I. Results

The implementation of all the programs contained in the project result in obtaining the data from the web scrapper, 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 the first few rows of the two cvs files: `property_codes.csv` and `property_details.csv` returned from the webscrapping. 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	contruction_year	dishwasher	...	rooms	secon_school	sq_meters	tv	type	wash_m
0	1012 Lausanne	A convenir	NaN	NaN	1933	NaN	...	8.5	NaN	337	NaN	Villa	NaN
1	1004 Lausanne	Immediate	NaN	NaN	Non disponible	NaN	...	Non disponible	NaN	Non disponible	NaN	Immeuble	NaN
2	La Conversion 1093	La Conversion	01.07.2022	NaN	485.0	2001	NaN	...	6	512.0	180	NaN	Maison mitoyenne
3	1026 Echandens	A convenir	NaN	NaN	Non disponible	True	...	6	NaN	210	True	Maison jumelée	NaN
4	1066 Epalinges	A convenir	NaN	NaN	1972	NaN	...	7.5	NaN	604	NaN	Maison	NaN
5	Rue du Centre 19	1023 Crissier	A convenir	True	NaN	1850	NaN	...	7.5	NaN	250	NaN	Ferme	NaN
6	1005 Lutry	A convenir	NaN	NaN	2009	NaN	...	3	NaN	163	NaN	Appartement	NaN
7	1026 Echandens-Denges	A convenir	NaN	NaN	Non disponible	NaN	...	Non disponible	NaN	188	NaN	Maison jumelée	NaN
8	1023 Crissier	A convenir	True	NaN	1850	True	...	7.5	NaN	Non disponible	NaN	Autre	NaN
9	1053 Cugy VD	A convenir	NaN	116.0	1987	NaN	...	2	NaN	48	NaN	Appartement	NaN

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

	price	rooms	sq_meters	construction_year	property_type	url	zip_code
	0	8.5	337	1933	Villa	https://fr.comparis.ch/immobilien/marktplatz/d...	1012
	0	0.0	0	0	Immeuble	https://fr.comparis.ch/immobilien/marktplatz/d...	1004
1790000		6.0	180	2001	Maison mitoyenne	https://fr.comparis.ch/immobilien/marktplatz/d...	1093
1950000		6.0	210	0	Maison jumelée	https://fr.comparis.ch/immobilien/marktplatz/d...	1026
	0	7.5	604	1972	Maison	https://fr.comparis.ch/immobilien/marktplatz/d...	1066
	0	7.5	250	1850	Ferme	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	188	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

B. GUI

The GUI presents the scrapped data in an orderly manner.

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

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)

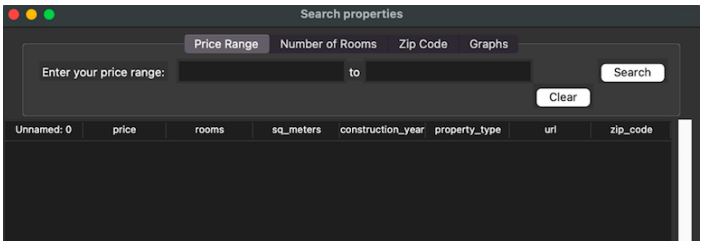


Fig. 6: View of the main window

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.

