CSCA48 Winter 2018
Week 2: Queue-Stack-Container

Marzieh Ahmadzadeh, Nick Cheng

University of Toronto Scarborough

Administrative Detail

- Tutorials, practicals and FSG starts this week
- Practicals and FSG: schedule now is online
- Ex0 due this week

Queues

- Requirement:
  - First In, First Out (FIFO)
- Application
  - Waiting list
  - Access to shared devices (e.g. printers, CPU)
  - Component of other data structures.

The Queue ADT

- Data:
  - Any arbitrary objects/elements
- Operations:
  - Main:
    - enqueue(e): add element *e* to the back/tail of the queue
    - dequeue(): remove and return the element from the front/head of the queue
  - Auxiliary:
    - front(): returns the element at the front without removing it
    - size(): returns the number of elements in the queue
    - is_empty(): indicates whether or not the queue is empty
- Exception:
  - Raise EmptyQueueException if the queue is empty and dequeue() or front() is requested

Representation Invariant

- Based on the story of a client and a server a representation invariant:
  - Describes how class variables represents the data
    - e.g. Q is a list, if Q is not empty then Q[0] is the top of the queue, etc.
  - Is always a true statement when
    - The ADT is instantiated.
    - After every method call
  - Is written as internal comments in __init__ method

Stack

- Requirement:
  - First In, Last Out (FILO, LIFO)
- Application:
  - Undo in a text editor
  - Chain of method calls in Python
  - Parentheses matcher
  - Matching tags in an HTML document
  - A component of other data structures

The Stack ADT

- Data:
  - Any arbitrary objects/elements
- Operations:
  - Main:
    - push(e): add element *e* to the front/head of the stack
    - pop(): remove and return the element from the front/head of the queue
  - Auxiliary:
    - top(): returns the element at the front without removing it
    - size(): returns the number of elements in the queue
    - is_empty(): indicates whether or not the queue is empty
- Exception:
  - Raise EmptyStackException if the stack is empty and pop() or top() is requested

Example: Parentheses Matching

- () (()) (()): Correct
- ((() (()) (()))): Correct
-) (()) (()): Incorrect
- (: Incorrect

The Container ADT

- It’s a general data structure that can be used for both the stack and the queue
- Operations:
  - put(e): we don’t know where in the container e is inseted.
  - get(): if you’re using it as queue or stack, it follows FIFO, FILO respectively
  - is_empty(): returns true if the container is empty

Question

- What type of data structure would you use to simulate a waiting list in a restaurant?