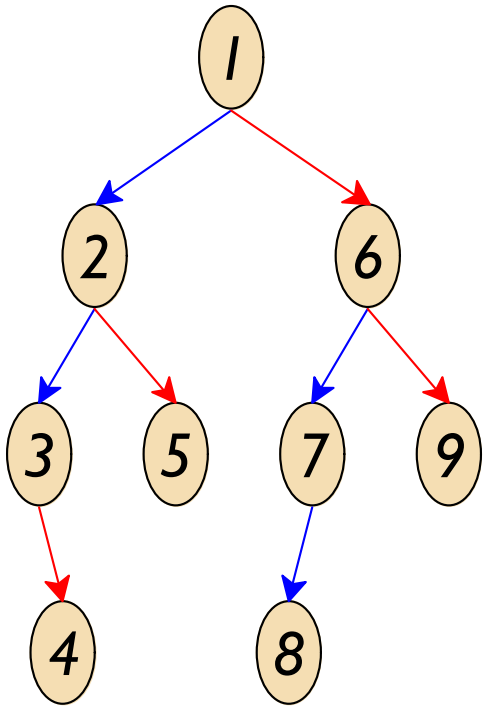
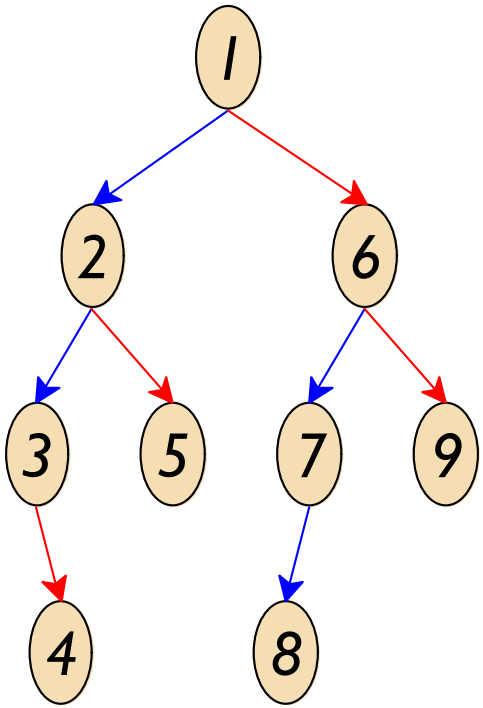
Depth-First Traversal



(black numbers indicate visit order)

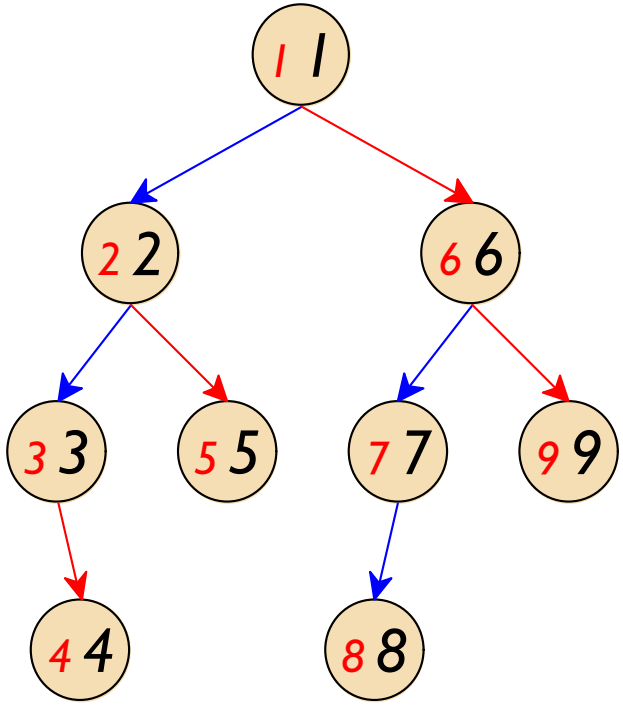
Depth-First Traversal




```
(define (depth-first t)
  (cond
   [(empty? t) ....]
   [else
    .... (node-val t) ....
    (depth-first (node-left t))
    (depth-first (node-right t))]))
```

Depth-First Traversal — Preorder

Preorder visits each node before its children

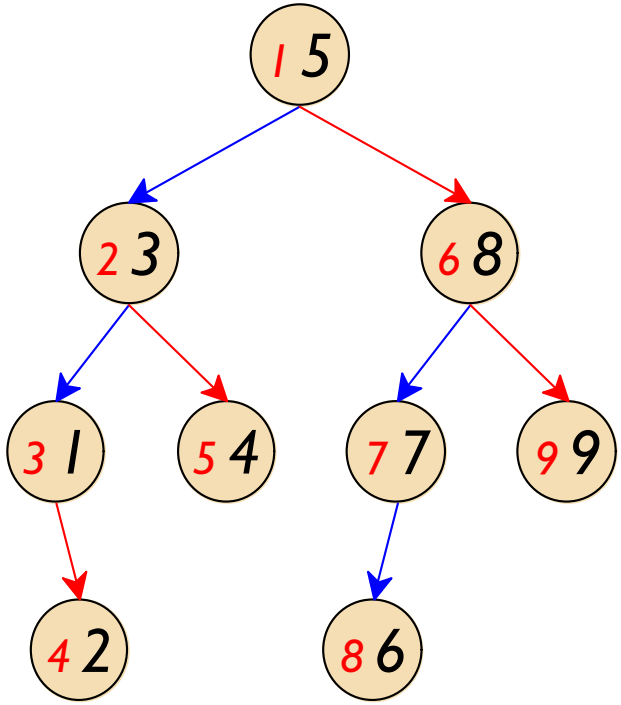



```
(define (preorder t visit)
  (cond
   [(empty? t) (void)]
   [else
    (visit (node-val t))
    (preorder (node-left t)
              visit)
    (preorder (node-right t)
              visit)]))
```

(red numbers are example node values)

Depth-First Traversal — Inorder

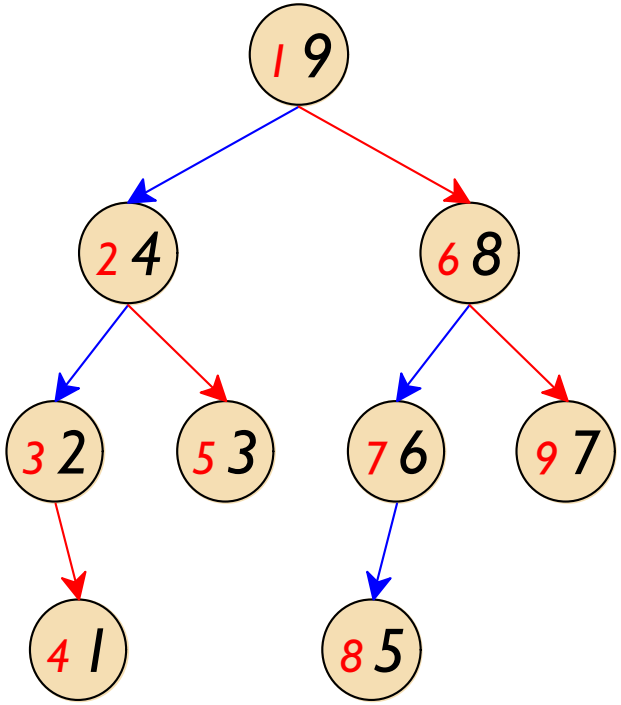
Inorder visits left children first, right children last




```
(define (inorder t visit)
  (cond
   [(empty? t) (void)]
   [else
    (inorder (node-left t)
             visit)
    (visit (node-val t))
    (inorder (node-right t)
             visit)]))
```

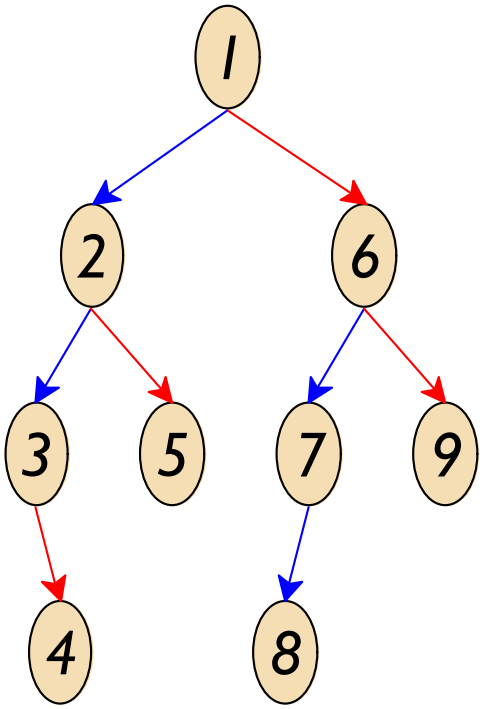
Depth-First Traversal — Postorder

Postorder visits each node after its children




```
(define (postorder t visit)
  (cond
   [(empty? t) (void)]
   [else
    (postorder (node-left t)
               visit)
    (postorder (node-right t)
               visit)
    (visit (node-val t))]))
```

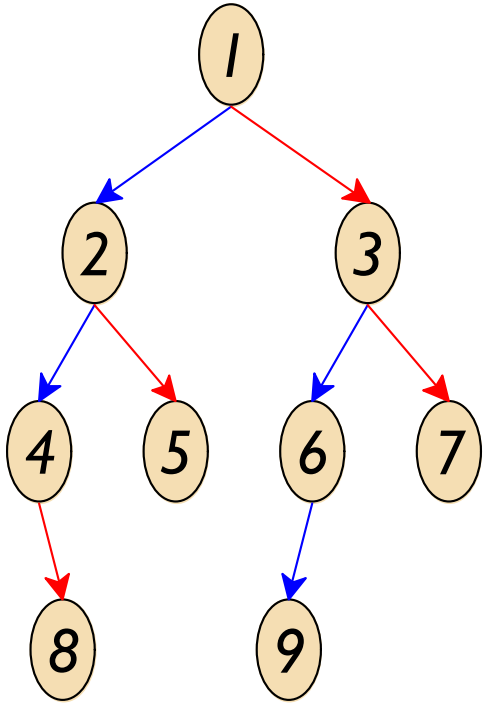
Depth-First Traversal and Loops



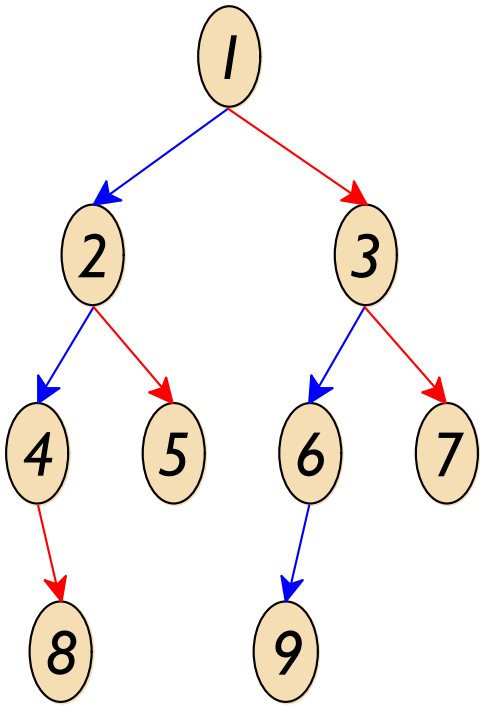

```
void depth_first(tree t) {
  while (t != NULL) {
    visit(t->val);
    t = t->???;
  }
}
```

A depth-first traversal doesn't fit directly into a loop

Breadth-First Traversal



Breadth-First Traversal




```
(define (breadth-first t)
  (cond
   [(empty? t) ....]
   [else
    .... (node-val t) ....
    ; ? explores left tree ?
    (breadth-first (node-left t))
    (breadth-first (node-right t))]))
```

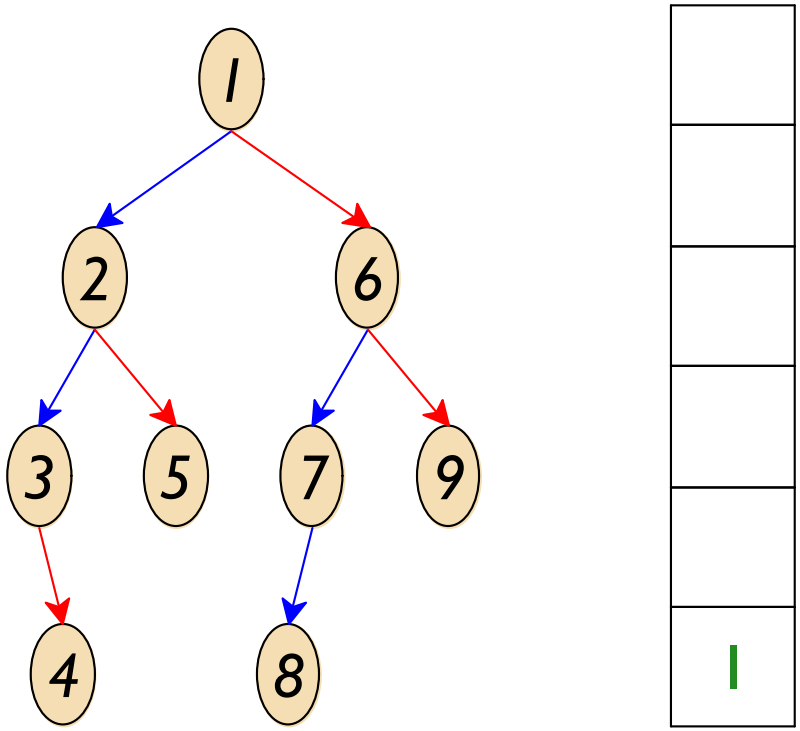
A breadth-first traversal doesn't fit directly into recursion

Traversals as Loops

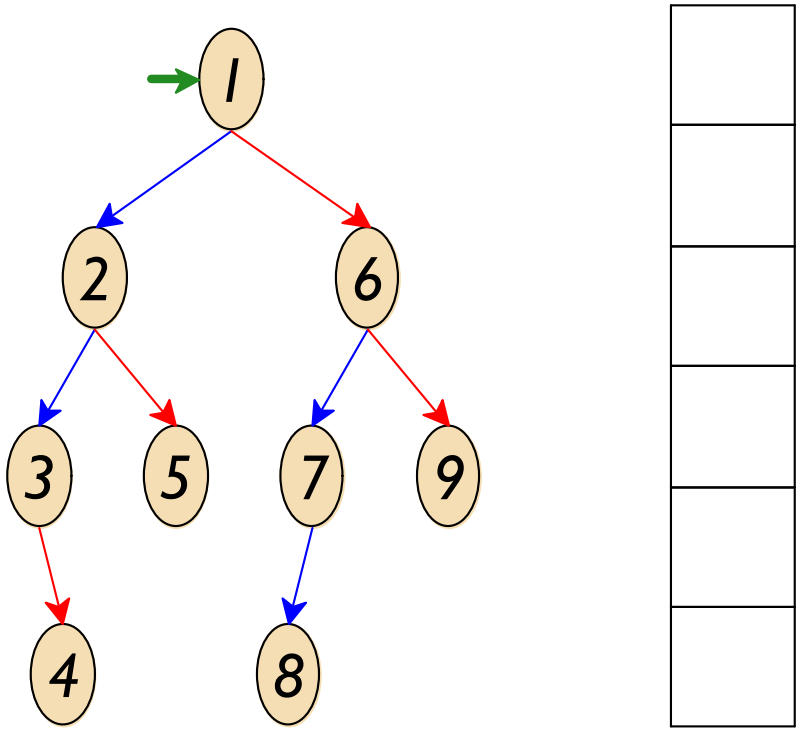
To turn a tree traversal into a loop, use a container to keep track of nodes yet to be visited

- **stack** container ⇒ **depth-first** traversal
- **queue** container ⇒ **breadth-first** traversal

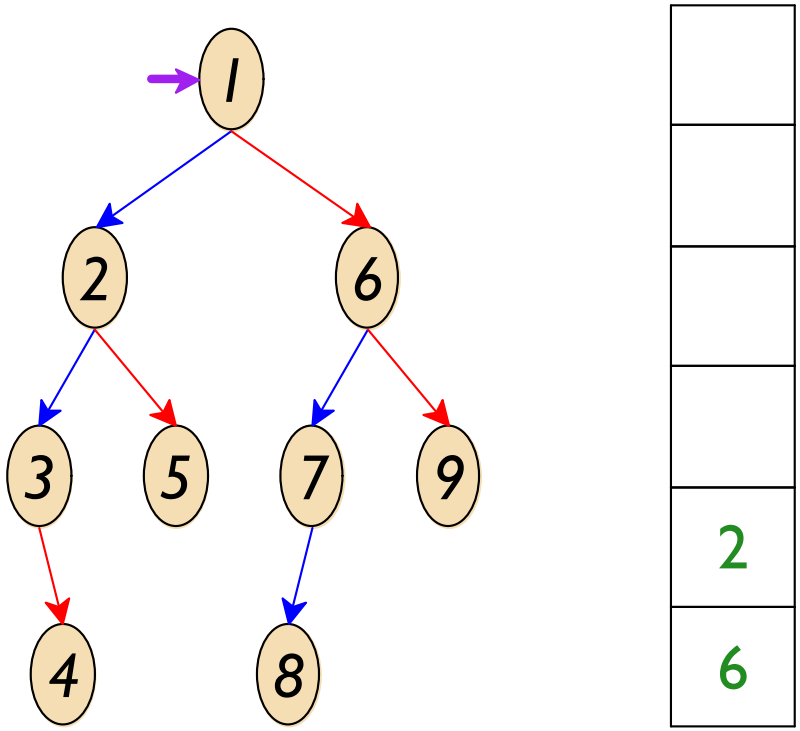
Depth-First Traversal (Preorder) via Stack



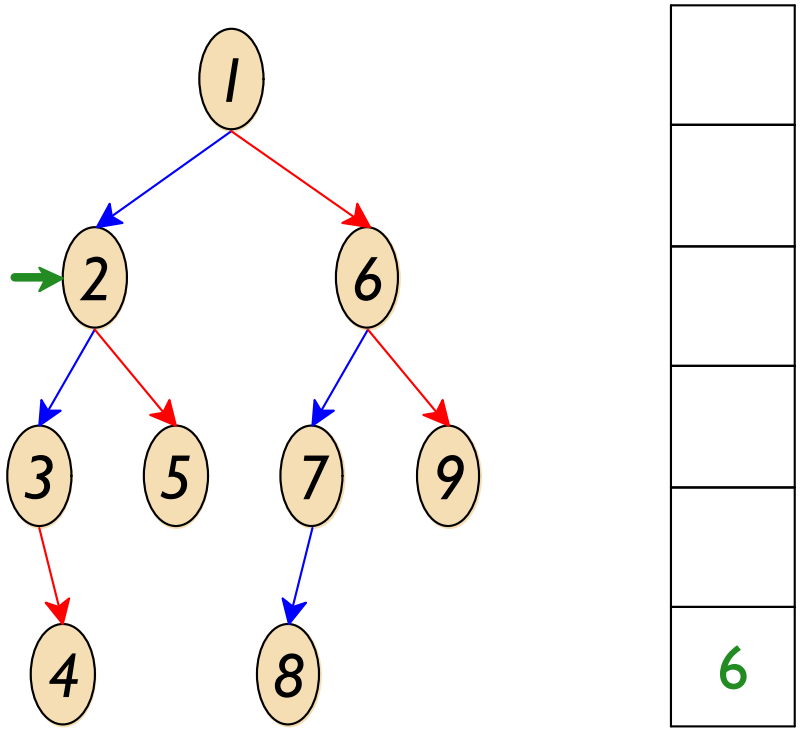
Depth-First Traversal (Preorder) via Stack



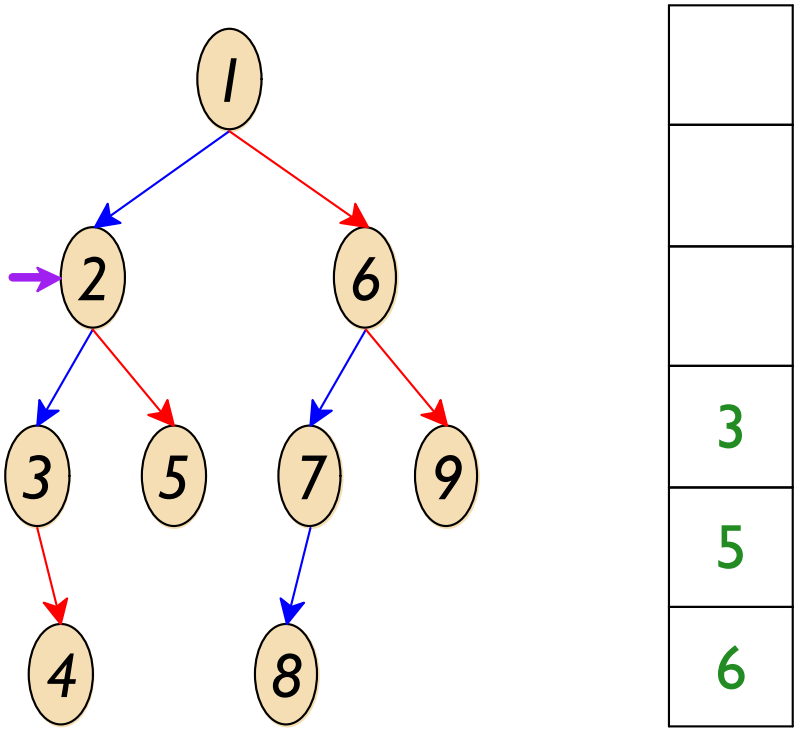
Depth-First Traversal (Preorder) via Stack



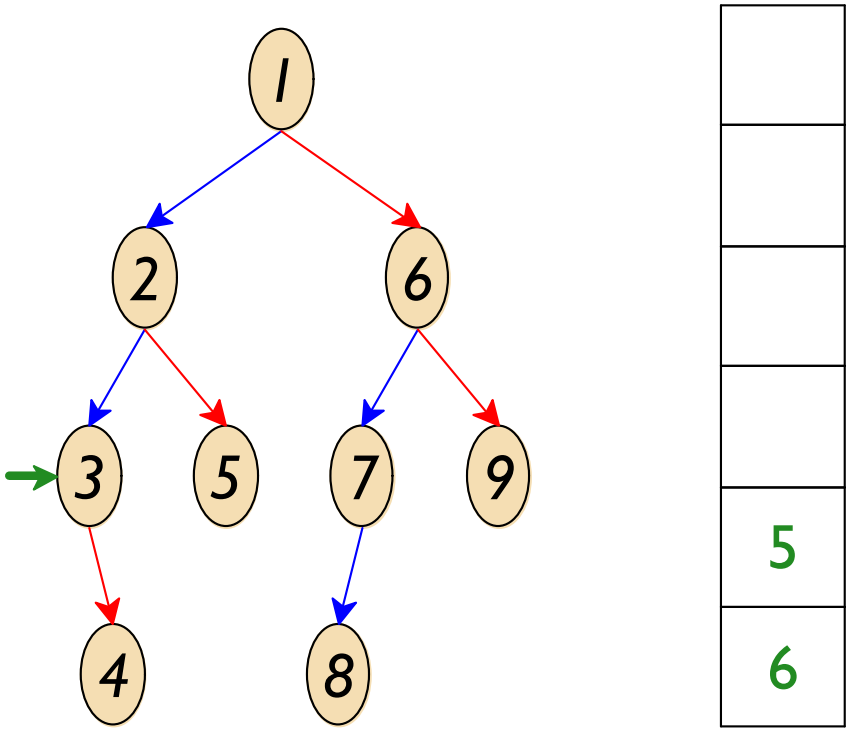
Depth-First Traversal (Preorder) via Stack



