

Eval_cost

July 1, 2022

1 Evaluation des couts sur la ville de Montreal

1.1 Liste des quartiers de Montreal

```
[1]: listofquarter = []
listofquarter.append("Verdun, Montreal, Canada")
listofquarter.append("LaSalle, Montreal, Canada")
listofquarter.append("Borough of Lachine, Montreal, Canada")
listofquarter.append("Saint-Laurent, Montreal, Canada")
listofquarter.append("Le Sud-Ouest, Montreal, Canada")
listofquarter.append("Côte-des-Neiges-Notre-Dame-de-Grâce, Montreal, Canada")
listofquarter.append("Ville-Marie, Montreal, Canada")
listofquarter.append("Outremont, Montreal, Canada")
listofquarter.append("Le Plateau-Mont-Royal, Montreal, Canada")
listofquarter.append("Rosemont-La Petite-Patrie, Montreal, Canada")
listofquarter.append("Hochelaga, Montreal, Canada")
listofquarter.append("Maisonneuve, Montreal, Canada")
listofquarter.append("Anjou, Montreal, Canada")
listofquarter.append("Rivière-des-Prairies, Montreal, Canada")
listofquarter.append("Pointe-aux-Trembles, Montreal, Canada")
listofquarter.append("Montréal-Nord, Montreal, Canada")
listofquarter.append("Saint-Léonard, Montreal, Canada")
listofquarter.append("Villeray-Saint-Michel-Parc-Extension, Montreal, Canada")
listofquarter.append("Ahuntsic, Montreal, Canada")
listofquarter.append("Cartierville, Montreal, Canada")
listofquarter.append("Pierrefonds-Roxboro, Montreal, Canada")
listofquarter.append("L'île-Bizard-Sainte-Geneviève, Montreal, Canada")
```

```
[ ]: def pull_all_graph(list_quarter):
    """
    Permet de recuperer les graphs associés à tous les quartiers
    """
    graph_of_quarter_drive = []
    graph_of_quarter_walk = []
    for i in range(len(list_quarter)):
        print(list_quarter[i])
        quarter = ox.graph_from_place(list_quarter[i], network_type='drive')
        print(ox.plot_graph(quarter))
```

```

graph_of_quarter_drive.append(quarter)
quarter_walk = ox.graph_from_place(list_quarter[i], network_type='walk')
print(ox.plot_graph(quarter_walk))
graph_of_quarter_walk.append(quarter_walk)

return (graph_of_quarter_drive, graph_of_quarter_walk)

```

```
[4]: def find_size_of_each_quarter(list_quarter, list_graph):
    arrayoflength = []
    allroad = 0
    for i in range(len(list_quarter)):
        print(list_quarter[i])
        proj = ox.project_graph(list_graph[i])
        nodes_proj = ox.graph_to_gdfs(proj, edges=False)
        graph_area_m = nodes_proj.unary_union.convex_hull.area
        length_road = ox.basic_stats(proj, area=graph_area_m, ↵
        clean_int_tol=15)["edge_length_total"]
        arrayoflength.append(length_road)
        allroad += length_road
        print(length_road)
    return (allroad, arrayoflength)
```

```
[5]: import math

def divide_nb_snowplot_by_quarter(array_size_quarter, total_size, ↵
    nb_drive_snowplot):
    """
    Permet de trouver le nombre de deneigeuse à utiliser par quartier
    """
    deneigeuseperquarter = []
    for i in range(len(array_size_quarter)):
        nb_deneigeuse = math.floor((nb_drive_snowplot * array_size_quarter[i]) / ↵
        total_size)
        print(str(listofquarter[i]) + " : " + str(nb_deneigeuse))
        deneigeuseperquarter.append(nb_deneigeuse)

    print(deneigeuseperquarter)
    return deneigeuseperquarter
```

```
[6]: import osmnx as ox
import networkx as nx
import numpy as np
```

```
[7]: def divideeulerbynbdenigeuse(nbd, circuit, G):
    size = len(circuit)
    start_node = circuit[0]
```

```

size_circuit = size // nbd
result = []
tmp = []
nb = 0
for i in circuit:
    if ( nb >= size_circuit):
        if (tmp[0] != start_node):
            st = ox.shortest_path(G, start_node, tmp[0])
            st.pop()
            tmp = st + tmp

        if (tmp[len(tmp) - 1] != start_node):
            st = ox.shortest_path(G, tmp[len(tmp) - 1], start_node)
            tmp.pop()
            tmp = tmp + st

        result.append(tmp)
        tmp = []
        nb = 0
        tmp.append(i)
        nb += 1
    if (tmp != [] and len(result) < nbd):
        result.append(tmp)
return result

```

```

[8]: def find_road_for_each_snowplot_in_quarter(which_quarter, nb_snowplot,
listofquarter, graph_quarter, speed_snowplot):
    print("===== " + listofquarter[which_quarter] + " =====")
    Hoch_unordered = ox.getUndirected(graph_quarter[which_quarter])
    H = nx.eulerize(Hoch_unordered)
    print("The graph is eulerian : " + str(nx.is_eulerian(H)))

    Hoch_unordered = ox.speed.add_edge_speeds(Hoch_unordered)
    Hoch_unordered = ox.speed.add_edge_travel_times(Hoch_unordered)

    euler_circuit = [u for u, v in nx.eulerian_circuit(H)]
    print(euler_circuit)

    print("show the eulerian circuit : ")
    print(ox.plot_graph_route(Hoch_unordered, euler_circuit, node_size=0))

    allcircuitquarter = divideeulerbynbdeneigeuse(nb_snowplot, euler_circuit,
Hoch_unordered)

```

```
for i in allcircuitquarter:
    print(i)
    print(ox.plot_graph_route(Hoch_unordered, i, node_size=0))

    edge_lengths = ox.utils_graph.get_route_edge_attributes(Hoch_unordered, ↴
    ↵i, "length")
    length = round(sum(edge_lengths))
    print("length of road : " + str(length))
    time_for_deneigeuse = ((length / 1000) * 60) / speed_snowplot
    print("time : " + str(time_for_deneigeuse) + str(" minutes"))
```

```
[9]: def show_road_for_each_snowplot(arr, listofquarter, graph_quarter, ↴
    ↵speed_snowplot):
    for i in range(len(arr)):
        find_road_for_each_snowplot_in_quarter(i, arr[i], listofquarter, ↴
    ↵graph_quarter, speed_snowplot)
```

1.2 Premièrement on récupère les graphs des quartiers

```
[10]: graphs = pull_all_graph(listofquarter)
```

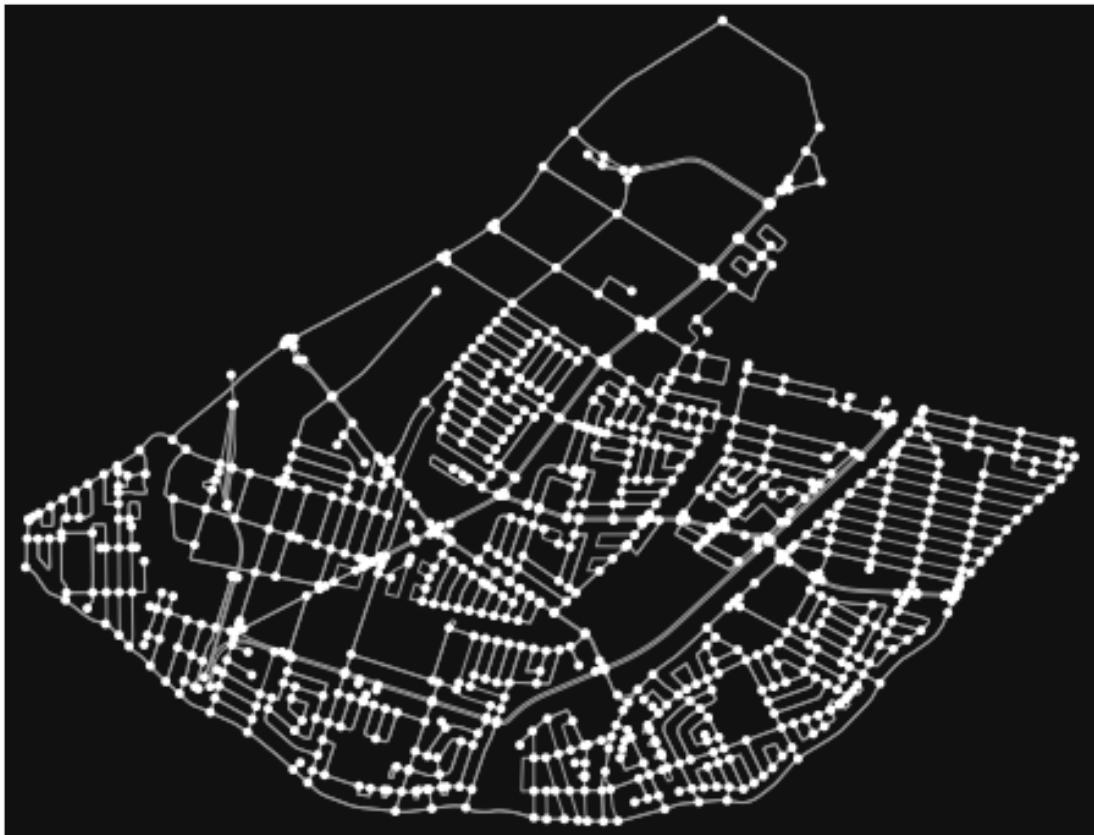
Verdun, Montreal, Canada



(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)



(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)
LaSalle, Montreal, Canada



(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)



(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)
Borough of Lachine, Montreal, Canada



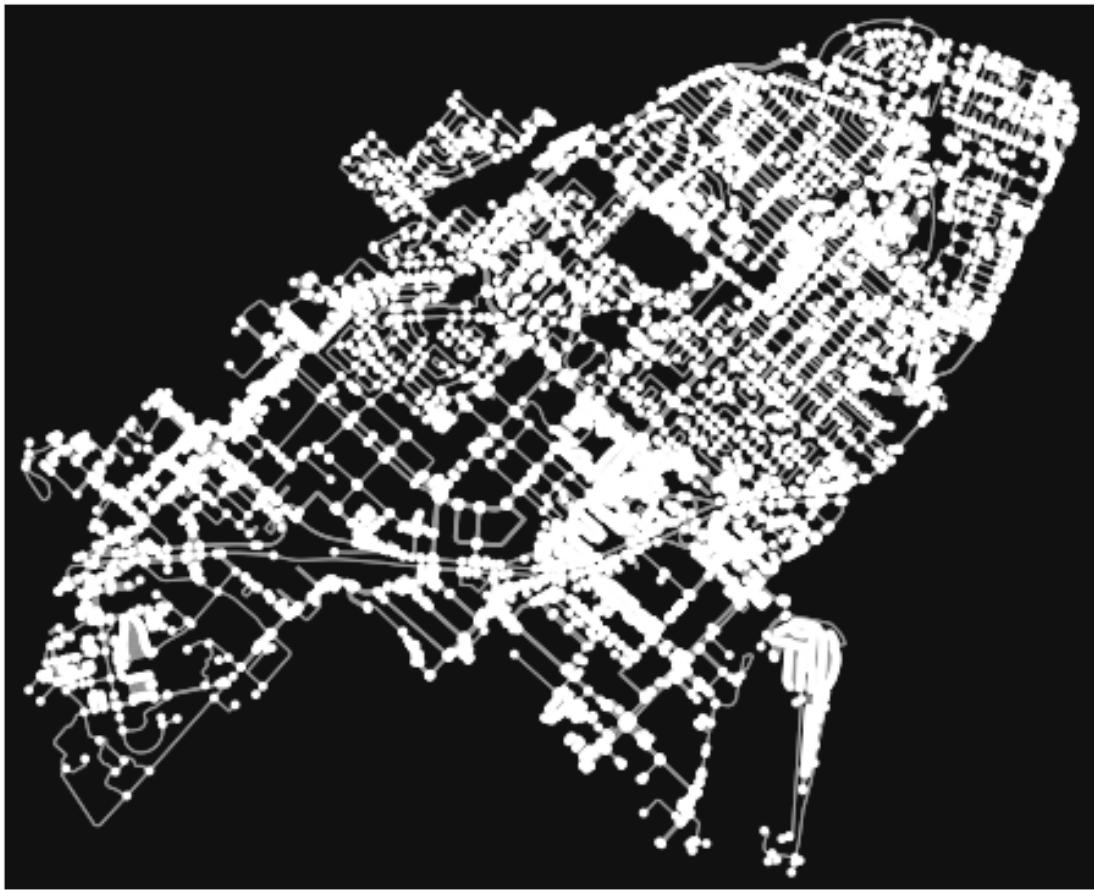
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(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)
Saint-Laurent, Montreal, Canada



