Worksheet: Conditionals

CS 101 Algorithmic Problem Solving

Fall 2023

Name(s): _____

HU ID *(e.g., xy01042)*: _____

1. Critical Roll

Matthew and Laura are waiting for the group to get together so they can continue with their regularly planned Dungeons & Dragons session.

In the meanwhile, they've decided to play an unconventional game with dice to kill the time. They both roll their dice at the same time and consider the roll to be a "CRIT" if the sum of their rolls is greater than 20.

Given values of X and Y, the values of Mathhew and Laura's rolls respectively, determine if the roll was a CRIT.

Constraints

- $X, Y \in \mathbb{Z}$
- $1 \leq X, Y \leq 20$

Interaction

The input comprises a single line containing 2 space-separated integers denoting the values of X and Y respectively.

The output must be "CRIT" if the roll was a crit and "NO CRIT" otherwise.

Sample

Input	Output
10 2	NO CRIT
12 13	CRIT

In the first case, $(X, Y) = (10, 2)$. The sum of their rolls is 12, which is not greater than 20 and hence, it is not a crit.

In the second case, $(X, Y) = (12, 13)$. The sum of their rolls is 25, which is greater than 20 and hence, it is a crit.

Exercise

In the space provided, indicate the outputs for the given inputs.

Input	Output
6 17	CRIT
10 10	NO CRIT
7 12	NO CRIT

Propose

Provide sample inputs and outputs below. Do not reuse any of the values from above.

Input	Output

Problem Identification

Briefly explain the underlying problem you identified in the above question that led you to your solution.

Input X, Y

Output: CRIT if $X + Y > 20$*, else NO CRIT.*

2. Trick or Treat

Miles and Gwen have dressed up as Spider-man and Spider-woman for Halloween and gone trick or treating.

After a long night, they come back home and sit down to start counting their earned sweets. Miles, just by looking over at Gwen's basket, realizes that they both didn't get the same amount of candy. The two collectively decide that they will sum their candies up and split them equally.

Given values of X and Y, the number of candies Miles and Gwen got respectively, determine if it is possible to split the candies such that both of them get an equal amount.

Constraints

- $X, Y \in \mathbb{Z}$
- $1 \leq X, Y \leq 10^5$

Interaction

The input comprises a single line containing 2 space-separated integers denoting the values of X and Y respectively.

The output must be "YES" if an equal distribution is possible and "NO" otherwise.

Sample

Input	Output
8 6	YES
10 11	NO

In the first case, $(X, Y) = (8, 6)$. Miles got 8 candies and Gwen got 6; these can be equally divided into 7 candies each.

In the second case, $(X, Y) = (10, 11)$. Miles got 10 candies and Gwen got 11; these cannot be equally divided.

Exercise

In the space provided, indicate the outputs for the given inputs.

Input	Output
5 5	YES
10^5 1	NO
123 12	NO

Propose

Provide sample inputs and outputs below. Do not reuse any of the values from above.

Input	Output

Problem Identification

Briefly explain the underlying problem you identified in the above question that led you to your solution.

Input X, Y
OUTPUT: YES if $(X + Y)\%2 = 0$*, else NO.*

3. Test Preparation

Anya has a test coming up in X days and in classic Anya fashion, she hasn't prepared at all. She was hoping she would be able to mind-read the answers of her classmates to pass but she's just realized the test falls on the same day as the new moon which disables her telepathic abilities.

Anya opens up her textbook and is overwhelmed by how much she needs to cover. The syllabus includes a total of N pages. Anya realizes she can read at most Y pages in a day to save time for the rest of her daily activities.

Given values of N, X, and Y, determine if Anya can cover the syllabus in time for the exam.

Constraints

- $N, X, Y \in \mathbb{Z}$
- $1 \leq N \leq 100$
- $1 \leq X, Y \leq 10$

Interaction

The input comprises a single line containing 3 space-separated integers denoting the values of N, X, and Y respectively.

The output must be "YES" if Anya can cover the syllabus and "NO" otherwise.

Sample

Input	Output
30 5 5	NO
90 10 10	YES

In the first case, $(N, X, Y) = (30, 5, 5)$. Anya needs to cover 30 pages in 5 days and it is not possible at her max rate of 5 pages per day.

In the second case, $(N, X, Y) = (90, 10, 10)$. Anya needs to cover 90 pages in 10 days, which is possible at her max rate of 10 pages per day.

Exercise

In the space provided, indicate the outputs for the given inputs.

Input	Output
99 11 9	YES
37 6 7	YES
5 1 5	YES

Propose

Provide sample inputs and outputs below. Do not reuse any of the values from above.

