

I. RESULTS

The implementation of all the programs contained in the project result in obtaining the data from the web scraper, then transforming it to build the Graphical User Interface (GUI). This will help the user to get information on the Lausanne housing market, see price listings, historical listings and navigate easily between available properties.

A. Dataset

The dataset we used for the building the GUI is reduced compared to all the data we initially have access to. We chose to keep this reduced version of the dataset, to keep the GUI easy to use and read for the user. Figure 1 and 2 show the first few rows of the two .csv files: `property_codes.csv` and `property_details.csv` returned from the web scraping. Figure 3 shows the data we used to feed the GUI. Figure 4 shows the data we used for the average price by ZIP code graph. Figure 5 shows the data we used for the average price by number of rooms graph.

Property Codes	url
0 27884987	https://fr.comparis.ch/immobilien/marktplatz/d...
1 27884155	https://fr.comparis.ch/immobilien/marktplatz/d...
2 27883605	https://fr.comparis.ch/immobilien/marktplatz/d...
3 27883164	https://fr.comparis.ch/immobilien/marktplatz/d...
4 27884625	https://fr.comparis.ch/immobilien/marktplatz/d...
5 27882768	https://fr.comparis.ch/immobilien/marktplatz/d...
6 27881358	https://fr.comparis.ch/immobilien/marktplatz/d...
7 27880295	https://fr.comparis.ch/immobilien/marktplatz/d...
8 27879577	https://fr.comparis.ch/immobilien/marktplatz/d...

Fig. 1: First rows of `property_codes.csv`

address	available_from	balcony	closest_shop	construction_year	dishwasher	rooms	secn_school	sq_meters	ts	type	with_b
1824 Lausanne	A	Non	Non	1911	Non	8.5	Non	207	Non	Villa	Non
1824 Lausanne	A	Non	Non	1911	Non	8.5	Non	207	Non	Villa	Non
1824 Lausanne	A	Non	Non	1911	Non	8.5	Non	207	Non	Villa	Non
1824 Lausanne	A	Non	Non	1911	Non	8.5	Non	207	Non	Villa	Non
1824 Lausanne	A	Non	Non	1911	Non	8.5	Non	207	Non	Villa	Non
1824 Lausanne	A	Non	Non	1911	Non	8.5	Non	207	Non	Villa	Non
1824 Lausanne	A	Non	Non	1911	Non	8.5	Non	207	Non	Villa	Non
1824 Lausanne	A	Non	Non	1911	Non	8.5	Non	207	Non	Villa	Non
1824 Lausanne	A	Non	Non	1911	Non	8.5	Non	207	Non	Villa	Non
1824 Lausanne	A	Non	Non	1911	Non	8.5	Non	207	Non	Villa	Non

Fig. 2: First rows of `property_details.csv`

price	rooms	sq_meters	construction_year	property_type	url	zip_code
0	0.0	337	1933	Villa	https://fr.comparis.ch/immobilien/marktplatz/d...	1012
1790000	0.0	380	2001	Maison mitoyenne	https://fr.comparis.ch/immobilien/marktplatz/d...	1004
1950000	0.0	210	0	Maison jumelée	https://fr.comparis.ch/immobilien/marktplatz/d...	1003
0	7.5	604	1972	Maison	https://fr.comparis.ch/immobilien/marktplatz/d...	1006
0	7.5	250	1950	Perme	https://fr.comparis.ch/immobilien/marktplatz/d...	1023
2250000	3.0	163	2009	Appartement	https://fr.comparis.ch/immobilien/marktplatz/d...	1095
1990000	0.0	180	0	Maison jumelée	https://fr.comparis.ch/immobilien/marktplatz/d...	1026
0	7.5	0	1850	Autre	https://fr.comparis.ch/immobilien/marktplatz/d...	1023
450000	2.0	48	1987	Appartement	https://fr.comparis.ch/immobilien/marktplatz/d...	1053

Fig. 3: First rows of `data.xlsx`

zip_code	price
1000	2.068504e+06
1003	9.634583e+05
1004	9.795278e+05
1005	1.678750e+06
1006	2.281701e+06
1007	1.222663e+06
1008	1.773321e+06
1009	2.083571e+06
1010	1.163966e+06
1012	2.206444e+06

Fig. 4: First rows of data used for the average price by ZIP code graph

rooms	price
0.0	1.500108e+06
1.0	2.940528e+05
1.5	4.541636e+05
2.0	5.551256e+05
2.5	7.196087e+05
3.0	1.043000e+06
3.5	8.988854e+05
4.0	1.056538e+06
4.5	1.492171e+06
5.0	1.946793e+06

Fig. 5: First rows of data used for the average price by number of rooms graph

B. GUI

The GUI presents the scraped data in an orderly manner.