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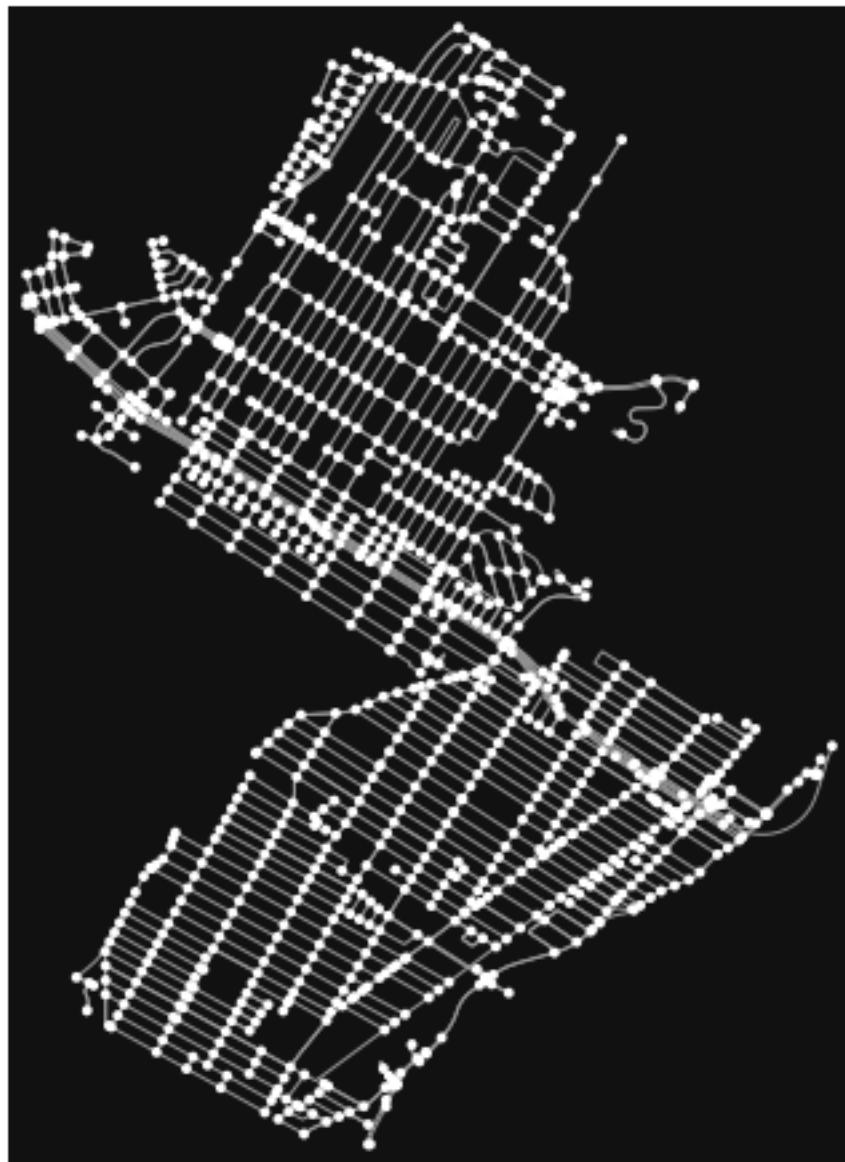
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Le Sud-Ouest, Montreal, Canada



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(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>
Côte-des-Neiges-Notre-Dame-de-Grâce, Montreal, Canada



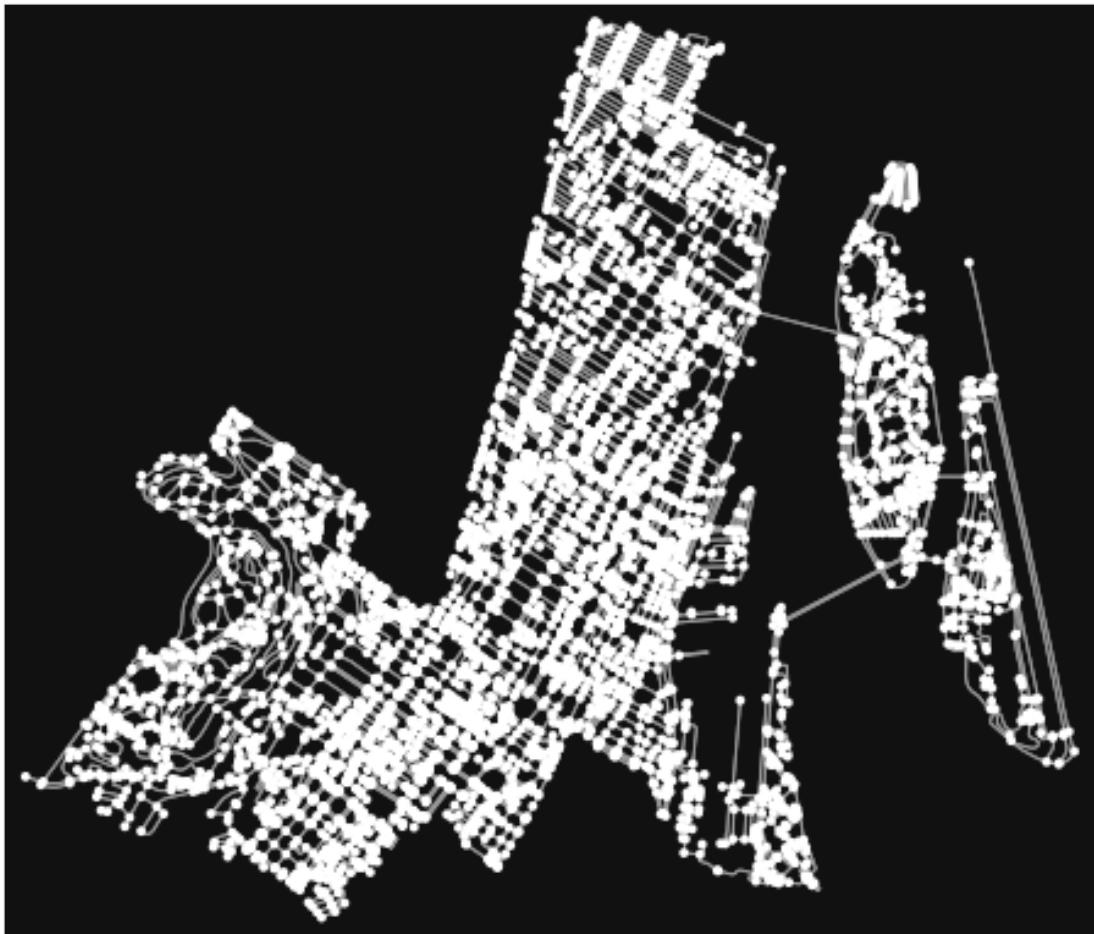
(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)



(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)
Ville-Marie, Montreal, Canada



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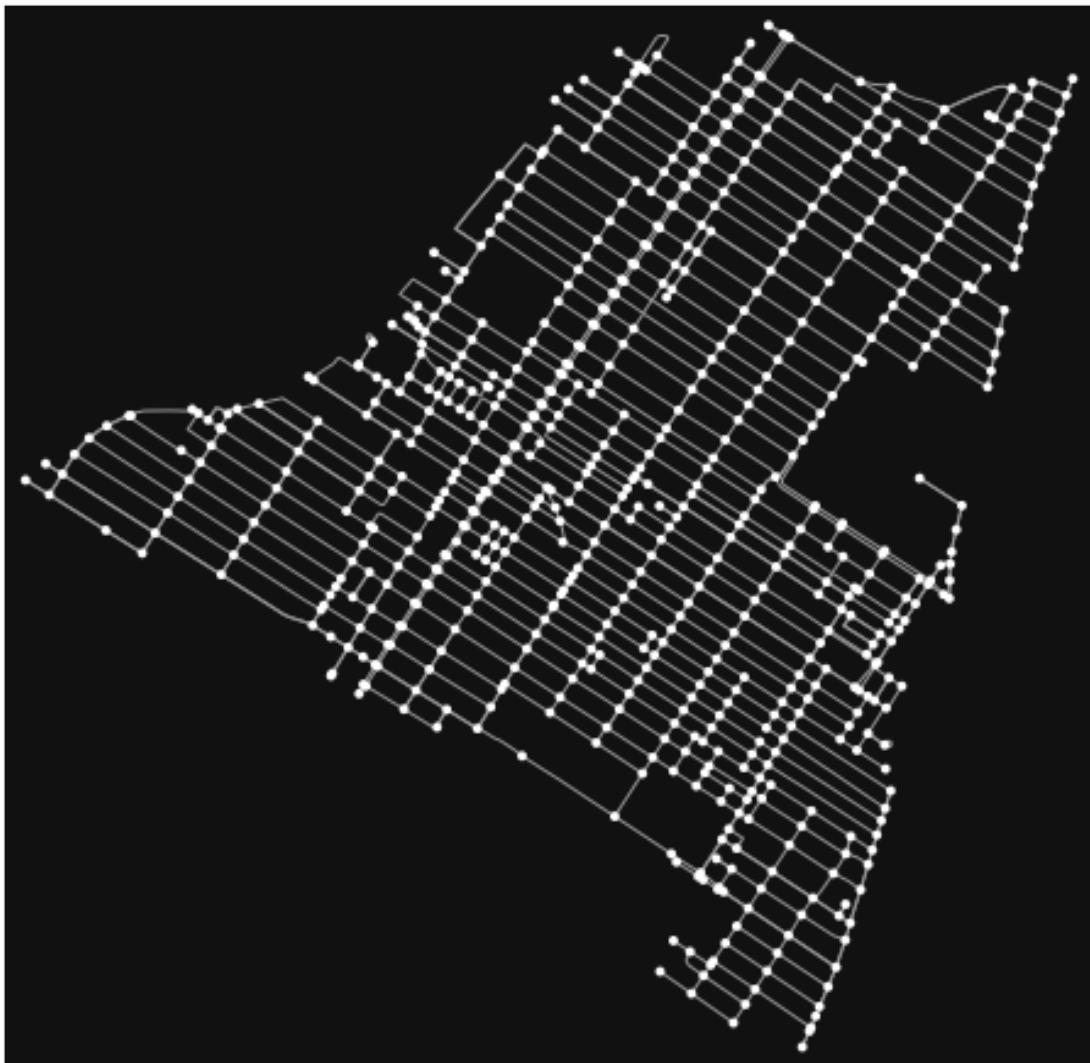
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Outremont, Montreal, Canada



