Data Structures and Algorithms (12)

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Textbook Authors: Ming Zhang, Tengjiao Wang and Haiyan Zhao
Higher Education Press, 2008.6 (the "Eleventh Five-Year" national planning textbook)

https://courses.edx.org/courses/PekingX/04830050x/2T2014/

Chapter 12 Advanced Data Structure

- 12.1 Multi-array
- 12.2 Generalized List
  - Basic Concepts
  - Different Types of Generalized List
  - Storage of Generalized List
  - Traversal algorithm for Generalized List
- 12.3 Storage management
- 12.4 Trie
- 12.5 Improved BST

Basic Concepts

- Review of linear list
  - Finite ordered sequence consisting of n(>=0) elements.
  - All elements of a linear list have the same type.
- If a linear list contains one or more sub-lists, then it is called a generalized list, usually represented as:
  - $L = (x_0, x_1, \ldots, x_i, \ldots, x_{n-1})$

12.2 Generalized list and Storage management

$L = (x_0, x_1, \ldots, x_i, \ldots, x_{n-1})$

- L is the **name** of this generalized list.
- n is the **length.**
- Each $x_i (0 \le i \le n-1)$ is an **element.**
  - either a single element, i.e. atom,
  - or another generalized list, i.e. sublist.
- **Depth** : the number of brackets when all the elements are converted to atoms.

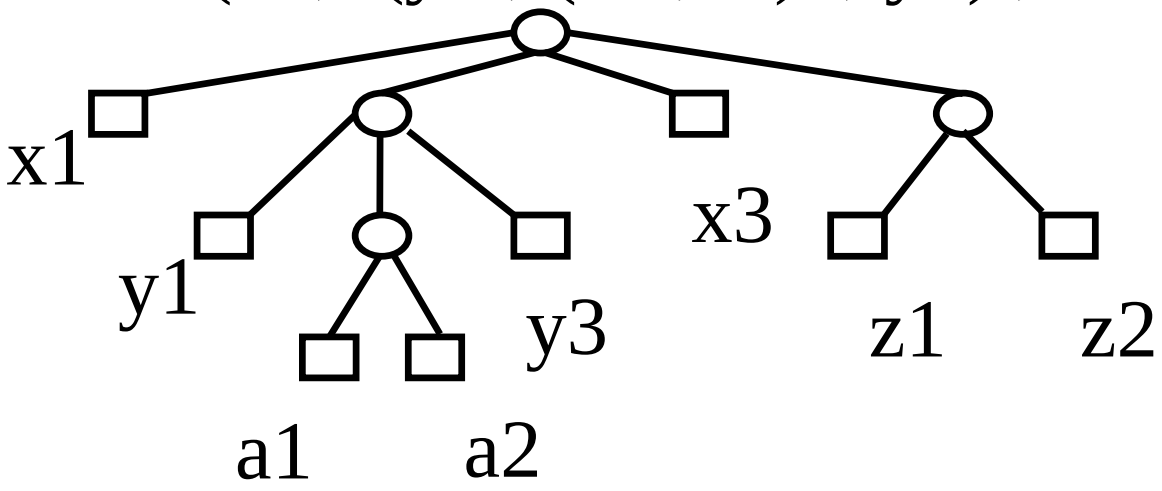
$L = (x_0, x_1, \ldots, x_i, \ldots, x_{n-1})$

- head = x_0
- tail = $(x_1, \ldots, x_{n-1})$
  - smaller lists
- Easier to store and to implement.

Different Types of Generalized Lits

- pure list
  - There is only one path existing from root to each leaf.
  - i.e. each element (atom, sublist) only appears once.

(x1, (y1 , (a1 ,a2) , y3) , x3 , (z1 ,z2))

