Median of Xor Sequence

Problem ID: medianxor

Given four non-negative integers a, b, c and d; let S be the "multiset" containing all values $z = x \oplus y$ of all pairs of integers (x, y) such that $a \leq x \leq b$ and $c \leq y \leq d$. Your task is to find the median value of S.

Please note that S is a "multiset". In other words, if there are several pairs (x, y) with the same value of $x \oplus y$, this value appears multiple times in S.

For example, consider $a = 3$, $b = 5$, $c = 6$ and $d = 9$. We have:

- $3 \oplus 6 = 5$, $3 \oplus 7 = 4$, $3 \oplus 8 = 11$, $3 \oplus 9 = 10$
- $4 \oplus 6 = 2$, $4 \oplus 7 = 3$, $4 \oplus 8 = 12$, $4 \oplus 9 = 13$
- $5 \oplus 6 = 3$, $5 \oplus 7 = 2$, $5 \oplus 8 = 13$, $5 \oplus 9 = 12$

Hence, 12 elements of S, in increasing order, are $2, 2, 3, 3, 4, 5, 10, 11, 12, 12, 13, 13$; meaning that the median of S, the sixth element, is 5.

A bitwise XOR (denoted as $\oplus$) is a binary operation that takes two bit patterns of equal length and performs the logical exclusive OR operation on each pair of corresponding bits. The result in each position is 1 if and only if two bits are different, and is 0 if two bits are equal. For example:

- $3 \oplus 6 = 011_2 \oplus 110_2 = 101_2 = 5$
- $4 \oplus 7 = 100_2 \oplus 111_2 = 011_2 = 3$
- $5 \oplus 8 = 0101_2 \oplus 1000_2 = 1101_2 = 13$

The median value of a sequence of numbers in increasing order $v_1 \leq v_2 \leq \ldots \leq v_n$ is $v_{\frac{n}{2}}$ if n is even and $v_{\frac{n+1}{2}}$ if n is odd.

Input

The first line of the input contain an integer t $(1 \leq t \leq 75)$ — the number of test cases.

In the last t lines, each contains four integers a, b, c, d $(0 \leq a, b, c, d < 10^{200}, a \leq b, c \leq d)$ representing a test case. All numbers are in decimal form.

Output

For each test case, write a single integer on a single line denoting the median value of S. All numbers should be in decimal form.

Sample Input 1	Sample Output 1
2 3 5 6 9 11 13 20 22	5 26