SOFE 4620U

Machine Learning & Data Mining

Mini Project 1 - Fuzzy Logic

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Step 1 - Specify the Problem

Determine the suitability of a person for marriage based on the following:

Personal characteristics, Education and the Major, Age, Sexual orientation, Financial standing, Career, Habits, Hubbies, Originality, Family, Future plans, Beauty, Religion, Political standing, etc.

Step 2 - Determine Fuzzy Sets

Antecedents

Personal Characteristic Compatibility (0 - 10)
Age Difference (0-100)
Education Level Similarity (0-10)
Education Field Similarity (0-10)
Sexual Attraction (0-10)
Income Similarity (0-10)
Career Similarity (0-10)
Career Satisfaction (0-10)
Habit Similarity (0-10)
Hobby Similarity (0-10)
Adventure Similarity (0-10)
Uniqueness (0-10)
Child Agreement (0-10)
Family Support (0-10)
Future Plans Similarity (0-10)
Religious Similarity (0-10)
Political Similarity (0-10)
Love (0-10)
Friend Support (0-10)

Consequent

Marriage (0-100)

Membership Ranges

Automatic Membership - poor (0-33%), average(33-66%), good(66-100%)

Age Difference - low(0-5), medium(5-10), high(10-100)
Marriage - low(0-30), medium(20-70), high(60-100)

Step 3 - Elicit and Construct Fuzzy Rules

```
rule1A = ctrl.Rule(personalChar['good'], marriage['high'])
rule1B = ctrl.Rule(personalChar['average'], marriage['medium'])
rule1C = ctrl.Rule(personalChar['poor'], marriage['low'])

rule2A = ctrl.Rule(ageDiff['low'], marriage['high'])
rule2B = ctrl.Rule(ageDiff['medium'], marriage['medium'])
rule2C = ctrl.Rule(ageDiff['high'], marriage['low'])

rule3A = ctrl.Rule(educationLevelSim['poor'], marriage['low'])
rule3B = ctrl.Rule(educationLevelSim['average'], marriage['medium'])
rule3C = ctrl.Rule(educationLevelSim['good'], marriage['high'])

rule4A = ctrl.Rule(educationFieldSim['poor'], marriage['low'])
rule4B = ctrl.Rule(educationFieldSim['average'], marriage['medium'])
rule4C = ctrl.Rule(educationFieldSim['good'], marriage['high'])

rule5A = ctrl.Rule(sexualAttraction['poor'], marriage['low'])
rule5B = ctrl.Rule(sexualAttraction['average'], marriage['medium'])
rule5C = ctrl.Rule(sexualAttraction['good'], marriage['high'])

rule6A = ctrl.Rule(incomeSim['poor'], marriage['low'])
rule6B = ctrl.Rule(incomeSim['average'], marriage['medium'])
rule6C = ctrl.Rule(incomeSim['good'], marriage['high'])

rule7A = ctrl.Rule(careerSat['poor'], marriage['low'])
rule7B = ctrl.Rule((careerSat['average'] & careerSim['poor']) |
                   (careerSat['average'] & careerSim['average']), marriage['medium'])
rule7C = ctrl.Rule(careerSat['good'], marriage['high'])

rule8A = ctrl.Rule(habitSim['poor'], marriage['low'])
rule8B = ctrl.Rule(habitSim['average'], marriage['medium'])
rule8C = ctrl.Rule(habitSim['good'], marriage['high'])

rule9A = ctrl.Rule(hobbySim['poor'], marriage['low'])
rule9B = ctrl.Rule((hobbySim['average'] & adventureSim['poor']) |
```

```
        (hobbySim['average'] & adventureSim['average']), marriage['medium'])
rule9C = ctrl.Rule(hobbySim['good'] | adventureSim['good'], marriage['high'])

rule10A = ctrl.Rule(uniqueness['poor'], marriage['low'])
rule10B = ctrl.Rule(uniqueness['average'], marriage['medium'])
rule10C = ctrl.Rule(uniqueness['good'], marriage['high'])

rule11A = ctrl.Rule(childAgreement['poor'], marriage['low'])
rule11B = ctrl.Rule(childAgreement['average'], marriage['medium'])
rule11C = ctrl.Rule(childAgreement['good'], marriage['high'])

rule12A = ctrl.Rule(familySupport['poor'], marriage['low'])
rule12B = ctrl.Rule(familySupport['average'], marriage['medium'])
rule12C = ctrl.Rule(familySupport['good'], marriage['high'])

rule13A = ctrl.Rule(futurePlanSim['poor'], marriage['low'])
rule13B = ctrl.Rule(futurePlanSim['average'], marriage['medium'])
rule13C = ctrl.Rule(futurePlanSim['good'], marriage['high'])

rule14A = ctrl.Rule(religiousSim['poor'], marriage['low'])
rule14B = ctrl.Rule(religiousSim['average'], marriage['medium'])
rule14C = ctrl.Rule(religiousSim['good'], marriage['high'])

rule15A = ctrl.Rule(politicalSim['poor'], marriage['low'])
rule15B = ctrl.Rule(politicalSim['average'], marriage['medium'])
rule15C = ctrl.Rule(politicalSim['good'], marriage['high'])

rule16A = ctrl.Rule(love['poor'], marriage['low'])
rule16B = ctrl.Rule(love['average'], marriage['medium'])
rule16C = ctrl.Rule(love['good'], marriage['high'])

rule17A = ctrl.Rule(friendSupport['poor'], marriage['low'])
rule17B = ctrl.Rule(friendSupport['average'], marriage['medium'])
rule17C = ctrl.Rule(friendSupport['good'], marriage['high'])
```

