ptv

March 26, 2024

1 Public Transport Victoria (PTV) Timetable API v3

This notebook is part of the PTV_v3 repository on Github.

1.1 Preliminaries: composing, signing and making a request

To instantiate a PTVv3 object, you will need to obtain your own id/key pair from PTV.

[1]:
```
from ptvv3 import PTVv3

ptv_id = input('PTV id: ')
ptv_key = input('PTV key: ')
ptv = PTVv3(ptv_id, ptv_key, debug=True)
```

```
PTV id:  <<<your id>>>
PTV key:  <<<your key>>>
```

[3]:
```
route_types = ptv('/v3/route_types')

print({rt["route_type_name"]: rt["route_type"] for rt in␣
 ↪route_types['route_types']})
ptv.debug = False  # if execution reached here, it worked! So disable debug␣
 ↪output
```

```
{'Train': 0, 'Tram': 1, 'Bus': 2, 'Vline': 3, 'Night Bus': 4}
```

1.2 Discovering bus stops and routes from GPS coordinates

[4]:
```
gps_latitude, gps_longitude, radius = -37.9057, 145.0927, 600  # degrees,␣
 ↪degrees, meters
stops = ptv(f'/v3/stops/location/{gps_latitude},{gps_longitude}',␣
 ↪route_types=2, max_distance=600)
print(f'Found {len(stops["stops"])} bus stops within {radius} meters from␣
 ↪({gps_latitude}, {gps_longitude})')
```

```
Found 10 bus stops within 600 meters from (-37.9057, 145.0927)
```

1.3 Find closest stops for each bus (*i.e. route*)

[5]:
```
def closest_stops_per_route(stops):

    stops_info, routes_info = {}, {}
    for stop in sorted(stops['stops'], key=lambda s: s['stop_distance']):  #␣
 ↪should already be ordered by distance. sorted is stable
        stops_info[stop['stop_id']] = tuple(stop[field] for field in 'stop_name␣
 ↪stop_latitude stop_longitude stop_distance'.split())

        for route in stop['routes']:
            if route['route_id'] not in routes_info:
                routes_info[route['route_id']] = tuple(route[name] for name in␣
 ↪'route_number route_name'.split()) + (stop['stop_id'], )

    unique_closest_stops = set(ri[-1] for ri in routes_info.values())
    stops_info = {k: v for k, v in stops_info.items() if k in␣
 ↪unique_closest_stops}
    return stops_info, routes_info

stops_info, routes_info = closest_stops_per_route(stops)
```

[6]:
```
from IPython.display import HTML, display

def notebook_html_table(data_dict, headers):
    header = '<th>#</th>' + ''.join(f'<th>{name.replace("_", " ")}</th>' for␣
 ↪name in headers.split())
    rows = [(index, dk) + dv for index, (dk, dv) in enumerate(data_dict.
 ↪items())]
    contents = '</tr><tr>'.join(''.join(list(map(lambda x: f'<td>{x}</td>',␣
 ↪row))) for row in rows)
    display(HTML(f'<table><thead><tr>{header}</tr></thead><tr>{contents}</tr></
 ↪table>'))
```