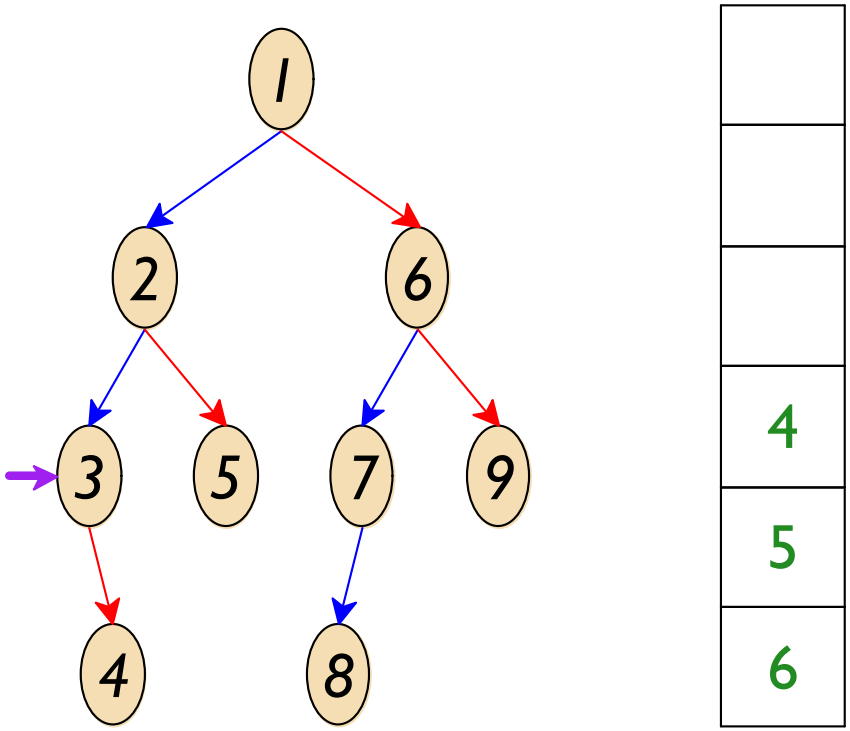
Depth-First Traversal (Preorder) via Stack



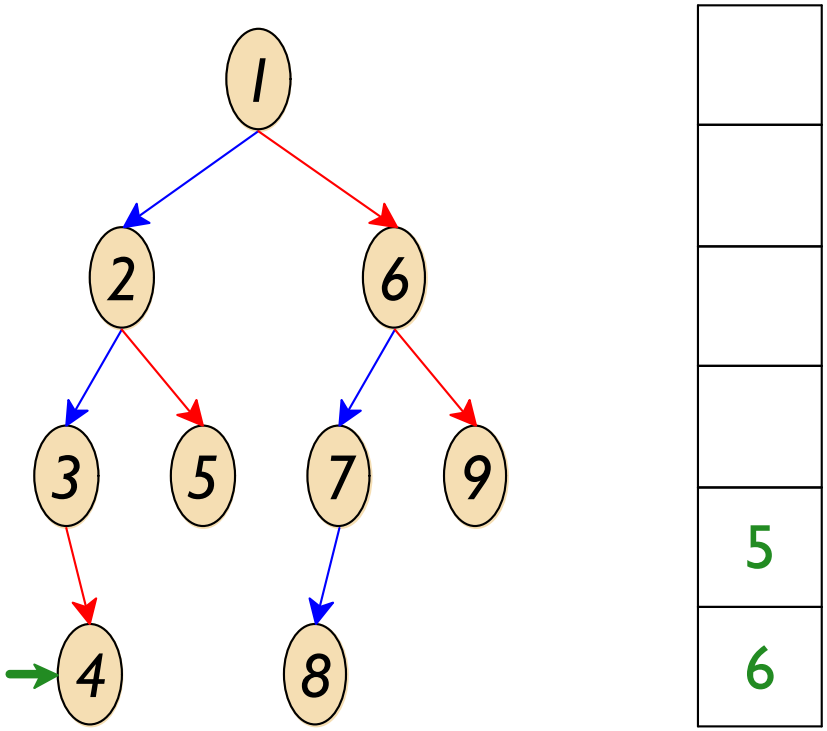
Depth-First Traversal (Preorder) via Stack



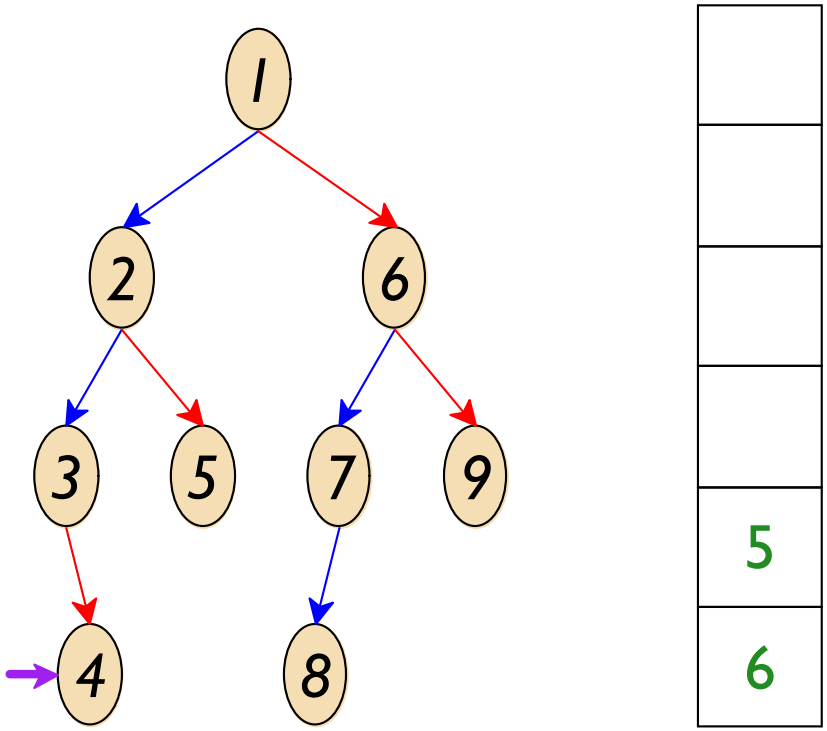
Depth-First Traversal (Preorder) via Stack



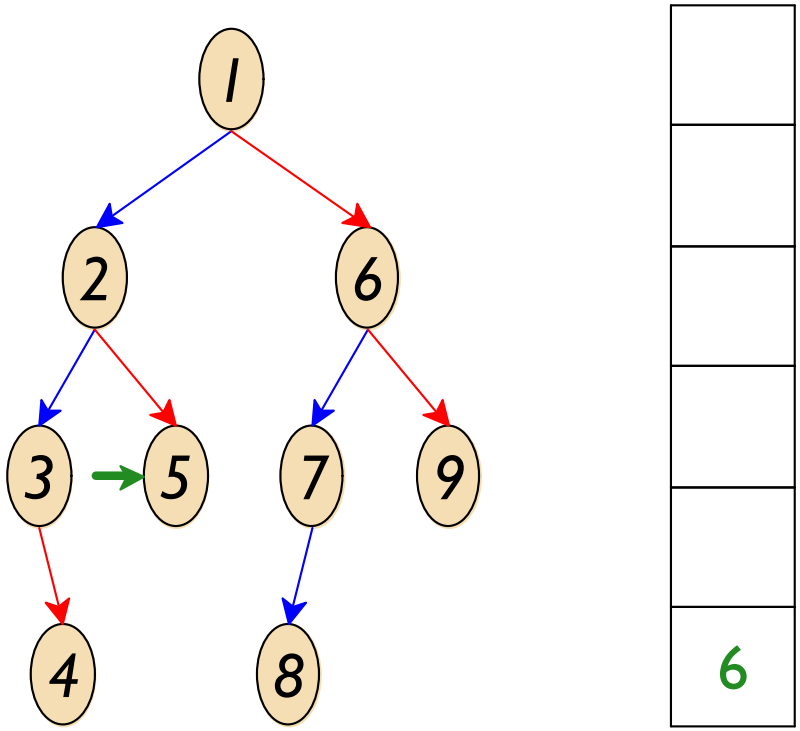
Depth-First Traversal (Preorder) via Stack



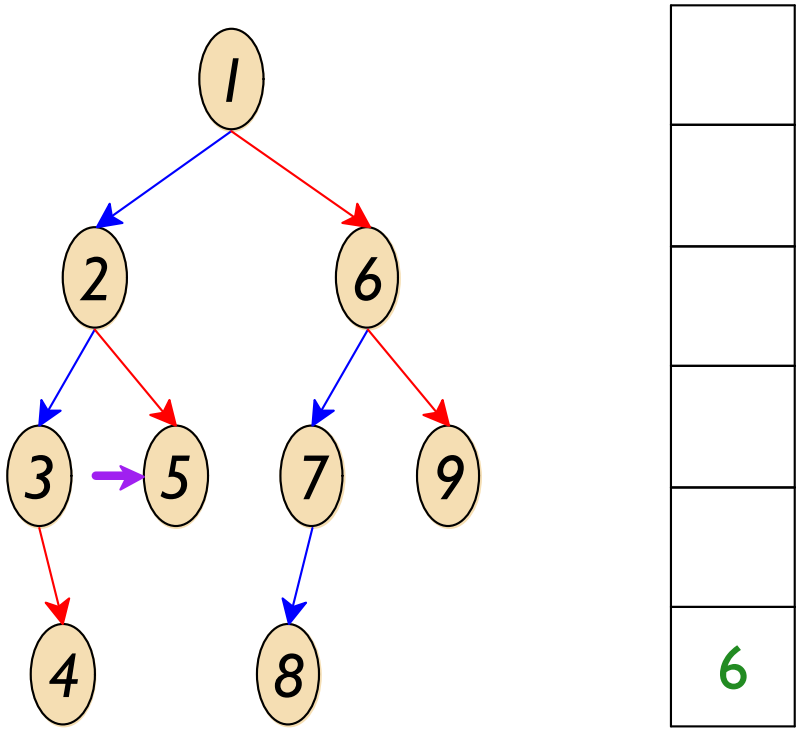
Depth-First Traversal (Preorder) via Stack



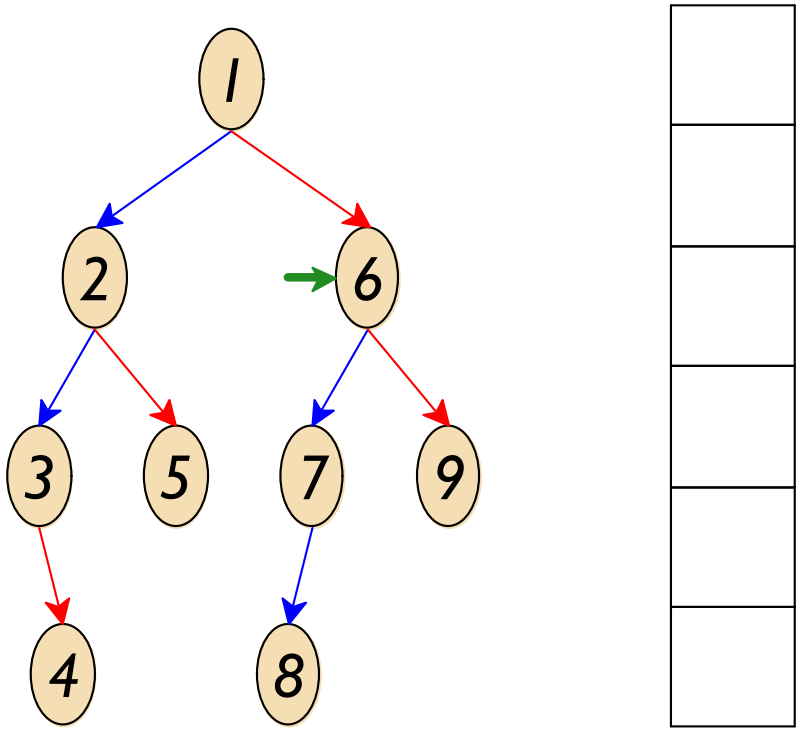
Depth-First Traversal (Preorder) via Stack



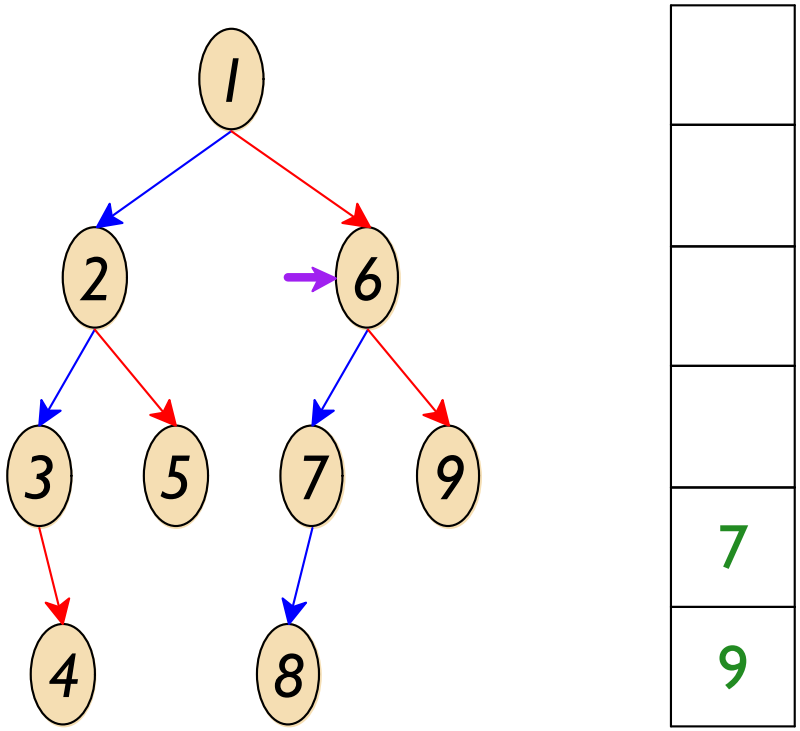
Depth-First Traversal (Preorder) via Stack



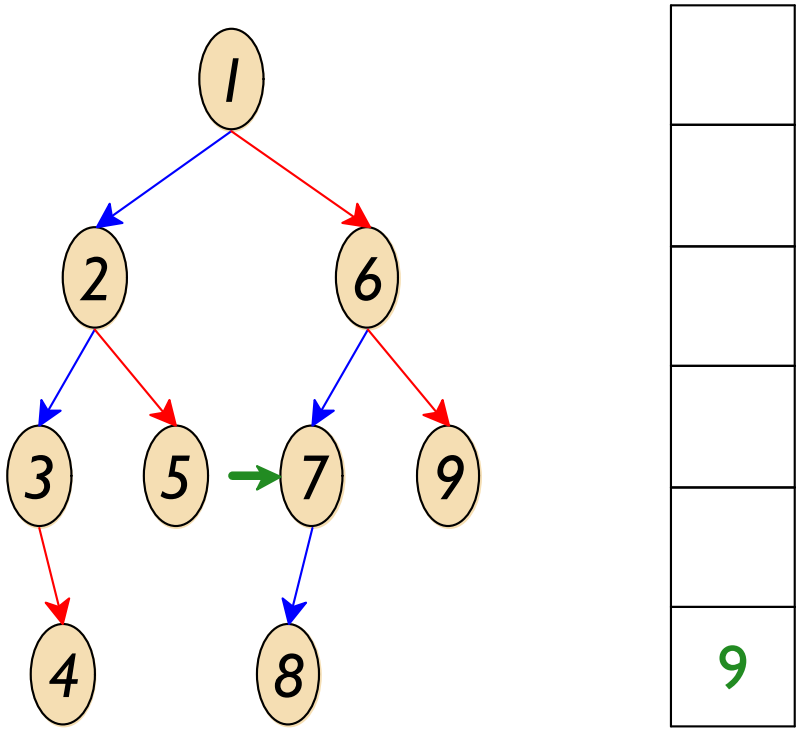
Depth-First Traversal (Preorder) via Stack



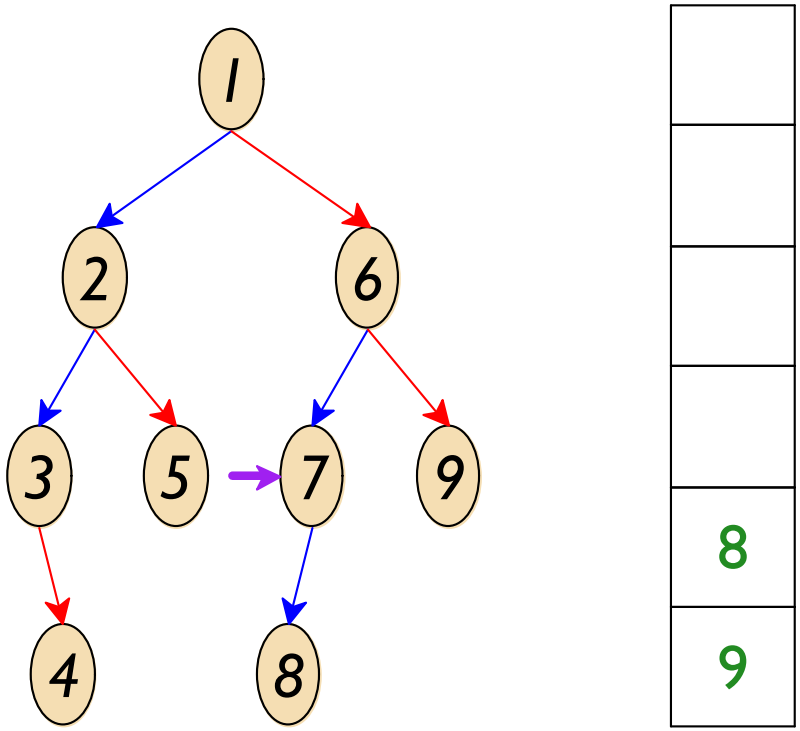
Depth-First Traversal (Preorder) via Stack



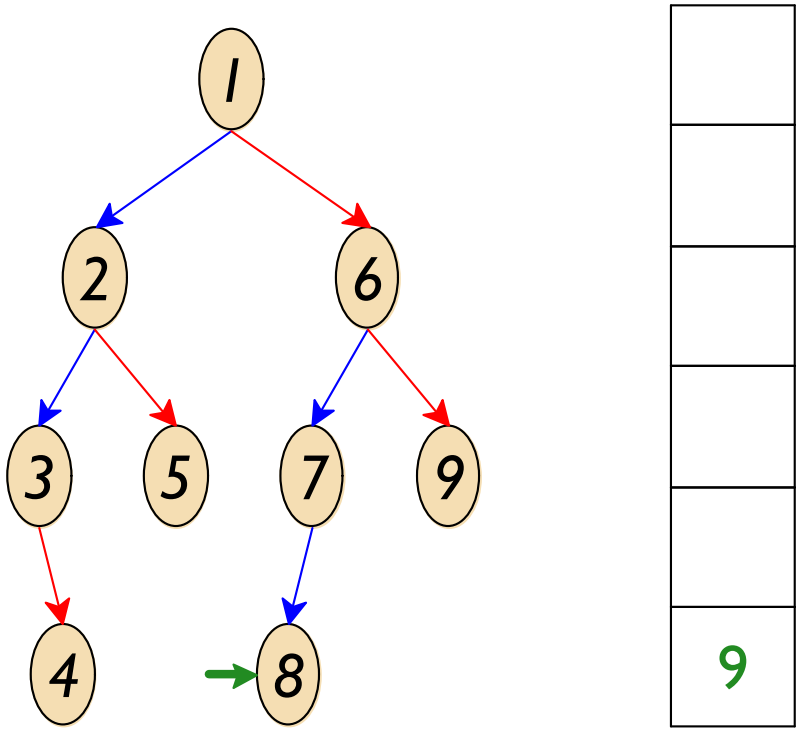
Depth-First Traversal (Preorder) via Stack



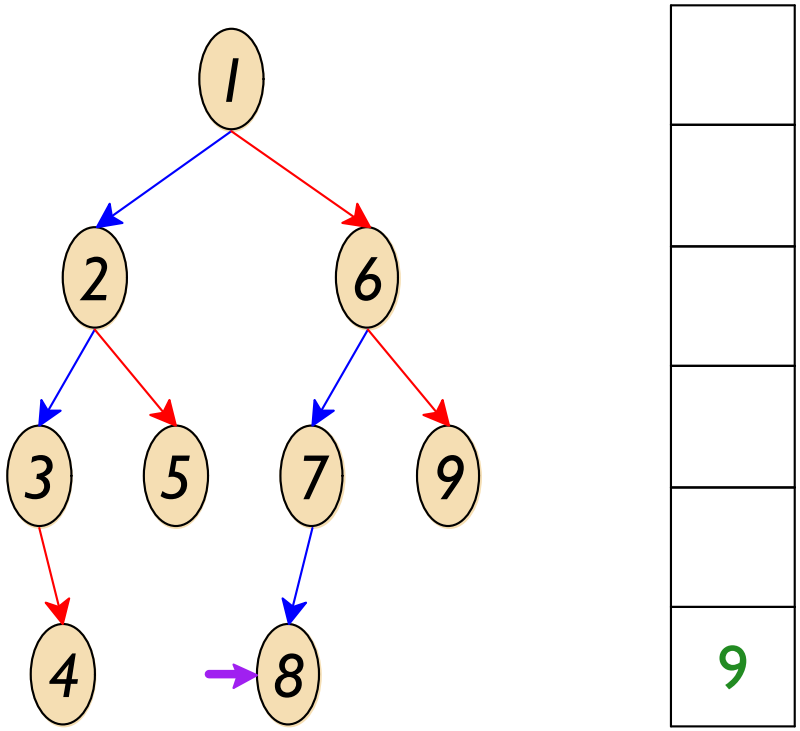
Depth-First Traversal (Preorder) via Stack



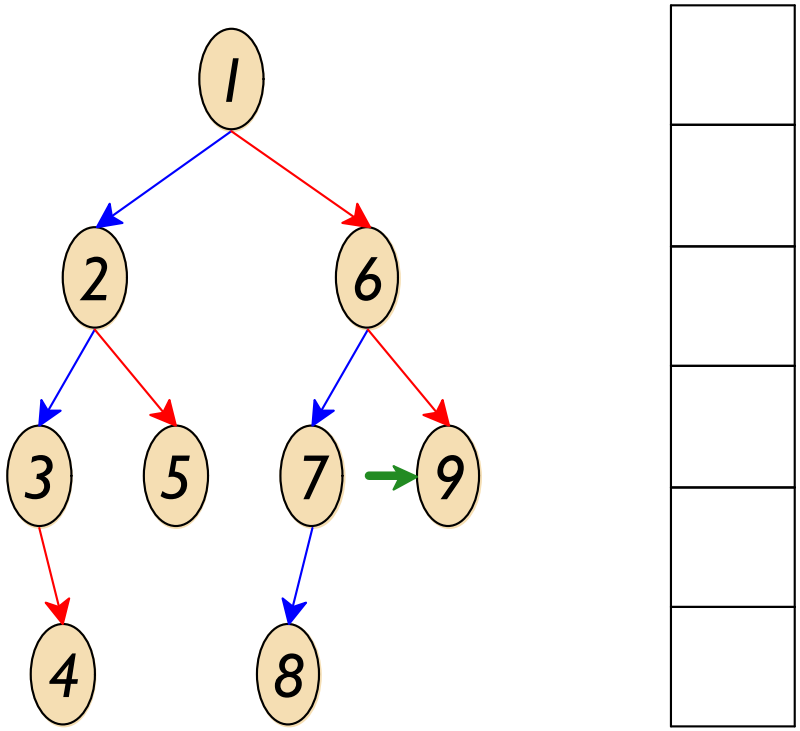
Depth-First Traversal (Preorder) via Stack



