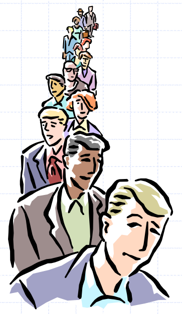
Sequences and Iterators



Sequence ADT (§ 5.3)

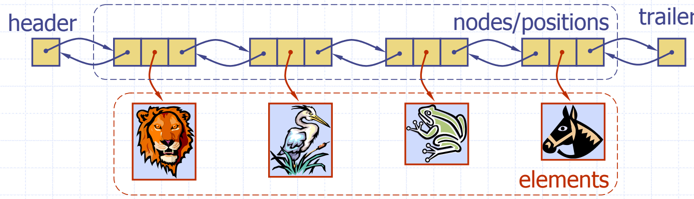
- The Sequence ADT is the union of the Vector and List ADTs
- Elements accessed by
  - Rank, or
  - Position
- Generic methods:
  - size(), isEmpty()
- Vector-based methods:
  - elemAtRank(r), replaceAtRank(r, o), insertAtRank(r, o), removeAtRank(r)
- List-based methods:
  - first(), last(), prev(p), next(p), replace(p, o), insertBefore(p, o), insertAfter(p, o), insertFirst(o), insertLast(o), remove(p)
- Bridge methods:
  - atRank(r), rankOf(p)

Applications of Sequences

- The Sequence ADT is a basic, general-purpose, data structure for storing an ordered collection of elements
- Direct applications:
  - Generic replacement for stack, queue, vector, or list
  - small database (e.g., address book)
- Indirect applications:
  - Building block of more complex data structures

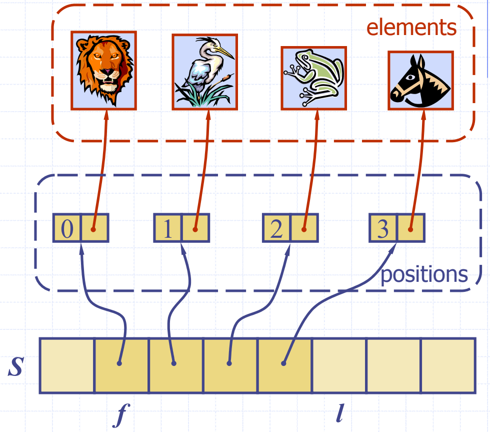
Linked List Implementation

- A doubly linked list provides a reasonable implementation of the Sequence ADT
- Nodes implement Position and store:
  - element
  - link to the previous node
  - link to the next node
- Special trailer and header nodes
- Position-based methods run in constant time
- Rank-based methods require searching from header or trailer while keeping track of ranks; hence, run in linear time



Array-based Implementation

- We use a circular array storing positions
- A position object stores:
  - Element
  - Rank
- Indices f and l keep track of first and last positions



Sequence Implementations

Operation	Array	List
size, isEmpty	1	1
atRank, rankOf, elemAtRank	1	n
first, last, prev, next	1	1
replace	1	1
replaceAtRank	1	n
insertAtRank, removeAtRank	n	n
insertFirst, insertLast	1	1
insertAfter, insertBefore	n	1
remove	n	1

Iterators (§ 5.4)

- An iterator abstracts the process of scanning through a collection of elements
- Methods of the ObjectIterator ADT:
  - object object()
  - boolean hasNext()
  - object nextObject()
  - reset()
- Extends the concept of Position by adding a traversal capability
- Implementation with an array or singly linked list
- An iterator is typically associated with an another data structure
- We can augment the Stack, Queue, Vector, List and Sequence ADTs with method:
  - ObjectIterator elements()
- Two notions of iterator:
  - snapshot: freezes the contents of the data structure at a given time
  - dynamic: follows changes to the data structure