CSA0670-Design and Analysis of Algorithms for Tractability Problems.

Assignment

1. Two Sum

Given an array of integers nums and an integer target, return indices of the two numbers such that they add up to target. You may assume that each input would have exactly one solution, and you may not use the same element twice.

You can return the answer in any order.

Example 1:

Input: nums = [2,7,11,15], target = 9 Output: [0,1]

Explanation: Because nums[0] + nums[1] == 9, we return [0, 1].

Example 2: Input: nums = [3,2,4], target = 6 Output: [1,2] Example 3: Input: nums = [3,3], target = 6 Output: [0,1]

Constraints:

● 2 <= nums.length <= 104

● -109 <= nums[i] <= 109

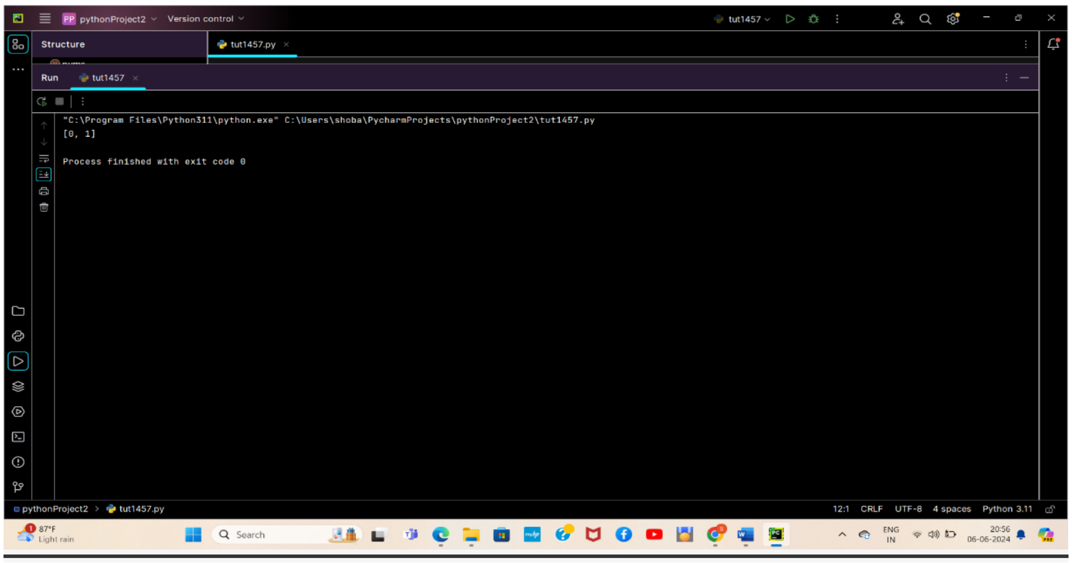
● -109 <= target <= 109

● Only one valid answer exists.

Program:

```python
def two_sum(nums, target):
    num_to_index = {}

    for index, num in enumerate(nums):
        complement = target - num

        if complement in num_to_index:
            return [num_to_index[complement], index]

        num_to_index[num] = index


nums = [2, 7, 11, 15]
target = 9
result = two_sum(nums, target)
print(result)   # Output: [0, 1]
```

Output:



```
"C:\Program Files\Python311\python.exe" C:\Users\shoba\PycharmProjects\pythonProject2\tut1457.py
[0, 1]

Process finished with exit code 0
```

2. Add Two Numbers You are given two non-empty linked lists representing two non-negative integers. The digits are stored in reverse order, and each of their nodes contains a single digit. Add the two

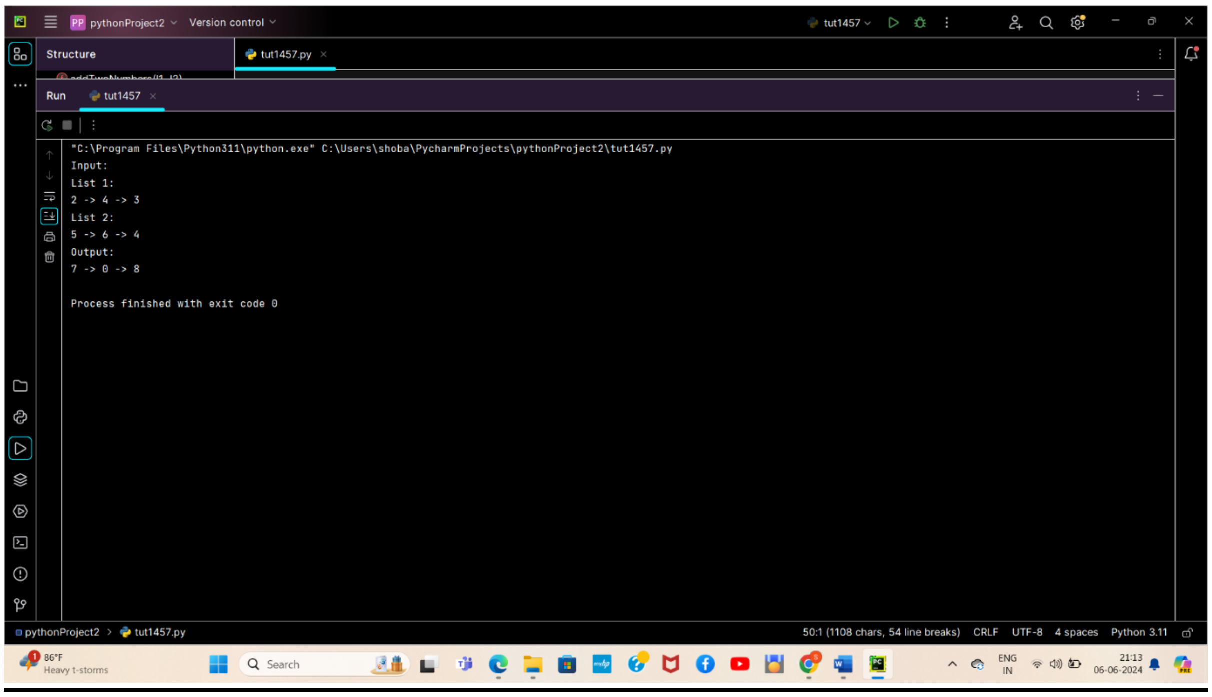
numbers and return the sum as a linked list. You may assume the two numbers do not contain any leading zero, except the number 0 itself.