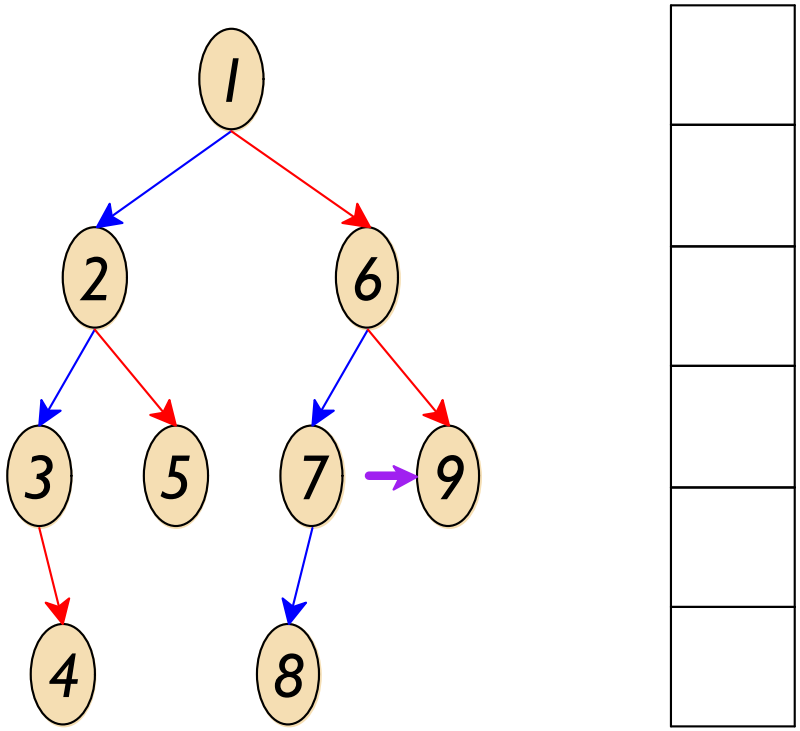
Depth-First Traversal (Preorder) via Stack



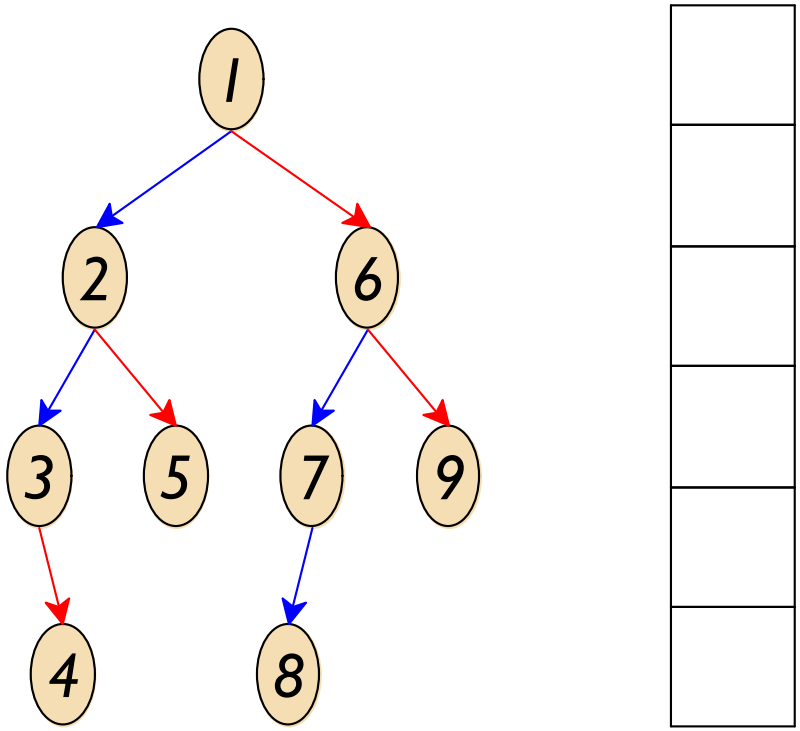
Depth-First Traversal (Preorder) via Stack



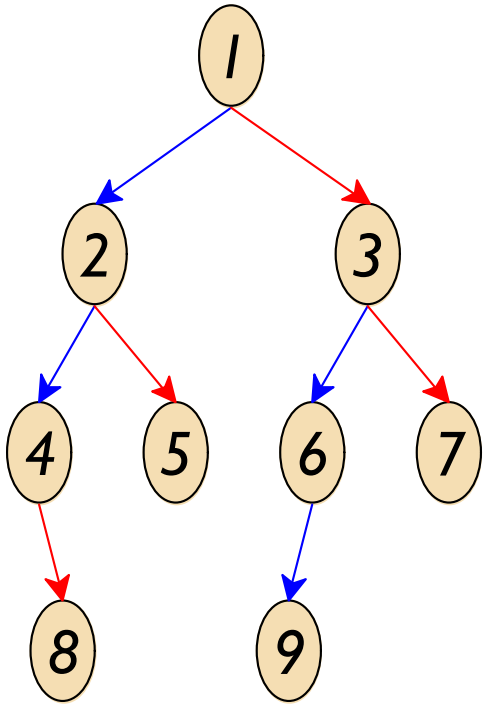
Depth-First Traversal (Preorder) via Stack

