ACE Coursework 1

This is the first assessed coursework. It is worth 20% of the final mark. Please submit Java code, a `read me' file (optional) and a 2-3 pages report describing the problem-solving process, including selection of data structures, algorithm design, algorithm correctness justification and efficiency analysis. The submission deadline is **4 pm, 14ᵗʰ of November 2023**.

Question 1 [10 marks]
Propositional logic has been introduced in COMP1046/AE1MCS (Mathematics for Computer Scientists). Write a Java program that takes a formula ϕ in propositional logic, as well as the truth value of each propositional variable involved in ϕ, as input, and outputs true if ϕ is evaluated to be true, otherwise, false.

Input
The first line is a Java string which represents a formula ϕ in propositional logic.
The second line includes a single number n indicating the total number of propositional variables involved in ϕ, where $0 \le n \le 200$.
If $n > 0$, then the $i + 2$-th line ($1 \le i \le n$) contains "true" or "false" indicating the truth value of the i-th propositional variable.

Lower case English letters, like p, q, r, s, are used to represent propositional variables. We use "T" and "F" to represent "true" and "false", respectively, in an input formula. Round brackets "( )" may be included in the input formula to indicate the order of applying logical operators. The following table shows standard logical operators, their corresponding symbols as Java String, and their precedence.

Standard logical operator	Corresponding symbol	Precedence
¬	~	1
∧	&	2
∨	|	3
→	->	4
↔	<->	5

Output
The output is true if the input formula ϕ is evaluated to be true, otherwise, false.

Example

Standard input	Standard output
p 1 true	true
~T 0	false
p & q 2 true false	false
p -> (q -> r)	true

3 false true false	
(p -> q) -> r 3 false true false	false

Question 2 [10 marks]

Suppose there is a sequence formed by n students. From left to right, the ID numbers of the students are $1, 2, 3, \ldots, n$, respectively; the ID numbers of the positions are also $1, 2, 3, \ldots, n$, respectively. The order of the students in the sequence can be adjusted by performing the following operations:

- $1\,x\,y$ moves the student with ID x to the *left* of the student with ID y such that they are next to each other.
- $2\,x\,y$ moves the student with ID x to the *right* of the student with ID y such that they are next to each other.
- $3\,x\,y$ exchanges the positions of the student with ID x and the student with ID y.

Input

The first line includes two positive numbers n and m, which represent the number of students in the initial sequence and the total number of operations to be performed, respectively. The numbers n and m are separated by one single space.

For every integer i such that $1 \le i \le m$, the $i+1$-th line includes one of the operations described above.

Output

Output the sum of the ID numbers of the students at *even* positions in the resulting sequence.

Example

Standard input	Standard output
6 3 1 5 2 2 3 4 3 1 6	10
6 3 3 2 5 1 6 1 2 3 2	8

Reference and Plagiarism

If you use code you found in a textbook or on the web, you must acknowledge it. We will run the plagiarism detector tools to check for similarities between submissions and web-based material. You are reminded of the School's Policy on Plagiarism. **Never do "copy and paste"**

in your coding, that will be easily detected by tools as plagiarism. Similar to academic writing, in addition to providing a citation, you still need to rephrase it.

How to submit

Online submission via Moodle. Please make sure that all the java files needed to compile your program are included. Please note that every next submission overwrites all the files in the previous one, so if you submit several times, make sure that your last submission includes all the necessary files.