1) *Main Window*: The main window contains the four available tabs namely, price range, Rooms, ZIP Code and Graphs and the empty treeview (see 6)

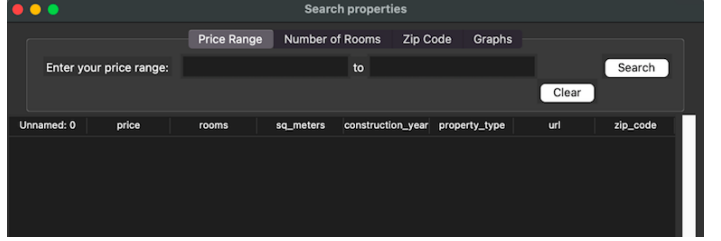


Fig. 6: View of the main window

2) *Frame 1*: The first frame allows the user to search within a specific price range. The user enters a minimum value and maximum value within each of the boxes and presses the search button. The treeview returns all the properties within the chosen price range (see 7). To restart the process, the user can either press the "clear" button or enter new values.

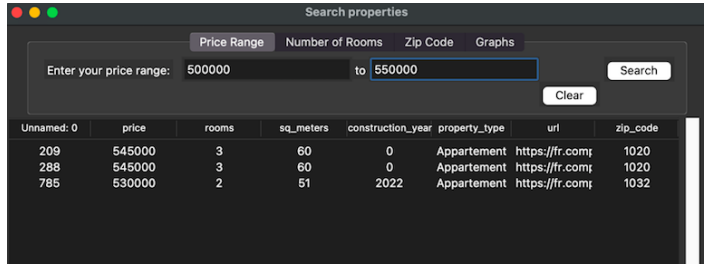


Fig. 7: View of the first frame

3) *Frame 2*: The second frame allows the user to search within a specific number of rooms. The user enters a minimum value and maximum value within each of the boxes and presses the search button. The treeview returns all the properties within the chosen number of rooms (see 8). To restart the process, the user can either press the clear button or enter new values.

4) *Frame 3*: The third frame allows the user to search for properties in a specific ZIP code. The user enters the desired ZIP code in the box and presses the search button.

Unnamed: 0	price	rooms	sq_meters	construction_year	property_type	url	zip_code
10	930000	3.5	84	1986	Attique	https://fr.com	1018
20	960000	3.5	77	1930	Appartement	https://fr.com	1004
58	930000	3.5	99	2012	Appartement	https://fr.com	1004
65	1850000	3.5	112	2017	Appartement	https://fr.com	1009
69	1850000	3.5	89	2017	Appartement	https://fr.com	1009
78	990000	3.5	0	0	Appartement	https://fr.com	1005
82	765000	3.5	60	1972	Villa	https://fr.com	1053
91	1070000	3.5	132	2023	Appartement	https://fr.com	1008
95	955000	3.5	76	2011	Appartement	https://fr.com	1005
96	950000	3.5	77	2020	Appartement	https://fr.com	1030
100	990000	3.5	85	0	Appartement	https://fr.com	1005
108	945000	3.5	81	2018	Appartement	https://fr.com	1008
116	890000	3.5	72	1945	Appartement	https://fr.com	1006
141	1390000	3.5	97	2015	Appartement	https://fr.com	1093
159	0	3.5	67	1968	Appartement	https://fr.com	1012
169	995000	3.5	0	2022	Appartement	https://fr.com	1008
175	995000	3.5	0	2022	Appartement	https://fr.com	1008
189	985000	3.5	71	1953	Appartement	https://fr.com	1005
190	985000	3.5	0	1953	Appartement	https://fr.com	1005
205	850000	3.5	96	0	Appartement	https://fr.com	1008
206	850000	3.5	78	0	Appartement	https://fr.com	1008
217	850000	3.5	85	1960	Appartement	https://fr.com	1031
220	895000	3.5	103	2008	Duplex	https://fr.com	1030
223	895000	3.5	0	2008	Duplex	https://fr.com	1030
234	665000	3.5	67	2023	Appartement	https://fr.com	1032
243	1973000	3.5	116	2022	Appartement	https://fr.com	1091
246	1728000	3.5	112	2022	Attique	https://fr.com	1091
286	1390000	3.5	116	0	Appartement	https://fr.com	1090
287	715000	3.5	73	1989	Appartement	https://fr.com	1030
289	715000	3.5	69	1989	Appartement	https://fr.com	1030
295	950000	3.5	85	1960	Appartement	https://fr.com	1031

Fig. 8: View of the second frame

The treeview returns all the properties within the chosen ZIP code.(see 9) To restart the process, the user can either press the clear button or enter a new value.