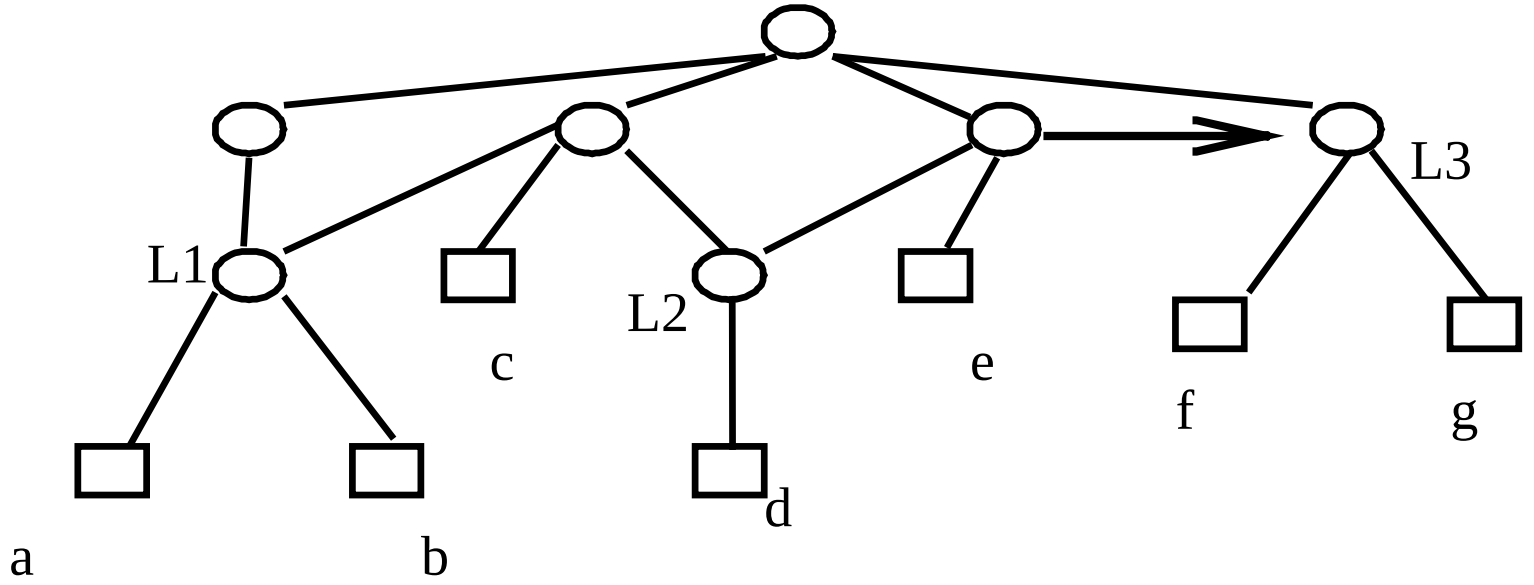


Different Types of Generalized Lits

- Reentrant lists
  - Its elements (atoms or sublists) might appear more than once.
  - Corresponds to a DAG if no circles exists.
- Sublists and atoms are labeled.

e.g. cycle lists

(((a, b)) , ((a,b) ,c,d) , (d, e, f, g) , (f ,g))

