Erste Versuche mit OSMNX

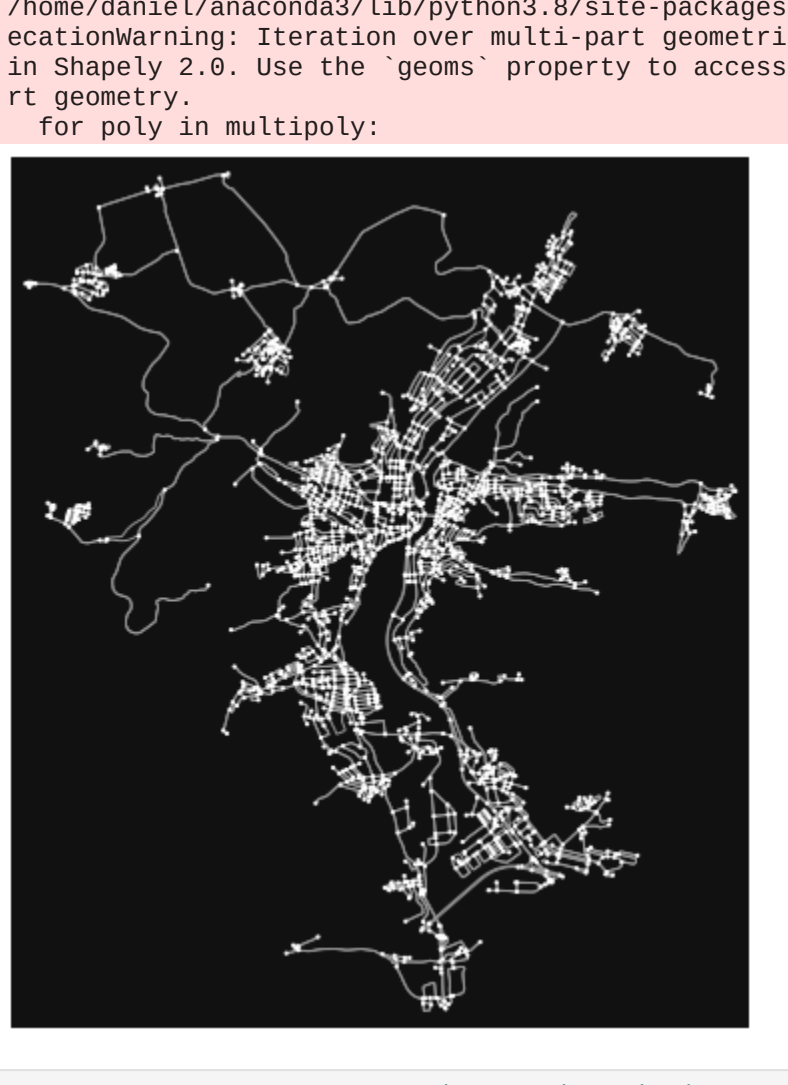
In [1]:
```
import networkx as nx
import osmnx as ox
```

In [2]:
```
# download/model a street network for some city then visualize it
Wash= ox.graph_from_place("Washington, USA", network_type="drive")
fig, ax = ox.plot_graph(Wash, node_size=2)
```

```
/home/daniel/anaconda3/lib/python3.8/site-packages/osmnx/utils_geo.py:335: ShapelyDeprecationWarning: Iteration over multi-part geometries is deprecated and will be removed in Shapely 2.0. Use the `geoms` property to access the constituent parts of a multi-part geometry.
  for polygon in geometry:
/home/daniel/anaconda3/lib/python3.8/site-packages/osmnx/utils_geo.py:426: ShapelyDeprecationWarning: Iteration over multi-part geometries is deprecated and will be removed in Shapely 2.0. Use the `geoms` property to access the constituent parts of a multi-part geometry.
  for poly in multipoly:
/home/daniel/anaconda3/lib/python3.8/site-packages/osmnx/utils_geo.py:426: ShapelyDeprecationWarning: Iteration over multi-part geometries is deprecated and will be removed in Shapely 2.0. Use the `geoms` property to access the constituent parts of a multi-part geometry.
  for poly in multipoly:
```

