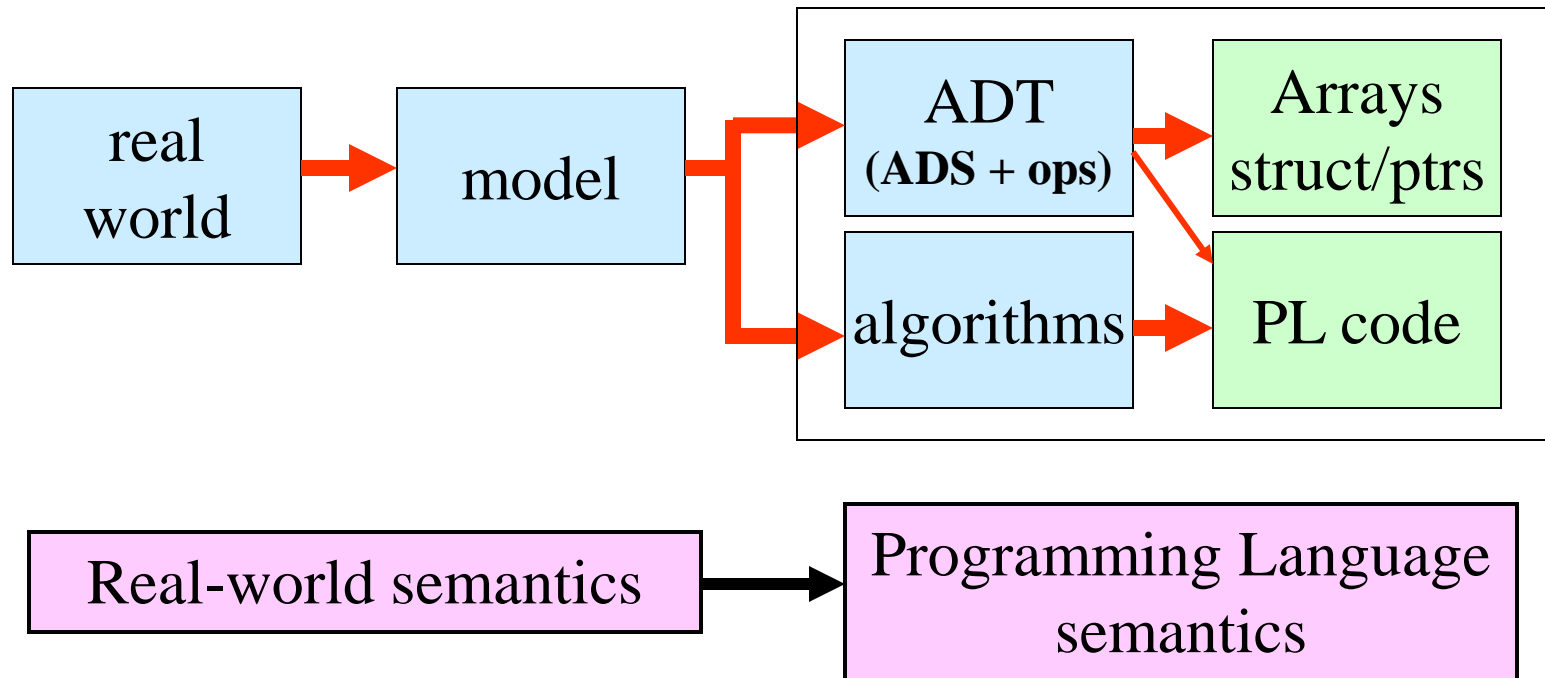