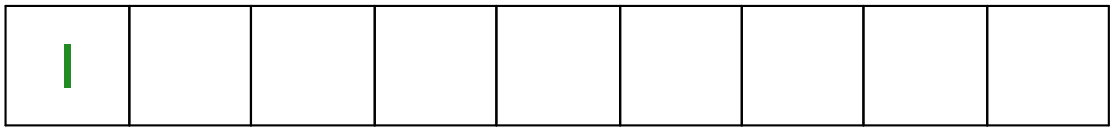


Depth-First Traversal (Preorder) via Stack

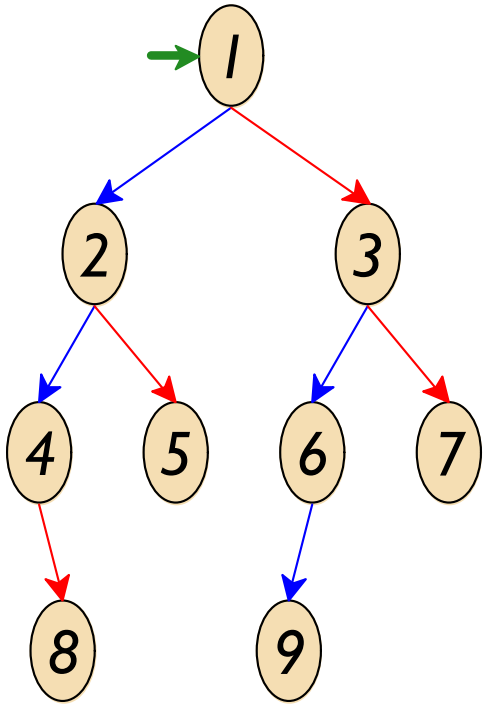


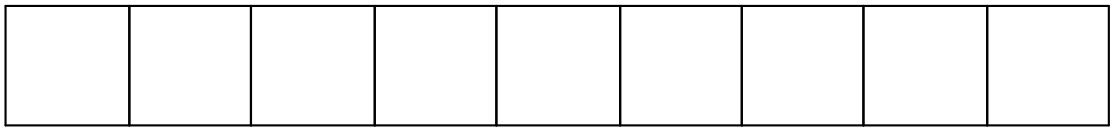
Breadth-First Traversal via Queue



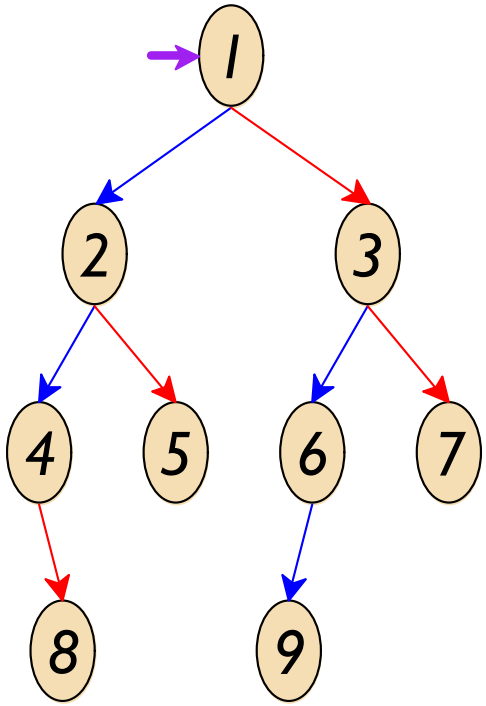


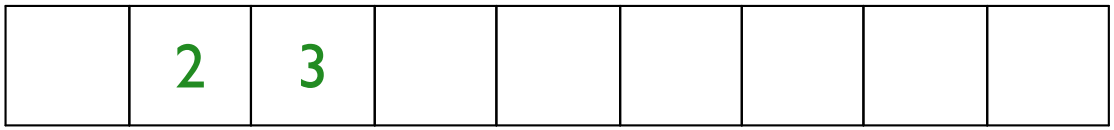
Breadth-First Traversal via Queue



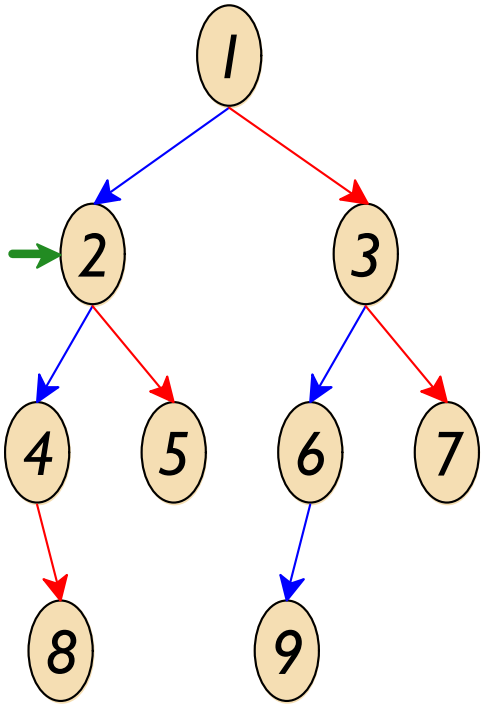


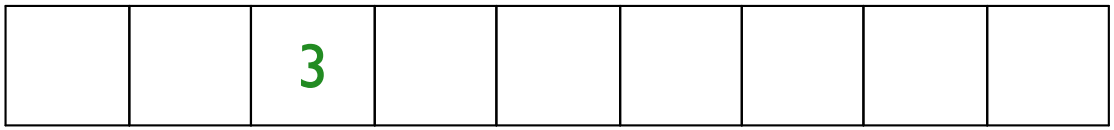
Breadth-First Traversal via Queue



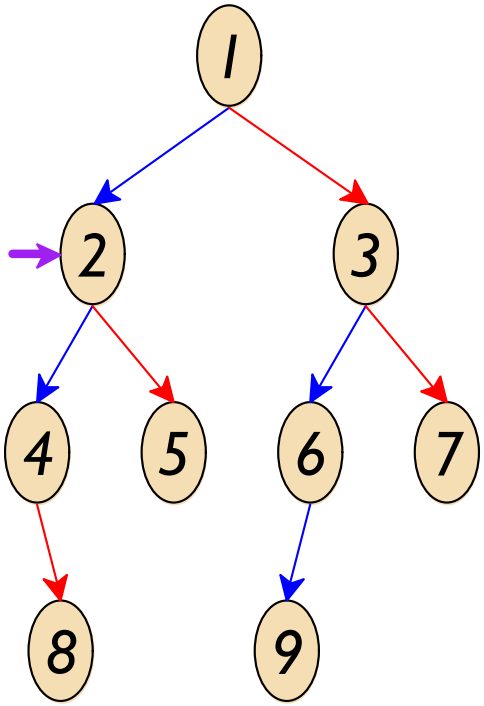


Breadth-First Traversal via Queue

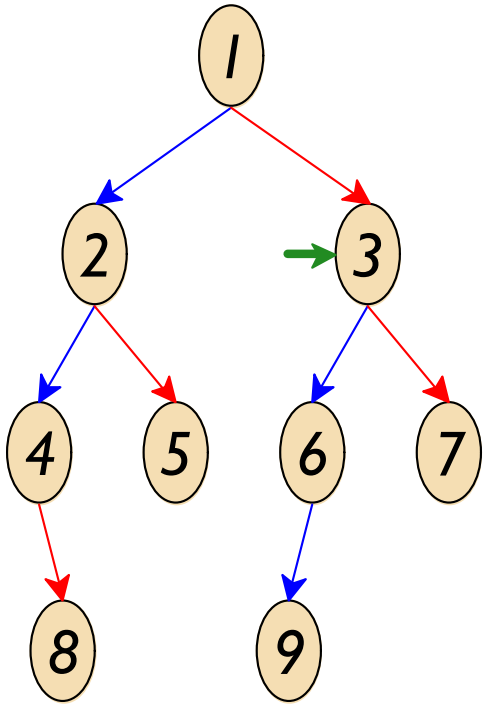




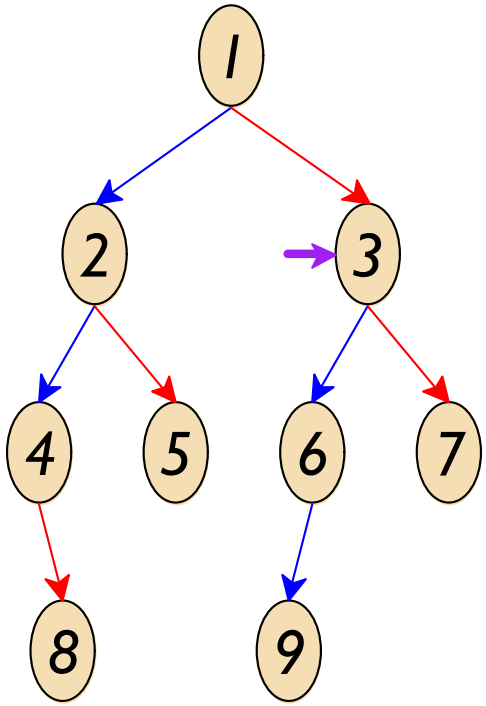
Breadth-First Traversal via Queue



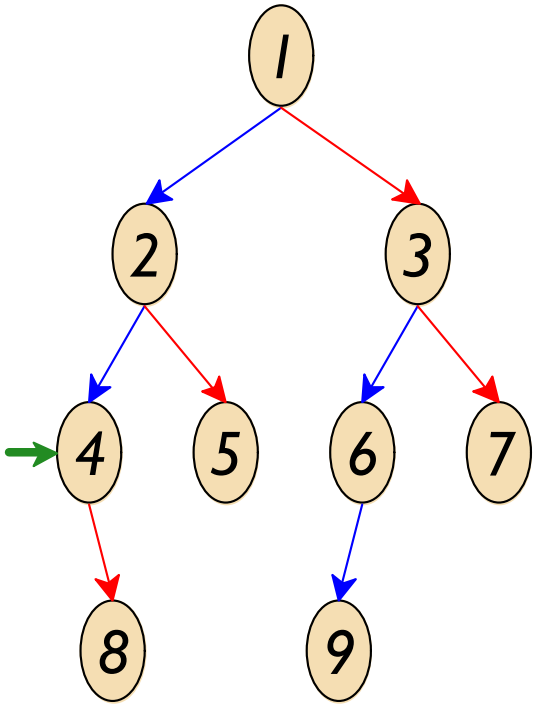
Breadth-First Traversal via Queue



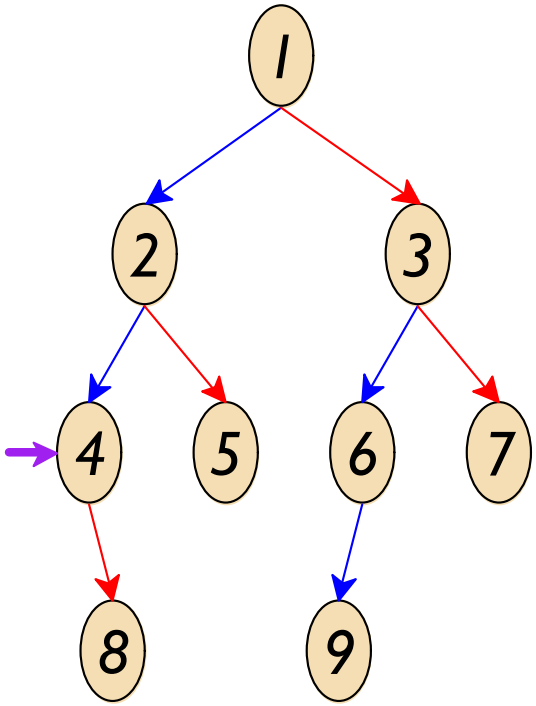
Breadth-First Traversal via Queue



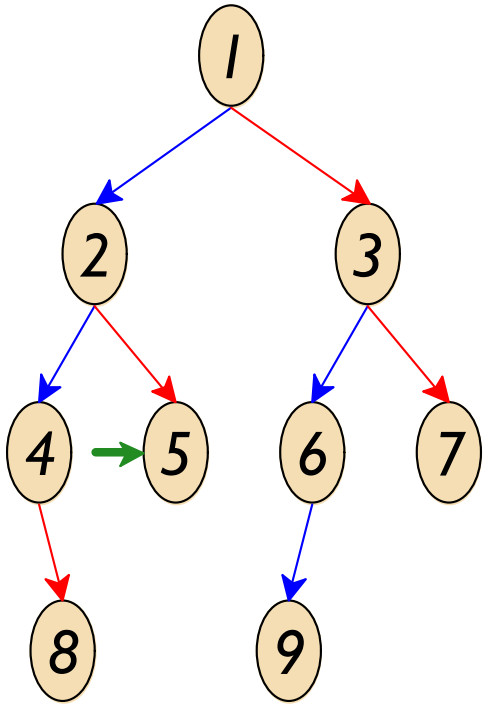
Breadth-First Traversal via Queue

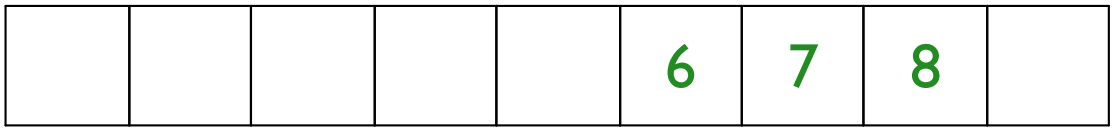


Breadth-First Traversal via Queue

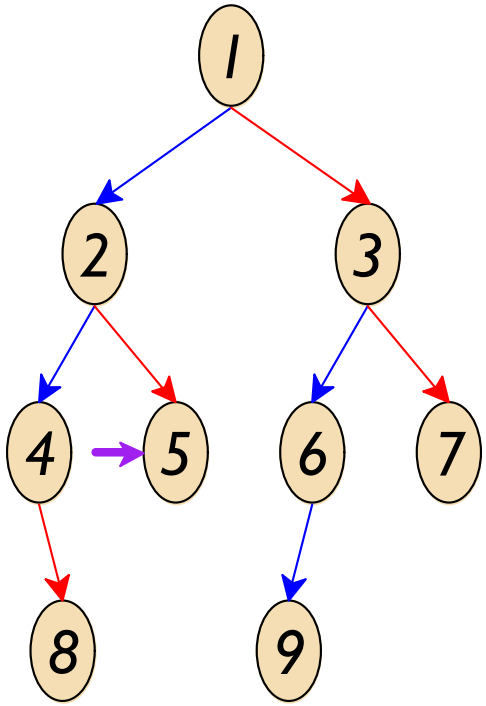


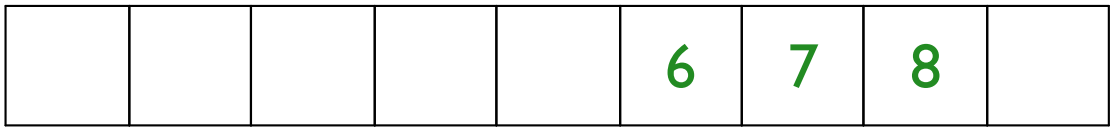
Breadth-First Traversal via Queue



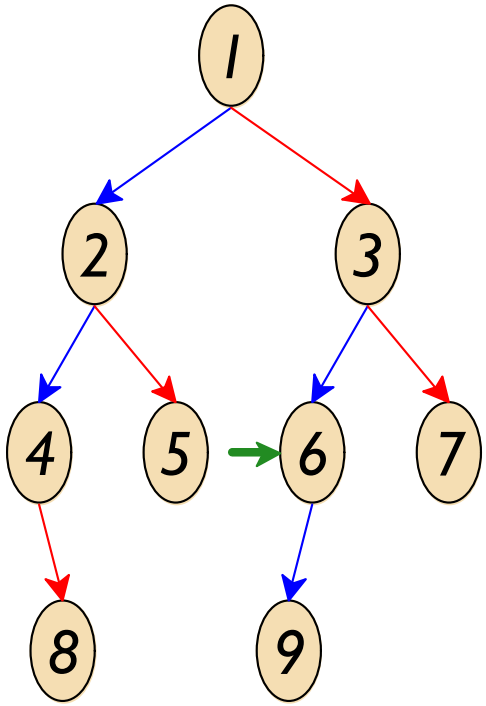


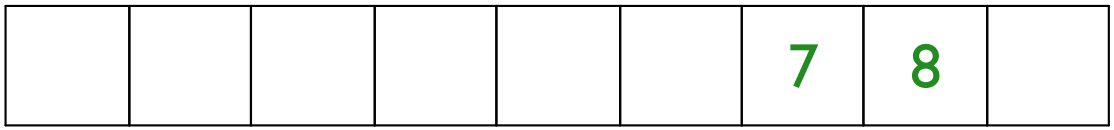
Breadth-First Traversal via Queue



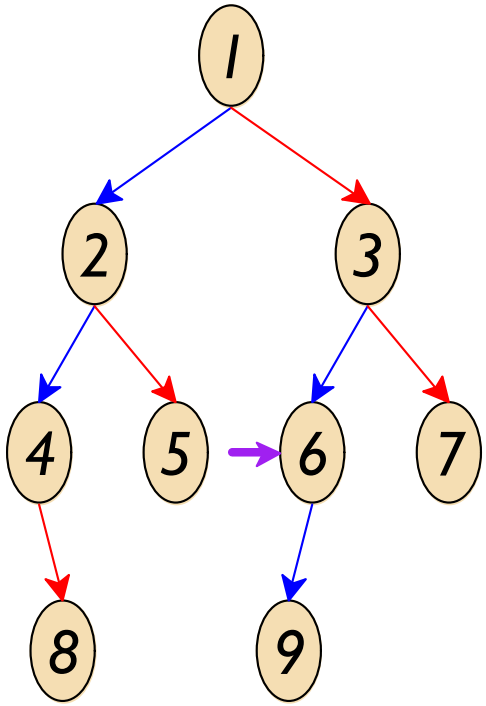


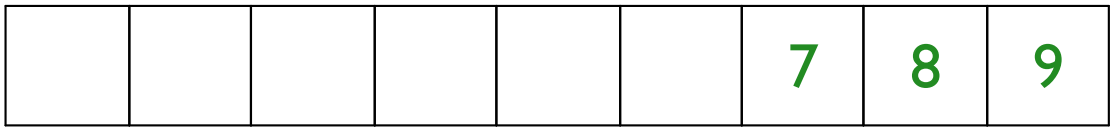
Breadth-First Traversal via Queue



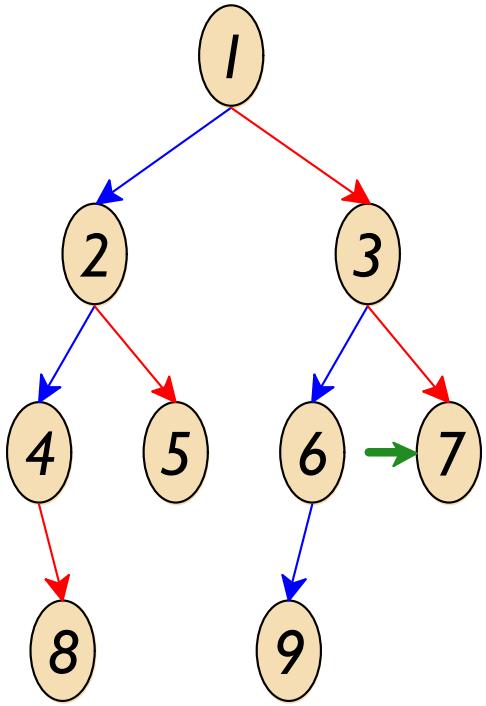


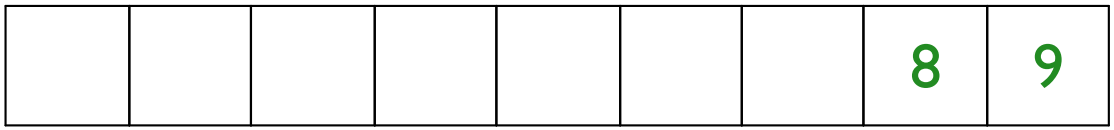
Breadth-First Traversal via Queue



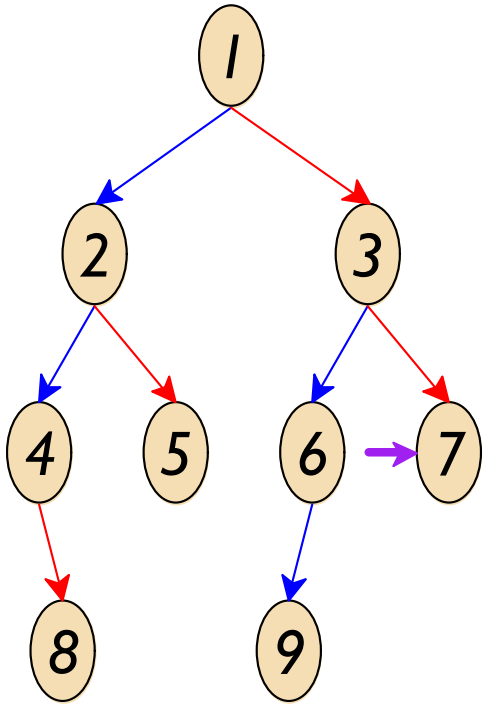


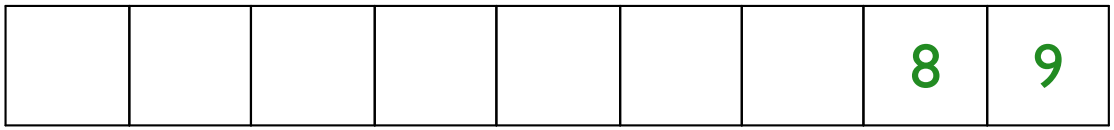
Breadth-First Traversal via Queue



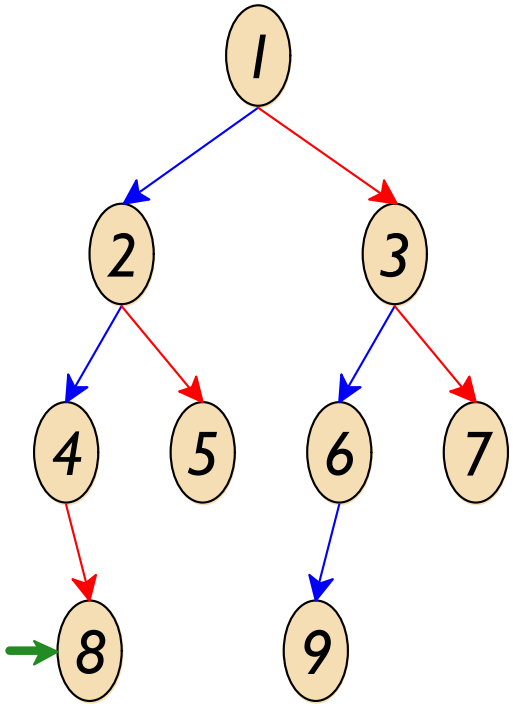


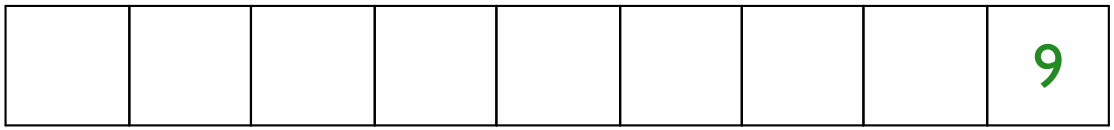
Breadth-First Traversal via Queue



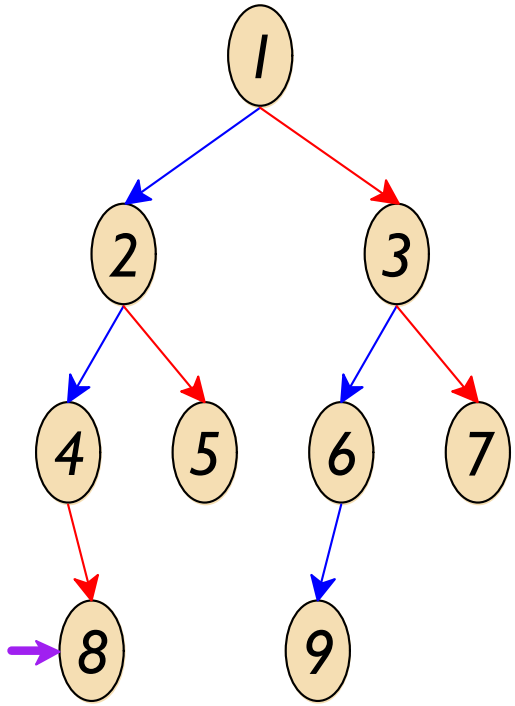


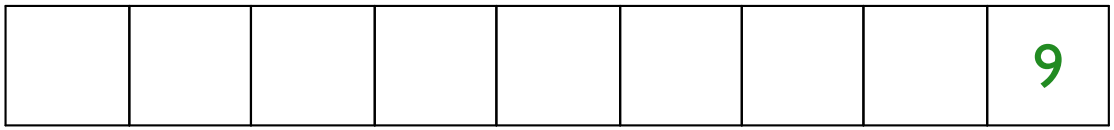
Breadth-First Traversal via Queue



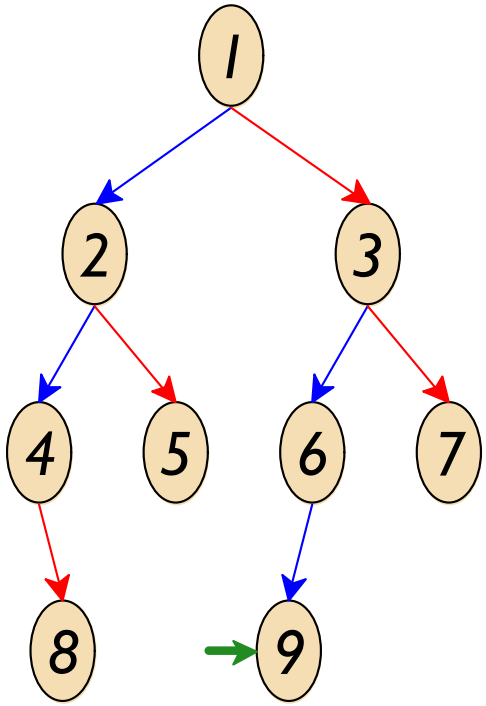


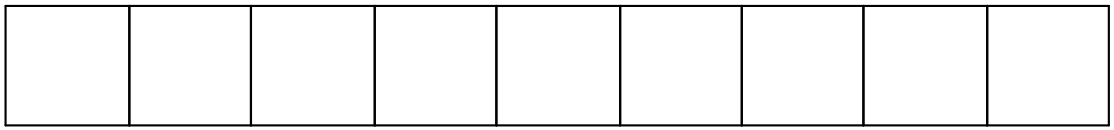
Breadth-First Traversal via Queue





Breadth-First Traversal via Queue





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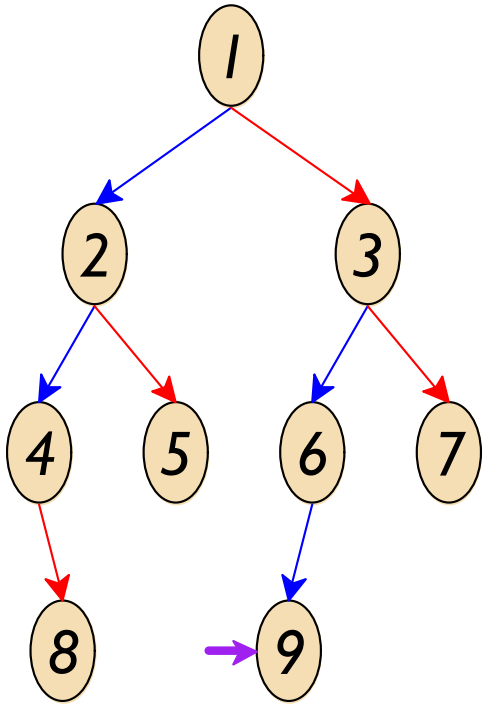

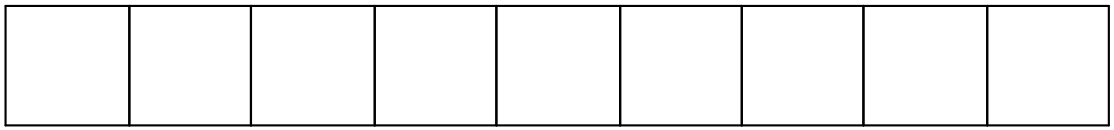

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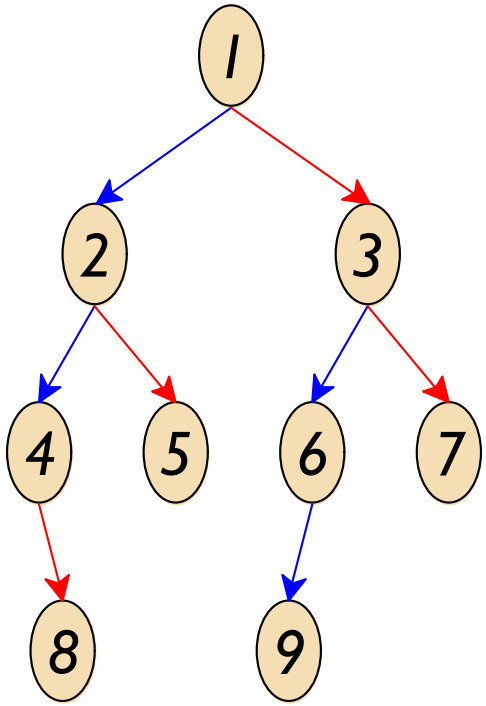
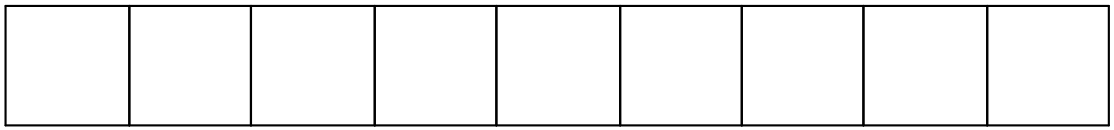
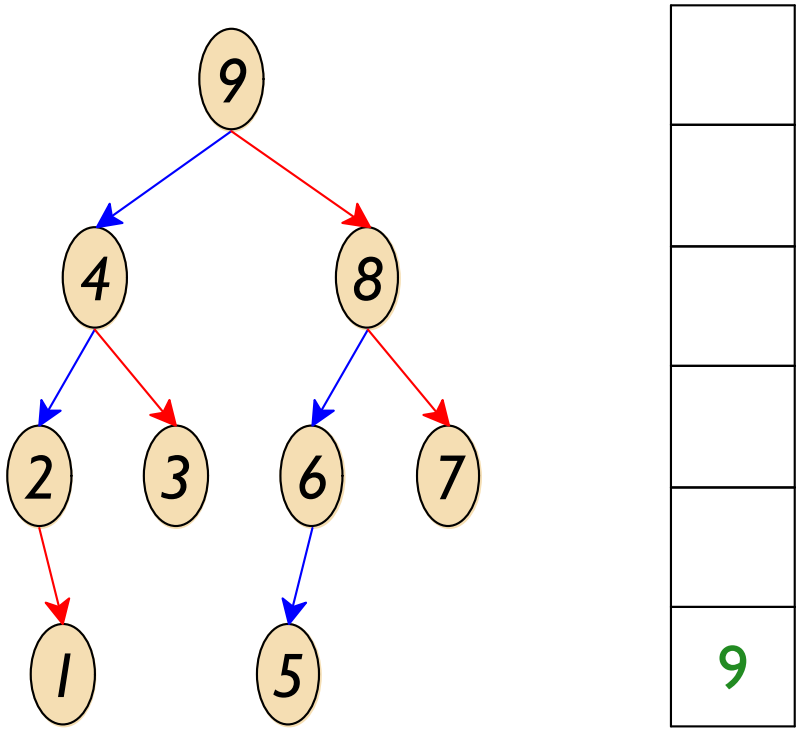




Depth-First Traversal (Postorder) via Stack



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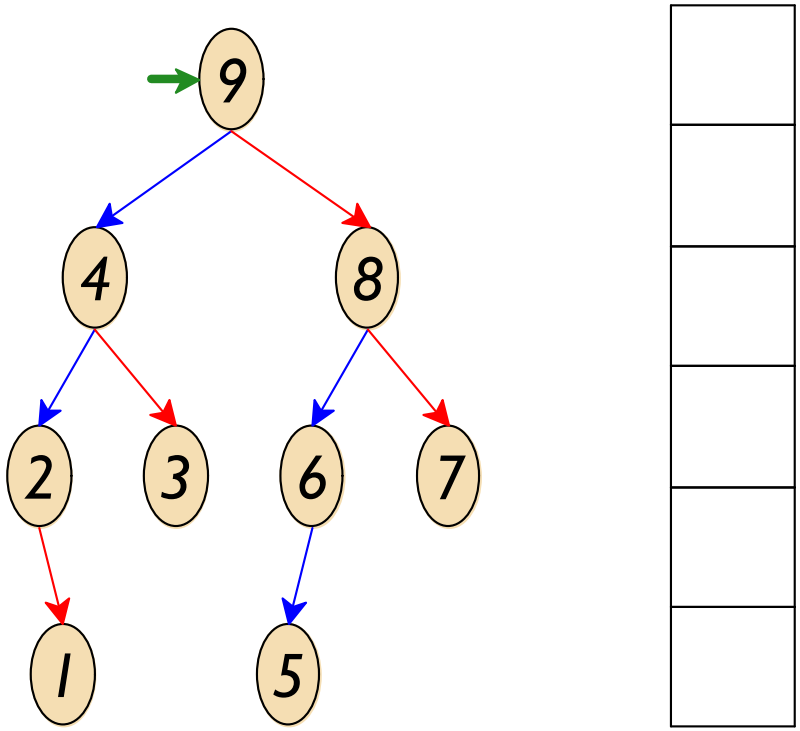

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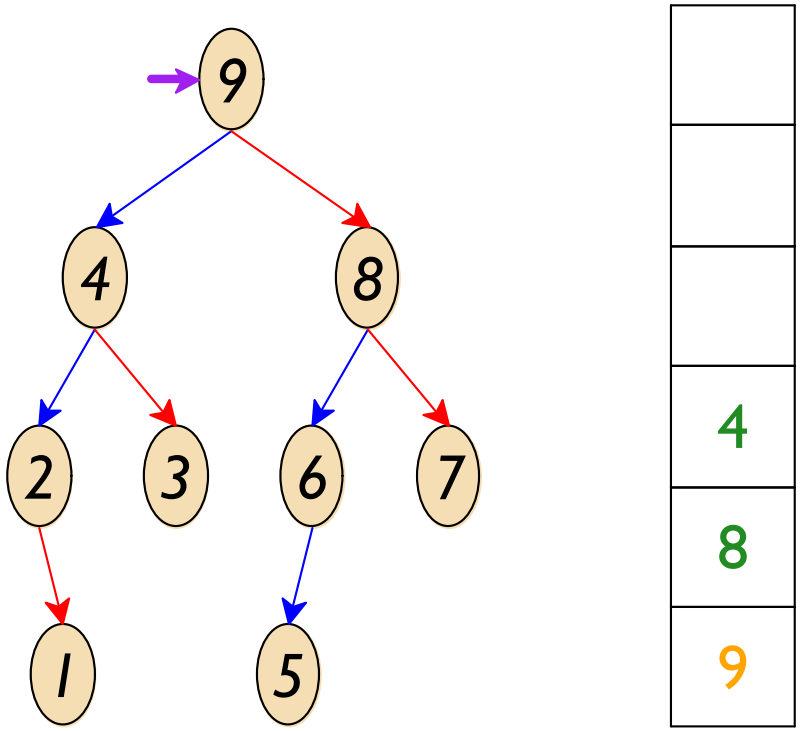

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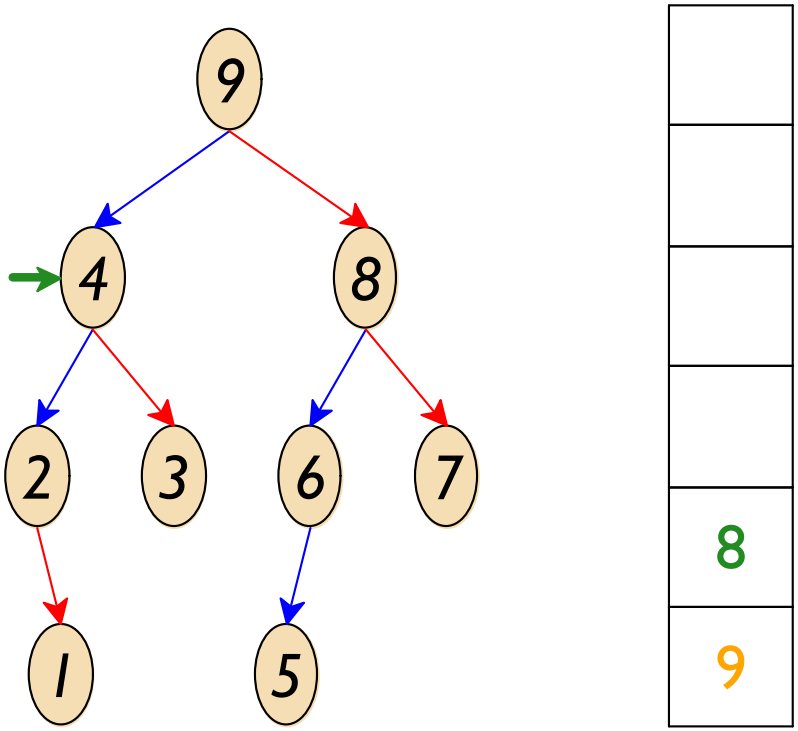

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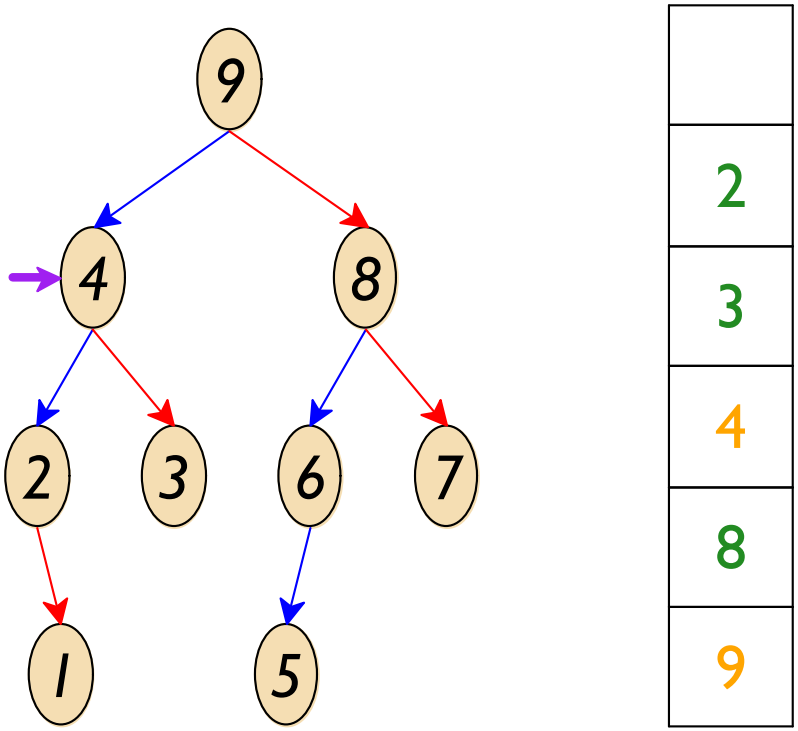

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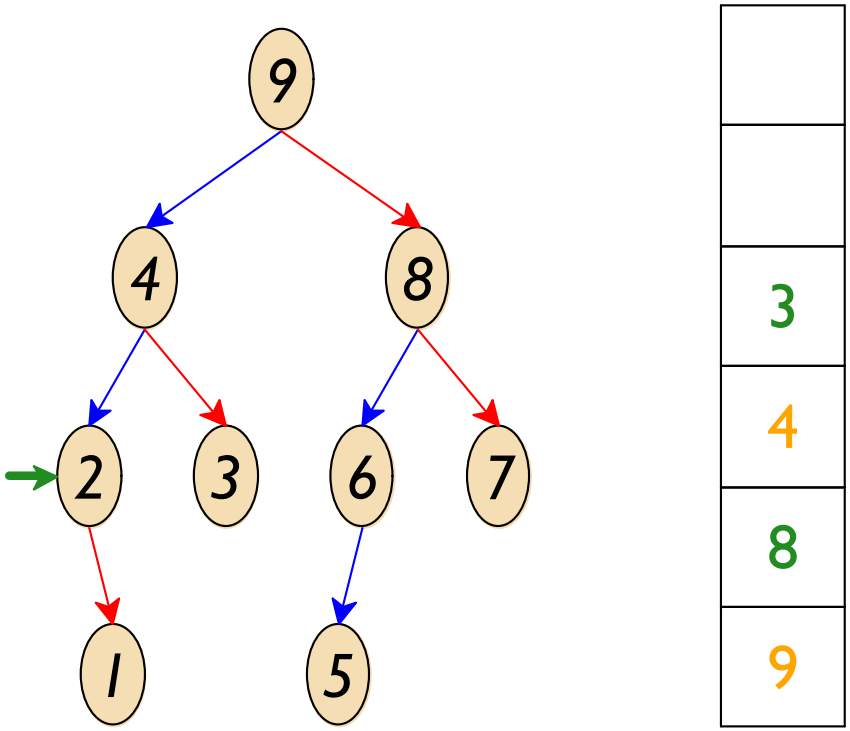

