

Worksheet: Computation

CS 101 Algorithmic Problem Solving

Fall 2023

Name(s): _____

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

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

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

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

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.

We are given two integers as input and need to find their product.

2. 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

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

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.

Exercise

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

Input	Output
56 23	33
62 89	27
71 29	42

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.

We are given two integers as input and need to find their absolute difference.

3. 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

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

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

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.

We are given three integers as input and need to find their product.

4. Coconut

Hawaii has 2 different types of coconuts, type A and type B . Type A contains x_a millilitres of coconut water and type B contains x_b grams of coconut pulp. Your nutritionist has advised you to consume X_a millilitres of coconut water and X_b grams of coconut pulp every week during your visit.

Given values of x_a , x_b , X_a , and X_b , determine how many total coconuts you will need each week.

Constraints

- $x_a, x_b, X_a, X_b \in \mathbb{Z}$
- $100 \leq x_a \leq 200$
- $400 \leq x_b \leq 500$
- $1000 \leq X_a \leq 1200$
- $1000 \leq X_b \leq 1500$
- x_a divides X_a
- x_b divides X_b

Interaction

The input comprises a single line containing 4 space-separated integers denoting the values of x_a , x_b , X_a , and X_b respectively.

The output must contain a single number denoting the total number of coconuts you need in a week.

Sample

Input	Output
100 400 1000 1200	13
150 400 1200 1200	11

In the first case, $(x_a, x_b, X_a, X_b) = (100, 400, 1000, 1200)$. Type A coconuts contain 100 millilitres of coconut water and type B coconuts contain 400 grams of coconut pulp. You need 1000 millilitres of coconut water and 1200 grams of coconut pulp each week. Therefore, you require $\frac{1000}{100} = 10$ type A coconuts and $\frac{1200}{400} = 3$ type B coconuts each week. So a total of 13 coconuts are required per week.

In the second case, $(x_a, x_b, X_a, X_b) = (150, 400, 1200, 1200)$. Type A coconuts contain 150 millilitres of coconut water and type B coconuts contain 400 grams of coconut pulp. You need 1200 millilitres of coconut water and 1200 grams of coconut pulp each week. Therefore, you require $\frac{1200}{150} = 8$ type A coconuts and $\frac{1200}{400} = 3$ type B coconuts each week. So a total of 11 coconuts are required per week.

Exercise

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

Input	Output
100 450 1000 1350	13
200 500 1200 1500	9
150 500 1050 1500	10

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.

We are given four integers as input (x_a, x_b, X_a, X_b) and need to find the sum of X_a/x_a and X_b/x_b .

5. True or False

Professor Oak has created an exam containing N true or false questions. Each question is worth 1 mark and there is no negative marking.

Ash and Gary are two students taking the exam. In an incredible coincidence, all answers of Ash and Gary are opposite of each other, i.e. if Ash marked a statement "true", Gary marked it "false", and vice versa.

Ash scored K marks on the exam.

Given values of N and K , determine the marks Gary scored.

Constraints

- $N, K \in \mathbb{Z}$
- $1 \leq N \leq 100$
- $0 \leq K \leq N$

Interaction

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

The output must contain a single number denoting Gary's obtained marks.

Sample

Input	Output
1 1	0
5 2	3

In the first case, $(N, K) = (1, 1)$. There is only 1 question in the exam and Ash obtained 1 mark, i.e. he answered the question correct. Therefore, Gary would have answered it incorrectly and obtained 0 marks.

In the second case, $(N, K) = (5, 2)$. There are 5 questions in the exam and Ash obtained 2 marks, i.e. he got 2 questions correct and 3 incorrect. Therefore, Gary would have answered 2 questions incorrect and 3 questions correct and obtained 3 marks.

Exercise

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

Input	Output
50 0	50
100 50	50
25 12	13

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.

We are given two integers as input and need to find the difference between the first and second integer.

6. Harley and the Chocolate Factory

Notorious chocolatier, Billy Bonka, has hidden a golden ticket in some of his chocolates. These ticket containing packets are incredibly rare and rumors say that there's only a dozen such packets around the globe. Bonka has announced that anyone who can get their hands on one of these precious tickets will be invited to visit his state-of-the-art chocolate factory.

Harley, who has been a fan of Bonka's chocolates since she was young, is infatuated by the idea of visiting Bonka's factory. She breaks open her piggy bank and finds that she has X 5-cent coins and Y 10-cent coins. Harley knows a packet of chocolate costs Z cents and wants to know how many packets she can purchase.

Given values of X , Y , and Z , determine how many packets Harley can purchase.

Constraints

- $X, Y, Z \in \mathbb{Z}$
- $1 \leq X, Y, Z \leq 1000$

Interaction

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

The output must contain a single number denoting the number of chocolates Harley can afford.

Sample

Input	Output
10 10 10	15
3 1 8	3

In the first case, $(X, Y, Z) = (10, 10, 10)$. Harley has 10 5-cent coins and 10 10-cent coins. She has a total of 150 cents. Since each packet costs 10 cents, she can afford 15 packets.

In the second case, $(X, Y, Z) = (3, 1, 8)$. Harley has 3 5-cent coins and 1 10-cent coins. She has a total of 25 cents. Since each packet costs 8 cents, she can afford 3 packets.

