Similarity Measure Of Any Two Vectors Of Same Size

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Technical Note

Abstract

In this research Technical Note the author has presented a novel method of finding a Generalized Similarity Measure between two Vectors of the same size.

Theory

We consider two vectors $\vec{A}_1 = \sum_{i=1}^{n}(x_{1i})\hat{e}_i$ and $\vec{A}_2 = \sum_{i=1}^{n}(x_{2i})\hat{e}_i$ and we consider a Similarity Vector given by

$$S_V\left(\vec{A}_1, \vec{A}_2\right) = \sum_{i=1}^{n}\left\{\left(\frac{x_{1i}^2}{x_{1i}x_{2i}}\right)F_1 + \left(\frac{x_{2i}^2}{x_{1i}x_{2i}}\right)F_2\right\}\hat{e}_i$$

where $F_1 = 1$ and $F_2 = 0$ when $x_{1i} < x_{2i}$ and $F_1 = 0$ and $F_2 = 1$ when $x_{1i} > x_{2i}$

That is,

$$S_V\left(\vec{A}_1, \vec{A}_2\right) = \sum_{i=1}^{n}\left\{\left(\frac{x_{1i}}{x_{2i}}\right)F_1 + \left(\frac{x_{2i}}{x_{1i}}\right)F_2\right\}\hat{e}_i$$

where $F_1 = 1$ and $F_2 = 0$ when $x_{1i} < x_{2i}$ and $F_1 = 0$ and $F_2 = 1$ when $x_{1i} > x_{2i}$

We now Normalize the vector $S_V\left(\vec{A}_1, \vec{A}_2\right)$ using L2 Norm. This gives us

$$\hat{S}_V\left(\vec{A}_1, \vec{A}_2\right) = \frac{\sum_{i=1}^{n}\left\{\left(\frac{x_{1i}}{x_{2i}}\right)F_1 + \left(\frac{x_{2i}}{x_{1i}}\right)F_2\right\}\hat{e}_i}{\sqrt{\sum_{i=1}^{n}\left\{\left(\frac{x_{1i}}{x_{2i}}\right)F_1 + \left(\frac{x_{2i}}{x_{1i}}\right)F_2\right\}^2}}$$

where $F_1 = 1$ and $F_2 = 0$ when $x_{1i} < x_{2i}$ and $F_1 = 0$ and $F_2 = 1$ when $x_{1i} > x_{2i}$

Now, we define the Similarity Measure of the considered two Vectors as

$$S_M\left(\vec{A}_1,\vec{A}_2\right)=\sum_{i=1}^{n}\left\{\frac{\left\{\left(\frac{x_{1i}}{x_{2i}}\right)F_1+\left(\frac{x_{2i}}{x_{1i}}\right)F_2\right\}}{\sqrt{\sum_{i=1}^{n}\left\{\left(\frac{x_{1i}}{x_{2i}}\right)F_1+\left(\frac{x_{2i}}{x_{1i}}\right)F_2\right\}^2}}\right\}$$

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