831. Masking Personal Information

Medium

phone number, and each has specific rules for masking.

This problem involves designing an algorithm to mask personal information. Personal information can be an email address or a

**Email Address Masking Rules:** • Transform all uppercase letters in the name and domain parts of the email address to lowercase.

String

**Problem Description** 

**Phone Number Masking Rules:** 

Mask all but the first and last letter of the name part with five asterisks (\*\*\*\*\*\*).

• Remove all separation characters (which may include +, -, (, ), and spaces) to only retain digits.

## • Format the number based on the leftover digit count after the local number (last 10 digits). The formatting is as follows:

- If there is no country code, the format is \*\*\*-\*\*\*-XXXX, where XXXX is the last four digits of the local number. If there is a country code, it should be represented by the same number of asterisks as digits, followed by the formatted local number \*\*\*-\*\*\*-XXXX.
- The algorithm must identify whether the provided string is an email or a phone number and mask it accordingly.
- The intuition behind solving this problem starts with identifying if the given s is an email address or a phone number. This can

### usually be identified by the presence of alphabetic characters and the special character @. If s [0] is an alphabetic character, it is an email, otherwise it's a phone number.

# For an email address:

Intuition

1. Convert the entire string to lowercase to satisfy the case-insensitivity requirement. 2. Replace the middle part of the name with five asterisks, but maintain the first character, the character before the @, and the complete domain after the @.

For a **phone number**: 1. Remove all separation characters by filtering out non-digit characters, leaving only the digits.

country code with asterisks.

- The implementation of the masking algorithm can be broken down into several steps and patterns used throughout the code:
- Solution Approach

2. The number of characters remaining after the last 10 gives us the number of digits in the country code. Depending on this count, mask the

3. The last 4 digits of the local number remain unmasked, while the others are replaced by asterisks, keeping consistent with the \*\*\*-\*\*\*- prefix.

**Determining the Type of Personal Information**: The algorithm first checks if the given string s represents an email address or a phone number. This is done by checking the first character of the string:

# If the first character is an alphabetical letter, it is an email address; otherwise, it is a phone number.

if s[0].isalpha():

**Email Masking:** 

- All characters of the email address are converted to lowercase using lower() to ensure case insensitivity. The first and the last character of the name part, along with the domain, are preserved. The middle part of the name is replaced with five asterisks (\*\*\*\*\*\*). return s[0] + '\*\*\*\*\* + s[s.find('@') - 1 :]
- **Phone Number Masking:** All non-digit characters are filtered out, leaving only digits in the string:
- - The algorithm calculates the length of the country code by subtracting 10 from the total length of the filtered digits. This is because the local number always consists of the last 10 digits.
  - used to handle different lengths of country codes: cnt = len(s) - 10suf = '\*\*\*-\*\*\*-' + s[-4:]

Given the email ExampleEmail@LeetCode.com, let's apply the solution approach:

Given the phone number +1 (234) 567-8901, let's apply the solution approach:

After following these steps, we get the masked phone number: \* \*\*\*-\*\*\*-8901.

1. Since the first character 'E' is an alphabetical letter, we identify the string as an email address.

return suf if cnt == 0 else f'+{"\*" \* cnt}-{suf}'

complexity, where n is the length of the input string.

2. Convert the email to lowercase: exampleemail@leetcode.com.

1. The first character '+' indicates it's a phone number.

s = ''.join(c for c in s if c.isdigit())

string concatenation to assemble the masked personal information. It uses the compactness of Python's string formatting to keep the code concise and readable. There is no explicit usage of complex data structures as the operations are basic string manipulations. This approach is efficient because it goes through the string at most two times: once to either lower the case of

the characters (for emails) or filter digits (for phone numbers), and once to construct the masked string. This is essentially O(n)

In summary, the solution makes use of string methods (like lower() and find()), list comprehensions (to filter characters), and

A switch-like statement, using if-elif, is avoided. Instead, a more elegant formatting via an f-string and repetition of asterisk characters is

- **Example Walkthrough** Let's walk through a small example illustrating the solution approach for both an email and a phone number. **Email Example**
- 3. Preserve the first and the last character of the name part and the entire domain: 'e' and 'l' are the two characters we preserve from exampleemail. 4. Replace the middle part of the name with five asterisks: e\*\*\*\*\*l@leetcode.com. After following these steps, we get the masked email address: e\*\*\*\*\*l@leetcode.com. **Phone Number Example**

4. Replace the country code with an asterisk and apply the standard mask for the remaining number, preserving the last four digits: \* \*\*\*-

applies the respective masking rules to conceal personal information while following the specified format.