In [3]:
```
# download/model a street network for some city then visualize it
G = ox.graph_from_place("Jena, Germany", network_type="drive")
fig, ax = ox.plot_graph(G, node_size=5)
```

```
/home/daniel/anaconda3/lib/python3.8/site-packages/osmnx/utils_geo.py:335: ShapelyDeprecationWarning: Iteration over multi-part geometries is deprecated and will be removed in Shapely 2.0. Use the `geoms` property to access the constituent parts of a multi-part geometry.
  for polygon in geometry:
/home/daniel/anaconda3/lib/python3.8/site-packages/osmnx/utils_geo.py:426: ShapelyDeprecationWarning: Iteration over multi-part geometries is deprecated and will be removed in Shapely 2.0. Use the `geoms` property to access the constituent parts of a multi-part geometry.
  for poly in multipoly:
/home/daniel/anaconda3/lib/python3.8/site-packages/osmnx/utils_geo.py:426: ShapelyDeprecationWarning: Iteration over multi-part geometries is deprecated and will be removed in Shapely 2.0. Use the `geoms` property to access the constituent parts of a multi-part geometry.
  for poly in multipoly:
```



In [4]:
```
# you can convert your graph to node and edge GeoPandas GeoDataFrames
gdf_nodes, gdf_edges = ox.graph_to_gdfs(G)
gdf_nodes.head()
```

Out[4]:

osmid	y	x	street_count	highway	ref	geometry
486374	50.878993	11.624104	3	NaN	NaN	POINT (11.62410 50.87899)
486611	50.871909	11.593532	3	NaN	NaN	POINT (11.59353 50.87191)
31918151	50.867655	11.597932	4	NaN	NaN	POINT (11.59793 50.86766)
31918156	50.872317	11.597213	3	motorway_junction	NaN	POINT (11.59721 50.87232)
31993078	50.867541	11.599958	3	NaN	NaN	POINT (11.59996 50.86754)

In [40]:
```
gdf_edges.head(50)
```

Out[40]:

