CS29003 ALGORITHMS LABORATORY
ASSIGNMENT 6 - Dynamic Programming
Date: 23rd Sep, 2021

Important Instructions

1. **Files to be submitted:** ROLLNO_A6.c/cpp
2. **THERE WILL BE PART MARKING.**
3. You are to stick to the file input output formats strictly as per the instructions above. Failing to do so might cause you to lose marks.
4. **Write your name and roll number at the beginning of your program.**
5. Code on the hackerrank platform to check whether you are able to pass the test cases. The exact same code should be submitte
6. Do not use any global variable unless you are explicitly instructed so.
7. Use proper indentation in your code.
8. Please follow all the guidelines. Failing to do so will cause you to lose marks.

Life is Strange

Kamala has time travelling superpower. But her access to this power is still limited, and she would like to gain more control over it. She has recently learned that there is a scope to upgrade her powers to have full control. She can do so during the next full solar eclipse.
You have the following basic information available to you.

1. The time T_0 (date and hour) when she got to know the time of next full solar eclipse.
2. The time of next full solar eclipse, T_S. (Date and hour)

Furthermore, her powers are currently constrained by the following rules.

1. Time-travel: She can only travel back in time to exactly J hours ago.
2. Cooldown-time: After a time-travel, she must wait for W hours to use the power again. Also, she can activate her powers after intervals in multiple of $+W$ hours. For example, if she makes a time-travel *to some time instance* T, then she can only activate her power again at $T + W, T + 2W, \ldots, T + kW, \ldots$ hours.
3. Forbidden past: The knowledge about the exact time of the eclipse comes at a cost too. By earning this information, she cannot travel back to any point earlier than T_0. And it has reset the timer of her power, so that first activation of her power can be at $T_0 + kW$ only ($k \in \{1, 2, 3, \ldots\}$).
4. Midnight madness: She should also make sure that any *midnight hour (00:00) falling between* T_0 *and* T_S does not align with any key moments on the timeline. *Key moments* are instances on her timeline which are either her time-travel destinations or when she can activate her power. This means that, if T_i is the *most recent* point she time-traveled to, before midnight, then $T_i + kW$ should not align with 00:00 hrs for any non-negative integer $k \in \{0, 1, 2, \ldots\}$. (*See Example C*)

Finally, to be able to upgrade her powers, she will either have to activate it during the point of full solar eclipse or make a time-travel to exactly that instance. This means that she can generally access any T_S through either $T_S - W$ or $T_S + J$ unless it coincides with midnight hour. You need to help her decide what steps she must take to be able to upgrade her powers.

Your objective is to find out whether she can upgrade her powers and the minimum-length sequence of actions to do so. The action sequence is represented using sequences of w and a's e.g.,

$$w\ w\ a\ w\ a \tag{1}$$

where 'a' means activation of time travel at a point in time, and 'w' means to wait for W hours. Find out such sequence of minimum length. Print '0'; if it is not possible to upgrade her powers under the given constraints.

Example A.

T_0 = 2021-01-31,01:00, T_S = 2021-01-31,10:00, $W = 3$, J = 15
Ans: [w,w,w] In this example, if she simply waits for $3W$ hours, she will be able to activate her power at T_S.

$$T_1 = T_0 + W = \text{2021-01-31 04:00}$$
$$T_2 = T_1 + W = \text{2021-01-31 07:00}$$
$$T_3 = T_2 + W = \text{2021-01-31 10:00}$$

Example B.

T_0 = 2021-09-15,11:00, T_S = 2021-09-15,18:00, $W = 16$, J = 9
Ans: [w,a] She waits for W hours and travels back once, which puts her at T_S.

$$T_1 = T_0 + W = \text{2021-09-16 03:00}$$
$$T_2 = T_1 - J = \text{2021-09-15 18:00}$$

Example C.

T_0 = 2021-01-01,02:00, T_S = 2021-01-04,02:00, $W = 26$, J = 6
Ans: She should **avoid the following situation**: If she takes the action sequence $w\ w\ a\ w$, then the following situation arrives:

$$T_1 = T_0 + W = \text{2021-01-02 04:00}$$
$$T_2 = T_1 + W = \text{2021-01-03 06:00}$$
$$T_3 = T_2 - J = \text{2021-01-03 00:00}$$

T_3 must be avoided as it aligns with a midnight between T_0 and T_S. Solution should be $w\ w\ w\ a$.

$$T_1 = T_0 + W = \text{2021-01-02 04:00}$$
$$T_2 = T_1 + W = \text{2021-01-03 06:00}$$
$$T_3 = T_2 + W = \text{2021-01-04 08:00}$$
$$T_4 = T_3 - J = \text{2021-01-04 02:00}$$

Input/Output Format

Note that input will be given through command line only, no file I/O is necessary.

Input The first two lines contain T_0 and T_S, respectively, in $YYYY-MM-DD\ hh$ format. We use 24-hour format for hh. Third and fourth lines contain W and J, respectively, in terms of hours.

Output If she can reach the hour of eclipse under the given constraints, the first line of output prints the number of steps (n) required. The following n lines print the sequence of steps she needs to follow. If such a solution does not exist, simply print '0' in the first line of the output file.

Limits on Problem Size

You may safely assume that we will not give any input outside these limits. No need to write code to explicitly check for these.

1. The input dates T_0 and T_S are both from the year 2021.
2. $T_0 \neq 00:00$ hrs (any day)
3. $T_S \neq 00:00$ hrs (any day)
4. $T_S - T_0 \leqslant 2000$ hrs
5. $1 \leqslant W, J \leqslant 2000$ hrs

More Example Input/Output pairs

FILE: *input1.txt*

```
2021-01-31 01
2021-01-31 10
3
15
```

FILE: *output1.txt*

```
3
w
w
w
```

FILE: *input2.txt*

```
2021-09-15 11
2021-09-15 18
16
9
```

FILE: *output2.txt*

```
2
w
a
```

FILE: *input3.txt*

```
2020-04-10 23
2020-04-11 05
5
25
```

FILE: *output3.txt*

```
0
```

FILE: *input7.txt*

```
2021-01-01 03
2021-01-02 19
7
5
```

FILE: *output7.txt*

```
16
w
w
a
w
w
w
a
w
a
w
a
w
a
w
a
w
```