

# Affinity propagation

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<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.228.3290&rep=rep1&type=pdf>

Affinity propagation (correct the spelling in the distributed file)

Similarity matrix

Preference: a preset negative number

Similarity measure: negative distance

Responsibility matrix

$$r(i, k) = s(i, k) - \max_{k' \neq k} \{a(i, k') + s(i, k')\},$$

Availability matrix

$$a(i, k) = \begin{cases} \min \left\{ 0, r(k, k) + \sum_{i' \notin \{i, k\}} \max \{0, r(i', k)\} \right\}, & \text{if } i \neq k \\ \sum_{i' \neq k} \max \{0, r(i', k)\}, & \text{if } i = k \end{cases}$$

Criteria matrix

$$c(i, k) \leftarrow r(i, k) + a(i, k).$$

|       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|
|       |       | $w_1$ | $w_2$ | $w_3$ | $w_4$ | $w_5$ |
| Input | $d_1$ | 3     | 4     | 3     | 2     | 1     |
|       | $d_2$ | 4     | 3     | 5     | 1     | 1     |
|       | $d_3$ | 3     | 5     | 3     | 3     | 3     |
|       | $d_4$ | 2     | 1     | 3     | 3     | 2     |
|       | $d_5$ | 1     | 1     | 3     | 2     | 3     |

  

|                     |       |       |       |       |       |            |
|---------------------|-------|-------|-------|-------|-------|------------|
|                     |       | $d_1$ | $d_2$ | $d_3$ | $d_4$ | $d_5$      |
| Negative similarity | $d_1$ | 0     | -7    | -6    | -12   | -17        |
|                     | $d_2$ | -7    | 0     | -17   | -17   | <b>-22</b> |
|                     | $d_3$ | -6    | -17   | 0     | -18   | -21        |
|                     | $d_4$ | -12   | -17   | -18   | 0     | -3         |
|                     | $d_5$ | -17   | -22   | -21   | -3    | 0          |

|                 |       |       |       |       |       |       |
|-----------------|-------|-------|-------|-------|-------|-------|
|                 |       | $d_1$ | $d_2$ | $d_3$ | $d_4$ | $d_5$ |
| Update diagonal | $d_1$ | -22   | -7    | -6    | -12   | -17   |
|                 | $d_2$ | -7    | -22   | -17   | -17   | -22   |
|                 | $d_3$ | -6    | -17   | -22   | -18   | -21   |
|                 | $d_4$ | -12   | -17   | -18   | -22   | -3    |
|                 | $d_5$ | -17   | -22   | -21   | -3    | -22   |

  

|                           |       |       |       |       |       |       |
|---------------------------|-------|-------|-------|-------|-------|-------|
|                           |       | $d_1$ | $d_2$ | $d_3$ | $d_4$ | $d_5$ |
| Responsibility matrix $R$ | $d_1$ | -16   | -1    | 1     | -6    | -11   |
|                           | $d_2$ | 10    | -15   | -10   | -10   | -15   |
|                           | $d_3$ | 11    | -11   | -16   | -12   | -15   |
|                           | $d_4$ | -9    | -14   | -15   | -19   | 9     |
|                           | $d_5$ | -14   | -19   | -18   | 14    | -19   |

|                     |       | $d_1$    | $d_2$ | $d_3$ | $d_4$     | $d_5$ |
|---------------------|-------|----------|-------|-------|-----------|-------|
| Availability matrix | $d_1$ | 21       | -15   | -16   | -5        | -10   |
|                     | $d_2$ | -5       | 0     | -15   | -5        | -10   |
|                     | $d_3$ | -6       | -15   | 1     | -5        | -10   |
|                     | $d_4$ | 0        | -15   | -15   | 14        | -19   |
|                     | $d_5$ | 0        | -15   | -15   | -19       | 9     |
|                     |       | $d_1$    | $d_2$ | $d_3$ | $d_4$     | $d_5$ |
| Criterion matrix    | $d_1$ | <b>5</b> | -16   | -15   | -11       | -21   |
|                     | $d_2$ | <b>5</b> | -15   | -25   | -15       | -25   |
|                     | $d_3$ | <b>5</b> | -26   | -15   | -17       | -25   |
|                     | $d_4$ | -9       | -29   | -30   | <b>-5</b> | -10   |
|                     | $d_5$ | -14      | -34   | -33   | <b>-5</b> | -10   |