Program:

```python
class ListNode:
    def __init__(self, val=0, next=None):
        self.val = val
        self.next = next


def addTwoNumbers(l1, l2):
    dummy_head = ListNode(0)
    current = dummy_head
    carry = 0

    while l1 or l2 or carry:
        val1 = l1.val if l1 else 0
        val2 = l2.val if l2 else 0
        total = val1 + val2 + carry
        carry = total // 10
        current.next = ListNode(total % 10)
        current = current.next

        if l1:
            l1 = l1.next
        if l2:
            l2 = l2.next

    return dummy_head.next


def create_linked_list(nums):
    dummy_head = ListNode(0)
    current = dummy_head
    for num in nums:
        current.next = ListNode(num)
        current = current.next
    return dummy_head.next


def print_linked_list(l):
    while l:
        print(l.val, end=" -> " if l.next else "\n")
        l = l.next

l1 = create_linked_list([2, 4, 3])
l2 = create_linked_list([5, 6, 4])

print("Input:")
print("List 1:")
print_linked_list(l1)
print("List 2:")
print_linked_list(l2)
```

```python
result = addTwoNumbers(l1, l2)

print("Output:")
print_linked_list(result)
```

Output:



```
"C:\Program Files\Python311\python.exe" C:\Users\shoba\PycharmProjects\pythonProject2\tut1457.py
Input:
List 1:
2 -> 4 -> 3
List 2:
5 -> 6 -> 4
Output:
7 -> 0 -> 8

Process finished with exit code 0
```

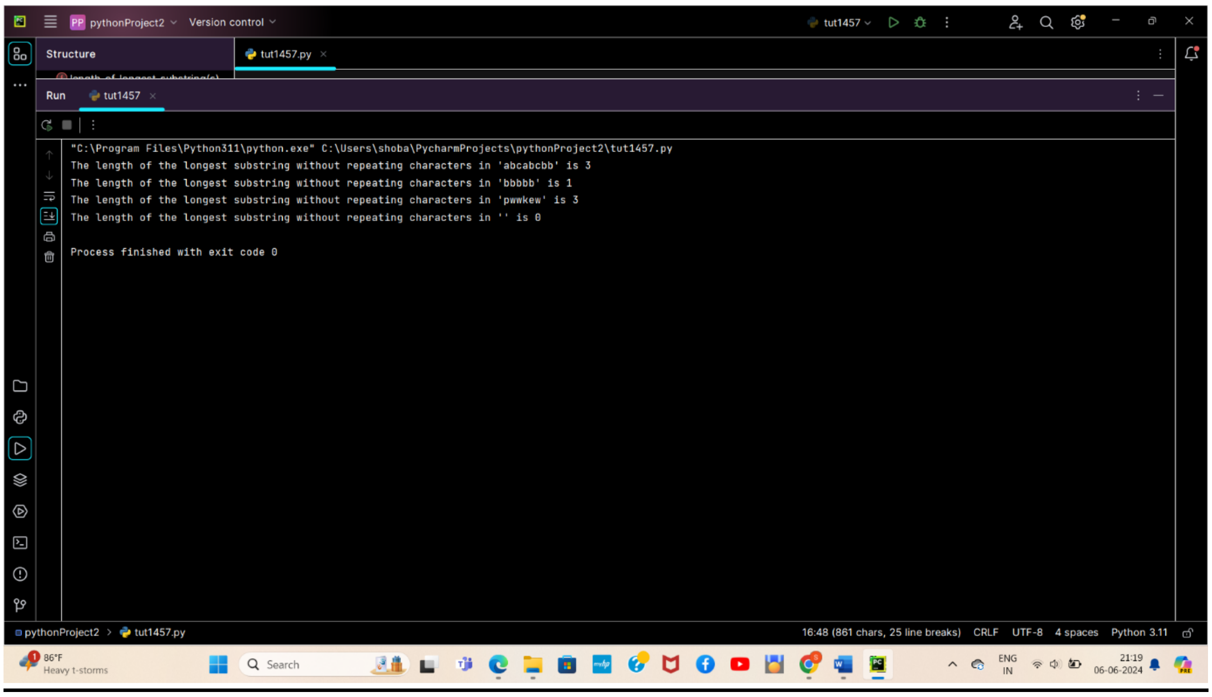
3. Longest Substring without Repeating Characters

