

# CS 514 HW 2 Report

Alias: Poseidon

## 1. Domain

The domain selected for this project is the inference of mushrooms whether they are poisonous, edible, not recommended or unknown category based on certain physical and demographic properties of the mushrooms. We use these properties as facts and based on these facts and the rules we defined based on study, we infer the edibility of the mushroom family and add them to our knowledgebase as facts, so that the next time we encounter any mushroom of the same family, we can directly infer its edibility. The data for facts and assumptions made to form the rules are based on the dataset obtained from the UCI repository<sup>[1]</sup>. Mushroom records have been drawn from The Audubon Society Field Guide to North American Mushrooms (1981). G.H.Press, New York: Alfred A. Knopf

### 2. Dataset Information:

This data set includes descriptions of hypothetical samples corresponding to 23 species of gilled mushrooms in the Agaricus and Lepiota Family (pp. 500-525). Each species is identified as definitely edible, definitely poisonous, or of unknown edibility and not recommended. The Guide clearly states that there is no simple rule for determining the edibility of a mushroom; no rule like "leaflets three, let it be" for Poisonous Oak and Ivy. But for the sake of forming rules, certain traits of mushrooms are assumed to be poisonous, edible or unknown edibility.

## 2. Instructions :

- This program uses JRE 1.8 runtime environment.
- We need to install FuzzyJ plugin for eclipse.
- Add fuzzyj-2.0.jar to your buildpath.
- Run the program as a java application, and give corresponding inputs it asks for in the console.

## 3. Encoding Knowledge Using FuzzyJess

```
/** PoisonousMushroom Fuzzy Expert System */
```

```
import java.io.BufferedReader;
import java.io.IOException;
import java.io.InputStreamReader;

import nrc.fuzzy.FuzzyException;
import nrc.fuzzy.FuzzyRule;
import nrc.fuzzy.FuzzyValue;
```

```

import nrc.fuzzy.FuzzyValueVector;
import nrc.fuzzy.FuzzyVariable;
import nrc.fuzzy.LFuzzySet;
import nrc.fuzzy.LeftLinearFunction;
import nrc.fuzzy.RFuzzySet;
import nrc.fuzzy.RightLinearFunction;
import nrc.fuzzy.TriangleFuzzySet;

/*Fuzzy Attributes :
 * cap-shape : bell=b,flat=f,sunken=s
 * odor : musty=m,pungent=p,foul=f
 * habitat : meadows=m,urban=u,waste=w
 * poisonous : poisonous=p,toxic=t,edible=e.
 */
public class PoisonousMushrooms {
    public static void main(String args[]) throws FuzzyException,
IOException
    {

        RightLinearFunction rlf = new RightLinearFunction();
        LeftLinearFunction llf = new LeftLinearFunction();
        FuzzyValue isPoisonous=null;
        FuzzyValueVector fvv = null;

        // cap-shape : bell=b,flat=f,sunken=s
        FuzzyVariable capShape = new FuzzyVariable("cap-shape",0.0,10.0,
"On a scale 1-10 sunken,flat,bell capShape");
        capShape.addTerm("sunken", new LFuzzySet(0.0,4.0,llf));
        capShape.addTerm("flat", new TriangleFuzzySet(4.0,6.0,7.0));
        capShape.addTerm("bell", new RFuzzySet(7.0, 10.0,rlf));
        // odor : musty=m,pungent=p,foul=f
        FuzzyVariable odor = new FuzzyVariable("odor", 0.0,10.0, "0-10 Scale
of musty,pungent and foul");
        odor.addTerm("musty", new LFuzzySet(0.0,4.0,llf));
        odor.addTerm("pungent", new TriangleFuzzySet(4.0,6.0,7.0));
        odor.addTerm("foul", new RFuzzySet(7.0, 10.0,rlf));
        // habitat : meadows=m,urban=u,waste=w
        FuzzyVariable habitat = new FuzzyVariable("habitat", 0.0,10.0, "0-10
Scale of meadows,urban and waste");
        habitat.addTerm("meadows", new LFuzzySet(0.0,4.0,llf));
        habitat.addTerm("urban", new TriangleFuzzySet(4.0,6.0,7.0));
        habitat.addTerm("waste", new RFuzzySet(7.0, 10.0,rlf));
        // poisonous : poisonous=p,toxic=t,edible=e
        FuzzyVariable poisonous = new FuzzyVariable("poisonous nature",
0.0,10.0, "0-10 Scale of edible,toxic and poisonous");
        poisonous.addTerm("poisonous", new LFuzzySet(0.0, 3.0,llf));
        poisonous.addTerm("toxic", new TriangleFuzzySet(3.0,4.5,6.0));
        poisonous.addTerm("edible", new RFuzzySet(7.0, 10.0,rlf));

        // Rules
        // Rule-1
        FuzzyRule mushroomAttrib[] = new FuzzyRule[50];

