

Wasp killing

You've just bought a house and discover that the attic is full of wasps' nests. You've decided to kill the wasps, before you move into your new home. So, you visit your local store featuring insecticides but found only three (3) containers of type "insect-bomb" which have a specific effect range and must be placed very close to the nest to kill the wasps inside. Unfortunately the 3 containers are not enough to kill all the wasps in the attic. Fortunately, luck helps and you find:

- ◆ a map left by the previous owner, showing the location of the nests as well as the number of wasps that have each nest (using an array of 100x100, Table 1),

Table 1. Nest coordinates and wasp populations

Nest number	Wasp population	Nest position	
		X axis	Y axis
1	100	25	65
2	200	23	8
3	327	7	13
4	440	95	53
5	450	3	3
6	639	54	56
7	650	67	78
8	678	32	4
9	750	24	76
10	801	66	89
11	945	84	4
12	967	34	23

- ◆ a formula on the container of the "insect-bomb" which gives the relationship between distance from the nest, and the number of wasps that are destroyed (Eq. 1).

$$K = n * \frac{d \max}{20 * d + 0.00001} \quad (\text{Eq. 1})$$

where:

K : Wasp number that will be killed in a nest.

n : Wasps living in this nest.

d : Distance between bomb and nest.

$d \max$: Greatest distance between two nests (141.42 for Table 1 with size 100x100)

The distance between two nest positions is calculated by equation (2):

$$d = \sqrt{(x1 - x2)^2 + (y1 - y2)^2} \quad (\text{Eq. 2})$$

The aim is to find the best placement of the containers so as to eliminate the greatest number of wasps.

Hints:

- In order to calculate the total number of wasps that are killed by an "insect-bomb", you have to sum the number of wasps that are killed in each nest. The total number of wasps that are killed by an "insect-bomb", can be computed by equation (3)

$$T = \sum_{i=1}^n K_i \quad (\text{Eq. 3})$$

where:

K_i : Number of wasps that will be killed in nest i

n : Number of nests (12 in our table)

- Be careful. The sum of the wasps that will be killed in a specific nest by all three "insect bombs" cannot exceed the number of wasps that leave in this nest. That is, if an "insect-bomb" kills all the wasps of a nest, then the other two "insect-bombs" will not kill any wasps in this nest.
- Generalize the solution in order to solve the problem for any position of the nests and not only for Table 1, i.e. the solution must solve the problem for any number of nests, in any position.