Step 4 - Encode

We used Python with skfuzzy & matplotlib in order to implement our fuzzy system.

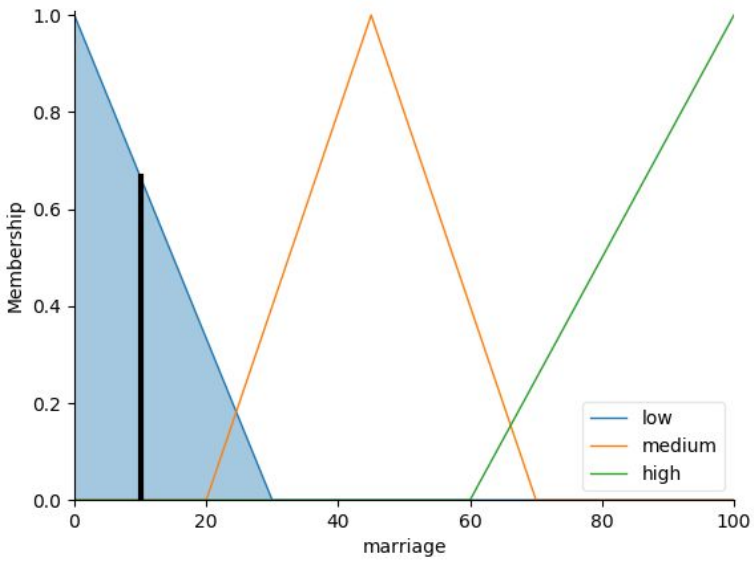
Step 5 - Evaluate & Tune

We tested many datasets and tuned the system until it was outputting realistic results consistently. Although many of the membership functions were auto-generated, we needed to custom make the functions for marriage and age difference.

