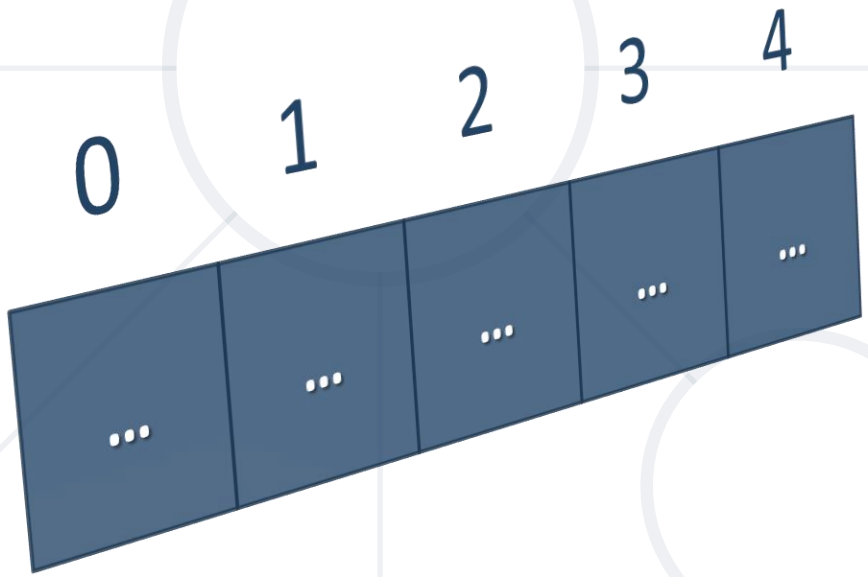
Stacks and Queues

Processing Sequences of Elements



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#cpp-advanced

Container Adaptors

- Wrap a container (e. g. `vector`) with a different interface
- Allow you to express intentions better
- Make code more abstract and focused on the task, not the code

STL Adapters for common Computer Science data structures:

`std::stack`
last-in, first-out (LIFO) data structure

`std::queue`
first-in, first-out (FIFO) data stucture

`std::priority_queue`
data structure that gives quick access to the "highest priority item"

Overview and Working with Stack

std::stack<T>

std::stack

- Represents a container (a **deque** by default) working like a stack
- A stack is a "last-in, first-out structure" (LIFO)
  - *Imagine a pile of dishes*
    – the last dish you put is the first you can remove
- Access to elements other than **top()** is not provided

top() gets the top

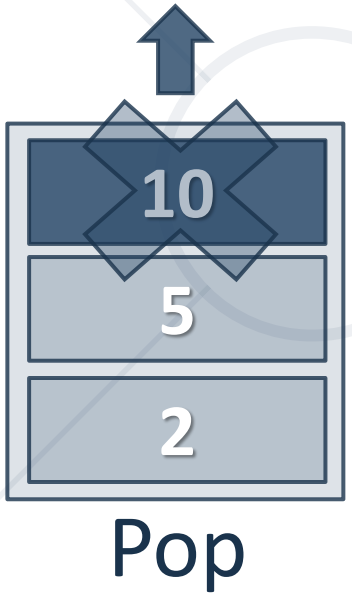
pop() removes top

push(T) adds to top

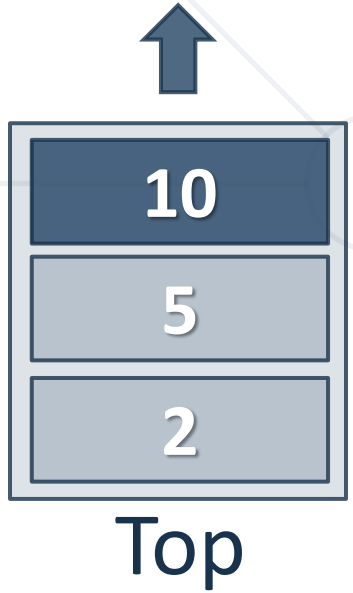
Stack

- Stacks provide the following functionality:
  - Pushing an element at the top of the stack
  - Popping element from the top of the stack
  - Getting the topmost element without removing it

