# Problem 2: Add Two Numbers

## Problem Information

**Difficulty:** Medium
**Acceptance Rate:** 0.00%
**Paid Only:** No

## Problem Description

You are given two

non-empty

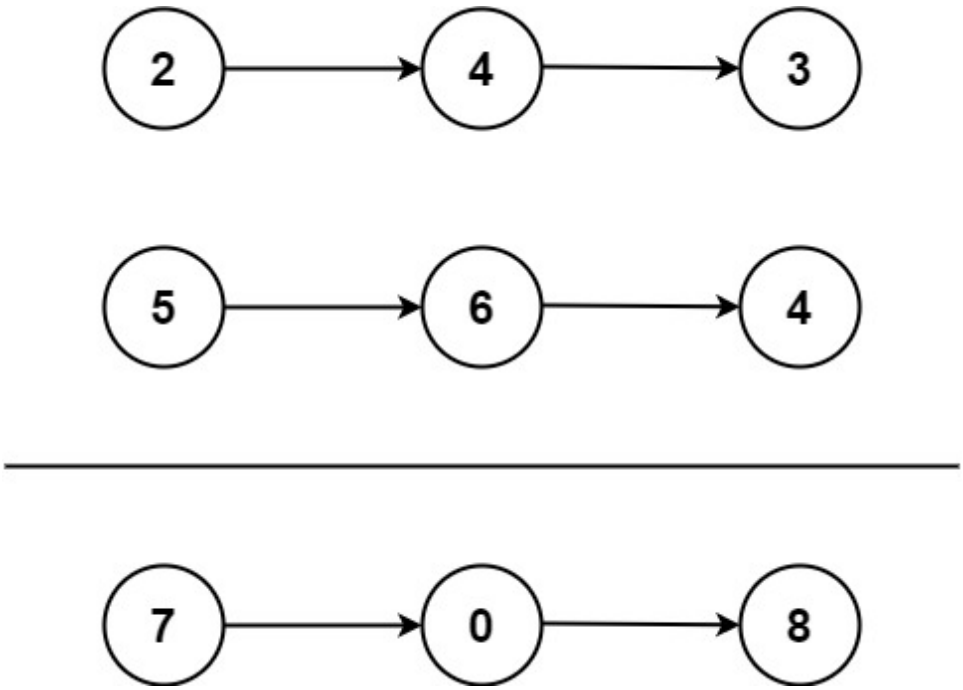
linked lists representing two non-negative integers. The digits are stored in

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.

Example 1:




Input:

l1 = [2,4,3], l2 = [5,6,4]

Output:

[7,0,8]

Explanation:

342 + 465 = 807.

Example 2:

Input:

l1 = [0], l2 = [0]

Output:

[0]

Example 3:

Input:

l1 = [9,9,9,9,9,9,9], l2 = [9,9,9,9]

Output:

[8,9,9,9,0,0,0,1]

Constraints:

The number of nodes in each linked list is in the range

[1, 100]

.

0 <= Node.val <= 9

It is guaranteed that the list represents a number that does not have leading zeros.

## Code Snippets

**C++:**

```
/**
* Definition for singly-linked list.
* struct ListNode {
* int val;
* ListNode *next;
* ListNode() : val(0), next(nullptr) {}
* ListNode(int x) : val(x), next(nullptr) {}
* ListNode(int x, ListNode *next) : val(x), next(next) {}
* };
*/
class Solution {
public:
ListNode* addTwoNumbers(ListNode* l1, ListNode* l2) {

}
```

```
};
```

**Java:**

```
/**
* Definition for singly-linked list.
* public class ListNode {
* int val;
* ListNode next;
* ListNode() {}
* ListNode(int val) { this.val = val; }
* ListNode(int val, ListNode next) { this.val = val; this.next = next; }
* }
*/
class Solution {
public ListNode addTwoNumbers(ListNode l1, ListNode l2) {

}
}
```

