Practice Worksheet 3 Solution: Psuedocode

CS 101 Algorithmic Problem Solving

Fall 2023

Name(s): _____

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1. Squats

Qasim went to the gym today. He decided to do X sets of squats. Each set consists of N squats.

Given X and N, determine how many squats Qasim did.

Constraints

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

Interaction

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

The output must contain a single number denoting the number of squats Qasim did.

Sample

Input	Output
1 2	2
10 10	100

In the first case, $(X, N) = (1, 2)$. Qasim did 1 set of squats and each set comprised of 2 squats. Therefore, Qasim did 2 squats.

In the second case, $(X, N) = (10, 100)$. Qasim did 10 sets of squats and each set comprised of 10 squats. Qasim did a total of $10 \cdot 10 = 100$ squats.

Exercise

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

Input	Output
10 1	10
24 10	240
9 9	81

Problem Identification

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

Input: X, N
Output: $X * N$

Pseudocode

```
return X * Y
```

Dry Run

Using any two of the inputs provided in the Exercise section above, dry run your psuedocode in the space below.

Input: $(X, N) = (10, 1)$
Output: $10 * 1 = 10$, which is the expected output, so correct!

Input: $(X, N) = (24, 10)$
Output: $24 * 10 = 240$, which is the expected output, so correct!

This means the applied logic is correct

2. Where's the Lamb Biryani?!

Michelin starred chef and lamb sauce enthusiast, Gordon Ramsey, wants to learn how to make a perfect biryani. For this reason, he's come to Karachi to learn under the tutelage of Uncle Farhan, owner of the renowned Farhan Biryani restaurant.

Uncle Farhan charges X rupees per class. Chef Ramsey can attend Y classes per week. Uncle Farhan suggests he should attend classes for N weeks in order to become a true master.

Given values of X, Y, and N, determine the total amount of money Chef Ramsey will have to pay.

Constraints

- $X, Y, N \in \mathbb{N}$
- $1 \leq X, N \leq 10^5$
- $1 \leq Y \leq 7$

Interaction

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

The output must contain a single number denoting the total amount of money Chef Ramsey has to pay.

Sample

Input	Output
500 3 3	4500
1000 7 1	7000

In the first case, $(X, Y, N) = (500, 3, 3)$. Uncle Farhan charges 500 rupees per class and Chef Ramsey has to take a total of 9 classes (3 classes per week for 3 weeks). He has to pay a total of $500 \cdot 9 = 4500$ rupees.

In the second case, $(X, Y, N) = (1000, 7, 1)$. Uncle Farhan charges 1000 rupees per class and Chef Ramsey has to take a total of 7 classes (7 classes per week for 1 week). He has to pay a total of $1000 \cdot 7 = 7000$ rupees.

Exercise

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

Input	Output
1350 5 4	27000
500 7 52	182000
1337 3 10	40110

Problem Identification

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

Input: X, Y, N
Output: $X * Y * N$

Pseudocode

```
return X*Y*N
```

Dry Run

Using any two of the inputs provided in the Exercise section above, dry run your psuedocode in the space below.

Input: $(X, Y, N) = (1350, 5, 4)$
Output: $1350 * 5 * 4 = 127000$, which is the expected output, so correct!

Input: $(X, Y, N) = (500, 7, 52)$
Output: $500 * 7 * 52 = 182000$, which is the expected output, so correct!

This means the applied logic is correct

3. Trick or Treat

Miles and Gwen have dressed up as Spiderman and Spiderwoman 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

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

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

Problem Identification

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

Answer: We are given two integers as input and need to determine if their sum is even or not.

> Input: X, Y
> Output: 'YES' if $(X + Y)\%2 == 0$, otherwise 'NO'

Pseudocode

```
if (X+Y) % 2 == 0:
    return 'YES'
else:
    return 'NO'
```

Dry Run

Using any two of the inputs provided in the Exercise section above, dry run your psuedocode in the space below.

Input: $(X, Y) = (5, 5)$
Output:
$5 + 5 = 10$
$10\%2 = 0$
As it is equally divisible, the output should be "Yes", which is the expected output, so correct!

Input: $(X, Y) = (10^5, 1)$
Output:

$10^5 + 1 = 100001$
$100001\%2 = 1$
As it is not equally divisible, the output should be "No", which is the expected output, so correct!

This means the applied logic is correct

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 into 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

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

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

Problem Identification

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

Answer: We are given two integers as input (X, Y) and need to find $Y - X$ if $Y > X$; otherwise, output 0.

Input: X, Y

Output: 0 if $(Y - X) <= 0$, otherwise $(Y - X)$

Pseudocode

```
if Y > X:
    return Y - X
else:
    return 0
```

Dry Run

Using any two of the inputs provided in the Exercise section above, dry run your psuedocode in the space below.