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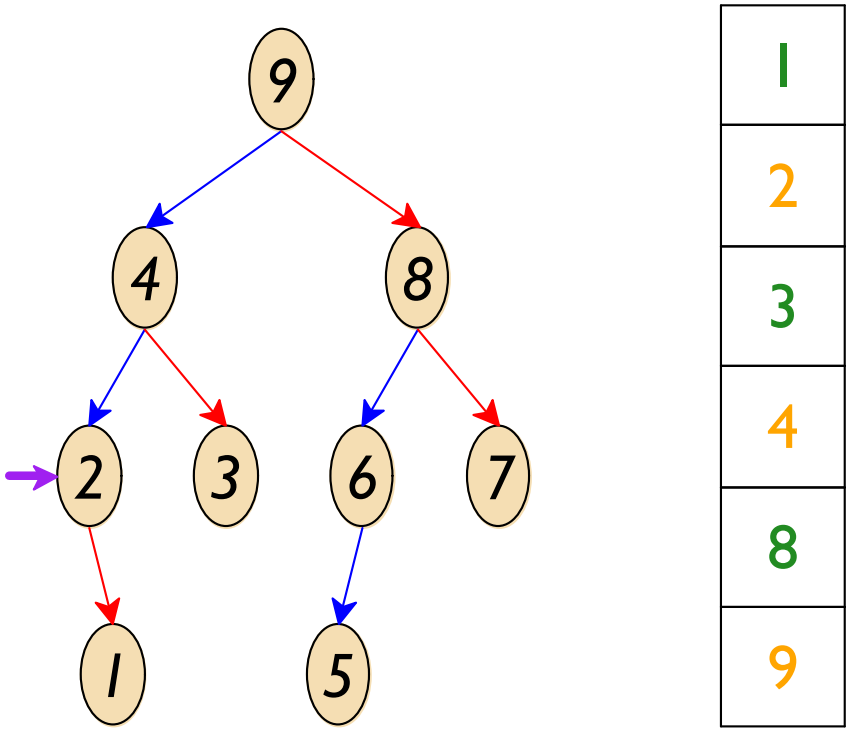
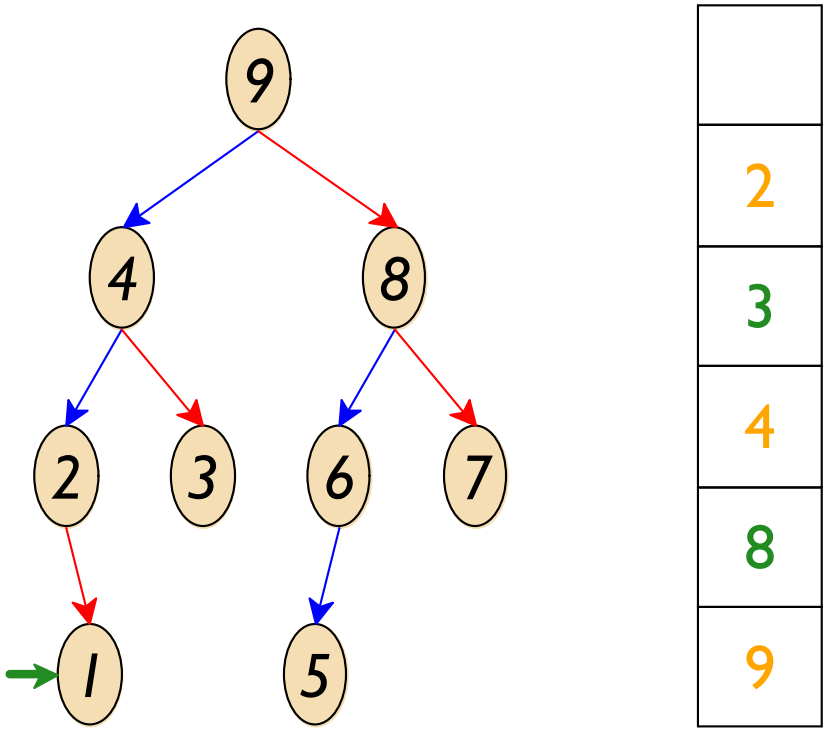


Depth-First Traversal (Postorder) via Stack



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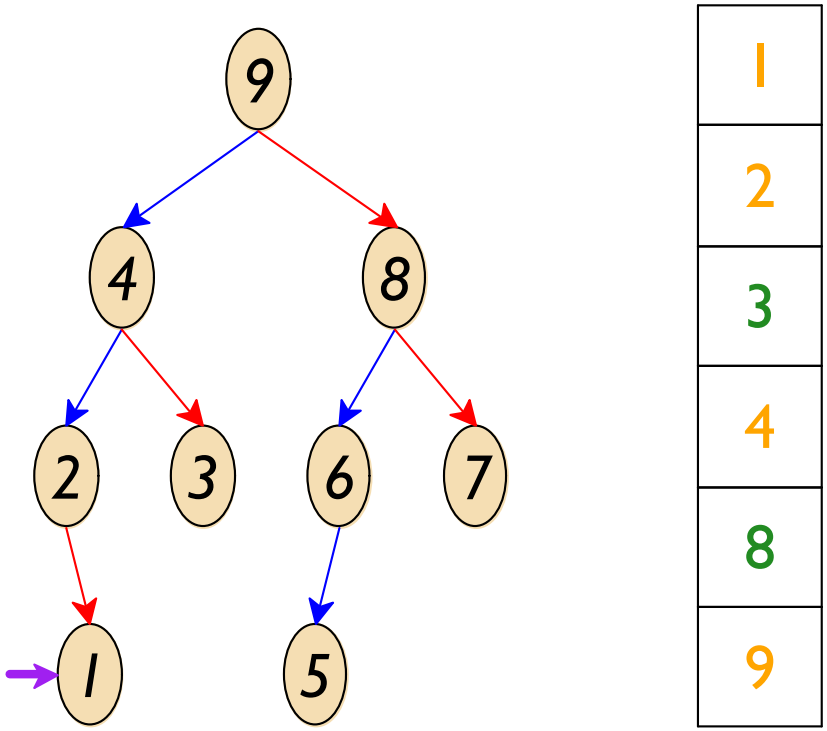

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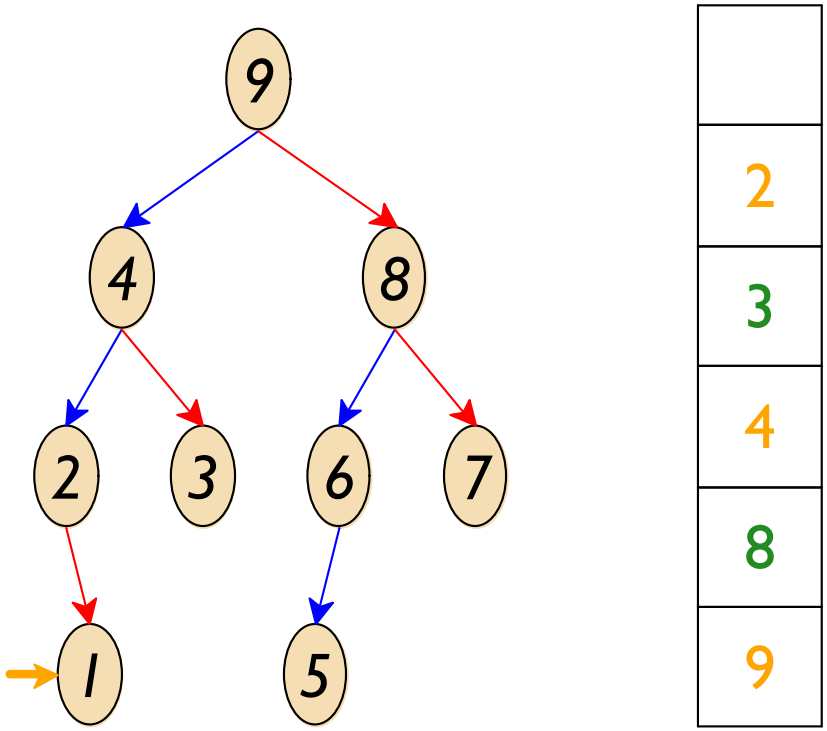

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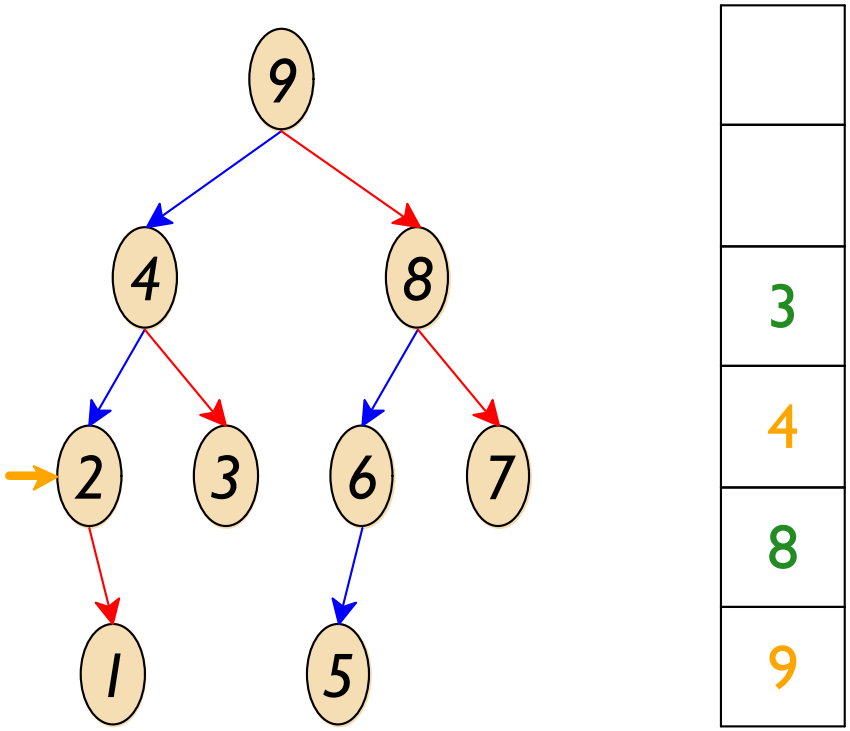

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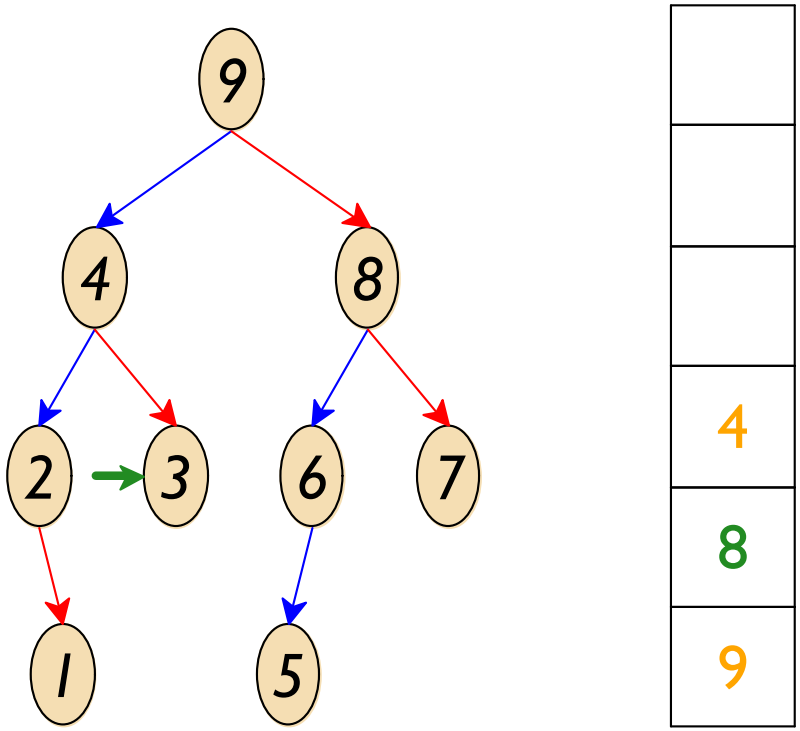

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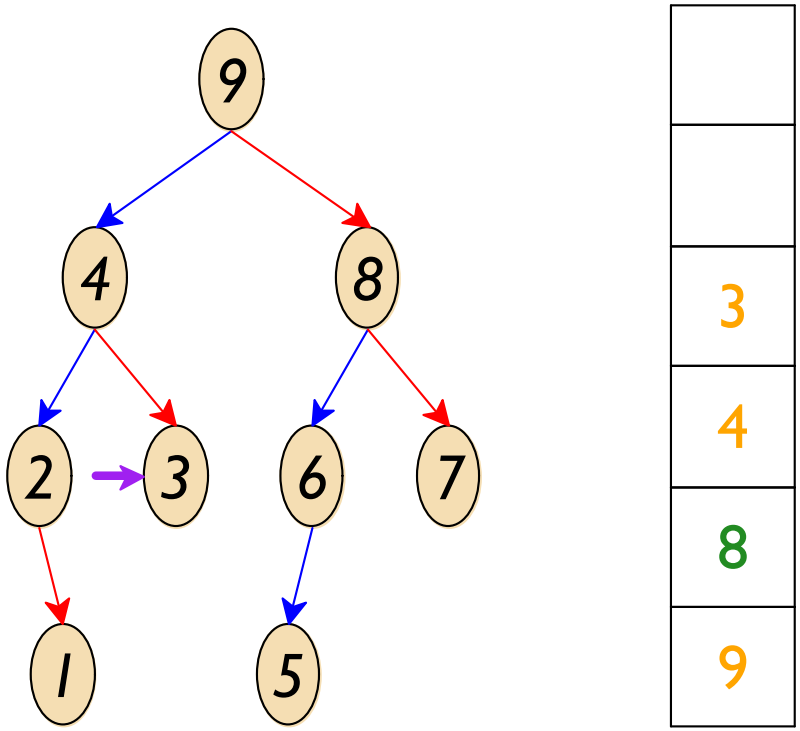

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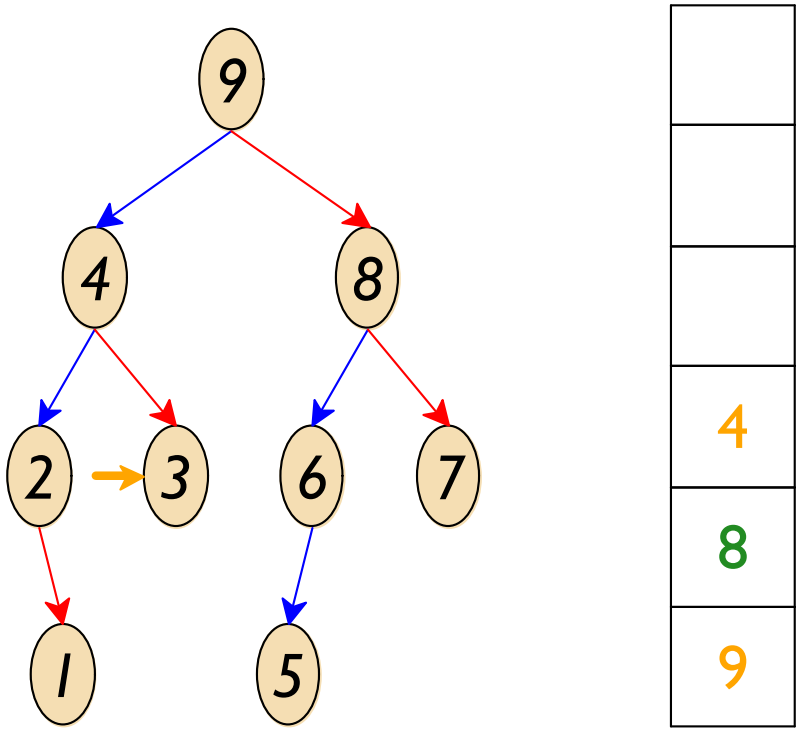

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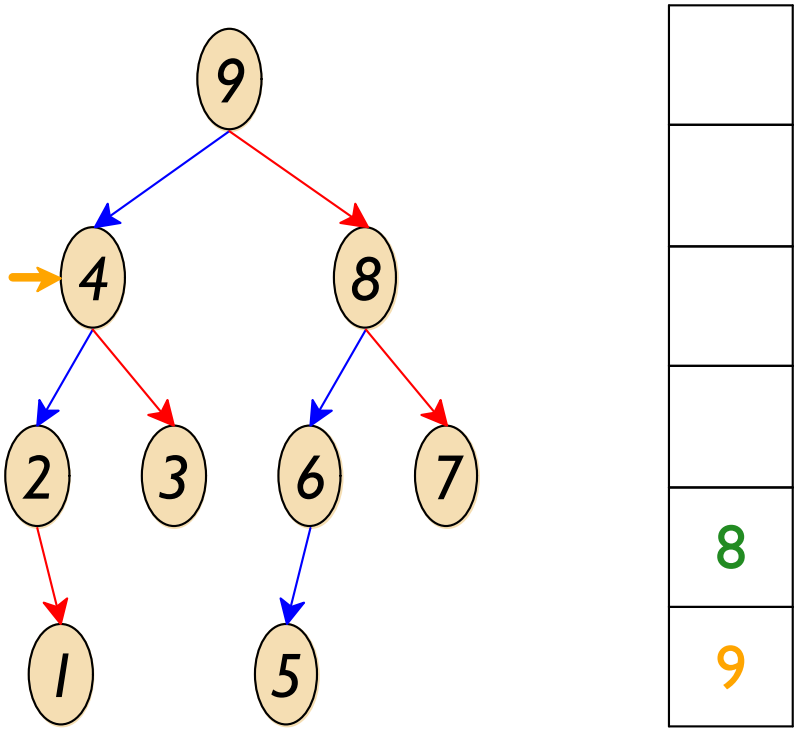

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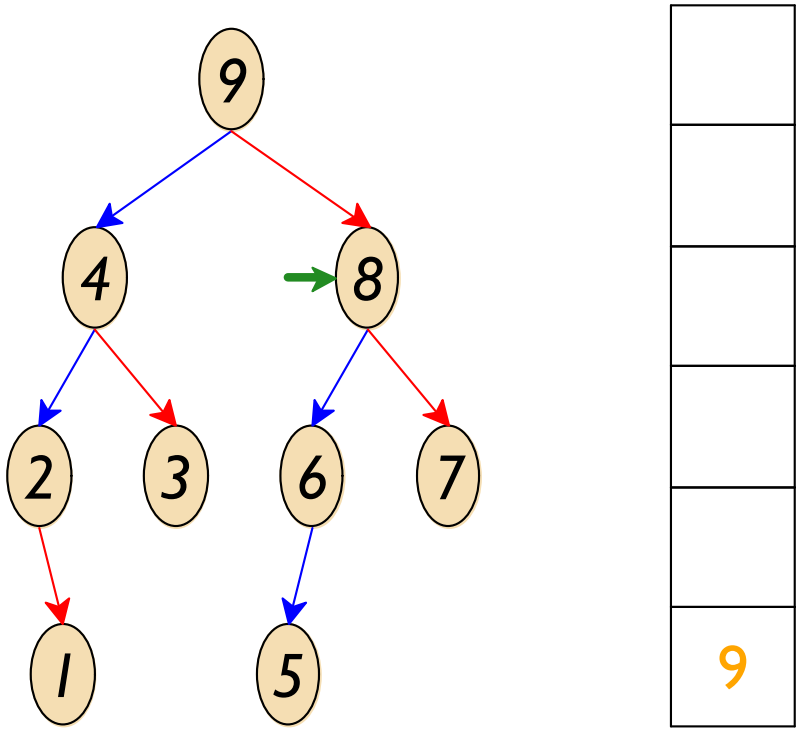

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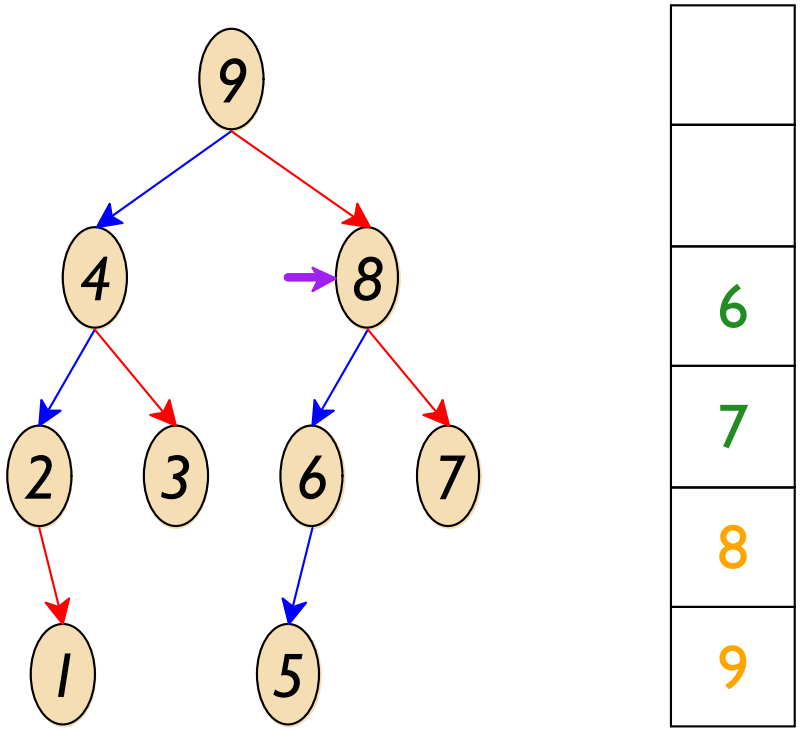

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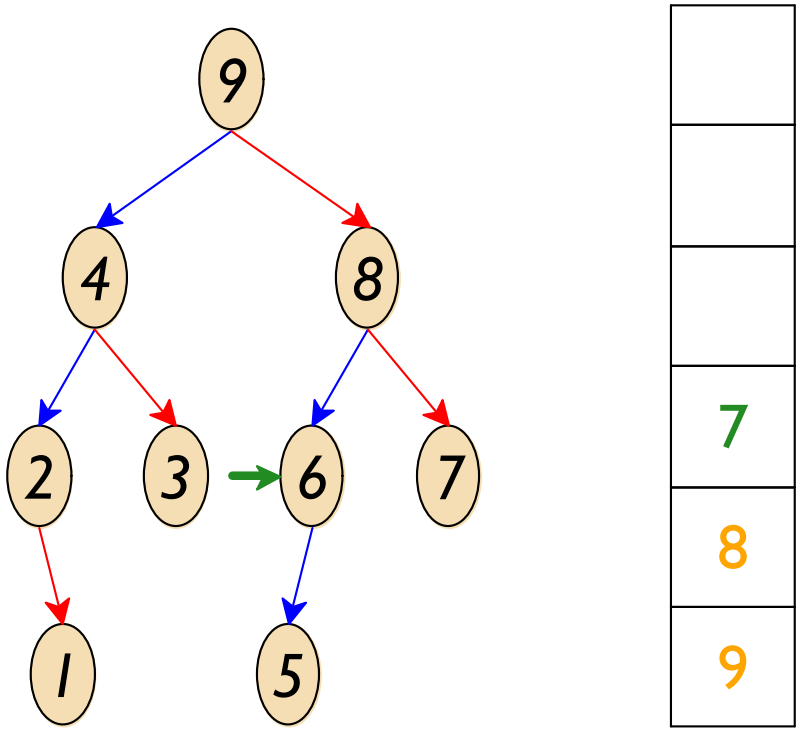

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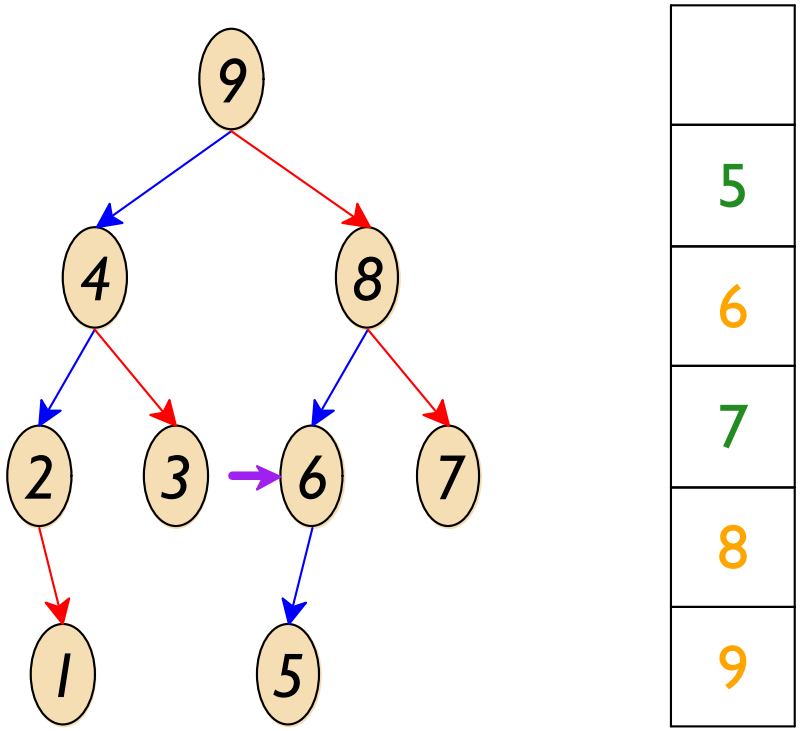

