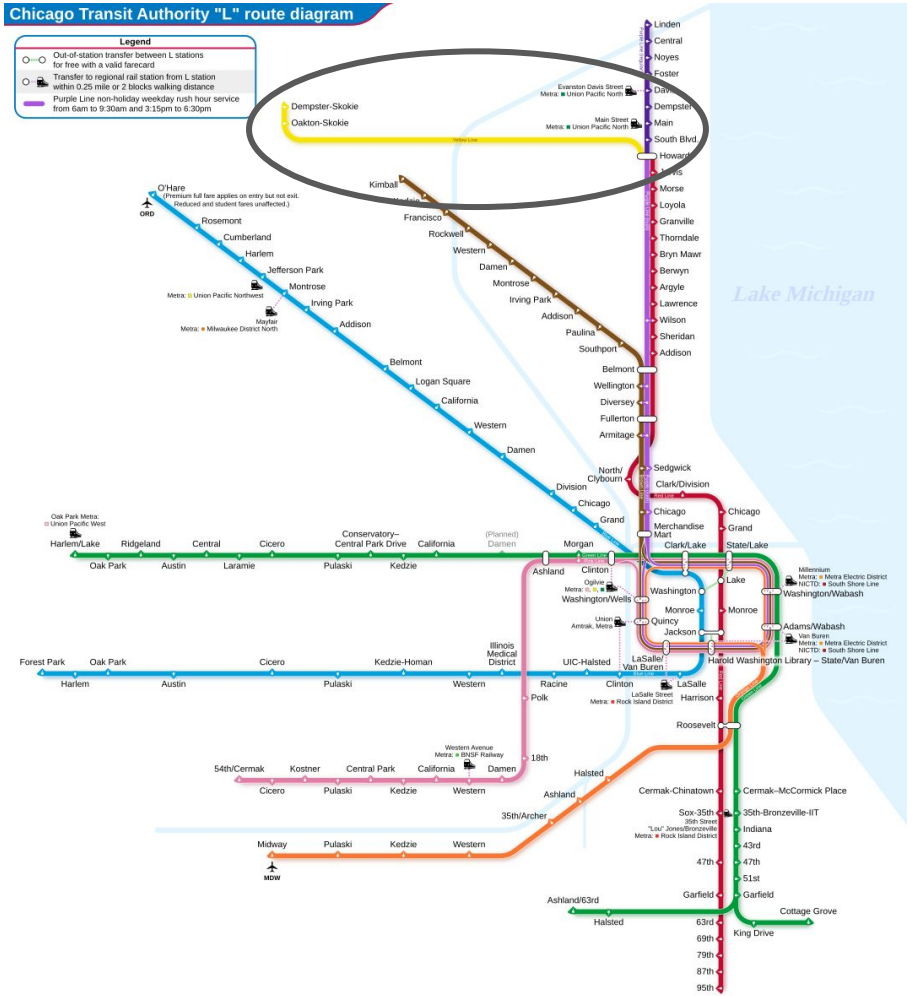


# Shanghai

**Impossible**

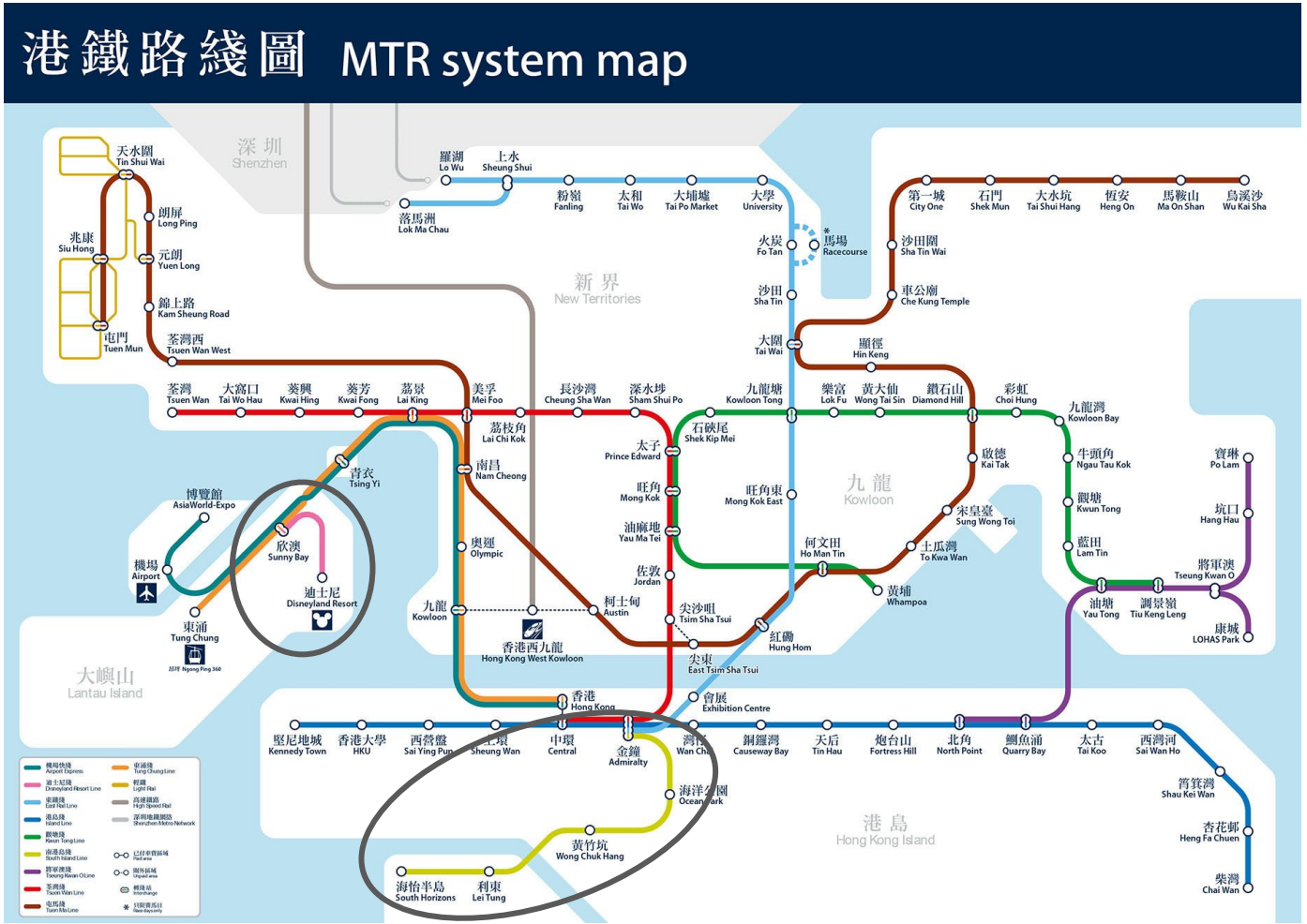
# Chicago

**Impossible**



# Hong Kong

**Impossible**

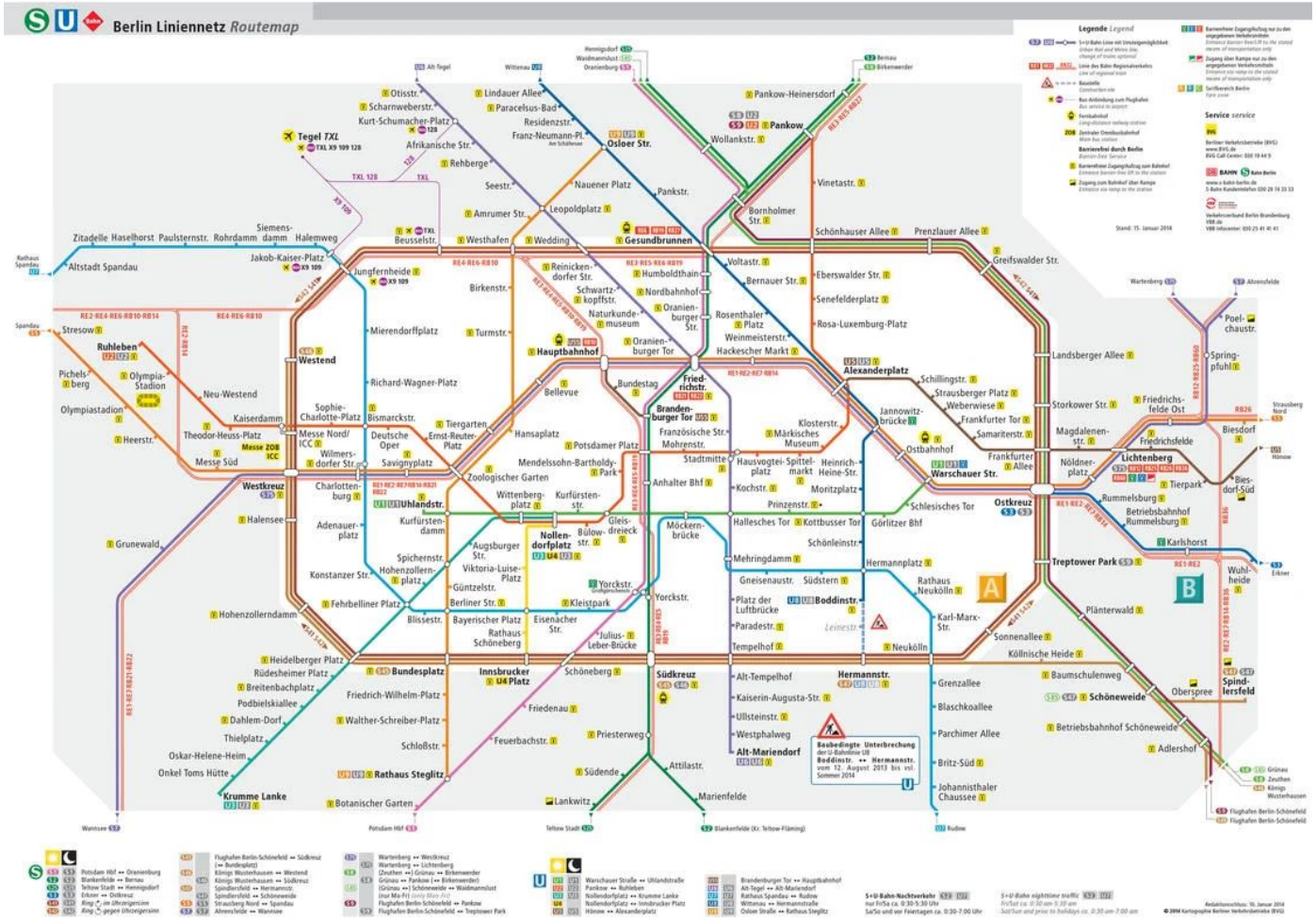


# Moscow

**Impossible**

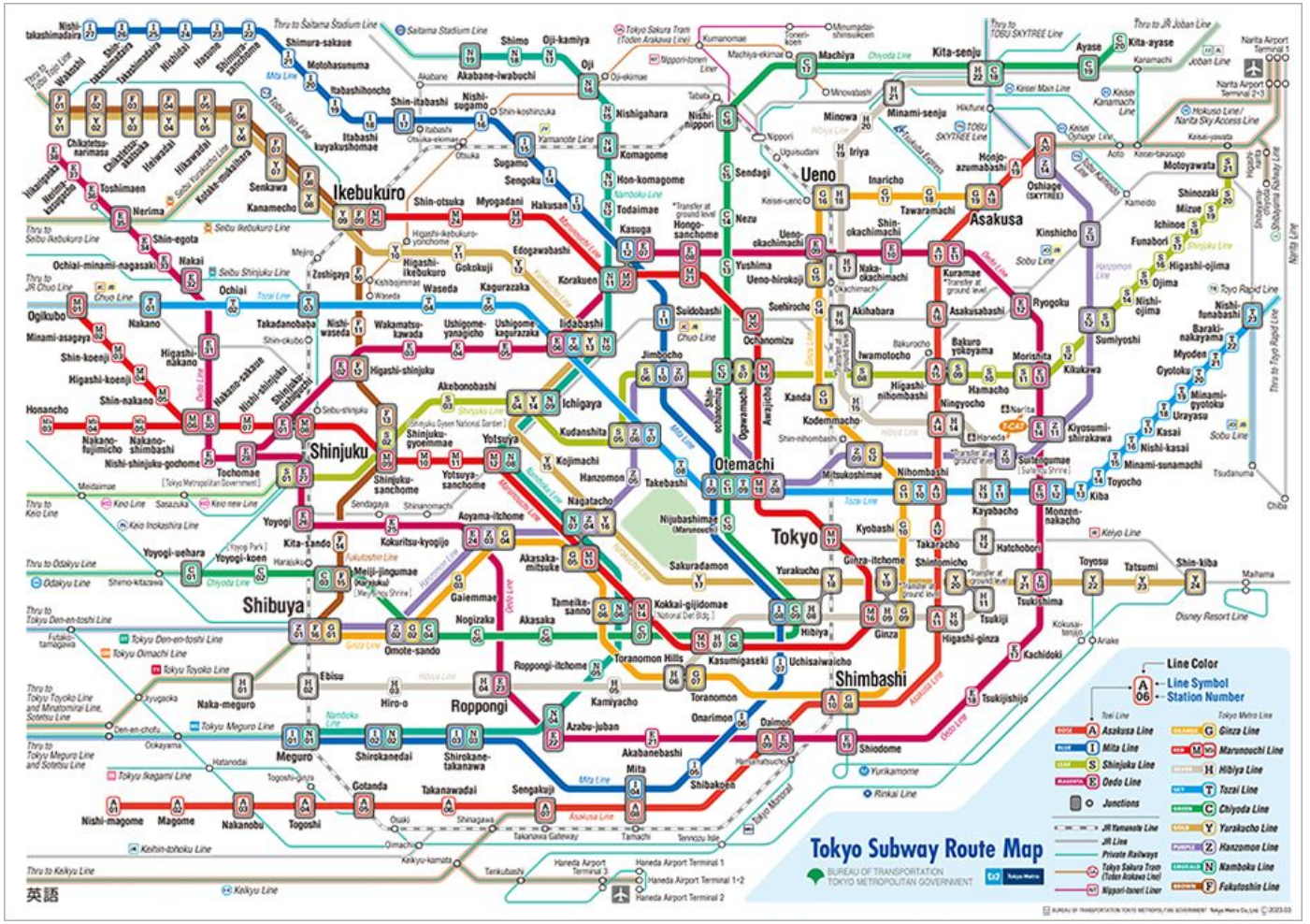
# Berlin

**Impossible**



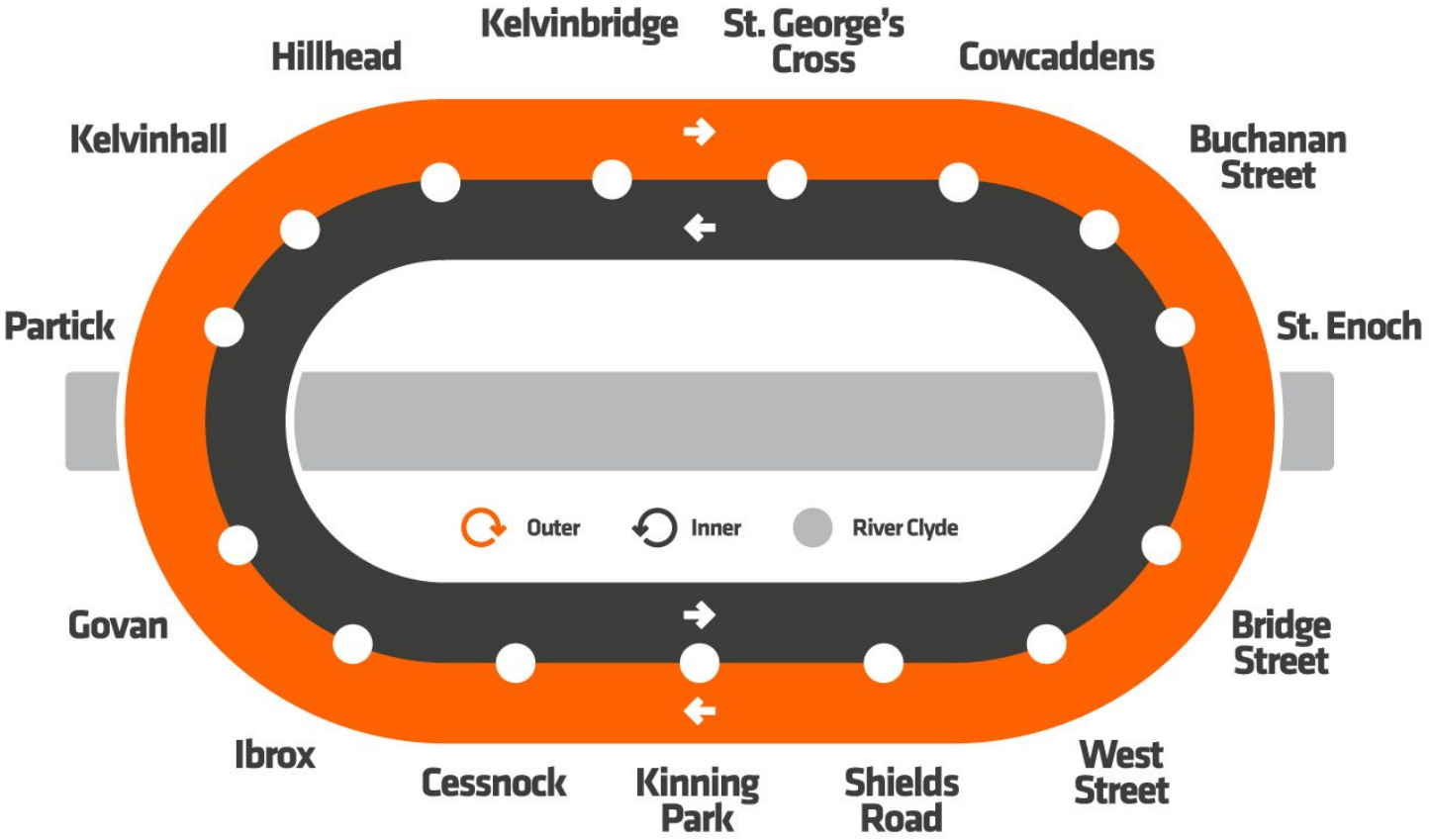
# Tokyo

Impossible


Tokyo Subway Route Map
BUREAU OF TRANSPORTATION
TOKYO METROPOLITAN GOVERNMENT
英語
Line Color
Line Symbol
Station Number
Ikebukuro
Shinjuku
Shibuya
Ueno
Asakusa
Otemachi
Tokyo
Shimbashi
Roppongi
Meguro
Nakano
Ogikubo
Honancho
Nishi-magome