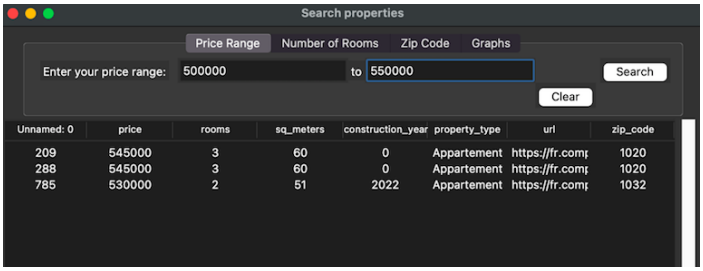
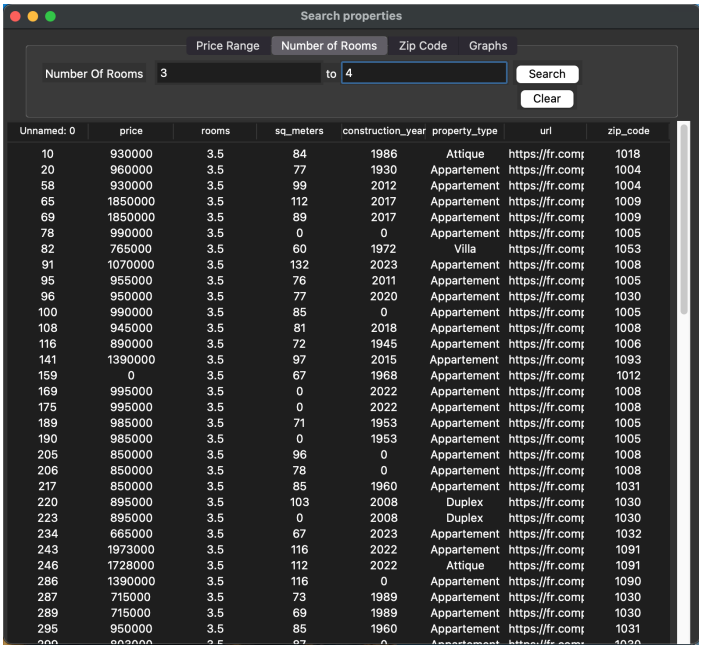


Fig. 7: View of the first frame

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.

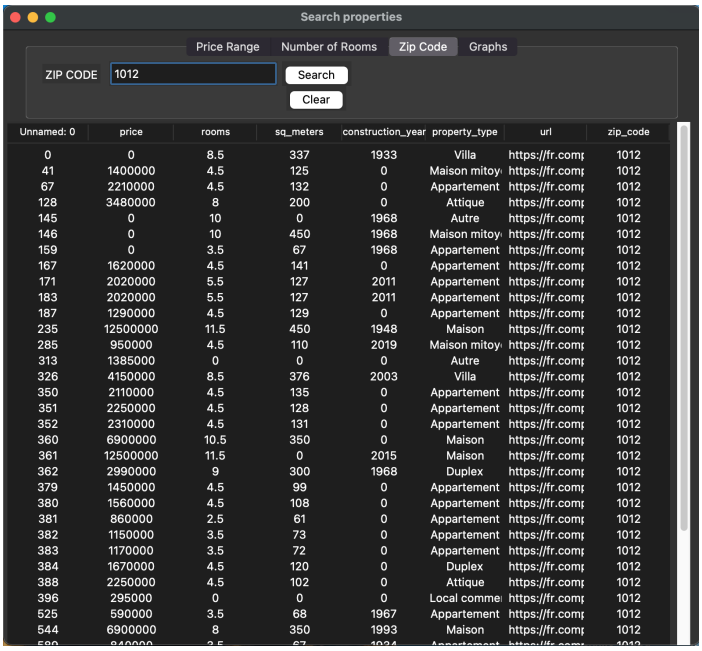
4) Frame 3: The third frame allows the user to search for properties in a specific zip code. The user enters the wished zip code in the box and presses the search button. The treeview returns all the properties within the chosen zip code.(see 9) To



