Worksheet: Functions

CS 101 Algorithmic Problem Solving

Fall 2023

Name(s): _____

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1. ATM Withdrawal

You have been hired by HUBL as a programming intern. You have been brought on board at a particularly revolutionary time in the bank's history. All HUBL ATM machine firmware is to be scrapped and rebuilt from the ground up. Your supervisor has reluctantly (and rather foolishly) given you one of the most important tasks in this process: making the display system for the ATM machine.

Before you start working on the UI, you have to work on a barebones functional program. To accomlish this, you are to make a function called `withdrawal` which takes two numeric parameters, `amount` and `balance`, corresponding to a withdrawal request and indicates whether the request can be serviced. If the withdrawal amount is within the account balance, it indicates the balance remaining after the withdrawal. Otherwise, it notifies of insufficient balance.

Write the described function.

Constraints

- $amount, balance \in \mathbb{Z}$
- $0 \leq amount, balance \leq 10^5$

Interaction

The input comprises of a single line containing two space separated integers denoting the values of *amount* and *balance* respectively.

The output is a string, either "N USD Remaining", where N is the amount remaining after the withdrawal, or "Insufficient funds for this withdrawal" if the withdrawal cannot be made.

Sample

Input	Output
23 25	"2 USD Remaining"
32 31	"Insufficient funds for this withdrawal"

In the first case, 25 - 23 = 2 USD remain in the account.

In the second case, the account balance is less than the withdrawal amount, and the corresponding string is output.

Exercise

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

Input	Output
234 234	"0 USD Remaining"
23 44	"21 USD Remaining"
00 00	"0 USD Remaining"

Problem Identification

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

> Input: `amount, balance`
> Output: A message indicating the remaining balance if `amount` is within `balance`, otherwise a message about insufficient funds.

Pseudocode

After defining the function, make sure to call it and print its result. You may assume that input has already been taken.

```
1  def withdrawal(amount,balance):
2      diff = balance - amount
3      if diff >= 0:
4          return str(diff) + ' USD Remaining'
5      else:
6          return 'Insufficient funds for this withdrawal'
7
8  print(withdrawal(amount,balance))
```

Dry Run

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

amount	balance	diff
23	44	21
return '21 USD remaining'		

amount	balance	diff
0	0	0
return '0 USD remaining'		

2. Can't Count Past Twelve

Your American friend has moved to Singapore and among the many cultural shocks, the one he has been having trouble adjusting to the most is the 24-hour clock. He's already missed several events, meetings and subway stops alike, because of not being able to understand the time. He has asked you for help.

You are to make a function called `time_conversion` that takes in two numeric parameters, hr and min, denoting the time on a 24-hour clock and you are to convert it into a 12-hour time format, and returns the time as a string of the form "HH:MM [AM/PM]" replacing the square brackets with the correct choice of AM or PM. The function should return "Invalid Time" for incorrect values of hr and min. That there is no such time as 24:00 or 11:60; the hours go from 0 to 23 and minutes go from 0 to 59.

Write the described function.

Constraints

- $hr, min \in \mathbb{Z}$

Interaction

The input comprises of a single line containing two space separated integers denoting the values of *hr* and *min* respectively.

The output must be a string indicating the time in the described format if the inputs are valid, or "Invalid Time" otherwise.

Sample

Input	Output
13 5	"1:05 PM"
12 61	"Invalid Time"

In the first case, 1345 corresponds to 1:45pm.

In the second case, 61 minutes is not a valid time.

Exercise

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

Input	Output
25 32	"Invalid Time"
0 23	"12:23 AM"
12 0	"12:00 PM"

Problem Identification

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

> Input: `amount, balance`
> Output: A message indicating the remaining balance if `amount` is within `balance`, otherwise a message about insufficient funds.