Input: $(X, Y) = (40, 57)$
Output:
Check if $57 > 40$? Yes, it is!
So output = 57 - 40 = 3, which is the expected output, so correct!

Input: $(X, Y) = (25, 23)$
Output:
Check if $25 > 23$? No, it is not!
So go to the else statement, and output = 0, which is the expected output, so correct!

This means the applied logic is correct

5. Icebreaker

Lee is a part of a karate demonstration and his 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).

Lee's punch has a strength of S. Whenever he 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. Lee 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 Lee needs to break through all three blocks if he performs the reversals optimally.

Constraints

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

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, $(W_1, W_2, W_3, S) = (1, 2, 2, 3)$. Lee 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, he 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, $(W_1, W_2, W_3, S) = (1, 2, 2, 3)$. Lee 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
7 5 6 10	3
4 4 1 9	1

Problem Identification

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

Answer: We are given four integers as input (W_1, W_2, W_3, S) and need to output 1 if $W_1 + W_2 + W_3 \leq S$, output 2 if the previous condition isn't met and the sum of any two consecutive numbers in the sequence $(W_1, W_2, W_3) \leq S$, and output 3 if none of the conditions are met.

Input: W_1, W_2, W_3, S
Output: 1 if $(W_1 + W_2 + W_3) <= S$, 2 if $W_1 + W_2 <= S$ or $W_2 + W_3 <= S$, otherwise 3

Pseudocode

```
if W_1 + W_2 + W_3 <= S:
    return 1
elif W_1 + W_2 <= S or W_2 + W_3 <= S:
    return 2
else:
    return 3
```

Dry Run

Using any two of the inputs provided in the Exercise section above, dry run your psuedocode in the space below.

Input: $(W_1, W_2, W_3, S) = (5, 1, 5, 6)$
Output:
Check if $5 + 1 + 5 <= 6$? No, it is not!
So check if $5 + 1 <= 6$? Yes, it is!
Thus, the output = 2, which is the expected output, so correct!

Input: $(W_1, W_2, W_3, S) = (7, 5, 6, 10)$
Output:

Check if $7 + 5 + 6 <= 10$? No, it is not!
So check if $7 + 5 <= 10$? No, it is not!
So check if $5 + 6 <= 10$? No, it is not!
So it goes to final else condition!
Thus, the output = 3, which is the expected output, so correct!

This means the applied logic is correct

6. Make Uncle Proud

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

Unfortunately, he seems to have forgotten what tastiness he 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 original assigned tastiness now, Uncle Roger 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 Uncle Roger's dishes.

Constraints

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

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

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

Answer: We are given two integers as input (N, S) and if $S \leq N$, we output S as the maximum difference will just be $S - 0$; otherwise, we output $2 * N - S$, as the maximum difference would be achieved by having one number at N, and the other at $S - N$.

> Input: N, S
> Output: S if $S <= N$, otherwise $(2 * N) - S$

Pseudocode

```
if S <= N:
    return S
else:
    return 2*N-S
```

Dry Run
Using any two of the inputs provided in the Exercise section above, dry run your psuedocode in the space below.

Input: $(N, S) = (4, 4)$
Output:
Check if $4 <= 4$? Yes, it is!
Thus, the output $= 4$, which is the expected output, so correct!

Input: $(N, S) = (1356, 2134)$
Output:
Check if $2134 <= 1356$? No, it is not!
So it goes to else statement:
Performs $(2*N) - S = (2*1356) - 2134 = 578$ Thus, the output $= 578$, which is the expected output, so correct!

This means the applied logic is correct

7. Weapon Division

A warlord has been terribly injured after a battle and it's looking like his time on Earth is coming to an end. Before he departs from the world, he wants to distribute all K of his weapons somewhat fairly among his N sons.

Unfortunately, his math skills have deteriorated greatly after decades of constant warring and bloodshed, and he has asked you for assistance in distributing the weapons. He has set just one condition: the difference between the son that got the least weapons and the son that got the most weapons should be no greater than 1.

Given values of K and N, determine the minimum number of weapons a son can have if all K weapons are distributed among them according to the above condition.

Constraints

- $K, N \in \mathbb{N}$
- $1 \leq K \leq 10^9$

- $1 \leq N \leq 10^5$

Interaction

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

The output must contain a single number denoting the minimum number of weapons a son can possess once all K weapons are distributed according to the warlord's condition.

Sample

Input	Output
8 5	1
5 8	0

In the first case, $(K, N) = (8, 5)$. The warlord has 8 weapons which are to be distributed among 5 sons. The first 5 weapons can be distributed equally among the 5 sons. The remaining 3 weapons will then be given to any 3 sons. Therefore, 3 sons will receive 2 weapons and 2 sons wil receive 1 weapon. Hence, minimum number of weapons possessed by a son is 1.

In the second case, $(K, N) = (5, 8)$. The warlord has 5 weapons which are to be distributed among 8 sons. The 5 weapons can be given to any 5 sons equally. The remaining 3 sons will receive no weapons. Hence, the minimum number of weapons possessed by a son is 0.