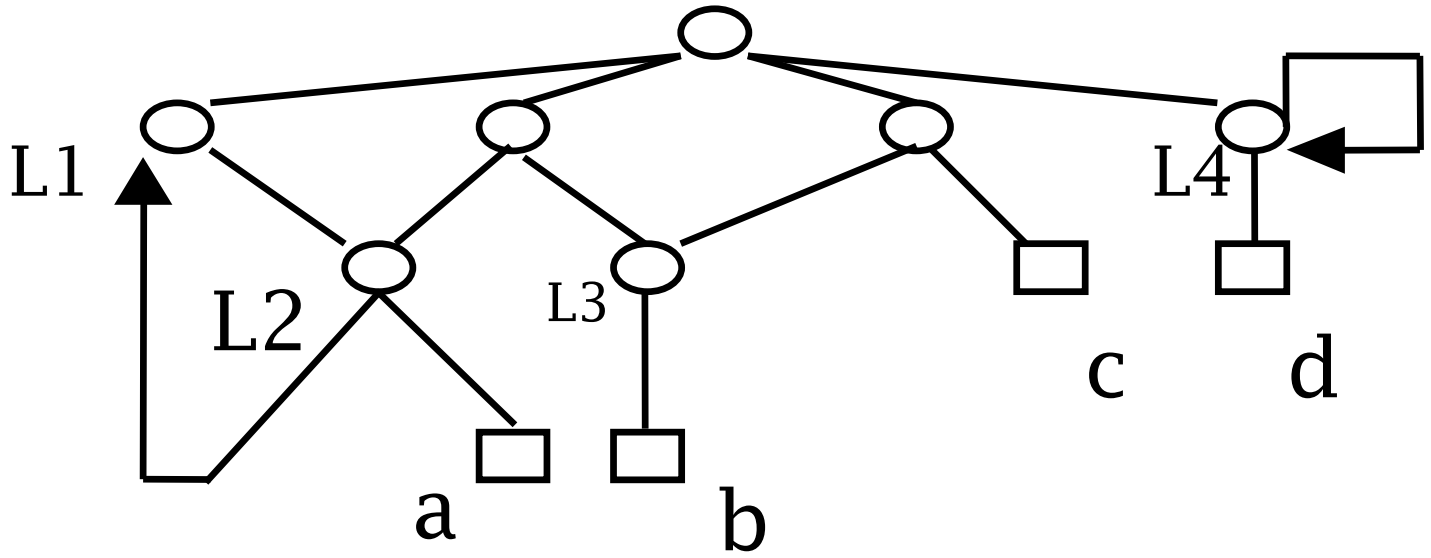


(L1: (a,b) , (L1, c ,L2: (d)) , (L2, e,L3: (f,g)) , L3)