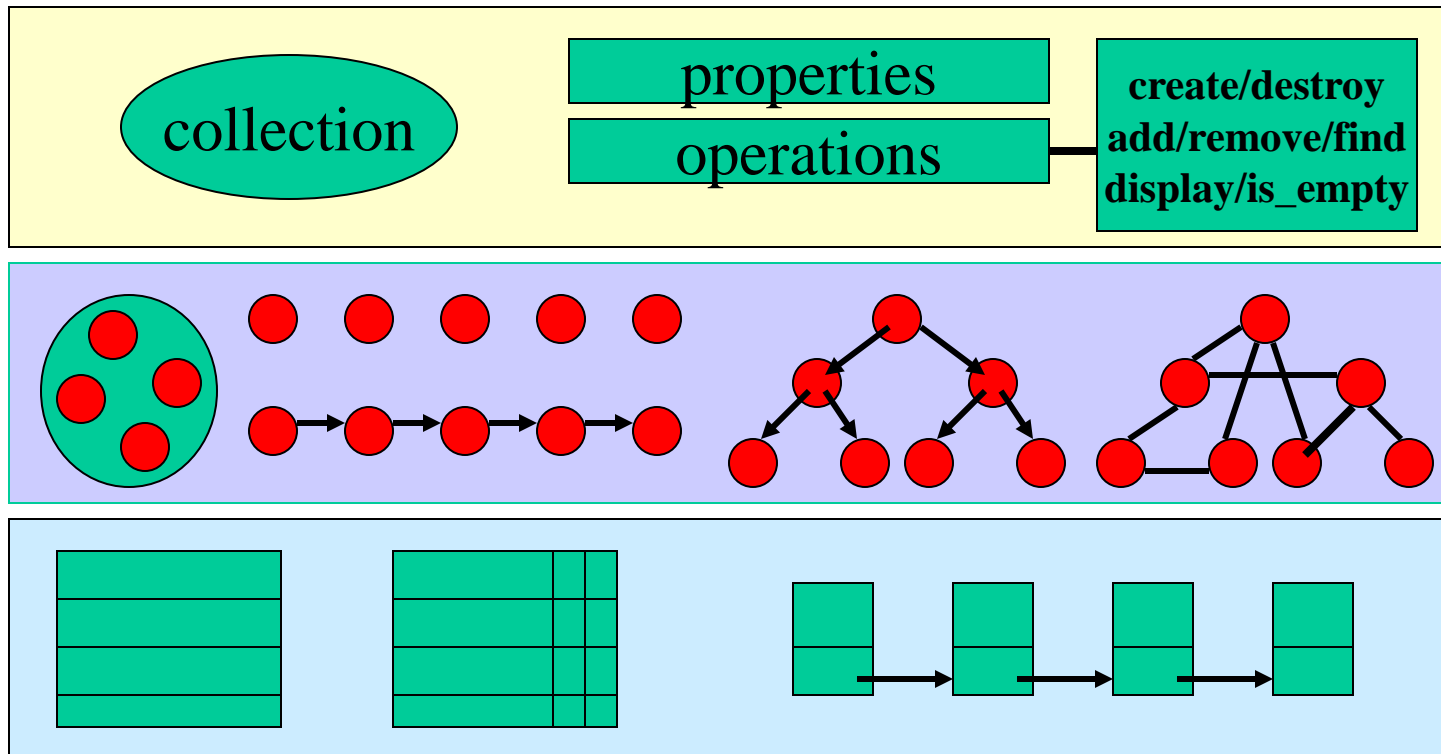