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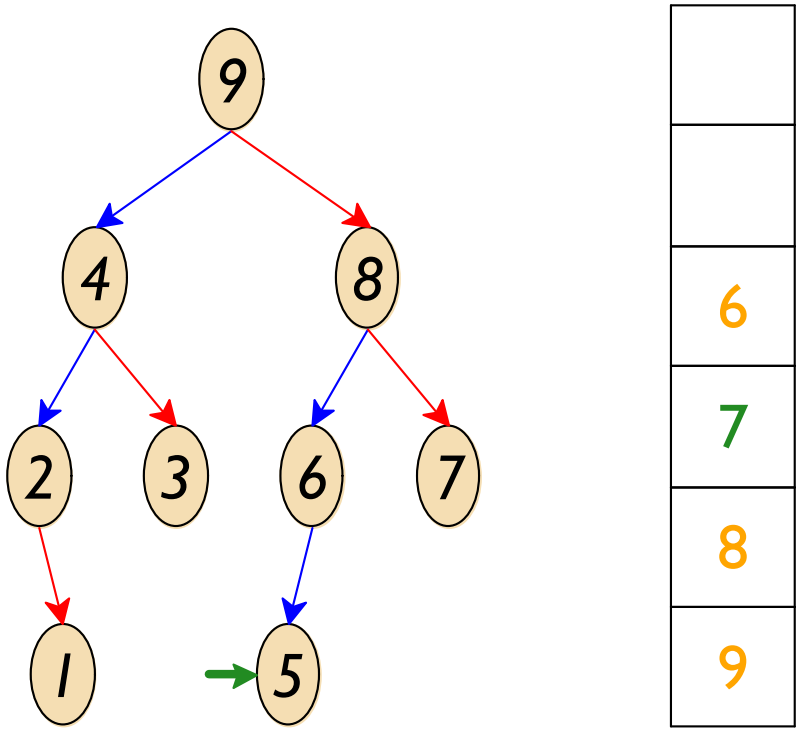

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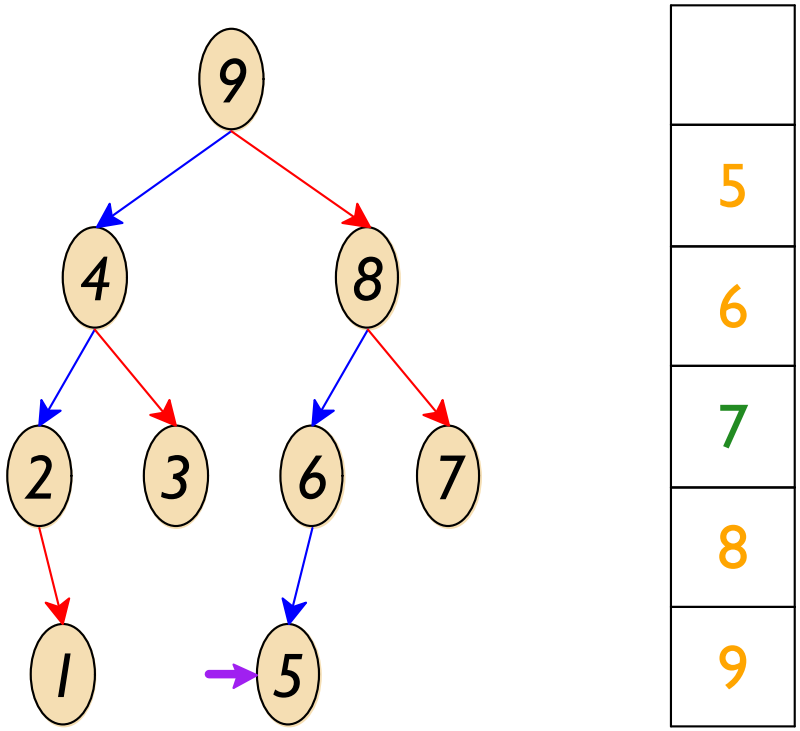

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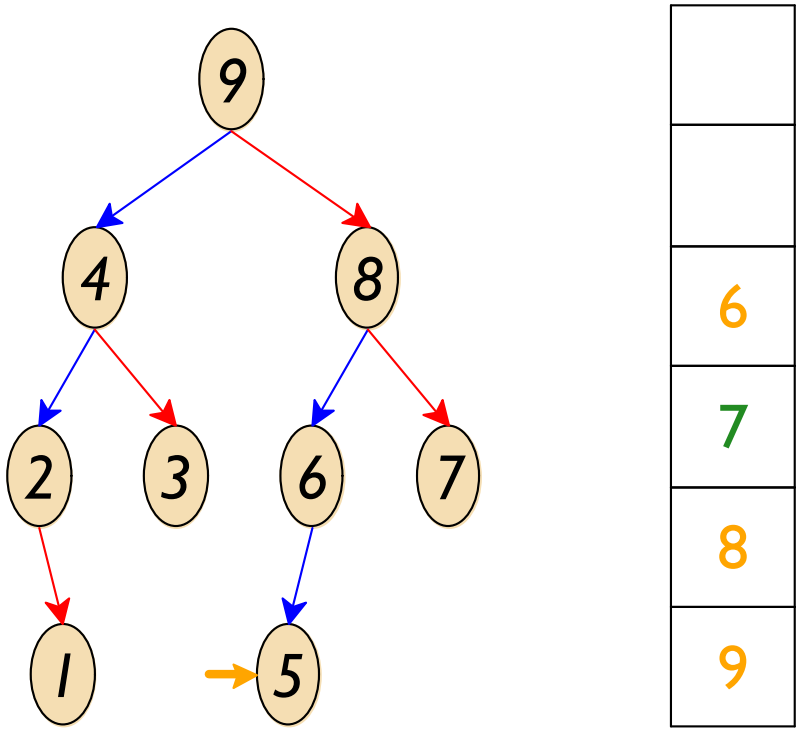

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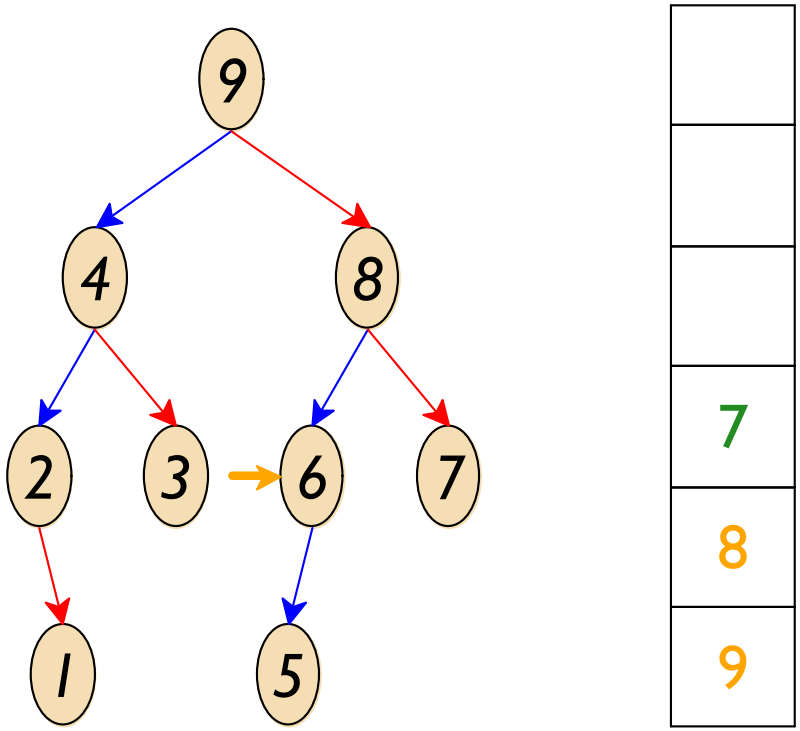
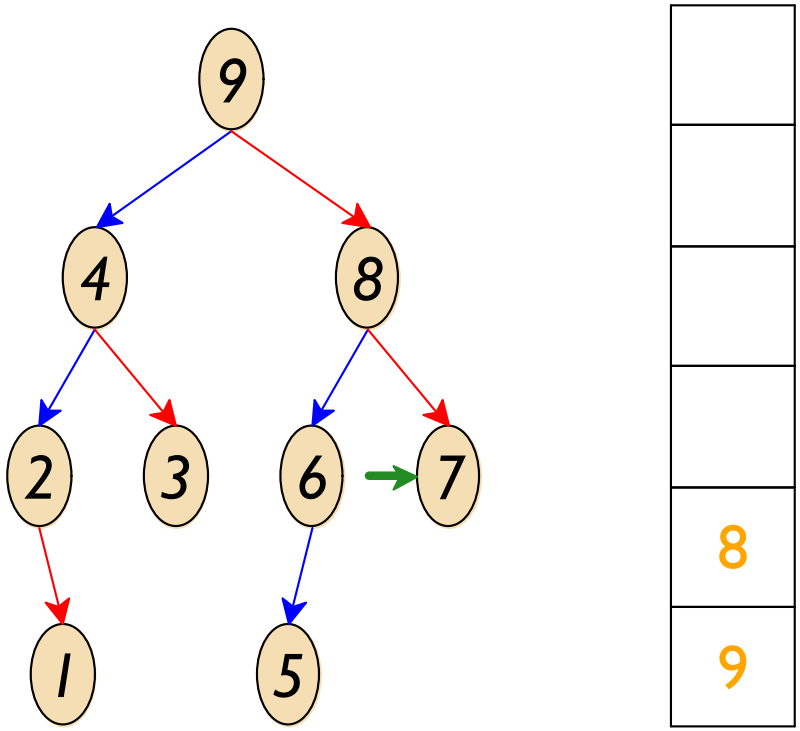
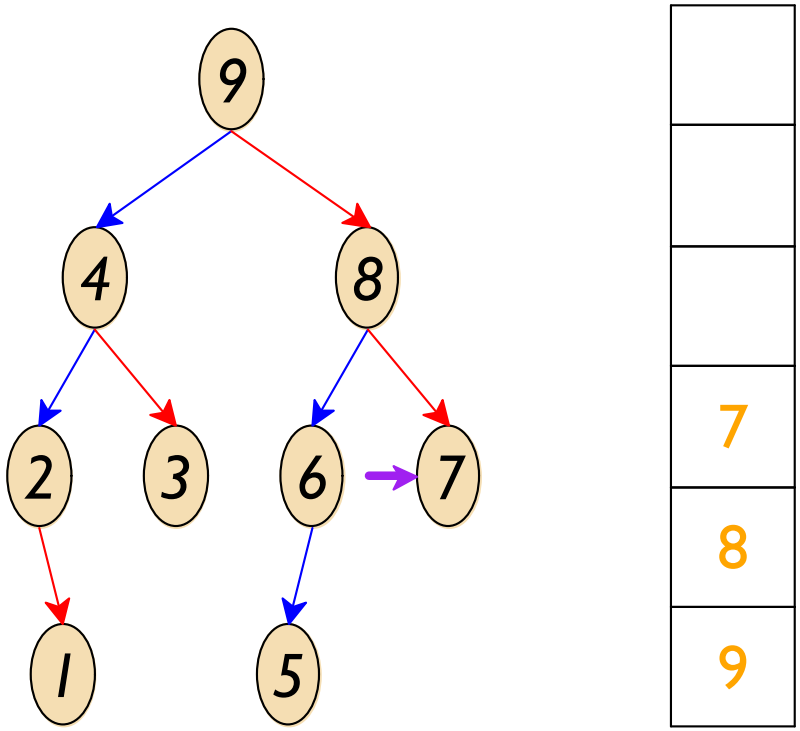


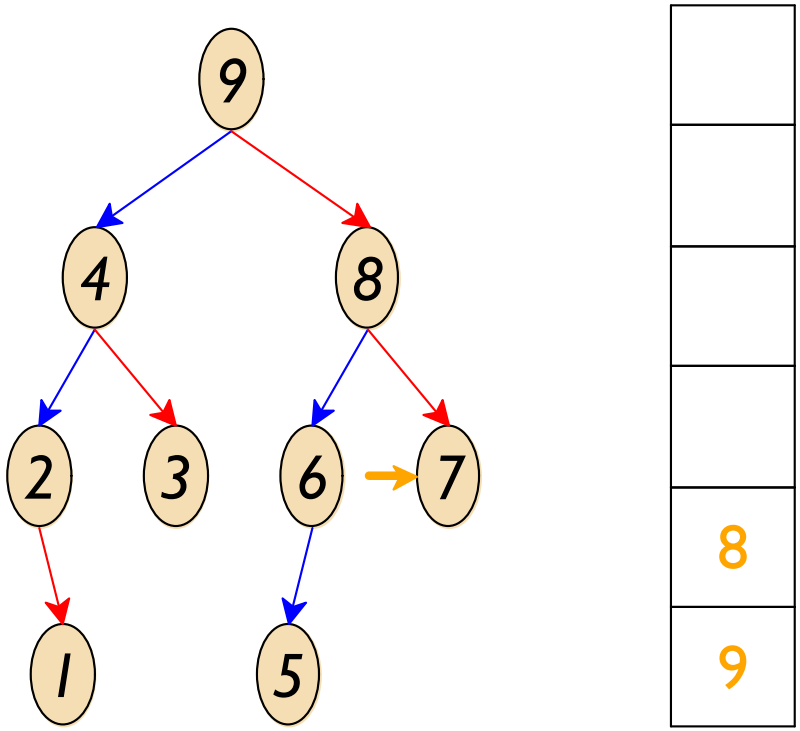
Depth-First Traversal (Postorder) via Stack



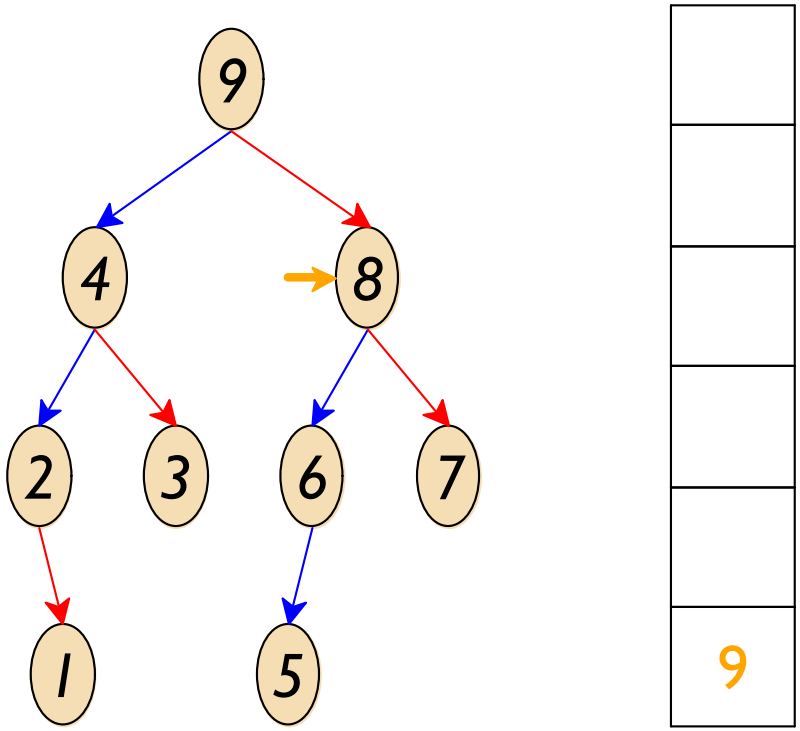
Depth-First Traversal (Postorder) via Stack



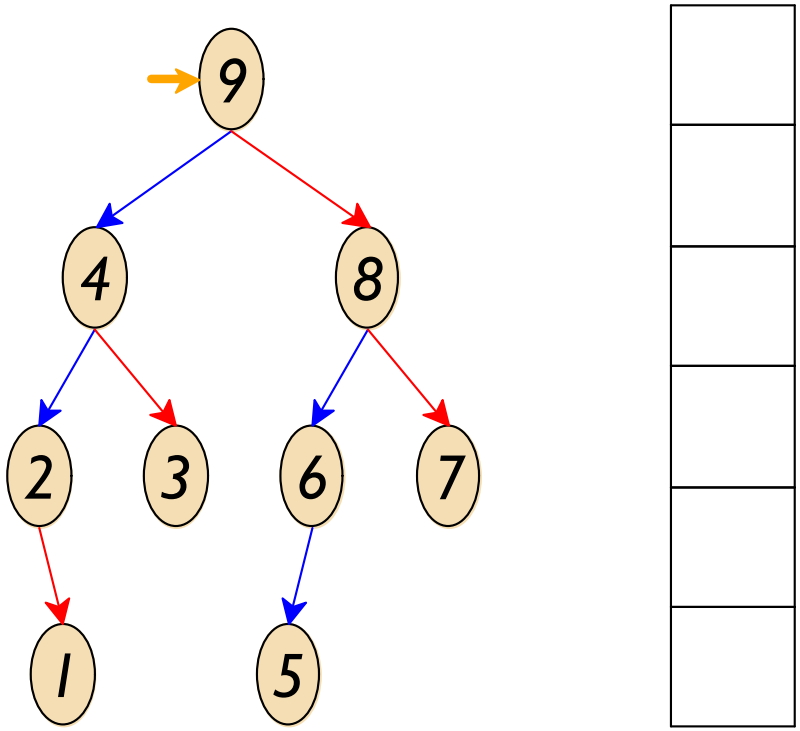
Depth-First Traversal (Postorder) via Stack



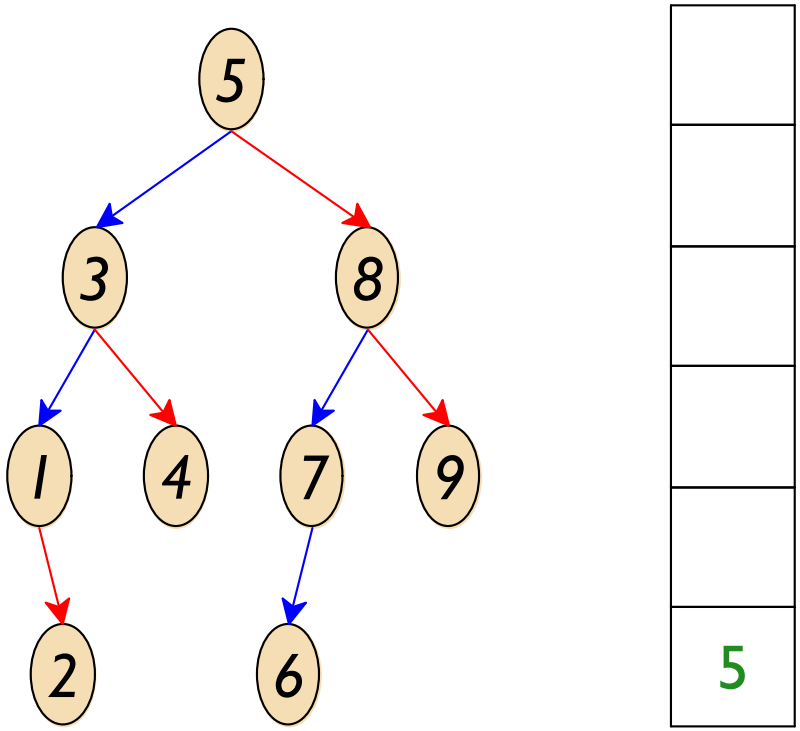
Depth-First Traversal (Postorder) via Stack



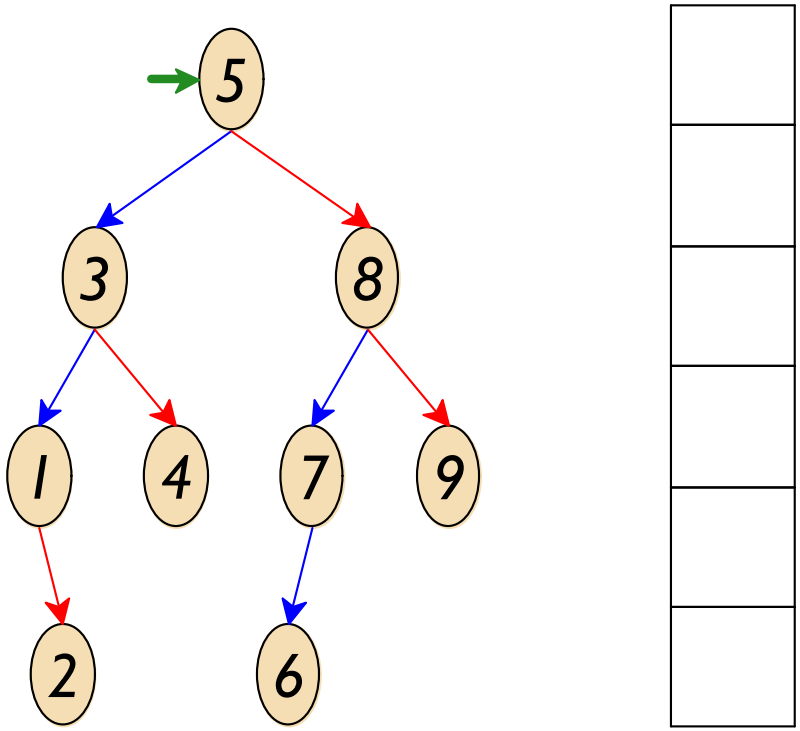
Depth-First Traversal (Postorder) via Stack



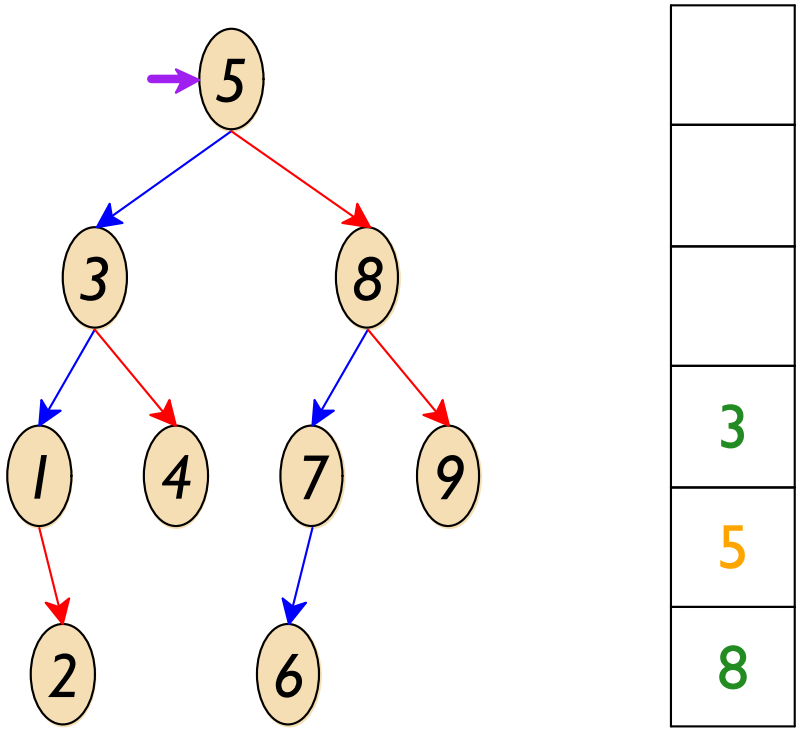
Depth-First Traversal (Inorder) via Stack



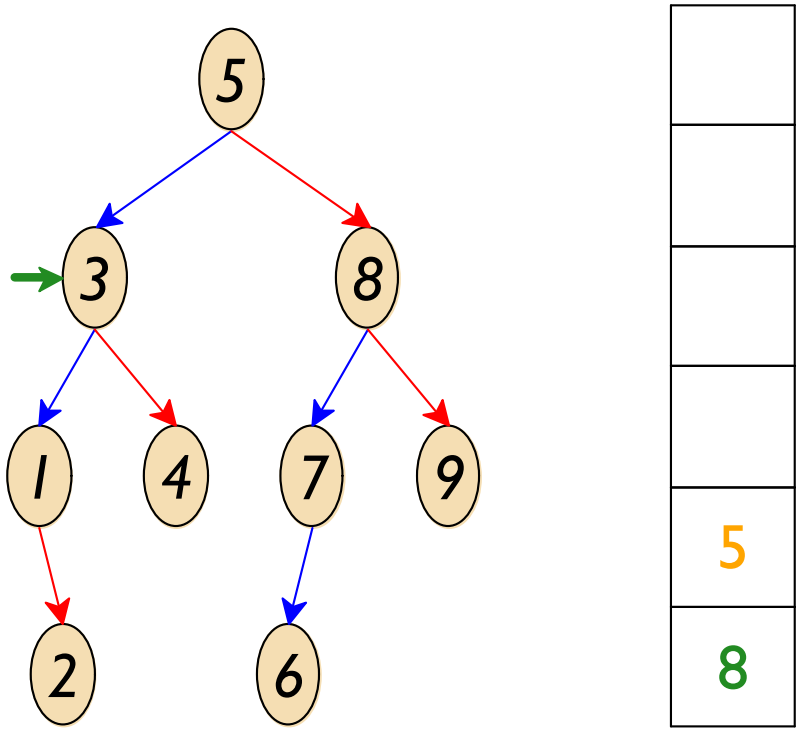
Depth-First Traversal (Inorder) via Stack