**Python3:**

```
# Definition for singly-linked list.
# class ListNode:
# def __init__(self, val=0, next=None):
# self.val = val
# self.next = next
class Solution:
def addTwoNumbers(self, l1: Optional[ListNode], l2: Optional[ListNode]) ->
Optional[ListNode]:
```

**Python:**

```
# Definition for singly-linked list.
# class ListNode(object):
# def __init__(self, val=0, next=None):
# self.val = val
# self.next = next
class Solution(object):
def addTwoNumbers(self, l1, l2):
"""
:type l1: Optional[ListNode]
```

```
:type l2: Optional[ListNode]
:rtype: Optional[ListNode]
"""
```

**JavaScript:**

```
/**
* Definition for singly-linked list.
* function ListNode(val, next) {
* this.val = (val===undefined ? 0 : val)
* this.next = (next===undefined ? null : next)
* }
*/
/**
* @param {ListNode} l1
* @param {ListNode} l2
* @return {ListNode}
*/
var addTwoNumbers = function(l1, l2) {

};
```

**TypeScript:**

```
/**
* Definition for singly-linked list.
* class ListNode {
* val: number
* next: ListNode | null
* constructor(val?: number, next?: ListNode | null) {
* this.val = (val===undefined ? 0 : val)
* this.next = (next===undefined ? null : next)
* }
* }
*/

function addTwoNumbers(l1: ListNode | null, l2: ListNode | null): ListNode |
null {

};
```

**C#:**

```
/**
* Definition for singly-linked list.
* public class ListNode {
* public int val;
* public ListNode next;
* public ListNode(int val=0, ListNode next=null) {
* this.val = val;
* this.next = next;
* }
* }
*/
public class Solution {
public ListNode AddTwoNumbers(ListNode l1, ListNode l2) {

}
}
```

**C:**

```
/**
* Definition for singly-linked list.
* struct ListNode {
* int val;
* struct ListNode *next;
* };
*/
struct ListNode* addTwoNumbers(struct ListNode* l1, struct ListNode* l2) {

}
```

**Go:**

```
/**
* Definition for singly-linked list.
* type ListNode struct {
* Val int
* Next *ListNode
* }
*/
func addTwoNumbers(l1 *ListNode, l2 *ListNode) *ListNode {

}
```

**Kotlin:**

```
/**
* Example:
* var li = ListNode(5)
* var v = li.`val`
* Definition for singly-linked list.
* class ListNode(var `val`: Int) {
* var next: ListNode? = null
* }
*/
class Solution {
fun addTwoNumbers(l1: ListNode?, l2: ListNode?): ListNode? {

}
}
```

**Swift:**

```
/**
* Definition for singly-linked list.
* public class ListNode {
* public var val: Int
* public var next: ListNode?
* public init() { self.val = 0; self.next = nil; }
* public init(_ val: Int) { self.val = val; self.next = nil; }
* public init(_ val: Int, _ next: ListNode?) { self.val = val; self.next =
next; }
* }
*/
class Solution {
func addTwoNumbers(_ l1: ListNode?, _ l2: ListNode?) -> ListNode? {

}
}
```

**Rust:**

```
// Definition for singly-linked list.
// #[derive(PartialEq, Eq, Clone, Debug)]
// pub struct ListNode {
// pub val: i32,
// pub next: Option<Box<ListNode>>
```

```
// }
//
// impl ListNode {
// #[inline]
// fn new(val: i32) -> Self {
// ListNode {
// next: None,
// val
// }
// }
// }
impl Solution {
pub fn add_two_numbers(l1: Option<Box<ListNode>>, l2: Option<Box<ListNode>>)
-> Option<Box<ListNode>> {

}
}
```

**Ruby:**

```
# Definition for singly-linked list.
# class ListNode
# attr_accessor :val, :next
# def initialize(val = 0, _next = nil)
# @val = val
# @next = _next
# end
# end
# @param {ListNode} l1
# @param {ListNode} l2
# @return {ListNode}
def add_two_numbers(l1, l2)

end
```