Input	Output

Problem Identification

Briefly explain the underlying problem you identified in the above question that led you to your solution.

Input (N, X, Y)

Output: YES if $X * Y \leq N$ *else NO*

4. Enrolment Time

For the upcoming fall semester, the Registrar's Office has decided to keep a total of X seats for the CS113 course. Upon conducting a student interest survey, it was found that Y students are interested in enrolling in CS113.

Given values of X and Y, determine the minimum number of extra seats that have to be added so that every interested student gets a seat.

Constraints

- $X, Y \in \mathbb{Z}$
- $1 \leq X, Y \leq 10^5$

Interaction The input comprises a single line containing 2 space-separated integers denoting the values of X and Y respectively.

The output must be a single integer denoting the number of extra seats that must be added.

Sample

Input	Output
24 27	3
13 13	0

In the first case, $(X, Y) = (24, 27)$. 24 seats are currently allotted to CS113 and 27 students are interested in taking up the course, so 3 more seats need to be added.

In the second case, $(X, Y) = (13, 13)$. 13 seats are currently allotted to CS113 and 13 students are interested in taking up the course, so no more seats need to be added.

Exercise

In the space provided, indicate the outputs for the given inputs.

Input	Output
40 57	17
25 23	0
31 62	31

Propose

Provide sample inputs and outputs below. Do not reuse any of the values from above.

Input	Output

Problem Identification
Briefly explain the underlying problem you identified in the above question that led you to your solution.
Input (X, Y)
Output: $Y - X$ *if* $Y > X$*; else* 0.

5. Money Withdrawal

Chef wants to withdraw X rupees from the ATM. However, the ATM only processes a transaction if the withdrawal amount is a multiple of 5 and the account contains sufficient money for the withdrawal plus the bank charges. For each successful transaction, the bank charges 2 rupees.

Given the value of X and Y, the withdrawal amount and account balance respectively, determine Chef's account balance after the transaction.

Constraints

- $X, Y \in \mathbb{Z}$
- $1 \leq X, Y \leq 10000$

Interaction

The input comprises a single line containing 2 space-separated integers denoting the values of X and Y respectively.

The output must be the account balance after the withdrawal if the transaction was successful. If the transaction was unsuccessful, the output should be the current account balance.

Sample

Input	Output
15 20	3
10 11	11

In the first case, $(X, Y) = (15, 20)$. The account balance is 20 rupees and the withdrawal amount plus the bank charges total up to 17 rupees; the remaining account balance is 3 rupees.

In the second case, $(X, Y) = (10, 11)$. The account balance is 11 rupees and the withdrawal amount plus the bank charges total up to 12 rupees; the transaction is unsuccessful.

Exercise In the space provided, indicate the outputs for the given inputs.

Input	Output
5 5	5
132 140	140
4158 5000	5000

Propose

Provide sample inputs and outputs below. Do not reuse any of the values from above.

Input	Output

Problem Identification

Briefly explain the underlying problem you identified in the above question that led you to your solution.

Input (X, Y)

Output $Y - (X + 2)$ *if* $X\%5 == 0$ *and* $Y \geq X + 2$*; else* Y*.*

6. Preferential Treatment

Chef is hosting a small party at her house and has baked N cookies for her six guests. Unfortunately, she didn't put much thought into what amount of cookies she should bake, while all her guests seem to be really keen on trying them. Chef prefers some guests over others and has thought of this cookie division opportunity to be the perfect time to show her preference by giving a different amount of cookies to each guest depending on how much she likes them.

Chef wants to divide these N cookies among her guests such that:

- No two guests get the same amount of cookies.
- Each friend gets a cookie.

Given the value of N, determine if such a division is possible.

Constraints

- $N \in \mathbb{Z}$
- $1 \leq N \leq 10^5$

Interaction

The input comprises a single line containing a single integer denoting the value of N.

The output must be "YES" if a division according to the aforementioned method is possible and "NO" otherwise.

Sample

Input	Output
4	NO
42	YES

In the first case, $N = 4$. It is impossible to divide 4 cookies such that each of the six guests gets one.

In the second case, $N = 42$. A division according to the aforementioned method is possible. One solution could be 2, 4, 6, 8, 10, 12.

Exercise

In the space provided, indicate the outputs for the given inputs.

Input	Output
20	NO
21	YES
10^3	YES

Propose Provide sample inputs and outputs below. Do not reuse any of the values from above.

