fuzzyLogic

October 29, 2022

[ ]:

```
# NAI Zjazd 2 - System logiki rozmytej - Cezary Graban s21752, Paweł Iwiński␣
 ↪s19771
%%capture
import sys
import os
import matplotlib.pyplot as plt
!{sys.executable} -m pip install simpful
!{sys.executable} -m pip install scikit-fuzzy
from IPython import display
```

[ ]:

```
from simpful import *
import matplotlib.pyplot as plt

class MyFuzzySystem:
    # A simple fuzzy inference system

    def __init__(self) -> None:
        """CConstructor responsible for the whole fuzzy system setup."""
        # Create a fuzzy system object.
        self.FS = FuzzySystem()

        # Create fuzzy variables.
        self.__prepare_fuzzy_variables()

        # Add rules to our system
        self.__prepare_fuzzy_rules()

    def __prepare_fuzzy_variables(self):
        """Private method to prepare the variables and add them to our system.
 ↪"""
        # Define fuzzy sets and linguistic variables
        M_1 = FuzzySet(function=Trapezoidal_MF(a=15, b=15, c=30, d=35),␣
 ↪term="low")
        M_2 = FuzzySet(function=Trapezoidal_MF(a=30, b=60, c=65, d=65),␣
 ↪term="medium")
        M_3 = FuzzySet(function=Trapezoidal_MF(a=60, b=80, c=280, d=280),␣
 ↪term="high")
```

```
        self.LV_1 = LinguisticVariable([M_1, M_2, M_3], concept="metrage",␣
↪universe_of_discourse=[0, 280])
        self.FS.add_linguistic_variable("metrage", self.LV_1)

        N_1 = FuzzySet(function=Trapezoidal_MF(a=0, b=2, c=2, d=3), term="low")
        N_2 = FuzzySet(function=Trapezoidal_MF(a=2, b=3, c=4, d=5),␣
↪term="medium")
        N_3 = FuzzySet(function=Trapezoidal_MF(a=4, b=5, c=10, d=10),␣
↪term="high")
        self.LV_2 = LinguisticVariable([N_1, N_2, N_3], concept="num_of_rooms",␣
↪universe_of_discourse=[1, 10])
        self.FS.add_linguistic_variable("num_of_rooms", self.LV_2)

        F_1 = FuzzySet(function=Trapezoidal_MF(a=0, b=1, c=3, d=4), term="low")
        F_2 = FuzzySet(function=Triangular_MF(a=3, b=5, c=7), term="medium")
        F_3 = FuzzySet(function=Trapezoidal_MF(a=6, b=8, c=28, d=28),␣
↪term="high")
        self.LV_3 =  LinguisticVariable([F_1, F_2, F_3], concept="floor",␣
↪universe_of_discourse=[0, 28])
        self.FS.add_linguistic_variable("floor", self.LV_3)

        # Define output fuzzy sets and linguistic variable
        A_1 = FuzzySet(function=Trapezoidal_MF(a=100000, b=135000, c=175000,␣
↪d=225000), term="low")
        A_2 = FuzzySet(function=Trapezoidal_MF(a=200000, b=300000, c=450000,␣
↪d=550000), term="medium")
        A_3 = FuzzySet(function=Trapezoidal_MF(a=475000, b=550000, c=750000,␣
↪d=800000), term="high")
        A_4 = FuzzySet(function=Trapezoidal_MF(a=750000, b=800000, c=1000000,␣
↪d=1100000), term="very high")
        A_5 = FuzzySet(function=Trapezoidal_MF(a=1000000, b=1200000, c=1400000,␣
↪d=2500000), term="extreme")
        self.LV_4 = LinguisticVariable([A_1, A_2, A_3, A_4],␣
↪universe_of_discourse=[100000, 2500000])