u	v	key	osmid	lanes	ref	name	highway	maxspeed	oneway	le
31918151	3579364826	0	4903733	2	K 2	Am Dorfplatz	tertiary	50	False	53
	271959925	0	[170709723, 157504029, 157504014, 199998366]	2	NaN	NaN	tertiary	50	False	160
	31993078	0	[4903732, 270937839]	2	NaN	Alter Handelsweg	[residential, unclassified]	[30, 50]	False	175
	31993087	0	[317664121, 270937836, 270937837]	2	K 2	[Am Dorfplatz, Am Leutrabach]	tertiary	[30, 50]	False	255
31918156	1478289439	0	134465497	1	NaN	NaN	trunk_link	50	True	161
	1789167540	0	134465550	2	B 88	NaN	trunk	80	True	367
31993078	31918151	0	[4903732, 270937839]	2	NaN	Alter Handelsweg	[residential, unclassified]	[30, 50]	False	175
	31995620	0	4903771	2	NaN	Alter Handelsweg	unclassified	30	False	33
	31993087	0	[23734531, 187161107, 270937838]	NaN	NaN	An der Kirche	residential	NaN	False	145
31993087	1270681906	0	24785229	2	K 2	Am Leutrabach	tertiary	30	False	23
	31993078	0	[187161107, 23734531, 270937838]	NaN	NaN	An der Kirche	residential	NaN	False	145
	31918151	0	[317664121, 270937836, 270937837]	2	K 2	[Am Dorfplatz, Am Leutrabach]	tertiary	[30, 50]	False	255
31993103	2247151078	0	23734532	1	NaN	Am Leutrabach	residential	30	False	23
	1713167808	0	[809278304, 809278305, 23734569, 24965389, 247...	2	K 2	NaN	tertiary	NaN	False	255
	2247151080	0	24785229	2	K 2	Am Leutrabach	tertiary	30	False	20
31993385	827460885	0	27430246	2	NaN	Stockholmer Straße	residential	50	False	383
	827460864	0	[317463393, 317463394, 317463396, 317463397, 3...	[3, 2]	NaN	Brüsseler Straße	residential	50	False	390
	51207548	0	159220658	3	NaN	Brüsseler Straße	tertiary	50	False	75
31995360	31995366	0	27606892	2	NaN	Im Semmicht	unclassified	50	False	83
	303140639	0	27606942	NaN	NaN	NaN	unclassified	NaN	False	108
	1468410624	0	27606892	2	NaN	Im Semmicht	unclassified	50	False	86
31995366	31995360	0	27606892	2	NaN	Im Semmicht	unclassified	50	False	83
	252102088	0	317663871	2	NaN	Im Semmicht	unclassified	50	False	34
	1468410624	0	192462953	2	NaN	An der Lehmgrube	unclassified	NaN	False	590
31995540	31995620	0	4903771	2	NaN	Alter Handelsweg	unclassified	30	False	93
	1468410627	0	25002161	2	NaN	Im Steinfeld	unclassified	NaN	False	493
	2099818856	0	[199998360, 320095652, 320095653]	2	NaN	Am Naßtal	unclassified	50	False	717
31995620	31993078	0	4903771	2	NaN	Alter Handelsweg	unclassified	30	False	33
	31995540	0	4903771	2	NaN	Alter Handelsweg	unclassified	30	False	93
	287129468	0	[170707134, 26222519]	1	NaN	Alter Handelsweg	residential	NaN	False	295
31996209	851562012	0	[25729953, 71594531, 150555942, 51939984, 2636...	4	A 4	Lobdeburgtunnel	motorway	[none, 80]	True	1654
32125579	1905241330	0	35303942	2	L 1060	Hauptstraße	secondary	30	False	90
	1633001138	0	35303942	2	L 1060	Hauptstraße	secondary	30	False	62
	301508632	0	38562797	NaN	NaN	Am Rasen	residential	NaN	False	84
	457496568	0	150208148	NaN	NaN	Hauptstraße	residential	NaN	False	90
32125585	361447052	0	32230942	NaN	NaN	St.-Florian-Weg	residential	30	False	167
	3232100614	0	[79701286, 664425676, 28279665, 317005330, 317...	[3, 2]	L 1060	Hauptstraße	secondary	[70, 50]	False	960
	1905241330	0	259630097	2	L 1060	Hauptstraße	secondary	30	False	102
32127618	2782061062	0	26751812	2	B 7	Bürgelsche Straße	primary	50	False	303
	304335455	0	26751812	2	B 7	Bürgelsche Straße	primary	50	False	33
	286742225	0	[26185960, 463132834, 907360739, 907360740]	NaN	NaN	Hinter der Linde	residential	NaN	False	72
32127691	262160203	0	[313579250, 25113077]	[3, 2]	NaN	Leutragraben	secondary	50	False	52
	1833464371	0	[167167868, 172441558]	3	B 7	Fürstengraben	primary	50	False	50
	291499661	0	[32543515, 313579260]	2	B 7	Straße des 17. Juni	primary	50	False	40
32127701	2158803324	0	[205891618, 23326806]	1	NaN	Erfurter Straße	tertiary	NaN	True	40
	2158803339	0	[40770717, 116902462]	2	B 7	Humboldtstraße	primary	50	False	29
	265784298	0	[40771529, 145663047]	[3, 2]	B 7	Erfurter Straße	primary	50	False	40
32127714	49319083	0	[34112986, 34112996, 369888870]	2	K 6	Über dem Grund	tertiary	NaN	False	40
	49315173	0	35067174	2	B 7	NaN	primary	70	False	225
	2606267957	0	[36334784, 369888867, 35067172, 35067973, 3506...	[3, 2]	B 7	Erfurter Straße	primary	[70, 50]	False	723

Questions:

- Is the length in meter?
- How to interpret the coordinates?
- Distance from node to note?

