PH502: Scientific Programming Concepts

Irish Centre for High End Computing (ICHEC)

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Overview

- Here we will discuss some elementary data structures.
- Hopefully you will recognise some of these.
- We are discussing them in a more general sense but they are found in many situations.

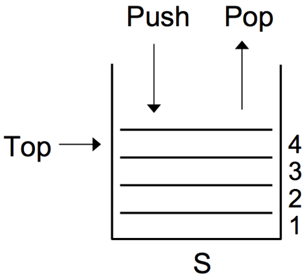
Elementary Data Structures-Stack

Usually, efficient data structures are key to designing efficient algorithms

- Implements the LIFO (last-in, first-out) policy
- S=S[1 ... top(S)]

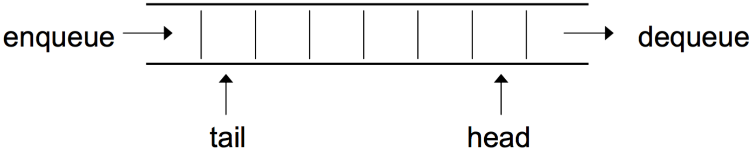
Push(S, x)
if Stack_Full(S) **then**
  Error: Overflow
else
  top[S]=top[S]+1
  S[top[S]]=x
end if

Pop(S)
if Stack_Empty(S) **then**
  Error: Underflow
else
  top[S]=top[S]-1
  return S[top[S]+1]
end if



Elementary Data Structures-Queues

- Implements the FIFO (first-in, first-out) policy
- Q=Q[head[Q], head[Q]+1, ..., tail[Q]]

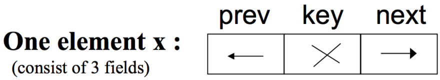


Enqueue(Q, x)
if Not Queue_Full(Q) **then**
    Q[tail[Q]]=x
    if tail[Q]=length[Q] **then**
        tail[Q]=1
    else
        tail[Q]=tail[Q]+1
    end if
end if

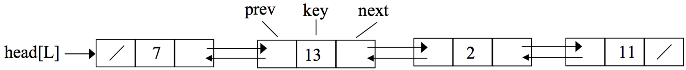
Dequeue(Q)
if Not Queue_Empty(Q) **then**
    x=Q[head[Q]]
    if head[Q]=length[Q] **then**
        head[Q]=1
    else
        head[Q]=head[Q]+1
    end if
    return x
end if

Elementary Data Structures-Linked List

- A concrete data structure consisting of a sequence of nodes. Each node has
  - a pointer to the previous node (except the first one)
  - a pointer to the next one (except the last one)
  - a field that contains a key

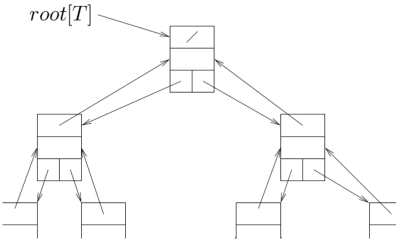


- Singly or Doubly Linked, Sorted or Unsorted, Circular or not
- Insert, Delete and Search Operations



Elementary Data Structures- Trees

- Abstract model of a hierarchical structure.
- A binary tree consists of nodes with
  - A key field
  - Pointer to the parent node
  - Pointer to the left child
  - Pointer to the right child
- Examples:
  - P-nary trees, Morse trees, Heaps, Search Trees, Red-Black Trees
- Insertion, Deletion, Traversal and IsRoot



Some References

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