Program:

```python
def length_of_longest_substring(s):
    char_index = {}
    start = 0
    max_length = 0

    for i, char in enumerate(s):
        if char in char_index and char_index[char] >= start:
            start = char_index[char] + 1
        char_index[char] = i
        max_length = max(max_length, i - start + 1)

    return max_length
```

```
s = "abcabcbb"
print(f"The length of the longest substring without repeating characters in
'{s}' is {length_of_longest_substring(s)}")

s = "bbbbb"
print(f"The length of the longest substring without repeating characters in
'{s}' is {length_of_longest_substring(s)}")

s = "pwwkew"
print(f"The length of the longest substring without repeating characters in
'{s}' is {length_of_longest_substring(s)}")

s = ""
print(f"The length of the longest substring without repeating characters in
'{s}' is {length_of_longest_substring(s)}")
```

Output:



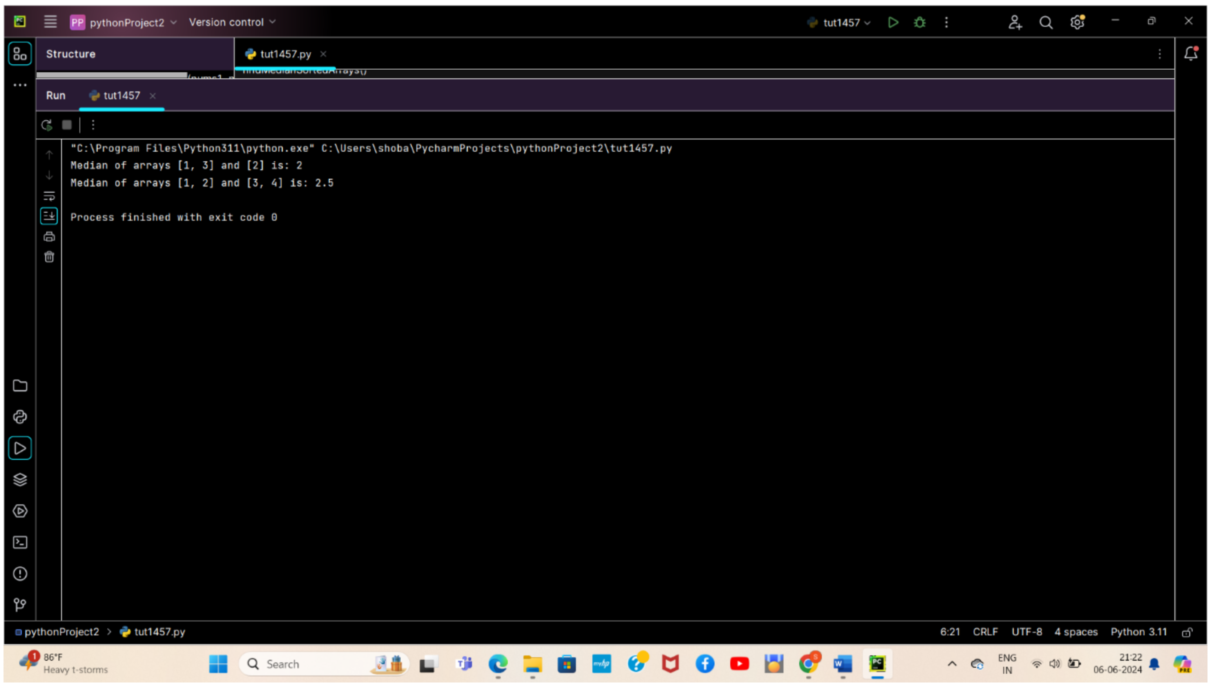
```
"C:\Program Files\Python311\python.exe" C:\Users\shoba\PycharmProjects\pythonProject2\tut1457.py
The length of the longest substring without repeating characters in 'abcabcbb' is 3
The length of the longest substring without repeating characters in 'bbbbb' is 1
The length of the longest substring without repeating characters in 'pwwkew' is 3
The length of the longest substring without repeating characters in '' is 0

Process finished with exit code 0
```

4. Median of Two Sorted Arrays.

Program:

```python
def findMedianSortedArrays(nums1, nums2):
    if len(nums1) > len(nums2):
        nums1, nums2 = nums2, nums1

    x, y = len(nums1), len(nums2)
    low, high = 0, x

    while low <= high:
        partitionX = (low + high) // 2
        partitionY = (x + y + 1) // 2 - partitionX

        maxX = float('-inf') if partitionX == 0 else nums1[partitionX - 1]
        minX = float('inf') if partitionX == x else nums1[partitionX]

        maxY = float('-inf') if partitionY == 0 else nums2[partitionY - 1]
        minY = float('inf') if partitionY == y else nums2[partitionY]

        if maxX <= minY and maxY <= minX:
            if (x + y) % 2 == 0:
                return (max(maxX, maxY) + min(minX, minY)) / 2
            else:
                return max(maxX, maxY)
        elif maxX > minY:
            high = partitionX - 1
        else:
            low = partitionX + 1

    raise ValueError("Input arrays are not sorted")


nums1 = [1, 3]
nums2 = [2]

print("Median of arrays {} and {} is: {}".format(nums1, nums2,
findMedianSortedArrays(nums1, nums2)))

nums1 = [1, 2]
nums2 = [3, 4]

print("Median of arrays {} and {} is: {}".format(nums1, nums2,
findMedianSortedArrays(nums1, nums2)))
```

Output:



```
"C:\Program Files\Python311\python.exe" C:\Users\shoba\PycharmProjects\pythonProject2\tut1457.py
Median of arrays [1, 3] and [2] is: 2
Median of arrays [1, 2] and [3, 4] is: 2.5

Process finished with exit code 0
```