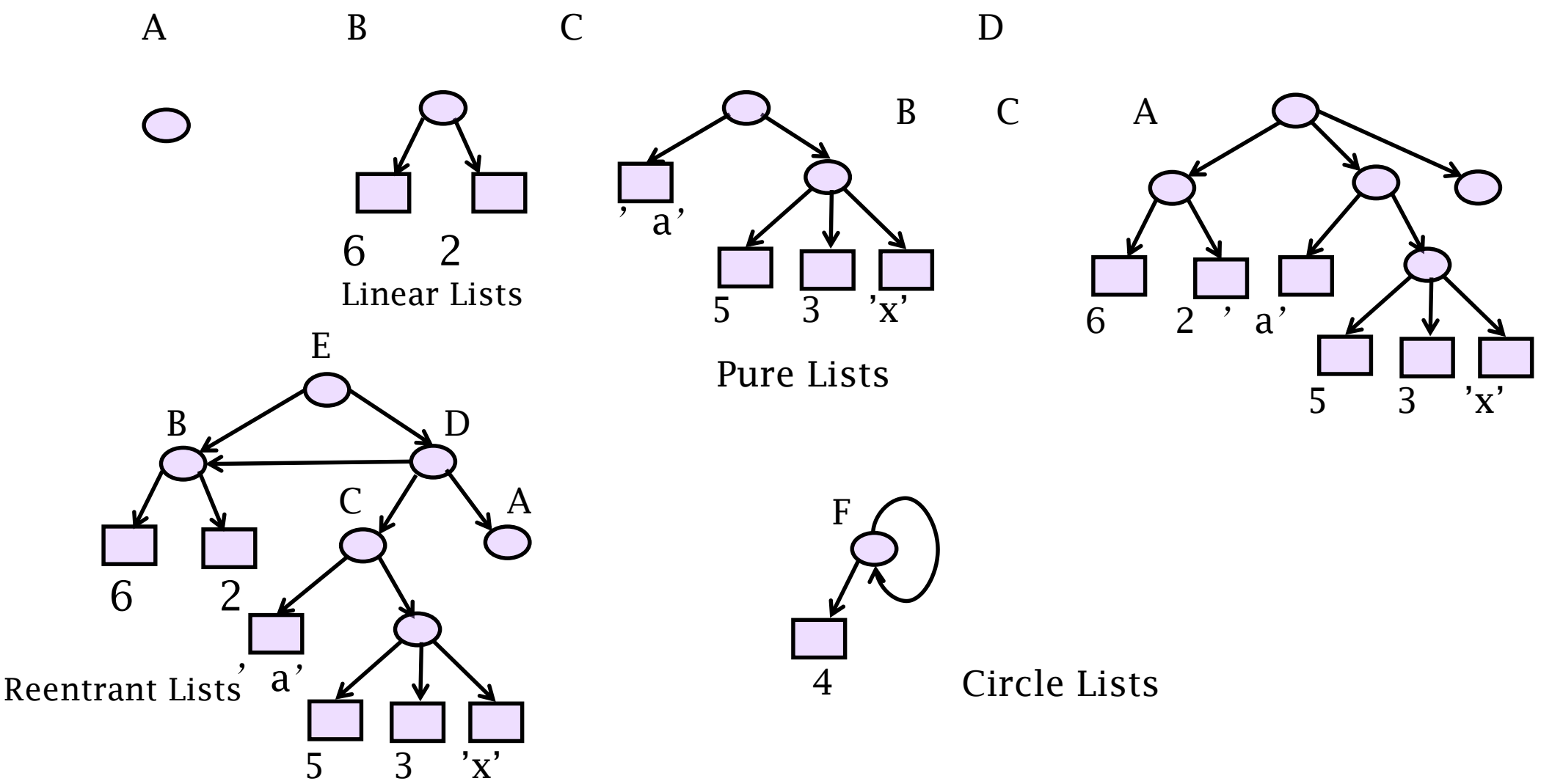
Different Types of Generalized Lits

- Circle lists
  - contains circles.
  - with infinite depth.

(L1: (L2: (L1, a)) , (L2, L3: (b)) , (L3, c) , L4: (d,L4))