Magome
Nakanobu
Togoshi
Gotanda
Takanawadai
Sengakuji
Mita
Shirokanedai
Shirokane-takanawa
Akabanebashi
Shibakoen
Onarimon
Daimon
Hamamatsucho
Shiodome
Kamiyacho
Azabu-juban
Roppongi-itchome
Toranomon
Toranomon Hills
Kasumigaseki
Uchisaiwaicho
Hibiya
Tsukiji
Higashi-ginza
Ginza
Ginza-itchome
Kyobashi
Takaracho
Hatchobori
Shintomicho
Tsukishima
Kachidoki
Tsukijishijo
Yurakucho
Sakuradamon
Nijubashimae
Takebashi
Kokkai-gijidomae
Tameike-sanno
Akasaka
Akasaka-mitsuke
Nagatacho
Hanzomon
Kojimachi
Yotsuya
Yotsuya-sanchome
Shinjuku-sanchome
Shinjuku-gyoemmae
Ichigaya
Kudanshita
Jimbocho
Suidobashi
Ochanomizu
Akihabara
Kanda
Kodemmacho
Shin-nihombashi
Nihombashi
Mitsukoshimae
Kayabacho
Hamacho
Higashi-nihombashi
Bakuro-yokoyama
Iwamotocho
Bakuro-machi
Kuramae
Asakusabashi
Ryogoku
Morishita
Kikukawa
Kinshicho
Oshiage (SKYTREE)
Honjo-azumabashi
Tawaramachi
Inaricho
Iriya
Ueno-hirokoji
Ueno-okachimachi
Shin-okachimachi
Naka-okachimachi
Yushima
Nezu
Hongo-sanchome
Sendagi
Nishi-nippori
Nippori
Minami-senju
Machiya
Kita-senju
Ayase
Kita-ayase
Myogadani
Hakusan
Shin-otsuka
Higashi-ikebukuro
Gokokuji
Edogawabashi
Kagurazaka
Waseda
Iidabashi
Korakuen
Kasuga
Todaimae
Hon-komagome
Komagome
Sugamo