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

Fig. 8: View of the second frame

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.comp	1012
41	1400000	4.5	125	0	Maison mitoy	https://fr.comp	1012
67	2210000	4.5	132	0	Appartement	https://fr.comp	1012
128	3480000	8	200	0	Attique	https://fr.comp	1012
145	0	10	0	1968	Autre	https://fr.comp	1012
146	0	10	450	1968	Maison mitoy	https://fr.comp	1012
159	0	3.5	67	1968	Appartement	https://fr.comp	1012
167	1620000	4.5	141	0	Appartement	https://fr.comp	1012
171	2020000	5.5	127	2011	Appartement	https://fr.comp	1012
183	2020000	5.5	127	2011	Appartement	https://fr.comp	1012
187	1290000	4.5	129	0	Appartement	https://fr.comp	1012
235	12500000	11.5	450	1948	Maison	https://fr.comp	1012
285	950000	4.5	110	2019	Maison mitoy	https://fr.comp	1012
313	1385000	0	0	0	Autre	https://fr.comp	1012
326	4150000	8.5	376	2003	Villa	https://fr.comp	1012
350	2110000	4.5	135	0	Appartement	https://fr.comp	1012
351	2250000	4.5	128	0	Appartement	https://fr.comp	1012
352	2310000	4.5	131	0	Appartement	https://fr.comp	1012
360	6900000	10.5	350	0	Maison	https://fr.comp	1012
361	12500000	11.5	0	2015	Maison	https://fr.comp	1012
362	2990000	9	300	1968	Duplex	https://fr.comp	1012
379	1450000	4.5	99	0	Appartement	https://fr.comp	1012
380	1560000	4.5	108	0	Appartement	https://fr.comp	1012
381	860000	2.5	61	0	Appartement	https://fr.comp	1012
382	1150000	3.5	73	0	Appartement	https://fr.comp	1012
383	1170000	3.5	72	0	Appartement	https://fr.comp	1012
384	1670000	4.5	120	0	Duplex	https://fr.comp	1012
388	2250000	4.5	102	0	Attique	https://fr.comp	1012
396	295000	0	0	0	Local comme	https://fr.comp	1012
525	590000	3.5	68	1967	Appartement	https://fr.comp	1012
544	6900000	8	350	1993	Maison	https://fr.comp	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. The 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 correspnding 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. has a much higher price.

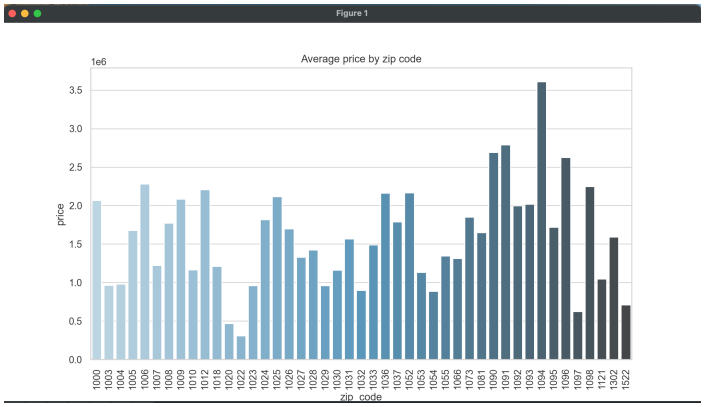


Fig. 10: Average price by zip code

The 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 messes with overall average. Moreover a lack of data can also explain the lack of exponential growth as the number of rooms increases.

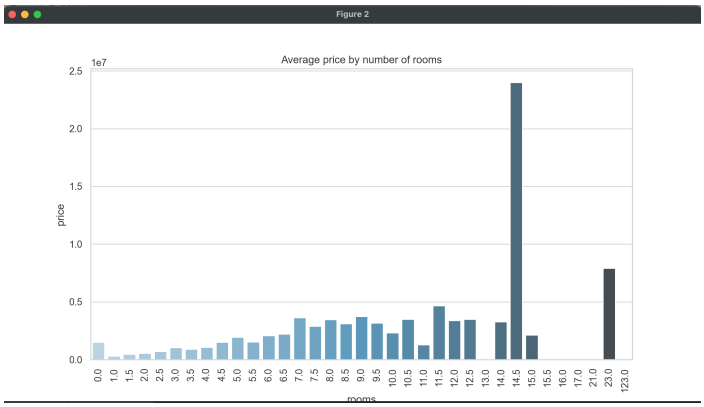


Fig. 11: Average price by zip code

6) Heatmap: Iniatially 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.