1. Supply Chain Management

Problem: A company wants to assess the reliability of two suppliers based on delivery tim product quality. Supplier A is rated with a fuzzy set for delivery time as $A = \{(1, 0.6), (2, 0.8), (3, 1)\}$ and for product quality as $B = \{(1, 0.7), (2, 0.9), (3, 1)\}$. Simi Supplier B has fuzzy sets for delivery time $C = \{(1, 0.5), (2, 0.9), (3, 1)\}$ and product qu $\{(1, 0.8), (2, 1), (3, 0.9)\}$.

Question: Use fuzzy intersection and union to determine which supplier is better consider delivery time and product quality.

2. Medical Diagnosis

Problem: A doctor uses fuzzy logic to diagnose a disease based on symptoms. The memb function for the presence of a symptom $S1$ is $A = \{(x_1, 0.8), (x_2, 0.5), (x_3, 0.3)\}$ and for symptom $S2$ is $B = \{(y_1, 0.7), (y_2, 0.4), (y_3, 0.6)\}$.

Question: Compute the fuzzy complement for both symptoms and interpret what it sugge the absence of symptoms.

3. Customer Satisfaction

Problem: A restaurant evaluates customer satisfaction with the quality of food and service set for food quality is given by $F = \{(good, 0.9), (average, 0.7), (poor, 0.2)\}$, and the for service is $S = \{(excellent, 0.85), (good, 0.6), (fair, 0.4)\}$.

Question: Determine the overall satisfaction using fuzzy union and suggest which aspect r improvement based on the results.

4. Traffic Control

Problem: In a traffic control system, the fuzziness of the traffic flow is represented by the s $\{(low, 0.3), (medium, 0.6), (high, 0.9)\}$. The fuzziness of accident risk is represented by $\{(low, 0.4), (medium, 0.7), (high, 1)\}$.

Question: Find the fuzzy intersection of traffic flow and accident risk and explain how it co traffic management decisions.

5. Environmental Assessment

Problem: An environmental scientist uses fuzzy logic to assess the air quality in a city. The membership functions for pollution level and health impact are given as $P = \{(low, 0.3), (moderate, 0.7), (high, 0.9)\}$ and $H = \{(low, 0.4), (moderate, 0.8), (sev$

Question: Use fuzzy union and intersection to assess the overall environmental risk and pr recommendation for pollution control measures.

These problems encourage students to apply fuzzy operations to real-world scenarios, hel understand the practical applications of fuzzy logic.

1. **Supply Chain Management**

Problem:

A company wants to assess the reliability of two suppliers based on delivery time a quality. Supplier A is rated with a fuzzy set for delivery time as $A = \{(1, 0.6), (2, 0$ for product quality as $B = \{(1, 0.7), (2, 0.9), (3, 1)\}$. Similarly, Supplier B has fuz time $C = \{(1, 0.5), (2, 0.9), (3, 1)\}$ and product quality $D = \{(1, 0.8), (2, 1), (3$

Solution:

1. **Fuzzy Intersection** (Minimum operation) for Supplier A:

$$A \cap B = \{(1, \min(0.6, 0.7)), (2, \min(0.8, 0.9)), (3, \min(1, 1))\} = \{(1, 0.6$$

2. **Fuzzy Intersection** for Supplier B:

$$C \cap D = \{(1, \min(0.5, 0.8)), (2, \min(0.9, 1)), (3, \min(1, 0.9))\} = \{(1, 0.5$$

3. **Fuzzy Union** (Maximum operation) for Supplier A:

$$A \cup B = \{(1, \max(0.6, 0.7)), (2, \max(0.8, 0.9)), (3, \max(1, 1))\} = \{(1, 0.$$

4. **Fuzzy Union** for Supplier B:

$$C \cup D = \{(1, \max(0.5, 0.8)), (2, \max(0.9, 1)), (3, \max(1, 0.9))\} = \{(1, 0$$

Conclusion:

Supplier A has a better intersection (0.6, 0.8, 1), showing consistency in high perfo both criteria, while Supplier B has a higher union (0.8, 1, 1), indicating better maxir performance. Depending on the priority (consistency vs. potential best performan might prefer Supplier A for reliable overall performance.

2. **Medical Diagnosis**

Problem:

A doctor uses fuzzy logic to diagnose a disease based on symptoms. The member the presence of a symptom $S1$ is $A = \{(x_1, 0.8), (x_2, 0.5), (x_3, 0.3)\}$ and for ano is $B = \{(y_1, 0.7), (y_2, 0.4), (y_3, 0.6)\}$.

Solution:

1. **Fuzzy Complement** for Symptom $S1$:

$$\bar{A} = \{(x_1, 1 - 0.8), (x_2, 1 - 0.5), (x_3, 1 - 0.3)\} = \{(x_1, 0.2), (x_2, 0.5$$

2. **Fuzzy Complement** for Symptom $S2$:

$$\bar{B} = \{(y_1, 1 - 0.7), (y_2, 1 - 0.4), (y_3, 1 - 0.6)\} = \{(y_1, 0.3), (y_2, 0.6$$

Conclusion:

The complements indicate the degree to which the symptoms are absent. A highe value suggests a lower likelihood of the symptom, which could help in ruling out c

3. **Customer Satisfaction**

Problem:

A restaurant evaluates customer satisfaction with the quality of food and service. T food quality is given by $F = \{(good, 0.9), (average, 0.7), (poor, 0.2)\}$, and the service is $S = \{(excellent, 0.85), (good, 0.6), (fair, 0.4)\}$.

Solution:

1. **Fuzzy Union** (Maximum operation) for Overall Satisfaction:

$$F \cup S = \{(\text{good}, \max(0.9, 0.6)), (\text{average}, \max(0.7, 0)), (\text{poor}, \max(0.2,$$

Conclusion:

The overall satisfaction is highest with "good" at 0.9. The "poor" aspect has a relat

satisfaction, which suggests that the restaurant might need to improve the areas v
rated poorly.

4. **Traffic Control**

Problem:
In a traffic control system, the fuzziness of the traffic flow is represented by the set
$\{(low, 0.3), (medium, 0.6), (high, 0.9)\}$. The fuzziness of accident risk is represe
$\{(low, 0.4), (medium, 0.7), (high, 1)\}$.

Solution:

1. **Fuzzy Intersection** for Traffic Flow and Accident Risk:

$$A \cap B = \{(\text{low}, \min(0.3, 0.4)), (\text{medium}, \min(0.6, 0.7)), (\text{high}, \min(0.9,$$

Conclusion:
The highest intersection is in the "high" category, suggesting that areas with high
have a high accident risk. Traffic control measures should focus on reducing conge
areas.

5. **Environmental Assessment**

Problem:
An environmental scientist uses fuzzy logic to assess the air quality in a city. The m
functions for pollution level and health impact are given as $P =$
$\{(low, 0.3), (moderate, 0.7), (high, 0.9)\}$ and $H = \{(low, 0.4), (moderate, 0.$

Solution:

1. **Fuzzy Intersection** for Environmental Risk:

$$P \cap H = \{(\text{low}, \min(0.3, 0.4)), (\text{moderate}, \min(0.7, 0.8)), (\text{high}, \min(0.$$

2. **Fuzzy Union** for Environmental Risk:

$$P \cup H = \{(\text{low}, \max(0.3, 0.4)), (\text{moderate}, \max(0.7, 0.8)), (\text{high}, \max(0$$

Conclusion:
The highest risk is associated with the "high" category, where both pollution and h
severe. The city should prioritize measures to reduce pollution levels to mitigate th