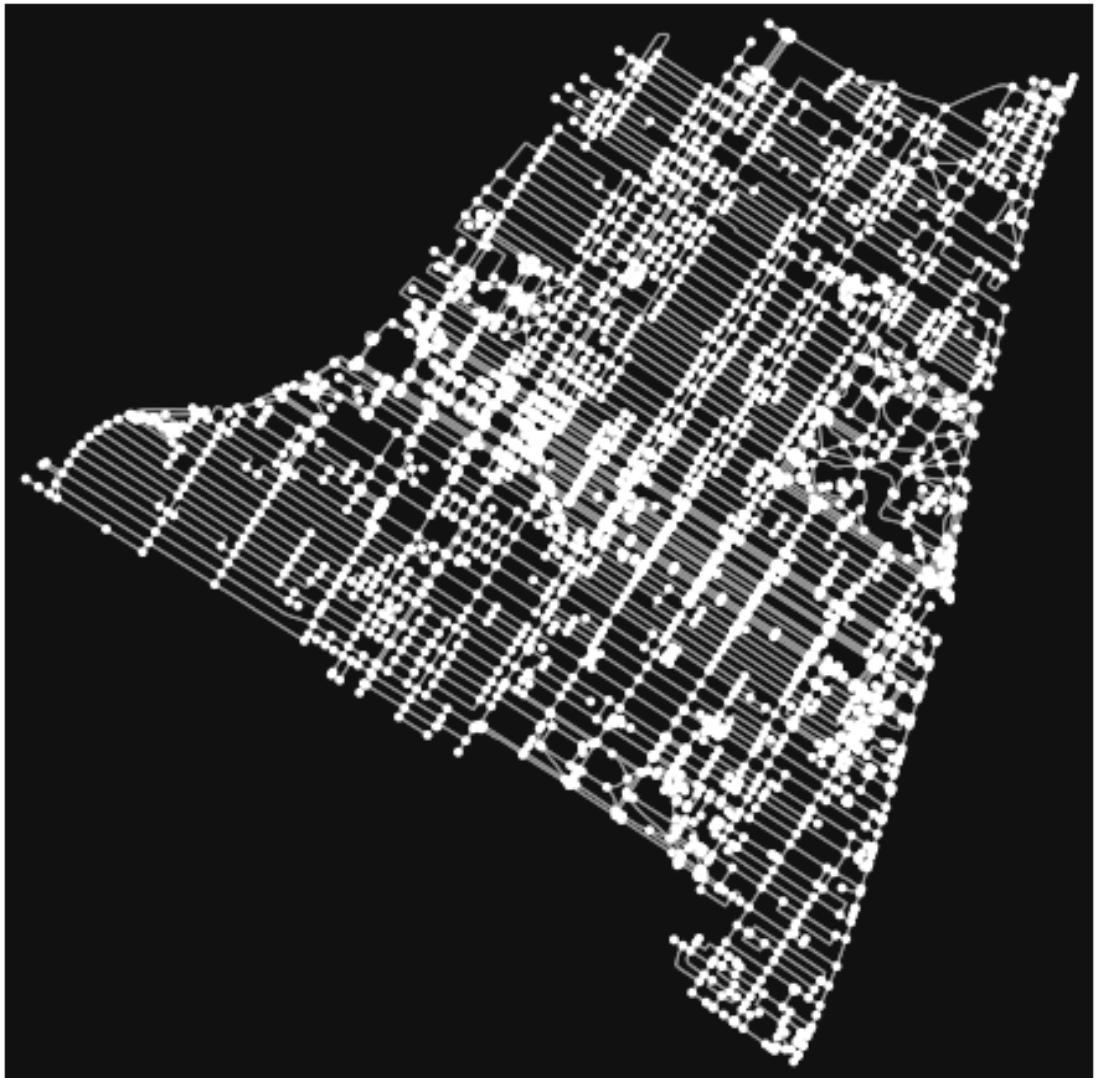
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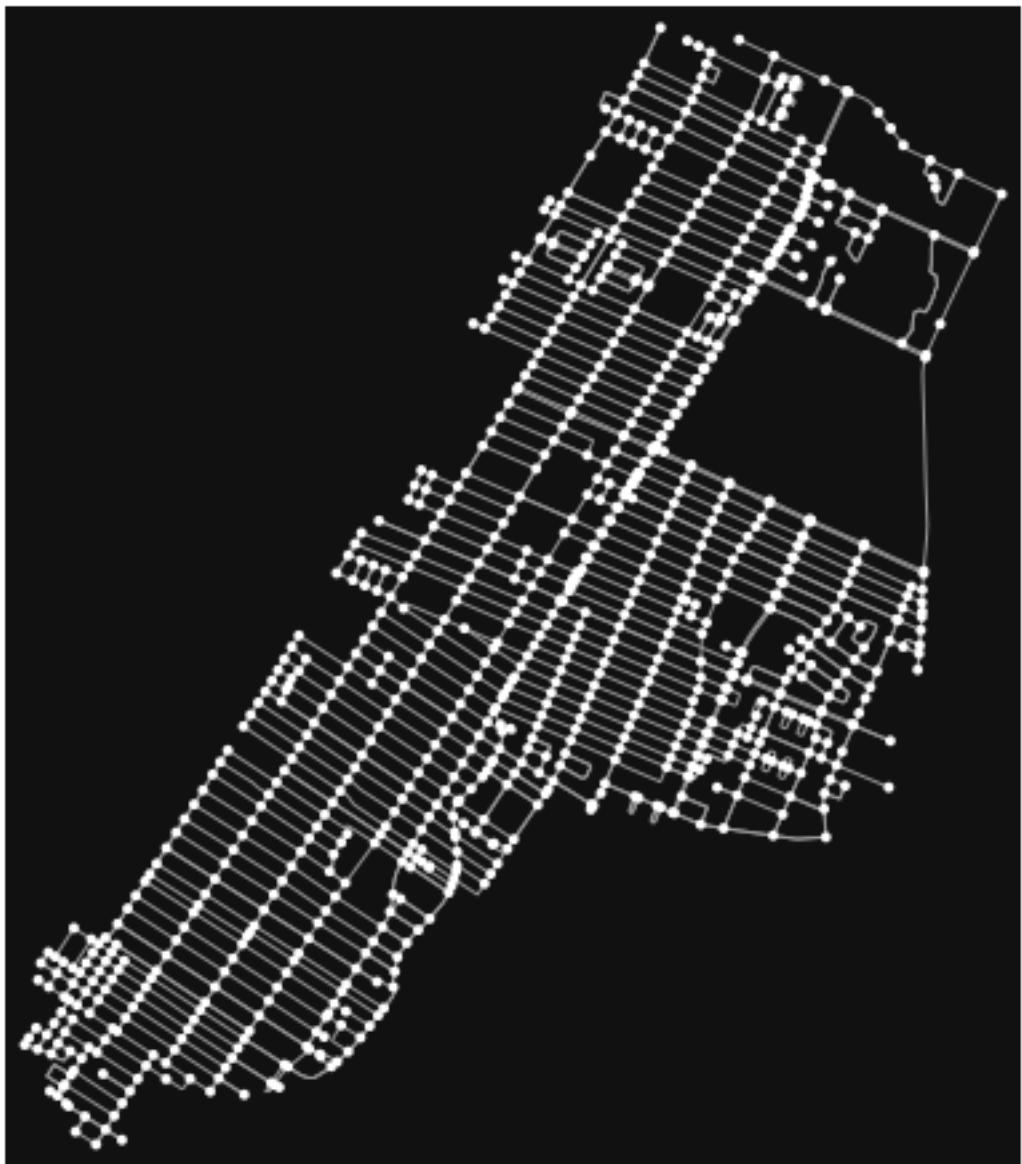
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Le Plateau-Mont-Royal, Montreal, Canada



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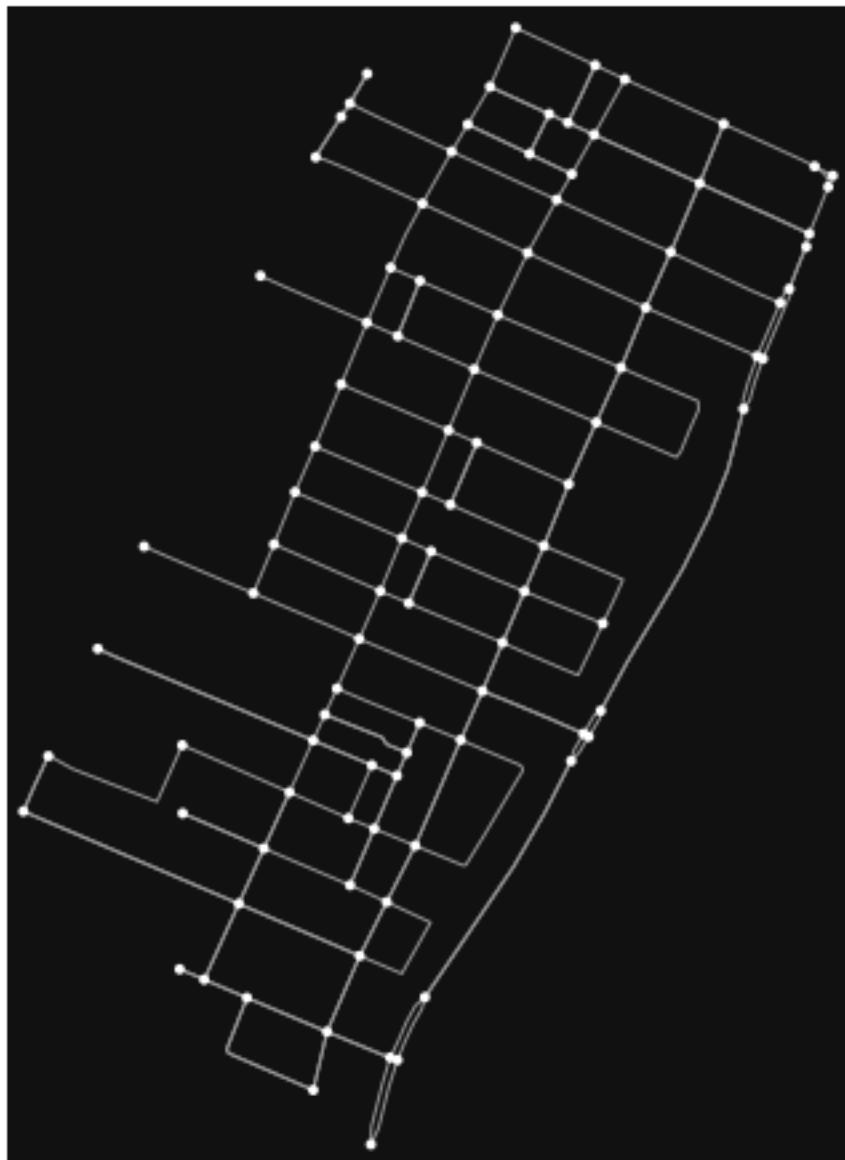
(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)
Rosemont-La Petite-Patrie, Montreal, Canada



