

## Introduction to Bioinformatics - the partial digest problem

### The task:

Implement an algorithm solving the partial digest problem.

$X$  — a set of  $n$  points lying on the axis.

$\Delta X$  — a multiset of all pairwise distances between points from  $X$ .

PDP: Having a multiset  $L$  of pairwise distances reconstruct  $X$  such that  $\Delta X = L$ .

### Format of input and output data

An input file contains elements of  $L$  separated by a single space:

1 1 3 4 4 4 5 5 8 9

An output file contains elements of  $X$  separated by a single space:

0 4 5 8 9

### Additional assumptions

- Use branch and bound approach.
- Finding any of possible solutions is sufficient.
- Elements of  $X$  are integers from the range  $\langle 0, 100 \rangle$ .

### Algorithm steps

1. Make  $X = \{0, M\}$ , remove number  $M$  from  $L$  ( $M = \max\{L\}$ ).
2. Find the next biggest number  $\alpha$  in  $L$ . We know that restriction site can be either at position  $y = \alpha$  (leftmost) or  $y = M - \alpha$  (rightmost). Assume that restriction site is at the leftmost position  $y = \alpha$ .
3. Calculate distances between  $y$  and all elements of  $X$ . This will be noted as  $\Delta(y, X)$ .
4. If  $\Delta(y, X) \subset L$  then  $L = L - \Delta(y, X)$  and go to the step 2 (or output a solution if  $L$  is empty). Otherwise there are two possibilities:
  - If only leftmost position has been already checked assume  $y = M - \alpha$  and go to the step 3.
  - If both leftmost and rightmost positions have been already checked, backtrack the last iteration and try again.