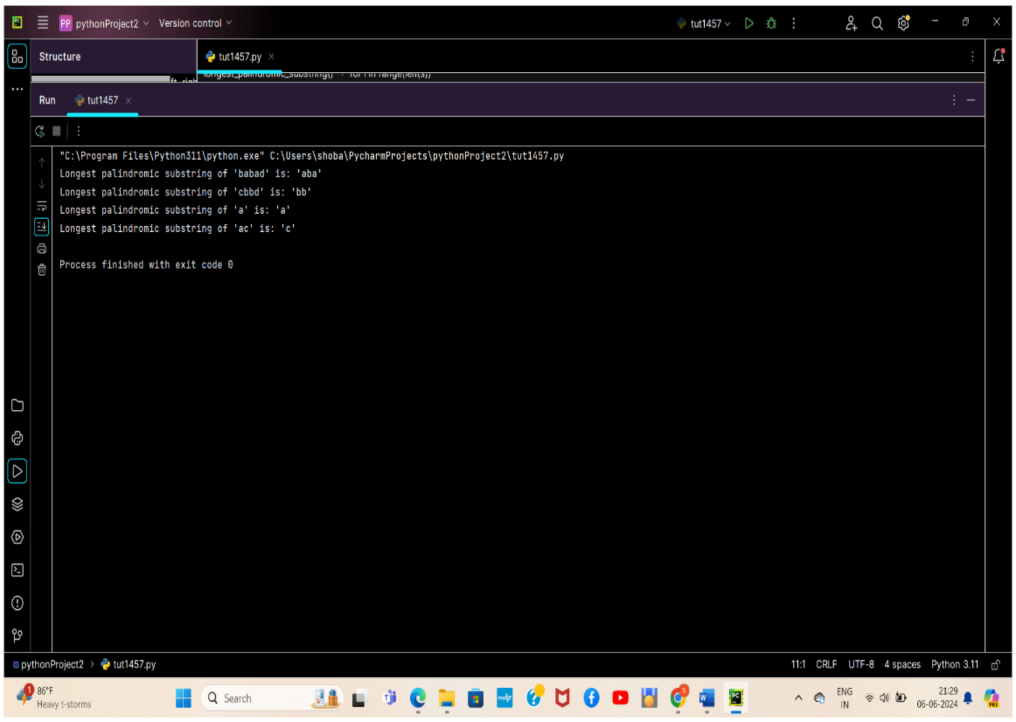
5. Longest Palindromic Substring.

Program:

```
def longest_palindromic_substring(s):
    if not s:
        return ""

    start, end = 0, 0

    for i in range(len(s)):
        len1 = expand_around_center(s, i, i)
        len2 = expand_around_center(s, i, i + 1)
        max_len = max(len1, len2)

        if max_len > (end - start):
            start = i - (max_len - 1) // 2
            end = i + max_len // 2

    return s[start:end + 1]


def expand_around_center(s, left, right):
    while left >= 0 and right < len(s) and s[left] == s[right]:
        left -= 1
        right += 1
    return right - left - 1
s = "babad"
print("Longest palindromic substring of '{}' is: '{}'".format(s,
longest_palindromic_substring(s)))
```

```python
s = "cbbd"
print("Longest palindromic substring of '{}' is: '{}'".format(s,
longest_palindromic_substring(s)))

s = "a"
print("Longest palindromic substring of '{}' is: '{}'".format(s,
longest_palindromic_substring(s)))

s = "ac"
print("Longest palindromic substring of '{}' is: '{}'".format(s,
longest_palindromic_substring(s)))
```

Output:



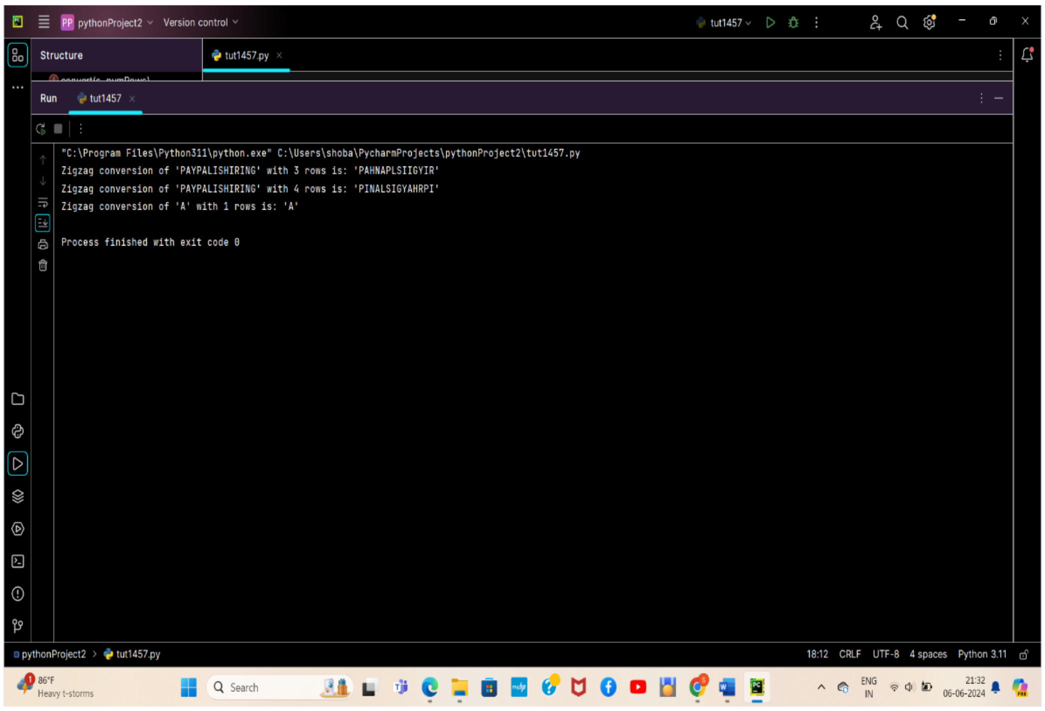
```
"C:\Program Files\Python311\python.exe" C:\Users\shoba\PycharmProjects\pythonProject2\tut1457.py
Longest palindromic substring of 'babad' is: 'aba'
Longest palindromic substring of 'cbbd' is: 'bb'
Longest palindromic substring of 'a' is: 'a'
Longest palindromic substring of 'ac' is: 'c'

Process finished with exit code 0
```

