Name: _____

Show all work clearly and in order. Please box your answers.

1. Every song is represented by a vector $\mathbf{S} = (s_1, s_2, \dots, s_n) \in \mathbb{R}^n$, where each s_i is either 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, or 5. How many possible **S** vectors are there if n = 150?

2. What do you think are some important song attributes? Which one is the most important?

3. Suppose we have three songs represented by 2 attributes (genes) in \mathbb{R}^2 :

$$\mathbf{S}_{1} = (1, 1.5) \in \mathbb{R}^{2}, \\
\mathbf{S}_{2} = (0, 0.5) \in \mathbb{R}^{2}, \\
\mathbf{S}_{3} = (5, 0.5) \in \mathbb{R}^{2}.$$

(a) Draw a picture of the database of songs.

(b) Using the first distance formula, which two songs are closest?

(c) Write down a weight vector $\mathbf{W} = (w_1, w_2)$ so your answer for (b) changes (using the modified distance formula $d_{\mathbf{w}}$).

4. Suppose we have three songs represented by 3 attributes (genes) in \mathbb{R}^3 :

$$\begin{aligned} \mathbf{S}_1 &= (1, 1.5, 0.5) \in \mathbb{R}^3, \\ \mathbf{S}_2 &= (0, 0.5, 3) \in \mathbb{R}^3, \\ \mathbf{S}_3 &= (5, 0.5, 3) \in \mathbb{R}^3. \end{aligned}$$

(a) Using the first distance formula, which two songs are closest?

(b) Write down a weight vector $\mathbf{W} = (w_1, w_2, w_3)$ so your answer for (a) changes (using the modified distance formula $d_{\mathbf{w}}$).

5. What is an example of a musical attribute (gene) that might be nonlinear?