To model input-output relationships of a process having two inputs and one output, let us use a fuzzy reasoning tool with Mamdani approach. Let us also assume three linguistic terms, namely Low (L), Medium (M) and High (H) to represent each of two inputs $I_1$, $I_2$ and one output $O$. The membership function distributions of the inputs and output are shown in Fig. 1, which are assumed to be symmetrical triangles.

![Membership function distributions of the variables.](image)

A binary-coded genetic algorithm will be used to evolve the optimized data base (DB) and rule base (RB) of the fuzzy reasoning tool. The base-widths of the triangles are decided by the $b$ values. A typical GA-string is shown below, where five bits are used to represent each of the $b$ values and nine bits are utilized to represent the RB (where 1 and 0 represent the presence and absence of the rules, respectively).

$$10111 \quad 01111 \quad 10101 \quad 100111101$$

$$b_1 \quad b_2 \quad b_3 \quad RB$$

The RB of the fuzzy reasoning tool is shown below.
Corresponding to the above GA-string, the modified RB is given below.

<table>
<thead>
<tr>
<th>$I_1$</th>
<th>$L$</th>
<th>$M$</th>
<th>$H$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$L$</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>$M$</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>$H$</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Take the ranges of $b_1$, $b_2$ and $b_3$ as follows:

- $0.5 \leq b_1 \leq 1.5$,
- $0.3 \leq b_2 \leq 0.9$,
- $1.0 \leq b_3 \leq 2.0$

Let us consider a training scenario as follows: $I_1 = 1.8, I_2 = 0.9$, and target output $T_0 = 3.0$.

Answer the following five questions (Q1 to Q5).

Q1. $I_1 = 1.8$ corresponds to $L$ and $M$ with approximate membership values of

- (a) 0.5500, 0.4500
- (b) 0.8565, 0.1435
- (c) 0.3548, 0.6452
- (d) 0.7520, 0.2480

No, the answer is incorrect.

Score: 0

Accepted Answers:
(c) 0.3548, 0.6452

Q2. $I_2 = 0.9$ corresponds to $M$ and $H$ with approximate membership values of

- (a) 0.644, 0.356
- (b) 0.755, 0.245
- (c) 0.815, 0.185
- (d) 0.455, 0.545

No, the answer is incorrect.

Score: 0

Accepted Answers:
(a) 0.644, 0.356

Q3. Firing strength of the first fired rule present in the rule base (i.e., if $I_1$ is $M$ AND $I_2$ is $M$ then Output $O$ is $M$) is approximately calculated as

- (a) 0.350
- (b) 0.250
- (c) 0.895

No, the answer is incorrect.

Score: 0

Accepted Answers:
(a) 0.644, 0.356
4) Firing strength of the second fired rule present in the rule base (i.e., if $I_1$ is M AND $I_2$ is H then Output O is H) is approximately calculated as

- (a) 0.856
- (b) 0.952
- (c) 0.356
- (d) 0.752

No, the answer is incorrect.
Score: 0
Accepted Answers:
(c) 0.356

5) Crisp output corresponding to the set of inputs ($I_1=1.8$, $I_2=0.9$) is found to be approximately equal to

- (a) 2.92
- (b) 16.85
- (c) 9.85
- (d) 10.86

No, the answer is incorrect.
Score: 0
Accepted Answers:
(a) 2.92

6) A fuzzy reasoning tool is a potential tool for

- (a) dealing with imprecision and uncertainty
- (b) optimization
- (c) conventional statistical regression analysis
- (d) clustering

No, the answer is incorrect.
Score: 0
Accepted Answers:
(a) dealing with imprecision and uncertainty

7) A fuzzy reasoning tool works based on the concept of

- (a) classical set
- (b) fuzzy set
- (c) combined classical and fuzzy set
- (d) neither fuzzy set nor classical set

No, the answer is incorrect.
Score: 0
Accepted Answers:
(b) fuzzy set

8) A fuzzy set is a

- (a) set with well-defined boundary
- (b) set with vague boundary
- (c) Universal set
- (d) Null set

No, the answer is incorrect.
Score: 0
Accepted Answers:
9) A genetic algorithm (GA) has the ability to
- (a) generate training data for the fuzzy reasoning tool
- (b) make the fuzzy reasoning tool faster
- (c) evolve suitable knowledge base for the fuzzy reasoning tool
- (d) compete with fuzzy reasoning tool

No, the answer is incorrect.
Score: 0
Accepted Answers:
- (b) set with vague boundary

10) To solve a variety of complex real-world optimization problems efficiently, we
need
- (a) intelligent and robust non-traditional optimization tool
- (b) problem-specific traditional optimization tool
- (c) any one of the optimization tools
- (d) not use any optimization tool

No, the answer is incorrect.
Score: 0
Accepted Answers:
- (a) intelligent and robust non-traditional optimization tool