In [5]:
```
# what sized area does our network cover in square meters?
G_proj = ox.project_graph(G)
nodes_proj = ox.graph_to_gdfs(G_proj, edges=False)
graph_area_m = nodes_proj.unary_union.convex_hull.area
graph_area_m
```

Out[5]: 98249473.52678213

Einige Daten über das Netzwerk

In [6]:
```
# show some basic stats about the network
ox.basic_stats(G_proj, area=graph_area_m, clean_int_tol=15)
```

```
/home/daniel/anaconda3/lib/python3.8/site-packages/osmnx/simplification.py:423: ShapelyDeprecationWarning: __len__ for multi-part geometries is deprecated and will be removed in Shapely 2.0. Check the length of the `geoms` property instead to get the number of parts of a multi-part geometry.
  return gpd.GeoSeries(list(merged), crs=G.graph["crs"])
/home/daniel/anaconda3/lib/python3.8/site-packages/osmnx/simplification.py:423: ShapelyDeprecationWarning: Iteration over multi-part geometries is deprecated and will be removed in Shapely 2.0. Use the `geoms` property to access the constituent parts of a multi-part geometry.
  return gpd.GeoSeries(list(merged), crs=G.graph["crs"])
```

Out[6]:
```
{'n': 2222,
 'm': 5464,
 'k_avg': 4.918091809180918,
 'edge_length_total': 728930.2220000001,
 'edge_length_avg': 133.40597035139095,
 'streets_per_node_avg': 2.6777677767776,
 'streets_per_node_counts': {0: 0, 1: 473, 2: 31, 3: 1467, 4: 242, 5: 8, 6: 1},
 'streets_per_node_proportions': {0: 0.0,
  1: 0.21287128712871287,
  2: 0.013951395139513951395,
  3: 0.6602160216021602,
  4: 0.10891089108910891,
  5: 0.0036003600360036,
  6: 0.00045004500450045},
 'intersection_count': 1749,
 'street_length_total': 398222.926999999,
 'street_segment_count': 2967,
 'street_length_avg': 134.2173667003704,
 'circuity_avg': 1.0914265629775388,
 'self_loop_proportion': 0.005729693292888439,
 'clean_intersection_count': 1386,
 'node_density_km': 22.615897268846922,
 'intersection_density_km': 17.801622107656737,
 'edge_density_km': 7419.176875296932,
 'street_density_km': 4053.181281337311,
 'clean_intersection_density_km': 14.106945821161942}
```

Erklärung in https://osmnx.readthedocs.io/en/stable/osmnx.html?highlight=ox.basic_stats#osmnx.stats.basic_stats

n:= Number of Nodes m:= Number of edges k_avg Average Degree of a node

In [7]:
```
# save graph to disk as geopackage (for GIS) or graphml file (for gephi etc)
ox.save_graph_geopackage(G, filepath="./data/mynetwork.gpkg")
ox.save_graphml(G, filepath="./data/mynetwork.graphml")
```

Routing befor add Speed and times

In [8]:
```
# get the nearest network nodes to two lat/lng points with the distance module
orig = ox.distance.nearest_nodes(G, X=-122.245846, Y=37.828903)
dest = ox.distance.nearest_nodes(G, X=0, Y=0)
```

In [9]:
```
# find the shortest path between nodes, minimizing travel time, then plot it0
route = ox.shortest_path(G, orig, dest, weight="travel_time")
fig, ax = ox.plot_graph_route(G, route, node_size=2)
```