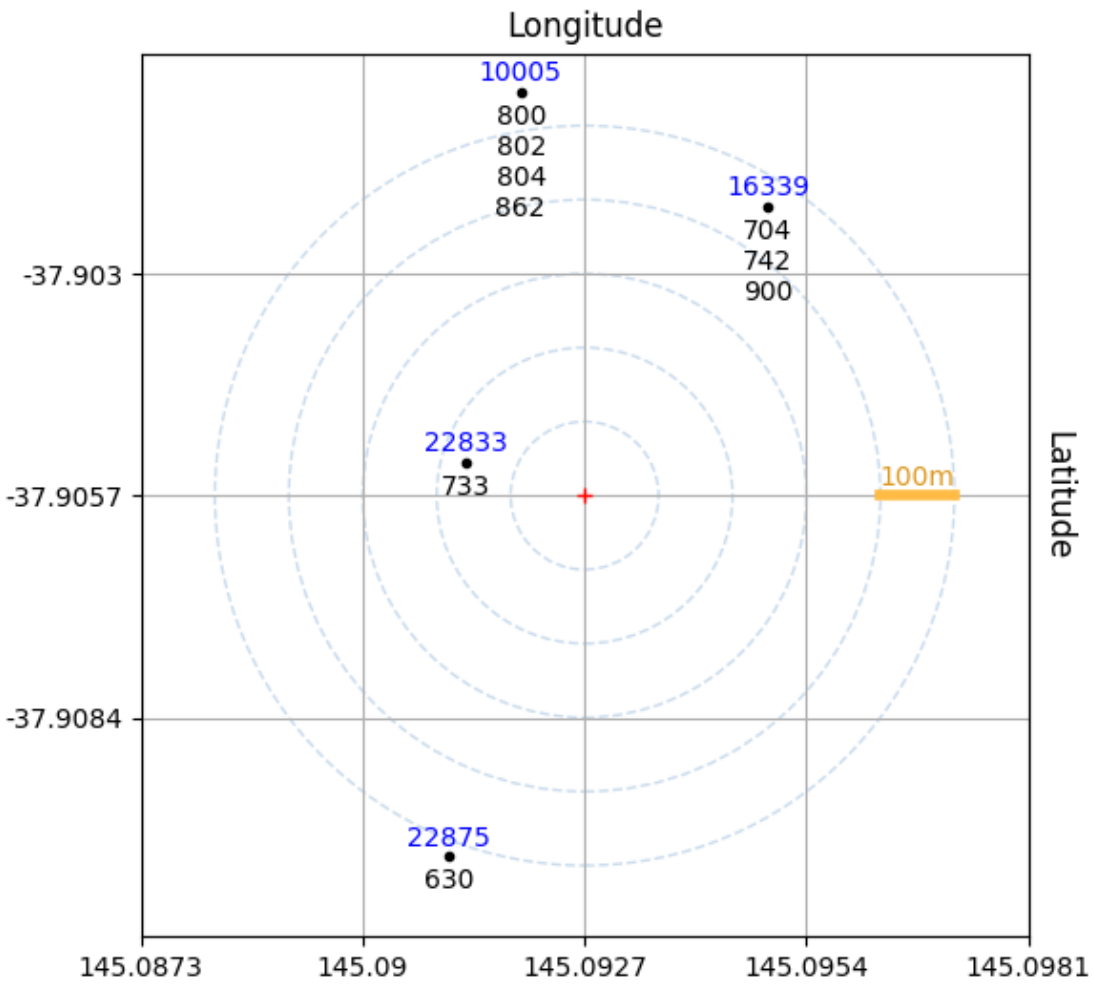
[7]:
```
notebook_html_table(routes_info, 'Route_ID Bus_number Route_name Stop_ID')
notebook_html_table(stops_info, 'Stop_ID Stop_name Latitude Longitude Distance')
```

```
<IPython.core.display.HTML object>
```

```
<IPython.core.display.HTML object>
```

[8]:
```
import numpy as np
import matplotlib as mpl
from matplotlib import pyplot as plot

def plot_gps_map(stops_info, routes_info):

    fig = plot.figure(figsize=(6, 6))
```

```
    plot.plot(gps_longitude, gps_latitude, 'r+')
    for stop_id, (stop_name, lat, lon, distance) in stops_info.items():  # draw␣
↪stops
        bus_list = '\n'.join(list(map(str, sorted(ri[0] for ri in routes_info.
↪values() if ri[-1] == stop_id))))
        plot.plot(lon, lat, 'k.')
        plot.annotate(int(stop_id), xy=(lon, lat), xycoords='data', xytext=(0,␣
↪12), textcoords='offset points', color='b', va='top', ha='center')
        plot.annotate(bus_list, xy=(lon, lat), xycoords='data', xytext=(0, -4),␣
↪textcoords='offset points', va='top', ha='center')

    # you cannot truly convert from GPS angles to meters unless you're a flat␣
↪earther, but it's a decent approximation at this scale
    meter = np.linalg.norm([gps_latitude - lat, gps_longitude - lon]) / distance
    lim = 100 * (1 + np.floor(distance / 100))  # plot extent

    for index, radius in enumerate(np.arange(100 * meter, lim * meter, 100 *␣
↪meter)):  # draw circles
        circle = mpl.patches.Circle((gps_longitude, gps_latitude),␣
↪radius=radius, color='#cde', fill=False, linestyle='--')
        fig.gca().add_patch(circle)

    plot.plot([gps_longitude + (lim - 200) * meter, gps_longitude + (lim - 100)␣
↪* meter], [gps_latitude, gps_latitude], color='#fb4', linewidth=4)  #␣
↪distance marker
    plot.annotate('100m', xy=(gps_longitude + (lim - 150) * meter,␣
↪gps_latitude), xycoords='data', xytext=(0, 12), textcoords='offset points',␣
↪color='#d92', va='top', ha='center')

    plot.axis('equal')  # make it pretty: ticks, labels, grid
    xticks = np.linspace(gps_longitude - lim * meter, gps_longitude + lim *␣
↪meter, 5)
    yticks = np.linspace(gps_latitude - lim * meter, gps_latitude + lim *␣
↪meter, 5)
    plot.xticks(xticks, np.round(xticks, 4))
    plot.yticks(yticks, np.round(yticks, 4))
    fig.gca().xaxis.set_label_position("top")
    fig.gca().yaxis.set_label_position("right")
    plot.xlabel('Longitude', fontsize='large', va='bottom')
    plot.ylabel('Latitude', rotation=270, fontsize='large', va='bottom')
    plot.grid()
    plot.show()

plot_gps_map(stops_info, routes_info)
```