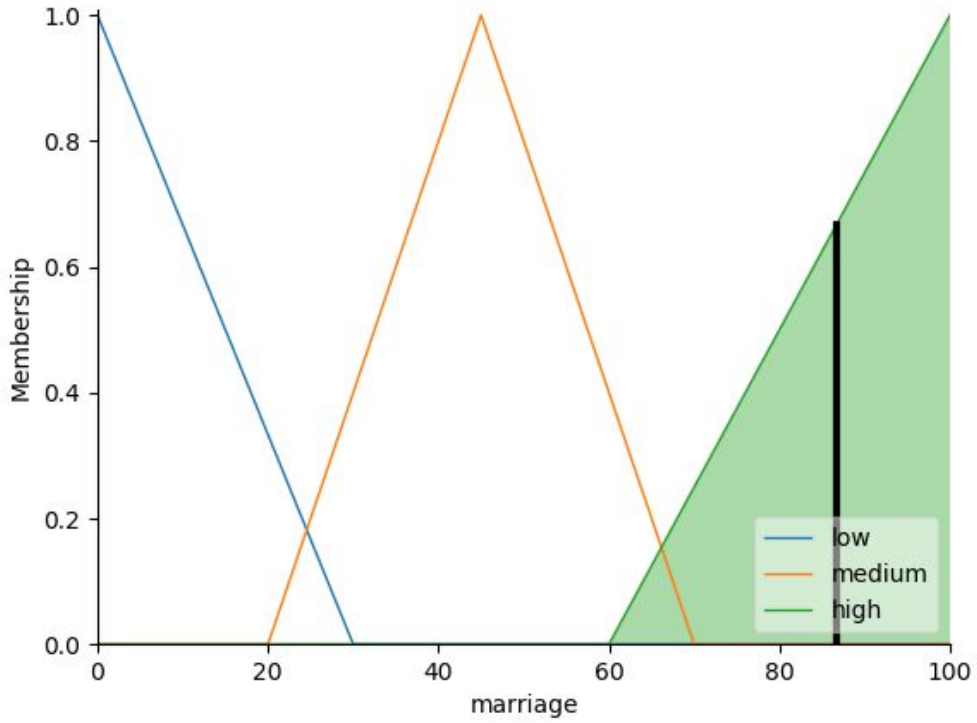
Step 6 - Examples

```
dataSet1 = {
   'personalChar': 0,
   'ageDiff': 100,
   'educationLevelSim': 0,
   'educationFieldSim': 0,
   'sexualAttraction': 0,
   'incomeSim': 0,
   'careerSim': 0,
   'careerSat': 0,
   'habitSim': 0,
   'hobbySim': 0,
   'adventureSim': 0,
   'uniqueness': 0,
   'childAgreement': 0,
   'familySupport': 0,
   'futurePlanSim': 0,
   'religiousSim': 0,
   'politicalSim': 0,
   'love': 0,
   'friendSupport': 0
}
```

Marriage: 9.999999999999998

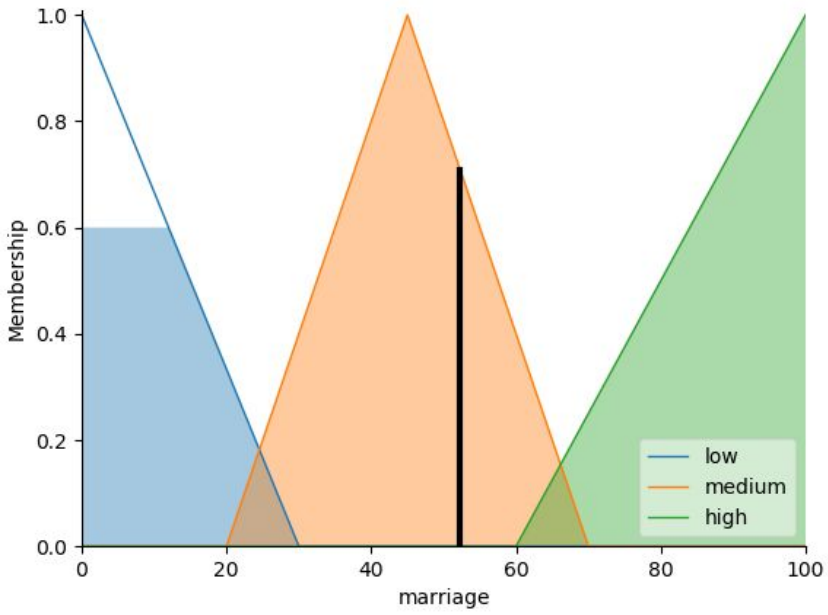


```
dataSet2 = {
   'personalChar': 10,
   'ageDiff': 0,
   'educationLevelSim': 10,
   'educationFieldSim': 10,
   'sexualAttraction': 10,
   'incomeSim': 10,
   'careerSim': 10,
   'careerSat': 10,
   'habitSim': 10,
   'hobbySim': 10,
   'adventureSim': 10,
   'uniqueness': 10,
   'childAgreement': 10,
   'familySupport': 10,
   'futurePlanSim': 10,
   'religiousSim': 10,
   'politicalSim': 10,
   'love': 10,
   'friendSupport': 10
}
Marriage: 86.66666666666664
```