Push



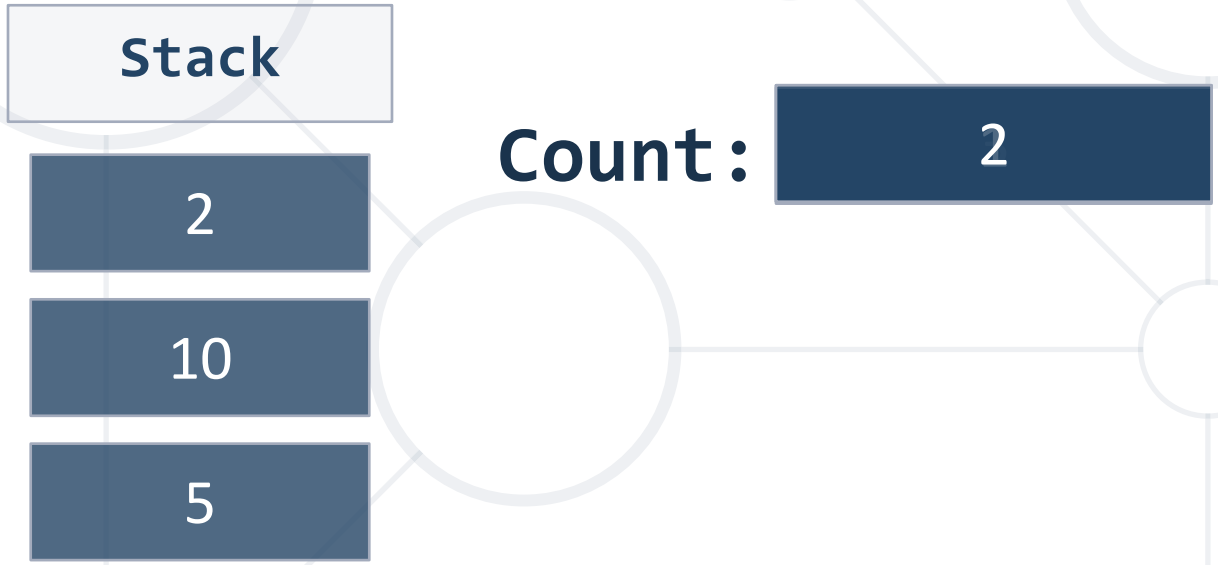
Pop



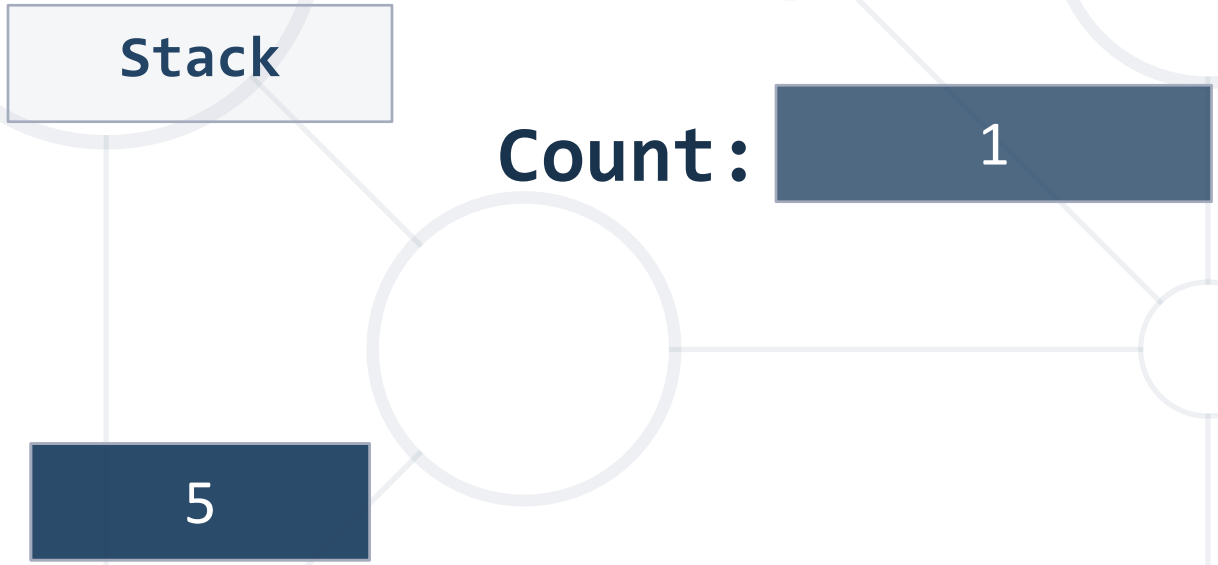
Top

push() – Adds an Element On Top of the Stack

pop() – Returns and Removes the Last Element



top() - Returns the Last Element



Overview and Working with Stack

LIVE DEMO

Practice

Live Exercise in Class

Stack Example: "Browser History"

- Write a program which takes 2 types of browser instructions:
  - Normal navigation: a URL is set, given by a string
  - The string `/back` that sets the current URL to the last set URL
- After each instruction the program should print the current URL
- If the `/back` instruction can't be executed, print "`no previous URLs`"

Overview and Working with Queue

std::queue<T>

std::queue

- Represents a container (**deque** by default) working like a queue
- A queue is a "first-in, first-out" structure (FIFO)
  - *Imagine a line at a store*
    – first person in the line is the first to get out
- Access to elements other than `front()` is not provided

`front()` gets first

`pop()` removes first

`push(T)` adds to back

Overview and Working with Queue

LIVE DEMO

Practice

Live Exercise in Class

Queue Example: "Browser History"

- Extend "Browser History" with a `/forward` instruction
  - Visits URLs that were navigated away from by `/back`
  - Each `/forward` instruction visits the next most-recent such URL
  - If a normal navigation happens, all potential `/forward` URLs are removed until a new `/back` instruction is given
- If the `/forward` instruction can't be executed, print "`no next URLs`"

std::priority_queue

std::priority_queue

- Represents a queue, but elements are ordered by priority
  - By default, "larger" elements have higher priority
  - *Imagine a queue at a hospital's emergency room*
    – Patients with more serious cases treated BEFORE those with less serious ones
- Higher priority elements move in front of lower priority ones
  - Getting top-priority element is `O(1)`, insertion is `log(N)`
  - To get top-priority element use `top()` (instead of `front()`)