12.2 Generalized list and Storage management

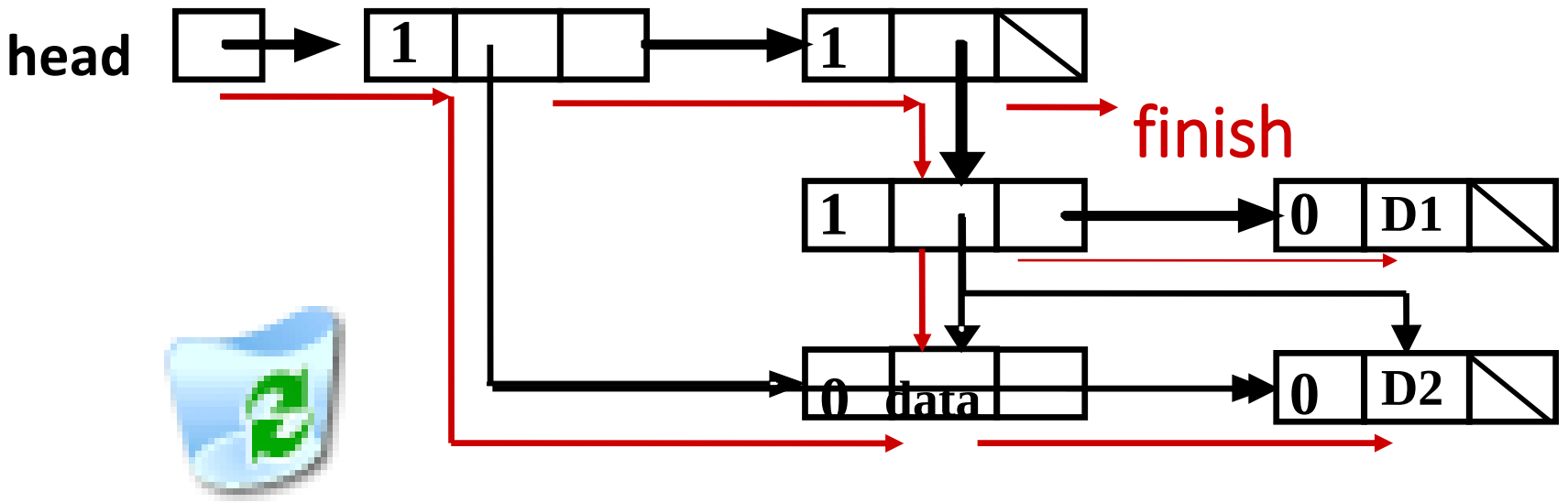


12.2 Generalized list and Storage management

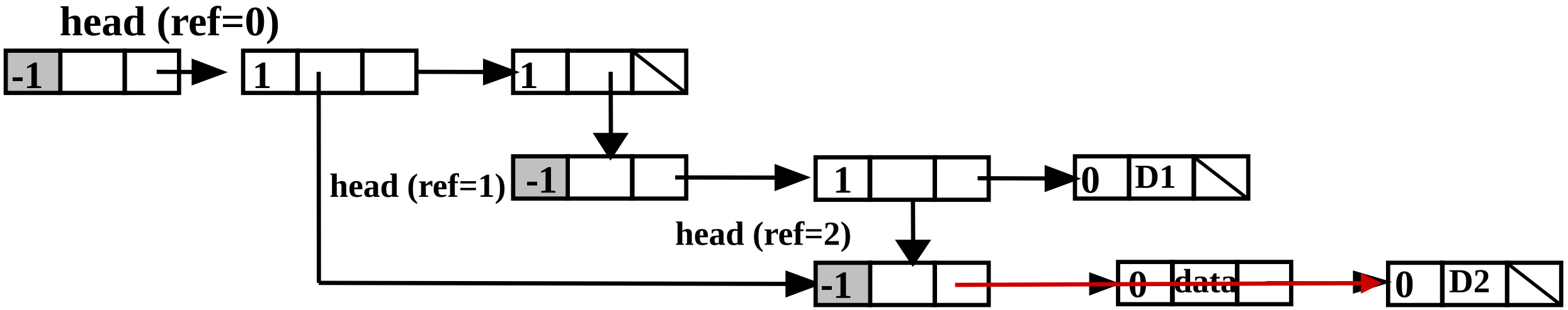
- Graph ⊇ Reentrant List ⊇ Pure List(Tree) ⊇ Linear List
  - Generaized lists are extensions of linear and tree structures.
- Circle lists are reentrant lists that have circles.
- Applications of generalized lists
  - Relations between the invocation of the function
  - Reference relations in memory space
  - LISP

Storage of Generalized Lists

- Generalized link lists without head node
  - Problems might occur when deleting nodes.
  - The list must be adjusted when deleting node 'data'.