1.4 Directions of travel for a route

[9]:
```
route_id = next(iter(routes_info.keys()))
directions = ptv(f'/v3/directions/route/{route_id}')

directions_names = {d['direction_id']: d['direction_name'] for d in␣
 ↪directions['directions']}
print(directions_names)
```

```
{30: 'Box Hill', 182: 'Oakleigh'}
```

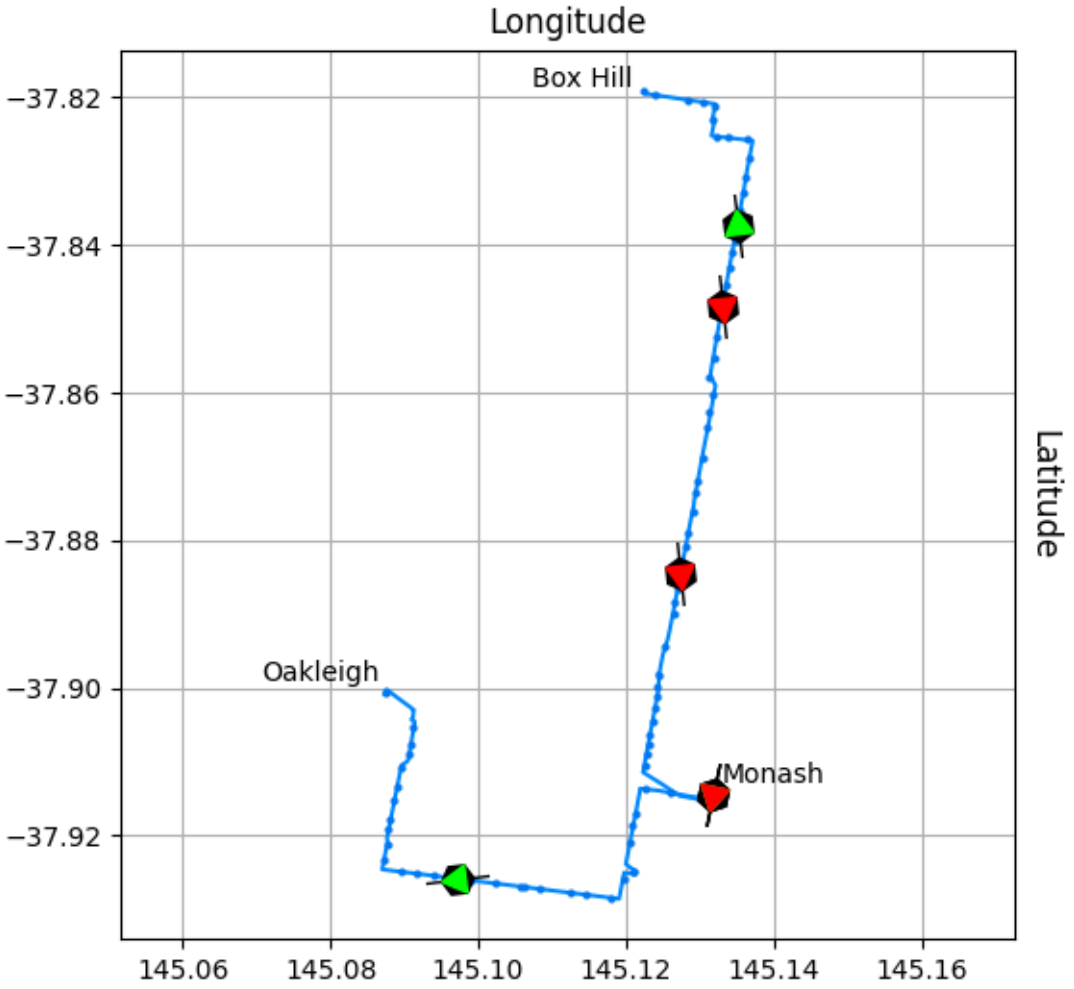
1.5 Real-time bus location

[10]:
```
route_id, (_, _, stop_id) = next(iter(routes_info.items()))
direction_id = next(iter(directions_names.keys()))
```