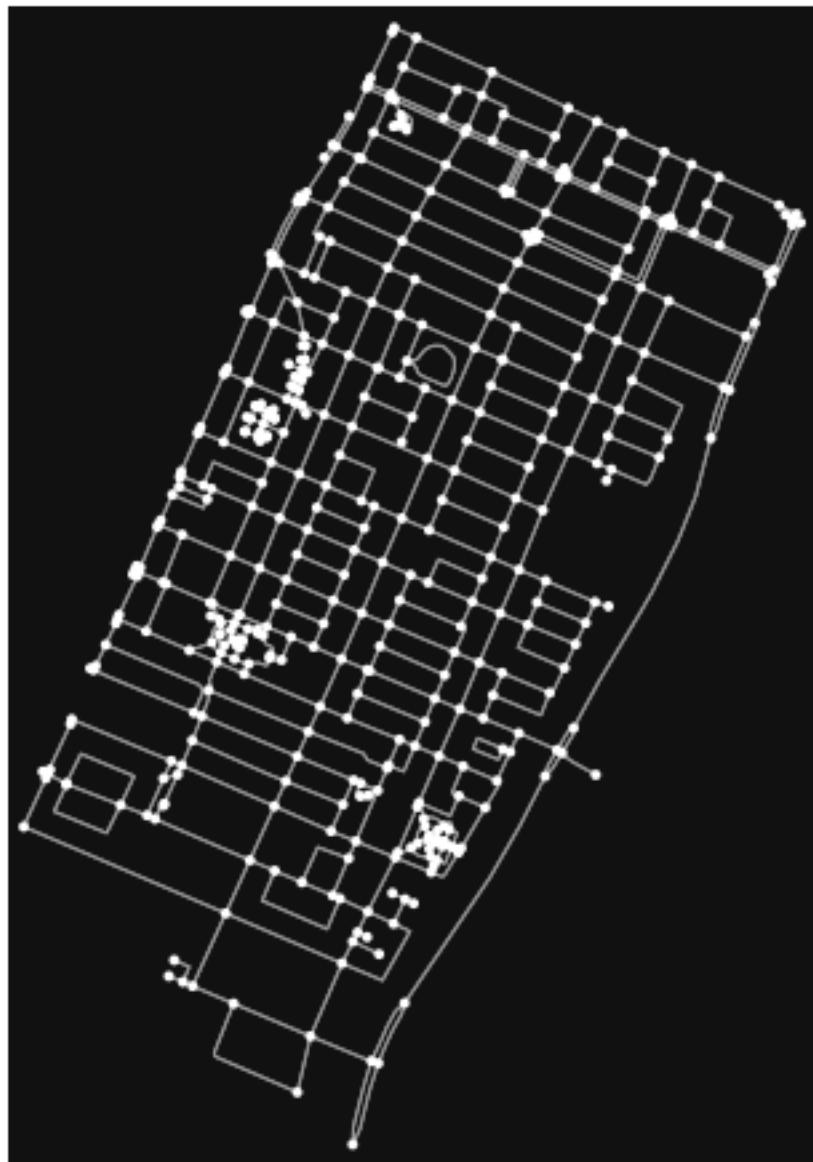
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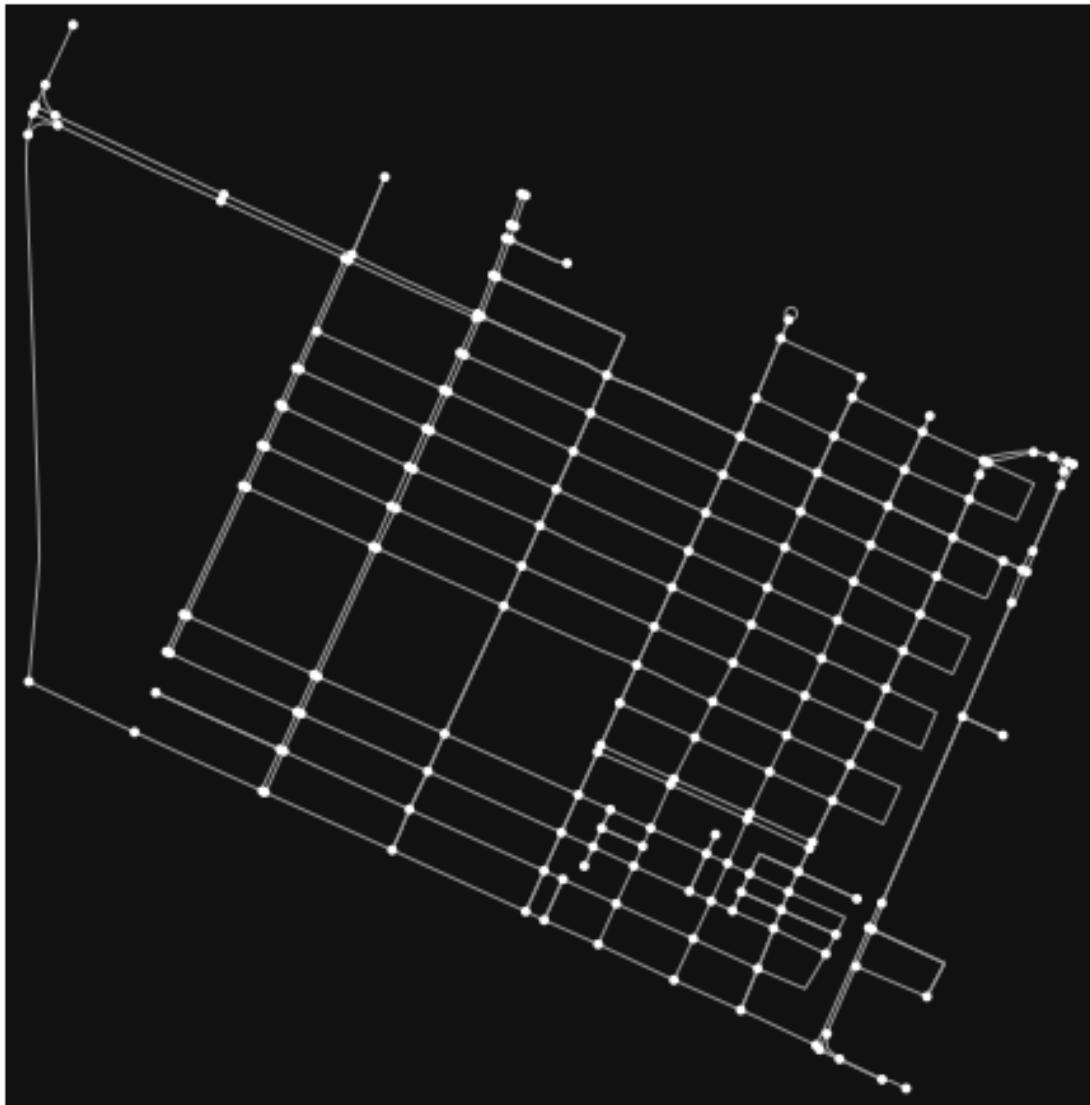
(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>
Hochelaga, Montreal, Canada



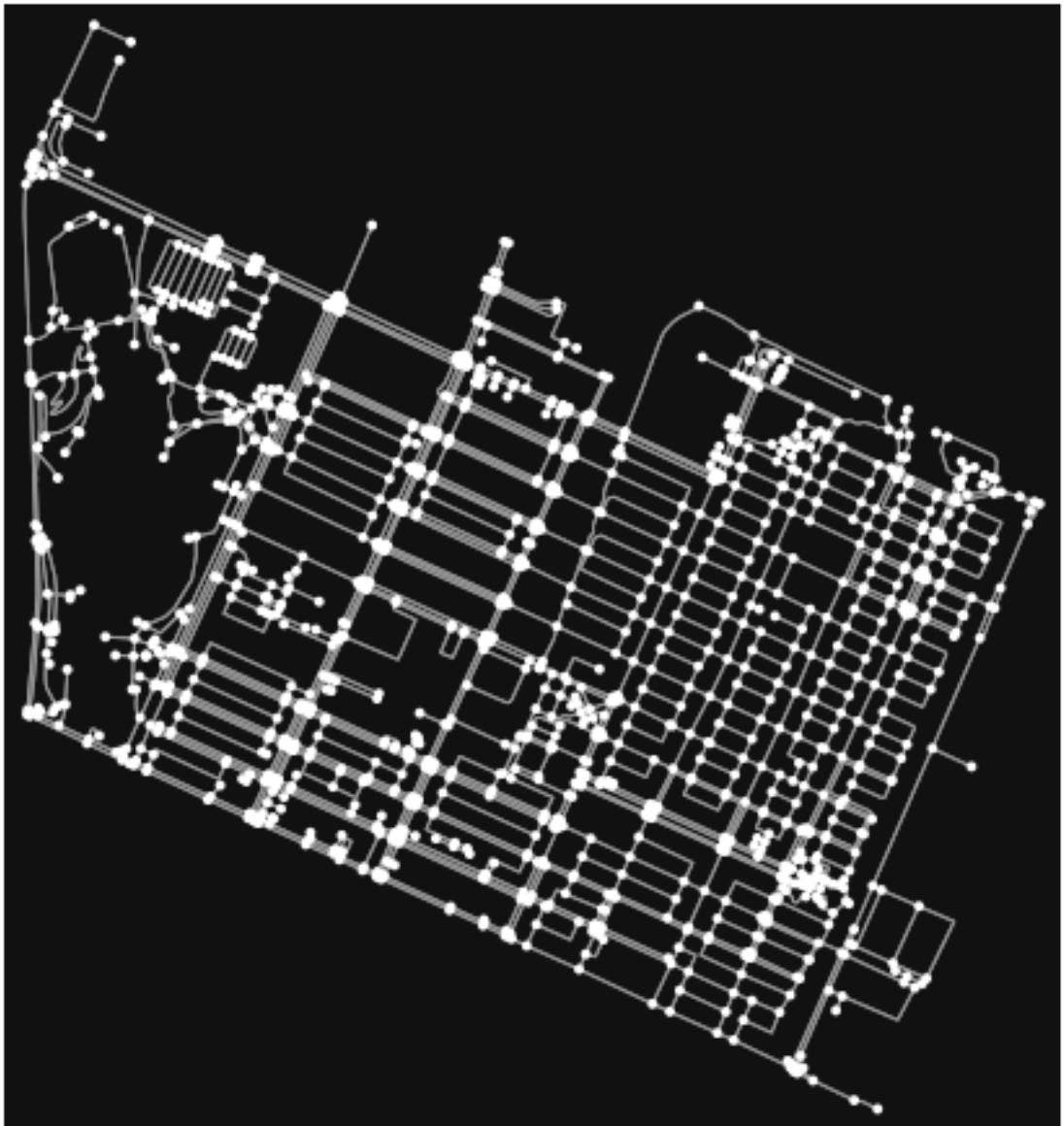
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(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)
Maisonneuve, Montreal, Canada



(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)



(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>
Anjou, Montreal, Canada



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Rivi re-des-Prairies, Montreal, Canada



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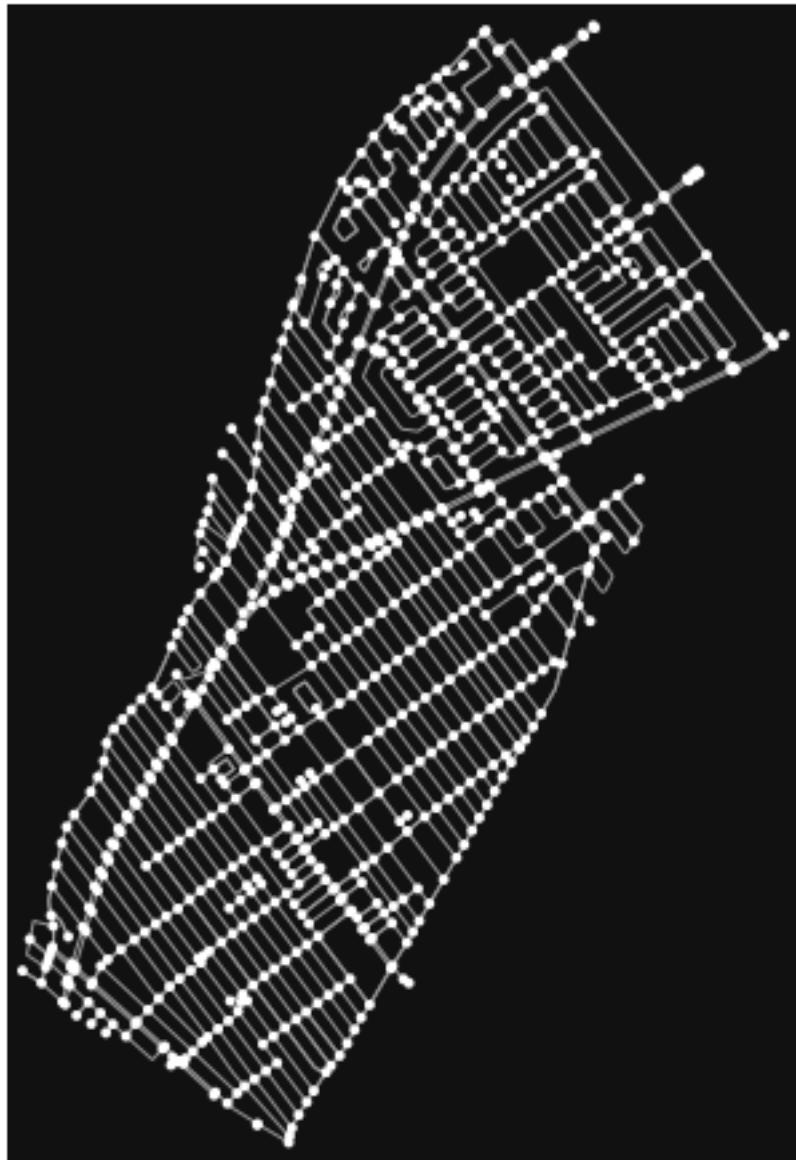
(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)
Pointe-aux-Trembles, Montreal, Canada