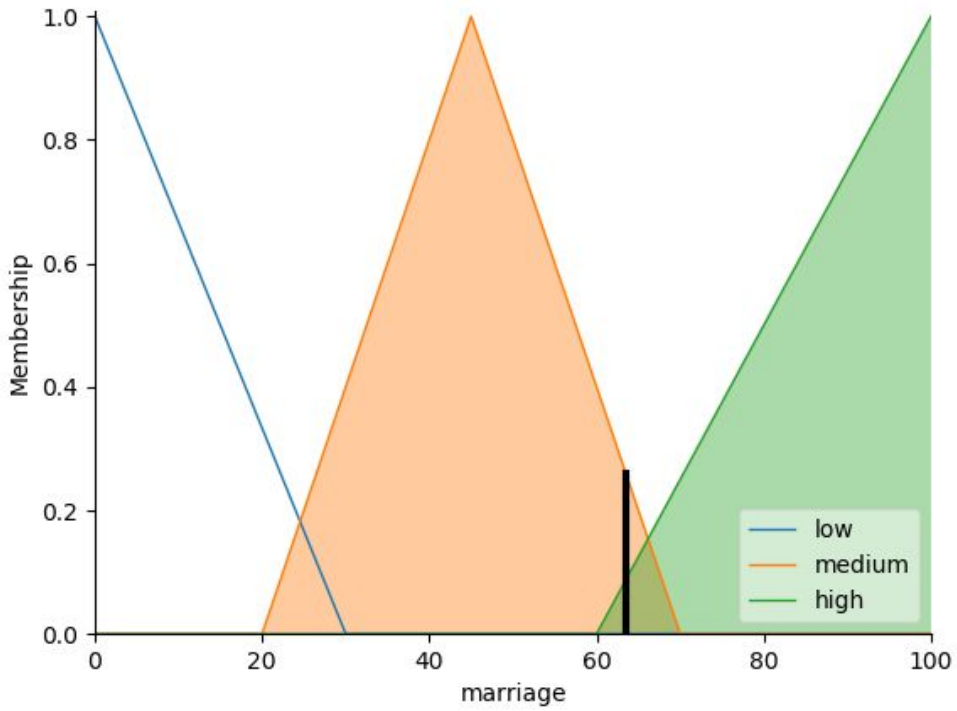
```
dataSet3 = {
   'personalChar': 7,
   'ageDiff': 3,
   'educationLevelSim': 7,
   'educationFieldSim': 5,
   'sexualAttraction': 8,
   'incomeSim': 6,
   'careerSim': 4,
   'careerSat': 2,
   'habitSim': 7,
   'hobbySim': 8,
   'adventureSim': 10,
   'uniqueness': 5,
   'childAgreement': 9,
   'familySupport': 6,
   'futurePlanSim': 4,
   'religiousSim': 8,
   'politicalSim': 4,
   'love': 9,
   'friendSupport': 8
}
```

Marriage: 52.3170048568279



```
dataSet4 = {
   'personalChar': 8,
   'ageDiff': 6,
   'educationLevelSim': 9,
   'educationFieldSim': 5,
   'sexualAttraction': 9,
   'incomeSim': 7,
   'careerSim': 5,
   'careerSat': 10,
   'habitSim': 9,
   'hobbySim': 7,
   'adventureSim': 6,
   'uniqueness': 7,
   'childAgreement': 9,
   'familySupport': 10,
   'futurePlanSim': 10,
   'religiousSim': 9,
   'politicalSim': 8,
   'love': 10,
   'friendSupport': 9
}
```

Marriage: 63.486341886138455



```
dataSet5 = {
   'personalChar': 5,
   'ageDiff': 27,
   'educationLevelSim': 4,
   'educationFieldSim': 0,
   'sexualAttraction': 10,
   'incomeSim': 2,
   'careerSim': 2,
   'careerSat': 10,
   'habitSim': 4,
   'hobbySim': 5,
   'adventureSim': 6,
   'uniqueness': 4,
   'childAgreement': 7,
   'familySupport': 5,
   'futurePlanSim': 6,
   'religiousSim': 4,
   'politicalSim': 7,
   'love': 8,
   'friendSupport': 4
}
Marriage: 50.329162023942196
```