```

```

    int i = 0;

    //rule for very slow wind and the target being very near
    mushroomAttrib[i] = new FuzzyRule();
    mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape, "bell"));
    mushroomAttrib[i].addAntecedent(new FuzzyValue(odor, "musty"));
    mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat, "meadows"));
    mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous, "edible"));
    // Rule-2
    mushroomAttrib[i] = new FuzzyRule();
    mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape, "bell"));
    mushroomAttrib[i].addAntecedent(new FuzzyValue(odor, "musty"));
    mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat, "urban"));
    mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous, "edible"));
    // Rule-3
    mushroomAttrib[i] = new FuzzyRule();
    mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape, "bell"));
    mushroomAttrib[i].addAntecedent(new FuzzyValue(odor, "musty"));
    mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat, "waste"));
    mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous, "toxic"));
    // Rule-4
    mushroomAttrib[i] = new FuzzyRule();
    mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape, "bell"));
    mushroomAttrib[i].addAntecedent(new FuzzyValue(odor, "pungent"));
    mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat, "meadows"));
    mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous, "toxic"));
    // Rule-5
    mushroomAttrib[i] = new FuzzyRule();
    mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape, "bell"));
    mushroomAttrib[i].addAntecedent(new FuzzyValue(odor, "pungent"));
    mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat, "urban"));
    mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous, "edible"));
    // Rule-6
    mushroomAttrib[i] = new FuzzyRule();
    mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape, "bell"));
    mushroomAttrib[i].addAntecedent(new FuzzyValue(odor, "pungent"));
    mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat, "waste"));

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        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous,"poisonous"));
// Rule-7
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape,"bell"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor,"foul"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat,"meadows"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous,"toxic"));
// Rule-8
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape,"bell"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor,"foul"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat,"urban"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous,"edible"));
// Rule-9
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape,"bell"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor,"foul"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat,"waste"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous,"poisonous"));
// Rule-10
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape,"flat"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor,"musty"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat,"meadows"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous,"toxic"));
// Rule-11
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape,"flat"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor,"musty"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat,"urban"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous,"edible"));
// Rule-12
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape,"flat"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor,"musty"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat,"waste"));

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        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous,"toxic"));
        // Rule-13
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape,"flat"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor,"pungent"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat,"meadows"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous,"toxic"));
        // Rule-14
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape,"flat"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor,"pungent"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat,"urban"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous,"edible"));
        // Rule-15
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape,"flat"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor,"pungent"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat,"waste"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous,"poisonous"));
        // Rule-16
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape,"flat"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor,"foul"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat,"meadows"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous,"poisonous"));
        // Rule-17
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape,"flat"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor,"foul"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat,"urban"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous,"toxic"));
        // Rule-18
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape,"flat"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor,"foul"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat,"waste"));

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        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous, "poisonous"));
        // Rule-19
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape, "sunken"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor, "musty"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat, "meadows"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous, "edible"));
        // Rule-20
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape, "sunken"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor, "musty"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat, "urban"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous, "edible"));
        // Rule-21
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape, "sunken"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor, "musty"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat, "waste"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous, "edible"));
        // Rule-22
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape, "sunken"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor, "pungent"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat, "meadows"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous, "edible"));
        // Rule-23
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape, "sunken"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor, "pungent"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat, "urban"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous, "edible"));
        // Rule-24
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape, "sunken"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor, "pungent"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat, "waste"));

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        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous,"toxic"));
        // Rule-25
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape,"sunken"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor,"foul"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat,"waste"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous,"poisonous"));
        // Rule-26
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape,"sunken"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor,"foul"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat,"urban"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous,"edible"));
        // Rule-27
        mushroomAttrib[i] = new FuzzyRule();
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(capShape,"sunken"));
        mushroomAttrib[i].addAntecedent(new FuzzyValue(odor,"foul"));
        mushroomAttrib[i].addAntecedent(new
FuzzyValue(habitat,"waste"));
        mushroomAttrib[i++].addConclusion(new
FuzzyValue(poisonous,"poisonous"));

        // Fetching the input variables.

        BufferedReader br = new BufferedReader(new
InputStreamReader(System.in));
        System.out.println("Do you want manual input or from a file?");
        double ishape,iodor,ihabitat;
        System.out.println("Please enter value for cap-shape:");
        System.out.println("sunken=0.0-4.0,flat=4.0-7.0,bell=7.0-
10.0");

        ishape= Double.parseDouble(br.readLine());

        System.out.println("Please enter value for odor");
        System.out.println("musty=0.0-4.0,pungent=4.0-
7.0,foul=7.0-10.0");
        iodor= Double.parseDouble(br.readLine());

        System.out.println("Please enter value for habitat");
        System.out.println("meadows=0.0-4.0,urban=4.0-
7.0,waste=7.0-10.0");
        ihabitat= Double.parseDouble(br.readLine());

        // create fuzzy values from the crisp values