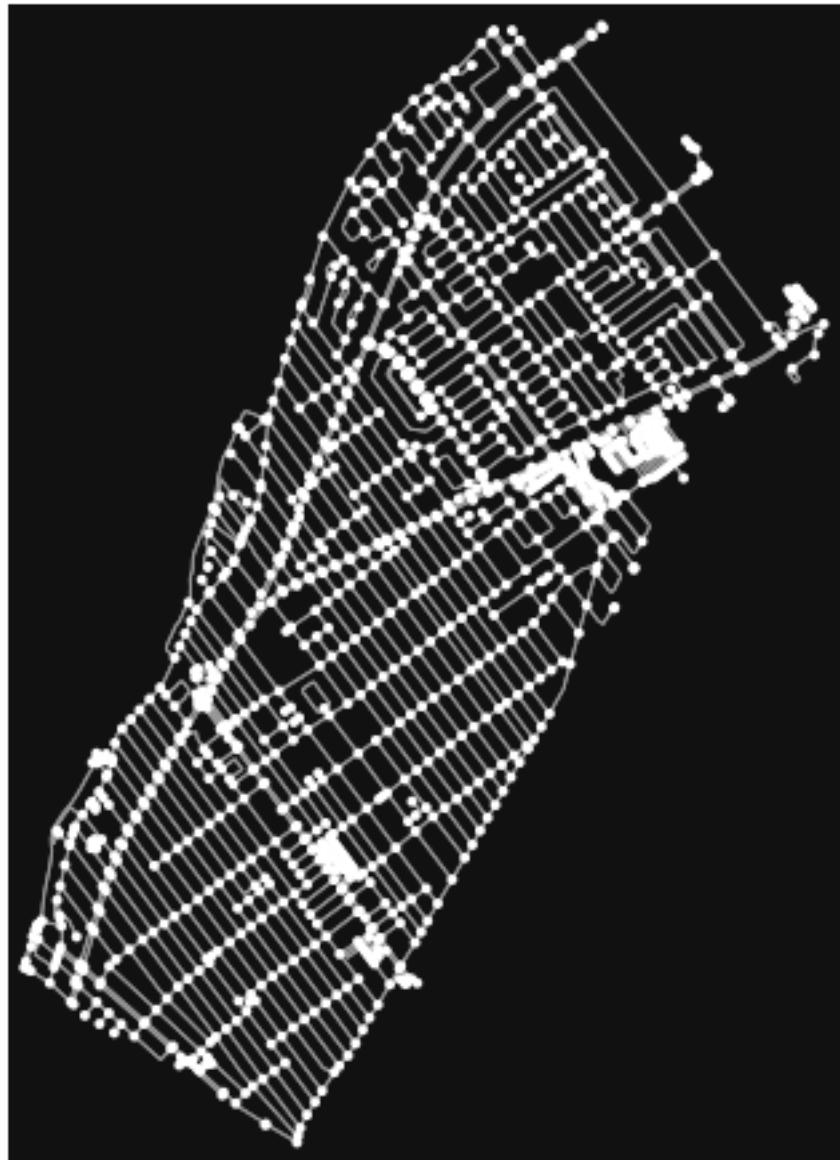
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(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)
Montréal-Nord, Montreal, Canada



(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)



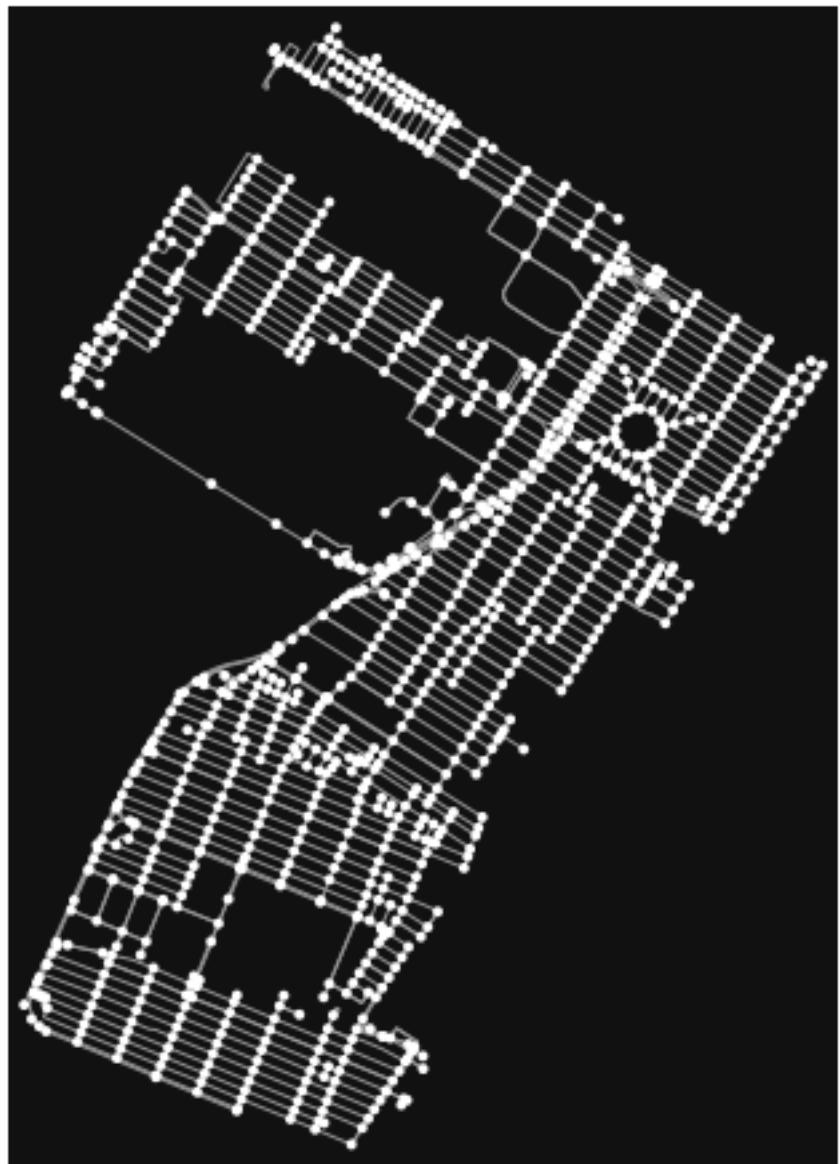
(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)
Saint-Léonard, Montreal, Canada



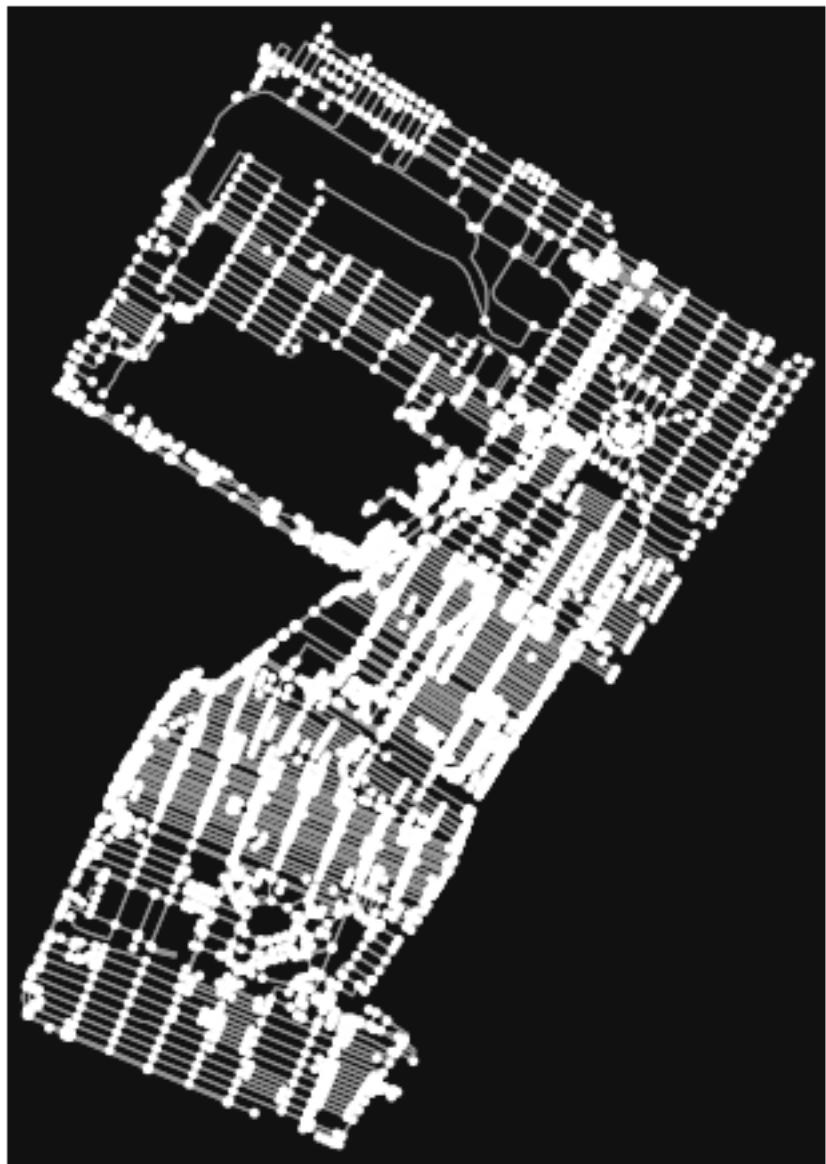
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(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)
Villeray-Saint-Michel-Parc-Extension, Montreal, Canada



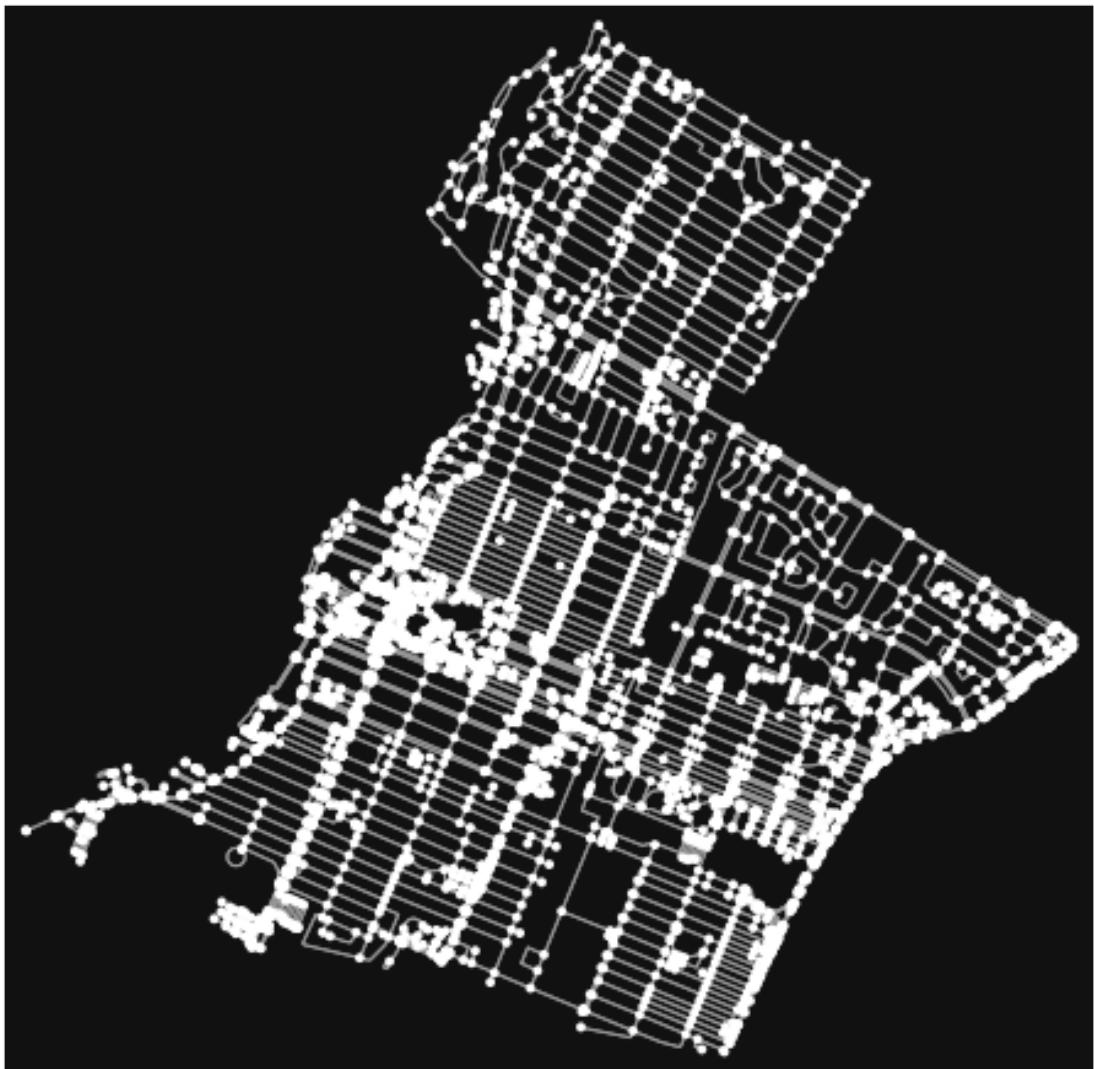
(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)