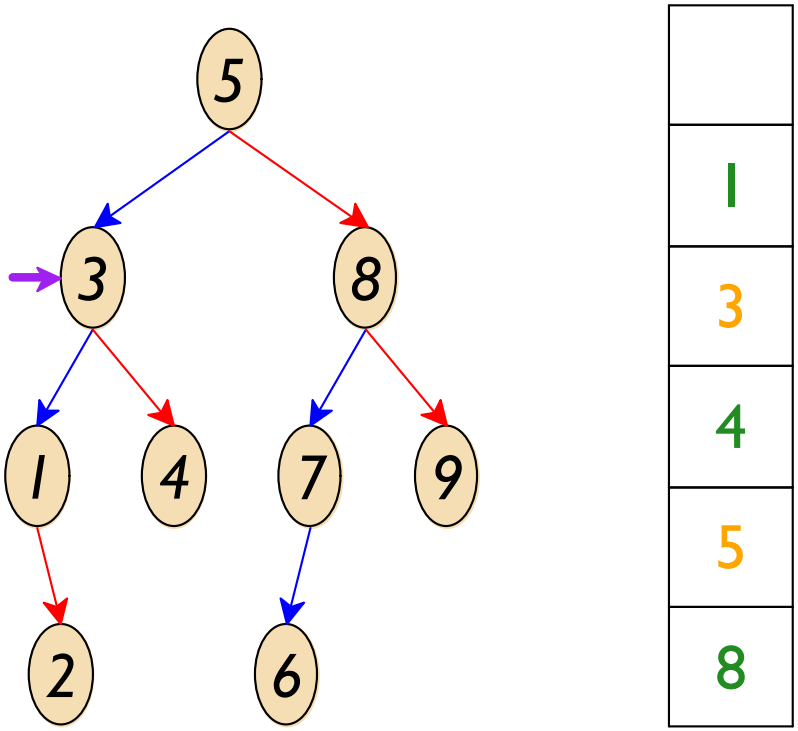
Depth-First Traversal (Inorder) via Stack



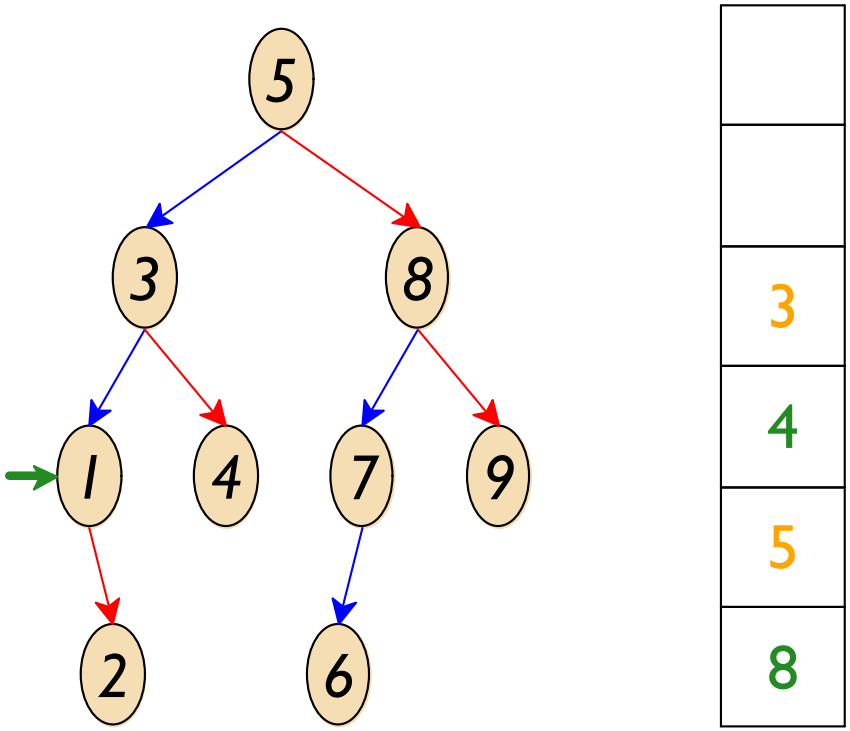
Depth-First Traversal (Inorder) via Stack



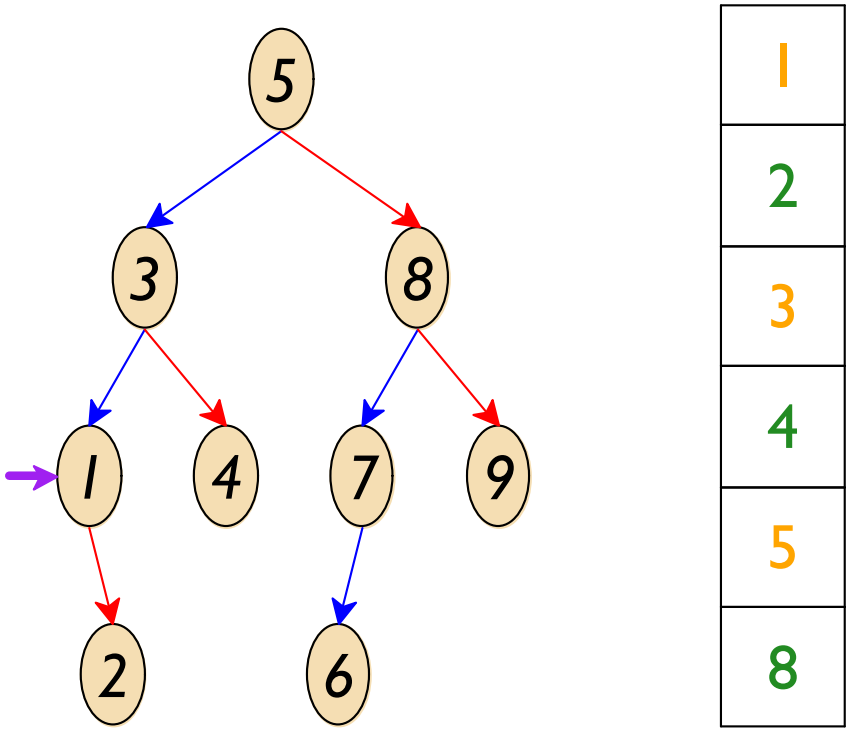
Depth-First Traversal (Inorder) via Stack



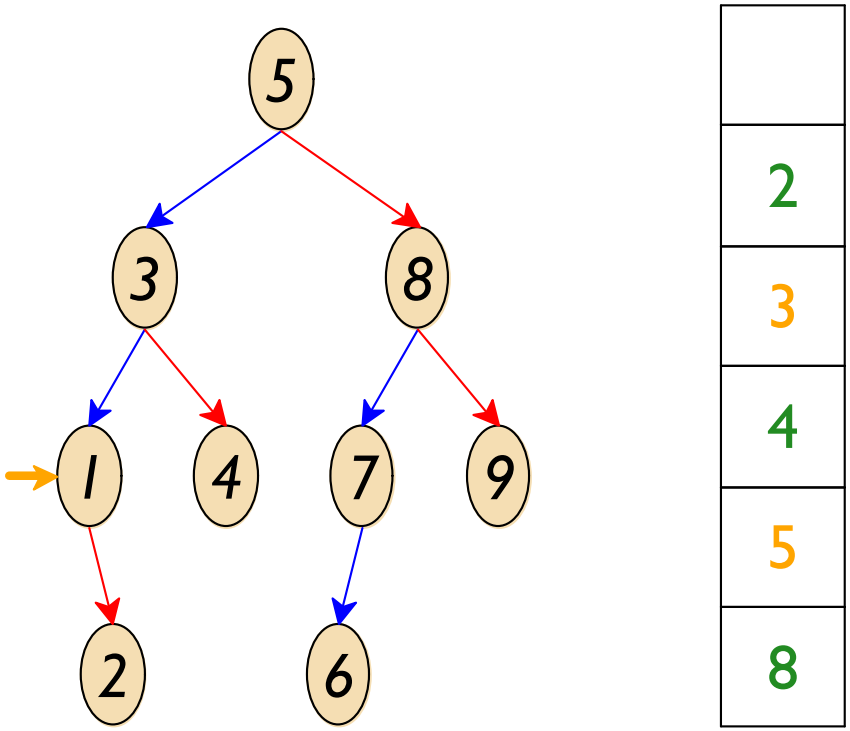
Depth-First Traversal (Inorder) via Stack



Depth-First Traversal (Inorder) via Stack



Depth-First Traversal (Inorder) via Stack



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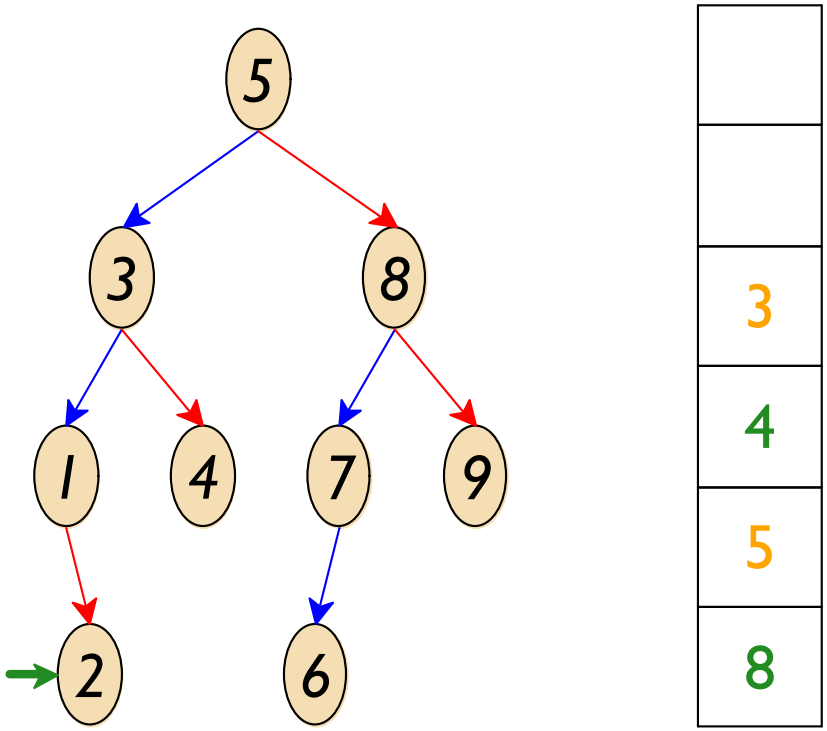

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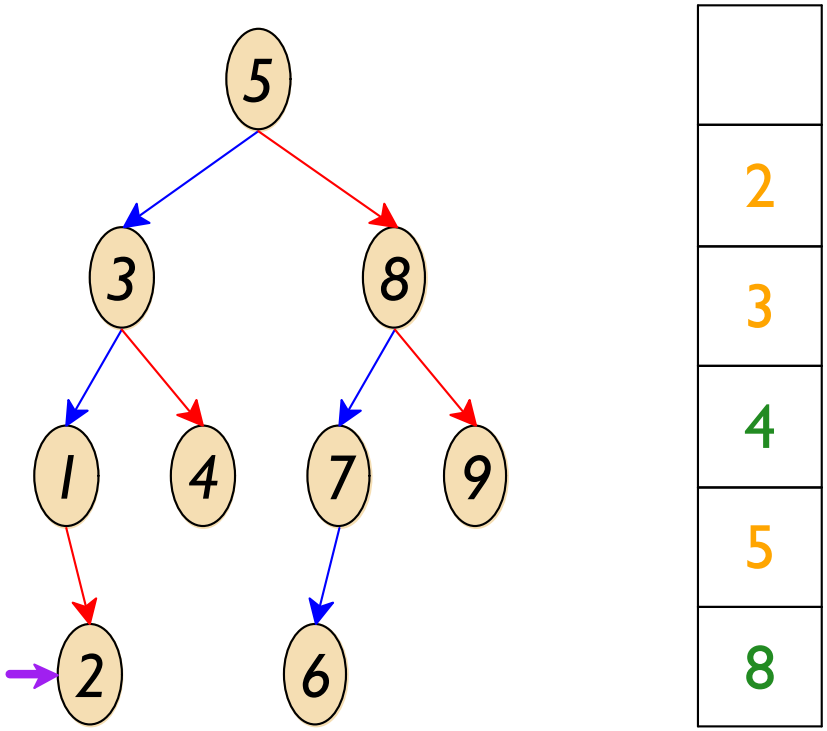
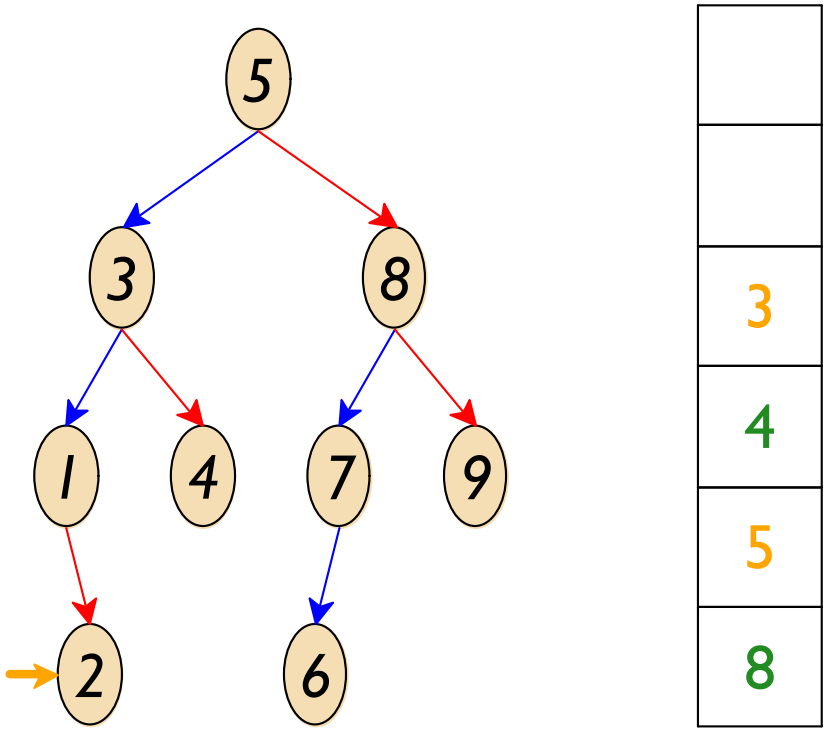
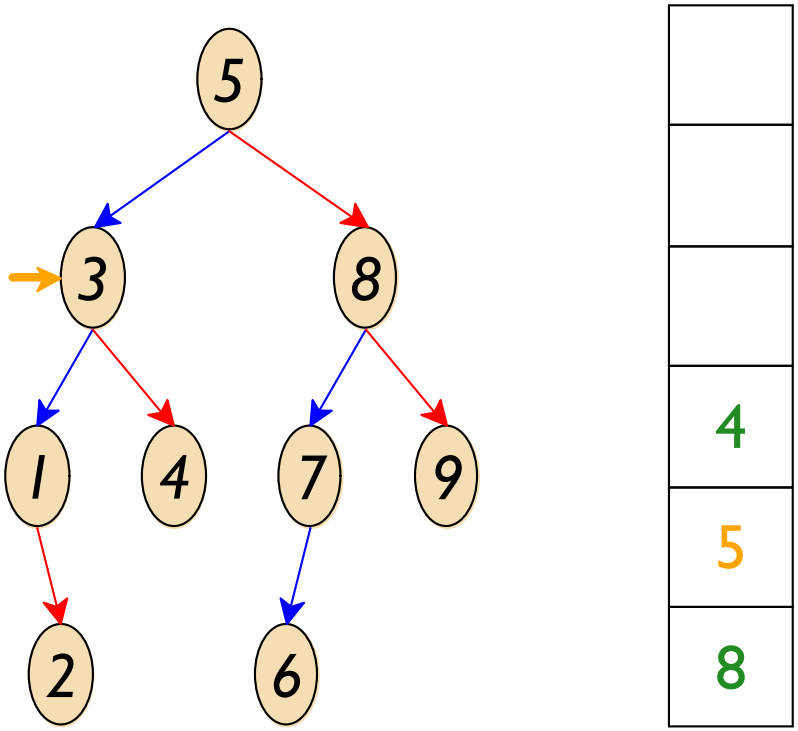


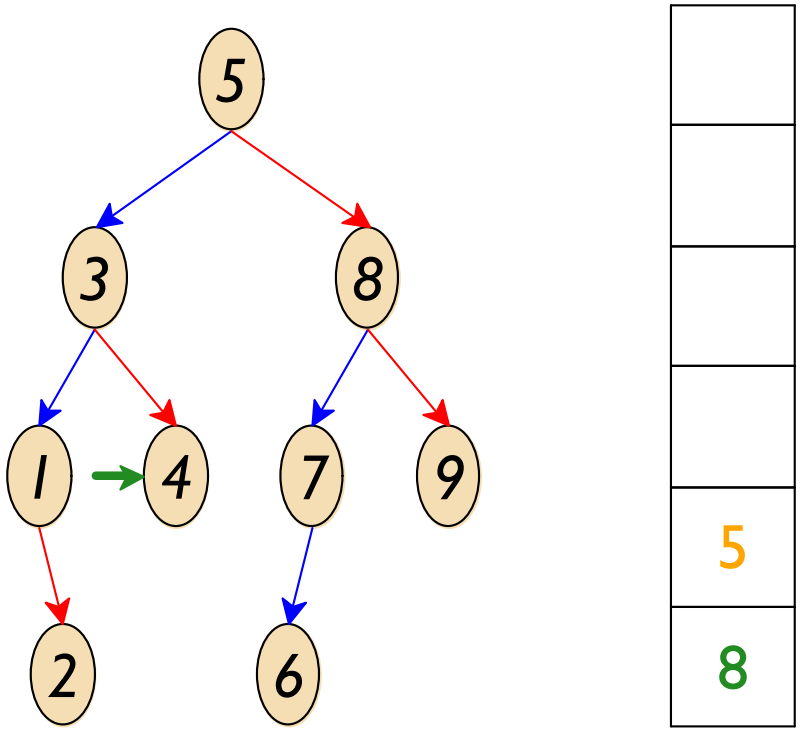
Depth-First Traversal (Inorder) via Stack



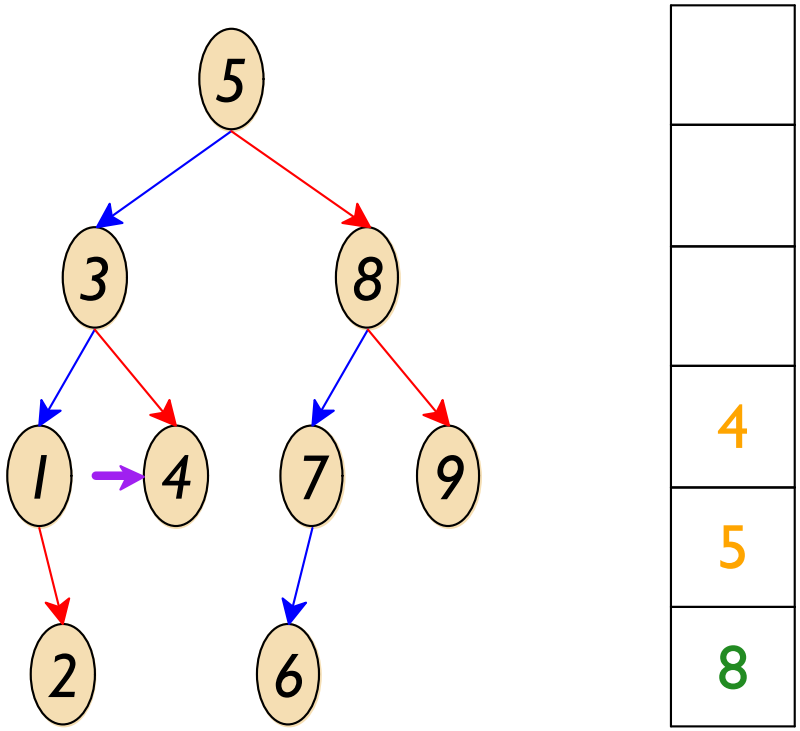
Depth-First Traversal (Inorder) via Stack



Depth-First Traversal (Inorder) via Stack



Depth-First Traversal (Inorder) via Stack



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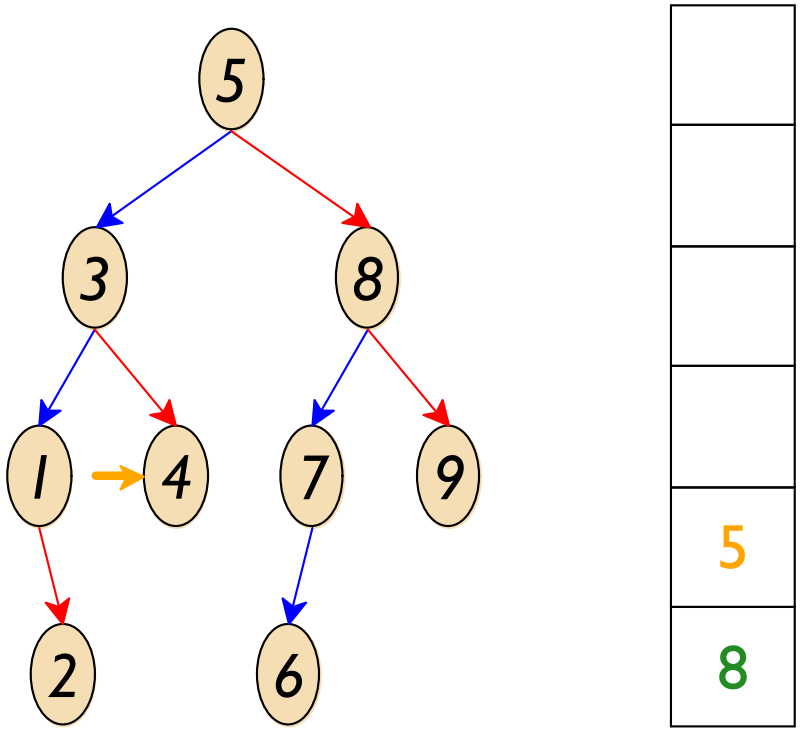