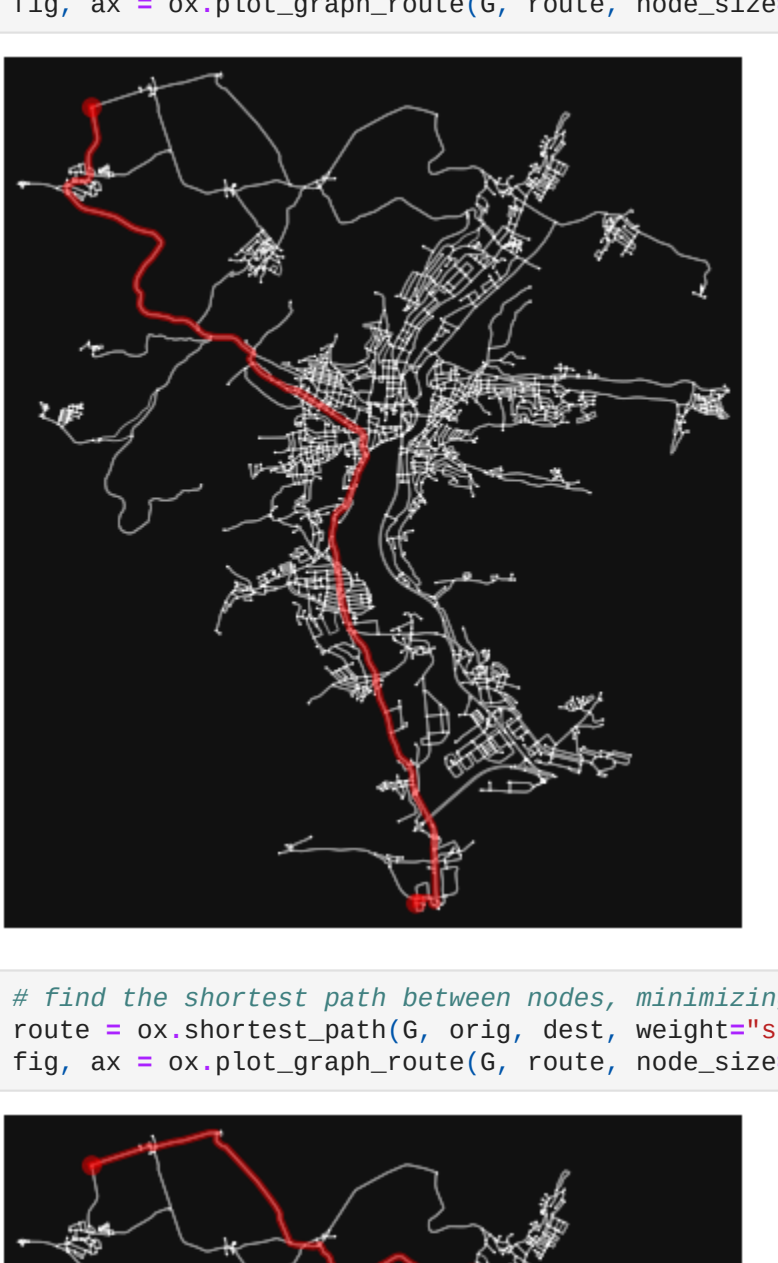
AD Speed and times

In [10]:
```
# impute missing edge speeds and calculate edge travel times with the speed module
G = ox.speed.add_edge_speeds(G)
G = ox.speed.add_edge_travel_times(G)
```

Sets speed in kph by maxspeed mean of highway typ (If type is not none, then mean of all highway types)

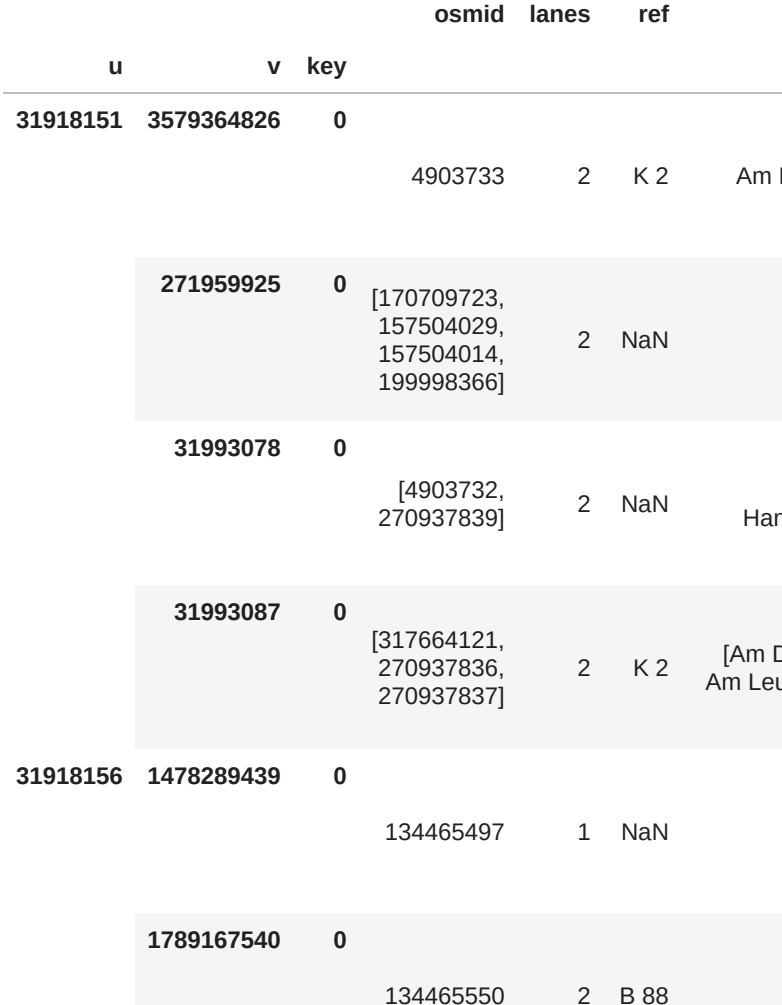
Sets time by length and speed of an edge in seconds