        self.FS.add_linguistic_variable("price", self.LV_4)

    def __prepare_fuzzy_rules(self):
        """Private method to define fuzzy variables for our fuzzy system."""
        self.FS.add_rules([
            "IF (num_of_rooms IS low) AND (floor IS low) AND (metrage IS low)␣
↪THEN (price IS low)",
            "IF (num_of_rooms IS low) AND (floor IS low) AND (metrage IS␣
↪medium) THEN (price IS medium)",
            "IF (num_of_rooms IS low) AND (floor IS low) AND (metrage IS high)␣
↪THEN (price IS high)",
            "IF (num_of_rooms IS low) OR (floor IS medium) AND (metrage IS low)␣
↪THEN (price IS low)",
            "IF (num_of_rooms IS low) AND (floor IS medium) AND (metrage IS␣
↪medium) THEN (price IS high)",
            "IF (num_of_rooms IS low) AND (floor IS high) AND (metrage IS high)␣
↪THEN (price IS extreme)",
            "IF (num_of_rooms IS medium) AND (floor IS medium) AND (metrage IS␣
↪medium) THEN (price IS high)",
            "IF (num_of_rooms IS medium) AND (floor IS medium) AND (metrage IS␣
↪high) THEN (price IS extreme)",
            "IF (num_of_rooms IS medium) AND (floor IS low) AND (metrage IS␣
↪high) THEN (price IS extreme)",
            "IF (num_of_rooms IS medium) OR (floor IS low) AND (metrage IS low)␣
↪THEN (price IS low)",
            "IF (num_of_rooms IS medium) OR (floor IS medium) AND (metrage IS␣
↪medium) THEN (price IS high)",
            "IF (num_of_rooms IS medium) AND (floor IS high) AND (metrage IS␣
↪medium) THEN (price IS very high)",
            "IF (num_of_rooms IS high) AND (floor IS high) AND (metrage IS␣
↪high) THEN (price IS extreme)",
        ])

    def plot_the_variables(self):
        """Function to plot all 3 variables used to determine the value."""
        # Start plotting on 2x4 matrix.
        fig, ax = plt.subplots(2, 2)
        fig.set_figheight(12)
        fig.set_figwidth(12)
        self.LV_1.draw(ax=ax[0][0])
        self.LV_2.draw(ax=ax[0][1])
        self.LV_3.draw(ax=ax[1][0])
        plt.tight_layout()

    def get_price(self, metrage, num_of_rooms, floor):
        """Calculate the price of a house for given variables.

        Args:
            metrage (int): House square meters as an int (Universe: 0 - 280).
            num_of_rooms (int): Number of rooms as int (Universe: 1 - 10).
            floor (int): Floor where apartment is located, where 0 is ground␣
↪floor (Universe: 0 - 28).

        Returns:
            Dict: Dictionary with price as key and property price as key value.
        """
        # Set antecedents values
        self.FS.set_variable("metrage", metrage)  # Universe: 0 - 280
        self.FS.set_variable("num_of_rooms", num_of_rooms)  # Universe: 1 - 10
        self.FS.set_variable("floor", floor)  # Universe: 0 - 28

        # Perform Mamdani inference and print output
        return self.FS.Mamdani_inference(["price"])  # Universe: 100000 -␣
 ↪1000000
```