**PHP:**

```
/**
* Definition for a singly-linked list.
* class ListNode {
* public $val = 0;
* public $next = null;
```

```
* function __construct($val = 0, $next = null) {
* $this->val = $val;
* $this->next = $next;
* }
* }
*/
class Solution {

/**
* @param ListNode $l1
* @param ListNode $l2
* @return ListNode
*/
function addTwoNumbers($l1, $l2) {

}
}
```

**Dart:**

```
/**
* Definition for singly-linked list.
* class ListNode {
* int val;
* ListNode? next;
* ListNode([this.val = 0, this.next]);
* }
*/
class Solution {
ListNode? addTwoNumbers(ListNode? l1, ListNode? l2) {

}
}
```

**Scala:**

```
/**
* Definition for singly-linked list.
* class ListNode(_x: Int = 0, _next: ListNode = null) {
* var next: ListNode = _next
* var x: Int = _x
* }
```

```
*/
object Solution {
def addTwoNumbers(l1: ListNode, l2: ListNode): ListNode = {

}
}
```

**Elixir:**

```
# Definition for singly-linked list.
#
# defmodule ListNode do
# @type t :: %__MODULE__{
# val: integer,
# next: ListNode.t() | nil
# }
# defstruct val: 0, next: nil
# end

defmodule Solution do
@spec add_two_numbers(l1 :: ListNode.t | nil, l2 :: ListNode.t | nil) ::
ListNode.t | nil
def add_two_numbers(l1, l2) do

end
end
```

**Erlang:**

```
%% Definition for singly-linked list.
%%
%% -record(list_node, {val = 0 :: integer(),
%% next = null :: 'null' | #list_node{}}).

-spec add_two_numbers(L1 :: #list_node{} | null, L2 :: #list_node{} | null)
-> #list_node{} | null.
add_two_numbers(L1, L2) ->
.
```

**Racket:**

```
; Definition for singly-linked list:
#|

; val : integer?
; next : (or/c list-node? #f)
(struct list-node
(val next) #:mutable #:transparent)

; constructor
(define (make-list-node [val 0])
(list-node val #f))

|#

(define/contract (add-two-numbers l1 l2)
(-> (or/c list-node? #f) (or/c list-node? #f) (or/c list-node? #f))
)
```

## Solutions

### C++ Solution:

```
/*
* Problem: Add Two Numbers
* Difficulty: Medium
* Tags: math, linked_list
*
* Approach: Optimized algorithm based on problem constraints
* Time Complexity: O(n) to O(n^2) depending on approach
* Space Complexity: O(1) to O(n) depending on approach
*/

/**
* Definition for singly-linked list.
* struct ListNode {
* int val;
* ListNode *next;
* ListNode() : val(0), next(nullptr) {}
* ListNode(int x) : val(x), next(nullptr) {}
* ListNode(int x, ListNode *next) : val(x), next(next) {}
* };
```

```
*/
class Solution {
public:
ListNode* addTwoNumbers(ListNode* l1, ListNode* l2) {

}
};
```

**Java Solution:**

```
/**
* Problem: Add Two Numbers
* Difficulty: Medium
* Tags: math, linked_list
*
* Approach: Optimized algorithm based on problem constraints
* Time Complexity: O(n) to O(n^2) depending on approach
* Space Complexity: O(1) to O(n) depending on approach
*/

/**
* Definition for singly-linked list.
* public class ListNode {
* int val;
* ListNode next;
* ListNode() {
// TODO: Implement optimized solution
return 0;
}
* ListNode(int val) { this.val = val; }
* ListNode(int val, ListNode next) { this.val = val; this.next = next; }
* }
*/
class Solution {
public ListNode addTwoNumbers(ListNode l1, ListNode l2) {

}
}
```

**Python3 Solution:**

```
"""
Problem: Add Two Numbers
Difficulty: Medium
Tags: math, linked_list

Approach: Optimized algorithm based on problem constraints
Time Complexity: O(n) to O(n^2) depending on approach
Space Complexity: O(1) to O(n) depending on approach
"""

# Definition for singly-linked list.
# class ListNode:
# def __init__(self, val=0, next=None):
# self.val = val
# self.next = next
class Solution:
def addTwoNumbers(self, l1: Optional[ListNode], l2: Optional[ListNode]) ->
Optional[ListNode]:
# TODO: Implement optimized solution
pass
```