# Build the masked email with the first character, five asterisks, and the domain part

These two examples demonstrate how the algorithm distinguishes between email addresses and phone numbers and how it

### 2. Remove all non-digit characters, leaving only the digits: 12345678901. 3. Identify the country code, which in this case is '1', by counting the digits beyond the last 10, which gives us 1 digit here.

Solution Implementation

\*\*\*-8901.

class Solution:

**Python** 

def maskPII(self, string: str) -> str: # Check if the string contains an email address by looking for an alphabetic character at the start if string[0].isalpha():

masked email = string[0] + '\*\*\*\*\*' + string[string.find('@') - 1:]

string = string.lower() # Convert the email to lowercase

return masked email # If it's not an email, assume it's a phone number else: # Remove all non-digit characters from the string digits only = ''.join(c for c in string if c.isdigit())

# Output: "\*\*\*-\*\*\*-7890"

# Output: "+\*-\*\*\*-\*\*\*-7890"

# If there are extra digits (international format), add the country code mask else: return f'+{"\*" \* extra\_digits\_count}-{phone\_suffix}'

# print(solution.maskPII("John.Doe@example.com")) # Output: "j\*\*\*\*e@example.com"

// Check if the first character is a letter to determine if it's an email

// Create a masked email with the first character, five stars, and the domain part

// Convert the entire input string to lower case for uniformity

return input.charAt(0) + "\*\*\*\*\*" + input.substring(atIndex - 1);

// StringBuilder to hold only the digits from the input (phone number)

# Count the number of digits beyond the local 10-digit format

# If there are no extra digits, return the standard format

extra digits count = len(digits only) - 10

if extra digits count == 0:

return phone suffix

# print(solution.maskPII("1(234)567-890"))

public String maskPII(String input) {

if (Character.isLetter(input.charAt(0))) {

int atIndex = input.index0f('@');

// Find the index of the '@' symbol in the email

StringBuilder digitBuilder = new StringBuilder();

input = input.toLowerCase();

maskedEmail += tolower(s[0]);

maskedEmail += tolower(s[j]);

// If "@" is not found, it's a phone number.

int countryCodeLength = digits.size() - 10;

// Determine how many digits are in the country code.

// Create the suffix for the standard 10-digit mask.

// If there's no country code, return just the suffix.

string suffix = "\*\*\*-\*\*\*-" + digits.substr(digits.size() - 4);

// If there's a country code, prepend it with masks.

string countryCodeMask = "+" + string(countryCodeLength, '\*') + "-";

return countryCodeMask + suffix; // Full masked string with country code.

// Extract all digits from the string.

maskedEmail += "\*\*\*\*\*";

return maskedEmail;

if (isdigit(c)) {

digits += c;

if (countryCodeLength == 0) {

return suffix;

} else {

string digits;

for (char c : s) {

// Append 5 asterisks to hide part of the local name.

for (size t i = atPosition - 1; i < s.size(); ++j) {</pre>

// Convert from before '@' to lowercase and append the domain.

# Create a suffix for the masked phone number

phone suffix = \*\*\*-\*\*\*- + digits only[-4:]

```
# print(solution.maskPII("+1(234)567-890"))
Java
```

