

# Stack (II): A Linked List-Based Implementation

CSCD 300 – Data Structures

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# Goal

We will demonstrate the details of implementing the stack data structure by using a singly linked list.

# Outline

- 1 The drawbacks of the array-based implementation
- 2 The singly linked list-based implementation

# The drawbacks of the array-based implementation

For example:

- There is a pre-defined capacity of the array that physically holds the stack, so the stack size **cannot grow to be arbitrarily large**.
- The **memory space** for all those unoccupied array locations is **wasted**.

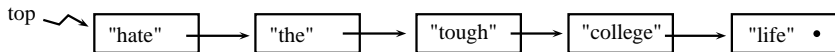
# The singly linked list-based implementation

- We view the whole linked list as a stack.
- For the singly linked list, because it's easier to insert a new node at the beginning of the list, we view the head of the list as the top of the stack, so ..
  - ▶ push: insert the new item into the beginning of the list.
  - ▶ pop: remove and return the head item of the list, if it exists.
- stack size: the number of nodes in the list <sup>1</sup>.
- stack top reference: the head reference of the list.

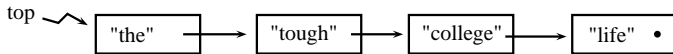
An example follows ...

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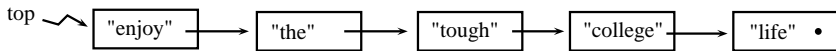
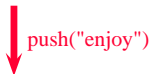
<sup>1</sup>Of course it does not include the dummy head node if the list has a dummy head node, which is not the case in our Java code.



stack size = 5



stack size = 4



stack size = 5

See the attached Java code for the singly linked list based implementation.

## The advantages of the linked list-based implementation:

- There is no pre-determined maximum size of the stack, so the stack **can grow as large as wanted** as long as the memory space is available.
- Every list node is used to save stack items, so **no space is wasted**.

## The drawbacks of the linked list-based implementation:

- Each node needs some **extra memory space usage** for the “next” links.
- The **push** and **pop** operations will be **slower** than those of the array-based implementation, because the operations will have more work to do in the manipulation of the “next” links among the relevant nodes.