In [19]:
```
# find the shortest path between nodes, minimizing travel time, then plot it0
route = ox.shortest_path(G, orig, dest, weight="travel_time")
fig, ax = ox.plot_graph_route(G, route, node_size=2)
```



In [12]:
```
# find the shortest path between nodes, minimizing travel time, then plot it0
route = ox.shortest_path(G, orig, dest, weight="length")
fig, ax = ox.plot_graph_route(G, route, node_size=2)
```

In [25]:
```
# find the shortest path between nodes, minimizing travel time, then plot it0
route = ox.shortest_path(G, orig, dest, weight="speed")
fig, ax = ox.plot_graph_route(G, route, node_size=2)
```



Questions

- How did the programm worked with weights befor?
- How to transform real GPS Data into that coordninates in the map?

In [22]:
```
gdf_nodes, gdf_edges = ox.graph_to_gdfs(G)
#Nach dem Neu Einlesen sind die neuen Attribute speed_kph and travel_time vorhanden in
```

In [23]:
```
gdf_edges.head(50)
```

Out[23]:

u	v	key	osmid	lanes	ref	name	highway	maxspeed	oneway	le
31918151	3579364826	0	4903733	2	K 2	Am Dorfplatz	tertiary	50	False	53
	271959925	0	[170709723, 157504029, 157504014, 199998366]	2	NaN	NaN	tertiary	50	False	160
	31993078	0	[4903732, 270937839]	2	NaN	Alter Handelsweg	[residential, unclassified]	[30, 50]	False	175
	31993087	0	[317664121, 270937836, 270937837]	2	K 2	[Am Dorfplatz, Am Leutrabach]	tertiary	[30, 50]	False	255
31918156	1478289439	0	134465497	1	NaN	NaN	trunk_link	50	True	161
	1789167540	0	134465550	2	B 88	NaN	trunk	80	True	367
31993078	31918151	0	[4903732, 270937839]	2	NaN	Alter Handelsweg	[residential, unclassified]	[30, 50]	False	175
	31995620	0	4903771	2	NaN	Alter Handelsweg	unclassified	30	False	33
	31993087	0	[23734531, 187161107, 270937838]	NaN	NaN	An der Kirche	residential	NaN	False	145
31993087	1270681906	0	24785229	2	K 2	Am Leutrabach	tertiary	30	False	23
	31993078	0	[187161107, 23734531, 270937838]	NaN	NaN	An der Kirche	residential	NaN	False	145
	31918151	0	[317664121, 270937836, 270937837]	2	K 2	[Am Dorfplatz, Am Leutrabach]	tertiary	[30, 50]	False	255
31993103	2247151078	0	23734532	1	NaN	Am Leutrabach	residential	30	False	23
	1713167808	0	[809278304, 809278305, 23734569, 24965389, 247...	2	K 2	NaN	tertiary	NaN	False	255
	2247151080	0	24785229	2	K 2	Am Leutrabach	tertiary	30	False	20
31993385	827460885	0	27430246	2	NaN	Stockholmer Straße	residential	50	False	383
	827460864	0	[317463393, 317463394, 317463396, 317463397, 3...	[3, 2]	NaN	Brüsseler Straße	residential	50	False	390
	51207548	0	159220658	3	NaN	Brüsseler Straße	tertiary	50	False	75