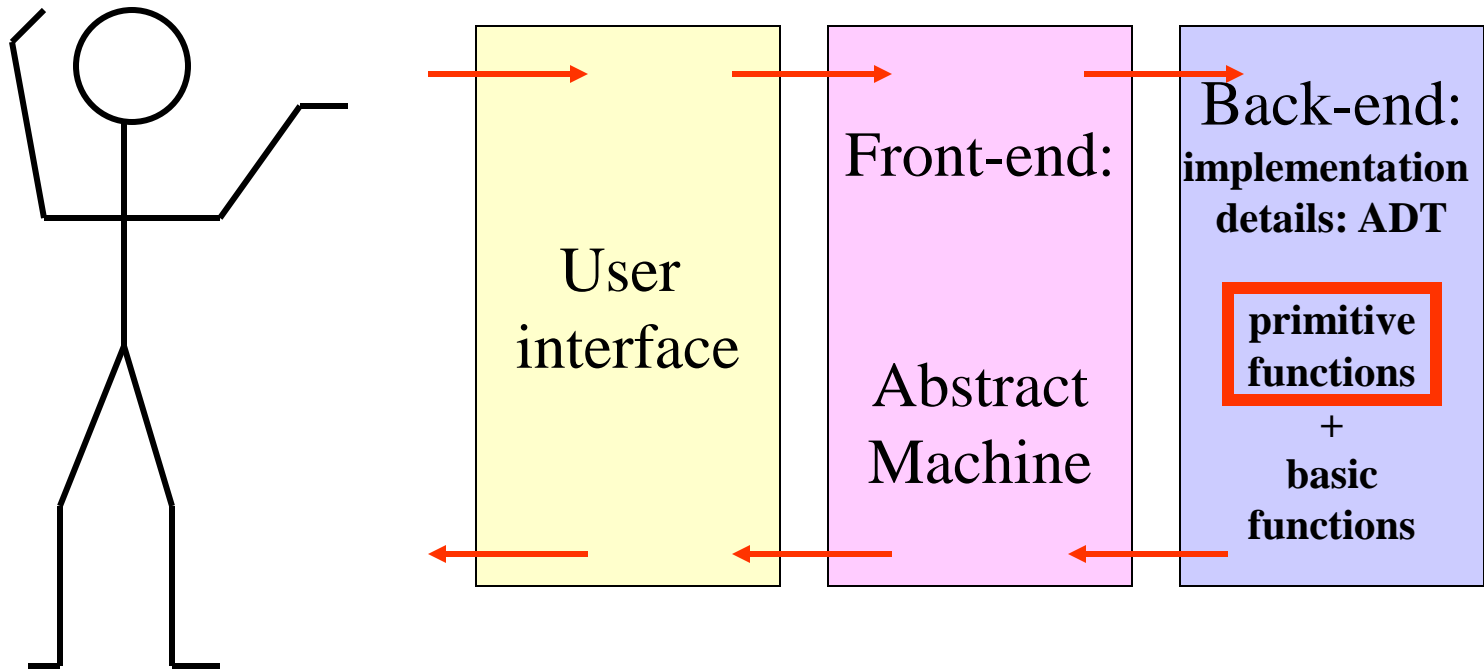
# Modelling and programming



# Levels of Abstraction

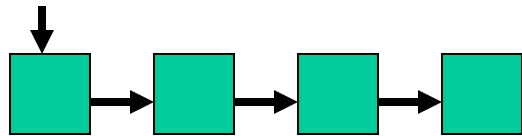


# Front-end Back-end Model

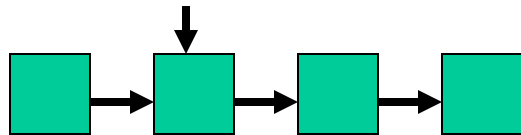


# ADT: Sequence

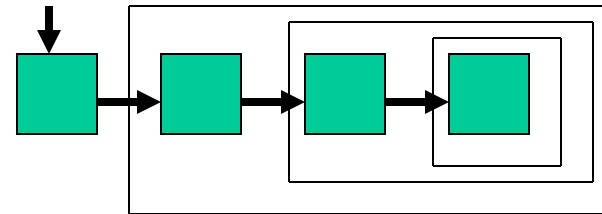
- Iterative view



- 1, 2, 3, 4, ...
- first, next(first),  
next(next(first)), ...



- Recursive view



- Seq ::= Head Tail |  $\alpha$   
Head ::= value  
Tail ::= Seq
- the “view” is reflected  
in the program !!!

# ADT: Binary Tree

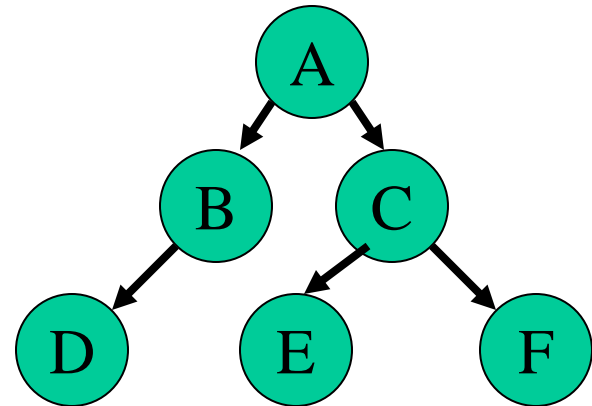
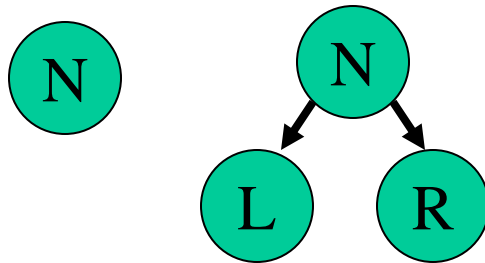
- BT Definition

