# Detailed Step-by-Step Solution for Weighted KNN

## Question 2: Weighted KNN Classification (k=5)

Weighted KNN classification involves the following steps:  
1. Compute Euclidean distances between the new applicant and all rows in the dataset.  
2. Select the 5 nearest neighbors based on the smallest distances.  
3. Assign weights to each neighbor based on the inverse of the distance (Weight = 1/Distance).  
4. Multiply each weight by the decision (1 for Yes, 0 for No) to calculate weighted votes.  
5. Classify the new applicant based on the higher weighted vote.

### Step 1: Compute Euclidean Distances

The formula for Euclidean distance is:  
Distance = sqrt((TOEFL\_1 - TOEFL\_2)^2 + (GRE\_1 - GRE\_2)^2 + (# Rec Letters\_1 - # Rec Letters\_2)^2).  
Using this formula, we compute the distances between the new applicant (TOEFL = 82, GRE = 35, Rec Letters = 3) and all rows in the dataset:

| Row | TOEFL | GRE | Rec Letters | Distance Computation | Distance |  
|-----|-------|------|-------------|-----------------------------------------------|-----------|  
| 1 | 70 | 60 | 3 | sqrt((82 - 70)^2 + (35 - 60)^2 + (3 - 3)^2) | 27.73 |  
| 2 | 87 | 22 | 3 | sqrt((82 - 87)^2 + (35 - 22)^2 + (3 - 3)^2) | 13.93 |  
| 3 | 86 | 38 | 2 | sqrt((82 - 86)^2 + (35 - 38)^2 + (3 - 2)^2) | 5.10 |  
| 4 | 96 | 40 | 2 | sqrt((82 - 96)^2 + (35 - 40)^2 + (3 - 2)^2) | 14.90 |  
| 5 | 90 | 40 | 3 | sqrt((82 - 90)^2 + (35 - 40)^2 + (3 - 3)^2) | 9.43 |  
| 6 | 75 | 60 | 2 | sqrt((82 - 75)^2 + (35 - 60)^2 + (3 - 2)^2) | 26.65 |  
| 7 | 72 | 20 | 4 | sqrt((82 - 72)^2 + (35 - 20)^2 + (3 - 4)^2) | 19.42 |  
| 8 | 90 | 42 | 2 | sqrt((82 - 90)^2 + (35 - 42)^2 + (3 - 2)^2) | 10.68 |

### Step 2: Select the 5 Nearest Neighbors

From the distances computed above, we select the 5 smallest distances. The neighbors are:  
| Row | TOEFL | GRE | Rec Letters | Distance | Decision |  
|-----|-------|------|-------------|-----------|----------|  
| 3 | 86 | 38 | 2 | 5.10 | No |  
| 5 | 90 | 40 | 3 | 9.43 | Yes |  
| 8 | 90 | 42 | 2 | 10.68 | Yes |  
| 2 | 87 | 22 | 3 | 13.93 | No |  
| 4 | 96 | 40 | 2 | 14.90 | Yes |

### Step 3: Assign Weights

For each neighbor, the weight is calculated as:  
Weight = 1 / Distance (where Distance ≠ 0).  
The weights are:  
| Row | Distance | Weight (1/Distance) | Decision | Weighted Decision |  
|-----|-----------|---------------------|----------|--------------------|  
| 3 | 5.10 | 0.196 | No | 0 × 0.196 = 0 |  
| 5 | 9.43 | 0.106 | Yes | 1 × 0.106 = 0.106 |  
| 8 | 10.68 | 0.094 | Yes | 1 × 0.094 = 0.094 |  
| 2 | 13.93 | 0.072 | No | 0 × 0.072 = 0 |  
| 4 | 14.90 | 0.067 | Yes | 1 × 0.067 = 0.067 |

### Step 4: Calculate Weighted Votes

Sum the weighted votes for Yes and No:  
 - Weighted Yes Votes = 0.106 + 0.094 + 0.067 = 0.267  
 - Weighted No Votes = 0.196 + 0.072 = 0.268

### Step 5: Classification

Since the weighted No votes (0.268) are greater than the weighted Yes votes (0.267), the new applicant is classified as No.