

Fuzzy toolkit for R, Python and Java

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1 Introduction

The availability of fuzzy toolkits allows further accessibility in the use of fuzzy systems and provides a basis for developers, practitioners and researchers to collaborate on scientific advancement of the field and the tackling of real-world problems. In this module, we will be using the following fuzzy toolkits developed here at Nottingham, depending on programming language used: JuzzyPy (Python), FuzzyR (R) or Juzzy (Java).

2 JuzzyPy

JuzzyPy is a free Python library which provides APIs for design and implementation of type-1, interval type-2, and general type-2 fuzzy logic systems. For more details about JuzzyPy, see <https://github.com/LUCIDresearch/JuzzyPython>.

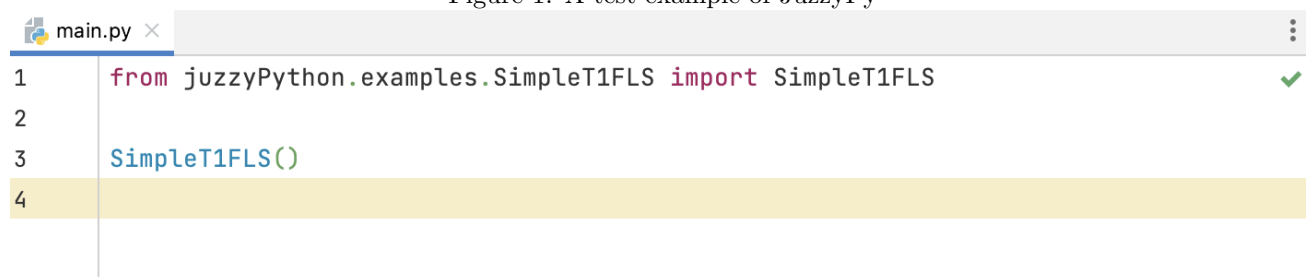
Installation:

1. Download the JuzzyPython library from <https://github.com/LUCIDresearch/JuzzyPython>.
2. Open the terminal, and type 'cd path'. Here, 'path' is the path of the directory where setup.py exists
3. Type 'python setup.py install' or 'python3 setup.py install' (depending on your python version).

Note that, using 'pip install JuzzyPy' will result 'ERROR: Could not find a version that satisfies the requirement JuzzyPy (from versions: none)', because JuzzyPy has not been published on <https://pypi.org/> yet.

To test whether the library are installed successfully, you can create a new '.py' file. In the created '.py' file, simply type 'from juzzyPython.examples.SimpleT1FLS import SimpleT1FLS' and 'SimpleT1FLS()' as shown in Fig. 1.

Figure 1: A test example of JuzzyPy



```
main.py ×
1 from juzzyPython.examples.SimpleT1FLS import SimpleT1FLS ✓
2
3 SimpleT1FLS()
4
```

Publications

Ahmad, M. S., & Wagner, C. (2022, December). JuzzyPy—A Python Library to Create Type—1, Interval Type-2 and General Type-2 Fuzzy Logic Systems. In 2022 IEEE Symposium Series on Computational Intelligence (SSCI) (pp. 735-742). IEEE.

3 FuzzyR

FuzzyR is a toolkit, based on the R programming language, which provides APIs for the design and implementation of fuzzy systems. The toolkit is an extension of a previous package FuzzyToolkitUoN <https://cran.r-project.org/src/contrib/Archive/FuzzyToolkitUoN/>. FuzzyR now includes both type-1 and interval type-2 implementations for traditional Mamdani type fuzzy inference systems. A graphical user interface (GUI) is also provided for demonstrations. For more details about FuzzyR, see <https://CRAN.R-project.org/package=FuzzyR>.

Installation (for Rstudio):

To install the package from CRAN in Rstudio, simply type:

```
> install.packages("FuzzyR")
```

After the installation finished, you can Load the package by using the command:

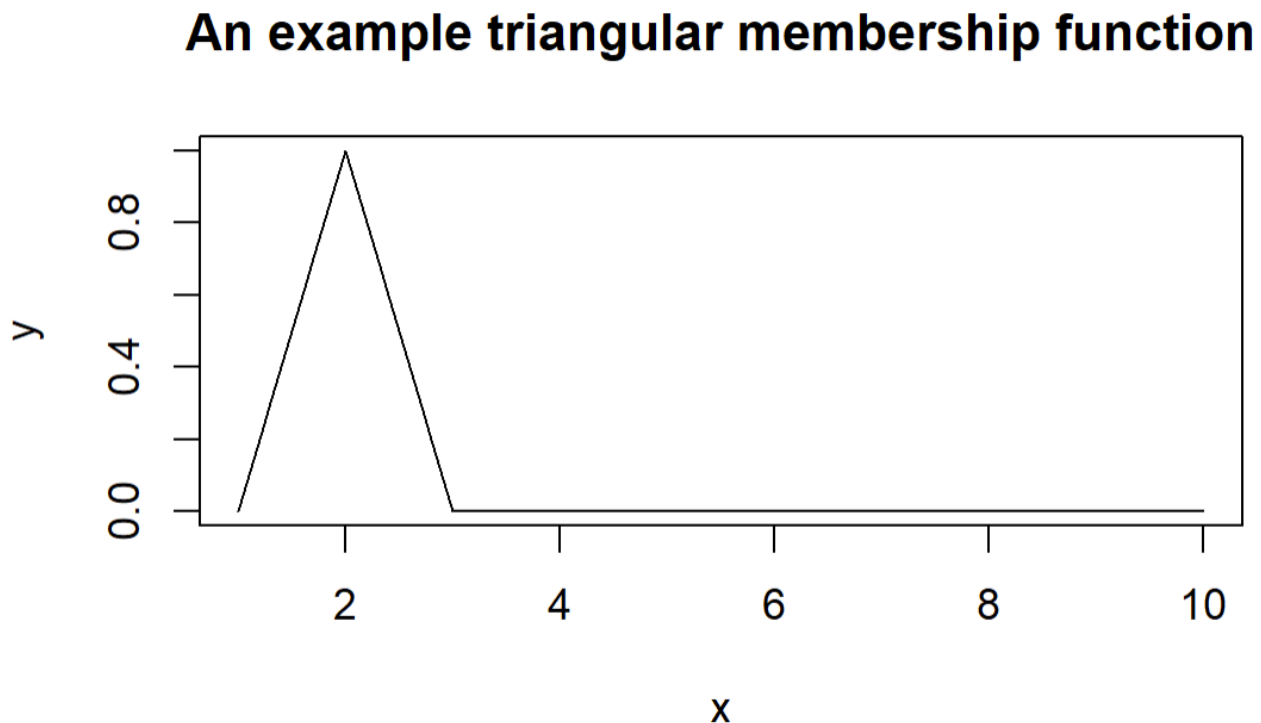
```
> library(FuzzyR)
```

You can start to use FuzzyR by trying the following lines:

```
> mytrimf <- genmf('trimf', c(1, 2, 3))
> x <- seq(1, 10, by = 0.1)
> y <- evalmf(x, mytrimf)
> plot(x, y, type = 'l')
> title("An example triangular membership function")
```

As a result, you should now be able to see the plot in the "plots" section.

Figure 2: Membership function plotted by FuzzyR



Publications

Chen, C., Razak, T. R., & Garibaldi, J. M. (2020, July). FuzzyR: An extended fuzzy logic toolbox for the R programming language. In 2020 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE) (pp. 1-8). IEEE.

Chen, C., Zhao, Y., Wagner, C., Pekaslan, D., & Garibaldi, J. M. (2021, July). An Extension of the FuzzyR

Toolbox for Non-Singleton Fuzzy Logic Systems. In 2021 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE) (pp. 1-6). IEEE.

Wagner, C., Miller, S., & Garibaldi, J. M. (2011, June). A fuzzy toolbox for the R programming language. In 2011 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE 2011) (pp. 1185-1192). IEEE.

4 Juzzy

Juzzy is a Java based toolkit for type-1, interval type-2 and general type-2 fuzzy logic and fuzzy logic systems.

Installation (for Eclipse):

1. Download Java Fuzzy Logic Toolkit (jar files – include jMathPlot.jar) from http://juzzy.wagnerweb.net/Juzzy_V2/Juzzy_V2.zip.
2. Unzip the toolkit, creating a Juzzy directory.
3. Open your project in Eclipse.
4. Right click the project name – "Build Path" – "Add External Archives to Java Build Path" – open the dictionary of the unzipped Juzzy toolkit – Select "Juzzy.jar"

A detailed introduction of Juzzy can be found in <http://juzzy.wagnerweb.net/>. Fig. 3 shows an example code to create and plot a triangular membership function to represent 'bad food quality'. And the result is shown in Fig. 4.

Figure 3: An example of Juzzy

```
1 package Mf_test;
2
3 import generic.Input;
4 import generic.Tuple;
5 import tools.JMathPlotter;
6 import type1.sets.T1MF_Interface;
7 import type1.sets.T1MF_Triangular;
8
9 public class MF_test {
10     Input food;
11     public MF_test(){
12         food = new Input("Food Quality", new Tuple(0,10));
13         T1MF_Triangular badFoodMF = new T1MF_Triangular("MF for bad food",0.0, 0.0, 10.0);
14         T1MF_Triangular greatFoodMF = new T1MF_Triangular("MF for great food",0.0, 10.0, 10.0);
15         plotMFs("Food Quality Membership Functions", new T1MF_Interface[]{badFoodMF, greatFoodMF}, food.getDomain(),
16     }
17
18     private void plotMFs(String name, T1MF_Interface[] sets, Tuple xAxisRange, int discretizationLevel)
19     {
20         JMathPlotter plotter = new JMathPlotter(17,17,15);
21         for (int i=0;i<sets.length;i++)
22         {
23             plotter.plotMF(sets[i].getName(), sets[i], discretizationLevel, xAxisRange, new Tuple(0.0,1.0), false);
24         }
25         plotter.show(name);
26     }
27
28     public static void main (String args[])
29     {
30         new MF_test();
31     }
32 }
33
```

Publications

Wagner, C. (2013, April). Juzzy-a java based toolkit for type-2 fuzzy logic. In 2013 IEEE Symposium on Advances in Type-2 Fuzzy Logic Systems (T2FUZZ) (pp. 45-52). IEEE.

Wagner, C., Pierfitt, M., & McCulloch, J. (2014, July). Juzzy online: An online toolkit for the design, implementation, execution and sharing of type-1 and type-2 fuzzy logic systems. In 2014 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE) (pp. 2321-2328). IEEE.

Figure 4: The result of the Juzzy example