**Python Solution:**

```
# Definition for singly-linked list.
# class ListNode(object):
# def __init__(self, val=0, next=None):
# self.val = val
# self.next = next
class Solution(object):
def addTwoNumbers(self, l1, l2):
"""
:type l1: Optional[ListNode]
:type l2: Optional[ListNode]
:rtype: Optional[ListNode]
"""
```

**JavaScript Solution:**

```
/**
* Problem: Add Two Numbers
* Difficulty: Medium
* Tags: math, linked_list
```

```
*
* Approach: Optimized algorithm based on problem constraints
* Time Complexity: O(n) to O(n^2) depending on approach
* Space Complexity: O(1) to O(n) depending on approach
*/

/**
* Definition for singly-linked list.
* function ListNode(val, next) {
* this.val = (val===undefined ? 0 : val)
* this.next = (next===undefined ? null : next)
* }
*/
/**
* @param {ListNode} l1
* @param {ListNode} l2
* @return {ListNode}
*/
var addTwoNumbers = function(l1, l2) {

};
```

**TypeScript Solution:**

```
/**
* Problem: Add Two Numbers
* Difficulty: Medium
* Tags: math, linked_list
*
* Approach: Optimized algorithm based on problem constraints
* Time Complexity: O(n) to O(n^2) depending on approach
* Space Complexity: O(1) to O(n) depending on approach
*/

/**
* Definition for singly-linked list.
* class ListNode {
* val: number
* next: ListNode | null
* constructor(val?: number, next?: ListNode | null) {
* this.val = (val===undefined ? 0 : val)
```

```
* this.next = (next===undefined ? null : next)
* }
* }
*/

function addTwoNumbers(l1: ListNode | null, l2: ListNode | null): ListNode |
null {

};
```

**C# Solution:**

```
/*
* Problem: Add Two Numbers
* Difficulty: Medium
* Tags: math, linked_list
*
* Approach: Optimized algorithm based on problem constraints
* Time Complexity: O(n) to O(n^2) depending on approach
* Space Complexity: O(1) to O(n) depending on approach
*/

/**
* Definition for singly-linked list.
* public class ListNode {
* public int val;
* public ListNode next;
* public ListNode(int val=0, ListNode next=null) {
* this.val = val;
* this.next = next;
* }
* }
*/
public class Solution {
public ListNode AddTwoNumbers(ListNode l1, ListNode l2) {

}
}
```

**C Solution:**

```c
/*
* Problem: Add Two Numbers
* Difficulty: Medium
* Tags: math, linked_list
*
* Approach: Optimized algorithm based on problem constraints
* Time Complexity: O(n) to O(n^2) depending on approach
* Space Complexity: O(1) to O(n) depending on approach
*/

/**
* Definition for singly-linked list.
* struct ListNode {
* int val;
* struct ListNode *next;
* };
*/
struct ListNode* addTwoNumbers(struct ListNode* l1, struct ListNode* l2) {

}
```

### Go Solution:

```go
// Problem: Add Two Numbers
// Difficulty: Medium
// Tags: math, linked_list
//
// Approach: Optimized algorithm based on problem constraints
// Time Complexity: O(n) to O(n^2) depending on approach
// Space Complexity: O(1) to O(n) depending on approach

/**
* Definition for singly-linked list.
* type ListNode struct {
* Val int
* Next *ListNode
* }
*/
func addTwoNumbers(l1 *ListNode, l2 *ListNode) *ListNode {

}
```

### Kotlin Solution:

```
/**
* Example:
* var li = ListNode(5)
* var v = li.`val`
* Definition for singly-linked list.
* class ListNode(var `val`: Int) {
* var next: ListNode? = null
* }
*/
class Solution {
fun addTwoNumbers(l1: ListNode?, l2: ListNode?): ListNode? {

}
}
```