31995360	31995366	0	27606892	2	NaN	Im Semmicht	unclassified	50	False	83
	303140639	0	27606942	NaN	NaN	NaN	unclassified	NaN	False	108
	1468410624	0	27606892	2	NaN	Im Semmicht	unclassified	50	False	86
31995366	31995360	0	27606892	2	NaN	Im Semmicht	unclassified	50	False	83
	252102088	0	317663871	2	NaN	Im Semmicht	unclassified	50	False	34
	1468410624	0	192462953	2	NaN	An der Lehmgrube	unclassified	NaN	False	590
31995540	31995620	0	4903771	2	NaN	Alter Handelsweg	unclassified	30	False	93
	1468410627	0	25002161	2	NaN	Im Steinfeld	unclassified	NaN	False	493
	2099818856	0	[199998360, 320095652, 320095653]	2	NaN	Am Naßtal	unclassified	50	False	717
31995620	31993078	0	4903771	2	NaN	Alter Handelsweg	unclassified	30	False	33
	31995540	0	4903771	2	NaN	Alter Handelsweg	unclassified	30	False	93
	287129468	0	[170707134, 26222519]	1	NaN	Alter Handelsweg	residential	NaN	False	295
31996209	851562012	0	[25729953, 71594531, 150555942, 51939984, 2636...	4	A 4	Lobdeburgtunnel	motorway	[80, none]	True	1654
32125579	1905241330	0	35303942	2	L 1060	Hauptstraße	secondary	30	False	90
	1633001138	0	35303942	2	L 1060	Hauptstraße	secondary	30	False	62
	301508632	0	38562797	NaN	NaN	Am Rasen	residential	NaN	False	84
	457496568	0	150208148	NaN	NaN	Hauptstraße	residential	NaN	False	90
32125585	361447052	0	32230942	NaN	NaN	St.-Florian-Weg	residential	30	False	167
	3232100614	0	[79701286, 664425676, 28279665, 317005330, 317...	[3, 2]	L 1060	Hauptstraße	secondary	[70, 50]	False	960
	1905241330	0	259630097	2	L 1060	Hauptstraße	secondary	30	False	102
32127618	2782061062	0	26751812	2	B 7	Bürgelsche Straße	primary	50	False	303
	304335455	0	26751812	2	B 7	Bürgelsche Straße	primary	50	False	33
	286742225	0	[26185960, 463132834, 907360739, 907360740]	NaN	NaN	Hinter der Linde	residential	NaN	False	72
32127691	262160203	0	[313579250, 25113077]	[3, 2]	NaN	Leutragraben	secondary	50	False	52
	1833464371	0	[167167868, 172441558]	3	B 7	Fürstengraben	primary	50	False	50
	291499661	0	[32543515, 313579260]	2	B 7	Straße des 17. Juni	primary	50	False	40
32127701	2158803324	0	[205891618, 23326806]	1	NaN	Erfurter Straße	tertiary	NaN	True	40
	2158803339	0	[40770717, 116902462]	2	B 7	Humboldtstraße	primary	50	False	29
	265784298	0	[40771529, 145663047]	[3, 2]	B 7	Erfurter Straße	primary	50	False	40
32127714	49319083	0	[34112986, 34112996, 369888870]	2	K 6	Über dem Grund	tertiary	NaN	False	40
	49315173	0	35067174	2	B 7	NaN	primary	70	False	225
	2606267957	0	[36334784, 369888867, 35067172, 35067973, 3506...	[3, 2]	B 7	Erfurter Straße	primary	[70, 50]	False	723

In [ ]: