Problem 3
Balancing Sculptures

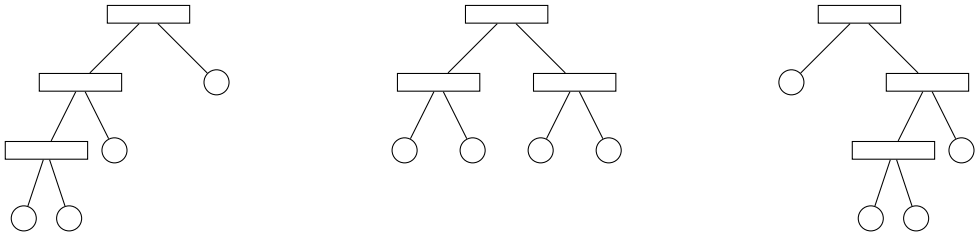
Input File: `xy.in`
Output File: `output_xy.txt`

Output Only Task

Congratulations on becoming the Chief Balance Officer at a hip new startup! Your primary responsibility is to produce sculptures which are as balanced as you can achieve.

Your latest client has tasked you with designing a sculpture that showcases a collection of circular wooden blocks, each with a particular weight. You will assemble them into a single sculpture using wire rods, each of negligible weight. You may use as many of these rods as you need.

Each rod has two hooks below it. To each hook, you **must** attach either a block or another rod – an empty hook is a plague to the eyes! All blocks must participate in the construction of the sculpture, and you must be able to pick up the entire sculpture from the topmost rod.



The *imbalance* of a rod is the absolute difference in weight between what is hanging from each of its two hooks. The *total imbalance* of the sculpture is the sum of imbalances over each of its rods.

Your client is quite the connoisseur of wooden blocks, and simply can't decide which of her collections of blocks to use. For each of them, find an arrangement of blocks and rods that produces the sculpture with as small a total imbalance as you can. Note that **you are not required to find the best possible solution**.

Input

You are given twelve input files `00.in`, `01.in`, ..., `11.in`, each describing a collection of wooden blocks. You can download these files as a Zip Archive from the Statement page for this problem. Please make sure you can do so and open and extract the input files (right click) from the zip, as you will be **unable to attempt this problem** without opening these files! *Contact the judges via the Communication page if you have any difficulties with this.*

In each input file:

- The first line contains a single integer N, the number of blocks.
- The following N lines contain one integer each. The i-th of which is w_i, the weight of the i-th block.

Output

For each input file `xy.in`, you must produce an output file `output_xy.txt` that contains your solution.

Each solution will be given by a string on a single line, describing the arrangement of your sculpture. This line must consist only of digits, `(`, and `)`. In particular, a block of weight `w` is represented by `(w)`, and a hook with two sub-sculptures `a` and `b` hanging from it is represented by `(ab)`.

Thus, a single rod with a weight 1 and a weight 2 block hanging from its hooks would be denoted by `((1)(2))`. If this in turn was hung from a hook on a rod with a weight 3 block hanging from the other hook, the sculpture would be given by `(((1)(2))(3))`.

Sample Input

```
4
10
20
30
40
```

Possible Output 1

```
(((40)(10))((20)(30)))
```

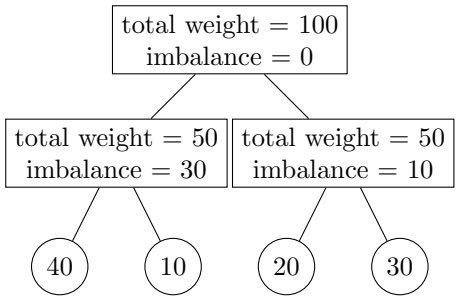
Possible Output 2

```
((((20)(10))(30))(40))
```

Explanation of Sample Input

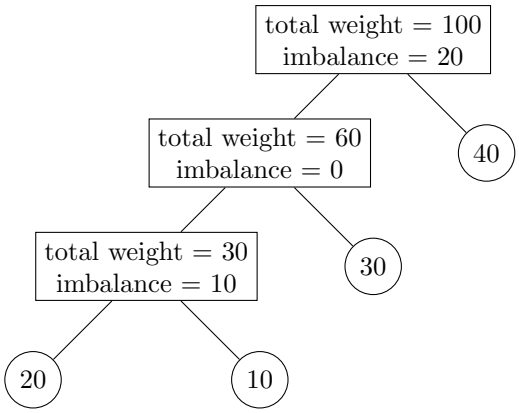
This Sample Input file corresponds to `00.in`.

Explanation of Possible Output 1



The first possible output represents a rod from which two other rods hang. One of these rods holds blocks with weights 10 and 40, while the other holds blocks with weights 20 and 30. The former rod has an imbalance of 30 since $|40 - 10| = 30$, for the same reason the latter rod has an imbalance of $|20 - 30| = 10$. Since both of these rods carry 50 weight in total, the topmost rod has no imbalance at all. The total imbalance of this sculpture is thus $30 + 10 + 0 = 40$.

Explanation of Possible Output 2



For the sculpture described by the second possible output, we find rods with imbalances 10, 0, and 20, and it therefore has a total imbalance of $10 + 0 + 20 = 30$.

Constraints

For all cases, $1 \leq N \leq 10\,000$ and $1 \leq w_i \leq 100\,000$.

Submission

In any submission, you may submit output files to some or all of the input files. You may do so by either uploading each output file on the Submission page for this problem, or by creating a zip archive containing your output files, and uploading this to the Submission page.

On a Unix system you can use a command like the following to create a zip:

```
zip mysolutions.zip output_*.txt
```

On Windows systems you can create a zip by selecting *File → New → Compressed (zipped) Folder* from within Windows Explorer, and then you can copy your output files into this new zip file.

If a submission lacks the output for a certain testcase, the current submission is completed with the **most recently submitted output for that testcase** (if it exists). This means you can work on a single testcase at a time and only need to submit for testcases you have worked on since your last submission.

Contact the judges via the Communication page if you have any difficulties zipping or making a submission.

Scoring

You are highly encouraged to look at the **details** *window for each of your submissions on the contest website.*

For each output file, your score will be computed as follows. If the output file does not describe a valid sculpture, you will score 0. In this case, the contest system will display either `Invalid output format` or `Invalid weights` (if an incorrect or incomplete set of weights are present) in the Details column for this testcase. Otherwise, the details column will display `Valid output` and your score is calculated according to the following formula, based on the imbalance of your solution and that of the judges' solution for the same testcase:

$$\text{Your score} = \max\left(0, \min\left(100, 105 - 10\left(\frac{\text{Your imbalance}}{\text{Judges' imbalance}}\right)^2\right)\right)\%$$

In particular, your score is always between 0 and 100 (inclusive) and the judges' solution scores 95% on each testcase. Note that if your imbalance is rather large, you may still score 0 with a `Not correct` outcome, so **please check details** to ensure that your output is valid.

Each subtask contains a single testcase, so your score for each subtask is your score on that testcase multiplied by the number of points for that subtask. Points are distributed across subtasks as follows.

Subtask	Input file	Output file	N	Judges' imbalance	Points
1	`00.in`	`output_00.txt`	4	30	1
2	`01.in`	`output_01.txt`	10	117	4
3	`02.in`	`output_02.txt`	100	961791	10
4	`03.in`	`output_03.txt`	1000	10848932	10
5	`04.in`	`output_04.txt`	10000	129746831	10
6	`05.in`	`output_05.txt`	16	64	5
7	`06.in`	`output_06.txt`	128	33216	10
8	`07.in`	`output_07.txt`	1024	260952	10
9	`08.in`	`output_08.txt`	8192	2049420	10
10	`09.in`	`output_09.txt`	100	82788	10
11	`10.in`	`output_10.txt`	1000	652093	10
12	`11.in`	`output_11.txt`	10000	6392613	10

Your score for each submission will be the sum of your scores for each subtask, rounded to 2 decimal places. Note that your score for this problem is the **maximum among all your submissions**, so you may wish to ensure that the best scoring output files for each input file are submitted together in a single submission before the end of the contest.