### Swift Solution:

```
/**
* Definition for singly-linked list.
* public class ListNode {
* public var val: Int
* public var next: ListNode?
* public init() { self.val = 0; self.next = nil; }
* public init(_ val: Int) { self.val = val; self.next = nil; }
* public init(_ val: Int, _ next: ListNode?) { self.val = val; self.next =
next; }
* }
*/
class Solution {
func addTwoNumbers(_ l1: ListNode?, _ l2: ListNode?) -> ListNode? {

}
}
```

### Rust Solution:

```
// Problem: Add Two Numbers
// Difficulty: Medium
// Tags: math, linked_list
//
// Approach: Optimized algorithm based on problem constraints
```

```
// Time Complexity: O(n) to O(n^2) depending on approach
// Space Complexity: O(1) to O(n) depending on approach

// Definition for singly-linked list.
// #[derive(PartialEq, Eq, Clone, Debug)]
// pub struct ListNode {
// pub val: i32,
// pub next: Option<Box<ListNode>>
// }
//
// impl ListNode {
// #[inline]
// fn new(val: i32) -> Self {
// ListNode {
// next: None,
// val
// }
// }
// }
impl Solution {
pub fn add_two_numbers(l1: Option<Box<ListNode>>, l2: Option<Box<ListNode>>)
-> Option<Box<ListNode>> {

}
}
```

**Ruby Solution:**

```
# Definition for singly-linked list.
# class ListNode
# attr_accessor :val, :next
# def initialize(val = 0, _next = nil)
# @val = val
# @next = _next
# end
# end
# @param {ListNode} l1
# @param {ListNode} l2
# @return {ListNode}
def add_two_numbers(l1, l2)
```

```
end
```

**PHP Solution:**

```
/**
* Definition for a singly-linked list.
* class ListNode {
* public $val = 0;
* public $next = null;
* function __construct($val = 0, $next = null) {
* $this->val = $val;
* $this->next = $next;
* }
* }
*/
class Solution {

/**
* @param ListNode $l1
* @param ListNode $l2
* @return ListNode
*/
function addTwoNumbers($l1, $l2) {

}
}
```

**Dart Solution:**

```
/**
* Definition for singly-linked list.
* class ListNode {
* int val;
* ListNode? next;
* ListNode([this.val = 0, this.next]);
* }
*/
class Solution {
ListNode? addTwoNumbers(ListNode? l1, ListNode? l2) {

}
```

```
}
```

### Scala Solution:

```
/**
* Definition for singly-linked list.
* class ListNode(_x: Int = 0, _next: ListNode = null) {
* var next: ListNode = _next
* var x: Int = _x
* }
*/
object Solution {
def addTwoNumbers(l1: ListNode, l2: ListNode): ListNode = {

}
}
```

### Elixir Solution:

```
# Definition for singly-linked list.
#
# defmodule ListNode do
# @type t :: %__MODULE__{
# val: integer,
# next: ListNode.t() | nil
# }
# defstruct val: 0, next: nil
# end

defmodule Solution do
@spec add_two_numbers(l1 :: ListNode.t | nil, l2 :: ListNode.t | nil) ::
ListNode.t | nil
def add_two_numbers(l1, l2) do

end
end
```

### Erlang Solution:

```
%% Definition for singly-linked list.
%%
```

```
%% -record(list_node, {val = 0 :: integer(),
%% next = null :: 'null' | #list_node{}}).

-spec add_two_numbers(L1 :: #list_node{} | null, L2 :: #list_node{} | null)
-> #list_node{} | null.
add_two_numbers(L1, L2) ->
.
```

**Racket Solution:**

```
; Definition for singly-linked list:
#|

; val : integer?
; next : (or/c list-node? #f)
(struct list-node
(val next) #:mutable #:transparent)

; constructor
(define (make-list-node [val 0])
(list-node val #f))

|#

(define/contract (add-two-numbers l1 l2)
(-> (or/c list-node? #f) (or/c list-node? #f) (or/c list-node? #f))
)
```