Exercise

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

Input	Output
15 5	3
39 10	3
24 25	0

Problem Identification

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

Answer:We are given two integers as input (K, N) and need to find $\lfloor K/N \rfloor$.

Input: K, N
Output: $K//N$

Pseudocode

```
return K//N
```

Dry Run

Using any two of the inputs provided in the Exercise section above, dry run your psuedocode in the space below.

Input: $(K, N) = (15, 5)$
Output: $15//5 = 3$, which is the expected output, so correct!

Input: $(K, N) = (24, 25)$

Output: $24//25 = 0$, which is the expected output, so correct!

This means the applied logic is correct

8. Preferential Treatment

You're hosting a small party at your house and have baked N cookies for your six guests. Unfortunately, you didn't put much thought into what amount of cookies you should bake and all your guests seem to be really keen on trying them. You prefer some guests over others and have thought of this cookie division opportunity to be the perfect time to show your preference by giving a different amount of cookies to each guest depending on how much you like them.

You want to divide these N cookies among your 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 get 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

Problem Identification

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

Answer: We are given an integer N as input and need to determine if $N \geq 21$. As the smallest six long sequence of distinct positive integer is (1, 2, 3, 4, 5, 6), so N must be greater than

or equal to the sum of the sequence in order for it to be divided into distinct proportions six ways

Input: N Output: YES if $N \geq 21$, otherwise NO

Pseudocode

```
if N >= 21:
    return "YES"
else:
    return "NO"
```

Dry Run

Using any two of the inputs provided in the Exercise section above, dry run your psuedocode in the space below.

Input: $(N) = (20)$
Output: $20 \geq 21$, As this condition is False, the output should be "NO", which is the expected output, so correct!

Input: $(N) = (10^3)$
Output: $10^3 \geq 21$
$1000 \geq 21$
As this condition is True, the output should be "YES", which is the expected output, so correct!

This means the applied logic is correct

LET'S LEARN TO DEBUG

9. Volume Control

Peter is watching TV. The current volume of the TV is X. Pressing the "volume up" button increases the volume by 1 while pressing the "volume down" button decreases the volume by 1. Peter wants to change the volume from X to Y.

Given values of X and Y, find the number of button presses it takes to change the volume from X to Y.

Constraints

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

Interaction

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

The output must contain a single number denoting the minimum number of button presses to change volume from X to Y.

Sample

Input	Output
50 54	4
100 60	40

In the first case, $(X, Y) = (50, 54)$. Peter wants to change the volume from 50 to 54 and this can be done by 4 presses of the "volume up" button.

In the second case, $(X, Y) = (100, 60)$. Peter wants to change the volume from 100 to 60 and this can be done by 40 presses of the "volume down" button.

Proposed Solution

```
return X-Y
```

Dry Run

Using the inputs provided in the Sample section above, dry run the proposed code solution below.

Input: $(X, Y) = (50, 54)$
Output: $50 - 54 = -4$, which is not what the output should be, so need to correct the logic!

Input: $(X, Y) = (100, 60)$
Output: $100 - 60 = 40$, which is the correct output!

However, logic cannot work only partially, so need to correct the logic!

Error Identification

Briefly explain the errors you identified in the proposed code solution. Mention the line number(s) and the errors in each line.

Line 1: The subtraction only works if Y is smaller than X, otherwise it outputs a negative number of button presses. We can either find the absolute difference or conditionals to get proper answer.

Correct Solution

Rewrite the lines of code you mentioned above with their errors corrected.

Line 1 can be corrected to:

```
return abs(X - Y)
```

or

```
if Y >= X:
    return Y - X
else:
    return X - Y
```

10. Critical Roll

Monis and Lubna 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 Monis' and Lubna's rolls respectively, determine if the roll was a crit.

Constraints

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

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 10	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.

Proposed Solution

```
1 if X+Y >= 20:
2     return 'CRIT'
3 else:
4     return 'NO CRIT'
```

Dry Run
Using the inputs provided in the Sample section above, dry run the proposed code solution below.

Input: $(X, Y) = (10, 10)$
Output:
Check if $10 + 10 >= 20$? Yes, it is!
But this is not what the output should be, so need to correct the logic!

Input: $(X, Y) = (12, 13)$
Output:
Check if $12 + 13 >= 20$? Yes, it is!
This is the correct output!

However, logic cannot work only partially, so need to correct the logic!

Error Identification
Briefly explain the errors you identified in the proposed code solution. Mention the line number and the errors in each line.

Line 1: The if statement means CRIT will be printed if the total is 20 or greater, when it should only be printed if greater.

Correct Solution
Rewrite the lines of code you mentioned above with their errors corrected.

Line 1 can be corrected to:

```
if X+Y > 20:
```

Rough Work