```

```

        FuzzyValue inpshape = new FuzzyValue(capShape, new
TriangleFuzzySet((ishape-2.5)>0.0?ishape-2.5:ishape,
                                                         ishape,
(ishape+2.5)<10.0?ishape+2.5:ishape));
        FuzzyValue inpodor = new FuzzyValue(odor, new
TriangleFuzzySet((iodor-2.5)>0.0?iodor-2.5:iodor,
                                                         iodod,
(iodor+2.5)<10.0?iodor+2.5:iodor));
        FuzzyValue inphabitat = new FuzzyValue(habitat, new
TriangleFuzzySet((ihabitat-2.5)>0.0?ihabitat-2.5:ihabitat,
                                                         ihabitat,
(ihabitat+2.5)<10.0?ihabitat+2.5:ihabitat));

        for(int j=0;j<i;j++)
            mushroomAttrib[j].removeAllInputs();

        //Firing rules

        int rule = 0;
        for(int j=0;j<i;j++)
        {
            mushroomAttrib[j].addInput(inpshape);
            mushroomAttrib[j].addInput(inpodor);
            mushroomAttrib[j].addInput(inphabitat);
            rule=j;
            if (mushroomAttrib[j].testRuleMatching())
            {
                fvv = mushroomAttrib[j].execute();
                if (isPoisonous == null)
                    isPoisonous = fvv.fuzzyValueAt(0);
                else
                    isPoisonous =
isPoisonous.fuzzyUnion(fvv.fuzzyValueAt(0));
            }
        }
        double poisVal = isPoisonous.momentDefuzzify();
        System.out.println("The poisonous nature of mushroom on a scale of
10 is : " +
            poisVal+ "");
        if(poisVal>0.0&&poisVal<4.0)
            System.out.println("The mushroom is edible");
        else if(poisVal>4.0&&poisVal<7.0)
            System.out.println("The mushroom is toxic");
        else if(poisVal>7.0&&poisVal<10.0)
            System.out.println("The mushroom is poisonous");
        System.out.println("\nSummary:\n\n" +
mushroomAttrib[rule].getConclusions());
        System.out.println(isPoisonous.plotFuzzyValue("."));
    }
}

```





## Run 2:

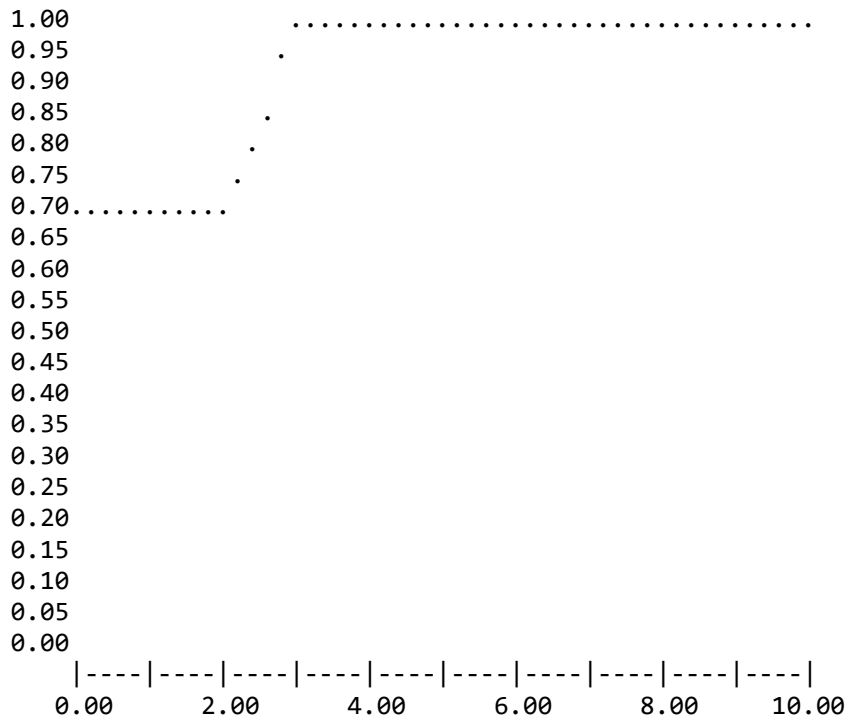
Do you want manual input or from a file?  
Please enter value for cap-shape:  
sunken=0.0-4.0,flat=4.0-7.0,bell=7.0-10.0  
1  
Please enter value for odor  
musty=0.0-4.0,pungent=4.0-7.0,foul=7.0-10.0  
4  
Please enter value for habitat  
meadows=0.0-4.0,urban=4.0-7.0,waste=7.0-10.0  
2

The poisonous nature of mushroom on a scale of 10 is : 5.314900760343635

The mushroom is toxic

Summary:

FuzzyVariable -> poisonous nature [ 0.0, 10.0 ] 0-10 Scale of  
edible,toxic and poisonous  
Linguistic Expression -> poisonous  
FuzzySet -> { 0/0 1/3 }  
Fuzzy Value: poisonous nature



## References :

1. <https://archive.ics.uci.edu/ml/datasets/Mushroom>
2. Schlimmer, J.S. (1987). Concept Acquisition Through Representational Adjustment (Technical Report 87-19). Doctoral dissertation, Department of Information and Computer Science, University of California, Irvine. [\[Web Link\]](#)