6. ZigZag Conversion.

Program:

```python
def convert(s, numRows):
    if numRows == 1 or numRows >= len(s):
        return s

    rows = [''] * numRows
    current_row = 0
    going_down = False

    for char in s:
        rows[current_row] += char
        if current_row == 0 or current_row == numRows - 1:
            going_down = not going_down
        current_row += 1 if going_down else -1

    return ''.join(rows)

s = "PAYPALISHIRING"
numRows = 3
print("Zigzag conversion of '{}' with {} rows is: '{}'".format(s, numRows,
convert(s, numRows)))

s = "PAYPALISHIRING"
numRows = 4
print("Zigzag conversion of '{}' with {} rows is: '{}'".format(s, numRows,
convert(s, numRows)))

s = "A"
numRows = 1
print("Zigzag conversion of '{}' with {} rows is: '{}'".format(s, numRows,
convert(s, numRows)))
```

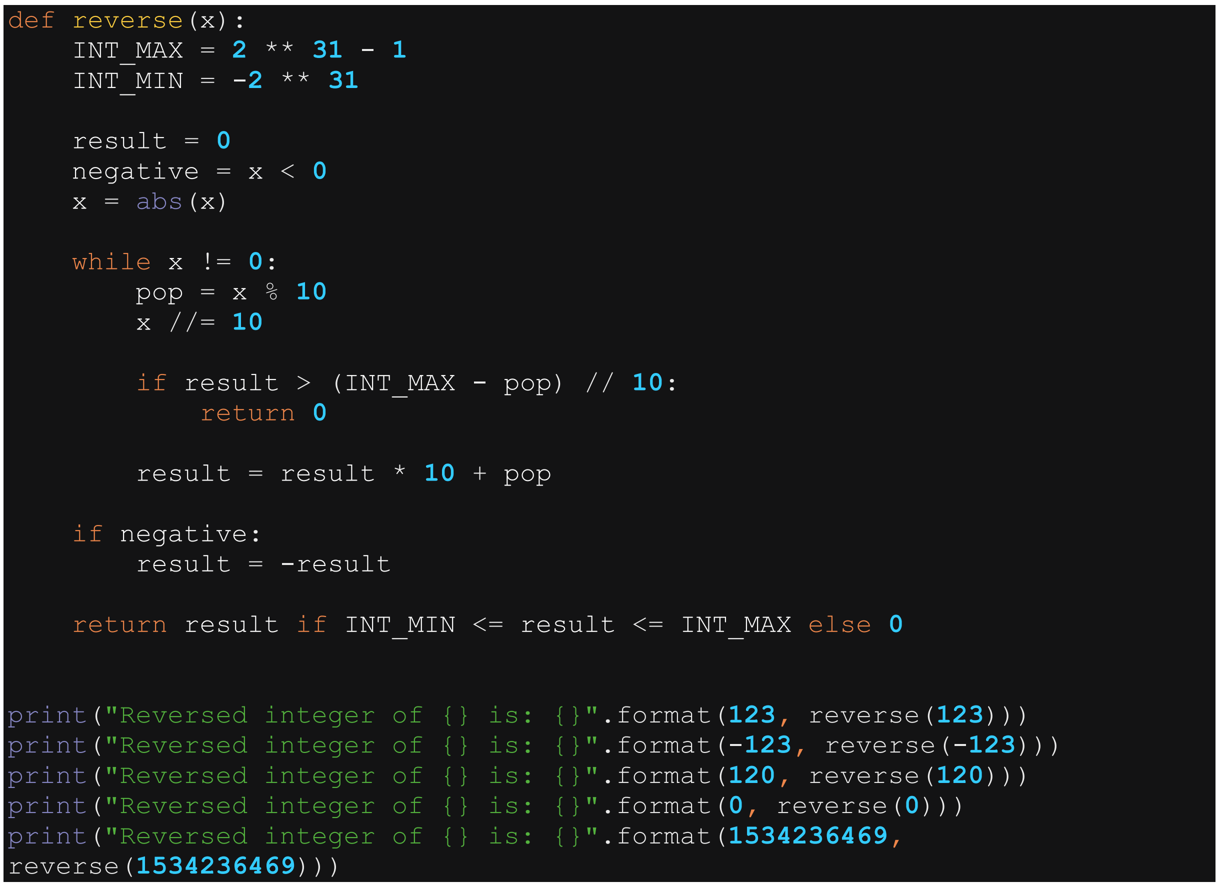
Output:



```
"C:\Program Files\Python311\python.exe" C:\Users\shoba\PycharmProjects\pythonProject2\tut1457.py
Zigzag conversion of 'PAYPALISHIRING' with 3 rows is: 'PAHNAPLSIIGYIR'
Zigzag conversion of 'PAYPALISHIRING' with 4 rows is: 'PINALSIGYAHRPI'
Zigzag conversion of 'A' with 1 rows is: 'A'

Process finished with exit code 0
```