[ ]:

```
# Define the problem parameters
metrage = 56
number_of_rooms = 3
floor = 9

# Construct fuzzy system
fuzzy_obj = MyFuzzySystem()
price = fuzzy_obj.get_price(metrage, number_of_rooms, floor)

# Elaborate on estimate and assert the values
print(f'Estimated price is {int(price["price"])} zł')

# Compare to real life example
display.Image("example_1.png")
```

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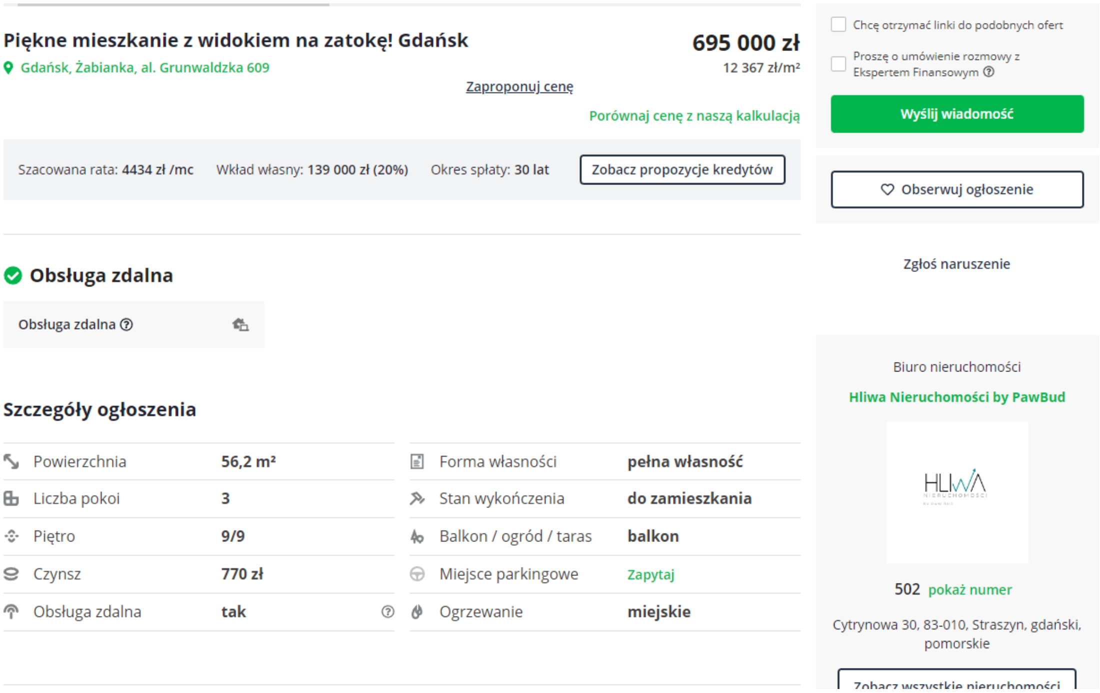
 Created by Marco S. Nobile (m.s.nobile@tue.nl)
 and Simone Spolaor (simone.spolaor@unimib.it)

Estimated price is 687375 zł
```

[ ]:



Piękne mieszkanie z widokiem na zatokę! Gdańsk

Gdańsk, Żabianka, al. Grunwaldzka 609

695 000 zł

12 367 zł/m²

Zaproponuj cenę

Porównaj cenę z naszą kalkulacją

Szacowana rata: **4434 zł /mc** Wkład własny: **139 000 zł (20%)** Okres spłaty: **30 lat**

Zobacz propozycje kredytów
□ Chcę otrzymać linki do podobnych ofert
□ Proszę o umówienie rozmowy z Ekspertem Finansowym ⓘ
Wyślij wiadomość
♡ Obserwuj ogłoszenie
Zgłoś naruszenie

Obsługa zdalna

Obsługa zdalna ⓘ

Szczegóły ogłoszenia

Powierzchnia	**56,2 m²**	Forma własności	**pełna własność**
Liczba pokoi	**3**	Stan wykończenia	**do zamieszkania**
Piętro	**9/9**	Balkon / ogród / taras	**balkon**
Czynsz	**770 zł**	Miejsce parkingowe	Zapytaj
Obsługa zdalna	**tak**	Ogrzewanie	**miejskie**

Biuro nieruchomości

Hliwa Nieruchomości by PawBud

502 pokaż numer

Cytrynowa 30, 83-010, Straszyn, gdański, pomorskie

```
[ ]: # Define the problem parameters
     metrage = 40
     number_of_rooms = 2
     floor = 4

     # Construct fuzzy system
     fuzzy_obj = MyFuzzySystem()
     price = fuzzy_obj.get_price(metrage, number_of_rooms, floor)