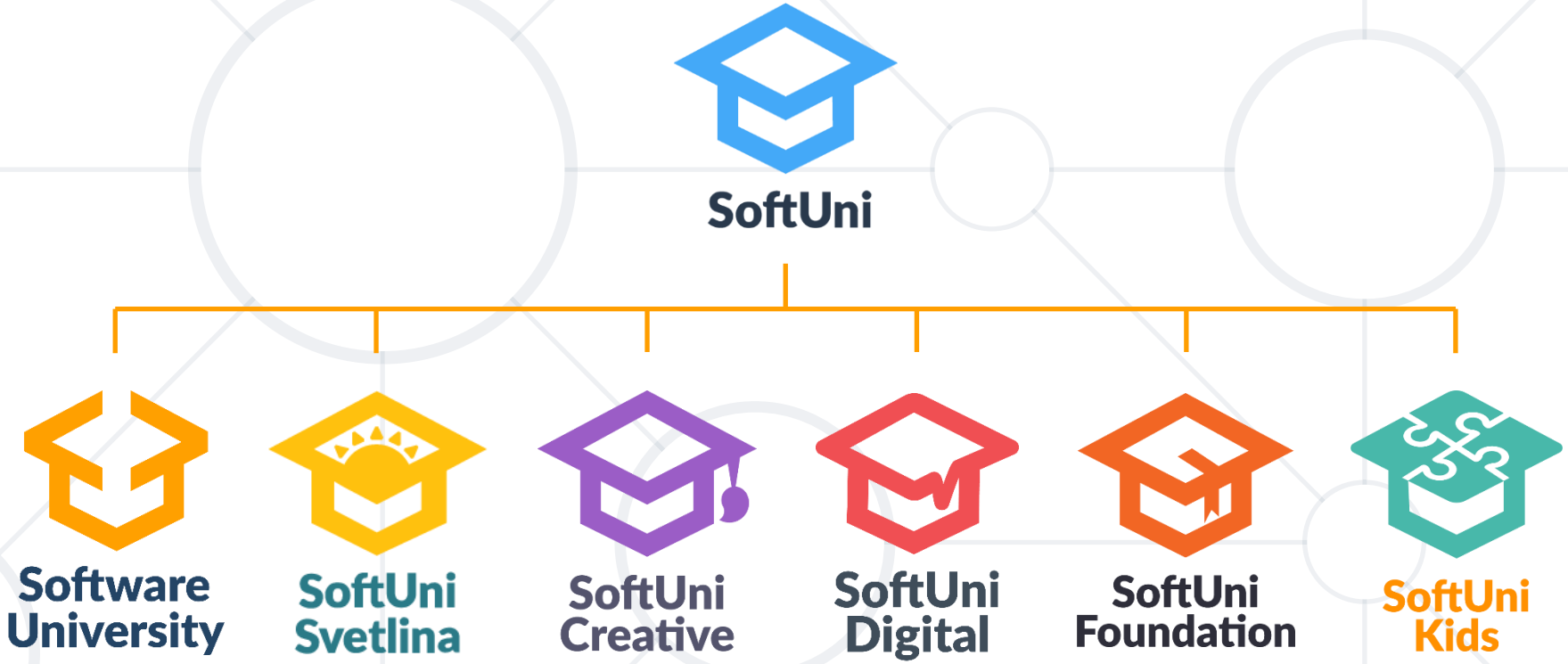
`std::priority_queue`

LIVE DEMO

Summary

- `stack<T>`
  - LIFO
- `queue<T>`
  - FIFO
- Container Adaptors
  - Each is efficient for certain use-cases

Questions?



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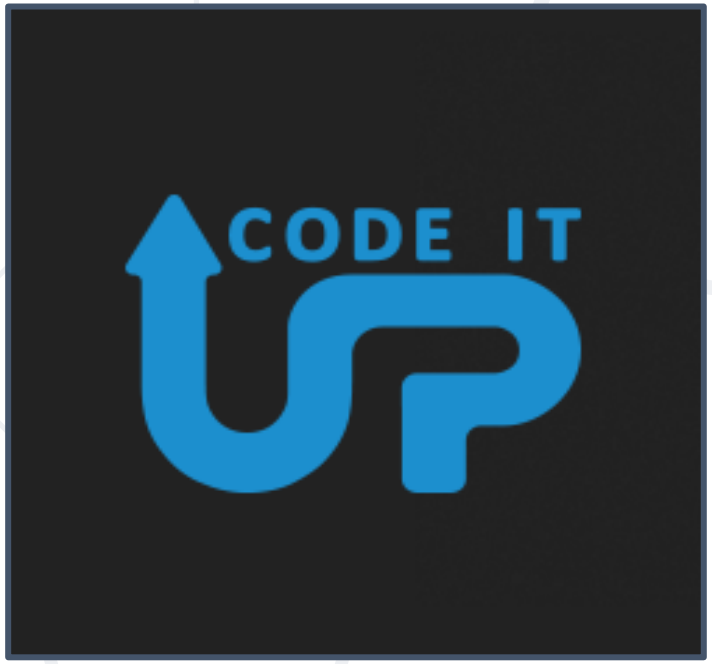

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