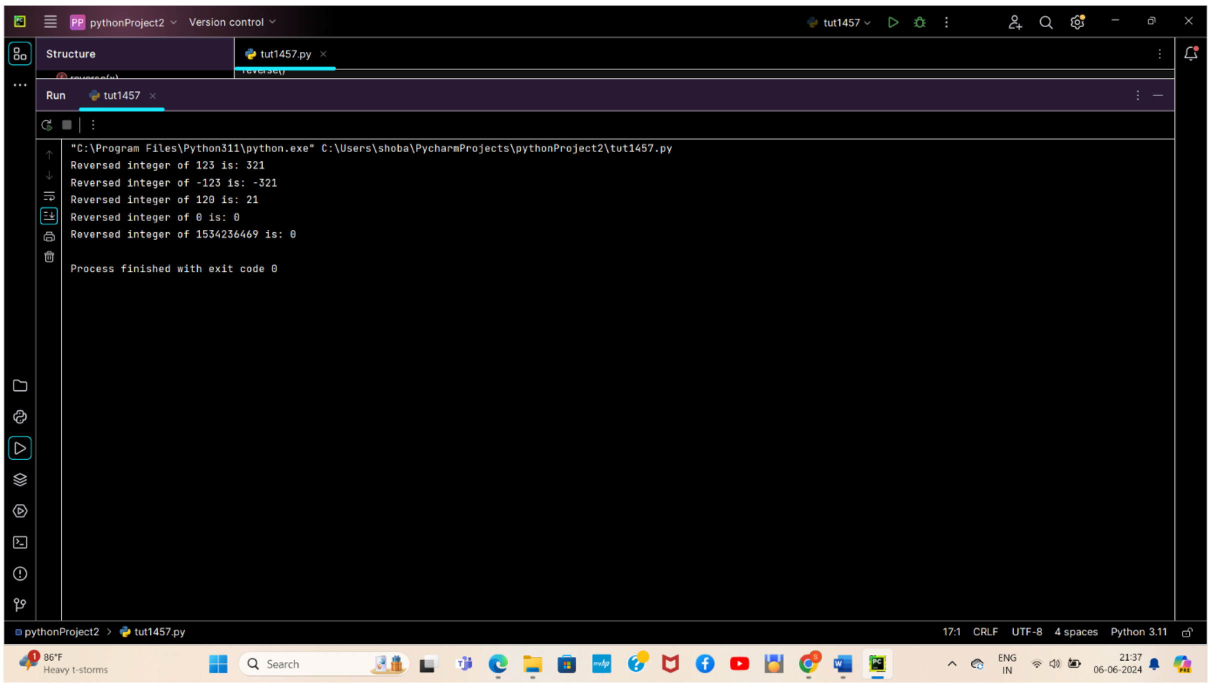
7. Reverse Integer.

Program:



```
def reverse(x):
    INT_MAX = 2 ** 31 - 1
    INT_MIN = -2 ** 31

    result = 0
    negative = x < 0
    x = abs(x)

    while x != 0:
        pop = x % 10
        x //= 10

        if result > (INT_MAX - pop) // 10:
            return 0

        result = result * 10 + pop

    if negative:
        result = -result

    return result if INT_MIN <= result <= INT_MAX else 0


print("Reversed integer of {} is: {}".format(123, reverse(123)))
print("Reversed integer of {} is: {}".format(-123, reverse(-123)))
print("Reversed integer of {} is: {}".format(120, reverse(120)))
print("Reversed integer of {} is: {}".format(0, reverse(0)))
print("Reversed integer of {} is: {}".format(1534236469,
reverse(1534236469)))
```

Output:



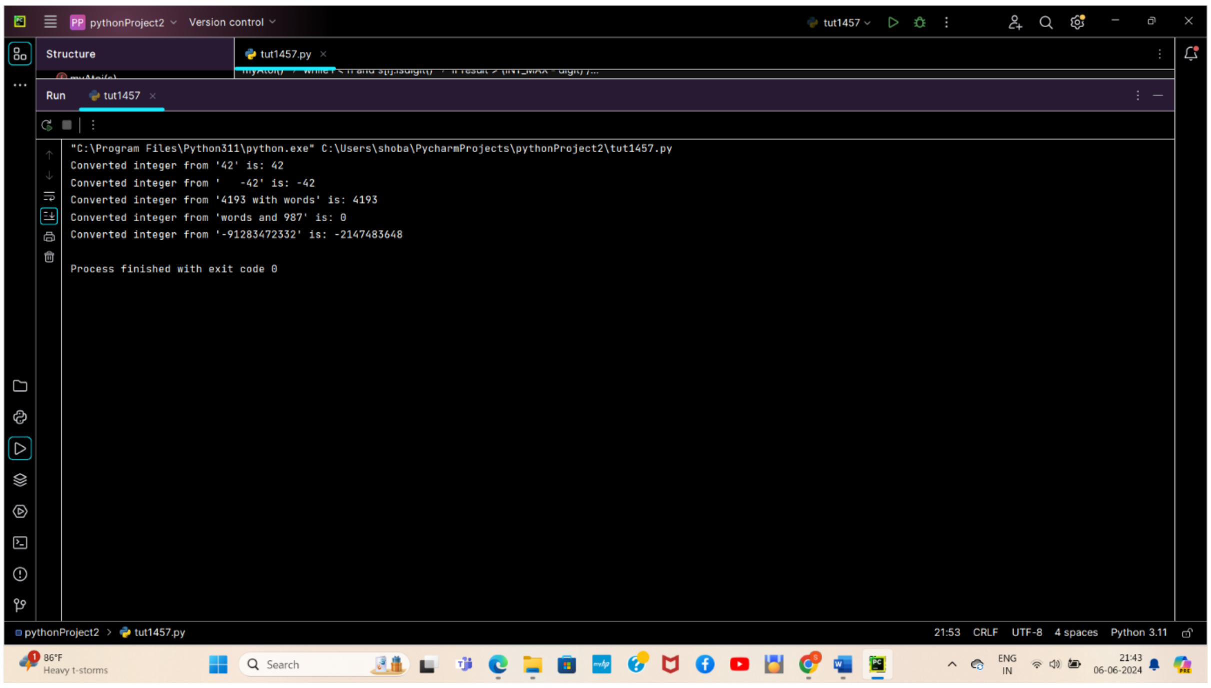
```
"C:\Program Files\Python311\python.exe" C:\Users\shoba\PycharmProjects\pythonProject2\tut1457.py
Reversed integer of 123 is: 321
Reversed integer of -123 is: -321
Reversed integer of 120 is: 21
Reversed integer of 0 is: 0
Reversed integer of 1534236469 is: 0

Process finished with exit code 0
```