     # Elaborate on estimate and assert the values
     print(f'Estimated price is {int(price["price"])} zł')

     # Compare to real life example
     display.Image("example_2.png")
```

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 Created by Marco S. Nobile (m.s.nobile@tue.nl)
 and Simone Spolaor (simone.spolaor@unimib.it)

Estimated price is 424164 zł
```
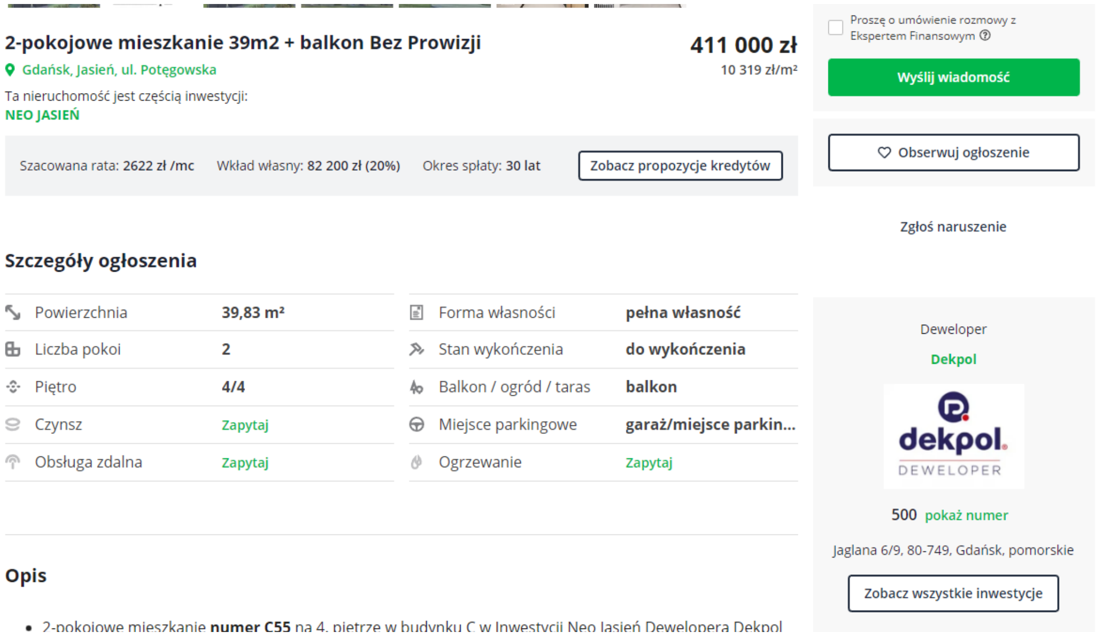

```
[ ]:
```



2-pokojowe mieszkanie 39m2 + balkon Bez Prowizji

411 000 zł
10 319 zł/m²

Gdańsk, Jasień, ul. Potęgowska

Ta nieruchomość jest częścią inwestycji:
NEO JASIEŃ

Szacowana rata: **2622 zł /mc** Wkład własny: **82 200 zł (20%)** Okres spłaty: **30 lat**

□ Proszę o umówienie rozmowy z Ekspertem Finansowym

Szczegóły ogłoszenia

Powierzchnia	**39,83 m²**	Forma własności	**pełna własność**
Liczba pokoi	**2**	Stan wykończenia	**do wykończenia**
Piętro	**4/4**	Balkon / ogród / taras	**balkon**
Czynsz	Zapytaj	Miejsce parkingowe	**garaż/miejsce parkin...**
Obsługa zdalna	Zapytaj	Ogrzewanie	Zapytaj

Deweloper
Dekpol

500 pokaż numer

Jaglana 6/9, 80-749, Gdańsk, pomorskie

Opis

- 2-pokojowe mieszkanie **numer C55** na 4. piętrze w budynku C w Inwestycji Neo Jasień Dewelopera Dekpol

[ ]:

```python
# Plot the variables used by our system
fuzzy_obj = MyFuzzySystem()
fuzzy_obj.plot_the_variables()
```