(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)
Ahuntsic, Montreal, Canada



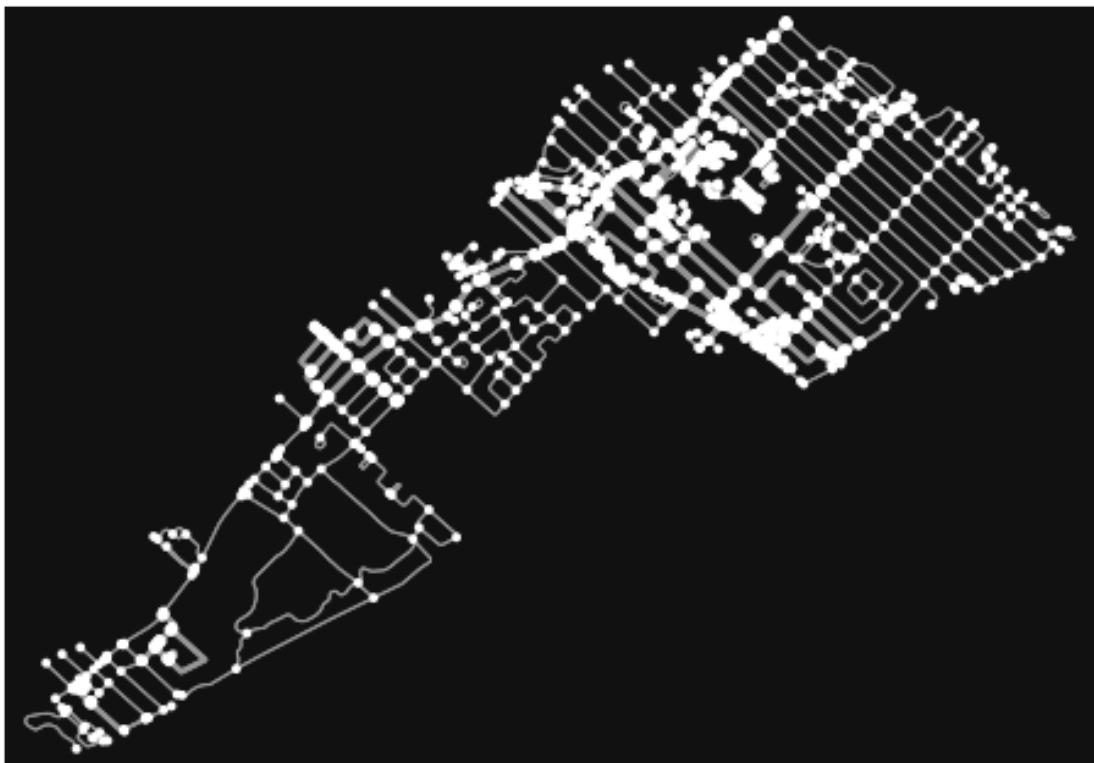
(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)



(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)
Cartierville, Montreal, Canada



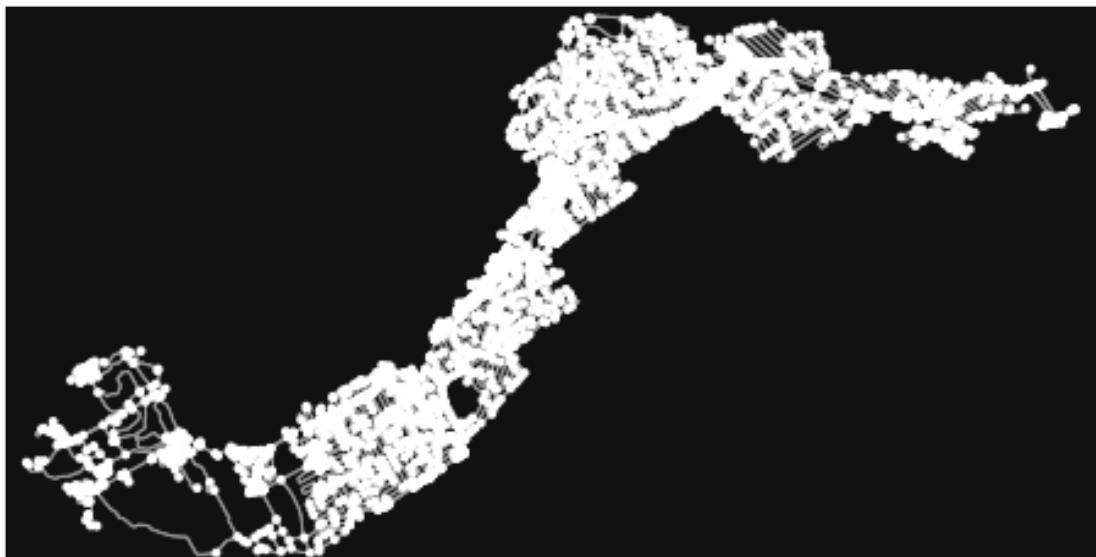
(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)



(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)
Pierrefonds-Roxboro, Montreal, Canada

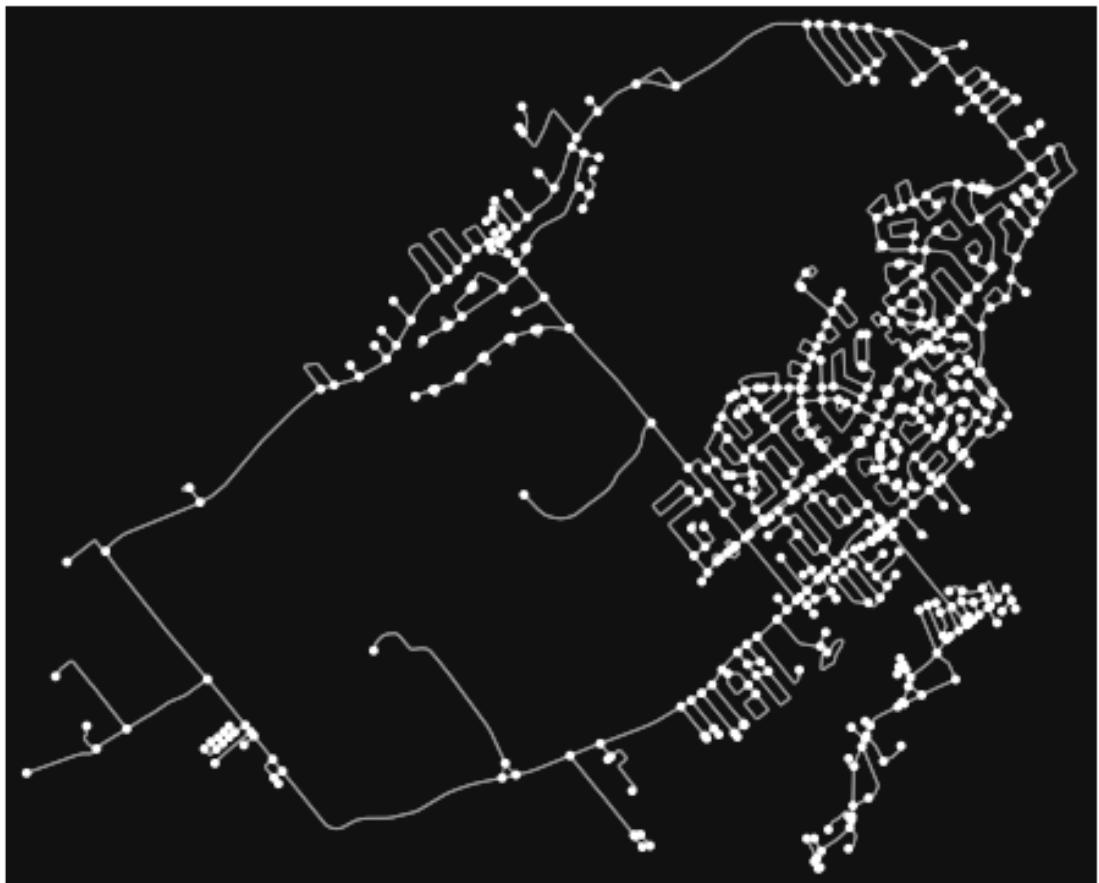


(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)

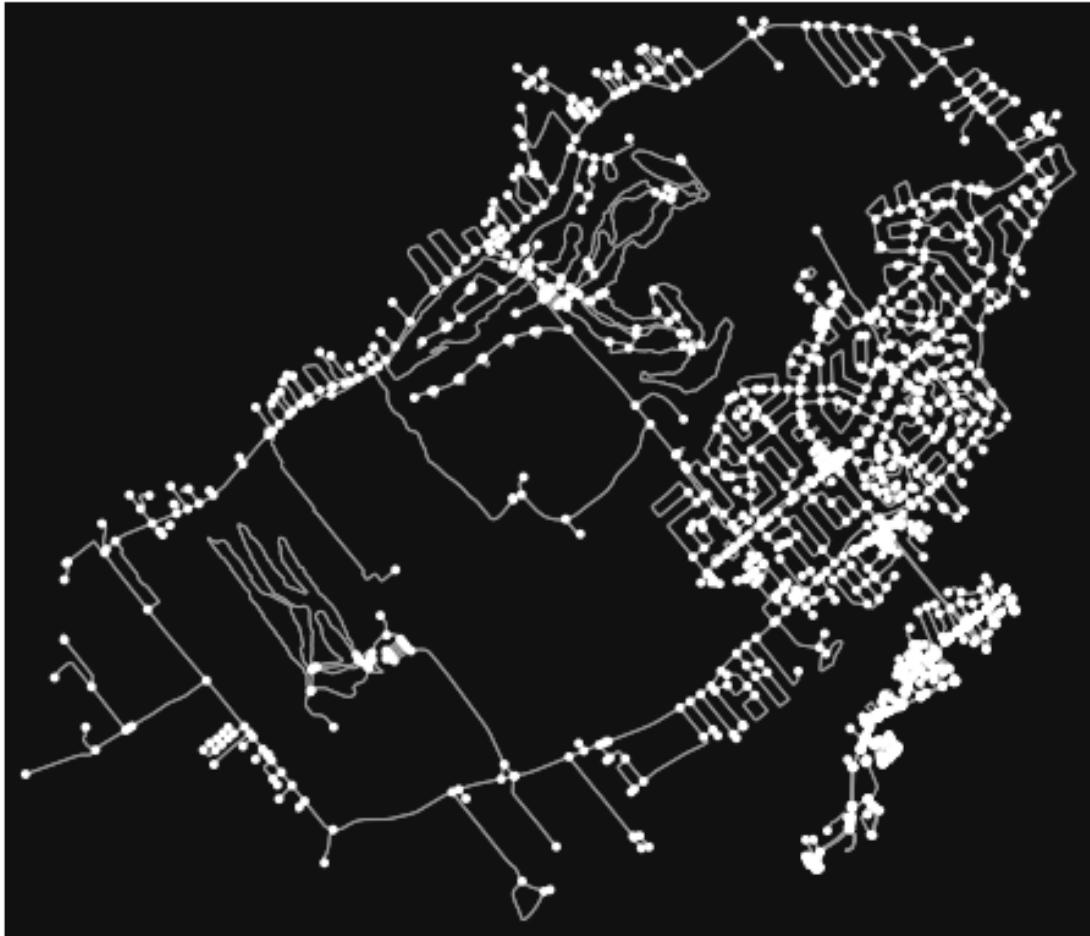


(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)

L'île-Bizard-Sainte-Geneviève, Montreal, Canada



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1.3 Puis on calcule leur taille

```
[11]: (graph_drive, graph_walk) = graphs

drive = find_size_of_each_quarter(listofquarter, graph_drive)
walk  = find_size_of_each_quarter(listofquarter, graph_walk)
```

Verdun, Montreal, Canada
103030.82699999987
LaSalle, Montreal, Canada
327102.20599999966
Borough of Lachine, Montreal, Canada
266243.77900000056
Saint-Laurent, Montreal, Canada
601857.605999998
Le Sud-Ouest, Montreal, Canada

