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Greece 2.0
NATIONAL RECOVERY AND RESILIENCE PLAN

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Concurrent Binary Search Trees Supporting Split and Join

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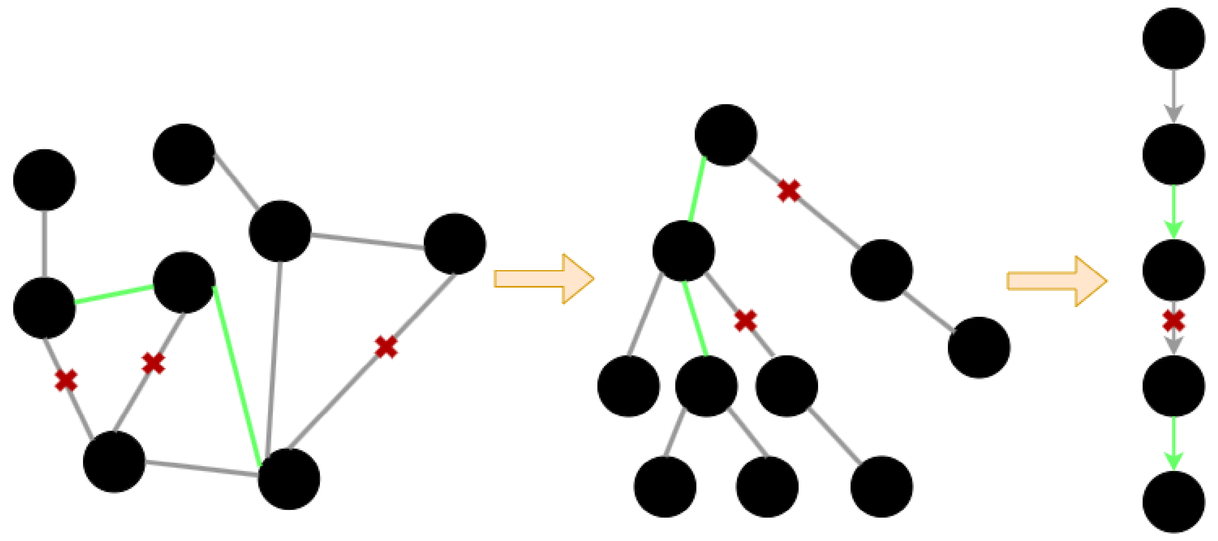
Motivation, Contribution

Need for BSTs that support Split and Join Operations

1.Dynamic Graph problems
- Maintain a graph under edge insertions/deletions
- Answer queries efficiently

2.Sequences that support Split and Join
- Essential for some Dynamic Tree data structure (e.g. Link/Cut Trees, Euler Tour Trees)
- Represented using BSTs



BST Operations

❑ Split(v): return two tree roots (v: node)
- R_1: keys < Key(v)
- R_2 keys ≥ Key(v)

❑ Join(R_1,R_2): join two tree roots
- Resulting tree has keys of both
- Precondition: the keys of Tree(R_1) are less than the keys of Tree(R_2)