8. String to Integer.

Program:

```python
def myAtoi(s):
    INT_MAX = 2**31 - 1
    INT_MIN = -2**31

    i = 0
    n = len(s)
    while i < n and s[i].isspace():
        i += 1

    sign = 1
    if i < n and s[i] == '-':
        sign = -1
        i += 1
    elif i < n and s[i] == '+':
        i += 1

    result = 0
    while i < n and s[i].isdigit():
        digit = int(s[i])
        if result > (INT_MAX - digit) // 10:
            return INT_MAX if sign == 1 else INT_MIN
        result = result * 10 + digit
        i += 1
    return sign * result

print("Converted integer from '{}' is: {}".format("42", myAtoi("42")))
print("Converted integer from '{}' is: {}".format("    -42", myAtoi("    -
42")))
print("Converted integer from '{}' is: {}".format("4193 with words",
myAtoi("4193 with words")))
print("Converted integer from '{}' is: {}".format("words and 987",
myAtoi("words and 987")))
print("Converted integer from '{}' is: {}".format("-91283472332", myAtoi("-
91283472332")))
```

Output:



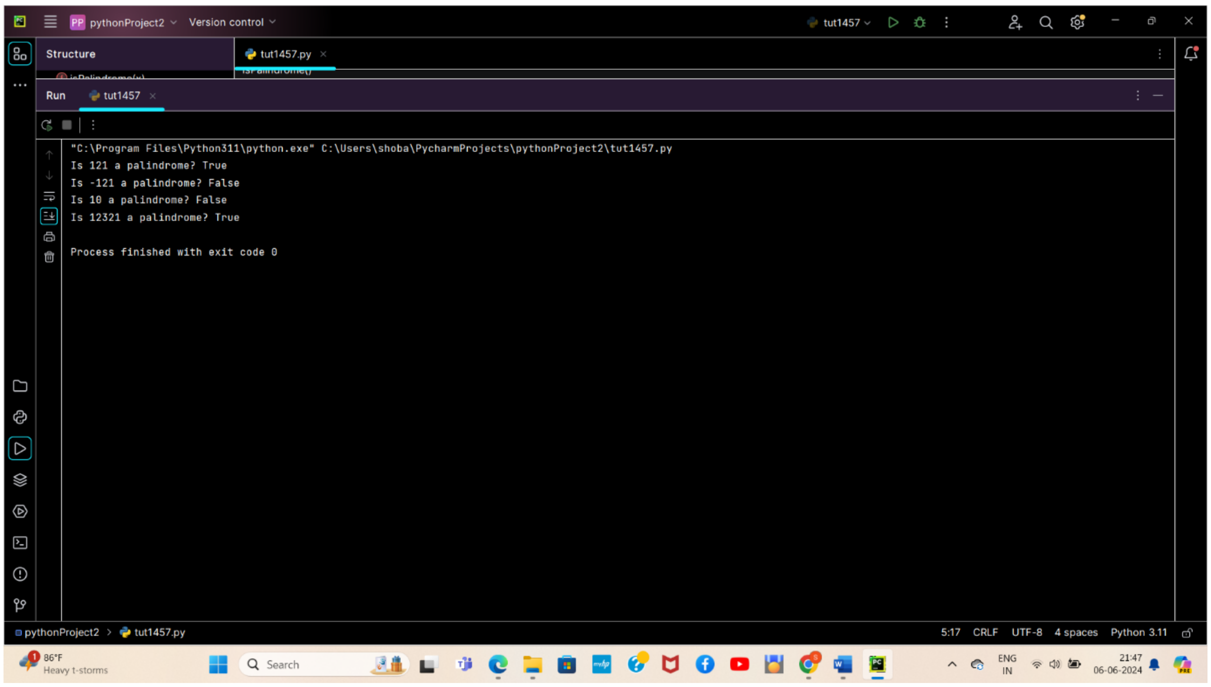
```
"C:\Program Files\Python311\python.exe" C:\Users\shoba\PycharmProjects\pythonProject2\tut1457.py
Converted integer from '42' is: 42
Converted integer from '   -42' is: -42
Converted integer from '4193 with words' is: 4193
Converted integer from 'words and 987' is: 0
Converted integer from '-91283472332' is: -2147483648

Process finished with exit code 0
```