272056.6470000001
Côte-des-Neiges-Notre-Dame-de-Grâce, Montreal, Canada
359709.7689999996
Ville-Marie, Montreal, Canada
273484.6549999998
Outremont, Montreal, Canada
73699.052
Le Plateau-Mont-Royal, Montreal, Canada
170335.16299999977
Rosemont-La Petite-Patrie, Montreal, Canada
279994.9649999991
Hochelaga, Montreal, Canada
22798.042000000005
Maisonneuve, Montreal, Canada
47705.07299999999
Anjou, Montreal, Canada
238484.23500000016
Rivière-des-Prairies, Montreal, Canada
176728.1629999994
Pointe-aux-Trembles, Montreal, Canada
330629.6569999991
Montréal-Nord, Montreal, Canada
242483.67400000012
Saint-Léonard, Montreal, Canada
319198.91800000076
Villeray-Saint-Michel-Parc-Extension, Montreal, Canada
301796.68999999954
Ahuntsic, Montreal, Canada
247607.03900000005
Cartierville, Montreal, Canada
100365.21200000019
Pierrefonds-Roxboro, Montreal, Canada
493348.5240000001
L'île-Bizard-Sainte-Geneviève, Montreal, Canada
214894.38099999982
Verdun, Montreal, Canada
197339.55800000005
LaSalle, Montreal, Canada
749792.2719999993
Borough of Lachine, Montreal, Canada
532975.5200000008
Saint-Laurent, Montreal, Canada
1647218.4240000134
Le Sud-Ouest, Montreal, Canada
765546.5860000039
Côte-des-Neiges-Notre-Dame-de-Grâce, Montreal, Canada
979713.835999995
Ville-Marie, Montreal, Canada

1023850.7239999999
 Outremont, Montreal, Canada
 183825.09800000011
 Le Plateau-Mont-Royal, Montreal, Canada
 571403.3900000008
 Rosemont-La Petite-Patrie, Montreal, Canada
 870318.0719999947
 Hochelaga, Montreal, Canada
 65880.0519999997
 Maisonneuve, Montreal, Canada
 206787.51600000027
 Anjou, Montreal, Canada
 464329.9460000014
 Rivière-des-Prairies, Montreal, Canada
 256253.4559999992
 Pointe-aux-Trembles, Montreal, Canada
 467516.5160000015
 Montréal-Nord, Montreal, Canada
 411295.9259999916
 Saint-Léonard, Montreal, Canada
 495939.0539999995
 Villeray-Saint-Michel-Parc-Extension, Montreal, Canada
 893917.9279999956
 Ahuntsic, Montreal, Canada
 686504.3799999974
 Cartierville, Montreal, Canada
 245492.7759999997
 Pierrefonds-Roxboro, Montreal, Canada
 891463.0779999953
 L'île-Bizard-Sainte-Geneviève, Montreal, Canada
 370921.05999999924

1.4 Enfin on calcule l'itinéraire de chaque quartier et chaque deneigeuse

```
[12]: import math

def resolve_function(listofquarter, nb_snowplot, speed_snowplot, drive, walk):

    (a_drive, b_drive) = drive
    (a_walk, b_walk) = walk

    speed_deneigeuse = 15

    allsuperficy = a_drive + a_walk
    snowplot_walk = math.floor((nb_snowplot * a_walk) / allsuperficy)
    snowplot_drive = math.floor((nb_snowplot * a_drive) / allsuperficy)
```

```

    array_of_quarter_snowplot = divide_nb_snowplot_by_quarter(b_drive, a_drive, ↵
    ↵snowplot_drive)
    array_of_quarter_snowplot_walk = divide_nb_snowplot_by_quarter(b_walk, ↵
    ↵a_walk, snowplot_walk)

    show_road_for_each_snowplot(array_of_quarter_snowplot, listofquarter, ↵
    ↵graph_drive, speed_snowplot)
    show_road_for_each_snowplot(array_of_quarter_snowplot_walk, listofquarter, ↵
    ↵graph_walk, speed_snowplot)

```

[]: resolve_function(listofquarter, 2200, 15, drive, walk)

Verdun, Montreal, Canada : 12
 LaSalle, Montreal, Canada : 38
 Borough of Lachine, Montreal, Canada : 31
 Saint-Laurent, Montreal, Canada : 71
 Le Sud-Ouest, Montreal, Canada : 32
 Côte-des-Neiges-Notre-Dame-de-Grâce, Montreal, Canada : 42
 Ville-Marie, Montreal, Canada : 32
 Outremont, Montreal, Canada : 8
 Le Plateau-Mont-Royal, Montreal, Canada : 20
 Rosemont-La Petite-Patrie, Montreal, Canada : 33
 Hochelaga, Montreal, Canada : 2
 Maisonneuve, Montreal, Canada : 5
 Anjou, Montreal, Canada : 28
 Rivièrel-des-Prairies, Montreal, Canada : 21
 Pointe-aux-Trembles, Montreal, Canada : 39
 Montréal-Nord, Montreal, Canada : 28
 Saint-Léonard, Montreal, Canada : 38
 Villeray-Saint-Michel-Parc-Extension, Montreal, Canada : 35
 Ahuntsic, Montreal, Canada : 29
 Cartierville, Montreal, Canada : 11
 Pierrefonds-Roxboro, Montreal, Canada : 58
 L'île-Bizard-Sainte-Geneviève, Montreal, Canada : 25
 [12, 38, 31, 71, 32, 42, 32, 8, 20, 33, 2, 5, 28, 21, 39, 28, 38, 35, 29, 11,
 58, 25]
 Verdun, Montreal, Canada : 23
 LaSalle, Montreal, Canada : 89
 Borough of Lachine, Montreal, Canada : 63
 Saint-Laurent, Montreal, Canada : 196
 Le Sud-Ouest, Montreal, Canada : 91
 Côte-des-Neiges-Notre-Dame-de-Grâce, Montreal, Canada : 116
 Ville-Marie, Montreal, Canada : 122
 Outremont, Montreal, Canada : 21
 Le Plateau-Mont-Royal, Montreal, Canada : 68
 Rosemont-La Petite-Patrie, Montreal, Canada : 103

Hochelaga, Montreal, Canada : 7
Maisonneuve, Montreal, Canada : 24
Anjou, Montreal, Canada : 55
Rivière-des-Prairies, Montreal, Canada : 30
Pointe-aux-Trembles, Montreal, Canada : 55
Montréal-Nord, Montreal, Canada : 49
Saint-Léonard, Montreal, Canada : 59
Villeray-Saint-Michel-Parc-Extension, Montreal, Canada : 106
Ahuntsic, Montreal, Canada : 81
Cartierville, Montreal, Canada : 29
Pierrefonds-Roxboro, Montreal, Canada : 106
L'île-Bizard-Sainte-Geneviève, Montreal, Canada : 44
[23, 89, 63, 196, 91, 116, 122, 21, 68, 103, 7, 24, 55, 30, 55, 49, 59, 106, 81, 29, 106, 44]
=====

===== Verdun, Montreal, Canada =====
The graph is eulerian : True
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time : 28.84 minutes
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===== LaSalle, Montreal, Canada =====
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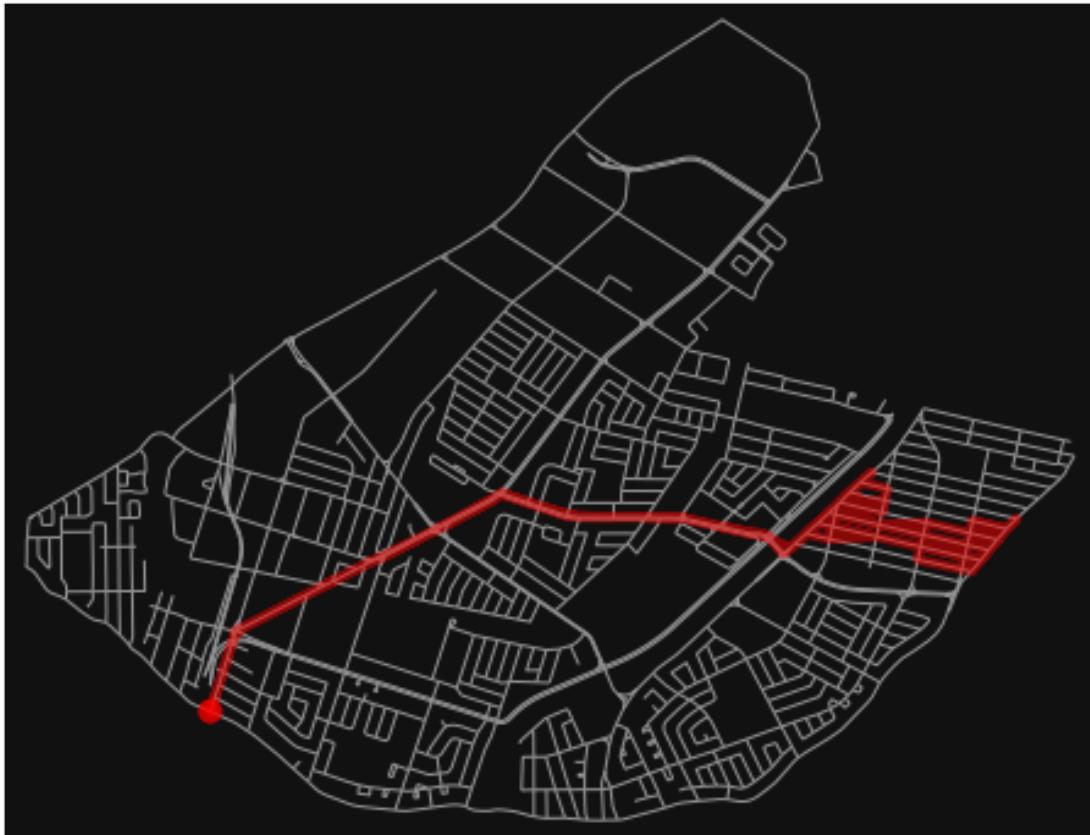