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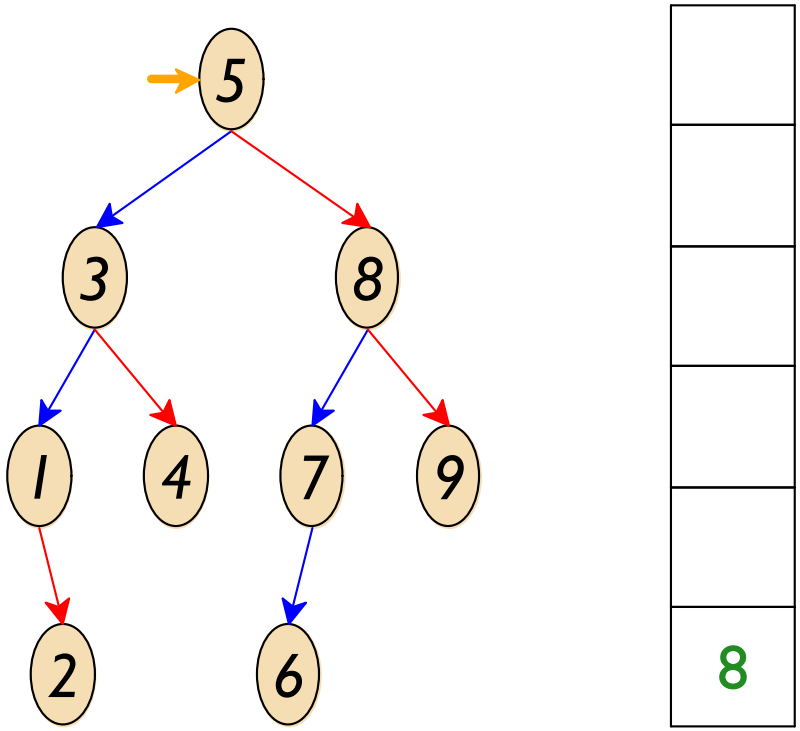
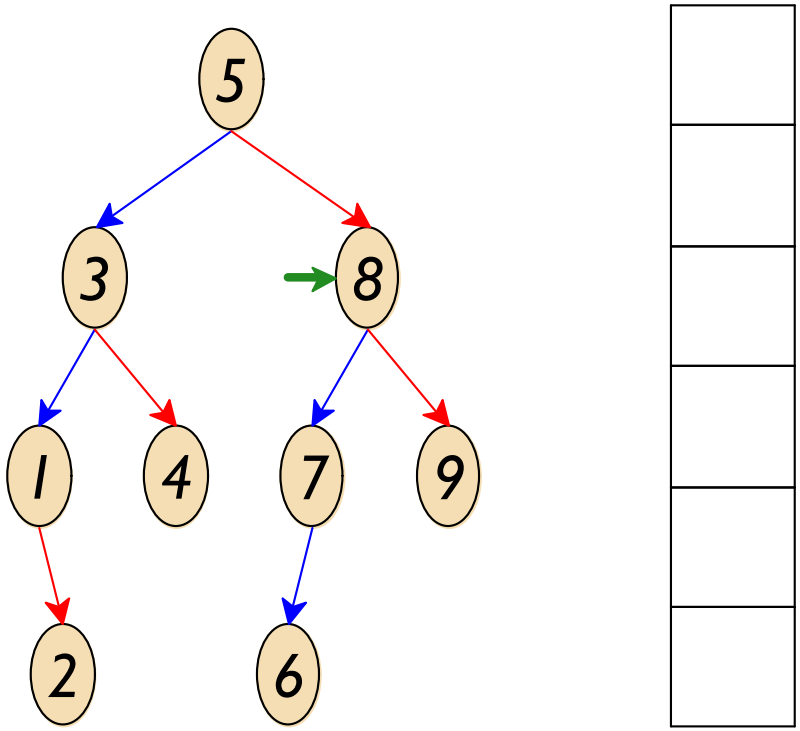
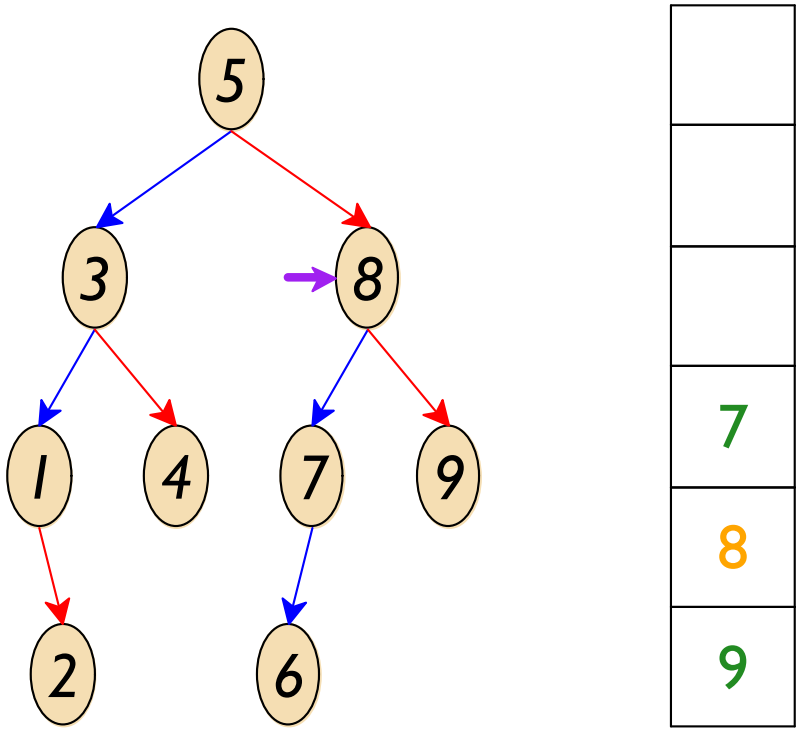


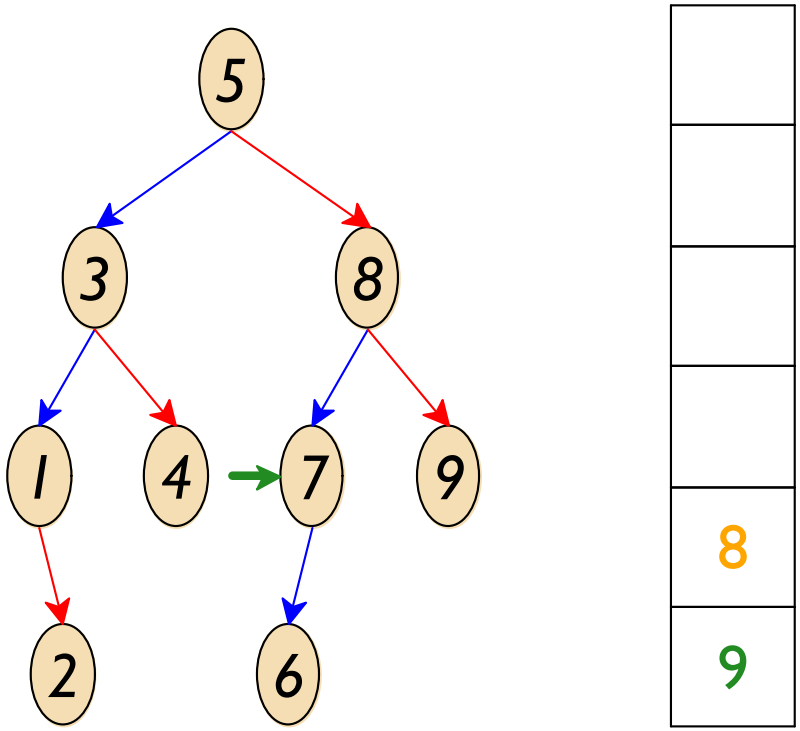
Depth-First Traversal (Inorder) via Stack



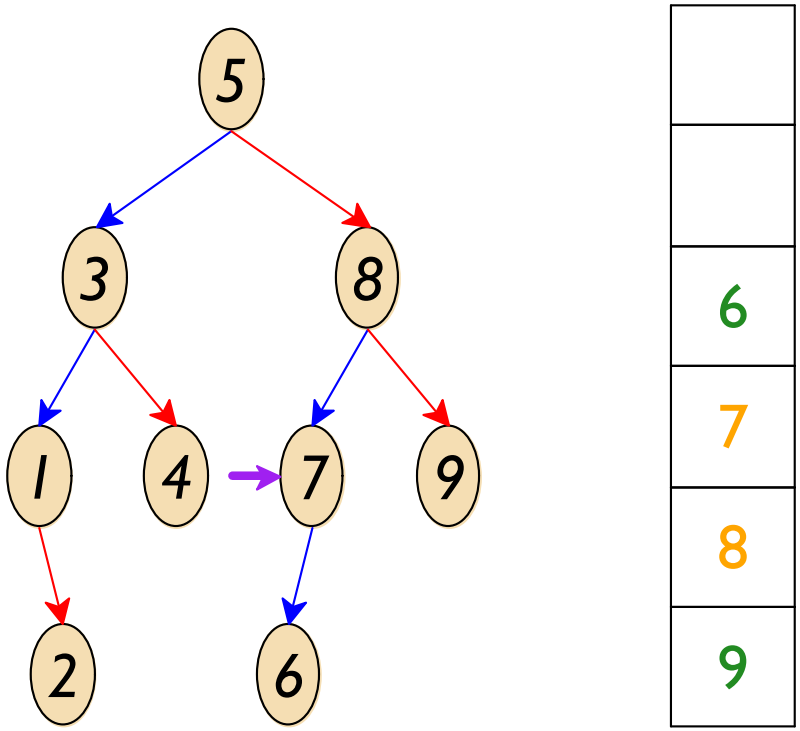
Depth-First Traversal (Inorder) via Stack



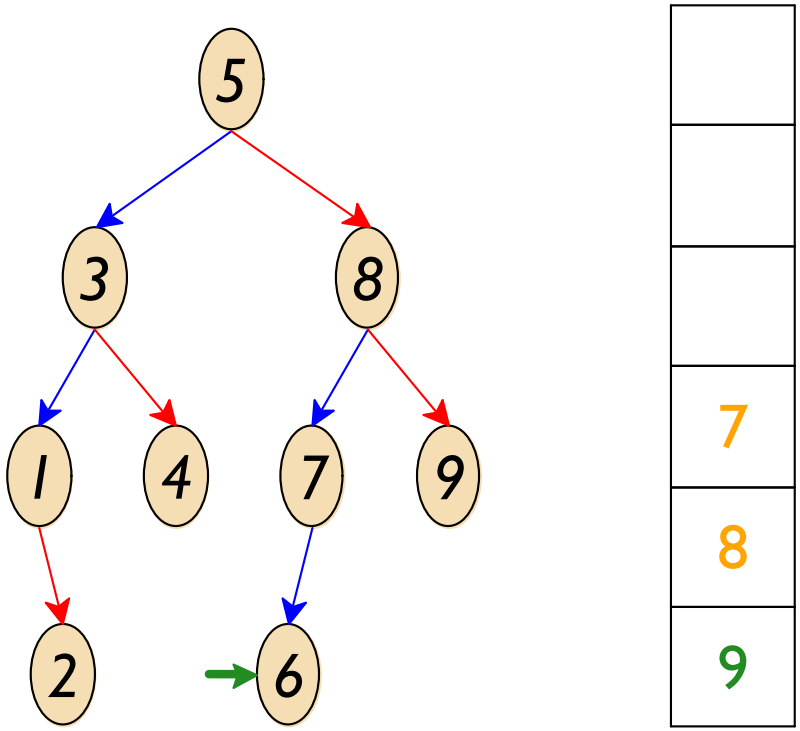
Depth-First Traversal (Inorder) via Stack



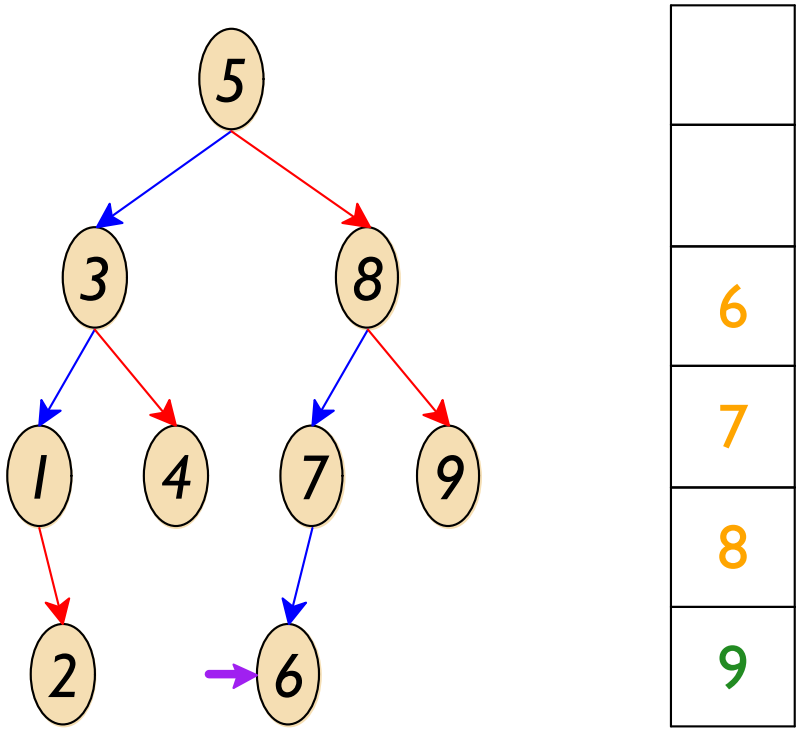
Depth-First Traversal (Inorder) via Stack



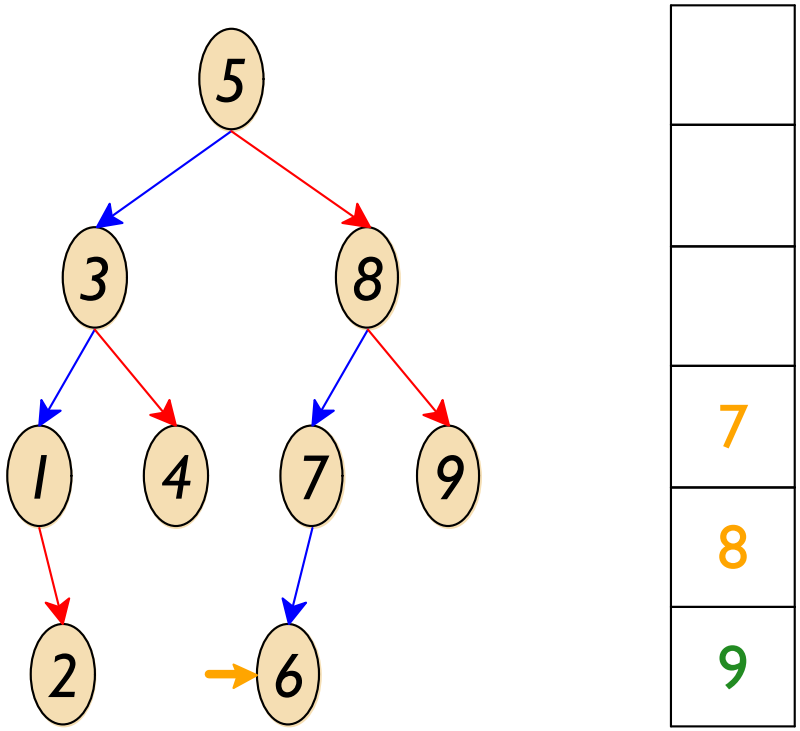
Depth-First Traversal (Inorder) via Stack



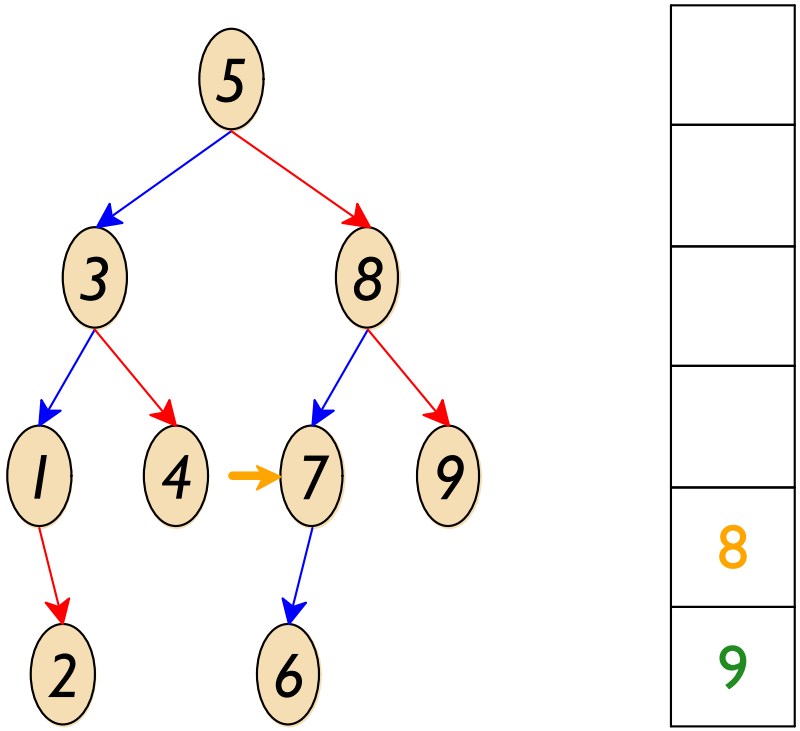
Depth-First Traversal (Inorder) via Stack



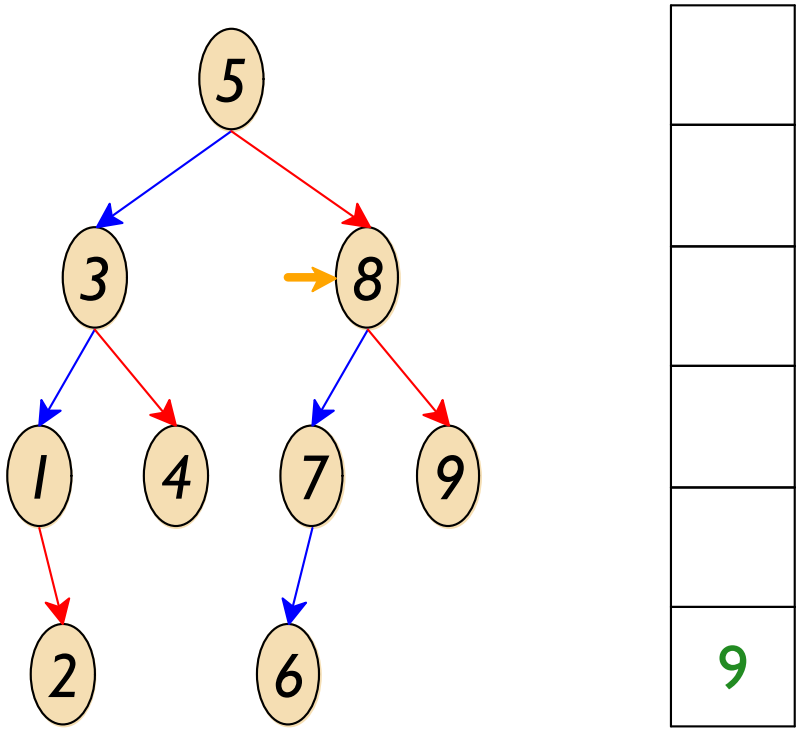
Depth-First Traversal (Inorder) via Stack



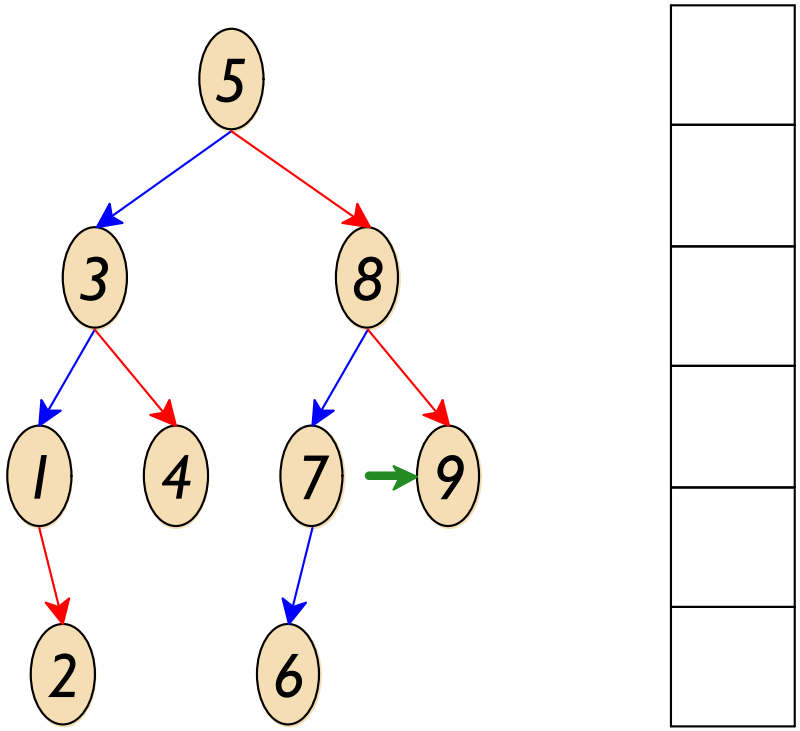
Depth-First Traversal (Inorder) via Stack



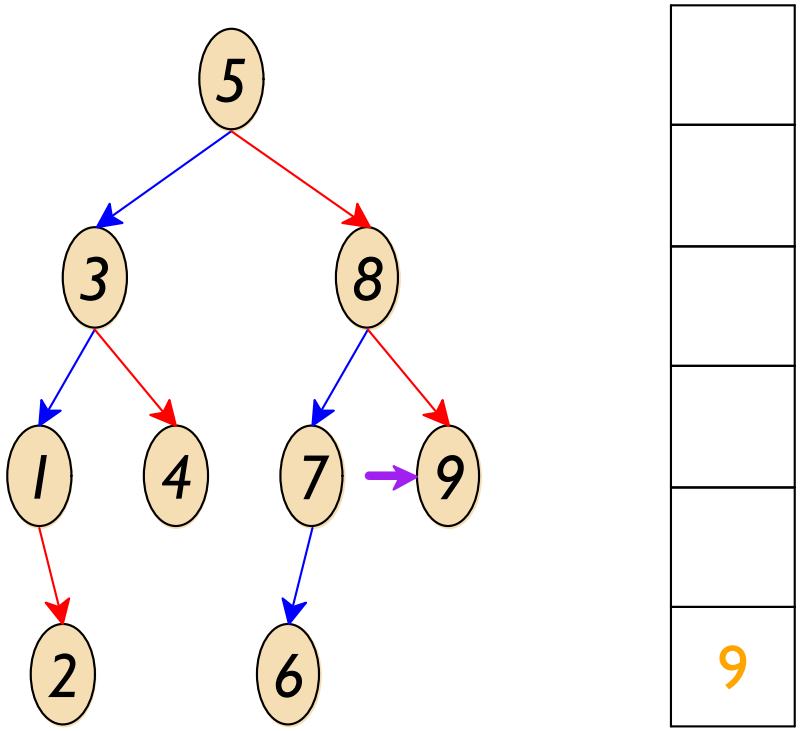
Depth-First Traversal (Inorder) via Stack



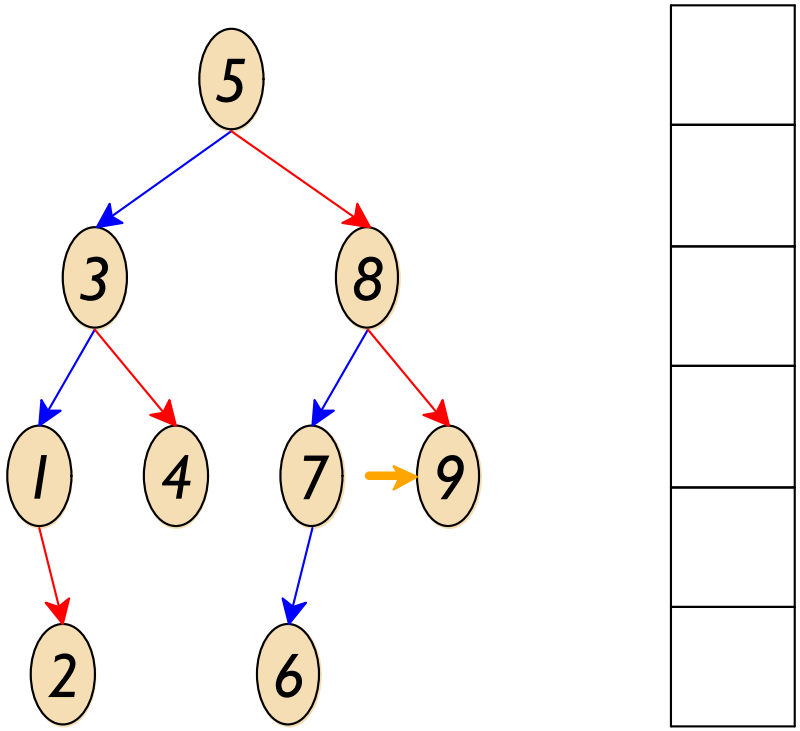
Depth-First Traversal (Inorder) via Stack



Depth-First Traversal (Inorder) via Stack



Depth-First Traversal (Inorder) via Stack



See **`traverse.c`**