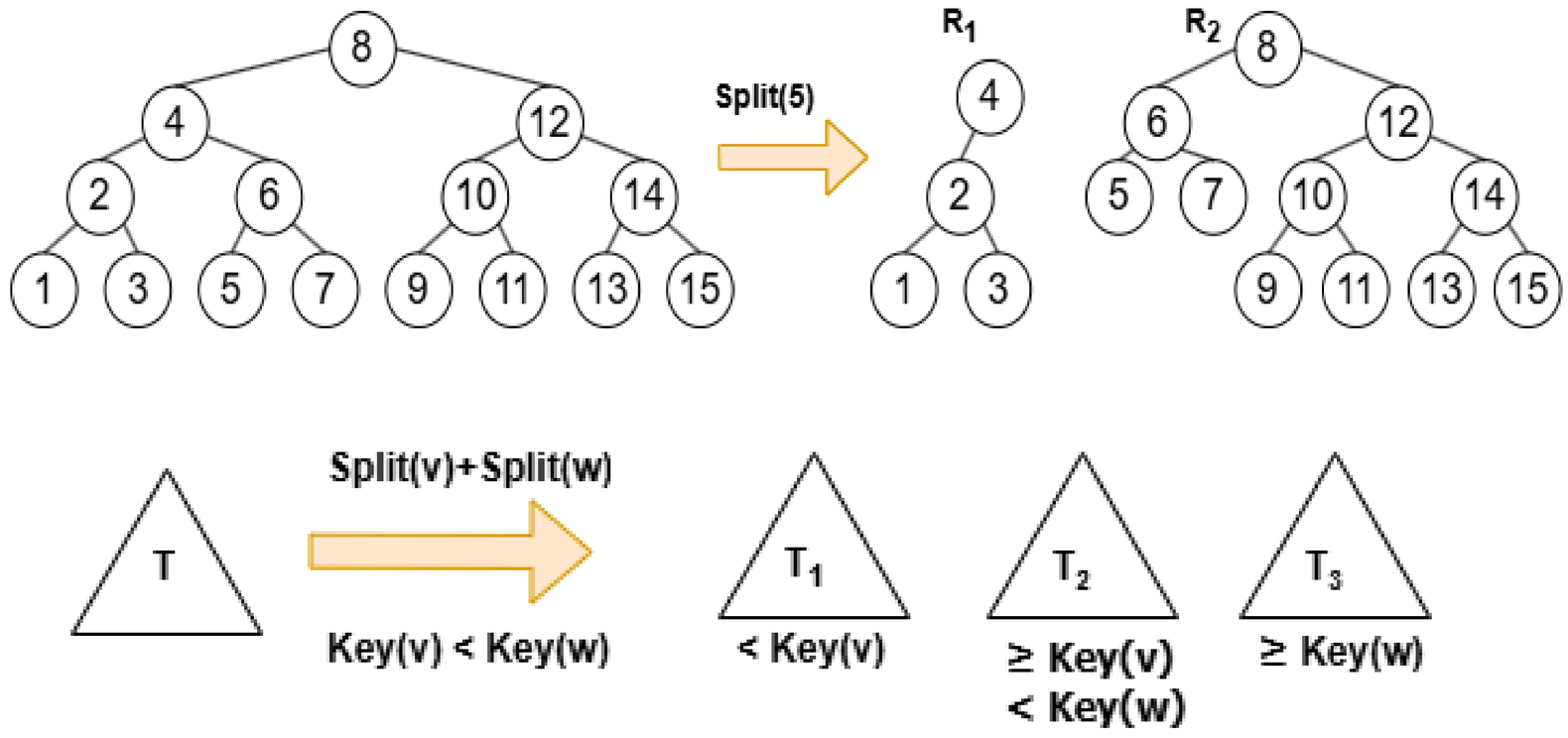
Contribution

Introducing a lock-based approach for Concurrent Binary Search Trees
- Maintained under Split/Join Operations
- Efficient design: Split operations can combine as they traverse up the Tree
- Intermediate step for solving Dynamic Graph problems in a concurrent setting

Serial Model

Basic Idea: Split(v)

1. v: leaf node (leaf-oriented tree)
2. Keep track of two roots (R_1, R_2) for the constructed trees
3. Initially R_1 := Null, R_2 := v
4. Traverse path from leaf v to root
5. If current node is a left child of its parent p:
   i. Connect R_2 as left child of p
   ii. R_2 := p
6. Else:
   i. Connect R_1 as right child of p
   ii. R_1 := p



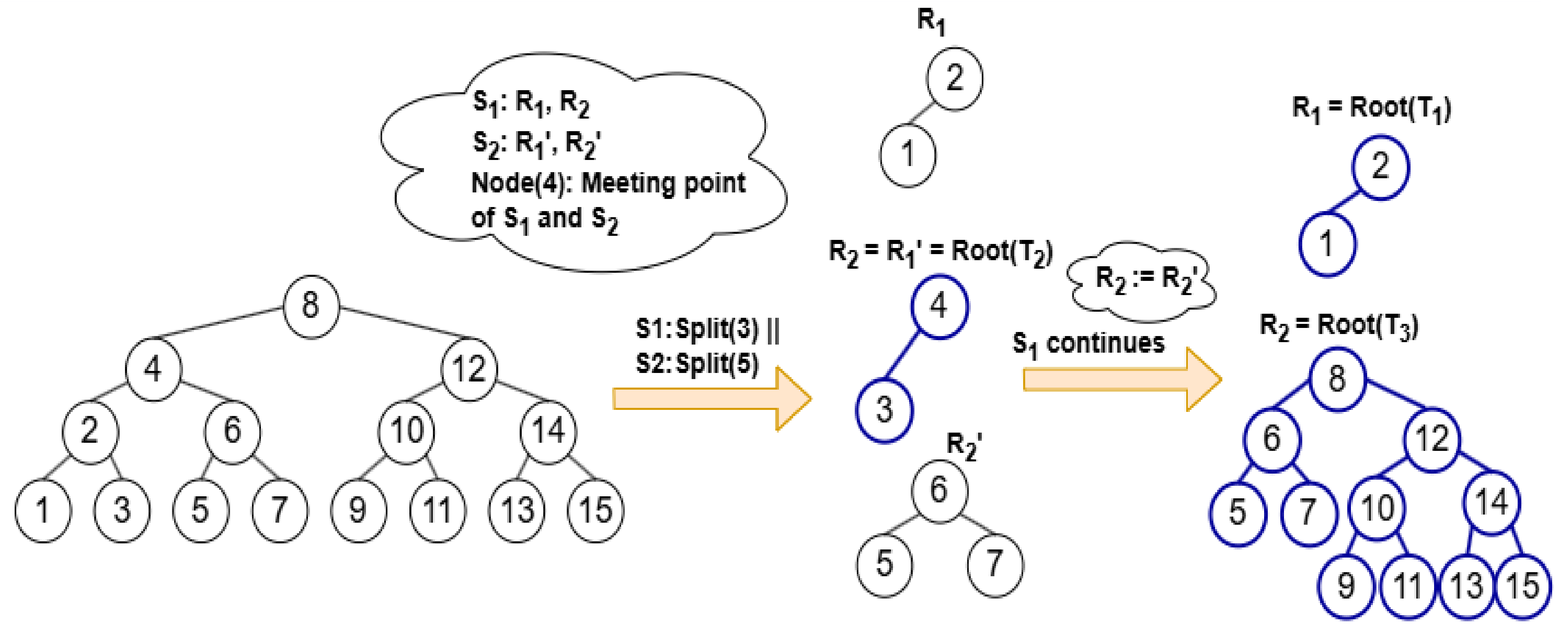
Concurrent Model

Basic Idea: Split(v)

❑ Similar algorithm to Serial Model

❑ Locking full path from v to root (synchronization)

❑ Combining: 2 Splits meet at node m
- m is the root of T_2
- One Split continues:
  - replaces its R_1 or R_2, with one of the roots from the other Split
  - completes the other Split operation along with its own



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