Pseudocode

After defining the function, make sure to call it and print its result. You may assume that input has already been taken.

```python
def time_conversion(hr, min):
    # error check
    if hr < 0 or hr > 23 or min < 0 or min > 59:
        return 'Invalid Time'
    # minute string
    if min < 10:  # add 0 for single digit
        min_str = '0' + str(min)
    else:
        min_str = str(min)
    # hour string and AM/PM
    if hr == 0:
        hr_str = '12'
        am_pm = 'AM'
    elif hr < 12:
        hr_str = str(hr)
        am_pm = 'AM'
    elif hr == 12:
        hr_str = str(hr)
        am_pm = 'PM'
    else:  # hr > 12
        hr_str = str(hr-12)
```

```
22        am_pm = 'PM'
23   return hr_str + ':' + min_str + ' ' + am_pm
24
25 print(time_conversion(hr, min))
```

Dry Run

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

hr	min	min_str	hr_str	am_pm
0	23	'23'	'12'	'AM'
return '12:23 AM'				

hr	min	min_str	hr_str	am_pm
12	0	'00'	'12'	'PM'
return '12:00 PM'				

3. Learning about Power

Your younger brother has just entered grade 4 and is learning about exponents for the first time. However, he doesn't quite have a good grasp on it and wants you to print out a sheet containing the answers to numbers raised to a power.

To accomplish this, you have decided to make a function, `power`, that takes in two integers, `X` and `N`, as parameters and returns a string statement of the form "X raised to N equals X ** N" where X, N, and X ** N are replaced with their values.

Write the described function.

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 is a single string of the form "X raised to N equals X ** N".

Sample

Input	Output
5 3	"5 raised to 3 equals 125"
2 1	"2 raised to 1 equals 2"

In the first case, $(X, N) = (5, 3)$. The function calculates the value of 5**3 and outputs a string.

In the second case, $(X, N) = (2, 1)$. The function calculates the value of 2**1 and outputs a string.

Exercise

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

Input	Output
12 2	"12 raised to 2 equals 144"
10 10	"10 raised to 10 equals 10000000000"
100 4	"100 raised to 4 equals 100000000"

Problem Identification

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

Input: X, N
Output: A string indicating the value of `X ** N`.

Pseudocode

After defining the function, make sure to call it and print its result. You may assume that input has already been taken.

```
def power(X,N):
    power = X**N
    return str(X) + ' raised to ' + str(N) + ' equals ' + str(power)

print(power(X,N))
```

Dry Run

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

X	N	power
12	2	144
return '12 raised to 2 equals 144'		

X	N	power
10	10	10000
return '10 raised to 10 equals 10000'		

4. Count It!

The local newspaper has started doing a "letter of the week" where they randomly select an English alphabet to call it the letter of that week. As of now, this new feature is barebones and just serves to take up space on the newspaper. You've been thinking of ways on how to make this atleast a little bit more interesting to readers. One way you thought of is giving statistics on how often that letter was used in that week's newspaper.

To accomplish this, you will make a function called `letter_freq` that takes two string parameters, `text` and `letter`, and returns an integer denoting the number of appearances of *letter* in *text*.

Write the described function.

Constraints

- `len(letter) == 1`
- `len(text) >= 0`

Interaction

The input comprises of two lines; the first line contains a string `text` and the second line contains a character `letter`.

The output must be a single integer denoting the number of appearances of the `letter` in the string `text`.

Sample

Input	Output
"welcome to algorithmic problem solving" "e"	3
"how have you been feeling?" "h"	2

In the first case, the letter "e" appears 3 times in the given string.

In the second case, the letter "h" appears 2 times in the given string.

Exercise

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

Input	Output
"now i am become death, the destroyer of worlds" "e"	6
"was it all a dream?" "i"	1
"we love programming." "x"	0

Problem Identification

Input: `text, letter`
Output: The number of occurrences of `letter` in `text`

Pseudocode

After defining the function, make sure to call it and print its result. You may assume that input has already been taken.

```
def letter_freq(text, letter):
    count = 0
    for c in text:
        if c == letter:
            count += 1
    return count

print(letter_freq(text, letter))
```

Dry Run

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

text	letter	c	count
'was it all a dream?'	'i'		0
		'w'	0
		'a'	0
		's'	0
		' '	0
		'i'	1
		't'	1
		' '	1
		'a'	1
		'l'	1
		'l'	1
		' '	1
		'a'	1
		' '	1
		'd'	1
		'r'	1
		'e'	1
		'a'	1
		'm'	1
		'?'	1
return 1			

text	letter	c	count
'we love programming.'	'x'		0
		'w'	0
		'e'	0
		' '	0
		'l'	0
		'o'	0
		'v'	0
		'e'	0
		' '	0
		'p'	0
		'r'	0
		'o'	0
		'g'	0
		'r'	0
		'a'	0
		'm'	0
		'm'	0
		'i'	0
		'n'	0
		'g'	0
		'.'	0
return 0			

5. Word Count

Your university wants to implement an automatic word counter for ensuring students are meeting the essay word counts. They've employed you for the task.