Shin-koshinzuka
Nishi-sugamo
Oji
Oji-kamiya
Shimo
Akabane-iwabuchi
Itabashihoncho
Motohasunuma
Shimura-sakaue
Nishi-takashimadaira
Takashimadaira
Shin-takashimadaira
Hasune
Shimura-sanchome
Hikawadai
Heiwadai
Chikatetsu-narimasu
Chikatetsu-akatsuka
Kotake-mukaihara
Senkawa
Kanamecho
Toshimaen
Nerima
Shin-egota
Ochiai-minami-nagasaki
Nakai
Ochiai
Higashi-nakano
Shin-koenji
Higashi-koenji
Shin-nakano
Nakano-fujimicho
Nakano-shimbashi
Nishi-shinjuku-gochome
Tochomae
Nishi-waseda
Waseda
Zoshigaya
Mejiro
Takadanobaba
Wakamatsu-kawada
Ushigome-yanagicho
Ushigome-kagurazaka
Higashi-shinjuku
Shin-okubo
Akebonobashi
Sendagaya
Shinanomachi
Yoyogi
Yoyogi-uehara
Yoyogi-koen
Meiji-jingumae (Kyodai)
Kita-sando
Kokuritsu-kyogijo
Aoyama-itchome
Gaiemmae
Nogizaka
Omote-sando
Ebisu
Hiro-o
Naka-meguro
Kamimeguro
Yugaoka
Den-en-chofu
Okusawa
Hatanodai
Togoshi-ginza
Ishikawadai
Futako-tamagawa
Shimo-kitazawa
Meidaimae
Sasazuka
Kami-yoga
Higashi-yoga
Setagaya-daita
Kyodo
Komazawa-daigaku
Sangubashi
Shimo-meguro
Yutenji
Nakameguro
Ikejiri-ohashi
Gakugei-daigaku
Jiyugaoka
Okusawa
Tokyu Toyoko Line
Tokyu Meguro Line
Tokyu Oimachi Line
Tokyu Ikegami Line
Tokyu Den-en-toshi Line
Tokyu Setagaya Line
Odakyu Line
Keio Line
Keio New Line
Keio Inokashira Line
Seibu Ikebukuro Line
Seibu Shinjuku Line
Seibu Toshima Line
Seibu Yurakucho Line
Tobu Tojo Line
Tobu Skytree Line
Tobu Isesaki Line
Saitama Stadium Line
Tokyo Sakura Tram (Toden Arakawa Line)
Nippori-Toneri Liner
Keisei Main Line
Keisei Oshiage Line
Keisei Kanamachi Line
Hokuso Line / Narita Sky Access Line
Narita Airport Terminal 1
Narita Airport Terminal 2-3
Joban Line
Tobu Kameido Line
Tobu Nikko Line
Tobu Kameido Line
Tobu Koizumi Line
Tobu Urban Park Line
Tobu Daishi Line
Tobu Skytree Line
Tobu Isesaki

# Glasgow

30 solutions!



# Thanks for listening!