Unnamed: 0	price	rooms	sq_meters	construction_year	property_type	url	zip_code
0	0	8.5	337	1933	Villa	https://fr.com	1012
41	1400000	4.5	125	0	Maison mitoy	https://fr.com	1012
67	2210000	4.5	132	0	Appartement	https://fr.com	1012
128	3480000	8	200	0	Attique	https://fr.com	1012
145	0	10	0	1968	Autre	https://fr.com	1012
148	0	10	450	1968	Maison mitoy	https://fr.com	1012
159	0	3.5	67	1968	Appartement	https://fr.com	1012
167	1620000	4.5	141	0	Appartement	https://fr.com	1012
171	2020000	5.5	127	2011	Appartement	https://fr.com	1012
183	2020000	5.5	127	2011	Appartement	https://fr.com	1012
187	1290000	4.5	129	0	Appartement	https://fr.com	1012
235	12500000	11.5	450	1848	Maison	https://fr.com	1012
285	960000	4.5	110	2019	Maison mitoy	https://fr.com	1012
313	1385000	0	0	0	Maison	https://fr.com	1012
326	4150000	8.5	378	2003	Villa	https://fr.com	1012
350	2110000	4.5	135	0	Appartement	https://fr.com	1012
351	2250000	4.5	128	0	Appartement	https://fr.com	1012
352	2310000	4.5	131	0	Appartement	https://fr.com	1012
360	6900000	10.5	350	0	Maison	https://fr.com	1012
361	12500000	11.5	0	2015	Maison	https://fr.com	1012
362	2990000	9	300	1968	Duplex	https://fr.com	1012
379	1450000	4.5	99	0	Appartement	https://fr.com	1012
380	1560000	4.5	108	0	Appartement	https://fr.com	1012
381	860000	2.5	61	0	Appartement	https://fr.com	1012
382	1150000	3.5	73	0	Appartement	https://fr.com	1012
383	1170000	3.5	72	0	Appartement	https://fr.com	1012
384	1670000	4.5	120	0	Duplex	https://fr.com	1012
388	2250000	4.5	102	0	Attique	https://fr.com	1012
396	295000	0	0	0	Local comm	https://fr.com	1012
525	590000	3.5	68	1967	Appartement	https://fr.com	1012
544	6900000	8	350	1993	Maison	https://fr.com	1012
590	840000	3.5	67	1924	Appartement	https://fr.com	1012

Fig. 9: View of the third frame

5) *Frame 4*: The fourth frame displays two buttons corresponding to two different bar graphs, namely the average price by ZIP code and the average price by number of rooms. The user must simply press on the corresponding button and the graph is displayed. Figure 10 displays the average price per ZIP code in millions of CHF. At the time when we run the

program we can see that the ZIP code 1094 corresponding to Belmont sur Lausanne has the highest average price, namely of 3.7 million CHF. In general, the ZIP codes corresponding to the outskirts of Lausanne have a higher average price. This could be due to those areas being less built up, hence the properties there tend to be houses and villas rather than apartments, which have higher prices.

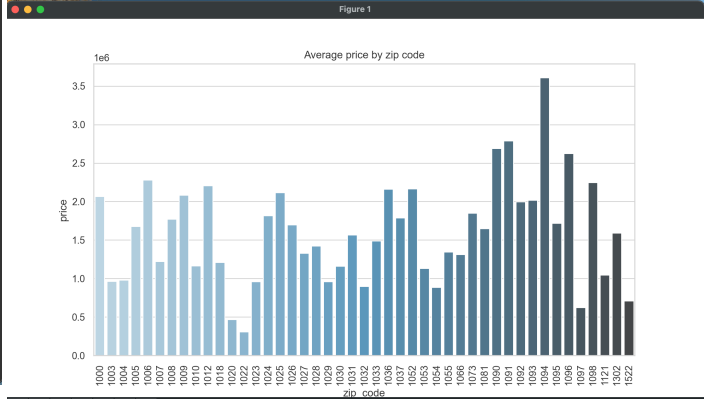


Fig. 10: Average price by ZIP code

Figure 11 displays the average price per number of rooms by a base of 10 million CHF. At the time when we run the program we can see that the price per number of rooms does not grow exponentially as the number of rooms increases. This could be due to the dataset containing many types of properties such as: commercial properties, apartments, houses and hotels, which distorts with overall average. Moreover, a lack of data can also explain the absence of an exponential growth in price as the number of rooms increases.

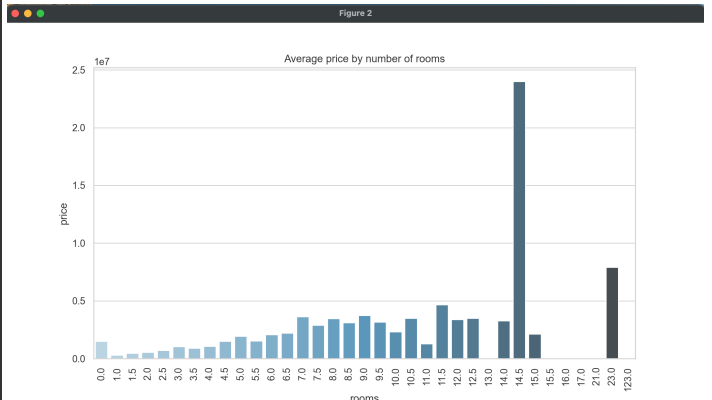


Fig. 11: Average price for a house with x rooms

6) *Heatmap*: Initially we wanted to display a heatmap of Lausanne based on the average price by ZIP code. This map is built with the help of the geopandas and folium packages. To build it we merge the MeanPriceZip file with the geolocations of the Lausanne's ZIP codes. Nonetheless, due to a merging and geolocation issue we were unable to display the map.