You are required to make a function, `word_count`, which takes a string parameter `text` and returns an integer denoting the number of words in `text`. Note that a word is separated by spaces on either side; the only exceptions being the first word which only has a space on the right and the last word which has a space on the left and a period on the right.

Write the described function.

Constraints

- `isinstance`(text, `str`)`== True`
- `text[0] != ' '`
- The last character in `text` is '.'
- Words in `text` are separated by a single space.
- `text` contains at least one word.

Interaction

The input comprises of a single line containing the string `text`.

The output must be a single integer denoting the number of words in `text`.

Sample

Input	Output
"I am sick."	3
"Always meet your essay word counts to avoid penalty."	9

In the first case, the string contains three words.

In the second case, the string contains nine words.

Exercise

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

Input	Output
"Maleeha's new puppy is a well-behaved and friendly dog."	9
"You die in the game, you die in real life."	10
"Never say never."	3

Problem Identification

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

Input: `text`
Output: The number of space-separated strings in `text`.

Pseudocode

After defining the function, make sure to call it and print its result. You may assume that input has already been taken.

```python
def word_count(text):
    count = 0
    for c in text:
        if c == ' ':
            count += 1
    count += 1  # the last word does not end with a space
    return count

print(word_count(text))
```

Dry Run

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

text	c	count
'You die in the game, you die in real life.'		0
	'Y'	0
	'o'	0
	'u'	0
	' '	1
	'd'	1
	'i'	1
	'e'	1
	' '	2
	'i'	2
	'n'	2
	' '	3
	't'	3
	'h'	3
	'e'	3
	' '	4
	'g'	4
	'a'	4
	'm'	4
	'e'	4
	','	4
	' '	5
	'y'	5
	'o'	5
	'u'	5
	' '	6
	'd'	6
	'i'	6
	'e'	6
	' '	7
	'i'	7
	'n'	7
	' '	8
	'r'	8
	'e'	8
	'a'	8
	'l'	8
	' '	9
	'l'	9
	'i'	9
	'f'	9
	'e'	9
	'.'	9
		10
return 10		

text	c	count
'Never say never.'		0
	'N'	0
	'e'	0
	'v'	0
	'e'	0
	'r'	0
	' '	1
	's'	1
	'a'	1
	'y'	1
	' '	2
	'n'	2
	'e'	2
	'v'	2
	'e'	2
	'r'	2
	'.'	2
	'.'	3
return 3		

6. Temperature Classification

Your friend is a bit sensitive to temperature. So sensitive in fact that she has to carry a bag with her to pull out clothes from if it's too cold or put clothes in if it's too hot. She says her clothing depends on the following categories of temperature: "Hot", "Warm", "Mild", "Cool", and "Cold". These five categories correspond to the following ranges of temperature: "Hot" is anything equal or higher than 45C, "Warm" is (40,45), "Mild" is (30,40], "Cool" is (25,30], and "Cold" is anything equal or less than 25C.

You've decided to make your friend's life easier by making a program where your friend can enter the schedule of her day and it will automatically tell her what categories of temperature she will encounter so she doesn't need to unnecessarily pack. To start off with this, you first need a function that classifies the temperature according to your friend's categories.

Write a function, `temp_classify`, which takes an integer parameter, T, and returns a string denoting the category which the temperature corresponds to.

Constraints

- $T \in \mathbb{Z}$
- $-273 \leq T \leq 10^5$

Interaction

The input comprises a single line containing a single number denoting the value of T.

The output must be one of the following five strings: "Hot", "Warm", "Mild", "Cool", or "Cold".

Sample

Input	Output
52	"Hot"
30	"Cool"

In the first case, $T = 52$, which corresponds to "Hot".

In the second case, $T = 30$, which corresponds to "Cool".