- empty
- Lchild Node Rchild
  - where Lchild and Rchild are BTs

- Traversals

- Pre-order      **NLR**
- In-order      **LNR**
- Post-order      **LRN**

α

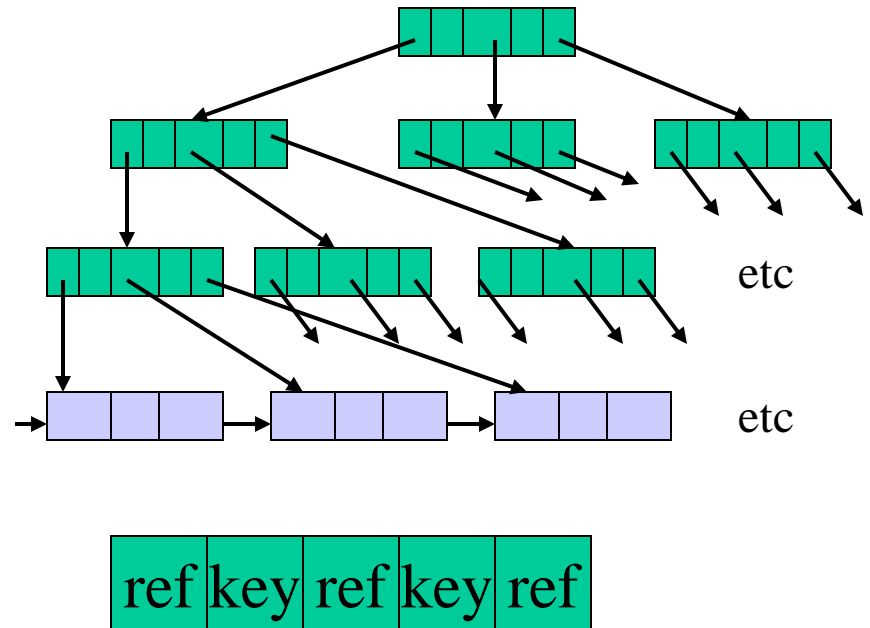


# Searching

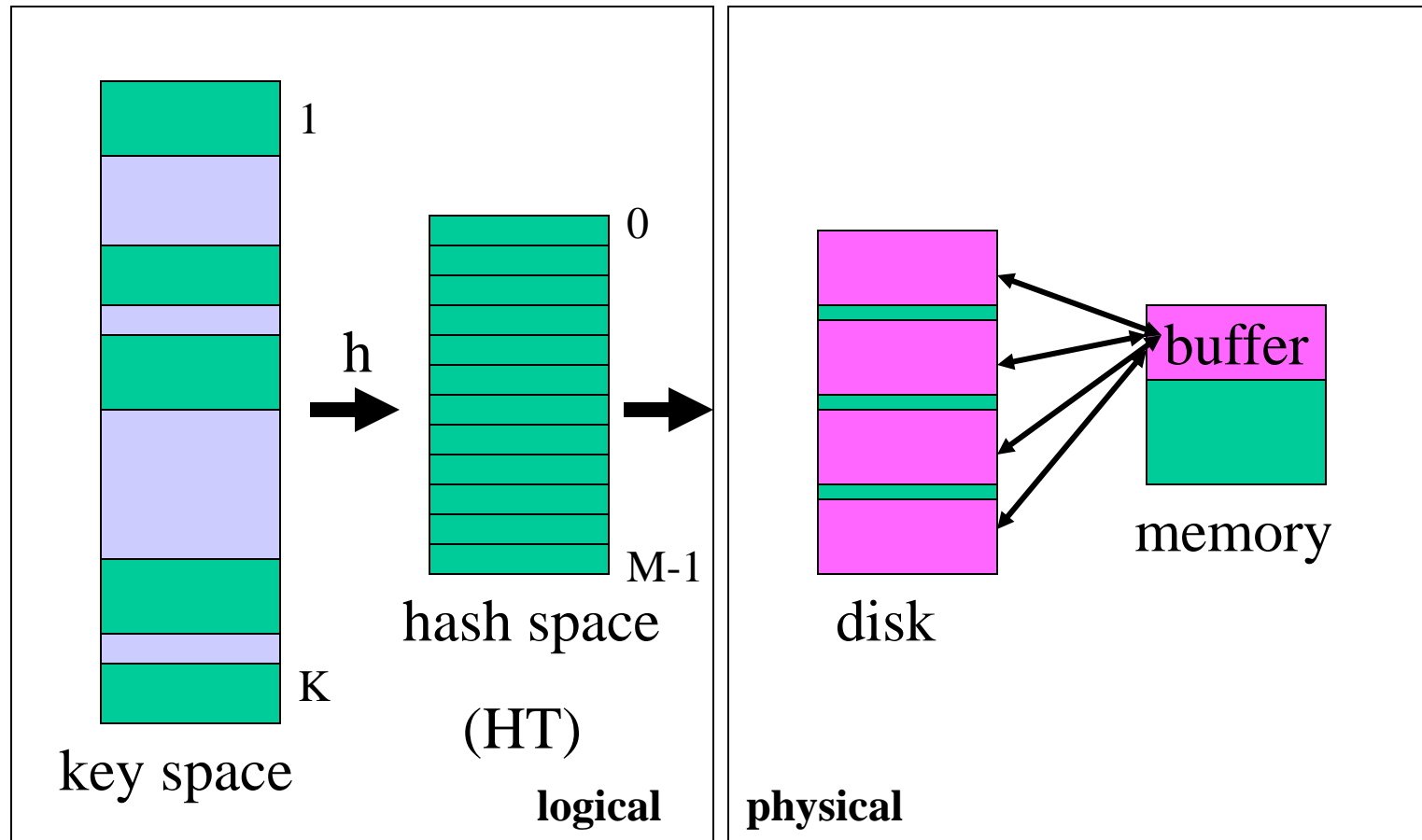
- Search space

	key	data	
→	A		1
	C		
	D		
	E		
	F		
	G		
	H		N

Knuth's B+ variant of a B-tree



# Hashing Model



# Algorithm Analysis: Examples of $O(n)$