Input	Output

Problem Identification
Briefly explain the underlying problem you identified in the above question that led you to your solution.
Input N
Output YES if $N \geq 21$ (where 21 is the sum of the smallest six-long sequence of distinct positive integers), else NO.

7. Block-breaker

Chef has decided to try her skills as Karate. She is a part of a karate demonstration and her next task is to break three blocks of ice with widths W_1, W_2, and W_3 stacked on top of each other (W_1 is on the top and W_3 is on the bottom).

Chef's punch has a strength of S. Whenever she strikes at the stacked blocks, consider the largest $k \geq 0$ such that the sum of the width of the topmost k blocks does not exceed S; the topmost k blocks shatter and are removed from the stack. Chef can also choose to reverse the order in which the blocks are stacked before every hit, without incurring any penalty.

Given values of W_1, W_2, W_3, and S, find the minimum number of hits Chef needs to break through all three blocks if she performs the reversals optimally.

Constraints

- $W_1, W_2, W_3, S \in \mathbb{Z}$
- $1 \leq W_1, W_2, W_3 \leq S$
- $1 \leq S \leq 10$

Interaction

The input comprises a single line containing 4 space-separated integers denoting the value of W_1, W_2, W_3, and S.

The output must be a single integer denoting the minimum number of hits required to break all three blocks if the reversals are performed optimally.

Sample

Input	Output
1 2 2 3	2
1 1 1 3	1

In the first case, $(W_1, W_2, W_3, S) = (1, 2, 2, 3)$. Chef can break through the first two blocks in one hit as $W_1 + W_2 \leq S$ and then the last block in a subsequent hit. Alternatively, she could flip the order, break through W_3 and then break through the remaining two blocks in the next hit. Minimum number of hits required is 2.

In the second case, $(W_1, W_2, W_3, S) = (1, 2, 2, 3)$. Chef can break through the three blocks in one hit as $W_1 + W_2 + W_3 \leq S$. Minimum number of hits required is 3

Exercise

In the space provided, indicate the outputs for the given inputs.

Input	Output
5 1 5 6	2
8 5 4 10	2
4 5 6 9	2

Propose

Provide sample inputs and outputs below. Do not reuse any of the values from above.

Input	Output

Problem Identification

Briefly explain the underlying problem you identified in the above question that led you to your solution.

Input: $(W1, W2, W3, S)$
Output 1 If $W1 + W2 + W3 \leq S$*, else if* $(W1 + W2 \leq S)$ *or* $(W2 + W3 \leq S)$*, output 2, else output 3.*

8. Make Chef Proud

Chef prepared two dishes yesterday and assigned tastiness T_1 and T_2 to the first and second dishes respectively. T_1 and T_2 can be any integer between 0 and N (both inclusive).

Unfortunately, she seems to have forgotten what tastiness she assigned to each dish and only remembers what the total tastiness S was ($S = T_1 + T_2$).

As there is no way to figure out the originally assigned tastiness now, Chef at least wants to figure out what was the maximum difference in the tastiness of the two dishes.

Given values of N and S, determine the maximum difference between the two of Chef's dishes.

Constraints

- $N, S \in \mathbb{Z}$
- $1 \leq N \leq 10^5$
- $1 \leq S \leq 2 \cdot 10^5$

Interaction

The input comprises a single line containing 2 space-separated integers denoting the values of N and S respectively.

The output must be a single integer denoting the maximum difference between the tastiness of the two dishes.

Sample

Input	Output
3 1	1
2 3	1

In the first case, $(N, S) = (3, 1)$. The maximum tastiness for each dish could be 3 and the sum of the tastiness for each dish is 1. Therefore, the cases where dishes have maximum difference are $(T_1, T_2) = (0, 1)$ and $(T_1, T_2) = (1, 0)$ where the maximum difference is 1.

In the second case, $(N, S) = (2, 3)$. The maximum tastiness for each dish could be 2 and the sum of the tastiness for each dish is 3. Therefore, the cases where dishes have maximum difference are $(T_1, T_2) = (2, 1)$ and $(T_1, T_2) = (1, 2)$ where the maximum difference is 1.

Exercise

In the space provided, indicate the outputs for the given inputs.

Input	Output
4 4	4
1356 2134	578
10^3 $2 \cdot 10^3$	0

Propose

Provide sample inputs and outputs below. Do not reuse any of the values from above.

Input	Output

Problem Identification

Briefly explain the underlying problem you identified in the above question that led you to your solution.

Input (N, S) if $S \leq N$, output S as the maximum difference will just be $S - 0$; else output $2 * N - S$, as the maximum difference would be achieved by having one number at N, and the other at $S - N$.