Exercise

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

Input	Output
25	"Cold"
45	"Hot"
40	"Warm"

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

Input: T
Output: The temperature classification of T as per the defined ranges.

Pseudocode
After defining the function, make sure to call it and print its result. You may assume that input has already been taken.

```
1  def temp_classify(T):
2    if T <= 25:
3        temp_str = 'Cold'
4    elif T <= 30:
5        temp_str = 'Cool'
6    elif T <= 40:
7        temp_str = 'Mild'
8    elif T < 45:
9        temp_str = 'Warm'
10   else:
11       temp_str = 'Hot'
12   return temp_str
13
14 print(TempClassify(T))
```

Dry Run

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

T	temp_str
25	'Cold'
return 'Cold'	

T	temp_str
45	'Hot'
return 'Hot'	

7. Currency Exchange

You are looking to purchase a video game on a digital platform. However, the game is only available in USD and you need to know the cost equivalent in PKR.

To accomplish this, you've decided to make a function, `usd_to_pkr`, which takes in numeric parameters, N, the cost of the game in USD, and R, the exchange rate, i.e. USD $1 = $ PKR R. The function returns the PKR amount corresponding to USD N under the rate, R.

Write the described function.

Constraints

- $N, R \in \mathbb{N}$.
- $0 < R, N \le 10^5$

Interaction

The input comprises of a single line containing two space separated numbers denoting the values of N and R respectively.

The output must be a single number denoting the PKR equivalent value of USD N as per the conversion rate, R..

Sample

Input	Output
10 287	2870
3 304	912

In the first case, USD 10 and a rate of 297 yield PKR 2870.

In the second case, USD 3 and a rate of 304 yield PKR 912.

Proposed Solution

```python
def usd_to_pkr(N, R):
  pkr = N * R
  print(pkr)

print(usd_to_pkr(N, R))
```

Dry Run

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

N	R	pkr
10	287	2870
return None		

N	R	pkr
3	304	912
return None		

Error Identification

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

> Line 3: Should `return` instead of `print`.

Correct Solution

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

> Line 3: `return pkr`

8. Remembering Pythagoras

Your school is holding a small event celebrating Pythagoras and his contributions to mathematics. Volunteering students are to make projects related to the Pythagorean theorem and present them. The best project will win a cash prize. You've decided to work on the distance formula, which is derived from the Pythagorean theorem.

As most of your peers are working on traditional mediums such as chart paper, you've decided to write a python program to stand out. You've decided to make a function called `distance_formula` that takes in 4 integer parameters, x_1, y_1, x_2, and y_2 and returns an integer denoting the distance between the points (x_1, y_1) and (x_2, y_2) in the xy-coordinate plate.

Given values of x_1, y_1, x_2, and y_2, give the output of the function DistanceFormula(x_1, y_1, x_2, y_2) for those values.

Constraints

- $x_1, y_1, x_2, y_2 \in \mathbb{Z}$
- $-10^5 \le x_1, y_1, x_2, y_2 \le 10^5$

Interaction

The input comprises a single line containing 4 space-separated integers denoting the values of x_1, y_1, x_2, and y_2 respectively.

The output must contain a single number denoting the distance between the points (x_1, y_1) and (x_2, y_2) in the xy-coordinate plate.

Sample

Input	Output
4 5 1 3	3.605551275464
1 2 2 1	1.4142135623731

In the first case, $(x_1, y_1) = (4, 5)$ and $(x_2, y_2) = (1, 3)$. The distance is 3.605551275464.

In the second case, $(x_1, y_1) = (1, 2)$ and $(x_2, y_2) = (2, 1)$. The distance is 1.4142135623731.

Proposed Solution

```python
def distance_formula(x1, y1, x2, y2):
    dist_sq =  (x2 - x1)**2 + (y2 - y1)**2
    dist = dist_sq ** 1/2
    return dist

print(distance_formula(x1, y1, x2, y2))
```

Dry Run

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

x1	y1	x2	y2	dist_sq	dist
4	5	1	3	13	6.5
return 6.5					

x1	y1	x2	y2	dist_sq	dist
1	2	2	1	2	1.0
return 1.0					

Error Identification

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

Line 3: `1 / 2` should be `(1 / 2)`

Correct Solution

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

Line 3: `dist = dist_sq ** (1 / 2)`