23 – Larger than Memory Database

1. Background
    - A. Allow an in-memory DBMS to store/access data on disk without bringing back all overheads of a disk-oriented DBMS
    - B. Handling OLAP in disk-oriented DB can use same mechanism of in-memory DB
    - C. Handling OLTP in disk-oriented DB should include handling hot and cold portions of DB
2. Implementation issues
    - A. OLTP issues
        - i. Runtime operations
          (cold data identification)
            1. On-line
               DBMS monitors transaction access patterns and track it.
               tracking data are included in tuples/pages
            2. Off-line
               maintain access log and process it in background to get frequencies.
        - ii. Eviction policies
          (timing, evicted metadata)
            1. Timing
                - A. Threshold
                  DBMS monitors memory usage, if memory usage reaches some threshold, eviction occurs
                - B. On demand
                  DBMS/OS runs a replacement policy

2. Evicted metadata

    A. Tuple tombstones

    B. Bloom filters

    C. DBMS managed pages

    D. OS virtual memory

iii. Data Retrieval Policies
(granularity, retrieval mechanism, merging)

1. Granularity

    A. All tuples in block

    B. Only tuples needed

2. Retrieval mechanism

    A. Abort and restart

    B. Synchronous retrieval

3. Merging

    A. Always merge

    B. Merge only on update

    C. Selective merge
    if a block's access frequency is above some threshold, merge it back into the table heap

3. Leanstore

   A. Prototype in-memory storage manager that supports larger-than-memory DB

   B. Hierarchical + randomized block eviction

      i. Pointer swizzling
         switch the content of pointers based on whether the target object resides in memory or on disk

      ii. Replacement strategy
         randomly select blocks for eviction, only track accesses for cold data
         unswizzle their pointer but leave in memory, maintain FIFO queue to block these flush

      iii. Block hierarchy
         DBMS can evict block if its children are also evicted.