9. Palindrome Number.

Program:

```python
def isPalindrome(x):
    if x < 0:
        return False
    original = x
    reversed_num = 0

    while x != 0:
        pop = x % 10
        x //= 10
        reversed_num = reversed_num * 10 + pop

    return original == reversed_num

print("Is {} a palindrome? {}".format(121, isPalindrome(121)))
print("Is {} a palindrome? {}".format(-121, isPalindrome(-121)))
print("Is {} a palindrome? {}".format(10, isPalindrome(10)))
print("Is {} a palindrome? {}".format(12321, isPalindrome(12321)))
```

Output:



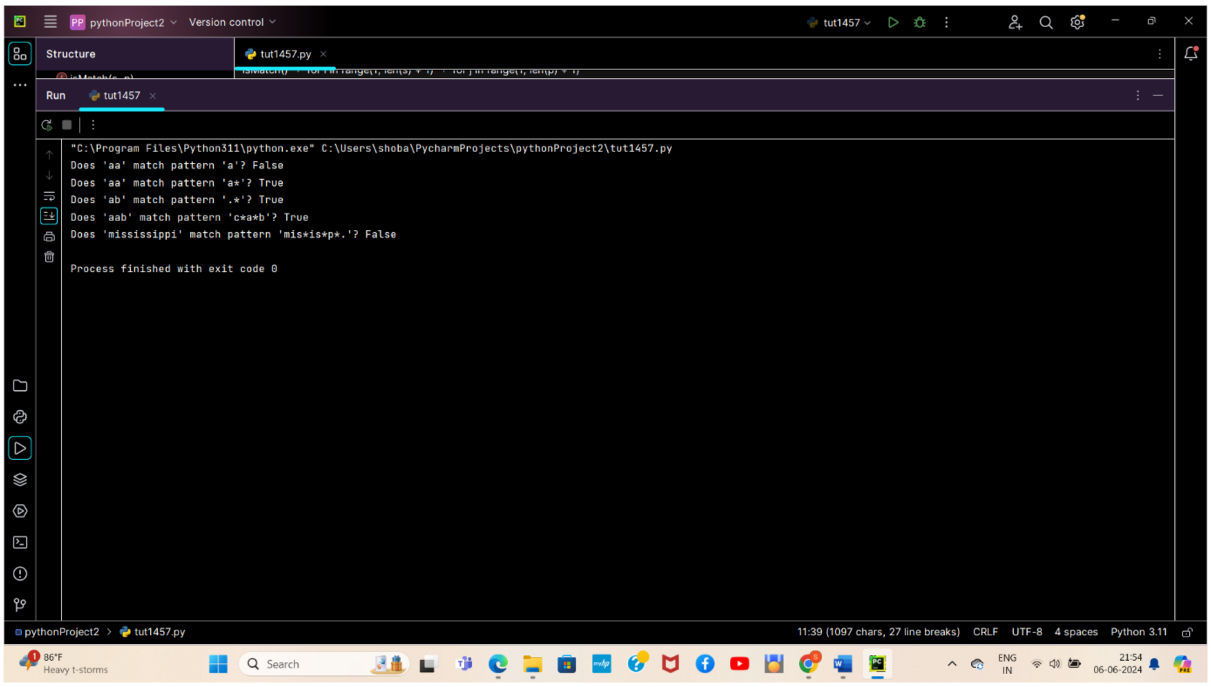
```
"C:\Program Files\Python311\python.exe" C:\Users\shoba\PycharmProjects\pythonProject2\tut1457.py
Is 121 a palindrome? True
Is -121 a palindrome? False
Is 10 a palindrome? False
Is 12321 a palindrome? True

Process finished with exit code 0
```

10. Regular Expression Matching.

Program:

```python
def isMatch(s, p):
    dp = [[False] * (len(p) + 1) for _ in range(len(s) + 1)]

    dp[0][0] = True
    for j in range(1, len(p) + 1):
        if p[j - 1] == '*':
            dp[0][j] = dp[0][j - 2]

    for i in range(1, len(s) + 1):
        for j in range(1, len(p) + 1):
            if p[j - 1] == '.' or p[j - 1] == s[i - 1]:
                dp[i][j] = dp[i - 1][j - 1]
            elif p[j - 1] == '*':
                dp[i][j] = dp[i][j - 2]
                if p[j - 2] == '.' or p[j - 2] == s[i - 1]:
                    dp[i][j] = dp[i][j] or dp[i - 1][j]

    return dp[len(s)][len(p)]


print("Does '{}' match pattern '{}'? {}".format("aa", "a", isMatch("aa",
"a")))
print("Does '{}' match pattern '{}'? {}".format("aa", "a*", isMatch("aa",
"a*")))
print("Does '{}' match pattern '{}'? {}".format("ab", ".*", isMatch("ab",
".*")))
print("Does '{}' match pattern '{}'? {}".format("aab", "c*a*b",
isMatch("aab", "c*a*b")))
print("Does '{}' match pattern '{}'? {}".format("mississippi",
"mis*is*p*.",
                                                isMatch("mississippi",
"mis*is*p*.")))
```

Output:



```
"C:\Program Files\Python311\python.exe" C:\Users\shoba\PycharmProjects\pythonProject2\tut1457.py
Does 'aa' match pattern 'a'? False
Does 'aa' match pattern 'a*'? True
Does 'ab' match pattern '.*'? True
Does 'aab' match pattern 'c*a*b'? True
Does 'mississippi' match pattern 'mis*is*p*.'? False

Process finished with exit code 0
```