

Question 1: Multi-Version Concurrency Control [100 points]

- (i) **[10 points] Multi-Version Concurrency Control:**
Distinguish between: (1) single-version and (2) multi-version CC.
- (ii) **[10 points] Multi-Version Concurrency Control:**
List the purpose of time-travel queries.
- (iii) **[10 points] Multi-Version Concurrency Control:**
Distinguish between: (1) append-only storage, (2) time-travel storage, and (3) delta storage.
- (iv) **[10 points] Multi-Version Concurrency Control:**
Distinguish between: (1) O2N and (2) N2O version chaining.
- (v) **[10 points] Garbage Collection:**
Distinguish between: (1) tuple-level GC, and (2) txn-level GC.
- (vi) **[10 points] Garbage Collection:**
Distinguish between: (1) background vacuuming, and (2) cooperative cleaning.
- (vii) **[10 points] Index Management:**
Explain how: (1) primary and (2) secondary indexes are maintained in an MVCC DBMS.
- (viii) **[10 points] Index Management:**
Distinguish between: (1) physical pointers, and (2) logical pointers.
- (ix) **[10 points] MVCC:**
Why is MVCC a widely used scheme in DBMSs?
- (x) **[10 points] MVCC:**
Why do NoSQL systems use MVCC? Illustrate with an example.