[11]:
```
stops = ptv(f'/v3/stops/route/{route_id}/route_type/2',␣
 ↪stop_disruptions='true', include_geopath='true', direction_id=direction_id)
departures = ptv(f'/v3/departures/route_type/2/stop/{stop_id}/route/
 ↪{route_id}', direction_id=direction_id)
runs = ptv(f'/v3/runs/route/{route_id}/route_type/2', expand='All')
```

[12]:
```
from datetime import datetime

def plot_bus_map(stops, runs, stop_id):

    fig = plot.figure(figsize=(6, 6))

    # sorting by stop_sequence does not seem to work, as there are multiple 0␣
 ↪entries. stop_sequence needs a direction_id
    stops_coords = np.array([[stop[key] for key in 'stop_latitude␣
 ↪stop_longitude'.split()] for stop in stops['stops'] if stop['stop_sequence']␣
 ↪!= 0])
    disruption_coords = np.array([[stop[key] for key in 'stop_latitude␣
 ↪stop_longitude'.split()] for stop in stops['stops'] if␣
 ↪stop['disruption_ids']])

    paths = stops['geopath'][0]['paths']
    for index, path in enumerate(paths):
        str_coords = path.replace(', ', ',').split()
        coords = np.array([list(map(float, str_coord.split(','))) for str_coord␣
 ↪in str_coords])
        plot.plot(coords[:, 1], coords[:, 0], '#08f', zorder=10)

    if len(disruption_coords):
        plot.plot(disruption_coords[:, 1], disruption_coords[:, 0], 'ro',␣
 ↪zorder=20)

    for run in runs['runs']:
        if not run['vehicle_position']:
            continue

        utc_string = run['vehicle_position']['datetime_utc']
        utc_format = f'%Y-%m-%dT%H:%M:%S{".%f" if "." in utc_string else ""}Z'
        utc_ts = datetime.strptime(utc_string, utc_format)
        sec_from_ts = (datetime.utcnow() - utc_ts).total_seconds()

        direction = run['vehicle_position']['bearing']
        color = '#0f0' if run['direction_id'] == direction_id else '#f00'
        plot.plot(run['vehicle_position']['longitude'],␣
 ↪run['vehicle_position']['latitude'], 'k', marker=(6, 0, direction or 0),␣
 ↪markersize=12, zorder=30)
```

```
        plot.plot(run['vehicle_position']['longitude'],␣
↪run['vehicle_position']['latitude'], color, marker=(3 if direction else 6,␣
↪0, direction or 0), markersize=12 if direction else 8, zorder=50)
        plot.plot(run['vehicle_position']['longitude'],␣
↪run['vehicle_position']['latitude'], 'k', marker=(2 if direction else 6, 0,␣
↪direction or 0), markersize=24 if direction else 0, zorder=40)

    plot.plot(stops_coords[:, 1], stops_coords[:, 0], '.', color='#07e',␣
↪markersize=4, zorder=15)
    plot.annotate('Oakleigh', xy=(145.0873714, -37.9005191), xycoords='data',␣
↪xytext=(-2, 4), textcoords='offset points', ha='right')
    plot.annotate('Box Hill', xy=(145.1217, -37.82010), xycoords='data',␣
↪xytext=(-2, 4), textcoords='offset points', ha='right')
    plot.annotate('Monash', xy=(145.1315377, -37.9142599), xycoords='data',␣
↪xytext=(4, 4), textcoords='offset points')

    fig.gca().xaxis.set_label_position("top")
    fig.gca().yaxis.set_label_position("right")
    plot.xlabel('Longitude', fontsize='large', va='bottom')
    plot.ylabel('Latitude', rotation=270, fontsize='large', va='bottom')
    plot.axis('equal')
    plot.grid()
    plot.show()

plot_bus_map(stops, runs, stop_id)
```


Longitude
Box Hill
−37.82
−37.84
−37.86
−37.88
−37.90
−37.92
Oakleigh
Monash
145.06
145.08
145.10
145.12
145.14
145.16
Latitude