# Example usage:

class Solution {

# solution = Solution()

```
// Loop through the characters in the input
        for (char c : input.toCharArray()) {
            // Append only if the character is a digit
            if (Character.isDigit(c)) {
                digitBuilder.append(c);
        // Convert the StringBuilder to a string containing only digits
        String digits = digitBuilder.toString();
        // Calculate the number of digits that are in the international code
        int internationalCodeLength = digits.length() - 10;
        // Create a masked string for the last 7 digits of the phone number
        String maskedSuffix = "***-***-" + digits.substring(digits.length() - 4);
        // Depending on whether there is an international code, mask the phone number appropriately
        if (internationalCodeLength == 0) {
            // If there's no international code, return just the masked U.S. number
            return maskedSuffix;
        } else {
            // If there's an international code, mask it and append the U.S. number
            String starsForInternational = "+":
            for(int i = 0; i < internationalCodeLength; i++) {</pre>
                starsForInternational += "*";
            return starsForInternational + "-" + maskedSuffix;
C++
#include <cctype> // include ctype for using tolower, isdigit functions
#include <string> // include string for using string class
using namespace std;
class Solution {
public:
    /**
     * @param s: The original string, either an email or a phone number.
     * @return: The masked string with PIIs (Personally Identifiable Information) hidden.
     */
    string maskPII(string s) {
        // Find the position of '@', which indicates an email.
        size t atPosition = s.find('@');
        // If "@" is found, mask it as an email.
        if (atPosition != string::npos) {
            string maskedEmail:
            // Convert first character to lowercase and append.
```

```
TypeScript
function maskPII(s: string): string {
    // Find the index of '@' to determine if it's an email.
    const atIndex: number = s.index0f('@');
    if (atIndex !== -1) {
        // If it's an email, mask the characters between the first character and the '@' symbol.
        let maskedEmail: string = s[0].toLowerCase() + '*****';
        for (let j: number = atIndex - 1; j < s.length; j++) {</pre>
            maskedEmail += s.charAt(j).toLowerCase();
        return maskedEmail;
    // If it's not an email, build a string containing only the digits from the input.
    let numericString: string = '';
    for (const char of s) {
        if (/\d/.test(char)) { // Check if the character is a digit.
            numericString += char;
    // Compute the count of digits to be replaced by '*' in the case there are country codes.
    const countryCodeStarsCount: number = numericString.length - 10;
    // The suffix for the phone number hiding the first 6 digits, revealing only the last 4.
    const maskedPhoneSuffix: string = x**-**- {numericString.substring(numericString.length - 4)};
    // Return the masked phone number with country code as '*' if there is a country code.
    return countryCodeStarsCount === 0 ? maskedPhoneSuffix : `+${'*'.repeat(countryCodeStarsCount)}-${maskedPhoneSuffix}`;
class Solution:
    def maskPII(self, string: str) -> str:
        # Check if the string contains an email address by looking for an alphabetic character at the start
        if string[0].isalpha():
            string = string.lower() # Convert the email to lowercase
            # Build the masked email with the first character, five asterisks, and the domain part
            masked email = string[0] + '*****' + string[string.find('@') - 1:]
            return masked email
        # If it's not an email, assume it's a phone number
        else:
            # Remove all non-digit characters from the string
            digits only = ''.join(c for c in string if c.isdigit())
            # Count the number of digits beyond the local 10-digit format
            extra digits count = len(digits only) - 10
            # Create a suffix for the masked phone number
            phone suffix = ***-***- + digits only[-4:]
```

# **Time Complexity:**

Time and Space Complexity

else:

# Example usage:

# solution = Solution()

**Space Complexity:** 

Converting the string to lower case if it's an email: O(n), where n is the length of the string s. Finding the position of '@' in the string: 0(n) in the worst case, since it requires scanning the string in case of an email

The time complexity of the maskPII function is determined by several operations that the function performs:

address. Stripping non-digit characters and joining digits into a new string: 0(n), because each character of the original string s is checked once.

Checking whether the first character is alphabetical: 0(1), since it's a constant-time check on a single character.

# Output: "\*\*\*-\*\*\*-7890"

# Output: "+\*-\*\*\*-\*\*\*-7890"

- Constructing the masked string: The actual construction is 0(1) because we are appending fixed strings and characters to a masked result.
- Combining these, the time complexity is dictated by the string operations, which are linear in the length of the input string s. Therefore, the time complexity is O(n).

The space complexity is determined by the additional space used by the function:

# If there are no extra digits, return the standard format

return f'+{"\*" \* extra\_digits\_count}-{phone\_suffix}'

# print(solution.maskPII("John.Doe@example.com")) # Output: "j\*\*\*\*e@example.com"

# If there are extra digits (international format), add the country code mask

if extra digits count == 0:

return phone suffix

# print(solution.maskPII("1(234)567-890"))

# print(solution.maskPII("+1(234)567-890"))

- A new lower case email id string if s[0].isalpha(): O(n) space for the new string. The list comprehension that filters digits: O(n) space for the new list of characters before it is joined into a string.
  - The final masked string has a constant size related to the format of the phone number or email (0(1) space), not dependent on the input size.
  - Thus, the dominating factor is the creation of new strings, which takes 0(n) space. Hence, the space complexity is 0(n).