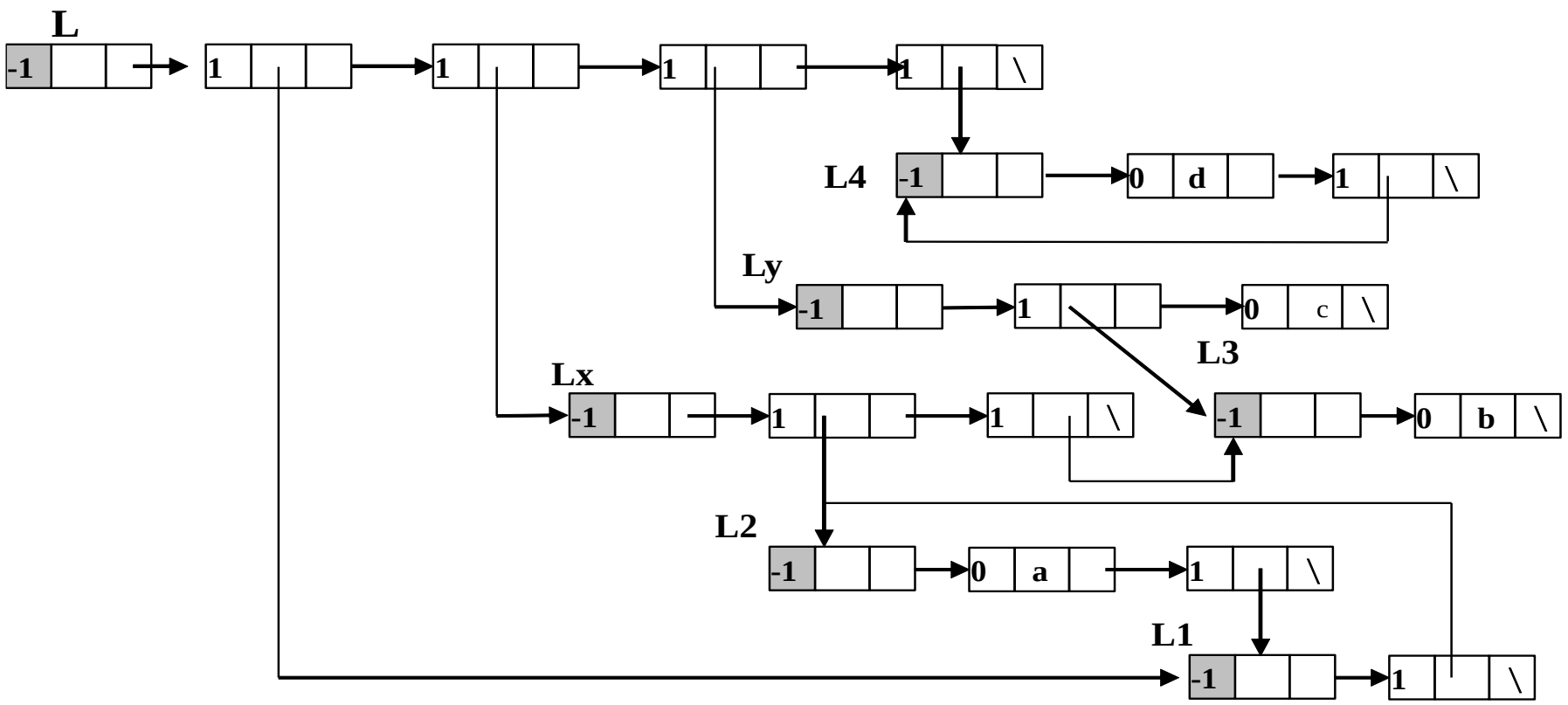


Storage of Generalized Lists



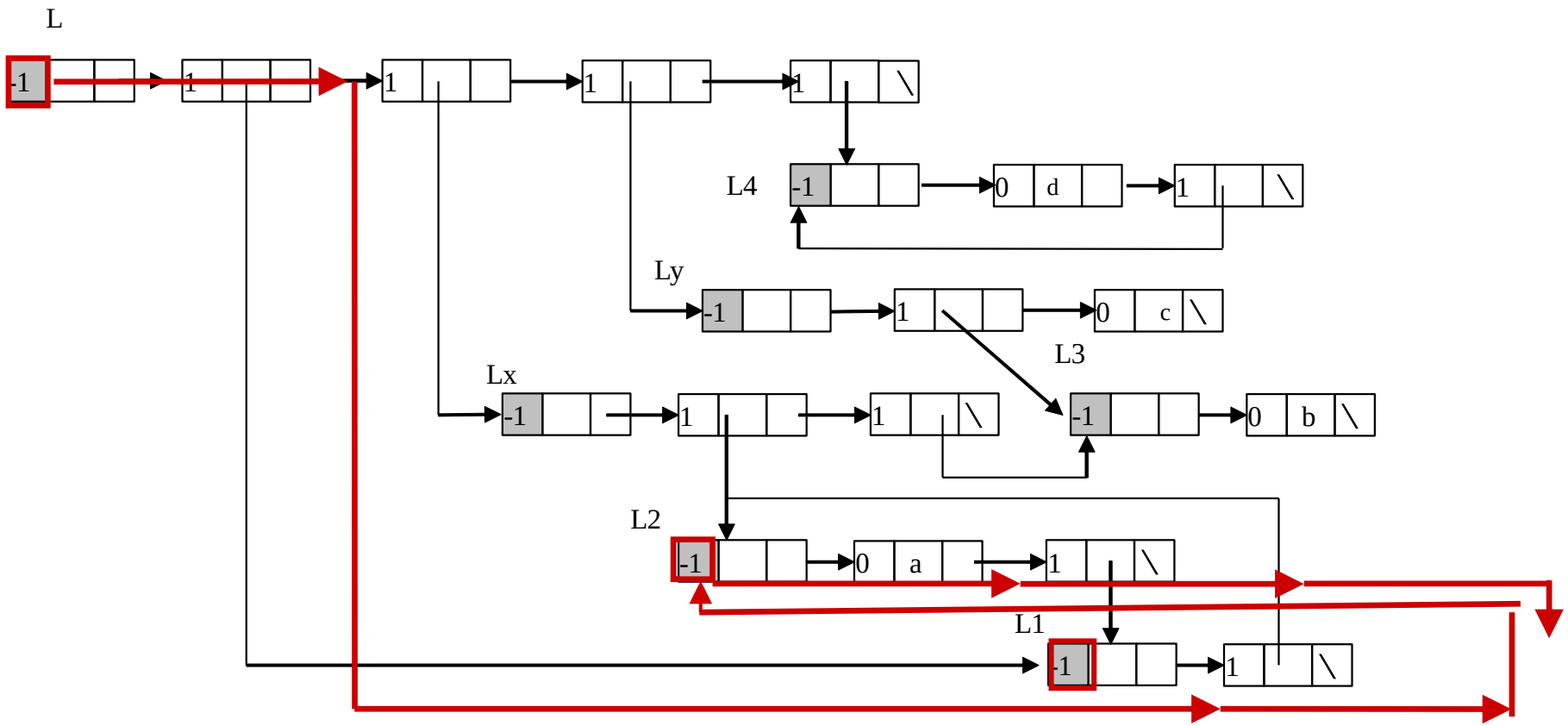
- Add the head node, and the deleting/inserting operation would be simplified.
- Reentrant lists, especially circle lists
  - mark each node (because it is a graph)