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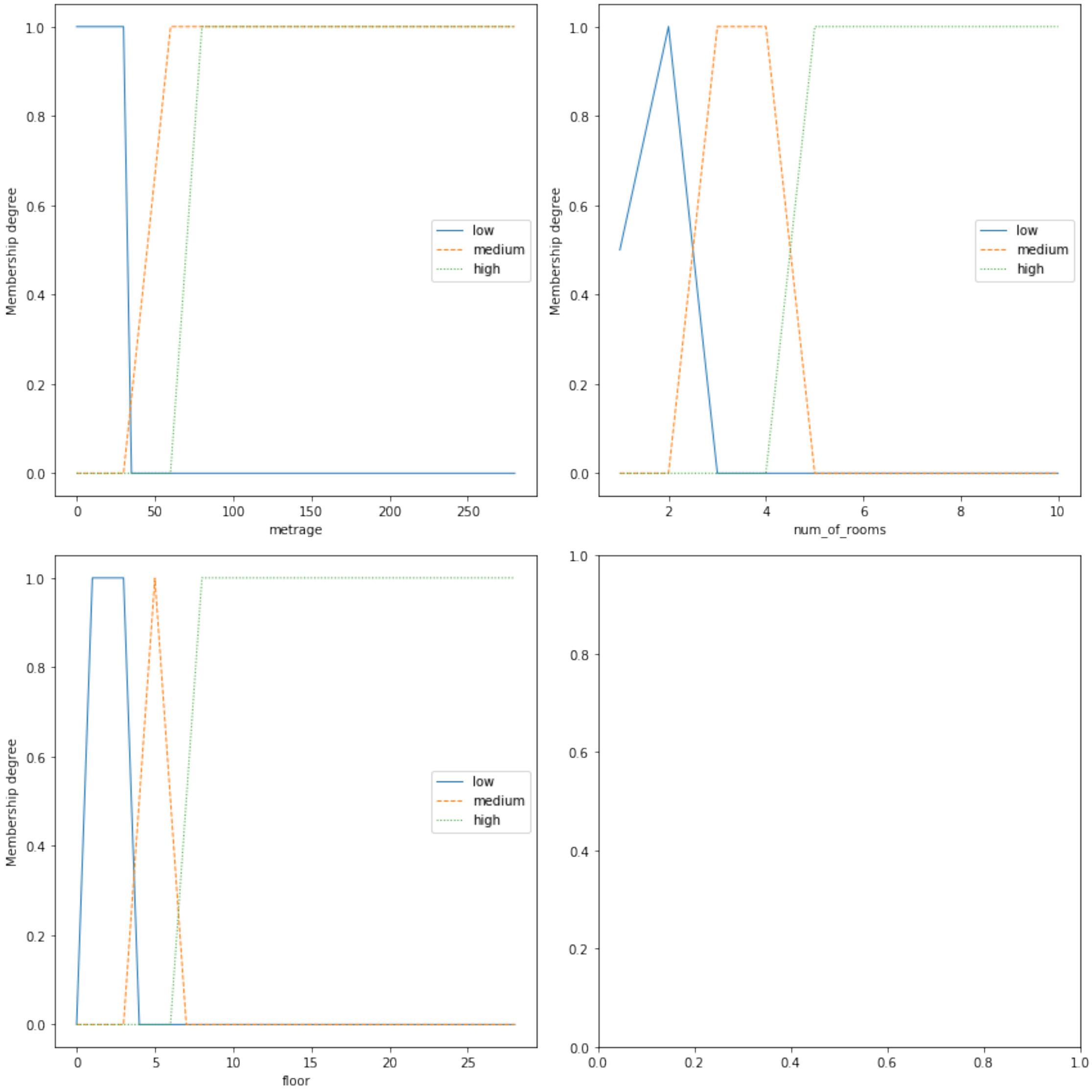
```


Membership degree
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
metrage
low
medium
high
Membership degree
2
4
6
8
10
num_of_rooms
low
medium
high
Membership degree
0
5
10
15
20
25
floor
low
medium
high
0.0
0.2
0.4
0.6
0.8
1.0

```
[ ]:
```