9. Who's better?

In a season of cricket, three metrics regarding a player are measured which are used to determine the quality of a player; these are runs (R), wickets (W), and catches (C). The player who is better in the most statistics is the better player. Below you are given the stats of two players A and B. The stats of player A are denoted as R_A, W_A, C_A and that of player B are denoted as R_B, W_B, C_B. Determine which is the better player.

Constraints

- $R_A, W_A, C_A, R_B, W_B, C_B \in \mathbb{Z}$
- $0 \leq R_A, R_B \leq 500$
- $0 \leq W_A, W_B, C_A, C_B \leq 20$

Interaction

The first line of the input contains 3 space-separated integers denoting the values of R_A, W_A, and C_A respectively. The second line of the input contains 3 space-separated integers denoting the values of R_B, W_B, and C_B respectively.

The output must be "A" or "B" depending on which player is better. In case of a tie, output "TIE".

Sample

Input	Output
0 1 2 2 3 4	"B"
10 0 10 0 10 0	"A"

In the first case, player "B" is better than player "A" in all three fields.

In the second case, player "A" is better than player "B" in two out of the three fields.

Exercise

In the space provided, indicate the outputs for the given inputs.

Input	Output
34 5 6 23 5 6	"A"
123 14 5 323 1 6	"B"
199 14 16 199 13 17	"TIE"

Propose

Provide sample inputs and outputs below. Do not reuse any of the values from above.

Input	Output

Problem Identification

Briefly explain the underlying problem you identified in the above question that led you to your solution.

If $\sum(A_i > B_i) > \sum(B_i > A_i)$*, output A. Else If* $\sum(B_i > A_i) > \sum(A_i > B_i)$*, output B. Else output TIE.*

10. Bouquet of Leaves

Chef wants to make a bouquet of leaves. It's fall season, so there's plenty of leaves on the ground. At her local park, she can find fallen leaves of maple, oak, and poplar trees. These leaves can be of three different colours: green, yellow, or red.

Chef has gone around the park picking up any leaf she sees and putting them in her basket. She wants to make a nice bouquet; a nice bouquet is one if and only if all the leaves in it are of the same type or colour. She also don't want to make a bouquet with an even number of leaves as she considers it bad luck. She lays out her collection of leaves and begins counting leaves of each number and type.

Given the number of leaves of each type, determine what is the maximum number of leaves she can have in a bouquet which satisfies the above requirements. She need not use all the leaves of a certain type/colour; e.g. if there are 20 red leaves, she can choose to use just 19 for the bouquet.

Constraints

- Number of leaves of each type/colour is a non-negative integer.

Interaction

The first line of the input contains 3 space-separated integers M_G, M_Y, and M_R denoting the values of a number of green, yellow, and red maple leaves respectively. The second line of the input contains 3 space-separated integers O_G, O_Y, and O_R denoting the values of a number of green, yellow, and red oak leaves respectively. The third line of the input contains 3 space-separated integers P_G, P_Y, and P_R denoting the values of a number of green, yellow, and red poplar leaves respectively.

The output must be a single integer denoting the maximum number of leaves Chef can have in a nice bouquet. The output must be 0 if it is impossible to create a nice bouquet.

Sample

Input	Output
1 2 3	7
3 2 1	
1 3 4	
3 5 13	29
25 4 1	
2 19 0	

In the first case, the sum of maple leaves is 6, the sum of oak leaves is 6, the sum of poplar leaves is 8, the sum of green leaves is 5, the sum of yellow leaves is 7, and the sum of red leaves is 8. The maximum number of leaves that can make a nice bouquet is 7.

In the second case, the sum of maple leaves is 21, the sum of oak leaves is 30, the sum of poplar leaves is 21, the sum of green leaves is 30, the sum of yellow leaves is 28, and the sum of red leaves is 14. The maximum number of leaves that can make a nice bouquet is 29.

Exercise

In the space provided, indicate the outputs for the given inputs.

Input	Output
11 23 13	87
31 21 14	
13 32 42	
50 20 10	99
10 60 30	
24 12 36	
11 2 3	39
7 8 13	
15 13 12	

Propose

Provide sample inputs and outputs below. Do not reuse any of the values from above.

Input	Output

Problem Identification
Briefly explain the underlying problem you identified in the above question that led you to your solution.

Let S_c represent the sum of numbers in the same color group, S_t represent the sum of numbers in the same type group, and S represent the maximum sum of S_c and S_t.
If $S = 0$, output 0. Else if $S\%2 \neq 0$, output S. Else output $S - 1$.

Rough Work