09 – Multi-Threaded Index Concurrency Control

1. Latch
    A. Read latch : multiple thread can share this
    B. Write latch : only one thread can acquire this
    C. Implementation
        i. Blocking OS Mutex
        ii. Test-and-Set Spin Latch
        iii. Reader-Writer Latch
2. Hash Table Latch
    A. Deadlocks are impossible (access direction are all same)
    Each threads are accessing only one page per time
    B. Implementation
        i. Page latches (Reader-Writer Latch)
        ii. Slot latches (Single Mode Latch)

3. B+Tree Latch
    A. Some problems
        i. Traversing during splitting/merging nodes
        ii. Each threads can access same nodes and modify it
    B. If all threads has simple top-down manner
        i. Latch Crabbing/Coupling (if node is safe, release parent's latch)
    C. Leaf Node Scans
        i. Each thread don't know what other threads are doing.
        So, if conflict occurs, abort one of thread can be a solution.
        ii. Leaf Node Scan protocol should provide "no-wait mode"
    D. Delayed Parent Updates
        i. If node overflows, we must update at least three nodes
        (leaf node, new leaf, parent)
        ii. New node will be a overflow page, and if another update occurs at that page, then update parent node.
4. What is it?
    A. Delay Parent Updates is valid?
5. Introduced Papers
    A. Concurrency of Operation on B+Trees