Circle Generalized Lists with Head Nodes



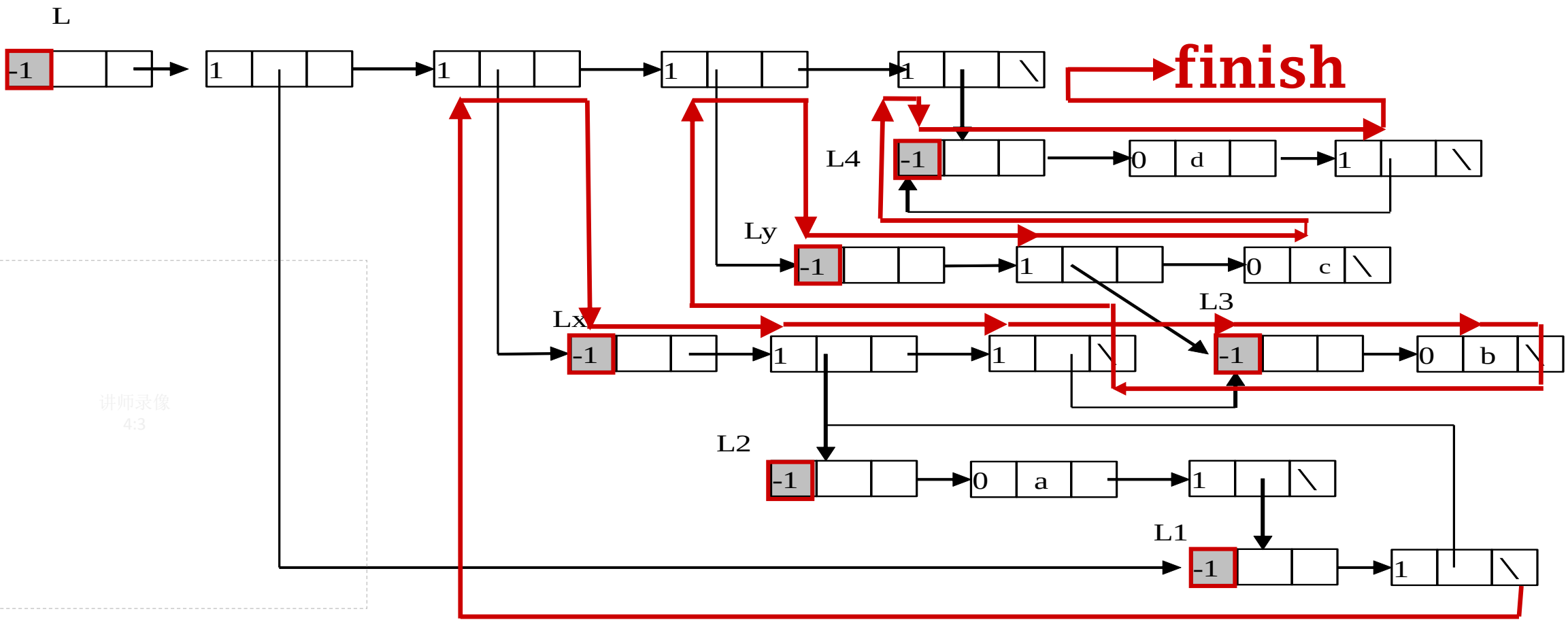
12.2 Generalized list and Storage management

(L1: (L2: (a ,L1))



12.2 Generalized list and Storage management

(L1: (L2: (a ,L1)) , Lx : (L2 , L3 : (b)) , Ly : (L3 , c) , L4 : (d , L4))



Data Structures and Algorithms

Thanks

the National Elaborate Course (Only available for IPs in China)
http://www.jpk.pku.edu.cn/pkujpk/course/sjjg/

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