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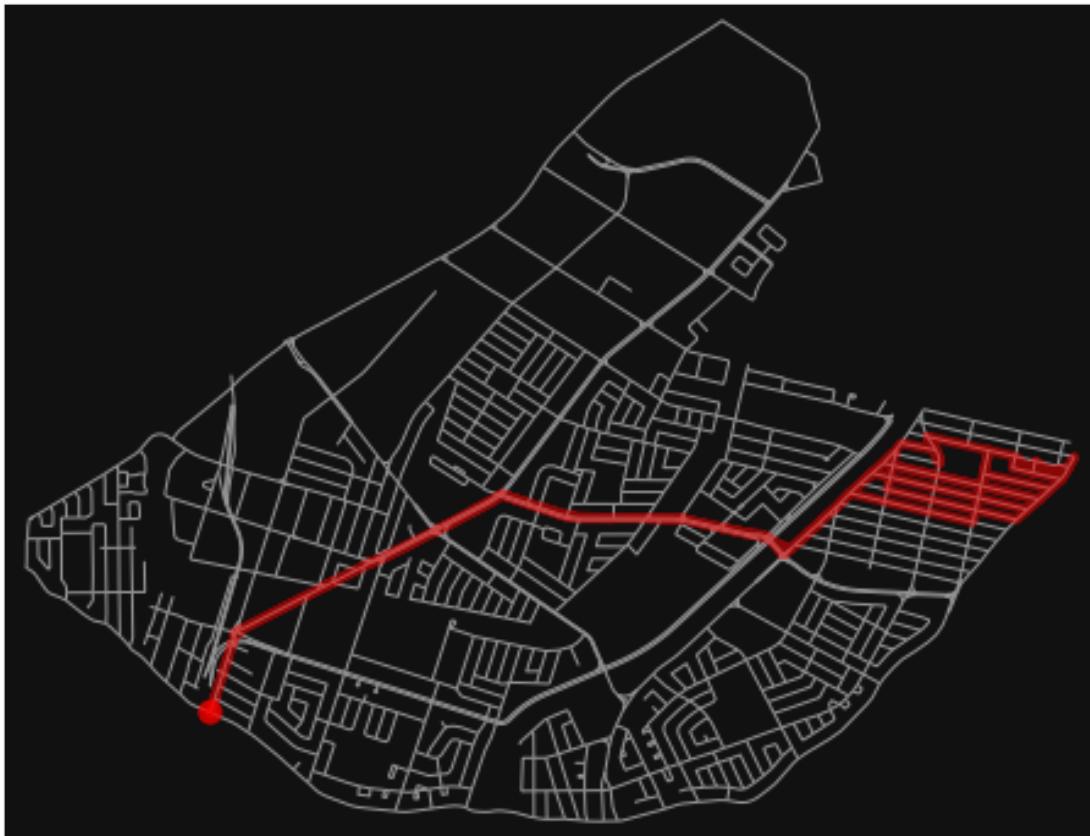
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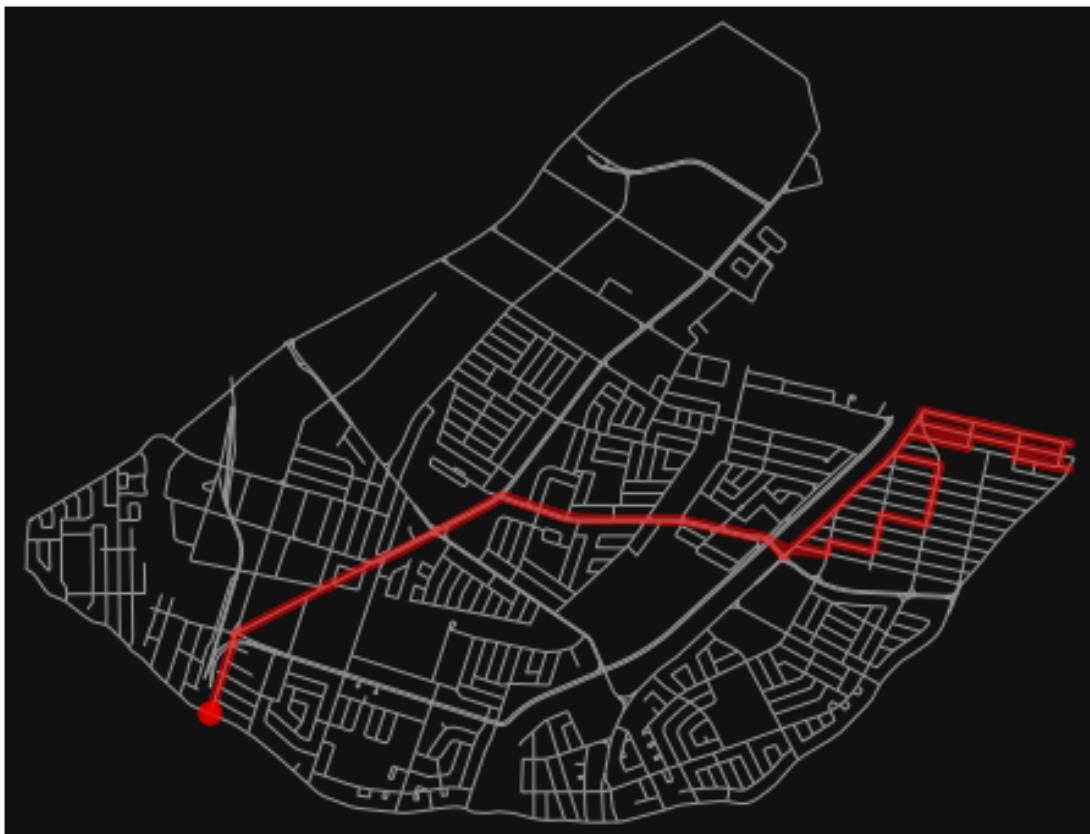
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32662002]



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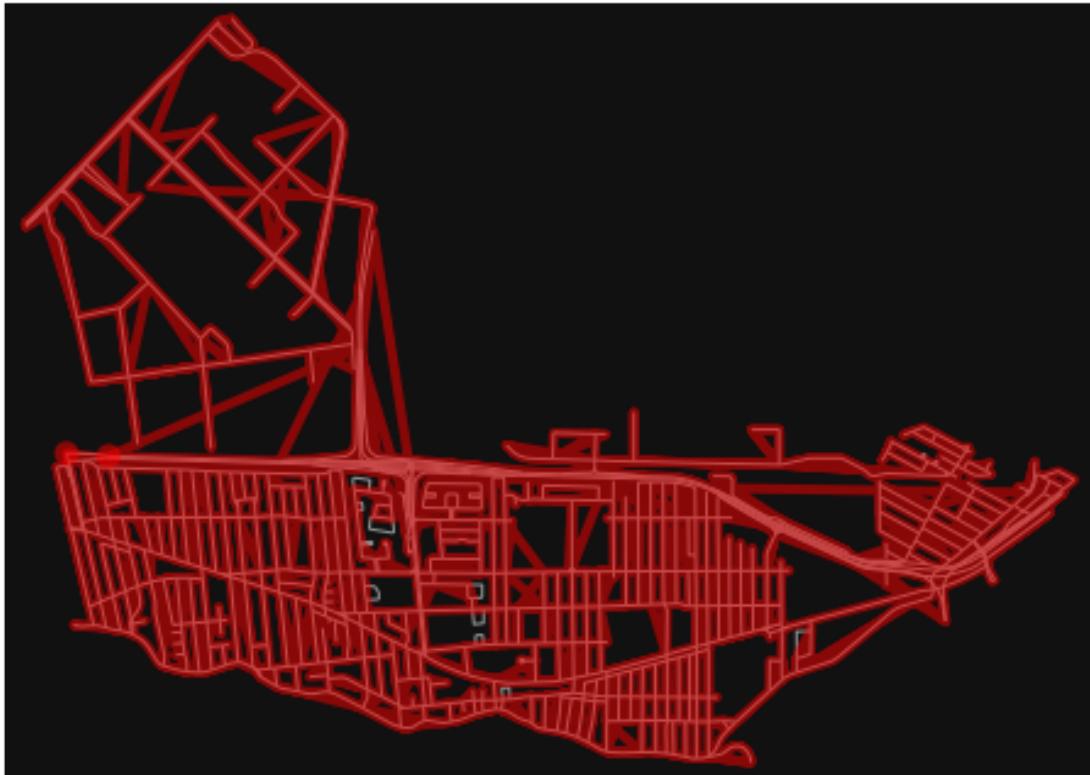
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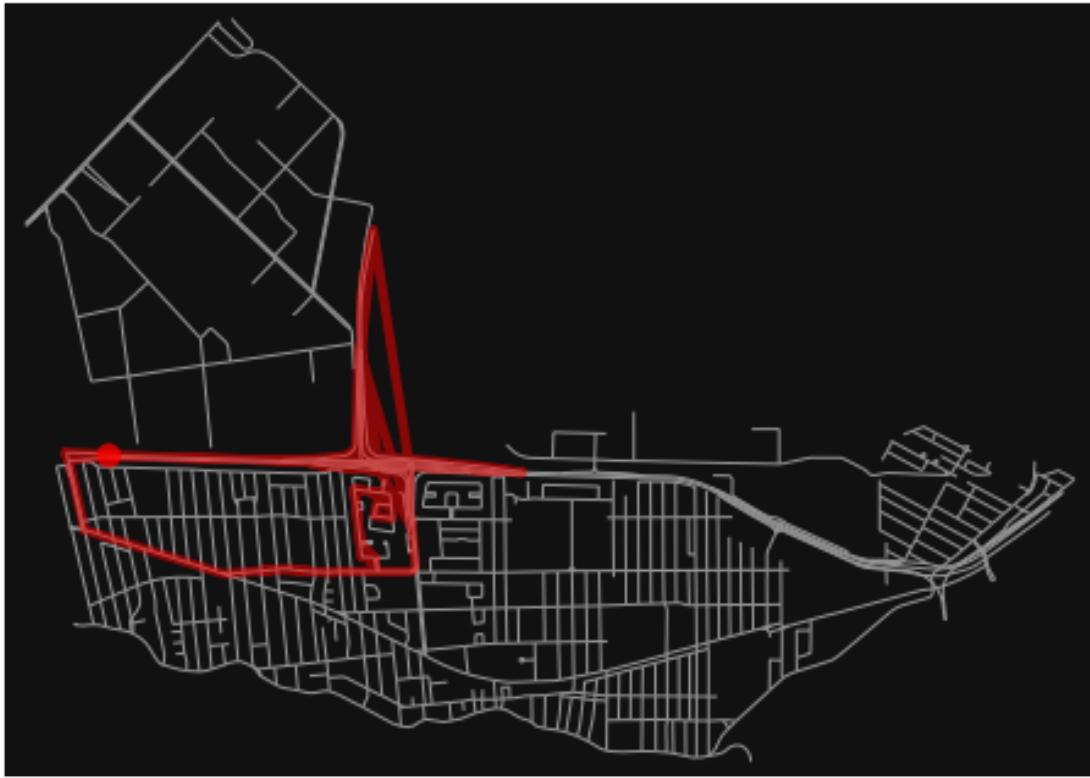
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===== Saint-Laurent, Montreal, Canada =====
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(<Figure size 576x576 with 1 Axes>, <AxesSubplot:>)

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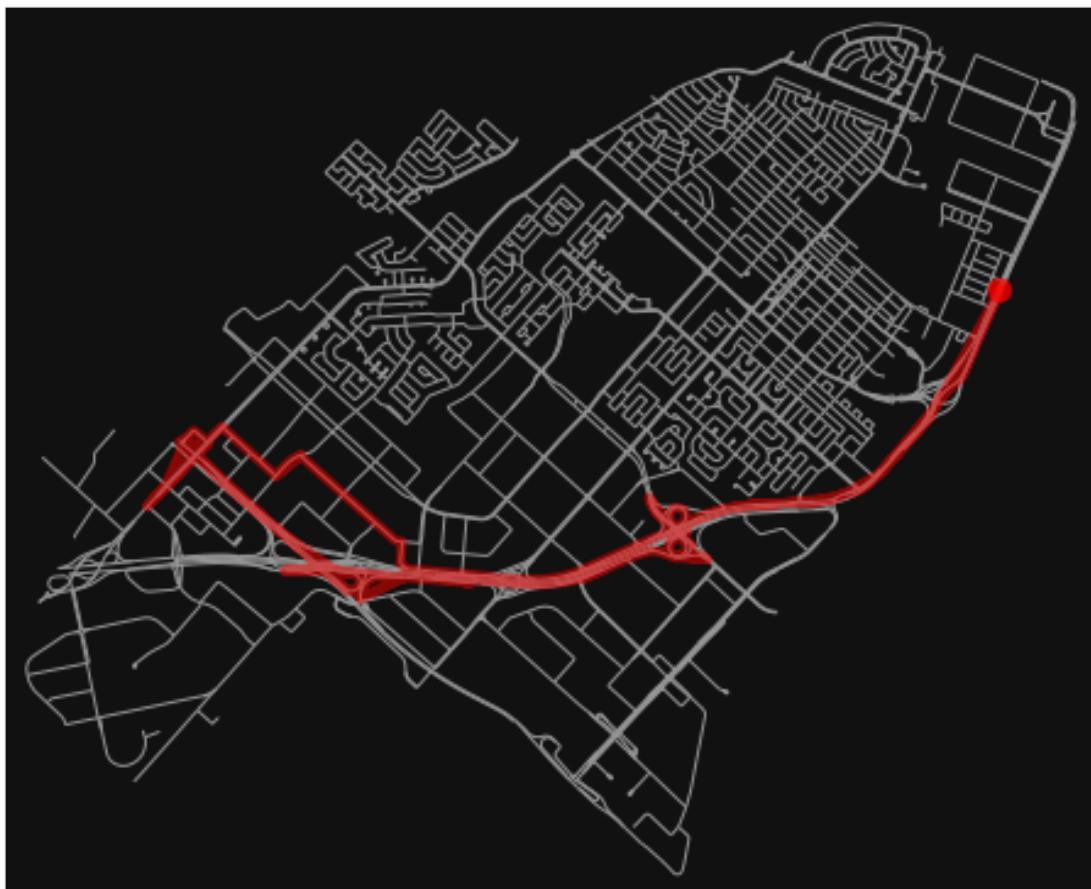


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length of road : 12407

time : 49.628 minutes

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length of road : 13792

time : 55.168 minutes

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3700802582, 17052772]



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