Exercise

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

Input	Output
4 4 1000	0
10 5 1	100
13 31 35	10

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.

*We are given three integers as input (X, Y, Z) and need to find $\lfloor Z / (X * 5 + Y * 10) \rfloor$.*

7. Wireframe

You have a rectangular plate of length N cm and width M cm. You want to make a wireframe around the plate. The wireframe costs X rupees per cm.

Given the values of N , M , and X , determine the total cost of the wireframe.

Constraints

- $N, M, X \in \mathbb{Z}$
- $1 \leq N, M, X \leq 1000$

Interaction

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

The output must contain a single number denoting the total cost of the wireframe.

Sample

Input	Output
10 10 10	400
1 2 3	18

In the first case, $(N, M, X) = (10, 10, 10)$. The length of the wireframe is 10cm and the width is 10cm. The total perimeter is $2 \cdot 10 + 2 \cdot 10 = 40$ cm. Since the cost is 10 rupees per cm, the total cost is $40 \cdot 10 = 400$ rupees.

In the second case, $(N, M, X) = (1, 2, 3)$. The length of the wireframe is 1cm and the width is 2cm. The total perimeter is $2 \cdot 1 + 2 \cdot 2 = 6$ cm. Since the cost is 3 rupees per cm, the total cost is $6 \cdot 3 = 18$ rupees.

Exercise

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

Input	Output
11 15 50	2600
1000 1000 1000	4000000
67 37 23	4784

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.

*We are given three integers as input (N, M, X) and need to find $(2 * N + 2 * M) * X$.*

8. Headmaster's Challenge

Your parents have enrolled you into a strange academy. The people here seem lifeless and in their eyes, you see an endless void. Nobody talks to anyone around here. Not even your dorm roommate seems to acknowledge your presence. On your first night, you say good night to your roommate before sinking into your bed after receiving no response. The next morning, you wake up in a strange room.

You look around and your attention is immediately drawn to a wall with N number of holes. In front of the wall, you see a bottomless pit with two spheres suspended above it. You also see a paper and a pen lying on the ground near the pit. As you pick up the pen and paper, you hear a voice echo in the room; it's the Headmaster.

He tells you that this is an initiation into the secret society. The academy was but a front; this is the real deal. He tells you that the pit and the spheres have a special interaction. The pit will clone the spheres if they fall into them. So if the two spheres fall, they will turn into four and be launched back up. He says the pen and paper is to write the number of times the pit is to be used before it shuts itself. So if you were to write "2" onto the paper and drop it into the pit, the two spheres will be dropped and launched back up as four, they will fall back into the pit and be launched back as eight, at which point the pit will close.

The Headmaster challenges you to determine the minimum number of uses of the pit to end up with enough spheres to fill all the N holes in the wall. He says if you end up with less spheres than required or use the pit more times than necessary, you will be discharged from the academy immediately.

Given the value of N , determine the minimum number of uses of the pit.

Constraints

- $N \in \mathbb{Z}$
- $1 \leq N \leq 2^{10}$

Interaction

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

The output must contain a single non-negative integer denoting the minimum number of uses of the pit required.

Sample

Input	Output
4	1
5	2

In the first case, $N = 4$. There are 4 holes in the wall and using the pit 1 time will give you exactly 4 spheres.

In the second case, $N = 5$. There are 5 holes in the wall, so using the pit 1 time will not give you enough spheres so you need to use the pit twice, ending up with 8 spheres.

Exercise

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

Input	Output
43	5
2^{10}	9
512	8

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.

We are given an integer N as input and need to find $\log_2 N - 1$.

9. 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

- $K, N \in \mathbb{Z}$
- $1 \leq K \leq 10^9$
- $1 \leq N \leq 10^5$

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 will 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

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.

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

10. Group Assignment

Your professor is planning on giving the class a group assignment. There are $2N$ students in your class, with roll numbers from 1 to $2N$. Your roll number is X .

The professor has decided to create N groups of 2 students each. The groups are to be created as follows: the first group contains roll numbers 1 and $2N$, the second group contains roll numbers 2 and $2N - 1$, the third group contains roll numbers 3 and $2N - 2$, and so on, with the N th group containing roll numbers N and $N + 1$.

You want to find out who your partner will be beforehand.

Given values of N and X , determine the roll number of your partner.

Constraints

- $N, X \in \mathbb{Z}$
- $1 \leq N \leq 10^8$
- $1 \leq X \leq 2N$

Interaction

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

The output must contain a single number denoting the roll number of your partner.

Sample

Input	Output
2 2	3
3 1	6

In the first case, $(N, X) = (2, 2)$. There are $2 \cdot 2 = 4$ students in the class and your roll number is 2. The groups will be as follows: $\{(1, 4), (2, 3)\}$. You are partnered with roll number 3.

In the second case, $(N, X) = (3, 1)$. There are $2 \cdot 3 = 6$ students in the class and your roll number is 1. The groups will be as follows: $\{(1, 6), (2, 5), (3, 4)\}$. You are partnered with roll number 6.

Exercise

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

Input	Output
15 5	26
35 23	48
123 189	67

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.

*We are given two integers as input (N, X) and need to find $1 + (2 * N - X)$.*

Rough Work